Final Report revised

National ICT Needs Assessment Consultancy

ICT Access and e-Services for hinterland, poor and remote Communities in Guyana

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Detecon International GmbH
Sternengasse 14 -16
50676 Cologne
Germany

Your Contact Person:

Mr. Stephan Dieter
Managing Consultant
Mobile GUY: +592 669 4180
Mobile GER: +49 160 3681360
e-Mail: stephan.dieter@detecon.com

Ms. Ulrike Eberhard
Managing Partner
Mobile GER: +49 170 2283963
e-Mail: ulrike.eberhard@detecon.com

This Final Report of the ICT Needs Assessment comprises all reports that have been elaborated by the project team during the runtime of this project from July to December 2016: Inception Report, Baseline Report, Technical Report, e-Service Readiness Assessment and Roadmap, Skill Development.

This report presents the comprehensive description of all project activities and results. In order to improve ease of reading, some chapters have been moved from one section to another to fit the overall structure of this Final Report compared to the structure of the documents submitted during the project phase.

All data used in this report has been provided by the different stakeholders and/or generated by primary research of the project team. In case no information has been provided the approach relied on assumptions based on Detecon's long experience in the ICT-sector.

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Definitions

10G Ethernet	10 Gigabit Ethernet (10GE, 10GbE, or 10 GigE) is a group of computer networking technologies for transmitting data at a rate of 10 gigabits per second.
3GPP	3rd Generation Partnership Project is a collaboration between groups of telecommunications associations. It comprises the development and maintenance of the following standards: GSM (2nd generation), UMTS (3rd generation), LTE (4th generation) and IP Multimedia Subsystem (MS). 3GPP standardization encompasses Radio, Core Network and Service architecture.
3GPP R8	Release 8 by 3GPP. For an overview of all releases see http://www.3gpp.org/specifications/releases/
5G	5th generation of wireless systems denotes the proposed next major phase of mobile telecommunications standards beyond the current 4G/IMT-Advanced standards. Focus is rather on faster internet connection but higher capacity allowing higher number of mobile users per area unit. There is currently no standard for 5G deployments.
802.11	IEEE 802.11 is a set of specifications for implementing wireless local area network (WLAN) computer communication in the 900 MHz and 2.4, 3.6, 5, and 60 GHz frequency bands. The standard and amendments provide the basis for wireless network products using the Wi-Fi brand. The 802.11a standard uses the same data link layer protocol and frame format as the original standard, but an OFDM based air interface (physical layer). It operates in the 5 GHz band with a realistic net achievable throughput in the mid-20 Mbit/s. The 802.11b standard has a maximum raw data rate of 11 Mbit/s, and uses the same media access method defined in the original standard. 802.11g works in the 2.4 GHz band (like 802.11b), but uses the same OFDM based transmission scheme as 802.11a. It operates at about 22 Mbit/s average throughput. 802.11ac is an amendment to IEEE 802.11, published in December 2013, that builds on 802.11n. Changes compared to 802.11n include wider channels (80 or 160 MHz versus 40 MHz) in the 5 GHz band, more spatial streams (up to eight versus four), higher-order modulation (up to 256-QAM vs. 64-QAM), and the addition of Multi-user MIMO (MU-MIMO). As of October 2013, high-end implementations are yielding a data rate of up to 433.3 Mbit/s per spatial stream, 1300 Mbit/s total, in 80 MHz channels in the 5 GHz band.
802.3	IEEE 802.3 is a working group and a collection of IEEE standards produced by the working group defining the physical layer and data link layer's media access control (MAC) of wired Ethernet. This is generally a local area network technology with some wide area network applications. Physical connections are made between nodes and/or infrastructure devices (hubs, switches, routers) by various types of copper or fiber cable.

Active infrastructure	The active elements of a mobile telecommunications network are the physical components of the radio access network that have to be managed or controlled by the operator after their installation. These elements include switches, antennas, transceivers, microwave equipment.
AP	An access point (AP) is a networking hardware device that allows WiFi compliant devices to connect to a wired network.
ARPU	Average revenue per user (ARPU) is a measure used primarily by consumer communications and networking companies, defined as the total revenue divided by the number of subscribers. It is a measure of the revenue generated by one customer phone, device, etc., per unit time, typically per year or month. In mobile telephony, ARPU includes not only the revenues billed to the customer each month for usage, but also the revenue generated from incoming calls, payable within the regulatory interconnection regime.
BB	In telecommunications, broadband (BB) is defined as a high bandwidth data transmission with an ability to simultaneously transport multiple signals and traffic types using different transmission media.
BOT	Build–operate–transfer (BOT) is a form of project realization, wherein a private entity receives a concession from the private or public sector to finance, design, construct, and operate a facility stated in the concession contract. This enables the project proponent to recover its investment, operating and maintenance expenses in the project.
Broadband internet access (fixed line)	internet access that is obtained via fixed line cable. The underlying physical network can be provided by a telco operator, using the telephone cable (technology used ADLS/VDSL) or a fiber optical cable (GPON) or the TV cable operator (following the DOCSIS standard).
Broadband internet access (fixed line)	internet access that is obtained via fixed line cable. The underlying physical network can be provided by a telco operator, using the telephone cable (technology used ADLS/VDSL) or a fiber optical cable (GPON) or the TV cable operator (following the DOCSIS standard). Achieved up-/download speeds under ideal conditions can be: ADSL: Down: 10 Mbit/s Up: 1 Mbit/s VDSL: Down: 50 Mbit/s Up: 10 Mbit/s GPON: Down 2.5 GBit/s Up: 2.5 GBit/s DOCSIS: Down 200 Mbit/s Up: 100 Mbit/s
Broadband internet access (mobile)	internet access (wireless communications) that is obtained through a portable modem or other device, such as a mobile phone. A number of network standards can be used for mobile broadband including: UMTS, LTE
Broadband internet access (mobile)	internet access (wireless communications) that is obtained through a portable modem or other device, such as a mobile phone. A number of network standards can be used for mobile broadband including: UMTS, LTE Achieved download rates under ideal conditions can be: UMTS: 7.2 Mbit/s (up to 42 Mbit/s for HSPA+) LTE: 100 Mbit/s (up to 1 Gbit/s for LTE advanced)
BSS	Business support systems (BSS) are the components that a telecommunications service provider needs to

	operate to run its business operations towards customers.
CA	Carrier Aggregations is the 4G frequency resource bundling to achive higher data rates per user.
CAPEX	Capital expense is an expense where the benefit continues over a long period, rather than being exhausted in a short period. Such expenditure is of a non-recurring nature and results in acquisition of permanent assets. CAPEX is the cost of developing or providing non-consumable parts for the product or system.
Carrier Aggregation	See CA
Carrier Grade	In telecommunication, a "carrier grade" or "carrier class" refers to a system, or a hardware or software component that is extremely reliable, well tested and proven in its capabilities. Carrier grade systems are tested and engineered to meet or exceed "five nines" high availability standards (i.e. availability of more than 99,999% of the overall time), and provide very fast fault recovery through redundancy
Cellphone	A portable cordless telephone for use in a cellular network, like GSM.
CPE	Customer-Premises equipment (CPE) is any terminal and associated equipment located at a subscriber's premises and connected with a carrier's telecommunication channel.
CS	Circuit switching is a method of implementing a telecommunications network in which two network nodes establish a dedicated communications channel (circuit) through the network before the nodes may communicate. The circuit guarantees the full bandwidth of the channel and remains connected for the duration of the communication session. The circuit functions as if the nodes were physically connected as with an electrical circuit.
CSR	Corporate Social Responsibility
Downlink	Link between a base station toward the user’s equipment (CPE).
EDGE	Early GSM standard (2G) for data transfer over the mobile network. Maximal transfer rate that can be provided is 220 Kbit/s.
EDGE, 2G	Early GSM standard (2G) for data transfer over a mobile network. Maximal transfer rate that can be achieved is 220 Kbit/s.
eGovernment Network	IP based data network provided by the eGovernment Agency
EHR	An Electronic Health Record (EHR) is an electronic version of a patient’s medical history, that is maintained by the provider over time, and may include all of the key administrative clinical data relevant to that persons care under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports.
eKiosk	The eKiosk is a place that provides access to the internet. Access to the internet is being sold using scratch cards from the local eKiosk operator. The eKiosk operator buys connectivity from a network provider.
eNodeB	Evolved Node B, (abbreviated as eNodeB or eNB) is the element in E-UTRA of LTE that is the evolution of the element Node B in UTRA of UMTS. It is the hardware that is connected to the mobile phone

	network that communicates directly wirelessly with mobile handsets (UEs), like a base transceiver station (BTS) in GSM networks.
EPC	Evolved Packet Core is the core network architecture of 3GPP's LTE wireless communication standard.
FAO	Food and Agriculture Organization of the United Nations
FDD	Frequency-division duplexing (FDD) means that the transmitter and receiver operate on different frequencies.
Fixed line penetration	Total number of households with fixed line access expressed as a percentage of the total number of households in the market (the country).
GDP	Gross domestic product (GDP) is a monetary measure of the market value of all final goods and services produced in a defined period. Nominal GDP estimates are commonly used to determine the economic performance of a whole country or region, and to make international comparisons.
GEO	Geostationary Earth orbit, another name for geostationary orbit, a geosynchronous orbit directly above the Earth's equator.
GPL	Guyana Power and Light is a utility company in Guyana, providing electric power in the country. As of 1 May 2003, it is entirely owned by the Government of Guyana.b
GSM, 2G	Global System for Mobile Communications as first world wide digital standard, with its data extensions GPRS and EDGE.
Health Center	Unit to perform basic care and full time services to the population, with appointment or without, on the basic services and can provide dental and other top-level professional assistance. Assistance should be permanent and provided by general practitioner or specialist in these areas. May or may not offer: Support Service for Diagnosis and Therapy and 24 hours Emergency Service.
Health Post	Unit designed to provide assistance to a particular population, with appointment or without, by mid-level professional with intermittent presence or absence of medical professional.
Hinterland Communities	Hinterland communities are inland communities in areas that are far from urban centers on the coastline. This applies to Region 7, 8, and 9. Region 1 is located on the coastline, but is still considered as Hinterland per definition. The regions classified as “Hinterland” are not necessarily difficult to access.
Hospital	Unit designed for the provision of care in the basic specialties, by experts and/or other medical professionals. May have Urgency/Emergency service. Must also have medium complexity Support Service for Diagnosis and Therapy. Being able to handle high complex procedures and systems.
ICT	Information and communications technology (ICT) is an extended term for information technology(IT) which stresses the role of communications and the integration of telecommunication, computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information
ICT4D	ICT for development

IDU	An In-Door Unit is a telecommunication device that is used in satellite and internet service environments to receive and decode satellite transmissions.
IMEI	The International Mobile Equipment Identity or IMEI is a number to identify mobile phones, as well as some satellite phones. It is usually found printed inside the battery compartment of the phone, but can also be displayed on-screen on most phones by entering *#06# on the dialpad, or alongside other system information in the settings menu on smartphone operating systems. The IMEI number is used by a GSM network to identify valid devices and therefore can be used for stopping a stolen phone from accessing that network. For example, if a mobile phone is stolen, the owner can call his or her network provider and instruct them to "blacklist" the phone using its IMEI number. This renders the phone useless on that network and sometimes other networks too, whether or not the phone's SIM is changed.
IMSI	The International Mobile Subscriber Identity or IMSI is used to identify the user of a cellular network and is a unique identification associated with all cellular networks. It is stored as a 64 bit field and is sent by the phone to the network. It is also used for acquiring other details of the mobile in the home location register (HLR) or as locally copied in the visitor location register. To prevent eavesdroppers identifying and tracking the subscriber on the radio interface, the IMSI is sent as rarely as possible and a randomly generated TMSI is sent instead. The IMSI is used in any mobile network that interconnects with other networks. For GSM, UMTS and LTE network, this number is provisioned in the SIM card.
IMT	International Mobile Telecommunications (see ITU)
IMT bands	IMT is the generic ITU name for 3G/4G. therefore the IMT bands refer to the respective 3G/4G bands.
ITU	The International Telecommunication Union is a specialized agency of the United Nations (UN) that is responsible for issues that concern information and communication technologies. The ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world, and assists in the development and coordination of worldwide technical standards.
Last Mile	The last mile is a colloquial phrase widely used in the telecommunication , cable television and internet industries to refer to the final leg of the telecommunications networks that deliver telecommunication services to retail end-users (customers). More specifically, the last mile refers to the portion of the telecommunications network chain that physically reaches the end-user's premises.
LEO	Low Earth Orbit is an orbit around Earth with an altitude between 160 kilometers and 2,000 kilometers.
Line of Sight	It describes the direct visible contact (line of sight) between sender and receiver.
LOS	See Line of Sight

LRIC	LRIC is an abbreviation for "Long-Run Average Incremental Cost". A LRIC model is often used in telecommunications regulation to determine the price paid by competitors for services provided by an operator with significant market power, usually the incumbent (former monopoly).
LTE	Long-Term Evolution (LTE) is a standard for high-speed wireless communication for mobile phones and data terminals and based on the GSM/EDGE and UMTS/HSPA network technologies. It is commonly marketed as 4G. Data rates of 100Mbit/s and up to 1Gbit/s with LTE-Advanced can be achieved under ideal conditions.
LTE, E-UTRAN (synonym), 4G	Long-Term Evolution (LTE) is a standard for high-speed wireless communication for mobile phones and data terminals and based on the GSM/EDGE and UMTS/HSPA network technologies. It is commonly marketed as 4G. Data rates of 100Mbit/s and up to 1Gbit/s with LTE-Advanced can be achieved under ideal conditions.
LTE450, LTE700, LTE800, LTE2300	LTE can use different frequency bands. Here it refers to the bands of 450 MHz, 700MHz, 800MHz and 2300 MHz.
MAC address	A media access control address (MAC address) of a computer is a unique identifier assigned to network interfaces for communications at the data link layer of a network segment.
Mbps	Transmission rate. Megabits per second
MIMO	Multiple Input, Multiple Output is the 4G basic transmission scheme for higher order communication to increase capacity and user performance.
Mobile penetration	Total mobile connections at the end of the period, expressed as a percentage share of the total market population (the population of the country).
Mobile phone	Umbrella term for all phone that have no physical cable connection. This includes cellphones and smart phones.
MOOC	Massively Open Online Courses
Moodle	Popular open source Learning Management System (LMS)
MoPH	Ministry of Public Health
MPLS	Multiprotocol Label Switching (MPLS) is a type of data-carrying technique for high-performance telecommunications networks that directs data from one network node to the next based on short path labels rather than long network addresses, avoiding complex lookups in a routing table.
Multimode smart phone	Smart phone or any other CPE that supports several frequency bands and/or even mobile standards at the same time and is able to switch between these technologies while keeping a communication active.
MU-MIMO	(Multi User) Multiple Input, Multiple Output. See MIMO
MVNO	A mobile virtual network operator (MVNO), is a wireless communications services provider that does not own the wireless network infrastructure over which the MVNO provides services to its customers. An MVNO enters into a business agreement with a mobile network operator to obtain bulk access to network services at wholesale rates, then sets retail prices independently. An MVNO may use its own customer service, billing support systems, marketing, and sales personnel, or it could employ the services of a mobile virtual network enabler (MVNE).[
MW	Microwaves are a form of electromagnetic radiation with wavelengths ranging from one meter to one millimeter; with frequencies between 300 MHz (100

	cm) and 300 GHz (0.1 cm). Microwave technology is state of the art for high directional links within backhaul access networks.
Narrowband internet access (mobile)	internet access with mobile device with a low bandwidth, using technologies like WAP, EDGE. Achieved download rates under ideal conditions can be: WAP: 9.6 Kbit/s EDGE: 220 Kbit/s
NLOS	Non Line of Sight (NLOS) describes the direct contact between sender and receiver without having a direct visible contact line between both of them.
ODU	Outdoor Device Unit refers to the set of satellite equipment which is placed outside of the building.
OFMD	Orthogonal frequency-division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wideband digital communication, used in applications such as digital television and audio broadcasting, DSL internet access, wireless networks, powerline networks, and 4G mobile communications.
Omnidirectional antenna	An omnidirectional antenna is a class of antenna which radiates radio wave power uniformly in all directions in one plane, with the radiated power decreasing with elevation angle above or below the plane, dropping to zero on the antenna's axis.
OPEX	Operational expenditure is an ongoing cost for running a product, business, or system. It reflects the day-to-day expenses such as sales and administration, research & development or maintenance.
OSS	Operations support systems (OSS) are computer systems used by telecommunications service providers to manage their networks (e.g., telephone networks). They support management functions such as network inventory, service provisioning, network configuration and fault management.
Overbooking	In a communications system in which multiple users share a common resource, oversubscription (=overbooking) refers to the ratio of the allocated bandwidth per user to the guaranteed bandwidth per user. Underlying the oversubscription model is the fact that statistically few users will attempt to utilize their allocated bandwidth simultaneously. Calculation and management of oversubscription ratios is common.
P2P, P2MP	A point-to-point (P2P) connection refers to a communications connection between two nodes or endpoints. This is contrasted with a point-to-multipoint (P2MP) or broadcast connection, in which many nodes can receive information emitted by one node.
Passive infrastructure	The passive elements of a mobile telecommunications network are the physical components of the radio access network that may not necessarily have to be managed or controlled by the operator after their installation. These elements include electrical or fiber optic cables, masts and pylons, physical space on the ground, towers, roof tops as well as shelter and support cabinets containing power supply, air conditioning, alarm installation and other passive equipment. The assembly of passive equipment in one structure is generally referred to as a ‘site’.
Play2Learn	A gamification platform which provides easy content generation and can be implemented in an LMS
PoE	Power over Ethernet or PoE describes any of several standardized or ad-hoc systems which pass electric power along with data on twisted pair Ethernet

	cabling. This allows a single cable to provide both data connection and electric power to devices such as wireless access points.
Poor Communities	Poor communities in the context of this study are communities where people live in conditions “near multidimensional poor”, “multidimensional poor” or “in severe poverty”. The Multidimensional Poverty Index (MPI) for developing countries captures the multiple deprivations that people face in their education, health and living standards. The MPI shows both the incidence of non-income multidimensional poverty (a headcount of those in multidimensional poverty) and its intensity (the relative number of deprivations poor people experience at the same time.
PoP	A point of presence (PoP) is an artificial demarcation point or interface point between communicating entities, esp between the backbone and the connecting networks.
PPDR services	Public Safety Disaster Recovery, successor of Terrestrial Trunked Radio (TETRA) specifically designed for use by government agencies, emergency services, (police forces, fire departments, ambulance) for public safety networks, rail transport staff for train radios, transport services and the military.
Project Loon	Project Loon is a research and development project being developed by X (formerly Google X) with the mission of providing internet access to rural and remote areas. The project uses high-altitude balloons placed in the stratosphere at an altitude of about 18 km (11 mi) to create an aerial wireless network with up to 4G-LTE speeds.
PS	Packet switching is a digital networking communications method that groups all transmitted data into suitably sized blocks, called packets, which are transmitted via a medium that may be shared by multiple simultaneous communication sessions. Packet switching increases network efficiency, robustness and enables technological convergence of many applications operating on the same network
QAM	Quadrature amplitude modulation (QAM) is both an analog and a digital modulation scheme. It conveys two analog message signals, or two digital bit streams, by changing (modulating) the amplitudes of two carrier waves, using the amplitude-shift keying (ASK) digital modulation scheme or amplitude modulation (AM) analog modulation scheme. The two carrier waves of the same frequency, usually sinusoids, are out of phase with each other by 90° and are thus called quadrature carriers or quadrature components — hence the name of the scheme.
QoS	Quality of service (QoS) is the overall performance indicator of a telephony or computer network, particularly the performance perceived by the users of the network. To quantitatively measure quality of service, several related aspects of the network service are often considered, such as error rates, bit rate, throughput, transmission delay, availability, jitter, etc
RAN	A radio access network (RAN) is part of a mobile telecommunication system. It implements a radio access technology. Conceptually, it resides between a device such as a mobile phone, a computer, or any remotely controlled machine and provides connection with its core network (CN).
Remote Communities	Remote communities are located in areas that are not necessarily far away from Georgetown and the coastline from a geographical point of view, but very difficult to access: Either due to poor road’s conditions, or due to accessibility only via water ways (by boat). These areas tend to be poor in terms of

	water supply, sewage services, electricity supply, schools, hospitals, road systems, policing, leisure facilities, etc.
RF	Radio frequency (RF) is any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz, which include those frequencies used for communications or radar signals
Smartphone	A smartphone is a cellular phone with an integrated computer and other features not originally associated with telephones, such as an operating system, Web browsing and the ability to run software applications.
SSID	service set identifier (SSID) is a sequence of alphanumeric signs. It is used as an identifier for a wireless LAN, and is intended to be unique for a particular area.
TDD	Time-division duplexing (TDD) is the application of time-division multiplexing to separate outward and return signals.
TDMA	Time division multiple access (TDMA) is a channel access method for shared medium networks. It allows several users to share the same frequency channel by dividing the signal into different time slots.
Tele-Consultation	A use case of e-Health in which a health care professional seeks advice from a colleague remotely using ICT infrastructure
Teledensity	Teledensity describes the number of telephone lines per population in a country or region.
Tele-Diagnosis	The collection of a patient's vital bodily data for the purpose of diagnosing a potential illness. The sensory date, e.g. x-rays, photos, ECG, will be analyzed by remote experts and a diagnosis with potential medication recommendation will be sent back to the patient.
UMTS, 3G	The Universal Mobile Telecommunications System (UMTS) is a third generation (3G) mobile cellular system for networks based on the GSM standard. UMTS supports maximum theoretical data transfer rates of 42 Mbit/s when Evolved HSPA (HSPA+) is implemented in the network. Users in deployed networks can expect a transfer rate of up to 384 kbit/s for Release '99 (R99) handsets (the original UMTS release), and 7.2 Mbit/s for High-Speed Downlink Packet Access (HSDPA) handsets in the downlink connection.
Uplink	Link between user equipment towards base station.
UTRAN	The radio technology used between mobile terminals and the base stations of 3G systems is generically known as 'Universal Terrestrial Radio Access' (UTRA) and the access network as 'Universal Terrestrial Radio Access Network' (UTRAN).
VoLTE	Voice over Long-Term Evolution (VoLTE) is a standard for high-speed wireless communication for mobile phones and data terminals
VSAT	A very small aperture terminal (VSAT) is a two-way satellite ground station with a dish antenna that is smaller than 3 meters. The majority of VSAT antennas range from 75 cm to 1.2 m. Data rates range from 4 kbit/s up to 16 Mbit/s.
WiBACK	A Wireless backhauling technology developed by Frauenhofer FOKUS institute with the aim to provide a broadband connectivity solution for developing countries .Aiming at minimizing the CAPEX and, especially, the OPEX, WiBACK features a very low energy foot print as well as a self-managed, autonomous operation. This allows for solarpowered deployments and reduces the demand for trained personal, which is often lacking in developing rural areas.

WPA, WPA2	Wi-Fi Protected Access (WPA) and Wi-Fi Protected Access II (WPA2) are two security protocols and security certification programs developed by the Wi-Fi Alliance to secure wireless computer networks.
WTP	Willingness to Pay (WTP) is the maximum price at or below which a consumer will definitely buy one unit of the product. It can be displayed as a range between the lowest Willingness to Pay to the highest Willingness to Pay.
XPIC	Cross Polarization Interference Cancellation (XPIC) is a feature used on Carrier-Class Microwave Link installations to increase capacity and spectral efficiency of a link. A Microwave Link using XPIC technology capabilities effectively doubles the potential capacity of a Microwave Path.

1. Management Summary - ICT access and e-Services for hinterland, poor, remote Communities

Celebrating its 50th year of independence, Guyana looks back at several ups and downs, socially as well as economically during these years. Despite having rich reserves in bauxite and gold, as well as rich nature and wildlife, especially in its rainforests, it is still struggling to overcome poverty in general as well as connecting the sparsely populated Hinterland to the densely populated areas at the coast.

ICT is seen as the major pillar to bring Guyana as a whole forward and connect all regions with the rest of the world.

A vision for the upcoming years needs to be elaborated to define this "ICT foundation" for Guyana, based on the needs and requirements of the different users and stakeholders. It is essential to understand that this vision cannot be limited to activities that only address the technology itself, it needs to be seen as a multidimensional vision and task plan, addressing technical infrastructure and platforms, tailored services, building of the capabilities of the people in the different communities and providing a suitable regulatory framework.

The e-Government Agency, as the project's implementing entity, will be responsible for the actual execution of project activities and elaborating an ICT centric vision. The United Nations Development Programme (UNDP), as the partner entity under the GRIF Framework, will be responsible for quality assurance and for providing and incorporating social, fiduciary, and environmental safeguards and best practices into the design and implementation of the project.

The Government of Guyana and UNDP have contracted "Detecon Consulting" to help define and elaborate this vision.[1]

1.1 Socio-Economic Situation and Demand for ICT-Access & -Services

The work stream 1, called Baseline Data Collection and Analysis, aims to collect data that represent the As-Is Situation in the country from different angles: the consumer perspective, the technology perspective, as well as the corner stones of the current regulation in place. It describes the current state (high-level) of the ICT-Situation in the country with focus on the Hinterland, Poor, and Remote areas.

This report will serve as basis for the following work streams: work stream 2 covers the technical report, work stream 3 the e-Services readiness assessment. Both work steams will elaborate a complete vision for ICT opportunities for Guyana's specific hinterland, poor and remote areas.

The applied Detecon methodology follows the TOGAF framework[2] that gives a state of the art "skeleton" for a structured approach towards the elaboration of specific architectures.

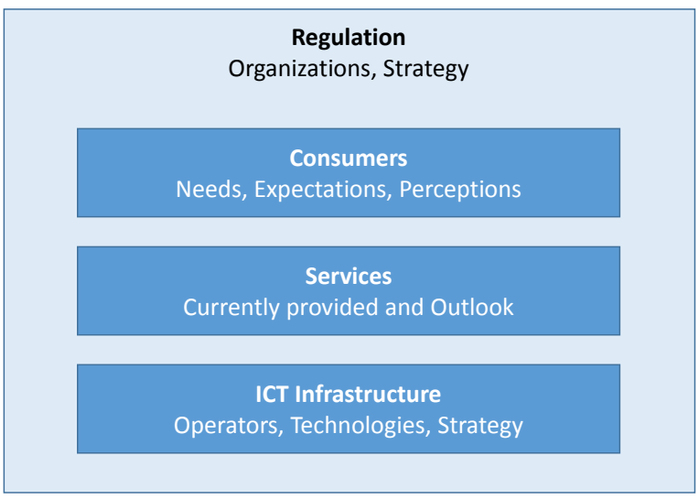

Figure 1 - Layers of Research

The analysis of all these layers are essential to compile a holistic overview about the current situation of ICT infrastructure and services in the Hinterland, Poor and Remote areas.

Key findings

This study comprised interviews at 30 communities in all 10 regions of Guyana. Those communities were amongst other criteria selected according to their area characteristics of poor, remote and hinterland. In addition commercial telecommunication operators and the eGovernment-Unit were interviewed in order to obtain a comprehensive picture and understanding of the current situation. The key findings can be summarized as follows:

[1] Source: Inception Report
[2] Source: https://www.opengroup.org/togaf/

Socio-economic situation

- Overall the economic development for Guyana has been positive and is expected to grow further. Still in most of the communities, the general economic situation is considered to have worsened during the last years. The main perceived causes are a general lack of training and education and the overdependence of local economy on extractive activities such as mining and logging.
- In terms of generating income and/or revenues the lack of proper education is seen as major problem. Even the few job opportunities available are hard to access for people from the communities due to a lack of proper qualifications. Further reasons are poor access to ICT services, the lack of markets to sell local products, and the absence of natural resources.
- Politics is seen as the most divisive issue in Guyana. Many respondents think that partisanship is a big problem in their country. While ethnical conflicts are in generally seen to be fading away with the younger generations, some interviewees still think that old problems are reenacted in specific situations. Indigenous people tend to express a feeling of alienation from decision-making in Guyana. They want not only to receive occasional aid, but also be consulted and included during the design of public policies.

Availability of ICT-Services:

- The survey shows, that the accessibility of telecommunication-services is very divers in Guyana. The coastal areas are better served by communication services, different from the areas in the interior with poor integration of communication systems. This pattern is reflected in the statements of respondents: The inhabitants on the coast complain about the price and quality of services, while inhabitants in the interior resent the lack of access to infrastructure.
- The communities surveyed can be clustered into three groups in terms of the current accessibility of ICT-Services:
    - **Communities with widespread access to a variety of services** presented a comparatively better situation than others regarding the ICT-Accessibility. For instance, in communities such as Albouystown and Kwakwani services such as 3G, landlines, cellphone signal, and internet are widely available to the public.
    - **Communities with a relatively limited number of widely-accessible services** have access to basic ICT-Services, but lack access to more advanced services. For example, people in places such as Mabaruma and Port Kaituma (both in Region 1) use cellphones, smartphones and narrowband internet. Broadband internet is available only through costly satellite services. Landline phones are also relatively rare, being available almost exclusively in some public facilities.
    - **Communities with very few, very unreliable, or quasi nonexistent telecommunication services** are practically cut off from access to telecommunication and information technology. Kako – a community in the Cuyuni-Mazaruni region with more than 2,000 people – for example, has only a few spots where it is possible to get proper mobile phone signal. In the same region, the Phillipai village does not have any mobile signal or landline phone – with the high frequency radio being the only device used to communicate with other villages and regions in Guyana.
- There is a considerable discrepancy between the accessibility of services in the communities and the statements provided by the telco operators who claimed that they are currently covering 98% percent of the population.[3] Even if a village had a mobile signal it mostly didn't cover the whole village, but only some spots of the community. Furthermore prices for some devices (mainly laptops and computers) were considered too high. Some communities, e.g. Kwakwani, have telecommunication services, but no store or shop to buy respective devices. Hence, cost calculations shall also consider the time and money spent to go to Georgetown in order to purchase such devices.

Improvement of ICT-Accessibility

- The quantitative data show that there has been low investment in ICT in the communities surveyed. Nearly 60% of communities claimed that there have been no ICT development projects previously. Many, however, have sought government support or private companies to help to develop actions to improve telecommunication, as they believe that this sort of project would help to develop the region. Besides that, they also believe it would help the youth to have more access to information.
- The most significant barriers in terms of infrastructure to be overcome are:
    - Lack of electricity access
    - Lack of internet access/ connectivity in form of telecommunication infrastructure
    - Lack of access to devices at the communities (phone/computer stores)
- The most significant barriers in terms of consumers to be overcome are:
    - Lack of knowledge of usage of the devices

[3] Source: Digicel

- Unawareness of all functions of the devices
- Low emotional affection towards ICT-devices
- Prices are not affordable/inappropriate to economical profiles of respondents
- Lack of feeling of unitedness (e.g. disconnected from the coastline or not equally appreciated as a citizen), even though respondents feel Guyanese

- The most significant barriers from the operators' perspective are:
  - High taxation level for telephone companies and high level of fees to the different agencies
  - Lack of skilled workforce in Guyana.
  - Complex and extremely time consuming processes to obtain permission for building new base stations in the country from public bodies.
  - Uncertainty about the market development and the specific role of e-Government Unit as a government funded infrastructure provider in this environment.
  - Uncertainty about future evolution of regulatory framework.

1.2 Technology Strategy

The Government of Guyana is committed to improving the quality of life for all citizens and the overall development of the country as a whole. To this end, ICT has been identified as a key pillar of national development and governance strategy. A whole-of-government approach has been adopted to ensure that the collaborative efforts of Ministries and Agencies achieve the shared vision of creating a digitally inclusive and accessible government.

The eGovernment Agency within the Ministry of Public Telecommunications (MoPT) is a key driver in the delivery of greater quality and efficiency of public services. Its mandate is to develop and implement appropriate ICT solutions that will transform the delivery of government services and help communities to get access to broadband internet and ICT-services. Special focus is on communities in hinterland, poor and remote areasthat are poor, remote and socially excluded. eGovernment in this context aims to provide ICT services to ministries and governmental institutions as well as to citizens. The services will cover all fields of societal development including administrative processes (e.g. visa or passport application), health-centric services and educational services, always in collaboration with the respective ministry responable for the sector. In the pursue of its mission eGovernment Agency will not compete with commerical operators, as it will not provide commercial broadband access services to citizens.

The collection and analysis of baseline data of the current environment showed two major pain points for the communities in hinterland, poor and remote areas in regards to ICT services:

First, the access to services is very limited or has poor quality meaning low data speeds or very weak signal coverage. In some of the communities, there is only access to ICT services like telecommunication or internet via satellite. This phenomenon is prevalent in communities in the hinterland and remote areas.

Second, ICT services are accessible, as there is the infrastructure needed, but prices for these services are perceived as too high. This has in particular been noticed for the communities classified as poor. These communities are located in the hinterland and remote areas, but also in the more densely populated coastal areas as "poor pockets".

To broaden access to ICT services a dedicated technology strategy has been developed including also the realization network with business model and stakeholders to be involved.

To address the affordability of ICT services, on one hand the overall competition on the service level must be increased – this is also covered by the business model recommended – and on the other hand supporting regulatory measures shall be applied to trigger the decrease of prices.

The technology strategy is based on three pillars: The first one is the need to build a future proof national backbone. The second one is to deploy the most appropriate backhaul and last mile technology for the different regions. The third one is that access technology will be Wi-Fi as it is a low maintenance solution compatible with almost all user devices.

- A national broadband backbone based on fiber technology is a mandatory prerequisite for the provision of broadband access to most of the hinterland and remote communities. The construction of this backbone is assumed to be executed in several steps:
  - Step 1 – Extend the eGovernment fiber ring deployed in Georgetown along the highly populated area of the coastline (either using the existing infrastructure already in place by partners like GPL or of a commercial operator, or building up own infrastructure)
  - Step 2 – Connect Lethem by fiber to the Brazilian Network
  - Step 3 – Connect Linden with existing fiber infrastructure at the coastline and connect Annai to Lethem.
  - Step 4 – Bridge the gap between Lethem and Anna with fiber.

  At the time of writing of this report a parallel project in the eGovernment Agency was still ongoing with the aim to assess the possibilities in how to establish high capacity connection along the Georgetown-Lethem-Linden corridor. Subsequently this backbone planning is not part of this report.

- Multiple technologies have been assessed to be used as backhaul and last mile technology. For the context of Guyana the following technologies have been identified as most suitable:
    - For communities in hinterland and remote areas with relatively high population and/or communities that build geographical clusters as they are located close to each other, LTE is recommended as last mile technology. LTE is the only future proof technology standardized for use in 450 MHz spectrum. This band has been recognized as a best fit frequency band particularly for the aim of bringing coverage to rural areas, because due to the far reach and large cell sites a high number of communities can be covered with one single LTE base station. The LTE last mile will be connected to a microwave backhaul with 7GHz frequency as a carrier grade technology allowing also high throughput rates.
    - For small communities in hinterland and remote areas and those that are farther away from other settlements, WiBACK is recommended as last mile technology as well as for the backhaul. This is in particular recommended because deployment costs of WiBACK are lower than those of LTE resulting in better per capita costs.
    - For remote and geographically secluded communities where PoPs cannot be connected via traditional backhaul and last mile technologies, satellite is seen as the only feasible solution. It provides the best trade-off between performance and ease of deployment. However satellite is not a long term solution as the physical limits of the existing satellite network will be reached in the near future, due to rapid traffic growth fueled by the introduction of broadband services and the growing popularity of smartphones, and tablets.
- The access network for all communities is based on WiFi-technology as it is low maintenance and compatible for the most common user devices.

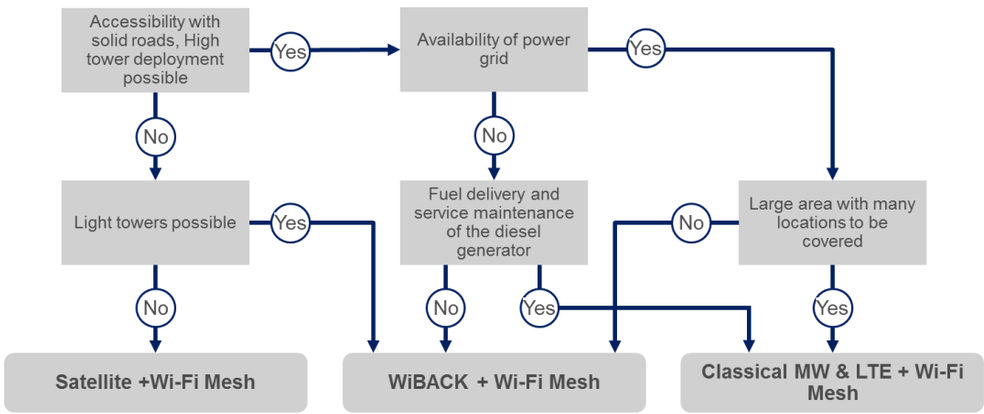

Figure 2 - Backhauling and last mile decision tree

A solution based on a single backhaul technology isn't a recommended option for the country, especially if the dimensions of "future proof" and "Frequency band usage" are defined as potential show-stoppers for one or the other technology:

Overview of the extensive assessment criteria

Assessment criteria	Solution 1 MW+LTE+Sat	Solution 2 WiBACK+Sat	Solution 3 Sat Only	Solution 4 Combined
Simplicity –flat technology, no technology zoo.	◑	◑	●	◔
Future proof – flexible, ready for new services, capacity reserve available	◑	●	○	●
Frequency usage – quality of service management	●	◔	◑	●
Green IT compliance - energy efficient solution and/or solar power based deployment	◔	●	●	◕
Ease of Operation and maintenance - no skills required for network maintenance.	◔	◑	◕	◔
Investment effectiveness – means the solution that is based on own infrastructure development	◕	◑	○	●
Cost assessment – allows to select the cheapest solution	◔	◕	●	◑

Figure 3 - Overview of assessment criteria

The rollout solution to be developed must enable the eGovernment Agency to connect the communities in the hinterland and remote areas to their broadband network with either of the above-described technologies. The solution development is based on data collected in the Census 2012. The data set provided contained 478 unique

locations for communities in the country[4]. All communities with a population of more than 10 people have been considered in the rollout planning, based on the assumption that smaller communities don't have any public building and are therefore out of the current scope of eGovernment Agencys's plan to connect public buildings first. According to the Census 2012 data 88,000 people live in the communities in the hinterland and remote areas that currently lack access to ICT services. At the end of the 5th rollout year, e-Services will be provided to people living in communities in hinterland and remote areas, via the eGovernment's network based on the three technologies recommended:

- 58,944 persons (66% of the population in hinterland and remote areas) using LTE450
- 17,865 persons (20% of the population in hinterland and remote areas) using VSAT
- 12,026 persons (14% of the population in hinterland and remote areas) using WiBACK

The following rollout phases for the next five years are recommended as follows:

- Phase 0 (Year 2017) – Extend current LTE infrastructure along the coastline
  Upgrading 18 of the existing eGovernment-towers with LTE450 technology will realize extended access to the eGovernment network in the coastal area. The extended range of LTE 450 technology compared to the currently deployed LTE 2300 will enable more than 84% of the total population to access the eGovernment broadband network, i.e. all villages within a radius of around 30km of each of these upgraded LTE tower.
- Phase 1 (Year 2017) – First VSAT connectivity deployed and capacity building started
  The major goal of this phase is to connect Lethem to the fiber line from Brazil. Furthermore, capacity building activities and negotiations with VSAT providers shall take place with the aim to connect the seven biggest communities[5] via VSAT to the eGovernment network in the 2nd half of the year. This will allow 14% of the population in communities in hinterland and remote areas to access broadband connections (87% of the total population of Guyana).
- Phase 2 (Year 2018) – Provide access to communities close to Lethem and along the highway from Linden to Georgetown
  LTE450 is being activated on the existing tower in Lethem. Additionally, to cover the area from Georgetown to Linden, 8 LTE450 towers will be deployed. The e-Service availability for communities between Lethem and Aishalton will be provided using WiBACK technology. On top of these, 16 remote communities will get access to e-Services using VSAT technology. Phase 2 will end with e-Services availability for around 94% of the population the hinterland and remote areas using broadband services provided by the eGovernment Agency. From a technology breakdown perspective, this means that 25% of the population in the hinterland and remote areas will use satellite connectivity, 60% LTE and 8% WiBACK. Considering the total population of Guyana about 99% will have access to e-Services.
- Phase 3 (Year 2019) – Expand fiber to Annai and connect additional communities using satellite
  Annai will be connected via fiber from Lethem. 14 communities with around 3800 people (4% of hinterland and remote population) will get access to eGovernment services via VSAT, resulting in 98% of population in hinterland and remote areas and 99% of the total population having access to e-Services.
- Phase 4 (Year 2020) – Close the fiber gap and extend WiBACK based solution
  As the fiber line from Annai to Linden will be completed, the locations along this fiber line within a range of around 40km can be connected using WiBACK or LTE450 technology. The communities of Madhia and Kwakwani will get their own high towers for LTE450 using additional microwave hops to connect to the fiber backbone. With Annai now connected to the fiber backbone, a second WiBACK cluster can be deployed in the south-west of the country to cover that area. This will result in 8 new Wi-Fi based backhaul towers to be built in a difficult mountain area which needs special planning, reflecting the individual area profile. At the end of this phase 99.7% of the people living in hinterland and remote areas will have access to e-Services, resulting in 99.7% of the total population.
- Phase 5 (Year 2021) – Connect the remaining villages
  Remaining nine communities with around 300 people will get access to the eGovernment service platform via VSAT. Thus this will help to achive the goal of bringing eGovernment e-Services to all communities in the scope of this project with 100% of the population in hinterland and remote areas having access to e-Services and 99.8% of the total population.

[4] The population numbers in the data set sum up to 590,000. This presents around 82% of the total population of Guyana (723.000). All numbers and percentages for the total population of Guyana are calculated over 590,000 unless further details is provided in the text.

[5] All locations are listed in the appendix on a per year basis for each technology.

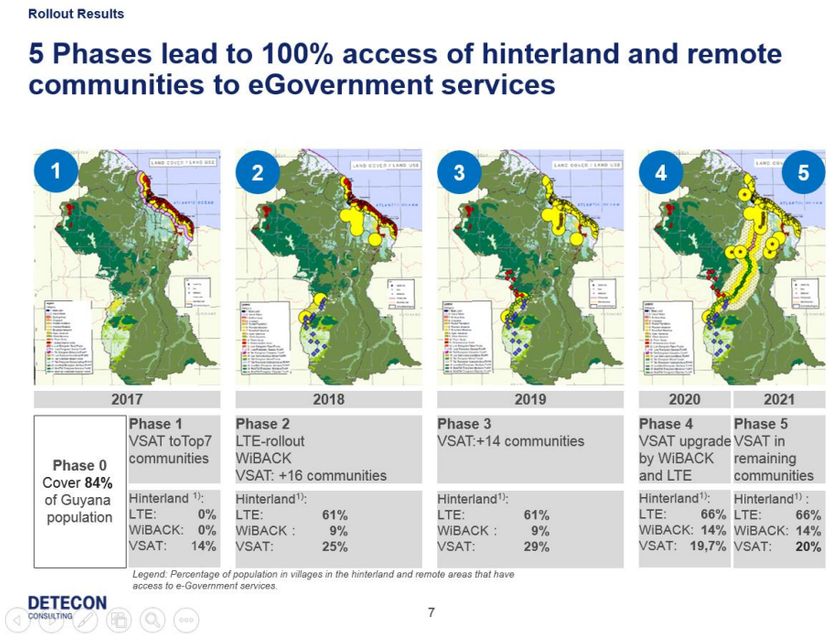

Figure 4 - Overview of rollout phases

It is important to highlight that the supporting activities within eGovernment Agency , e.g. the rollout of the ICT Hubs and of devices like laptops (program “One Laptop per Teacher”) need to be aligned with the phase by phase implementation of the eGovernment network.

The purpose of the commercial assessment of the different technical solutions is to define the most cost effective way of offering the connectivity in the hinterland taking into account network development plans and service demands during the years 2017-2021. The high-level commercial assessment of the different technologies extends beyond the initial capital expenditures, maintenance and software assurance costs and considers all potential operational costs over the next 5 years.

Due to the fact, that the access network consumes a major part of the CAPEX of the whole telecommunication network during the deployment phase, network operators choose access network technologies based on a cost/benefit analysis.

Together with technical selection criteria and service selection criteria, cost analysis serves as one solution selection criterion and gives the outline of the potential investment needs in the upcoming years.

To increase the area of e-service availability esp. to poor communities, the target of phase 0 of the deployment plan was set to provide connectivity along the coastal area by upgrading existing eGovernment agency LTE base stations. As specified in the description this Phase, optimal coverage can be achieved by deploying the 450 MHz LTE frequency layer on 18 LTE base stations. As these base stations are already operating with LTE services, upgrade should include only the installation of the new radio units and antennas, cabling and purchase of the licenses.

The next table shows the estimation of the numbers of equipment planned to be needed for the deployment in coastal areas for the next five years.

New Deployment	2017	2018	2019	2020	2021
Upgrade of 3 Sector LTE2300 to LTE 2300/450	18	0	0	0	0
MW Link capacity extension	18	0	0	0	0
Core deployment Mbps	210	200	130	0	0
User Access devices	650	750	400	0	0

Table 1 - Itemized deployment plan for coastal area

Based on the deployment plan and unit price information the following capital and operational expenses are expected to occur during the 5 years.

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$906,000	$400,000	$260,000	$0	$0	$1,566,000
Towers and facilities	$0	$0	$0	$0	$0	$0
User access	$97,500	$112,500	$60,000	$0	$0	$270,000

					Sub-total	$1,836,000
OPEX Components						
Active equipment	$150,600	$170,600	$183,600	$183,600	$183,600	$872,000
Towers and facilities	$0	$0	$0	$0	$0	$0
User access	$19,500	$42,000	$54,000	$54,000	$54,000	$223,500
					Sub-total	**$1,095,500**
					TOTAL	**$2,931,500**

Table 2 - Overall cost expectations in USD for the coastal area

To connect the hinterland and the remote areas to the national backbone or directly via satellite, the following numbers of infrastructure and equipment deployments are expected to be needed for the next 5 years:

New Deployment	2017	2018	2019	2020	2021
LTE BS 3 Sector Outdoor 24 hours battery backup	0	7	0	3	0
Microwave backhaul link 7GHz	0	2	0	5	0
WiBACK Link	0	20	0	11	0
Evolved Packet Core upgrade	0	210	0	90	0
Diesel generator approx. 17 KW for LTE, Microwave and/or satellite equipment	0	3	0	3	0
User Access devices	56	501	70	49	18
Tower 60 m	0	4	0	5	0
Tower 30 m	0	18	0	8	0
Satellite link user Low requirements	7	0	0	0	0
Satellite link user Med requirements	0	16	14	6	0
Satellite link user High requirements	0	0	0	3	9

Table 3- Itemized deployment plan for Solution 4 “Combined”

In the next table, the expenses forecast for the next 5 years based on the rollout plan specified for this solution is shown:

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$7,000	$825,000	$14,000	$400,000	$9,000	$1,255,000
Towers and facilities	$0	$849,000	$0	$625,000	$0	$1,474,000
User access	$50,400	$450,900	$63,000	$44,100	$16,200	$624,600
					Sub-total	**$3,353,600**
OPEX Components						
Active equipment	$21,000	$162,300	$187,500	$394,790	$432,590	$1,198,180
Towers and facilities	$0	$336,800	$336,800	$353,600	$353,600	$1,380,800
User access	$5,600	$55,700	$62,700	$67,600	$69,400	$261,000
					Sub-total	**$2,839,980**
					TOTAL	**$6,193,580**

Table 4 - Cost expectations in USD for the solution 4 “Combined” based on Detecon prices

This solution of blended technology options looks to be the most sophisticated one due to optimal selection and application of the technologies for each specific area within the country. It fully allows utilizing the benefits of each technology. Nevertheless, the mixture of the technologies in one solution requires having dedicated specialists for each of the technologies and makes maintenance, service and spare part management a bit more complicated.

The implementation of the technology solution relies on five pillars: The stakeholder management, the financing scheme, the business model, the implementation model, and the regulatory framework.

The identified stakeholders can be clustered along the different building blocks that define sustainable ICT services:

- Technical stakeholders (e.g. GTT+, Digicel, GPL) can either take a role as supplier or infrastructure partner, allowing eGovernment Agency to use their infrastructure. Or they can be potential users of eGovernment's infrastructure if they make use of eGovernment's wholesale access offering.
- Legal and Regulatory stakeholders (e.g. Ministry of Telecommunication, NFMU, PUC) define the legal framework for ICT services. A close alignment is essential to rollout eGovernment infrastructure and services efficiently.
- Financial stakeholders (e.g. UNDP, IDB) can provide additional funding for infrastructural activities in the hinterland and remote areas. In addition they can also benefit from the "ICT for hinterland, poor and remote areas"-program for the achievement of their own goals and targets
- Services/Use Cases stakeholders (e.g. Ministry of Health, PAHO, UNICEF) are key target groups/potential users for specific eGovernment services.
- Partners (e.g. Ministry of the Presidency, Ministry of Infrastructure) might help to drive the success of the project in different dimensions: They might be interested in using the infrastructure to establish and provide e-Services and furthermore they will push the achievement of the targets as they pursue the overarching common political interests.
- Business Model stakeholders (e.g. Toshao, community head) hold in many cases the sole rights to grant access to the respective communities and hence deployment of ICT-infrastructure and provision of e-Services depends on their consent. Early involvement of them in the planning of the ICT network and decision making process is crucial. In addition protecting the installation of infrastructure in the hinterland and remote areas is achieved best by creating a feeling of "ownership" or responsibility for the hardware/infrastructure deployed locally. These local "owners" shall be members of the respective communities, ideally with a strong standing. They are also essential multipliers in regards to the adoption and acceptance of ICT services especially in remote areas.

For the financing scheme for Guyana ICT infrastructure several models must be applied and a blended approach is recommended:

- For more densely populated areas (Georgetown and the more densely populated coastal area) the principle of Pure Competition between the commercial operators Digicel and GTT+ is working for the deployment of infrastructure, as access to ICT services is available to a large extent. Regarding the financing scheme, it is beneficial to provide Indirect Subsidies in forms of tax incentives for basic ICT-services to the commercial operators. Currently the operators bear a tax load of 40% what is at comparable level of other commercial sectors, even though the ICT sector requires much higher investments than e.g. retail, transportation or agriculture. Mapped against the theoretical framework of financing schemes for broadband roll out these high taxes rather hinder than foster the evolution of ICT services.
- To bring ICT access and services to the communities in the hinterland and remote areas a different approach is needed. The pure commercial roll-out of broadband networks in Guyana started in the major cities and then slowly penetrated smaller cities along the coastline until it also reached remote and hinterland areas. This typical development also left some unprofitable regions as "white spots" or underserved areas. To connect these areas a commercial approach is not viable. If any financing scheme is appropriate it is the Public Infrastructure. The advantage of the Public Infrastructure model is, that the government is fully in control of the target achievements and can bypass slow infrastructure roll out from GTT+ and Digicel in the commercially less attractive areas. The challenge for the government will be the foresighted development of the infrastructure roll out and management of the costs. A plus is that existing public infrastructure, such as transport network, backhaul and towers can be leveraged to set up the new network without building it from the scratch. Funding for the CAPEX will come from the GRIF fund and the national budget.

Financing scheme	Favorable conditions to promote success	Applicability to Guyana	
Pure Competition	• Strong customer demand • No remote / difficult-to-serve areas • Strong regulatory regime	There is strong customer demand, but population is sparse in hinterland and remote areas and the majority of the communities in scope fall under the category of "difficult-to-serve areas", either because of their geographic position, challenging terrain or poor infrastructure access (e.g. power supply, roads). This model is only appropriate for dense urban and economically well developed areas of Guyana, that are already being covered by commercial operators	✘
Indirect Subsidies	• Functioning market with operators that react to subsidies with investment • Right design of subsidies	The outcomes are hard to steer as they depend strongly on how subsidies are adopted by the commercial operators. As Guyana's government has the concrete goal to develop ICT in communities in hinterland and remote areas indirect subsidies are not the most effective approach.	✘
Direct Subsidies	• Competitive market that serves most areas • Strong civil society creating local initiatives	There is competition between mainly GTT+ & Digicel in many areas, especially the more densely populated ones. The communities in the hinterland, poor and remote areas show strong interest in the ICT program and would probably be willing to support the process. Direct subsidies are appropriate and beneficial for the development of ICT in the communities in the hinterland and remote areas that currently do not benefit from any competitive market structure. But subsidies must be	✓

		designed properly to address explicitly the designated areas (lack of service provision by commercial operators, difficult to serve, commercially less attractive).	
Public Private Partnerships	• Strict control of target achievement and costs	Public Private Partnerships can help to overcome a potential blockage by incumbent operators, but requires firm and persistent control and enforcement. As Guyana has recently gone through political change this model is a big challenge for the public authorities and will take long time to be implemented due to the lengthy tender process and negotiations with private sector to elaborate the Public Private Partnership contract.	✘
Indirect Government Control	• Strong government influence on operators (total or partial state ownership) • Complete and exhaustive regulatory framework	The commercial operators in Guyana are private enterprises and act rationally and independently following their economic interest. The government influence on their behavior is limited to the formal legislative and regulatory framework. As legislations and regulation in the telecommunication sector is currently being revised and amended, this model is not appropriate to support the government in the short- to mid-term realization of its goal to enhance ICT in the hinterland, poor and remote-communities.	✘
Public Infrastructure	• Strict control of target achievement and costs	Public Infrastructure can help to compensate the rather hesitant approaches of GTT and Digicel to build ICT-infrastructure in the hinterland and remote communities. Self-reliant and sustainable management of costs and target achievements can be carried out by a dedicated public body. The new regulator can monitor as second instance.	✓

Table 5 - Assessment of potential financing schemes for Guyana

The proposed business model will be based on the mandate of the eGovernment Agency: The Agency will provide internet access to public buildings and provide ICT-services. The access and the services shall be free of charge for consumers. A cost-based levy can be applied to the ministries responable for the ICT services (e.g. Ministry of Health for health-centric ICT services). At the same time the eGovernment Agency shall operate a wholesale model and grant access to the broadband network to commercial operators, ISPs, and other interested enterprises, enabling them to commercialize connectivity and sell services to the consumers. This can be realized in form of eKiosks and internet labs, where consumers can purchase internet vouchers and access the internet. Revenues generated from this wholesale business will contribute to covering the OPEX of eGovernment's broadband network. Opening the infrastructure to commercial operators will also stimulate competition on the service level and lower retail prices as new players can enter the service market with little CAPEX. Furthermore new business opportunities arise for local entrepreneurs, who can manage the local eKiosk and start a small business. Essential for the success of the wholesale model is the determination of price points: The retail prices (prices commercial operators charge to the consumers) must not be too high as purchasing power in the hinterland, poor and remote communities is low. Prerequisite for affordable retail prices are appropriate wholesale prices. The charges of eGovernment Agency to commercial operators / ISPs must be non-discriminatory and lower than the retail prices. They must allow the commercializing enterprises to cover their costs and to still make some profit.

As eGovernment Agency's mission is also to facilitate extensive ICT adoption and usage by citizens, basic connectivity shall be provided to the consumers for free, but with an overall limit of 100 MB per month, per person. This will allow them to satisfy basic communication needs, but is still small enough that it leaves room for upselling for commercial operator. The volume cap of 100 MB data allowance is based on the average traffic load generated by a blend of communication and information services. The calculation estimates usage of email with and without attachments, chats and web browsing as indication for the overall traffic load. Two exemplary calculations have been done representing on one hand more private usage and on the other hand a more business oriented usage. Regular usage of media services such as YouTube and Facebook will require higher data volumes.

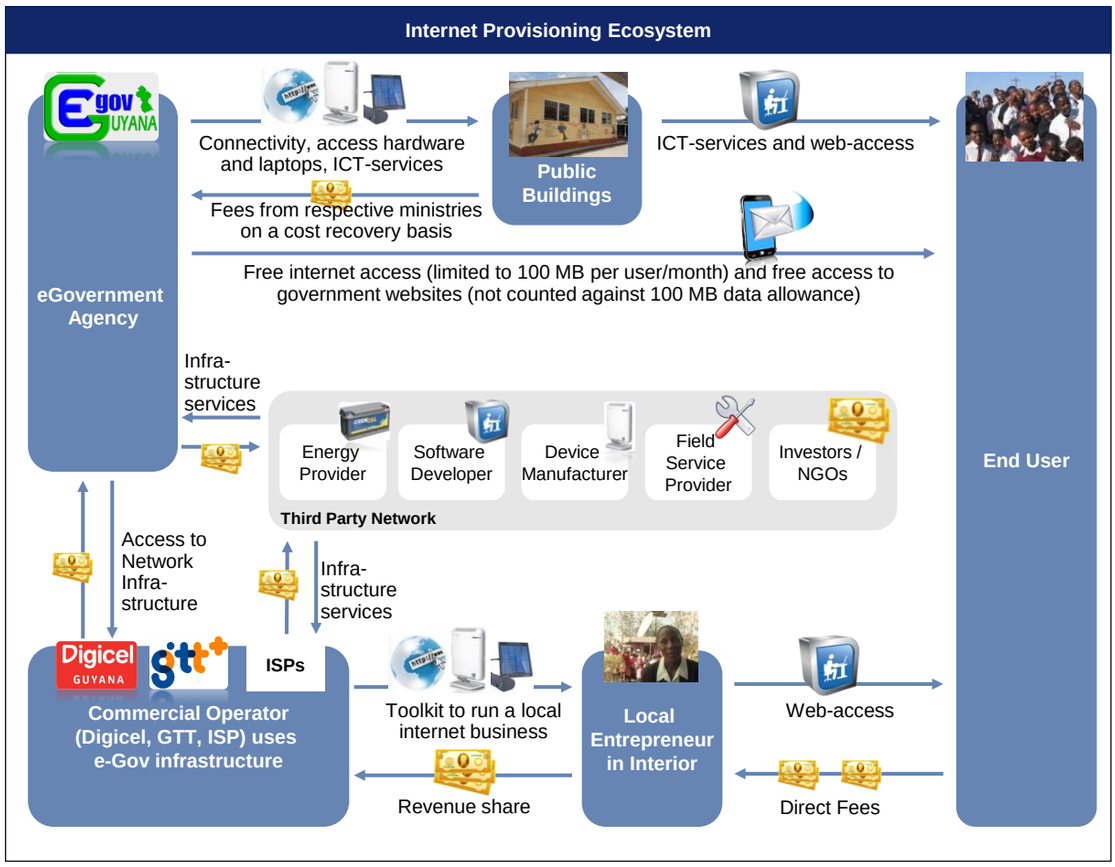

Figure 5 - Rural internet ecosystem with eKiosk model

The whole business model and all relationships between the eGovernment Agency and the other players is depicted in the following illustration.

Figure 6 - The business model canvas for the eGovernment wholesale model[6]

The planning, building, operation and maintenance of the ICT network requires dedicated resources and skills. The eGovernment Agency is recommended to select the BOT(T) approach for the implementation model to realize this endeavor: BOT(T) stands for "built-operate-train-transfer" meaning the eGovernment Agency contracts a private entity to build the network, to operate it for an explicit time and to provide trainings and skill development. Afterwards operations are transferred from the subcontracting unit to eGovernment Agency. By outsourcing the

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development and deployment of the network eGovernment can overcome potential shortages of resources but has still full control over the assets and the target achievement. Furthermore a prolonged period of transfer and training will significantly contribute to capacity building at eGovernment Agency for the future operation and maintenance of the network

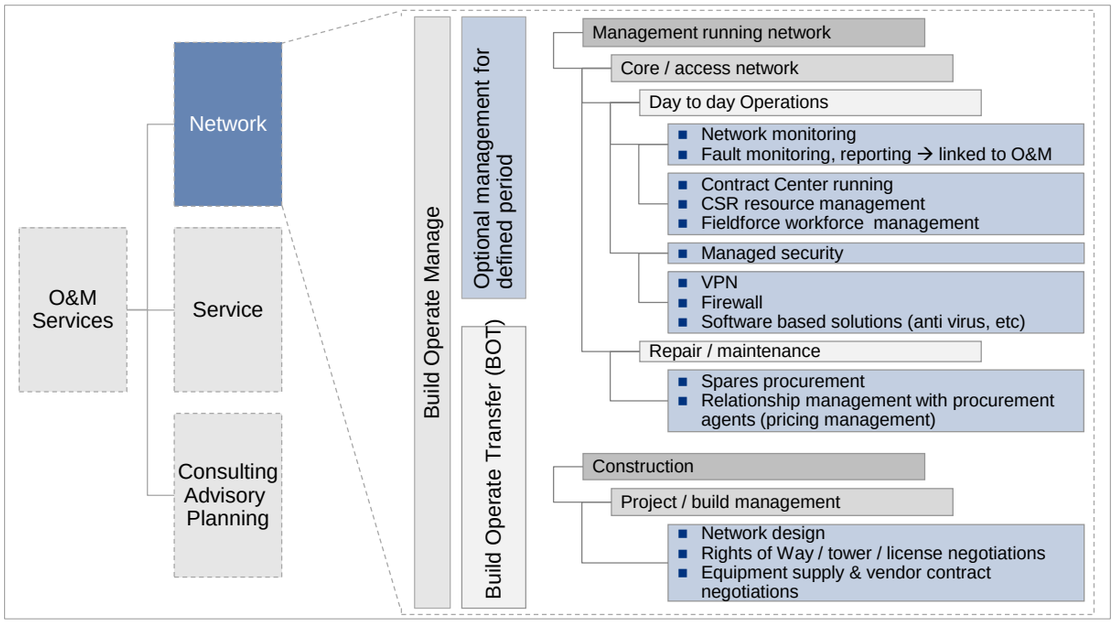

Figure 7 - Build-Operate-Transfer approach to create the future network

The regulatory framework must create the environment and legal base prerequisite to put the concept of bringing ICT-services to hinterland, poor and remote communities into practice.

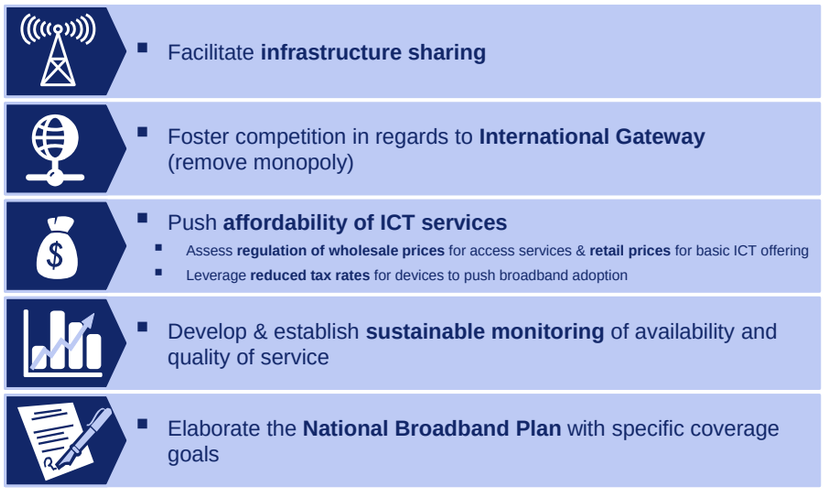

Figure 8 - Implications for regulatory framework

The wholesale model requires a legal base facilitating infrastructure sharing, what is already being addressed in the new Telecommunication Bill from 2016. Granting access to the public broadband network will also open the market for new entrants and increase competition on the service level. The increase in competition will impact consumer prices, making services more affordable. Furthermore it is recommended to bring competition to the international exchange layer, to remove the monopoly on the international gateway, and to establish additional international exchange points. This measure can also considerably reduce prices at the wholesale and retail layers of the value chain.

In case all the measures to increase competition will not bring down consumer prices to an affordable level, next stage will be the regulation of retail prices. This remedy must be given careful consideration as it represents a strong regulatory intervention in the telecommunication market. To reduce market impact and distortion, retail price controls shall only be applied to entry-level broadband services. The regulated product might be a basic broadband lower capacity service that a dominant service provider is obliged to offer at a specific price, or it could be a standardized product that all broadband service providers are obliged to offer as a minimum. This approach has the virtue of ensuring that an acceptable minimum broadband service is made available at an affordable price, thereby stimulating greater adoption. At the same time it encourages competition among the higher speed services to which most consumers will upgrade after entering the market.

The affordability of devices is yet another barrier for the adoption of ICT services: To increase population penetration with devices capable of accessing the internet, several initiatives have been started in the recent years, e.g. the international “one Computer per Child” program, where computers were provided free of charge to students in public schools. In 2011 the government of Guyana has tailored this approach to the local specifics and started the “One Laptop per Child” program. Today this initiative is revived, but with a slightly changed focus and runs as the “One

Laptop per Teacher" program. Further access to laptops and computers is also provided via the ICT hubs in the public buildings, which are being rolled out and equipped in the "Community ICT Hub" project. To reach more people the initiatives ongoing should be complemented by a program to support individual purchases of ICT devices: Special subsidized loans explicitly for the purchase of ICT devices shall be designed, enabling people to buy a simple smartphone, tablet or laptop at no or below-market rate interest. The advantage of such a program supporting reduced rate loans for the purchase of ICT devices is, that emotional connection to the device purchased at own costs is higher compared to devices that are given to users without any invest required. As overarching measure reduction in or exempt of VAT and import duties for all ICT devices facilitating broadband access including laptops, tablets, smartphones, and feature phones is recommended as this would directly lower the consumer prices and increase affordability of devices significantly.

The realization of the overall ICT concept for hinterland, poor and remote communities is a long term endeavor, what requires forward-thinking aims. To give guidance a National Broadband Plan for Guyana should be developed as part of the overall regulatory strategy. There must be considered, that there is a significant difference in terms of ICT access and service quality between the densely populated coastal areas and the hinterland and remote areas. Hence the National Broadband should stipulate dedicated targets for each of these area clusters. Based on the current situation and the network solution design targets for the hinterland and remote areas have been developed. In addition to the targets stipulated it is recommended to establish a process to review the targets annually and to adjust to a more ambitious level if necessary. This is to ensure the ambition is at level with ongoing technology and industry innovations.

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Communities >1000 people	20% covered at 6Mbps	85% covered at 6Mbps	85% covered at 6Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	50% covered at 100 Mbps 50% covered at 50 Mbps
Communities with 101-1000 people	-	80% covered at 3Mbps	95% covered at 3Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	50% covered at 100 Mbps 50% covered at 50 Mbps
Communities with 11-100 people	-	70% covered at 1Mbps	70% covered at 1Mbps	70% covered at 1Mbps	100% covered at 1Mbps	30% covered at 6 Mbps 70% covered at 1 Mbps	60% covered at 6 Mbps 40% covered at 1 Mbps	100% covered at 6Mbps	50% covered at 12 Mbps 50% covered at 6 Mbps	100% covered at 12Mbps

Table 6 - Recommended broadband coverage targets for hinterland and remote areas

The recommendation for the broadband targets is based on the following principles:

- All targets count for the status achieved by 31st of December of the respective year
- All targets present minimum requirements
- Total sample is the same as comprised in the technology solution design and the data base of 163 communities in hinterland and remote areas in scope of this assessment
- Coverage is prioritized over bandwidth: first general coverage shall be ensured, required data rates are to be increased over the time
- Coverage targets are per community not per individual. A community has full coverage if the public buildings have access to ICT service with the respective bandwidth stipulated. The public buildings comprise: secondary schools, primary schools, post offices, hospitals, health stations, health huts, benabs, police stations

- Larger communities are to be covered before smaller communities to connect as many people as fast as possible
- The roll out must be supplemented by the provision of devices to be used by the people in the communities in the respective public buildings connected. When a community is covered, adequate computer labs shall be installed and working especially in schools, hospitals / health stations / health huts and benabs. Ongoing governmental projects, such as the “One laptop per teacher” or the “ICT hubs” can be leveraged to achieve this goal.

In addition to the targets stipulated it is recommended to establish a process to review the targets annually and to adjust to a more ambitious level if necessary. This is to ensure the ambition is at level with ongoing technology and industry innovations.

Broadband service providers often advertise broadband speeds that are higher than the bandwidths actually experienced by the user. Differences between advertised and actual speed can affect users’ confidence in the quality of broadband services. This lack of confidence can be overcome through regular reporting of service quality levels. For Guyana it is recommended to apply a two sided approach: The base data shall be collected from the operators and ISPs on a regular base (e.g. quarterly). In addition information from users about real network performance at the point of usage (the smartphone) shall be recorded and measured against the data base from the commercial operators. Making the performance data publicly available will increase transparency for consumers and also for operators.

1.3 E-Services Vision and Roadmap

There are many reasons for fostering an eGovernment initiative, such as the increased effectiveness and efficiency of the public sector and the improved quality of government services provided to citizens (G2C), the business sector (G2B) and within the government agencies (G2G), which inevitably lead to economic growth and improved gross domestic product.

Provisioning these government services online needs a close cooperation of all involved agencies and units, including a common vision, mission and strategy as well as a work split and clear mandate for the work to be done. The eGovernment Agency defined its vision to be the ICT vanguard that enables equitable digital citizenship for all Guyanese. This will be achieved by developing and implementing appropriate ICT solutions, i.e., e-Services that will transform the delivery of government services.

These e-Services will address all citizens, regardless of their location, i.e., in the hinterland, poor and remote areas as well as in the economic hotspots along the coast. All e-Services will essentially be free of charge to consumers, thus poor communities are benefitting in the same way as remote and hinterland communities. Special e-Services will target hinterland and remote areas and increase the ability to communicate with the coastal areas, e.g., remote classrooms and Tele-Consultation. The extension of reach of selected e-Services to people living abroad might be considered at a later stage.

In the context of e-Service provisioning by all government agencies and ministries, a target picture of a complete service portfolio comprises all necessary components for an effective eGovernment and shows exemplary use cases for the domains of e-Learning, e-Health and other additional e-Services:

- **eAssistance**: Provides general information concerning the public administration or government. This includes, for instance, opening times, contact numbers, staff information, forms or general description of government agency tasks. It can also be seen as self-marketing of the institution. The advantages for citizens are service improvement (quality and cost) and reaching the agency through multiple channels.
- **eAdministration**: These are the typical public administration tasks and processes, which have to be done by citizens or businesses. Existing processes are handled digitally and possibly through a well-defined electronic workflow with minimal personal face-to-face visits. Examples include applications for all kinds of government issued licenses, electronic censuses, application for social welfare, registration in a new community, or electronic tax declaration.
- **eParticipation**: This e-Service domain comprises online surveys to include the citizens and enterprise in the political process, eCommunities (electronic discussion arenas), internet petitions, or creation of government/agency wikis. Examples are the information about potholes on streets, general feedback about government performance (see: “Tell Us” project) or Q&A sessions with elected officials on government portals.
- **Open Government Data**: All data, which is not expressly categorized as confidential, is proactively and completely published to make it accessible to other government agencies and the public. Open data enables new business models between government, citizens and businesses, but it also constitutes a major cultural and paradigm shift.
- **eSignature**: This enabling service makes it possible to establish the identity of an individual remotely and securely. It is generally a challenge to administrations to guarantee the end beneficiary is truly the one she or he claims to be. Registered email systems or electronic national IDs with special encryption functions can serve as an electronic signature tool.
- **Security** is a paramount guiding principle, which also needs to extend into the digital domain. This can be achieved by adhering to the ISO 27000 guidelines and a certification process.

- **ePayment** is needed for some of the e-Services, which involve monetary transactions, and generally makes handling money more secure. A collaboration with existing payment systems by commercial providers might be prudent.
- A **Government Service Bus** connects all administrative domains and ensures the availability of relevant data to all government stakeholders. Databases need to be harmonized and every citizen and business needs to be identifiable by a unique ID, e.g., the social security number or tax ID.
- **E-Learning**, **e-Health** and **additional e-Services** are offered by ministries and agencies on top of the government ICT infrastructure to the respective stakeholders.

All stakeholders that have interest in using e-Services have expressed their need for basic communications. Besides this generic need, a detailed look along the building blocks reveals the following interests and needs:

Technical stakeholders, e.g., operators like Digicel and GTT, can provide platforms for eGovernment services. The eGovernment Agency can either license the complete platform and operate it then on their own premises or just use a white label version of the service provided by the stakeholder.

Legal and regulatory stakeholders, e.g., Ministry of Telecommunications, have needs for services in the field of collaboration, document management and dissemination of information.

Financial Stakeholders, e.g., UNDP and IDB, have interest in deploying services that increase the wealth especially in underdeveloped regions of the country. This might include, besides the above mentioned basic communication services, services that foster the development of local business in these remote areas.

Services/use case Stakeholders, e.g., Ministries and UN agencies as PAHO and FAO, have need for basic communication services, and in addition require e-Services that are more sophisticated. The more complex eServices are in particular relevant for ministries (like document management, passport application).

Partners, like foundations, NGOs and companies that provide Corporate Social Responsibility Programs can be a source for cost-effective licensing, e.g., for e-Learning tools.

Business Model stakeholders (e.g., Toshao, community head) hold in many cases the sole rights to grant access to the respective communities and hence deployment of ICT-infrastructure and provision of e-Services depends on their consent. Early involvement of them in the planning of the ICT network and decision making process is crucial. In addition, protecting the installation of infrastructure in the hinterland and remote areas is achieved best by creating a feeling of “ownership” or responsibility for the hardware/infrastructure deployed locally. These local “owners” shall be members of the respective communities, ideally with a strong standing. They are also essential multipliers in regards to the adoption and acceptance of ICT services especially in remote areas.

Setting the right ownership and responsibilities when operating e-Services is of great importance. The eGovernment Agency is the catalyst for e-Service introduction, but also serves the role of gatekeeper and organizer of agency cooperation. It needs to oversee, steer and streamline all efforts towards e-Services, however leaving enough room for individual agencies to pursue important special projects by themselves. Generally, all applications shall be hosted by the eGovernment Agency. However, in specific cases each of the Ministries or Agencies can host and operate the applications itself. The eGovernment Agency should target to host and support about 80% of the services offered online.

Several e-Services were considered fundamental in addressing the needs of hinterland, poor and remote communities, namely e-Learning, e-Health and e-Government services. Special emphasis is given to e-Learning as it is considered as the underpinning of all activities and the platforms can be leveraged in other government domains:

- e-Learning
    - Teacher support: The most effective way to bolster the educational system of a nation is to support its teachers appropriately. The Guyanese government has recognized this and the “One Laptop per Teacher” program has been started. These laptops already come with a slew of different materials, such as curriculum ideas, governmental forms and electronic textbooks. However, this material is static in nature and there is no means of updating it. A much more flexible way of supporting teachers can be delivered online through specialized learning management applications (LMS), the availability of special support forums for knowledge exchange and mutual support and the subsequent use of electronic media in the classroom.
    - Individual Student Learning: In the case of hinterland and remote schools where special subject teachers are very few, students can engage in direct learning with special subject-based applications or gamification platforms that convey specialized knowledge. In addition, these systems are useful when topics need to be re-learned or a student has special needs, which cannot be satisfied in the regular classroom interactions.
    - School management application: The hinterland and remote primary and secondary schools are located far away from Georgetown and are hard to reach with long car rides or taking plane trips. Still, there is a need to track and control these schools to elevate them to a standardized school system and curriculum. The national school authority needs a reliable way to communicate with the interior school staff and exercise steering control. Thus, an application which makes it possible to chat with teachers and administrative staff (either text chat or video), gives remote access to schools attendance records and other school statistics, helps in class schedule preparation, and can track school inventory would be a very helpful service.

- Remote Classroom: When there is a shortage of teachers for a certain subject, it is very useful to multiply a teacher's impact via real-time tele-education. This is the case for remote classroom, where a single class is recorded in one location and transmitted to multiple locations in real-time.

- E-Health
  - Basic Asynchronous Services: Implementing simple communication services can make a big impact on the operation of the healthcare services in the hinterland and remote communities.
  - Warehouse management for medical supplies: Medical stores management at central-level stores and at regional district-level stores is a widespread problem in Guyana's hinterland and remote health centers. Oftentimes the inventory levels are unknown and drugs are kept (and used) well beyond their expiration dates. A common system for creating transparency and aide in drug management should be implemented. There is a trend towards a decentralized model supported by an efficient IT system and a well-organized supply chain
  - HIS – Health Information System: A HIS can be described as any system that captures, stores, manages or transmits information about the health of individuals or the activities of institutions that work within the health sector. A strong HIS is the backbone of an effective healthcare system. An EHR (electronic health record) is used to capture all relevant information based on a unified patient identifier. This system has to be developed for the entire healthcare system in Guyana and is not special to the HPR communities. However, it should be extended into regional hospitals and health stations as soon as they are reasonably well connected.
  - Tele-Consultation: Teleconsultation means obtaining the professional opinion of an expert who is not physically present at the location where the patient and/or the local health worker are.
  - Tele-Diagnosis: This form of telemedicine is defined as a "diagnosis that is made at a remote location and is based on the evaluation of data transmitted from instruments that monitor the patient and a transfer link to a diagnostic center."
  - Tele-Surveillance and Early Outbreak Detection for Disease Containment: In order to fight communicable diseases effectively and curb their spreading, accurate and timely field data is necessary. Therefore, health workers consolidate weekly health record statistics gathered from the field at the health stations level and send it to the regional level. MoPH and PAHO would like to reduce this turn-around time for early intervention. This can be addressed through an ICT system that incorporates the collection of clinical information for the purpose of detecting disease outbreaks before reaching epidemic states. Web-based data entry on PCs at health stations can be a first step towards an electronic filing of health data. This can be addressed through an ICT system that incorporates the collection of clinical information for the purpose of detecting disease outbreaks before reaching epidemic states. Web-based data entry on PCs at health stations can be a first step towards an electronic filing of health data.
  - Diabetes Management: Diabetes has become an increasing problem for hinterland and remote communities. An effective monitoring and management of diabetes (type I and type II) can make the lives of diabetics much easier and convenient in terms of tracking and analyzing their glucose levels.
  - Maternal Healthcare: One statistic from the World Health Organization shows that more than 800 women die globally every day from preventable circumstances related to pregnancy and childbirth. Almost all of those women live in developing nations. Major complications accounting for most of these maternal deaths include severe bleeding, infections, high blood pressure during pregnancy, complications during birth and unsafe abortions. Given more education and more access to healthcare workers, there is a good chance to reduce the mortality rate in remote communities.
  - VoIP: a voice services for the health sector in Guyana will increase the ability to communicate in real time with remote health posts, especially in emergencies. This service will provide a better protection of patient related information than currently used HF radios.
- E-Government services
  - Document Management: To handle documents digitally and to exchange them between different relevant users, a document management system (DMS) needs to be deployed. It represents an IT tool that is used to track, manage and store documents digitally.
  - Basic Email System: Ministries and government agencies need to use emails following an aligned domain model provided by eGovernment Agency for the government. For security reasons as well as to support a certain "corporate identity" of the country, the usage of free email providers for professional emails shall not to be accepted.
  - Birth / Marriage / Death Certificate Provisioning: Citizens shall be able to use government services online, especially to reduce their needs to travel to the next physical government location. This applies not only to the request for birth certificates, but as well to the submission of marriage and death related information.
  - Passport application: The passport application allows the users to enter all their personal data online, meaning they only have to travel once to the passport agency or never if the whole process documentation can be signed digitally and the passport sent back to the citizen via mail.
  - Enabling services
    - ID/Account Management / digital signature: Trust worthy accounts of users are essential to use eGovernment services. This account helps to prevent the misuse of the services, e.g., claiming a passport under false ID. With a digital signature, the citizen can digitally sign official documents.
    - E-Payment services: online payment is needed to settle fees for government e-Services online but also as a service to enable business and to transfer money between citizens, especially in the hinterland and remote areas.

- Common Data model: To increase the usage of digital information and to ease the exchange of information between different governmental entities, a unified and harmonized data model as a foundation for all digital data needs to be developed and enforced by the Government.
- Carrier-grade service provisioning and hosting Services provided by the eGovernment Agency need to be available for the customers 24hrs a day, 365 days a year.

In order to create a roadmap and detailed implementation plan, the above-mentioned e-Services and their respective use cases have to be prioritized. A prioritization of services for the years 2017 to 2021 includes the following:

- e-Learning: Finalizing and extending the One Laptop per Teacher program is the most important initiative. School management does not affect students as much as individual learning programs, thus it should be de-prioritized.
- E-Health: The basic services such as internet access via a stationary PC and communication availability and providing for enhanced maternal healthcare should be the focuses for the next years. Tele-Surveillance enhances the data gathering capacity and is important for disease control and early intervention capability. Tele-Diagnosis and Tele-Consultation rely on fairly stable and high-bandwidth connections, thus should be deployed when those are ready.
- E-Government services: The programs which are already partially in place (email, DMS, calendar) should be expanded and made into enterprise-grade services. In addition, extending the website hosting capability should be tackled in the first year. The most demanding enabling services like eSignature and ePayment can be implemented at a later stage as prerequisites for complete online transaction services. It should be noted that all service delivery processes need to be re-engineered for being provided online. Mostly also, an offline component (backend) involved needs to fall into place as well.

A high-level cost estimation for the next years to rollout and implement these services is as follows:

	Cost block	#	unit cost	Total
e-Learning	Primary Schools	434	$ 2.000	$ 868.000
	Secondary Schools	111	$ 9.500	$ 1.054.500
	Backend	1	$ 45.000	$ 45.000
				$ 1.967.500

	Cost block	#	unit cost	Total
e-Health	Health Stations	200	$ 6.400	$ 1.280.000
	Regional Hospitals	10	$ 21.250	$ 212.500
	Backend	1	$ 183.000	$ 183.000
				$ 1.675.500

	Cost block	#	unit cost	Total
e-Governance	Community building	249	$ 1.950	$ 485.550
	State building (post)	67	$ 1.950	$ 130.650
	Backend	1	$ 164.000	$ 164.000
				$ 780.200

Total	$ 4.423.200

Figure 9 - Summary of estimated e-Services implementation costs for the next five years (2017-2021)

Additional services can profit from an ICT infrastructure and the digital connectivity this infrastructure can provide. This include civil security apps, aiming to increase the perceived security situation of the citizens by better connect them to a public security infrastructure. Other e-services can support environmental protection and e-commerce possibilities of the citizens.

The eGovernment Agency itself needs to be prepared for the additional new roles it has to fulfill if providing connectivity to the hinterland, poor and remote areas as well as e-Services to all citizens. This includes the needs of additional operational skills, like for the operation of OSS (Operational Support Systems) and BSS (Billing Support Systems), the implementation of a transparent Demand Management Process to align and prioritize the new and additional demands based on available resources and planned roadmaps, as well as the skills to develop, operate and maintain the new e-Services.

1.4 Training Concept

The need for a thorough training to increase the individual's skills in using ICT infrastructure and services has been highlighted by the different stakeholders. Furthermore the use of computers requires, according to the view of respondents, greater specialization than the use of smartphones. So they see themselves depend on courses and learning, particularly aimed at older audiences, which have more difficulties in operating these types of equipment.

To secure a sustainable implementation and operation of these e-Services and the respective infrastructure, an efficient capacity building approach needs to be deployed to permit the single users, irrespective of their location in the country, to build up the needed knowledge.

The capacity building must follow a step-wise approach, starting with the development of basic skills among all stakeholders, continuing to an advanced level up to very specialized capacities for the usage and provision of specific e-Services.

The content of the training will be organized in various modules that build on one another. Depending on the future role of the trainees, different modules are mandatory, recommended and optional. This way the minimum capacities and skills for the usage of ICT-devices, e-Services and the navigation in the internet will be built up at all stakeholder groups. More complex operations like data analyses and presentation design are being elaborated in the more advanced modules that are only mandatory for selected stakeholder groups.

The challenge in the development of a training plan for the sustainable introduction of e-Services is that there are many stakeholders involved with different skill profiles. Furthermore, the stakeholders can be divided into two major groups:

Firstly, the officials at the ministries will on one hand use the e-Services and on the other hand will define design requirements and create content for the e-Services. The majority of the officials is based in Georgetown.

Secondly, the members from the communities in the hinterland, remote and poor areas will predominantly use the e-Services, especially teachers, health professionals and administrative workers. These stakeholders live in communities geographically scattered over Guyana.

A detailed description of the training concept is shown in the chapter 7.3

To train stakeholders in the Georgetown area it is recommended to establish a National Training Center in Georgetown and provide trainings on a regular basis.

To reach stakeholders in the hinterland, remote and poor communities a "train-the-trainer" scheme is recommended: Master trainers will be trained and qualified in the National Training Center and then transfer this knowledge and skills to experts from the communities. There should be one master trainer for each administrative region of Guyana.

The master trainer will instruct and train teachers and health professionals from the communities, who in return will transfer this knowledge to their peers in their communities.

2. Implementation Plan

2.1 Overview

The following chapters outline the high-level technology architecture proposed for hinterland, poor and remote regions as well as a feasible business model to finance, build, operate, and manage the infrastructure in a sustainable way. The next step in the overall rollout needs to be the detailed plan for infrastructure implementation. The following section serves as a guideline for the activities that need to be performed during the in-depth planning phase.

The final goal of the implementation phase is providing the first set of hinterland and remote communities with internet access. Therefore, the implementation partner needs to be chosen and in parallel, the target business model needs to be defined and agreed with all stakeholders. Regulatory frameworks need to be adapted or introduced potentially for both, implementing as well as wholesaling the technology infrastructure for hinterland and remote communities.

2.2 Next Steps

2.2.1 Detailed Implementation Plan

The detailed implementation plan needs to focus on three dimensions:

I. Technology – all aspects of the technical infrastructure solution
II. Business Model – operations, processes, governance, financing, partnerships
III. Regulation – needed adjustments to the legal framework to enable business model

In each of these dimensions there are a number of activities which need to be planned. The following checklists will guide the planning phase.

Technology

- ❑ Validate list of villages in hinterland and remote areas to be connected: exact naming convention, delineation of village boundaries, exact location (lat/lon), exact population number (if possible by age group), exact number of public buildings (schools, health care facilities, town hall, benab, community center, post office, ferry terminal, police station, …)
- ❑ Revise the high-level rollout plan as proposed in chapter 1.2.: detail prioritization criteria (e.g., village social needs, cost optimization, special needs, economic impact on particular village, rollout synergies, etc.) and select a subset of villages for rollout in the subsequent years.
- ❑ Define which of the public buildings should be connected in which order and with which data speeds: align with stakeholders as referred to in Sec.4.1.
- ❑ Validate the estimation of needed throughput capacity and volume for each selected village based on requirements of the planned e-Services, adjust if necessary: alignment with e-Service providers is needed to create buy-in and to come up with a realistic estimate
- ❑ Perform a site survey of the selected villages: map location of public buildings, map and list of power supply locations and alternative solutions, investigate right of way challenges, assess climate, surrounding terrain and natural obstacles, refine the needed e-Services based on interviews with local residents and institutions, inform residents about plan
- ❑ Create the detailed technology design for backhaul and access networks for each village: based on the available technology options as per Sec.3.2, a subset needs to be selected per village and dimensioned as per the individual site survey.
- ❑ Create the Request for Proposal (RfP) for the planning and building of the network: describe the context of the infrastructure rollout project (general conditions), the currently installed e-Government infrastructure in coastal regions, available resources, detailed target architecture for villages, incl. Bill of Quantities BoQ (technical conditions), any SLA requirements, pricing input form (commercial conditions), etc. A Request for Information (RfI) or Request for Quotation (RfQ) could proceed the RfP phase to receive more information during the architecture design phase.
- ❑ Create tender strategy and launch tender phase: choose best tender format (limited, one, two stage bidding), set pre-qualification criteria, select an appropriate channel to float the tender, set the tender guidelines, solicit responses from all appropriate vendors. This step has to be performed by an external and independent partner with in-depth knowledge of tendering approaches in general, incl. financial expertise as well as broad knowledge of the different vendors/suppliers.
- ❑ Manage vendor inquiries: hold Q&A sessions, manage information flow from and to vendor, create answer sheets
- ❑ Evaluate tender and select shortlisted vendors: define tender evaluation criteria, benchmark the received proposals, SWOT analysis, weighting scenarios, balance score board, ranking. Sample evaluation criteria:
    - **Technical**: specifications, performance and extendibility, features, applications and functionality, system operability, training & system documentation, implementation management and schedule, experience and references

- **Commercial**: general conditions, total price (incl. equipment, spare parts, prices for training and other services, installation costs, shipment costs), offered discounts, projected O&M costs, warranty, payment schedule, price benchmarks, equipment availability and delivery schedule

- ❑ Enter vendor negotiations and select final vendor: based on selected tender strategy there are a few rounds of negotiations necessary.
- ❑ Plan the rollout project and execute rollout: there are three main phases which need to be executed:
  - **Rollout preparation**: check project schedule and rollout plan, verify project contract conditions, check vendor procedures, processes and resources, set reporting and controlling guidelines
  - **Technical review**: review alignment of planned to contracted for architecture design, network topology, integration strategy, BoQ estimation, dimensioning assumptions& planning methodology, service plan
  - **Rollout supervision**: inspect, report and control the project implementation w.r.t. progress and performance, QoS, monitor risks, follow up with change requests, monitor SLAs, run smooth integration, update project plans and documentation

Business Model

- ❑ Decide on the final implementation model: review the proposed BOT model and compare with alternative rollout and operations models, e.g. built and operated by e-Government Unit, turnkey model by vendor, etc.
- ❑ Align all stakeholders required for implementation model: create project structure and set up communication plan towards stakeholders, see also technical project setup and alignment
- ❑ Clarify governance with implementation partner (systems integrator): ownership and financing options need to be discussed, funds need to be secured in governmental budget
- ❑ Align all new processes with existing process framework at e-Government unit: any new process needed for maintenance of the infrastructure and end user equipment needs to be compliant with the existing process framework.
- ❑ Define training needs and execute training: existing staff needs to be able to effectively support the network and end user devices. The systems integrator should provide training to familiarize e-Government staff with the new equipment, monitoring and servicing.
- ❑ Create staff job descriptions to prepare for takeover of operations: work with the systems integrator to understand the needed skills and quantities of staff for effective infrastructure operations

Regulation

- ❑ Develop the regulatory strategy and roadmap: Define the overall vision, mission and targets for Guyana w.r.t. ICT and derive policies to support these targets.
  "Define a policy and define a plan. This should be debated and all parties should participate. Over time the policy and resulting approaches specified in the broadband plan may need to be adapted, but countries that are leading with broadband do have some direction and policy. No policy is likely to result in no change or else monopoly provision of services in only a few areas."[7]

- ❑ Define the Digital Agenda and National Broadband Plan for Guyana! Validate and detail the coverage targets recommended in chapter 1.2. Develop and introduce a regular process to revise these targets on an annual base.
  "Ensure the national policy covers all of ICT. Next Generation Networks (NGN) and broadband may be the key investment area and are where the main telecoms issues reside, but all other aspects should be linked in to obtain the wider social benefits of a broadband economy." [8]

- ❑ Define price floors & price ceilings for wholesale & retail prices: Define relevant retail and wholesale markets and identify need for regulatory intervention especially with regards to affordability of services. Define price floors for wholesale costs in markets susceptible to regulation based on cost assessments and incremental costs e.g.LRIC (long run incremental cost)

2.2.2 e-Services

In order to create a roadmap and detailed implementation plan, the identified e-Services and their respective use cases have to be prioritized. The goal of this section is to detail the prioritization criteria and propose a roadmap of use cases to be implemented between 2017 and 2021.

Prioritization Criteria

There are a number of criteria which can be used for prioritizing the use cases, grouped along three main categorization areas.

- **Impact**
  - number of potential users, frequency of use
  - perceived importance of service by user
  - potential for creating economic value
  - potential hassle reduction for end user
- **Readiness**
  - Users' willingness to switch to solution
  - Target group availability

[7] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013
[8] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

  - Ministries/agencies: resources and existing IT infrastructure, readiness to change processes
  - Delivery: complexity of process, suitability of process for alternative channels, need for personal interaction, dependency on other not yet digital processes
- **External factors**
  - Experiences from previously launched e-Services
  - Limitation in number, scope and depth to remain manageable by the team
  - Boundary conditions for service prioritization/pilot programs

A first prioritization is suggested in the next section, however the final set of criteria used and the order of implementation needs to be decided by the project team once all parameters have been checked prior to project start.

Roadmap for e-Services and Use Cases

Based on the described prioritization criteria the following roadmap is been derived. It is advised to perform **pilot projects** with a number of communities and government agencies to validate the assumptions and enable the stakeholders to adopt an "online mindset." Special care should be taken to not only implement the online components of the use case, but also provision for the offline business processes and resources which are required to fulfill the requested government service. A well-established **Business Process Redesign (BPR) Methodology** can be used by a specialized team. This requires a deep understanding of the current status for processes in the organization to provide a basis for developing the services/processes framework and set the change boundaries.

A Pilot Project…

…must have a wide audience

- Affect a large number of citizens
- Affect a large number of government units

…must have compelling reasons to adopt

- saves time
- saves money
- avoids dealing with corruption
- enforced by law

E-Learning Roadmap

Finalizing and extending the One Laptop per Teacher program is the most important initiative. School management does not impact students as much as individual learning programs, thus it should be de-prioritized.

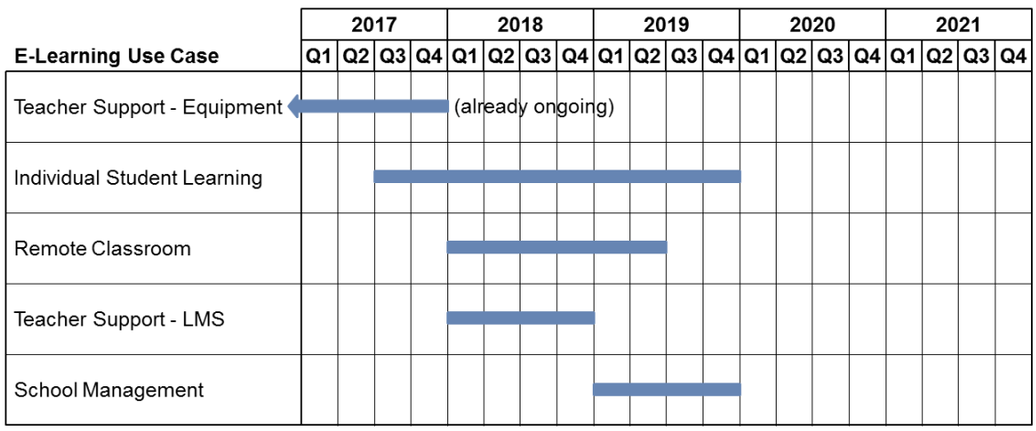

Figure 10 - e-Learning roadmap

E-Health Roadmap

The basic services such as internet access via a stationary PC and communication availability and providing for enhanced maternal healthcare should be the focus for the next years. Tele-Surveillance enhances the data gathering capacity and is important for disease control and early intervention capability. Tele-Diagnosis and Tele-Consultation rely on fairly stable and high-bandwidth connections, thus should be deployed when those are ready.

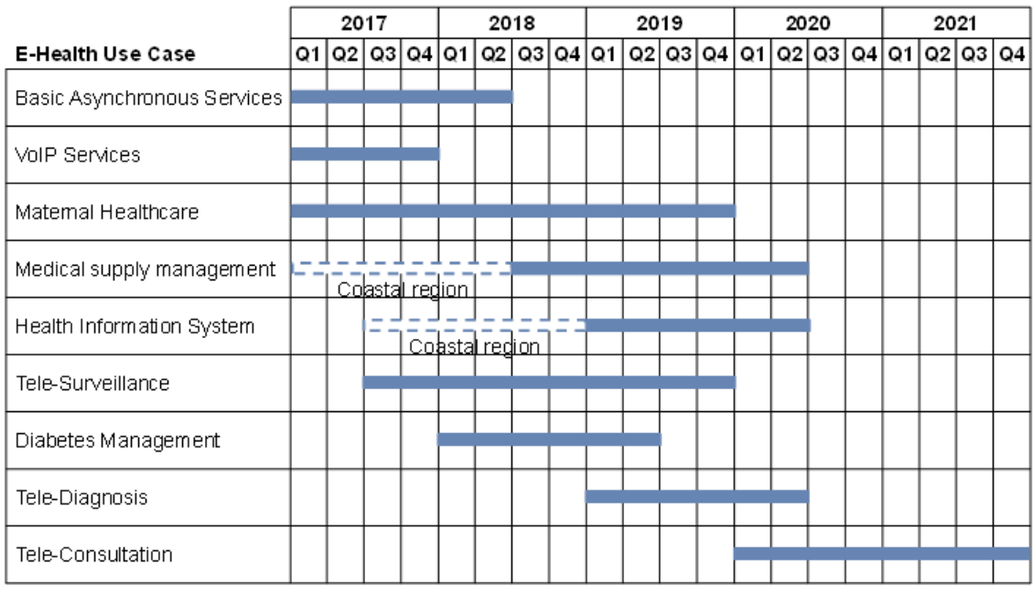

Figure 11 - e-Health roadmap

E-Government Roadmap

The programs which are already partially in place (email, DMS, calendar) should be expanded and made into enterprise-grade services. In addition, extending the website hosting capability should be tackled in the first year. The most demanding enabling services like eSignature and ePayment can be implemented at a later stage as prerequisites for complete online transaction services. It should be noted that all service delivery processes need to be re-engineered for being provided online. There is mostly also an offline component (backend) involved which needs to fall into place as well.

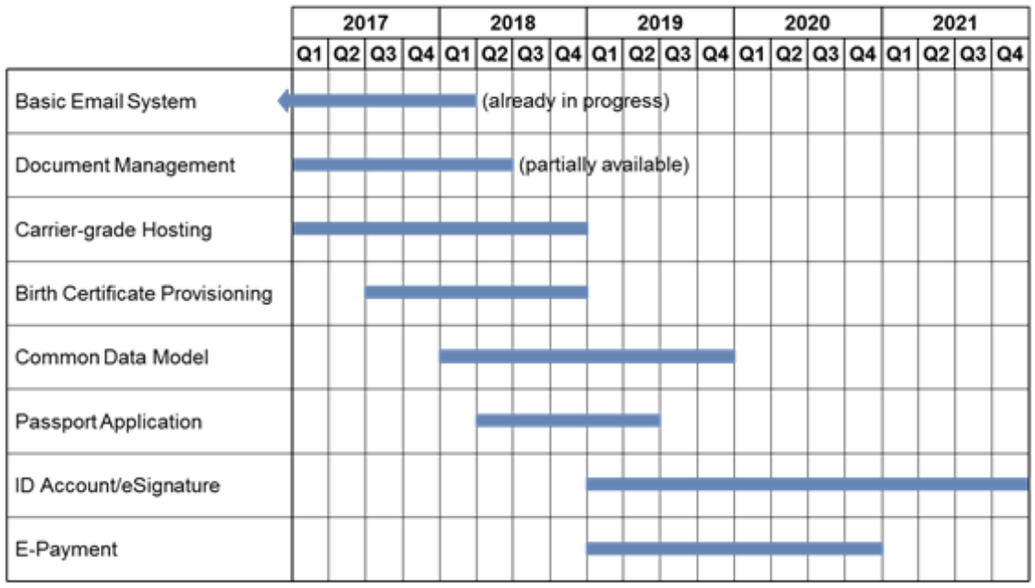

Figure 12 - e-Government roadmap

Further e-Service use cases should be evaluated by their impact on the eGovernment Agency's delivery capability and planned and rolled out on an on-demand basis.

In addition to the e-Services and use cases for other government agencies, the eGovernment Agency should include other projects such as: applications for generic services that are not bound to one agency and integration projects to facilitate and support all other projects and applications across Guyana.

Next Step– The Action Plan

A detailed Action Plan is the next step towards successful implementation of the roadmap. It should contain a detailed description of all major projects to be implemented and the steps to be taken within the eGovernment Agency. It needs to be at a level of detail that is sufficient to follow up on reaching milestones and objectives.

An Action Plan can have the following structure:

- Vision and objectives for eGovernment initiative
- E-Services projects to be implemented
- Infrastructure projects to be implemented
- Roles and responsibilities

- Timeline with well-defined milestones
- Budget, incl. planning on which funding mechanisms are planned to be applied

After these points have been clarified and agreed upon by the stakeholders, the individual e-Service projects can be launched using a traditional project management methodology.

2.2.3 Training Plan

Securing a sustainable impact of implemented infrastructure and services is essential to generate the benefits that are expected to come with the investments in better ICT infrastructure and new e-Services. A thorough training concept, addressing the different users and stakeholders of ICT infrastructure and eServices is recommended to be implemented. This concept should consider the specific situation in Guyana in how to address all ten regions as well as build on existing training concepts available in the country.

- ❑ Setup Training Center in Georgetown (Location, Trainers, Funding)
- ❑ Elaborate skill profile and job descriptions for IT specialists in all ministries
- ❑ Elaborate skill profile and job descriptions for master trainers
- ❑ Prepare curriculum and develop detailed content of the trainings modules
- ❑ Develop and implement an information campaign about risks of using the internet and ICT services and how to stay safe. Develop dedicated information material to ensure children stay safe when using e-Services and the internet.
- ❑ Elaborate and implement reporting measures in case users observe harmful conduct when using the internet (fraud, sexual harassment, etc.). Create and empower organizations to report to and publish the contact details to the users.
- ❑ Buildup of operational skills at eGovernment Agency and initiate the transformation to implement these skills
    - Step 1 – Implement a standardized Project Management Framework (PRINCE2 or PMI)
    - Step 2 – Identify and implement relevant aspects of eTOM framework needed for existing and future domains of activities of eGovernment Agency
    - Step 3 – Transform operation and management according to ITIL and CoBIT
    - Step 4 – Implement Enterprise Architecture Capabilities based on TOGAF

The realization of the capacity building concept must be aligned with the roll out of the technical infrastructure, the programs for the provision of devices (e.g. one laptop per teacher project, ICT hub program), and with the availability of e-Services.

The National Training Center is key for the coordination and operation of the trainings and must be established and operational from the very beginning of the realization of ICT services roll out.

- Phase 1 (2017):
  Establish the National Training Center in Georgetown.
  Establish regional training hubs in:
  Port Kaituma (Region 1)
  Charity (Region 2)
  Mahaica (Region 4)
  Belladrum, Mahaicony (Region 5)
  New Amsterdam, Rose Hall, Skeldon (Region 6)
  Kato, Mahdia (Region 8)
  Kwakwani (Region 10)
- Phase 2 (2018):
  Establish regional training hubs in:
  Mabaruma, Moruca (Santa Rosa) (Region 1)
  Anna Regina (Region 2)
  Vreed en Hoop (Region 3)
  Mon Repos, Timehri (Region 4)
  Tacama (Region 6)
  Bartica, Kamarang (Region 7)
  Lethem, Aishalton, Annai (Region 9)
  Linden (Region 10)
- Phase 3 – 5 (2019 - 2021):
  Expand local training hubs as more communities will have access to e-Services

3. Inception Report

3.1 Introduction

3.1.1 Description of the Project

Celebrating its 50th year of independence, Guyana looks back at several ups and downs, socially as well as economically during these years. Despite having rich reserves in bauxite and gold, as well as rich nature and wildlife,

especially in its rainforests, it is still struggling to overcome poverty in general as well as connecting the sparsely populated Hinterland to the densely populated areas at the coast.

Information and Communication Technologies (ICT) are seen as the major foundation to overcome several challenges that are very specific to Guyana:

- Bridging the gap between the Hinterland and remote areas and the highly populated coastal areas
- Providing platforms for people in poor and remote areas, helping them to sell locally produced items
- Promote Guyana as an eco-tourism destination and connect the tourists with the people in the respective areas
- Increase the possibilities to communicate over large distances, personally and business related, helping to exchange experiences to, e.g., improve agricultural methods
- Developing the social cohesion between the different ethnicities and therefore drive a distinctive Guyanese nation building
- Help to protect and secure remote border regions and protect the rainforest from illegal activities

ICT is seen as the major pillar to bring Guyana as a whole into the 21st century and connect all regions with the rest of the world.

A vision for the upcoming years needs to be elaborated to define this “ICT foundation” for Guyana, based on the needs and requirements of the different users and stakeholders. It is essential to understand that this vision cannot be limited to activities that only address the technology itself, it needs to be seen as a multidimensional vision and task plan, addressing technical infrastructure and platforms, tailored services, building of the capabilities of the people in the different communities and providing a suitable regulatory framework.

The e-Government Agency, as the project’s implementing entity, will be responsible for the actual execution of project activities and elaborating an ICT centric vision. The United Nations Development Programme (UNDP), as the partner entity under the GRIF Framework, will be responsible for quality assurance and for providing and incorporating social, fiduciary, and environmental safeguards and best practices into the design and implementation of the project.

The Government of Guyana and UNDP have contracted “Detecon Consulting” to help define and elaborate this vision within the next months.

3.1.2 Purpose and Scope

3.1.2.1 Work Stream 1 - Baseline Data Collection

Work stream 1 contains a baseline data collection (qualitative and quantitative) with focus on the overall project scope. This includes an assessment of existing infrastructure and a needs assessment of the hinterland, poor and remote communities. The survey does not set out to be a statistical data collection in terms of a census-type data collection. The collected data will be analyzed to provide a recommendation in line with the project objectives.

The baseline data collection, which consists of both a qualitative and a quantitative part, is designed to gather data on a community level. In the quantitative part, a community leader (e.g. Toshao) will be questioned and complemented by follow-up interviews on-site until one complete set of data has been compiled per community. Additionally 6 quantitative ICT checklists will be handed out to people in the respective communities. The sample will be comprised of both genders in the following age groups: 1) under 20 years, 2) 21-55 years, and 3) 56 years and over.[9] The ICT checklist is designed to gather data on a personal level.

In the qualitative part, data is gathered on a personal (persona-specific) level, where several selected persons from different sectors (prevailing economic activity, educational and medical sector) will be interviewed. Those persons are selected from general population and asked about their personal reality as well as the impression they have about the community they live in. This part aims at identifying the existing national ICT infrastructure and outlines specific ICT infrastructural needs.

During the field work period, which is set between mid-July and end of August 2016, a maximum of 30 communities in all 10 regions of Guyana will be visited by researchers who conduct the surveys. Multiple teams are set out to depart from the headquarters in Georgetown. The teams will cover different regions and report back to Georgetown when necessary.

Collected data will be processed in Georgetown and entered into a database to ensure data backups and continuous analyses.

3.1.2.2 Work stream 2 - Elaboration of the extensive Technical Report

Work stream 2 is based on the results of work stream 1. The aim of this work stream is to provide an overview of potential technologies that might be used to provide both suitable internet and telephony services in the hinterland, poor and remote communities of Guyana.

In order to decide on an optimal solution for the targeted areas, a comprehensive stakeholder map will be developed and first requirements for a successful implementation of the identified technologies will be derived.

To guide the identification of further requirements, Detecon will provide a high level list of requirements in regulation/legislation in order to support the medium- and long term success of the project endeavor.

To leverage all potential synergies, Detecon will analyze potential partnership capabilities that might be used and elaborate a comprehensive map of potential partners in the dimensions Public, Private, Over-The-Top (OTT) and beyond.

In order to find a target picture for the most suitable ICT solution, Detecon will provide a high level target architecture and design of the infrastructure, description of equipment needed for using internet and telephony communications and high level cost estimates and breakdowns including indicative costs for maintenance over 5 year period.

Clearly defined business and operational models are essential prerequisites for the success of the overall ICT strategy and implementation program. Therefore, Detecon will provide best suiting business and operational models for this program in order to meet the ICT needs in hinterland, poor, and remote areas, taking into consideration the specific situation (very rural and very low income/purchasing power).

[9] Only on best effort basis, based on the availability of target segments.

Based on a set of assumptions and priorities acting as boundary conditions, Detecon will elaborate recommendations for a prioritized technology rollout and implementation sequence.

For the successful implementation of the ICT program, the identification of appropriate vendors and potentially system integrators is essential. Detecon will support the Guyana e-Government team in the setup and design of the RFP documents for the planned next phase during the duration of this project. A separate consultant at the e-Government team has the ownership of the overall tender documents and is responsible for the detailing of the respective chapters and technical solutions.

3.1.2.3 Work stream 3 - e-Services Readiness Assessment and Elaboration of Respective Action Plan

Work stream 3 is based on results of work streams 1 and 2. It covers the preparation of readiness assessments and action plans for national e-Government and other e-Services. Detecon will document the as-is situation in Guyana regarding availability, quality and reach of existing e-Government services, frameworks needed for efficient e-Government services, like legal, institutional, technological and infrastructural. It will contain an elaborated high-level vision of a realistic e-Government service offering addressing the population in hinterland, poor and remote communities and elaborated gap-analysis and recommendation for next steps to reach the vision including needed ICT solutions, organizational changes, human resources requirements, processes and policies. The financial part will include high-level cost estimations and proposed prioritization for the implementation of the “next steps”. To elaborate a respective action plan, Detecon will provide an updated stakeholder map, highlighting roles and responsibilities, as well as support the e-Government team in the development of technical documents regarding the “next steps activities.”

Special focus will lie on describing how e-Learning programs need to be tailored to suit the hinterland, poor and remote communities. Different target groups and educational levels, as identified in WS1, will play an important role. E-Learning collaborations and partnerships will be described.

To use the identified e-services and to have scope of trainings for the hinterland, poor and remote communities, Detecon will develop recommendations for a training plan for the different target groups, i.e. members of the hinterland, poor and remote communities including teachers and health professionals, to increase their capabilities in using the proposed technologies and e-Services.

3.2 Project Framework

3.2.1 Overall Approach

3.2.1.1 Work stream 1 – Baseline Data Collection

The main objective of work stream 1 is to gather data on the communities' infrastructure and on the peoples' attitudes towards specific ICT use cases as well as the communities' needs. The aim is to compile relevant data on shortcomings in different sectors, such as social, economic or health and a potential overall improvement plan for the communities in relation to the access to infrastructure for online and/or telephony services.

Work package 1.1

It covers the collection and analysis of data based on the current environment in hinterland, remote and poor communities.

To collect this data, a quantitative survey on community level and an ICT checklist on personal level is compiled, which sets the basis for qualitative interviews. The interviews will be conducted at 30 sites in all 10 regions of Guyana. Those sites are distributed between poor, remote and hinterland areas.

Work package activities:

- Design, preparation and execution of field study:
  - Identify and collect data based on the current environment, indicators to be assessed quantitatively include:
    - number of communities or households that have internet and telephony access
    - number of children aged x-y in the communities accessing online education, or separately enrolled in primary, secondary and tertiary education
    - poverty levels of all identified communities
    - number of ICT literate persons within all identified communities
    - number of desktop computers and laptops within all identified communities
    - number of schools, medical facilities, and communal buildings in each community identified
  - The quantitative survey is based on information given by a representative of each community, e.g. Toshao or community leader. This method carries a measurement error because any number given relies on estimations. The quantitative survey is set out to gather indications; this does not include statistically relevant data in the context of a full census or census-type survey. The data will be informative for the scope of the project.
  - Facilitate achievable target setting for the project. The individual communities' needs regarding ICT infrastructure will be gathered, assessed, and put into context.
  - Information on key indicators will assist in the evaluation of the achievement of project progress, objectives, outcomes, and impacts.
  - The qualitative survey aims for enriching quantitative data with complimentary background information and covers topics that need to be explored freely to uncover so far unknown circumstances and needs.
- Preparation of field study includes the following work package deliverables:
  - Detailed work plan
  - Design of field study: methodological approach (quantitative and qualitative)
  - Work breakdown structure
  - Draft travel agendas
  - Sites to be visited
  - Persons to be interviewed
- Deliverable formats:
  - Report of results in MS Word format
  - Labelled data sets of relevant splits, such as number of devices (mobile phones, computers, etc.) per geographical area (hinterland, remote, poor), list of main economic activity of the sites visited
  - Quantitative data will be entered into a database (data can be consulted at later point as SPPS data file)
  - PowerPoint presentation of selected results at Steering Committee

Work Package 1.2:

This work package aims to collect relevant data on existing ICT-infrastructure and to identify national ICT infrastructural needs

Work package activities:

- Evaluate national network capabilities (focusing on national backbone as well as all existing operators)

Work package deliverables:

- Identified networks and infrastructure in relation to communities plotted on a map of Guyana
- Description of ICT-infrastructural needs as conclusion from findings from WP 1.1 and 1.2

3.2.1.2 Work Stream 2 - Elaboration of the extensive Technical Report

The work stream contains work packages 2.1 until 2.8.

Work Package 2.1:
The main objective of work package 2.1 is to provide an overview of potential technologies that might be used to provide both suitable internet and telephony services in the hinterland, poor and remote communities.

Work package activities:

- Description of the technology for access, aggregation and core elements
- Pro's and con's of the different technologies will be listed in general and recommendations with respect to the specific situation in Guyana will be provided
- As per TOR, this will include (but will not be limited to)
    - Potential target communities
    - Risks and mitigation measures
    - High level implementation scenarios
    - Costs, capacities, reach reliability, security
    - Operational aspects
    - Environmental concerns

Work package deliverables:

- Comprehensive list of potential available technologies to deploy internet and telecom services in the hinterland, poor and remote communities with the focus on Guyana's specific needs for these regions

Work Package 2.2:
The main objective of work package 2.2 is the Identification of necessary stakeholders and derivation of requirements for a successful implementation of the identified technologies. In order to decide on an optimal solution for the targeted areas, a comprehensive map of all relevant stakeholders is required to make sure that besides the technologies in WP 2.1. all other topics and requirements that might influence the technical solution are recognized.

Work package activities:

- Expert interviews with representatives of all relevant institutions and bodies that might have an impact on the targeted solution, e.g. Guyana telephone and Telegraph Company (GT&T), Digicel, National Frequency Management Unit (NFMU), E-Government Unit- Ministry of the Presidency, Ministry of Indigenous Peoples' Affairs, National Toshaos Council, Ministry of Communities, Ministry of Public Infrastructure, Ministry of Education

Work package deliverables:

- Comprehensive stakeholder map to serve as input for work package 2.5
- Records of all stakeholder meetings will be summarized and presented in a report, serving as meeting minutes

Work Package 2.3:
The main objective of work package 2.3 is an assessment of the impact of legislation (existing and impending) in the context of this project this work package identifies and compiles all relevant impacts, risks and opportunities from relevant legislation of ICT infrastructure and services in Guyana.

Work package activities:

- Perform analysis that includes but is not limited to requirements, opportunities, risks evoked of the relevant stipulations in Guyana with special focus on the draft Telecommunications Bill and the draft Public Utilities Commission Bill. The regulatory instruments shall all be balanced to foster the development of the ICT-market in Guyana and the respective economy in general.

Work package deliverables:

- Overview of identified related dependencies with regulation and highlighting the legislative impact towards the projects
- High level list of further requirements in regulation/legislation in order to support the medium- and long term success of the project endeavor

Work Package 2.4:
The main objective of work package 2.4 is the identification of potential partners. It also generates input for work package 2.5 (Identification of best ICT solution).

Work package activities:

- Elaborating recommendations on potential partners that might be used to reach the elaborated vision. Both public and private network and infrastructure providers will be analyzed (existing and near term plans).

Work package deliverables:

- Comprehensive map of potential partners serving as input to work package 2.5

Work Package 2.5:
The main objective of work package 2.5 is the elaboration of a high level technical architecture / design of an optimal ICT framework.

Work package activities:

- Sketching the target picture for the most suitable ICT solution, providing internet and telephony access to all identified hinterland, poor and remote communities/cluster of communities
- Based on the information gathered in work package 2.1 – 2.4 the optimal solution will be elaborated considering commercial and technical viability, as well as existing capabilities.
- Identification of required hard- and software, technical infrastructure for both network and CPEs (functional requirements that will serve as input to WP 2.8 (tendering preparation))
- Identification of smart (i.e. renewable) energy solutions taking into consideration the specific situation of Guyana
- Elaborating recommendations on locations for the above mentioned infrastructure (High level, i.e. based on coverage assumptions)
- Identification of required hard- and software, technical infrastructure for both network and CPEs (functional requirements that will serve as input to work package 2.8)

Work package deliverables:

- High level target architecture and design of the infrastructure
- Description of equipment needed for using internet and telephony
- Recommendations regarding legal, infrastructural, social, and environmental aspects
- High level cost estimate and breakdown including indicative costs for maintenance over a five year period.

Work Package 2.6:
The main objective of work package 2.6 is to have viable business model/models for implementation elaborated.

A clearly defined business and operational model is an essential prerequisite for the success of the overall program. Due to the specific nature of the hinterland, poor and remote areas, , a solely self-sustained approach for a telecommunication network in the framework of this program is difficult. The principle of (infrastructure-based) competition that is meant to be beneficial in all areas, regardless of density, does not apply to remote areas:

- Urban areas enjoy choice between two or three infrastructure networks, while large part of rural areas have no modern ICT-infrastructure at all
- Private operators usually have lower incentive to invest in broadband infrastructure in rural & remote areas

Hence, public intervention, e.g. via funding, is necessary to meet future bandwidth needs and to ensure that society at large can reap the benefits of the digital economy. Therefore, a best suiting business and operational model for this program will be elaborated in order to meet the ICT-needs in hinterland, poor, and remote areas.

For above mentioned reasons, the business potential in the rural internet ecosystem is rather limited. Specifics of this ecosystem, such as additional revenue streams arising from e.g. eco-tourism, will be considered as well as all other levers mentioned in the TOR.

Work package activities:

- Based on international best practice, Detecon will analyze up to five different business and will propose the most promising model for this program:
- Drafting of different business and financing model for ICT-Access in remote and rural areas using Detecon's knowledge base based on international experience
- Evaluation of feasibility of the business models: Assessment of benefits, risks and impacts on Guyanese population, governmental institutions, and market players.
- Recommendation of the best suitable business and financing model. The models consider different approaches e.g. public infrastructure (solely government owned), Public-Private-Partnership, Locally Supported, Direct and Indirect Subsidies

Work package deliverables:

- Best fitting operational and business model taking into consideration the specific situation (very rural and very low income and purchasing power).

Work Package 2.7:
The main objective of work package 2.7 is the prioritization of the recommended rollout / implementation activities.

The idea of the approach is to sequence the rollout (and hence the CAPEX flow over time) according to a set of requirements that are essential for the overall program.

The requirements should be derived from facts like

- Ease of implementation
- Coverage for specific groups
- Commercial viability
- Public needs
- Etc.

Work package activities:

- Based on these requirements, a target function for the overall rollout sequence will be compiled and a correspondent rollout plan will be elaborated

Work package deliverables:

- Recommendations for a prioritized rollout and implementation sequence of activities identified.

Work Package 2.8:
The main objective of work package 2.8 is to support the e-Government team in preparing their follow up RfP to this project.

For the successful, i.e. sustainable, implementation of the identified activities and recommendations, the identification of appropriate vendors and potential system integrators is essential.

Work package activities:

- Support the e-Government team in their RFP preparation from a technical perspective and share best practice experiences.
- Elaborate specific RfP guidelines to define as precise as possible the requirements towards vendors / system integrators.

A separate consultant at the e-Government team has the ownership of the overall tender documents and is responsible for the detailing of the respective chapters and technical solutions

Work package deliverables:

- RFP guidelines
- Support in the design and layout of the tendering documents
- Know how transfer with experts

3.2.1.3 Work Stream 3 - e-Services Readiness Assessment and Elaboration of Respective Action Plan

The work stream contains work packages 3.1, 3.2, and 3.3.

Work Package 3.1:
The main objective of work package 3.1 covers the preparation of a National e-Government Readiness Assessment and Action Plan.

Work package activities:

- As-Is Analysis: Documenting the existing types, levels, quality and reach of e-Government services in Guyana; documenting the existing frameworks in place in the country that can drive and enable e-Government services.
- Elaboration of e-Government Vision for Guyana's hinterland, poor and remote communities: Draft of a holistic view on e-Government services to support these communities
- Gap-Analysis: Elaboration of needed activities to reach the e-Government Vision including a high level cost assessment. This analysis will address all architecture layers "Business" (i.e. organization, skills, processes), "Application" (i.e.-Government services, tailoring, supporting services) and "Technology" (i.e. required ICT equipment, infrastructure)
- Support of the e-Government team in the development of related documents needed to execute the activities identified in the Gap-Analysis

Work package deliverables:

- Documented as-is situation in Guyana regarding availability, quality and reach of existing e-Government services, frameworks in place for efficient e-Government services, like legal, institutional, technological and infrastructural
- Elaborated high-level vision of a realistic e-Government service offering addressing the population in hinterland, poor and remote communities
- Elaborated gap-analysis and recommendation for next steps to reach the vision including needed ICT solutions, organizational changes, human resources requirements, processes, and policies
- Cost estimations and proposed prioritization for the implementation of the "next steps"
- Updated stakeholder map, highlighting roles and responsibilities

Work Package 3.2:
The main objective of work package 3.2 is the elaboration of an e-learning customization strategy for hinterland, poor and remote communities.

Work package activities:

- Elaboration of an extended stakeholder view on e-learning programs
- Development of recommendations, and requirements necessary to develop tailored e-learning programs for different target groups and for different educational levels.
- Assess the potential for collaboration and partnerships with the private sector in Guyana and assess synergies with Government Learning Channel, Amerindian Development Fund and Amerindian Land Tiling Projects, One Laptop per Family Project, Telecom Liberalization

- Laying the foundation to build the right capacities and therefore potentially increase Guyana's Human Development Index

Work package deliverables:

- Documented stakeholders and their needs and requirements regarding e-learning
- Examined potential for collaboration and partnerships with the private sector
- Recommendations for next steps and other inputs that can be used to develop tailored e-learning programs for the different educational levels in Guyana

Work Package 3.3:
The main objective of work package 3.3 is the scoping of trainings for the hinterland, poor and remote communities.

Work package activities:

- Determination of the scope of training required for members of hinterland, poor and remote communities on how to use the identified e-services. Special focus groups like teachers and health professionals will be considered as well.

Work package deliverables:

- Training plan for the different target groups, i.e. members of the hinterland, poor and remote communities including teachers and health professionals, to increase their capabilities in using the proposed technologies and e-services.

3.2.2 Stakeholders

Name	Organization
Phillip Walcott	eGovernment Agency
Francis Simmons	eGovernment Agency
Floyd Levi	eGovernment Agency
Samantha Scotland	eGovernment Agency
Nickolaus Oudkerk	Office of the President
Catherine Hughes	Ministry of Public Telecommunications
Sydney Allicock	Ministry of Indigenous Peoples Affairs
Enrico Wollford	Ministry of Public Telecommunications
Hector C. Butts Ph.D.	Ministry of Finance
Sheranne Isaacs	Ministry of Finance
Ronald Bulkan	Ministry of Communities
Lelon Saul, Msc., BSc.	United Nations Department of Safety & Security
Dr. Rupert Roopnaraine	Ministry of Education
Errol Ross	Personal Assistant to VP and Minister of Indigenous Affairs
Martin Cheong	Special Assistant to the Minister of Indigenous Peoples´Affairs
Trevor L. Benn	Guyana Lands and Surveys Commission
Shabnam Mallick	United Nations Development Programme
Patrick John	United Nations Development Programme

Additional stakeholders need to be identified at Guyana Telephone and Telegraph Company (GT&T), Digicel Corporation, National Frequency Management Unit (NFMU) etc.

3.2.3 Risks and Limitations

Risks will arise during the project. An early identification of a possible risk is essential to initiate the right mitigation activities as early as possible. Some risks were already obvious prior to project start:

WP1	The quantitative survey is based on information given by a representative of each community, e.g. Toshao. This method carries a measurement error for each information because any number given relies on an estimation. Answers don't represent reliable and numbers, but estimations.	To minimize possible errors due to estimations, the answers will be cross checked by follow-up interviews on-site until one complete set of data is available per community.
WP1	The ICT checklist partly carries a measurement error for some of the information because some numbers given rely on an estimation.	To minimize possible errors due to estimations, multiple checklists will be collected to be able to analyze the overall entity of checklists throughout all communities,
WP1	At the time of designing the questionnaire, Census data from 2012 was not available. Therefore, answer categories for closed-ended questions will be put in percentages. Additionally, quantitative questions ask for an estimation of an exact number. Example: "Please enter the estimated quantity and percentage of people using the following options in their houses."	Quantitative questions ask for estimations of numbers. Additionally, answer categories are put in percentages. Example: "Please enter the estimated quantity and percentage of people using the following options in their houses."
WP1	Qualitative interviewing targets on insight generation. Due to naturally small sample sizes (and under the effect of only a small sample of communities), gained insights might be deep, but not fully representative for the given population. Derivations of underlying distributions or actual dimensions cannot be drawn.	Representative persons are pre-selected thoroughly to maximize the applicability of gained insights to the underlying basic population.
WP1	Sampling: due to selecting representative persons for the qualitative research part, those persons might be prone to depict their cohort/ group in an idealized way. This might be enforced by the importance that is conveyed by the mere visit of the research team (many visitors, travelling a long way, official/ governmental background etc.).	Interviewers are trained and advised to build a trustful atmosphere during the interview so that effects of social desirability on answering behavior are mitigated.
WP1	Chosen representative persons might not be dedicated spokespersons of their group and thus not experts for the research questions. All qualitative data are subjected to the bias of subjective statements and points of view.	Representative persons are pre-selected thoroughly to maximize the applicability of gained insights to the underlying basic population.
WP1	During field work the research teams might experience obstacles, such as weather conditions, that are beyond their control (flooded roads, flight delays, impenetrable areas, diseases/illnesses, etc.). Events of the above nature might entail a delay in fieldwork timing or a change of communities, interviewers and organizational approach.	Fallback communities have been defined for this reason, as some communities might not be accessible.
WP1	Safety threats in the coastal area, especially close to mining settlements can be a risk.	Travelling will only be done in daylight, in teams of many persons and public transport will be avoided (replaced by e.g. taxi). Extra overnight stays are scheduled in case of daylight travelling not being possible.

WP1	No shows of scheduled interviewees might lead to a delay in field work.	At least one back up respondent is recruited per community.
WP1	Difficult or non-existing access to experts in Guyana ministries and to other stakeholders to gather relevant information.	Use of a local Liaison Officer with extensive knowledge of local culture and with a wide network.
WP1	Access to and generation of relevant data is hindered by external limitations/effects.	Ability to complete generated data with qualified expert estimations, based on data sets and the broad experience of Detecon in multiple projects in the field of ICT-strategy and in emerging and developing countries.
WP1	Bias of community leader towards questionnaire and possible impact on other interviewees in community.	Careful design of survey method as to have 1:1 interviews with community members, preferably without community leader.
WP1	Telco operators might not be willing to share their information in regards to network planning.	Involvement of the Government (e.g. Ministry of Telecommunication, e-Government Unit) to explain the strategic need of their information of the study. If it doesn't succeed, usage of best guess and market benchmarks.
WP2	Intentions of possible suppliers to influence any (investment) decision in the project.	Following Detecon's and Deutsche Telekom's compliance and anti-corruption processes.
WP2	Relevant legislations are non-existing, not sufficient, or not sufficiently documented.	Access to Detecon Regulation Toolkit and usage of Best Practices to elaborate a sound target picture.
WP3	Insufficient access to information in relevant Governmental programs and (e-learning) activities and/or to other stakeholders to gather relevant information.	Use of a local Liaison Officer with extensive knowledge of local culture and with a wide network.

3.3 Proposed Methodologies

3.3.1 Work stream 1 – Baseline Data Collection

3.3.1.1 Quantitative and qualitative Approach:

The quantitative survey, as such a questionnaire that is designed to collect data in a statistical format, whether numeric, on a percentage basis, or as open-ended question type, aims at gathering baseline data of the community and on usage and existing ICT infrastructure, focusing on topics related to ICT literacy. Representative persons of each community are asked to give information about their community. This information is obtained by multiple-choice answers, closed-ended and open-ended questions. . The individual interviewee in one community will be a community leader, or a person that has certain knowledge of the community. In many cases this might entail interviewing multiple persons in the respective community, which additionally helps to reconfirm data and complete any data that might not be answerable by any one person.

The quantitative questioning as described above will produce one complete data set of the quantitative questionnaire per community, which equals n=30. Additionally, a quantitative questionnaire checklist has been compiled to monitor n=6 filled in checklists per community. The sample will be chosen randomly out of persons in the community. The researchers will strive to cover different age groups and both genders. This sums up to approximately n=180 checklist questionnaires among the 30 communities.[10] This data can be analysed according to the following sub-groups over all communities, but not for any specific community: age, gender, ethnicity, level of education.

The aim for the quantitative survey is not to collect statistically valid answers, this is not possible if the prerequisites in timing and in available resources are considered. Nonetheless, the data collected can be analyzed according to different approaches, which will be more than conclusive for defining the following work packages.

Given sample allows to analyze the collected data on the basis of common statistical standards.

The binomial distribution is frequently used to model the number of successes in a sample of size n drawn with replacement from a population of size N. If the sampling is carried out without replacement, the draws are not independent and so the resulting distribution is a hypergeometric distribution, not a binomial one. However, for N much larger than n, the binomial distribution is a good approximation, and widely used.

Binomial probability mass function and normal probability density function approximation for n = 6 and p = 0.5

If n is large enough, then the skew of the distribution is not too great. In this case a reasonable approximation to B(n, p) is given by the normal distribution and this basic approximation can be improved in a simple way by using a suitable continuity correction. The basic approximation generally improves as n increases (at least 20) and is better when p is not near to 0 or 1.

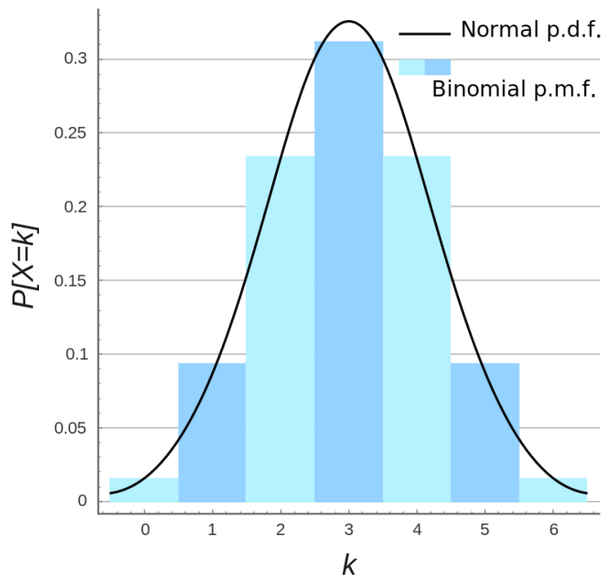

Figure 13 - Schematic Overview of Distribution

Approaches for analysis can be, e.g. a frequency analysis and a descriptive statistics analysis.

Frequency data may be analyzed by several different techniques, depending upon how the sample units were located and how the data was collected.

Values collected from randomly located quadrats to determine frequency follow a binomial distribution. In this case, the comparison of sample means (evaluating significant differences between years or among sites, should be based on binomial statistics). In this situation, binomial confidence intervals are used to assess if two sample means are significantly different. The binomial confidence interval for a given frequency remains constant, according to sample

[10] Only on best effort basis, based on the availability of target segments.

size and the level of probability. For a binomial distribution a minimum number of N=30 is required. Tables listing the width of confidence intervals have been developed for commonly used sample sizes and probability levels. If the confidence intervals (for the correct sample size and probability level) for the sample means being compared overlap, it is concluded that these values are not significantly different.

Categorical variables and quantitative variables are defined as follows:

Categorical variables:

> Categorical variables are also called qualitative variables or attribute variables. The values of a categorical variable can be put into a countable number of categories or different groups. Categorical data may or may not have some logical order.

Quantitative variables:

> The values of a quantitative variable can be ordered and measured.

Often, both types of data are collected when exploring a single subject, because categorical variables are often used to group or subset the data in graphs or analyses.

Examples of categorical and quantitative data when exploring the same subject:

Subject of the analysis	Possible categorical variables	Possible quantitative variables
Communication devices in community	Type of devices; Make and model	Price of different devices; fees

Examples of categorical variables

Data type	Examples
Numeric	Gender (0=Male, 1=Female) Survey results (1=Disagree, 2=Neutral, 3=Agree)
Text	Different kind of water supply (nobody, nearly no one, some, …) Product types (landline telephone, cell phone, smartphone, …)
Date/time	Days of the week (Monday, Tuesday, Wednesday) Months of the year (January, February, March)

Examples of quantitative variables

Data type	Examples
Numeric	Number of electric devices available in community Percentage of paid back loan Number of people being affected by different living conditions
Date/time	Date and time payment is received Date and time of technical support incident

Moreover a descriptive statistics analysis can be applied to the data collected. Descriptive statistics is the term given to the analysis of data that helps describe, show or summarize data in a meaningful way such that, for example, patterns might emerge from the data. Descriptive statistics do not, however, allow us to make conclusions beyond the data we have analyzed or reach conclusions regarding any hypotheses we might have made. They are simply a way to describe our data.

Descriptive statistics are very important because if we simply presented our raw data it would be hard to visualize what the data was showing, especially if there was a lot of it. Descriptive statistics therefore enables us to present the data in a more meaningful way, which allows simpler interpretation of the data. For example, if we had the results of 30 persons, we may be interested in the overall performance of those target group. We would also be interested in the distribution or spread of the marks. Descriptive statistics allow us to do this. Typically, there are two general types of statistic that are used to describe data:

- Measures of central tendency: these are ways of describing the central position of a frequency distribution for a group of data. We can describe this central position using a number of statistics, including the mode, median, and mean.

- Measures of spread: these are ways of summarizing a group of data by describing how spread out the scores are. For example, the mean score of 100 persons may be 65 out of 100. However, not all persons will have scored 65. Rather, their scores will be spread out. Some will be lower and others higher. Measures of spread help us to summarize how spread out these scores are. To describe this spread, a number of statistics are available to us, including the range, quartiles, absolute deviation, variance and standard deviation.

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When descriptive statistics are used, it is useful to summarize the group of data using a combination of tabulated description (i.e., tables), graphical description (i.e., graphs and charts) and statistical commentary (i.e., a discussion of the results).

Descriptive statistics provide information about our immediate group of data. For example, in case of calculating the mean and standard deviation of a special characteristic for 30 persons, this could provide valuable information about this group. Any group of data like this, which includes all the data you are interested in, is called a population. A population can be small or large, as long as it includes all the data you are interested in.

Descriptive statistics are applied to populations, and the properties of populations, like the mean or standard deviation, are called parameters as they represent the whole population (i.e., everybody you are interested in).

Often, however, you do not have access to the whole population you are interested in investigating, but only a limited number of data instead. It is not feasible to measure all characteristics of all persons in a group you are interested in. So you have to measure a smaller sample, which are used to represent the larger population of all persons of the target group. Properties of samples, such as the mean or standard deviation, are not called parameters, but statistics. Inferential statistics are techniques that allow us to use these samples to make generalizations about the populations from which the samples were drawn. It is, therefore, important that the sample accurately represents the population. The process of achieving this is called sampling. Inferential statistics arise out of the fact that sampling naturally incurs sampling error and thus a sample is not expected to perfectly represent the population. The methods of inferential statistics are (1) the estimation of parameter(s) and (2) testing of statistical hypotheses.

The determination of the ICT literacy will be reliant on a set of basic skills beyond the pure ability to handle devices and includes skill for:

- information processing and retrieval
- participation in social networks for creation and sharing of knowledge, information and education
- wide range of professional computing and digital devices skills

The ICT literacy assessment in the context of the project focus will be addressed in the Checklist, the Quantitative and the Quantitative Questionnaires.

The qualitative survey aims for enriching quantitative data with complimentary background information and covers topics that need to be explored freely to uncover so far unknown circumstances and needs. Representative persons of each community are asked to speak about their community, conditions and habits. Those persons are selected from general population and asked about their personal reality as well as the impression they have about the community they live in. This information is obtained by open-ended questions and selective inquiring in individual face-to-face interviews or round of talks interview approach.

Contextual Inquiry is an ethnographic interviewing technique that is used to gather qualitative data about users and their goals. The interviewer goes to the user and interviews them at the place where the user uses the product and/or does the work under study. The idea is to interview users in their natural setting, while they are performing their tasks, asking them questions about what they are doing and why (when necessary) along the way. Observing users as they perform activities and questioning them in their environments can bring important details of the behaviours to light. The qualitative methods are extremely dependent on the interviewees' participation, in case where someone does not make their home available, the researchers will try to obtain any environmental indicators from the interviewee during the conversation.

The applied method EthnObserve has been developed in order to align ethnographic interviewing (deep-dive into the living world and values of respondents) and participating observation with fitting camera work. The ethnographic interview conveys insights into life, world and everyday life of the target audience by empathic understanding of the respondents' lifeworld and culture. In doing so, participants are questioned about their usage habits and needs as well as attitudes, values and other habits and observed during product usage, respectively usage of the object of investigation. Due to certain restrictions in the context of the project (given due dates, resources like budget) the method cannot be applied to its full extend, and has been adapted to fit the scope of this study. Therefore ethnographic interviews were adapted to a semi-ethnographic approach that entails use-cases as a conceptual examination of the study subject, combined with observation of the cultural context by ethnographically trained interviewers and by photo documentation.
To complement the subjective view of interviewed persons, trained researchers assess an outside view by observing habits, behavior and ecosystem of respondents. To assess living situation, infrastructure, living standards and local particularities, photo-documentation is made that depicts the respective ecosystem. . The aim is to comprehend, which facts and what knowledge is important to the interviewee and how their knowledge is linked to their cultural context or their community.

Qualitative data is processed in different steps. The data is collected by audio recording to ensure gapless data assessment with no loss of information. Then audio recordings are transcribed (written down from audio recording) literally, i.e. verbatim transcripts, without shortening of text or any summarization. To complement statements of respondents by an external perspective, interviewers are advised to note down peculiarities that occur to them during the interview (such as irregularities in respondents' statements, e.g. a respondent talks about a new model of mobile phone, but shows a dated model, that might seem new to him). Our analysis generally follows the approach of Grounded Theory (Strauss & Corbin 1990) that is a „qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon".

For analysis, two ways of analytical approach are used. There is the single case analysis (analysis within one respondent), where one after another, all interviews are reviewed and analyzed in depth. Results of this way of analysis are: current status of ICT usage of respondent in their individual context, motives and reasons for acting in a specific way, identification of individual needs and demands. After analysis of each single case, comparison between cases are drawn through a comparative analysis (analysis between respondents), where a comparison of the whole sample is made. Step by step, each interview topic is reviewed across all respondents to identify differences and patterns within the whole sample for the respective topic. Results of this analysis could be to identify different sub-groups (if existent), differences are then outlined and described.

Furthermore, a comparison of identified or pre-defined sub-groups: to verify the identified sub-samples and test pre-defined possible sub-groups (like the differentiation poor-remote-hinterland), cases within those groups are compared with each other again. If necessary, further sub-groups are identified and described (e.g. remote-female, remote-male). Results of the qualitative analysis entails a summarized description of the sample in total and of all identified and relevant sub-groups including their attributes and characteristics, motives habits and demands.

3.3.1.2 Selection Parameters of Communities:

Through intertwining the selection parameters below, we aim at a representative proportion of the population.

- Geographic
  - To cover the entire territory of Guyana and its ten regions, including indigenous territory, urban, rural, remote and hinterland areas

- Ethnical-racial
  - To include the different ethnic and racial inscriptions of the country: Afro-Guyanese, Indo-Guyanese, Indigenous People and Mixed

- Socio-economic
  - To include poor localities and other non-poor and economic activities as mining, logging, agriculture, commerce and tourism.

3.3.1.3 Overview of selected Sites per Region

The sample set for the study is n=30 communities

Region	Region Name	Main City	Site 1	Site 2	Site 3	Site 4	Fall-Back-Sites		
1	Barima	Mabaruma	Port Kaituma	Mabaruma			Eclipse Falls	Aruau	Kumaka
2	Pomeroon-Supenaam	Anna Regina	Mainstay/Whayak	Charity	Santa Monica		Tapakuma	Kabakaburi	Bethany
3	Essequibo Islands-West Demera	Vreed en Hoop	Wales	Saxacally	Hog Island		Santa Aratak	Sand Hills	Nismes/Canal#1
4	Demerara-Mahaica	Georgetown	Albouystown	Buxton	Laluni	St. Cuthberts	Wayaleng		
5	Mahaica-Berbice	Fort Wellington	Perth	Ithaca	Number 3/Rosignol		Moraikobai		
6	East Berbice-Corentyne	New Amsterdan	West Canjie	Plegt Anker	Orealla		Port Mourant		
7	Cuyuni-Mazaruni	Bartica	Pillipai	Kako	Bartica		Kambaru		
8	Potaro-Siparuni	Mahdia	Tumatumari	Mahdia	Kato		Waipa	Taruka	
9	Upper Takutu-Upper Essequibo	Lethem	Karasabai	Lethem	Aishalton		Quiko	Massara (Annai	Karaudanaw
10	Upper Demerara-Berbice	Linden	Wismar	Kwakwani	Coomaca		Wallaba	Muritaro Paripi	Wikki

Table 7 - Sample set for the study (communities)

Legend:

Mixed	Afro-Guyanese	Indo-Guyanese	Indigenous People

The distribution of the sample considered an equal division of cities per region. However, region 4 comprises an extra site (n=4), because it contains different profiles which are of interest to the project.

Overview of selection parameters in relation to the communities[11]:

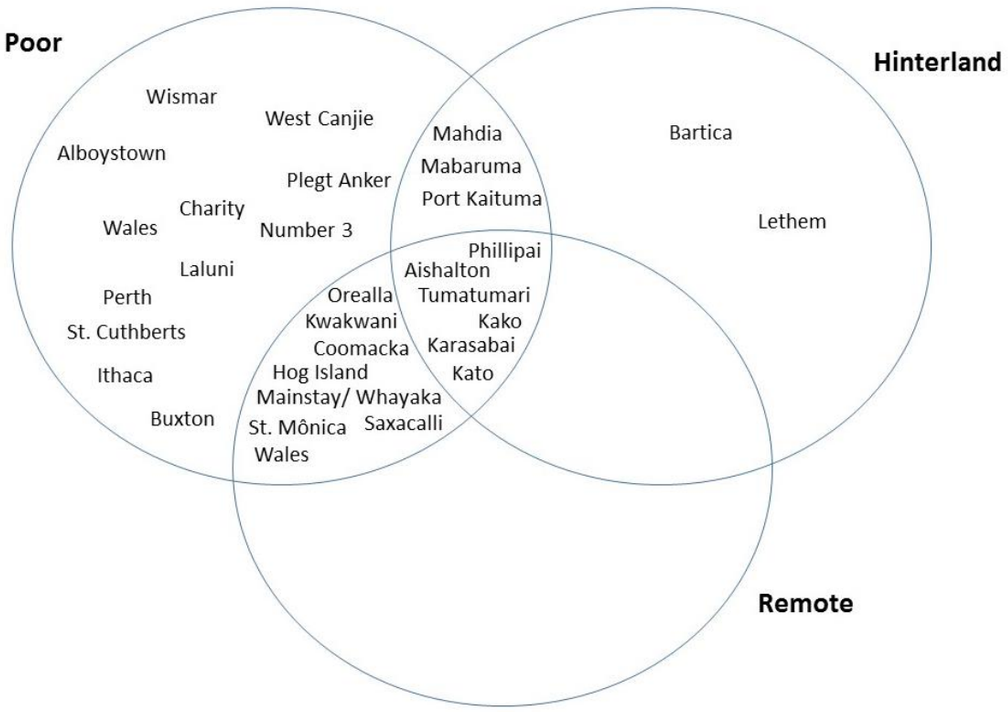

Figure 14 - Geographical distribution

This graph indicates the intersections between the three main quota criteria of all selected communities. It shows that most remote communities overlap with the other two criteria, hinterland and poor and indicates that communities in all three dimensions will be covered in the research. Remote communities will most likely always be poor, too. This can also be an overall indicator of the countries' structural disposition.

Overview on prevailing economic activities in selected communities:

[11] All communities were approved by the e-Government team and based on the criteria mentioned below. Part of the criteria were requested by e-Government team (ethnical groups, rural and urban).

	Community	Prevailing industry				
		Agriculture	Mining	Logging	Commercial	Tourism
Region 1	Mabaruma	•	•	•		
	Port Kaituma		•			
Region 2	Santa Monica	•		•		
	Charity	•			•	
	Mainstay/ Whayaka	•		•		•
Region 3	Saxacally			•		•
	Hog Island	•				
	Wales	•				
Region 4	Alboystown				•	
	Laluni	•				
	St. Cuthberts	•		•		
	Buxton				•	
Region 5	Perth	•				
	Ithaca	•				
	Number 3	•				
Region 6	West Canjie	•				
	Plegt Anker	•				
	Orealla			•		•
Region 7	Phillipai	•	•			
	Kako	•	•			
	Bartica		•		•	•
Region 8	Tumatumari		•			
	Mahdia		•			
	Kato	•	•			
Region 9	Karasabai	•				
	Lethem[12]				•	•
	Aishalton		•	•		
Region 10	Wismar		•			
	Kwakwani	•				
	Coomaca			•		

Table 8 - Prevailing Industries per Region

This table indicates the prevailing economic activity in a community. The different profiles support a diverse sample of communities. The economic activity may be strongly connected to the individual ICT needs of a community.

[12] Lethem was chosen because of its proximity to the border with Brazil and due to the high flow of people moving from one country to another due to commercial activities.

3.3.1.4 Map of Guyana indicating Communities to be visited:

Figure 15 - Map of Guyana with communities to be visited

3.3.1.5 Definition of Concepts

3.3.1.5.1 Ethnographic criteria[13]

- Remote[14]
  - Areas inaccessible due to poor roads, need to access via water ways (by boat), not necessarily far from a geographical point of view. These areas tend to be poor in terms of water supply, sewage services, electricity supply, schools, hospitals, road systems, policing, leisure facilities, etc. This difficulty of access, expressed in physical space, is one of the facets of the separation that exists between the different human groups that form Guyana: Afro-Guyanese, Indo-Guyanese, Indigenous People and Mixed; especially among the majority group of Indo-Guyanese and Afro-Guyanese people. With the end of slavery and the beginning of the country's modernization process in the nineteenth century, a growing competition between Indo-Guyanese and Afro-Guyanese for legitimizing their social position in Guyanese society as the most prestigious group has been noticeable. Indo-Guyanese arrived in the country to replace slave labor. They took over the work from the Afro-Guyanese, and from there on the tensions grew about who would achieve more social success. Remote areas, poor in infrastructure of all types just represent the manifestation within regions that are becoming the sidelines, with little economic, political and cultural identity, precisely because the disputes between Afro-Guyanese and Indo-Guyanese are concentrated in coastal and urban areas.
- Hinterland[15]
  - Inland areas, far from urban centers and the coastal areas, except Region 1 that has a coast, but is considered hinterland. They are not necessarily difficult to access and have previously been defined as Region 1, 7, 8 and 9. These areas can have problems in terms of water supply, sewage services, electricity supply, schools, hospitals, road systems, policing, leisure facilities, etc. The hinterland has not developed because of its lack in real political and economic identity. The hinterland is considered a discontinuous area in comparison to the coastal and urban areas where there is more economic activity to be found. This could be a reason why region 1 is defined as hinterland since it is close to the coast. The opposition between hinterland, urban and coastal areas mirrors the design of the geographic space of tension and opposition in Guyanese society between Afro-Guyanese and Indo-Guyanese. This tension emerged and grew after the end of slavery in the mid-nineteenth century. Since then, the Indo-Guyanese immigration grew in the country in order to meet the demand for physical and manufactural labor which got more and more specialized with the modernization of the country. Since the end of slavery and with the modernization of the country, the growing tension and stress dispute about who is more or less successful in modern society grew between the two groups of Afro- and Indo-Guyanese. This underlines the opposition between hinterland and urban areas in terms of geographical space
- Urban[16]
  - Areas characterized by continuous construction and the existence of urban infrastructure, comprising the set of utilities: water supply, sewage service, electricity supply, schools, hospitals, road system, policing, leisure facilities, etc. The economic activities in these areas are mainly activities related to commerce.

[13] Besides all the criteria and variables mentioned above, the sample considered also a wider variety of aspects of the communities such as predominant ethnic groups, poverty levels, population density and structural profiles like rural or urban. These combinations ensure that a wider spectrum of geographical diversity is being covered in the study.

[14] ALALHAR, Anton (edited). *Ethnicity, Class and Nationalism*: *Caribbean and Extra-Caribbean Dimension*. Lanham: Lexinton Books, c2005.Link:https://books.google.gy/books?id=PbMM74ucos0C&pg=PA118&lpg=PA118&dq=academic+citation+meaning+hinterland++Guyana&source=bl&ots=ytt1Xi1LTt&sig=ajpGhrmGAUhY_8bwpRSq7YpGl6o&hl=pt-BR&sa=X&ved=0ahUKEwjvsoemi5TOAhUMOz4KHUAzDUoQ6AEILzAD#v=onepage&q=academic%20citation%20meaning%20hinterland%20%20Guyana&f=false (specifically on pages 94; 95; 110; 118).

[15] ALALHAR, Anton (edited). *Ethnicity, Class and Nationalism*: *Caribbean and Extra-Caribbean Dimension*. Lanham: Lexinton Books, c2005.Link:https://books.google.gy/books?id=PbMM74ucos0C&pg=PA118&lpg=PA118&dq=academic+citation+meaning+hinterland++Guyana&source=bl&ots=ytt1Xi1LTt&sig=ajpGhrmGAUhY_8bwpRSq7YpGl6o&hl=pt-BR&sa=X&ved=0ahUKEwjvsoemi5TOAhUMOz4KHUAzDUoQ6AEILzAD#v=onepage&q=academic%20citation%20meaning%20hinterland%20%20Guyana&f=false (specifically on pages 94; 118).

[16] PEREIRA, Mariana Cunha. Processos migratórios na fronteira Brasil-Guiana. Estud. av. [online]. 2006, vol.20, n.57 [cited 2016-07-27], pp.209-219. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-40142006000200016&lng=en&nrm=iso>.

- Rural[17]
  - Rural areas are non-urbanized areas, aimed at activities of agriculture and livestock, extraction, rural tourism, forestry or environmental conservation. It is in rural areas where much of the food consumed in urban areas is produced. In rural areas, there are large green areas, which can be natural or cultured. Low concentration of people and buildings, and a striking presence of natural elements, such as river and vegetation.

- Poor[18]
  - Fundamentally, poverty is a denial of choices and opportunities, a violation of human dignity. It means lack of basic capacity to participate effectively in society. It means not having enough to feed and cloth[e] a family, not having a school or clinic to go to, not having the land on which to grow one's food or a job to earn one's living, not having access to credit. It means insecurity, powerlessness and exclusion of individuals, households and communities. It means susceptibility to violence, and it often implies living on marginal or fragile environments, without access to clean water or sanitation. "The Multidimensional Poverty Index (MPI) for developing countries captures the multiple deprivations that people face in their education, health and living standards. The MPI shows both the incidence of nonincome multidimensional poverty (a headcount of those in multidimensional poverty) and its intensity (the relative number of deprivations poor people experience at the same time). Based on intensity thresholds, people are classified as near multidimensional poverty, multidimensional poor or in severe poverty, respectively. The contributions of deprivations in each dimension to overall poverty are also included. The table also presents measures of income poverty—population living on less than PPP $1.25 per day and population living below the national poverty line."
    According to the numbers from 2009, 18,8% of the population live near and 1,2% of the population in severe multidimensional poverty[19].
    According World Bank (2016), "The majority of Guyana's poor live in rural areas, while extreme poverty is concentrated in the interior regions. The rural poor are self-employed in agriculture or work as agricultural laborers. Poor rural households have access to adequate land resources, indicating that low productivity is a major cause of poverty. Along the coastal areas, poor households are involved in subsistence agriculture and small-scale rice production. In the interior, subsistence farming is most prevalent. In urban areas, the poor include those employed as wage laborers in a variety of occupations, in small informal businesses, as public servants at the bottom end of the salary scale, and pensioners"[20].
  - The Enumeration District Marginality Index (EDMI) has been used to identify poor communities (see A.3.1.5.3).

3.3.1.5.2 Ethnic-racial Criteria

- Indigenous People
  - Indigenous People were the very first inhabitants of the land. They share a rich and diverse culture and are one of the many ethnic groups that make up the people of Guyana. According to the Ministry of Indigenous People´s Affairs (2016)[21], there are nine Indigenous Peoples tribes settled across the ten administrative Regions of Guyana: Wai Wais, Macushis, Patomonas, Arawaks, Caribs, Wapishana, Arecunas, Akawaios, and Warraus. The nine Indigenous People tribes, according to official census in 2012[22], made up 11% of the population by that time.

- Afro-Guyanese[23]
  - Afro-Guyanese people in Guyana are from Sub-Saharan African descent. As the Afro-Guyanese people from Guyana they were the inhabitants forcibly brought as slaves to work on the sugar plantations of British Guyana. After the abolition of slavery in the British Colonies, Afro-Guyanese joined together and established small villages. According to the official census in 2012, Afro-Guyanese made up 29% of the population.

[17] PEREIRA, Mariana Cunha. Processos migratórios na fronteira Brasil-Guiana. Estud. av. [online]. 2006, vol.20, n.57 [cited 2016-07-27], pp.209-219. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-40142006000200016&lng=en&nrm=iso>

[18] A poverty map for Guyana: Based on the 2002 population and housing census: Skoufias, Emmanuel. The World Bank, 2005.

[19] Human Development Report 2015: Work for Human Development, p. 205, UNDP

[20] THE WORLD BANK, (2016). GUYANA: STRATEGIES FOR REDUCING POVERTY. (ON-LINE) WORLDBANK. AVAILABLE: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20207586~menuPK:435735~pagePK:148956~piPK:216618~theSitePK:430367,00.html, (13TH JULY, 2016).

[21] MINISTRY OF INDIGENOUS PEOPLE´S AFFAIRS. (2016). *Amerindian Nations*. (On-line) Ministry of Indigenous People´s Affairs. Available: http://indigenouspeoples.gov.gy/amerindian-nations/, (13th July, 2016).

[22] BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (13th July, 2016).

[23]BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (15th July, 2016).

- Indo-Guyanese[24]
    - Current Indo-Guyaneses are descendants of the first East Indian immigrants who arrived in British Guyana in the mid-nineteenth century after the abolition of slavery in 1838. Ethnically, they were originated from different parts of India; more specifically from a part known to Hindi people (People of Hind). Ethno/linguistic groups came primarily from the north-central Indian region of Hind, which is located in the Gangetic Plain of the Ganga and Yamuna rivers in North India, between the Himalayas and the Vindhyas. Nowadays, Indo-Guyanese are the largest ethnic group in Guyana identified by the official census in 2012, which accounted for about 39,83% of the population.

- Mixed source[25]
    - Mixed group are originated from marriages amongst Afro-Guyanese people, Indigenous People and Indo-Guyanese. According to official census in 2012, the mixed group made up 20% of population.

3.3.1.5.3 Economic Criteria

The main economic activities include mining (gold, diamond and bauxite), logging, agriculture (rice farms, sugarcane production) and commerce.
The key factors that influence the choice of the communities is the level of poverty existing, especially communities with smaller population tend to have greater levels of poverty. The extent of poverty within the community can be evaluated considering, for instance, an appropriate energy supply. This choice is made by reviewing the most recent poverty indicators available. The 2002 National Population Census Database was utilized by the World Bank to compile two poverty indexes: the Living Conditions Index (LCI) and the Enumeration District Marginality Index (EDMI).
The first index called Living Conditions Index (or LCI) considers the following variables:

- The access and quality of a household's source of water
- Source of drinking water
- The type of toilet facility
- The main method of garbage disposal
- And extent of crowding in the household (the number of the people in the household divided by the number of bedrooms in dwelling).

The second index created, the Enumeration District Marginality Index (EDMI) is based on the following variables:

- The proportion of adults (15 yrs. of age or older) in the enumeration district (ED) who have either no education at all or did not complete primary schooling,
- The proportion of adults (15 yrs. of age or older) in the enumeration district who work in the primary sector,
- The proportion of children (6-14 yrs. of age or older) in the enumeration district who do not attend school full-time,
- The proportion of dwellings in the enumeration district that report not having piped water as their main source of water supply,
- The proportion of dwellings in the enumeration district that do not have a toilet linked to a sewer,
- The proportion of dwellings in the enumeration district that do not report electricity as their main source of lighting,
- The proportion of dwellings in the enumeration district that report their main method of garbage disposal is not garbage collection service, compost, or burying,
- The average number of family members per bedroom in the enumeration.

Regardless of the equation used for the formation of an index, the study will be based on some of these variables which have been used to measure what the level of poverty of the chosen locations is, and thus delimit the distribution of the sample regarding poverty classifications with accurate data.

These indexes can give a fairly accurate picture of the levels of poverty in the various Neighborhood Democratic Councils (NDC) within Guyana regarding the living conditions of the population in each NDC. Both indexes are related, but the LCI reflects the poverty levels of individual households in the NDC, while the EDMI presents the poverty levels of the individual Enumeration District (ED). The EDMI also presents a wider range of variables and will thus be used for analysis purposes, because it shows the poverty level more accurately in the NDCs.

Communities which have a greater need for energy supply, ergo a bad energy supply system, tend to also have a higher level of poverty. This serves as an indicator in selecting fitting communities. This primary objective however was modulated by imposing another condition: the community should not be very difficult to access, because the time necessary to access them would have to be in time with the implementation of the project.[26]

[24]BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (15th July, 2016).
[25] BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (15th July, 2016).
[26] Analyse and selection of Communities in Guyana: Ketwaru, Patrick, 2005.

3.3.1.5.4 People to meet/Persona profiles of preferred Interview Partners:

- Quantitative interviews will be conducted with the Toshao or a respective community leader. The given data will then be confirmed at least once or until one set of complete data has been collected. To verify, a random selection of interviewees can be chosen, including, but not limited to a representative person with knowledge of the requested data, such as consulting health centers, respectively doctors, nurses or schools, respectively teachers for their records. For the quantitative ICT checklist, people of the respective community will be approached randomly, regardless of their occupation, having in mind that age groups and both genders should be covered, where possible. A number of 3-5 checklists will be collected per community. The collection of more checklists will be intended on best effort.
- The data gathered will be entered into the Spiegel-Institute's survey engine (web-based) only once per community.
- The qualitative interview can also be held with the Toshao or Community Leader respectively, if this seems absolutely necessary out of respect or expectation. Additionally, a maximum of 2-3 further representative people, as described below, will be questioned:
    - Toshao/Community Leader
    - Representative person of prevailing industry (tourism, handcraft, agriculture, etc.)
    - Representative person of local educational institution (directors, supervisors, teachers)
    - Representative person of local healthcare institution (physicians, nurse, vet)

With representative people any person in the community is meant, both genders will be taken into consideration. These interviewees are most likely not preselected, but that does not entail that they show different prerequisites than any randomly selected person. These people can also be visited or searched for by recommendations of people in the community. While for the selection of the different personas a random selection can be made, it is important to stick to the persona profiles given (see above) to ensure the scope of the other work packages.

The communication protocol is specified as follows: all visits will be scheduled by the e-Government team together with the Ministry of Communities and the Ministry of Indigenous Affairs. The researchers will complete the interviews during one full day per community, meeting local representatives who confirmed and authorized the visits. In case of Indigenous People[1]s communities, the Toshaos will be pre-contacted with an official letter from the UNDP.

As soon as the contact with the local leader or official is made and the visits are scheduled and authorized, the researchers will set out to the communities. None of the researchers will be travelling to any of the communities alone. In some cases of travelling by air or boat precautions have been taken to hire boat captains who are known by the community leader or the research team personally. For air travelling the researchers will be accompanied to the airport and picked up at their destination. All travel by road will also be accompanied by a trusted local driver.

The current status of officials who accompany our researchers to establish official presence at the communities is as follows:

- Region 2, respectively route 2 will be accompanied by an official of the Ministry of Amerindian Affairs. Chairman of the National Toshaos Council Joel Fredericks

3.3.1.6 Exemplary Itinerary of Interview Activities per Day

- 8:00 am: Arrival
- 8:15 am: Introduction and confirmation of the activities of the day with the local leader.
- 8:30 am: Quantitative interview with the local leader or someone indicated by the leader (who is aware of quantitative data from the community), then validation of quantitative data until one complete set of data has been collected.
- 12:00 pm: Lunch break.
- 01:00 pm: One-on-one qualitative interviews (or situational mini groups) will be conducted with representative persons.
- 01:15 pm: Qualitative interviews
- 03:15 pm: Final considerations
- 03:30 pm: If needed, approach individuals/citizens to gather further information or take pictures, also collect local maps.
- 05:30 pm: Departure

It should be noted that the script involves possible changes, as events that are beyond the interviewer will occur. This itinerary only reflects the current planning status.

3.3.1.7 Timeline –Detail View

	CW 26	CW 27	CW 28	CW 29	CW 30	CW 31	CW 32	CW 33	CW 34	CW 35
Elaborating of study design, draft travel agendas, sites to be visited. Preparing material (questionnaire, script, etc.), Refining and finalising study design, approval of routes and contacts.	26 Jun-2 Jul	3-9 Jul	10-16 Jul	17-23 Jul						
Personal contact with entities, government agencies to arrange interviews with those responsible			10-16 Jul	17-23 Jul						
Training of team				17-23 Jul						
Conducting field study					24-30 JuL	31 Jul-6 Aug	7 - 13 Aug			
Receiving material and compilation of content						31 Jul-6 Aug	7 - 13 Aug	14-20 Aug	21-27 Aug	
Preliminary Results of field study									21-27 Aug	
Final Results and presentation										28 Aug-3 Set

Figure 16 - Timeline for field research at the time of planning

This chart only reflects the current planning status and might change.[27]

3.3.1.8 Evaluation Planning Matrix

Evaluation Question	Indicator(s)	Data Collection method(s)	Data Source	Sampling	Comments
Demography, including: population of community, domiciles, population split, age ranges, ethnicity, degree of sedentariness, languages.	Check boxes; exact numbers and/ or percentages, open ends.	Personal standardized interview (additionally, to some extent, observation), descriptive analysis with frequencies and means	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Quantitative
Community facilities and finances, including: number of facilities, infrastructure,	Check boxes; exact numbers and/ or percentages, open ends.	Personal standardized interview (additionally, to some extent, observation), descriptive	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or	Quantitative

27 for a detailed schedule see Appendix B.4

poverty indicators, organized crime, micro loans.		analysis with frequencies and means		remote communities and recommendations of authorities.	
Education, including: attendance at educational institutions, completion of education	Check boxes (quantity ranges)	Personal standardized interview (additionally, to some extent, observation), descriptive analysis with frequencies and means	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Quantitative
Power supply, including: power supplie(s) in community, hours of electricity, number of power breakdowns	Check boxes; indicate percentage range; multiple selection options; open ends.	Personal standardized interview (additionally, to some extent, observation), descriptive analysis with frequencies and means	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Quantitative
Electric devices and ICT usage, including: ownership of devices in community, frequency of use of devices, usage of internet and telephony services, type of calls, online service usage	Check boxes; indicate percentage range; multiple selection options; open ends.	Personal standardized interview (additionally, to some extent, observation), descriptive analysis with frequencies and means	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Quantitative
Mobile network infrastructure, including: carrier and providers available, current status of ICT infrastructure in community, perceived benefits of technology, governmental support	Check boxes; indicate percentage range; multiple selection options; open ends.	Personal standardized interview (additionally, to some extent, observation), descriptive analysis with frequencies and means	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Quantitative
Previous ICT development projects, including: Past projects, description, success of projects, subjective opinion on these initiatives, benefits of ICT-related projects,	Check boxes; indicate percentage range; multiple selection options; open ends.	Personal standardized interview (additionally, to some extent, observation), descriptive analysis with frequencies and means	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Quantitative

current economic situation, sources of income, challenges of generating revenue, time line of developments (past, present, future)					
SITUATIONS Interpersonal communication, including: Communication over long distances, frequency of long distance communication	Guideline; open ends	Personal interview (additionally, to some extent, observation); content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (I. and II.)
DEVICES Interpersonal communication, including: means of communication for individual occasions, typical device for long distance communication,	Guideline; open ends	Personal interview (additionally, to some extent, observation), content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (III. and IV.)
Communication role of interviewee, points of contacts with tele-communication	Guideline; open ends	Personal interview (additionally, to some extent, observation), content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (V.)
NO OWNERSHIP of devices, including: landline telephone, mobile phone, computer, laptop, tablet, smart phone; assessment of reasons for absence of	Guideline; open ends	Personal interview (additionally, to some extent, observation), content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (VI. + i.-iv.)

devices, purchase intention, preconditions, future developments					
OWNERSHIP of devices, including: landline telephone, mobile phone, computer, laptop, tablet, smart phone; period of ownership, capability of usage, ICT literacy, frequency of usage, usage of online services, occasions of usage, usage of specific devices	Guideline; open ends	Personal interview (additionally, to some extent, observation), photo documentation, content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (VI. + v.-x.)
Use case definition for individual devices and considerations on usage	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (VI. + xi.)
Assessment of desired means of communication	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (VII.)
USE CASE E-Commerce (sell handcrafts, goods or buy anything online)	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (UC 1)
USE CASE Money Transfer	Guideline; open ends	Personal interview (additionally, to some extent, observation)	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or	Qualitative (UC 2)

(transferring money via cell phone deposit)		content analysis		remote communities and recommendations of authorities.	
USE CASE Contacting authorities (public or government)	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (UC 3)
USE CASE (only for medical professionals/ vets/ farmers) Consultation of fellow physicians etc.; possibility to seek help and training online	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (UC 4)
USE CASE (only for police chiefs/ responsible person for security issues) Usage of cameras and drones against organized crimes	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (UC 5)
Assessment of cultural identity, national identity, measurements necessary to strengthen national identity, common value systems, unique features, identity construction in relation to communication infrastructure	Guideline; open ends	Personal interview (additionally, to some extent, observation) content analysis	Representatives and/or preselected interviewees of each community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and recommendations of authorities.	Qualitative (final questions)
Assessment of living situation, infrastructure, living standards, local particularities	Guideline topics	Photo documentation	Respective community	All 30 sites (priority 1). Selection of communities on the basis of secondary (census) data, the split of hinterland, poor or remote communities and	Ethnographic

				recommendations of authorities.	

Table 9 - Evaluation Planning Matrix

3.3.1.9 Data entry and Deliverables Quantitative Survey

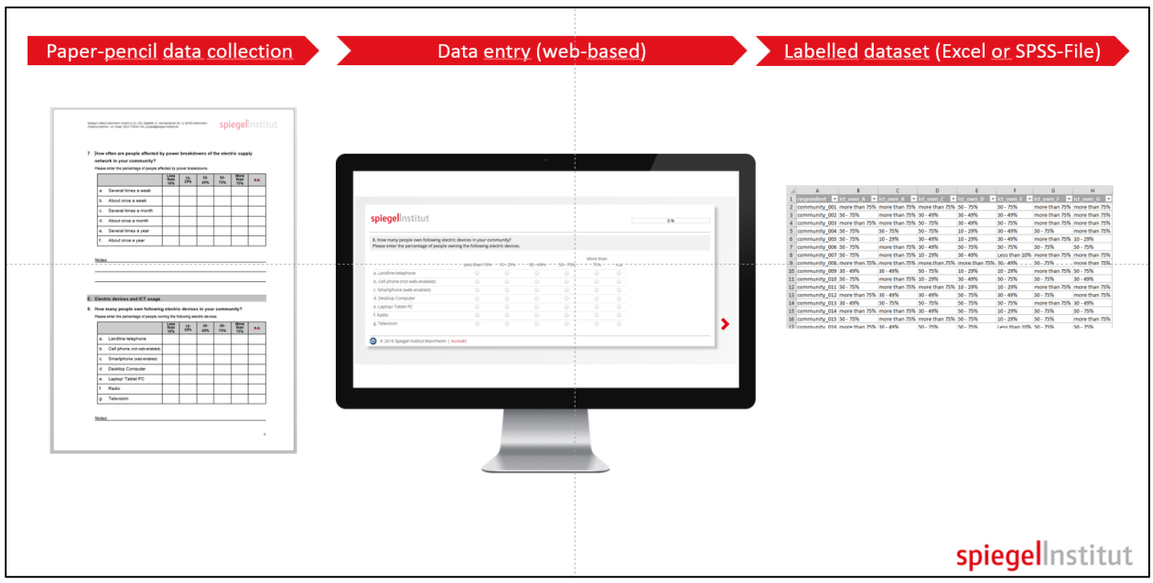

Figure 17 - Example workflow for the quantitative survey

3.3.1.10 Example for Data Entry into the SurveyEngine:

Data is collected via paper-pencil during fieldwork in Guyana. For entering these questionnaires into a database a web-based tool is used (SurveyEngine from Spiegel Institut). This procedure allows a cost-efficient way to produce a clean dataset as Excel or SPSS file with distinct labels for each question.

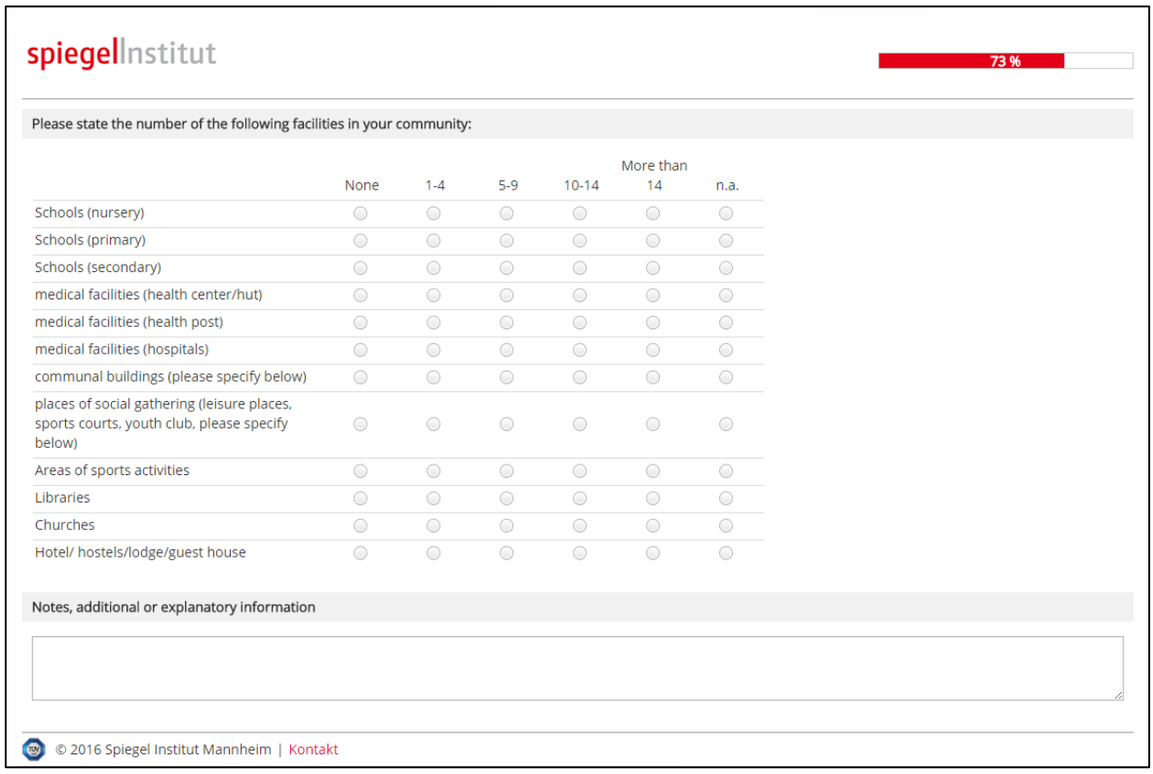

Figure 18 - Screenshot data collection tool

For closed-ended questions, frequencies for each answer category are reported. These frequencies may be reported for different groups, for example for each community or different zones (remote, hinterland, poor).

3.3.1.11 Example for Reporting Frequencies:

Please describe the power supply in your community.			
Type	**Remote**	**Hinterland**	**Poor**
Electric supply network (landline)	30 (86%)	28 (57%)	12 (31%)
Electric generator (local)	15 (43%)	15 (31%)	18 (46%)
Solar electricity	3 (9%)	1 (2%)	0 (0%)
Hydropower	0 (0%)	0 (0%)	0 (0%)
Wind energy	0 (0%)	0 (0%)	0 (0%)
Thermoelectricity	0 (0%)	0 (0%)	0 (0%)
Biothermal energy	0 (0%)	0 (0%)	0 (0%)
No electricity at all	1 (3%)	5 (10%)	11 (28%)
Total	**35**	**49**	**39**

Table 10 - Example for reporting frequencies

To illustrate qualitative findings, exemplary/ typical “personas“will be outlined in the result report. These personas are idealized profiles of representative persons who were interviewed during the research phase. They help to understand the situations, perspectives, needs and expectations of different population groups. E.g. a typical farmer who had problems in the past with diseases of his cattle that died because he had no opportunity to seek veterinarian consultation. Such personas are ideal means to communicate in an illustrative way to stakeholders and an ideal basis for derivation of further measures.

3.3.1.12 Technical As-Is Analysis

The objective of this network and capacity as-is analysis is to obtain information regarding the existing telecommunications networks in Guyana and to analyze them in terms of the requirements of the project.

It will be based on a structured multi step approach, including a questionnaire for guided interviews to get reliable and comparable feedback.

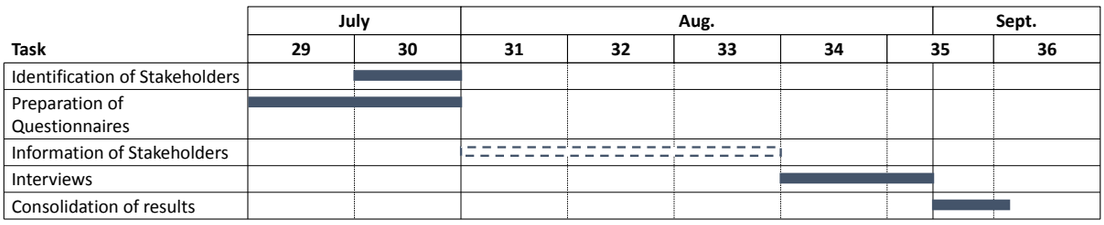

Figure 19 - Timeline for stakeholder interviews (planned)

Step 1: *Identification of the relevant stakeholders and interview partners.*

Focus for a first introductions are the CEOs from all network operators operating networks the Country, i.e. GT&T, Digical, the e-Government Unit as well as Satellite operators (e.g. i-Net). While they represent the company and are important stakeholders, technical and commercial persons (e.g. CTO, CFO) will be needed for the interviews to be conducted.

Step 2: Preparation and elaboration of the questionnaire.

The questionnaire will have:

- a fixed line part: relevant for GT&T and e-Government
- a mobile part: relevant for GT&T, Digicel and e-Government
- a satellite part: relevant for i-Net and other players

Step 3: Information of the stakeholders

After an introduction by the e-Government team to the relevant stakeholders the questionnaires will be send as an advance information to help them to prepare for the planned interviews and to gather the needed and correct information. If there are immediate questions from the stakeholders they can be answered as well.

Step 4: Guided Interviews

Guided interviews, based on the questionnaires will be done with the different stakeholders and their experts to gather relevant information.

If needed, selected side visits in alignment with the stakeholders will be executed to validate the information and to gather additional insights.

Step 5: Consolidation of results

Results and findings will be documented in the final report for work stream 1, i.e. highlighting the current ICT infrastructure situation and the derivation of needs in alignment with WP1.1

Additionally, an interactive map will be elaborated to show selected results dynamically.

3.3.2 Work stream 2 – Elaboration of the extensive Technical Report

Based on each work package, Detecon will use its ICT expertise and specific methodologies to elaborate the best possible solution and to provide recommendations in line with the project objectives.

Work package 2.1: Potential Technologies

Detecon will use its database for wireline and wireless technologies (terrestrial and satellite, licensed and unlicensed spectrum technologies, upcoming and novel technologies) and apply descriptions of implementation scenarios and potential combinations of technologies, which might be suited to fulfil the needs of the surveyed communities following international best practice. Detecon's ICT experts with many years of practical experience will perform this analysis and description of available technologies.

Work package 2.2: Stakeholder Assessment

To identify impacted stakeholders and derive requirements for a successful implementation of the defined technologies, Detecon will perform expert interviews with representatives of all relevant institutions and bodies.

Those include, but are not limited to, Guyana Telephone and Telegraph Company (GT&T), Digicel Corporation, National Frequency Management Unit (NFMU), e-Governance Unit, Ministry of Indigenous Peoples' Affairs, and others. A report will outline the topics and requirements stemming from those stakeholders.

Work package 2.3: Regulatory Analysis

For the assessment of the impact of Guyana legislation on technology rollout, Detecon will identify the pertinent provisions with focus on ICT-infrastructure and ICT-services. An expert analysis of these provisions and resolutions will result in guidelines for technology selection and installation.

Furthermore, Detecon will perform interviews with representatives of the regulatory bodies in Guyana and make a high-level analysis of the existing related and relevant laws (telecommunications law, competition law, etc.) and any existing regulations. Based on Detecon's telecommunications legislation and regulation database, an expert will identify opportunities, risks and further impacts on the proposed solution.

If there is the need for further regulation or legislation, this will be outlined separately. These could include specifications on passive and active ICT-infrastructure sharing, fixed and Mobile Virtual Network Operators (MVNO), rollout targets and population coverage obligations and further wholesale regulations.

Work package 2.4: Potential Partnerships

To identify potential partnerships, Detecon will analyze the capabilities of potential partners via desktop research and dedicated interviews with experts and partners. Interviews are important to clarify topics that go beyond the possibilities of desktop research.

Work package 2.5: Technology Solution

Detecon will elaborate an optimal technology solution with respect to commercial factors, technical feasibility, proposed e-Services, and available capabilities for the implementation and maintenance tasks. The solution will take into consideration at least all requirements collected in WP2.1-2.5 in a scoring model. However, if additional frame conditions arise during the design and specification work, the expert will adopt the target picture accordingly. A high-level cost breakdown will be given. However, the final cost for the solution can only be determined during the tendering phase.

Work package 2.6: Business Model

Based on international best practice, Detecon will analyze up to five different business models, including some already mentioned in the TOR (see Appendix). The focus will lie on long-term sustainability and benefits & risks for the affected communities. The experts will also identify possible funding and partnership models, such as PPP, pure government owned, subsidy supported, etc. Revenue opportunities will be identified, however the business potential is deemed rather limited.

Work package 2.7: Rollout Prioritization

Detecon, in close alignment with the e-Governance team, will develop a model for prioritizing the infrastructure rollout to the affected communities. Possible factors can include, but are not limited to, ease of implementation, number of people affected, commercial opportunities, coverage of special-interest groups, etc.

Work package 2.8: Support in Tender Preparation

Detecon will use the proven tendering and vendor selection tool suite to optimize the preparation of the planned RFPs. Clear RfP guidelines will be set up to precisely describe the requirements towards the vendor or system integrator. Experts will support local Guyanese staff from the e-Government team during the elaboration of the document and during the runtime of this preparation project.

3.3.3 Work stream 3 – e-Services Readiness Assessment and Action Plan

Work package 3.1: e-Government Readiness Assessment and Action Plan

Two specific methodologies will be used to approach this work package from a holistic perspective:

- e-Government expertise will be used following the Detecon e-Government Innovation House model, which profits from previous projects in different fields of government related activities,
- Business Transformation approach, based on open standards like TOGAF to secure a proven and structured framework and methodology to elaborate the expected results.

- Following an As-Is analysis of existing and planned services, specific use cases will be described and their relationship to the survey findings of WS1 explained. Possible e-Service use cases include, but are not limited to, the following:
- E-Health
- E-Commerce
- Surveillance/Border protection
- Mobile/virtual payment
- Animal tracking
- Administrative e-Government

Detecon will compile all proposed services into an e-Services vision for the surveyed communities.

Work package 3.2: e-Learning Customization Strategy

Hinterland, poor and remote communities require a tailored e-Learning approach. Following an As-Is analysis of existing offerings, the special needs as identified in WS1 will be transformed into an e-Learning vision for the surveyed communities. Detecon will identify collaborations and partnerships, which can deliver the customized e-Learning services based on per-defined criteria.

Work package 3.3: Training plan for Communities

Based on the results of WS1 and WP3.1 and 3.2 as well as interviews with experts on Guyana hinterland and remote areas, Detecon will elaborate a training plan for the different target groups in the surveyed communities.

3.4 Work Plan and Project Monitoring & Reporting

3.4.1 Work Plans

3.4.1.1 Work Plan Gantt chart

Overview of the current work plan:

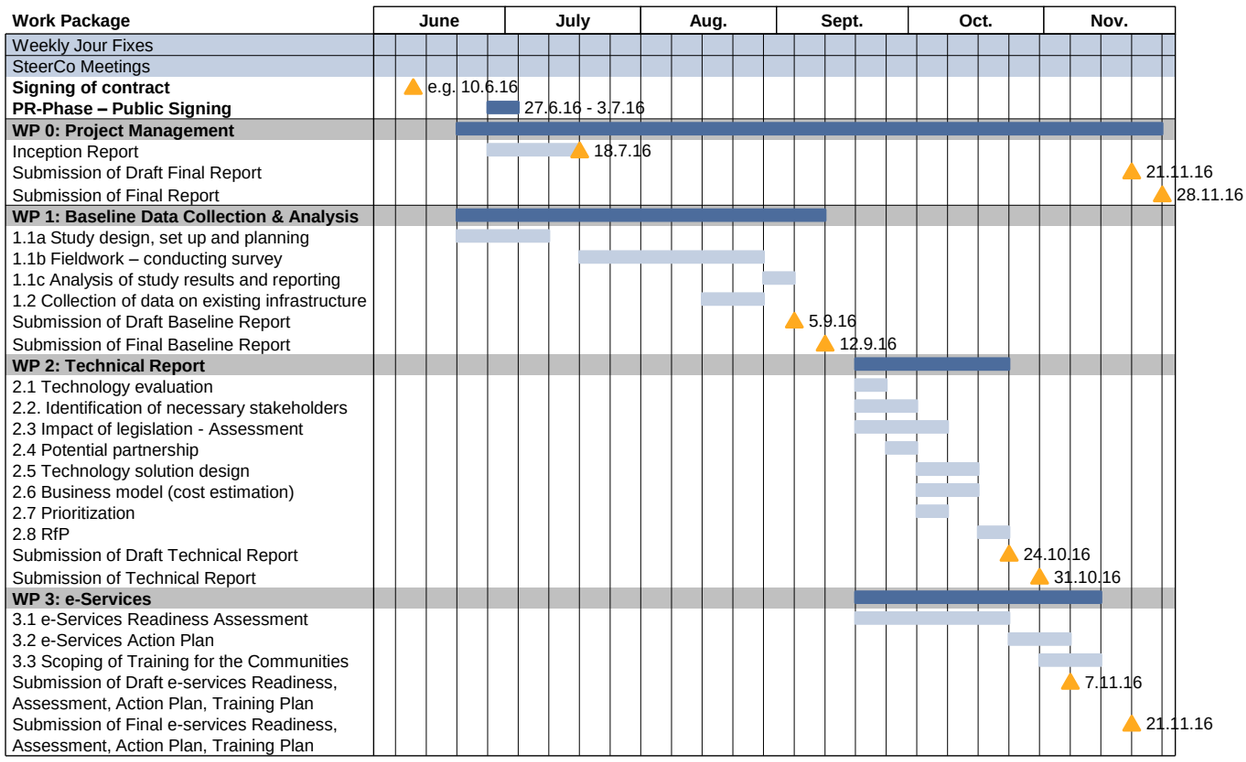

Figure 20 - Work Plan Chart

3.4.1.2 Workforce planning

It is planned that the following experts support the project in the calendar weeks as indicated:

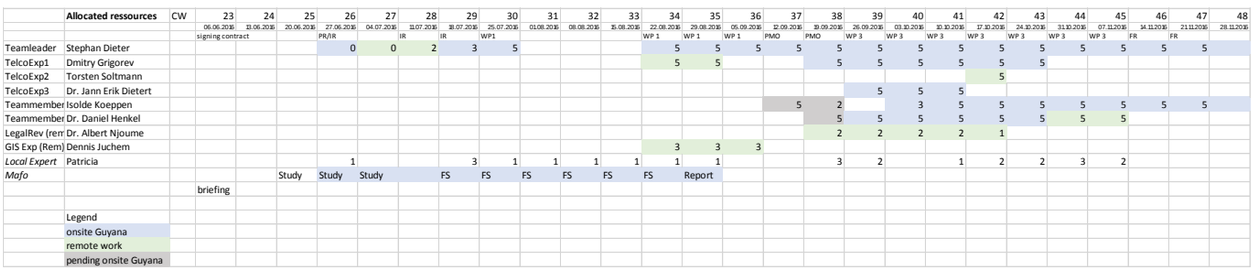

Figure 21 - Workforce Planning

3.4.2 Project Reporting

Weekly Reports will be elaborated and send to UNDP and the e-Government counterparts.

Steering Committee meetings will be scheduled once per month and initiated on an individual basis, if needed.

Final reports for the respective work streams are planned to be elaborated until the following dates:

Submission and Acceptance of Final Baseline Data Report	Final Baseline Data Report after the field work has been completed. This should include the analysis and recommendations based on the collected data supported by the complete dataset from the baseline study and needs assessment.	12th September, 2016
Submission and Acceptance of Final Technical Report	Final Technical Report	31st October, 2016
Submission and Acceptance of Final e-	Final E-Services Readiness Assessment and	21st November, 2016

services Readiness Assessment and Action Plan, in addition to Training Plan.	Action Plan, in addition to Training Plan	
Final Report	A compiled final report should cover all activities identified under the scope of work and include any recommendations made by the e-Government Unit prior to final approval of the report.	28th November, 2016

3.5 Logistics

- For the execution of this project at nine Indigenous Peoples communities/sites, the team should require authorization and permission from the Toshaos to conduct the interviews
- At the others communities/sites we need contact of the representatives from each locality
- Other contacts/permissions (if needed)

Some need for support might only arise during extensive travel planning and can only be determined before setting off on the individual routes or experiencing difficult situations during travel.

WP 2 and 3 will be delivered out of Georgetown with special focus on close interaction with the Guyana e-Government team and the respective stakeholders and players.

4. Baseline Report (WP1)

4.1 Introduction

This report comprises the findings from the work stream 1 of the project "ICT Access and e-Services for hinterland, Poor and Remote Communities in Guyana". This work stream aims to describe the current situation in regards to the context of the project from three dimension: the customer needs and their specific perspective on telecommunication infrastructure and services in Guyana, the activities of the different providers for telecommunication services in the country as well as the highlighting the current players in the field of regulation and their corresponding activities.

The results from this chapter might update findings from the previous chapters.

4.2 As-Is analysis: Customer Needs and their Perspectives

This chapter shows the results from the market research, it covers the consumer needs and their perspective in regards to ICT infrastructure, its usage and the experience with the different service providers.

In the following, the objectives and the methodologies of the market research performed in this project are outlined.

4.2.1.1 Objectives

The main objective of this work was to gather data on the communities' infrastructure and on the people's attitudes towards Information and Communication Technology (ICT) as well as understanding the people's needs regarding ICT-services, their expectations towards ICT-Infrastructure and ICT-Services including an indication of their willingness to pay for ICT services as well as getting an understanding of their respective ICT literacy. The aim was also to compile relevant data on shortcomings in different sectors, such as social, economic or health. These shortcomings will be considered in work streams 2 and 3 and might be remedied by the evolution of the ICT-infrastructure and ICT services in the future.

To collect this data, a quantitative survey and a qualitative survey on community level addressing the head of the community as well as key experts in different domains like health and education. To broaden the sample size and to be able to reflect the different age groups and other variables of the population an ICT checklist was elaborated to be used as a "self-services" questionnaire. The interviews were conducted at 30 communities in all 10 regions of Guyana. Those communities were amongst other criteria selected according to their area characteristics of poor, remote and hinterland.

The data collected identified the current environment of those communities. The indicators assessed quantitatively included:

- number of communities that have internet and/or telephony access;
- number of children in the communities accessing online education, or separately enrolled in primary, secondary and tertiary education;
- poverty levels of all identified communities;
- number of ICT literate persons within all identified communities;
- number of desktop computers and laptops within all identified communities;
- number of schools, medical facilities, and communal buildings in each community identified.[28]

The quantitative survey was set out to gather indications - this does not include statistically relevant data in the context of a full census or census-type survey. The data will be informative for the scope of the project. The ICT checklists aims to gather a broader sample of the population in a village to get data with relevance.

The qualitative survey enriched the quantitative data with additional background information and addresses topics that need to be explored freely aiming to uncover so far unknown circumstances and needs.

4.2.1.2 Methodology

The methodology includes quantitative and qualitative analyses. The selection of the sample is based on social-economical and geographical criteria.

4.2.1.2.1 Quantitative and Qualitative Approach

The chosen general approach for the research has been described in chapter3.3.

[28] For additional information see Inception Report, chapter 3.1.2.

From chapter 4.2.4 to chapter 4.2.6, the study addressed the issue of access to and usage of telecommunication infrastructure and services in a qualitative way. In these chapters, the focus is not to quantify – the focus is to understand the individual vision, associations and feelings in regards to the access or lack of access to the available means of telecommunications in Guyana. That helps the researchers to develop a deeper understanding of the subject, more than can be obtained by quantitative research alone. Qualitative research uses methods such as in-depth interviews and direct observation, so that researchers can investigate attitudes, beliefs and preferences of stakeholders - the how and why. These qualitative research methods provide an opportunity for a systematic in-depth assessment of a question that cannot be easily answered through quantitative methods. In addition, the quantitative results add figures to the desires and needs detected using the qualitative method.

During the execution of the interviews, the following deviations from the planned approach have been noted. They are not affecting the overall research aim to outline the ICT usage in the different communities and to set the baseline for the following work packages:

- gender and age spilt not 100% fulfilled: primarily due to the fact that more women than men were in the communities during the interviews
- short term cancellation of interviews: due to the non-availability of interview partners during the scheduled interview time

4.2.1.2.2 Guyana's Profile

The economy of Guyana is based on agriculture and extractive industries. It is mainly focused on the export of six commodities – sugar, gold, bauxite, shrimps, timber and rice – and it has experienced a moderate growth in the past few years; it is estimated to maintain its levels of growth in the future years. Still, the moderate growth in the economy is only marginally reflected by unemployment rates. In recent years, this rate has demonstrated little change – In 2012 it was 11.3% and in 2013 it dropped to 11.1%. The population of Guyana is predominantly young. The young, young adults and adults represents 65% of the population, followed by those of younger age – 30% between 0-14 years old, and 5% of the population is 65 years and over. The electricity in Guyana is mainly composed by fossil fuel; it was estimated that in 2011 fossil fuel electricity represented 96% of the electricity capacity installed, while the electricity from renewable sources were responsible for only 3,7%. An estimated data for 2011 revealed an electricity production of 725 million KWh and a consumption of 523 million KWh.[29]

	Population	Main economic activity
Region 1 - Barima-Waini	18,590	Logging
Region 2 - Pomeroon-Supernaan	42,769	Rice farming
Region 3 - Essequibo Island-West Demerara	91,328	Rice farming
Region 4 - Demerara-Mahaica	297,162 *	Administrative and Commercial activities
Region 5 - Mahaica-Berbice	49,498	Rice farming
Region 6 - East Berbice-Corentyne	142,839	Rice and Sugarcane farming and gold and diamond mining
Region 7 - Cuyuni-Mazaruni	15,342	Cattle rearing
Region 8 - Potaro-Siparuni	5,737	Cattle rearing
Region 9 - Upper Takutu-Upper Essequibo	15,087	Cattle rearing
Region 10 - Upper Demerara-Upper Berbice	39,106	Bauxite extraction
	Total population: 717,458	GDP by sector of origin (2014): Agriculture: 20.3%; Industry: 39.2%; Services: 40.5%.
* The capital city, Georgetown, has 56,095 inhabitants.		

Table 11 - Regions of Guyana

4.2.1.2.3 Selection Parameters of Communities

[29] All data presented in the Results – overview section is a compilation of the data presented in the book *Guyana. Information strategy, internet and e-commerce developed handbook. Strategic information, programs and regulation*. Published by International Business Publication, USA, 2015.

Through intertwining the selection parameters below, the aim was to cover a representative sample of the population. Selection parameters are:

- **Geographic location** – in order to cover the entire territory of Guyana and its ten regions, including indigenous territory, urban, rural, remote and hinterland areas;
- **Ethnical-racial criteria** – in order to include the different ethnic and racial inscriptions of the country: Afro-Guyanese, Indo-Guyanese, Indigenous People and Mixed;
- **Socio-economic aspects** – in order to include communities of all kind of economic strength: Poor localities as well as non-poor localities: namely localities with economic activities such as mining, logging, agriculture, commerce and tourism.

4.2.1.2.4 Overview of selected Communities per Region[30]

Region	Region Name	Main City	Community 1	Community 2	Community 3	Community 4
1	Barima	Mabaruma	Port Kaituma	Mabaruma		
2	Pomeroon-Supenaam	Anna Regina	Mainstay/Whayaka	Charity	Santa Monica	
3	Essequibo Islands-West Demerara	Vreed en Hoop	Wales	Saxacally	Hogg Island	
4	Demerara-Mahaica	Georgetown	Albouystown	Buxton	Laluni	St. Cuthberts
5	Mahaica-Berbice	Fort Wellington	Perth	Ithaca	Number 3/Rosignol	
6	East Berbice-Corentyne	New Amsterdam	West Canjie	Plegt Anker	Orealla	
7	Cuyuni-Mazaruni	Bartica	Phillipai	Kako	Bartica	
8	Potaro-Siparuni	Mahdia	Tumatumari	Mahdia		
9	Upper Takutu-Upper Essequibo	Lethem	Karasabai	Lethem	Aishalton	Nappi
10	Upper Demerara-Berbice	Linden	Wismar	Kwakwani	Coomacka	

Mixed	Afro-Guyanese	Indo-Guyanese	Indigenous People

Figure 22 - Communities per region visited

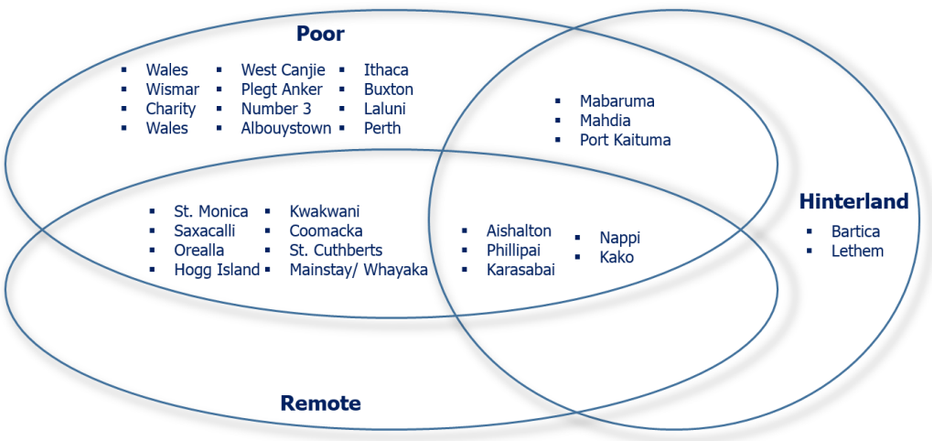

Figure 23 - Characteristics of visited communities

This graph indicates the intersections between the three main quota criteria of all selected communities. It shows that most remote communities overlap with the other two criteria: hinterland and poor. Communities in all three dimensions were covered in the research. Remote communities will most likely always be poor, too.

4.2.1.2.5 Geographic Criteria[31]

- Remote[32]

  Classified as remote areas are the areas that are not necessarily far from Georgetown and the coastline from a geographical point of view, but hard to access: Either due to poor roads, or due to

[30] Regions 1,7, 8 and 9 in blue are defined as Hinterland. For further information on sample selection see Inception Report p.24.

[31] For further information on sample selection, see Inception Report p.24.

[32] ALALHAR, Anton (edited). Ethnicity, Class and Nationalism: Caribbean and Extra-Caribbean Dimension. Lanham: Lexinton Books, c2005.Link:https://books.google.gy/books?id=PbMM74ucos0C&pg=PA118&lpg=PA118&dq=academic+citation+meaning+hinterland++Guyana&source=bl&ots=ytt1Xi1LTt&sig=ajpGhrmGAUhY_8bwpRSq7YpGl6o&hl=pt-BR&sa=X&ved=0ahUKEwjvsoemi5TOAhUMOz4KHUAzDUoQ6AEILzAD#v=onepage&q=academic%20citation%20meaning%20hinterland%20%20Guyana&f=false (specifically on pages 94; 95; 110; 118).

accessibility only via water ways (by boat). These areas tend to be poor in terms of water supply, sewage services, electricity supply, schools, hospitals, road systems, policing, leisure facilities, etc.

- Hinterland[33]

  Classified as "Hinterland" are inland areas that are far from urban centers and the coastline. This applies to Region 7, 8, and 9. Region 1 has a coast, but still is considered as Hinterland per definition. The regions classified as "Hinterland" are not necessarily difficult to access. These areas can have problems in terms of water supply, sewage services, electricity supply, schools, hospitals, road systems, policing, leisure facilities, etc. The Hinterland has not developed because of its lack in real political and economic identity. It is considered an underdeveloped area in comparison to the coastal and urban areas where there is more economic activity. This could be a reason why region 1 is defined as Hinterland despite the fact, that it is located at the coastline.

Figure 24 - Regions of Guyana[34]

- Urban[35]

  Urban areas are characterized by the existence of urban infrastructure, comprising the set of utilities: water supply, sewage service, electricity supply, schools, hospitals, road system, policing, leisure facilities, etc. They undergo continuous development through construction activities. Population per km2 is significantly higher than in remote or Hinterland regions. Economic activities in these areas are mainly related to commerce.

- Rural[36]

  Rural areas are non-urbanized areas. The main activities are agriculture and livestock farming, mining, rural tourism, forestry or environmental conservation. It is in rural areas where much of the food consumed in urban areas is produced. In rural areas, there are large green areas, which can be natural or cultured. Furthermore concentration of people and buildings is low, and there is a striking presence of natural elements, such as rivers and vegetation.

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[33] ALALHAR, Anton (edited). Ethnicity, Class and Nationalism: Caribbean and Extra-Caribbean Dimension. Lanham: Lexinton Books, c2005.Link:https://books.google.gy/books?id=PbMM74ucos0C&pg=PA118&lpg=PA118&dq=academic+citation+meaning+hinterland++Guyana&source=bl&ots=ytt1Xi1LTt&sig=ajpGhrmGAUhY_8bwpRSq7YpGl6o&hl=pt-BR&sa=X&ved=0ahUKEwjvsoemi5TOAhUMOz4KHUAzDUoQ6AEILzAD#v=onepage&q=academic%20citation%20meaning%20hinterland%20%20Guyana&f=false (specifically on pages 94; 118).

[34] Source: https://upload.wikimedia.org/wikipedia/commons/thumb/0/0f/Guyana_regions_numbered_(GINA).png/175px-Guyana_regions_numbered_(GINA).png

[35] PEREIRA, Mariana Cunha. Processos migratórios na fronteira Brasil-Guiana. Estud. av. [online]. 2006, vol.20, n.57 [cited, 2016-07-27], pp.209-219. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-40142006000200016&lng=en&nrm=iso>.

[36] PEREIRA, Mariana Cunha. Processos migratórios na fronteira Brasil-Guiana. Estud. av. [online]. 2006, vol.20, n.57 [cited, 2016-07-27], pp.209-219. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-40142006000200016&lng=en&nrm=iso>.

- Poor[37]

  Several aspects must be considered in order to classify areas as "poor": The Multidimensional Poverty Index (MPI) for developing countries captures the multiple deprivations that people face in their education, health and living standards. The MPI shows both the incidence of non-income multidimensional poverty (a headcount of those in multidimensional poverty) and its intensity (the relative number of deprivations poor people experience at the same time). Based on intensity thresholds, people are classified as near multidimensional poor, multidimensional poor or in severe poverty, respectively. The contributions of deprivations in each dimension to overall poverty are also included. According to numbers from 2009, 18,8% of the population of Guyana live near multidimensional and 1,2% of the population live in severe multidimensional poverty.[38]

  According to the World Bank (2016), "The majority of Guyana's poor live in rural areas, while extreme poverty is concentrated in the interior regions. The rural poor are self-employed in agriculture or work as agricultural laborers. Poor rural households have access to adequate land resources, indicating that low productivity is a major cause of poverty. Along the coastal areas, poor households are involved in subsistence agriculture and small-scale rice production. In the interior, subsistence farming is most prevalent. In urban areas, the poor include those employed as wage laborers in a variety of occupations, in small informal businesses, as public servants at the bottom end of the salary scale, and pensioners".[39]

  To identify poor communities to be considered in the survey, the Enumeration District Marginality Index (EDMI) has been used.[40]

4.2.1.2.6 Ethnic-Racial Criteria

- Indigenous People

  Indigenous People were the very first inhabitants of the land. They share a rich and diverse culture and are one of the many ethnic groups that make up the people of Guyana. According to the Ministry of Indigenous People´s Affairs (2016)[41], there are nine Indigenous People tribes settled across the ten administrative Regions of Guyana: Wai Wais, Macushis, Patomonas, Arawaks, Caribs, Wapishana, Arecunas, Akawaios, and Warraus. The nine Indigenous People tribes, according to official census in 2012[42], made up 11% of the population by that time.

- Afro-Guyanese[43]

  Afro-Guyanese people in Guyana are from Sub-Saharan African descent. As the Afro-Guyanese people from Guyana they were the inhabitants forcibly brought as slaves to work on the sugar plantations of British Guyana. After the abolition of slavery in the British Colonies, Afro-Guyanese joined together and established small villages. According to the official census in 2012, Afro-Guyanese made up 29% of the population.

- Indo-Guyanese[44]

  Current Indo-Guyaneses are descendants of the first East Indian immigrants who arrived in British Guyana in the mid-nineteenth century after the abolition of slavery in 1838. Ethnically, they were originated from different parts of India; more specifically from a part known to Hindi people (People of Hind). Ethno/linguistic groups came primarily from the north-central Indian region of Hind, which is located in the Gangetic Plain of the Ganga and Yamuna rivers in North India, between the Himalayas and the Vindhyas. Nowadays, Indo-Guyanese are the largest ethnic group in Guyana identified by the official census in 2012, which accounted for about 39,83% of the population.

- Mixed source[45]

  Mixed group are originated from marriages amongst Afro-Guyanese people, Indigenous People and Indo-Guyanese. According to official census in 2012, the Mixed group made up 20% of population.

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[37] A poverty map for Guyana: Based on the 2002 population and housing census: SKOUFAS, Emmanuel. The World Bank, 2005.
[38] Human Development Report 2015: Work for Human Development, p. 205, UNDP.
[39] The World Bank (2016). Guyana: Strategies for reducing poverty (on-line). WORLDBANK. Available: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20207586~menuPK:435735~pagePK:148956~piPK:216618~theSitePK:430367,00.html, (13TH JULY, 2016).
[40] See Inception Report, Chapter A.3.1.5.3, p. 32, for details regarding the Economic Criteria.
[41] MINISTRY OF INDIGENOUS PEOPLE´S AFFAIRS. (2016). *Amerindian Nations*. (On-line) Ministry of Indigenous People´s Affairs. Available: http://indigenouspeoples.gov.gy/amerindian-nations/, (13th July, 2016).
[42] BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (13th July, 2016).
[43] BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). Compendium 2 Population Composition. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (15th July, 2016).
[44] BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (15th July, 2016).
[45] BUREAU OF STATISTICS A GOVERNMENT OF GUYANA AGENCY. (2012). *Compendium 2 Population Composition*. (On-line) estatisticsguyana. Available: http://statisticsguyana.gov.gy/census.html (15th July, 2016).

4.2.1.2.7 Economic Criteria

The main economic activities include mining (gold, diamond and bauxite), forestry and logging, agriculture (rice farms, sugarcane production) and commerce.
The key factors that influenced the selection of communities to be interviewed was the level of poverty. Especially communities with smaller population tend to have more severe levels of poverty. The extent of poverty within the community could be evaluated considering, for instance, an appropriate energy supply. This selection was made by reviewing the most recent poverty indicators available[46].

4.2.1.2.8 People to Meet/Persona Profiles of preferred Interview Partners

- Quantitative interviews were conducted with the Toshao or a respective community leader. The given data was confirmed at least once or until one set of complete data has been collected.
- For the quantitative ICT checklist, people of the respective community were approached randomly, regardless of their occupation, having in mind that the different age groups (0-4 yrs, 5-15 yrs, 16-24 yrs, 25-54 yrs and 55 yrs and older) and both genders should be covered, whenever possible. A number of 5-6 checklists was collected per community. The collection of more checklists was intended on best effort.
- The data gathered were entered into the Spiegel-Institute's survey engine (web-based) only once per community.
- The qualitative interview could also be held with the Toshao or Community Leader respectively, when this seemed absolutely necessary out of respect or expectation. Additionally, a maximum of 2-3 further representative people, as described below, was questioned:
    - Toshao/Community Leader/Chairman
    - Representative person of prevailing industry (tourism, handcraft, agriculture, etc.)
    - Representative person of local educational institution (directors, supervisors, teachers)
    - Representative person of local healthcare institution (physicians, nurse, vet)

These interviewees were most likely not preselected, but that does not entail that they show different prerequisites than any randomly selected person. These people could also be visited or searched for by recommendations of people in the community. While for the selection of the different personas a random selection could be made.

The communication protocol as advised was followed in interacting with ministries and agencies. The researchers completed the interviews during one full day per community, meeting local representatives who confirmed and authorized the visits. In case of Indigenous People's communities, the Toshaos was pre-contacted with an official letter from the UNDP.

4.2.2 Results

This report describes and analyzes the information gathered in 70 qualitative interviews and 30 quantitative interviews and 142 ICT checklists conducted between July the 19th and August the 9th of 2016, in thirty communities across all ten regions of Guyana. The qualitative respondents were professionals from health sector, education sector, and business owners. Whenever possible, representatives from these three profiles were interviewed. The quantitative respondents were the Toshaos or community leaders. The ICT checklist respondents were randomly chosen following the criteria specified above.

Based on the presented data, it is clear that the telecommunication systems in Guyana are not equally distributed. The coastal areas are better served by communication services, different from the areas in the interior with poor integration of communication systems. This pattern is reflected in the statements of respondents: the inhabitants at the coast complain about the price and quality of services, while inhabitants in the interior resent the lack of access to infrastructure.

There are three types of variations in access to information and communication technology in the surveyed communities:

1) **Communities that in general have access to a large number services.** In these communities access to 2G or 3G mobile connection, landline phones, and internet is widely available to the public. Kwakwani and Albouystown are examples of communities with this profile. On the other hand, there are some issues: Mobile Broadband Data and internet are considered expensive and unreliable. Moreover, the prices of devices like computers and laptops are considered as high. Furthermore, there are mentions of difficulties in operating ICT devices.

2) **Communities that have access to a limited number of services with moderate to good quality**. Here, the same difficulties are encountered as in group 1) such as instability of internet connection, difficulties in handling some appliances and high service costs. There are, however, areas with good signal quality. Though, this signal is available only in few areas in the respective communities.

3) **Communities with few or very few services available to only a limited number of people**. A situation of isolation regarding access to communication and information technology prevails. Kako is an example, as there are only few

[46] For further information about the poverty indexes used, see Inception report, p.32.

spots with cellular coverage. In Philipai there is neither cellular coverage nor landline connection, and therefore HF-radio is communication device most used.

Quantitative interviews also provide the numerical references to regional differences in access to ICT. Despite of not having a consistent sample to divide communities into regional segments, the conclusions take into account the estimates of access to education, infrastructure and communication (estimated percentage) from the total population or households informed by local leaders, which gives us an overview of the reality of the communities.

The observed growth[47] of purchasing personal mobile phones can be ascribed to lack of access and lack of repair of landlines for personal and professional usage. Some regions in remote areas are more affected by poor services of telephone and internet access as well because there are still problems with electricity.

Besides that, according to the obtained data, communities falling under all three categories (poor & remote & Hinterland), which include the communities of Kako and Philipai, are the poorest in access to essential services such as water, sewage or garbage collection. Furthermore, corroborated with the distribution developed in the qualitative stage, those are communities with very low access to ICT. 40% of the population surveyed have access to mobile telephony. In contrast, only 5% of all communities of the category Poor & Remote & Hinterland have Smartphones and other modern devices for communication as devices are quasi nonexistent.

The general interest and demand for better products and telecommunication services increase, as in some regions people have started to use smartphones for multiple functions, such as: chat, purchasing products, downloading videos, online courses and social media.

The quantitative data also show that there has been low investment in ICT in the communities surveyed. Nearly 60% of communities had no ICT development projects previously. Many, however, have sought government support or private companies to help to develop actions to improve telecommunication.

Access to internet is much desired: According to 27% of the respondents, internet inclusion would help to develop their region and to improve education.

Taking into account the findings from the survey, there are several barriers to be overcome in order to improve ICT access for Hinterland, Remote and Poor regions:

Dealing with some infrastructural barriers:

- poor electricity access
- poor internet access/ data service
- poor access to devices in the communities (phone/computer stores)

Dealing with consumers' barriers:

- Lack of knowledge of usage of the devices
- Unawareness of all functions of the devices
- Low emotional connection to the devices
- Prices not affordable/inappropriate to economical profiles of respondents
- Lack of feeling of unitedness, even though respondents feel Guyanese – requires different communication approach

4.2.3 Interviews with Leaders of the Communities

4.2.3.1 Toshao/Community Leader

The majority of the interviewees occupied a role of leadership in the communities. They had the necessary knowledge regarding their communities and were able to answer the quantitative questions with detailed information.

30% of respondents were Toshaos – Indigenous People leaders; followed by Chair leaders[48] and other communities' leaders with 13% each; the other positions – not specified by the respondents – reached the sum of 17%.

[47] Based on statements in the qualitative interviews – impressions and opinions of the respondents.

[48] Role defined by interviewed person

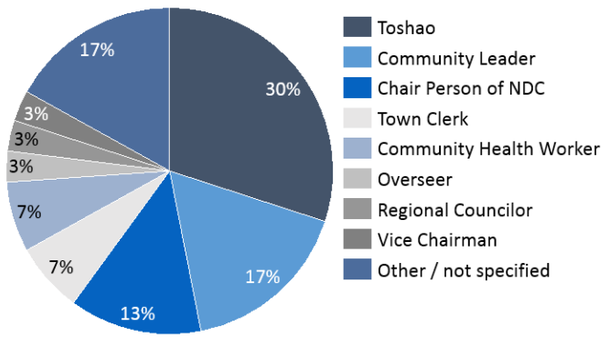

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Figure 25 - Interviewees occupation (roles as being stated by the interviewees) (in %)

4.2.3.2 Community Segments

Following the criteria mentioned above (see 4.2.1.2.5), which were decisive for the community's choice, we were able to distinguish amongst the communities, considered that 93% are poor, 47% are remote and 37% are hinterland. A single community may be in more than one category, for example, Kwakwani is poor and remote. Table 12 describes the category of each community visited.

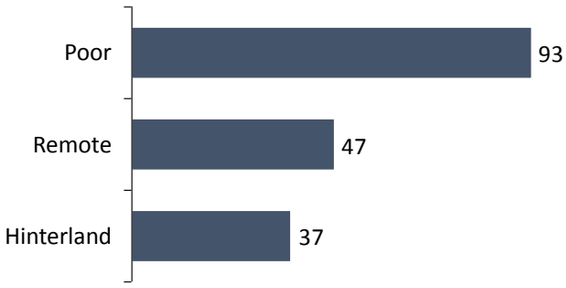

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Figure 26 - Overview of characteristics of the different segments of communities visited (in %)

Poor	Albouystown, West Canjie, Wismar, Plegt Anker, Number 3, Charity, Wales, Perth, Laluni, Ithaca, Buxton
Remote and Poor	Kwakwani, Coomacka, Mainstay/Whayaka, St. Cuthberts, Sta. Monica, Saxacalli, Orealla, Hogg Island
Remote, Poor and Hinterland	Kako, Philipai, Aishalton, Nappi, Tumatumari, Karasabai
Hinterland	Bartica and Lethem
Hinterland and Poor	Mahdia, Mabaruma and Port Kaituma

Table 12 - Communities per community segment (%)

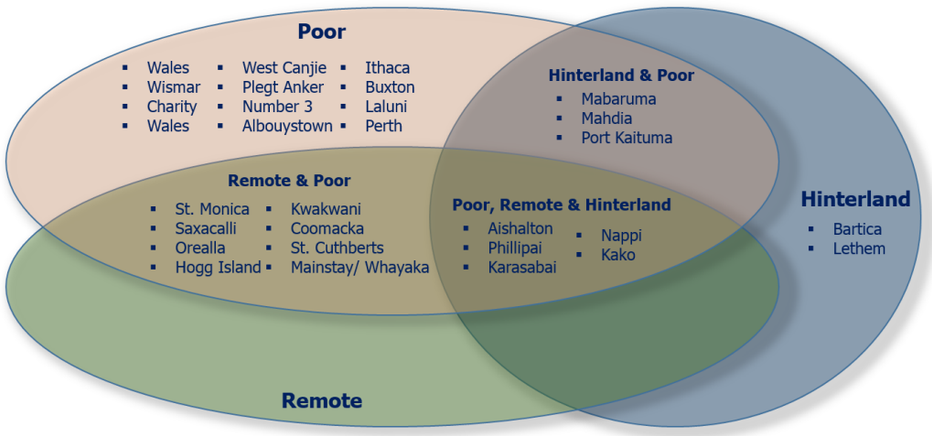

Figure 27 - Characteristics of communities visited and segment definitions

The communities surveyed covered all three characteristics: Hinterland, Poor and Remote. Whilst "remote" implies difficulties to access this very location, "Hinterland" is per definition any community located in region 1, 7, 8 or 9. Hence some communities fall under both categories and are "remote" and "Hinterland" at the same time.

Amongst the communities visited, almost eight in ten communities were located in rural areas (77%).

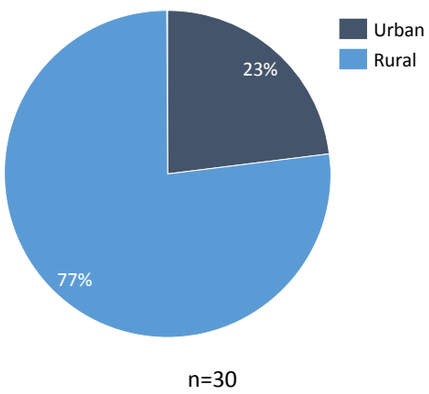

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Figure 28 - Characteristics of visited communities (in %)

4.2.3.3 Demography

The population in the communities considered for this study vary from 100 to, approximately, 30.000 inhabitants. The average of person per household is 5. The majority of the population are estimated to be permanent residents in their communities (84%). Hinterland and poor communities have 24% of temporary residents, this is mainly due to the displacement between the mines (where they spend from three to six months working) and their communities or due to the activity of logging that forces them to leave their community for a period as well. For the construction of houses wood is used preponderantly, especially in community segments defined as poor (91% of houses utilize wood). Overall brick is used for 50% of the houses and concrete for 33% (Figure 36).

	Population	Domiciles	Average (people by domiciles)
Lethem	8000	4000	2.0
Santa Monica	510	106	4.8
St. Cuthberts	1700	400	4.3
Mainstay	650	120	5.4
Wismar	29298	4883	6.0
Coomaca	900	150	6.0
Bartica	12000	10000	1.2
Aishalton	1058	220	4.8
Charity	3000	2600	1.2
Port Kaituma	7000	400	5.2
Hogg Island	300	50	6.0
Saxacally	104	32	3.3
Karasabai	1300	250	5.2
Wales	6000	2000	3.0
Kako	760	200	3.8
Nappi	690	125	5.5
Perth	1200	60	4.2
Buxton	8000	3000	2.7
No.3/Rosignol	578	100	5.8
Kwakwani	2503	695	3.6
Ithaca	1200	300	4.0
Laluni	735	140	5.3
Albouystown	15000	2000	7.5
West Canje	6000	1000	6.0
Phillipai	1700	700	2.4
Mabaruma	5638	2000	2.8
Tumatumari	135	29	4.7
Plegt Ankor	160	30	5.3
Orealla	500	150	3.3
Mahdia	4200	600	7.0

Table 13 - Average number of persons per domicile (household) [49]

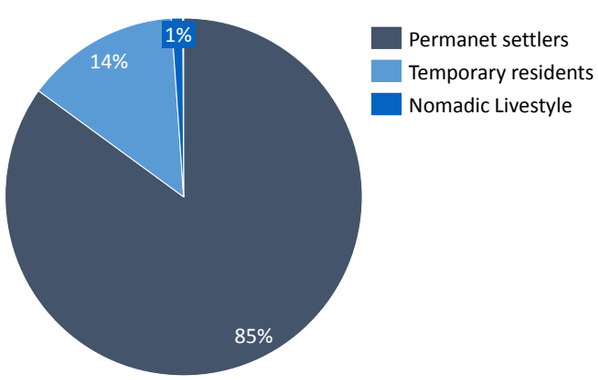


Figure 29 - Types of residents in the communities (in %)

[49] The average was calculated dividing the number of people in the community, mentioned by the leader, per the number of domiciles estimated by the same respondent. By discrepant values (occurred in Philippai and Port Kaituma) the data from the Census (2002) related to the number of inhabitants and households were considered instead. In the case of Kwakwani, value is discrepant, but there is no information about the number of domiciles which prevented the replacement.

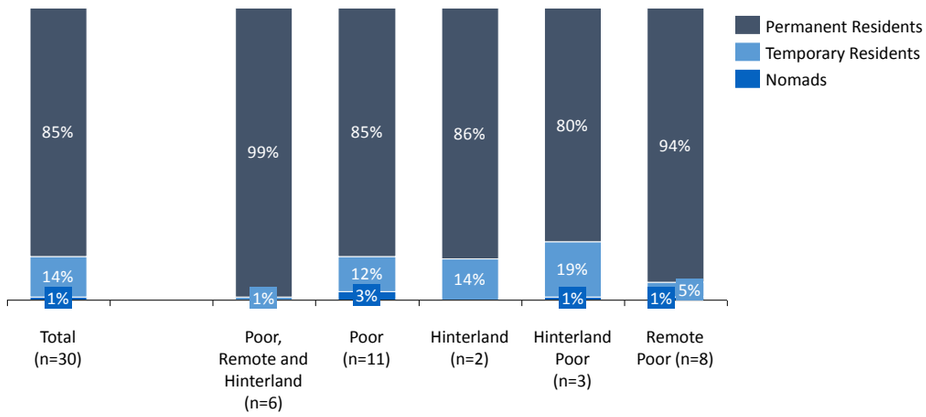


Figure 30 - Types of residents per community segments (in %)

The population of the community is relatively young, with a concerntration to the age group of between 5 to 15 years old.

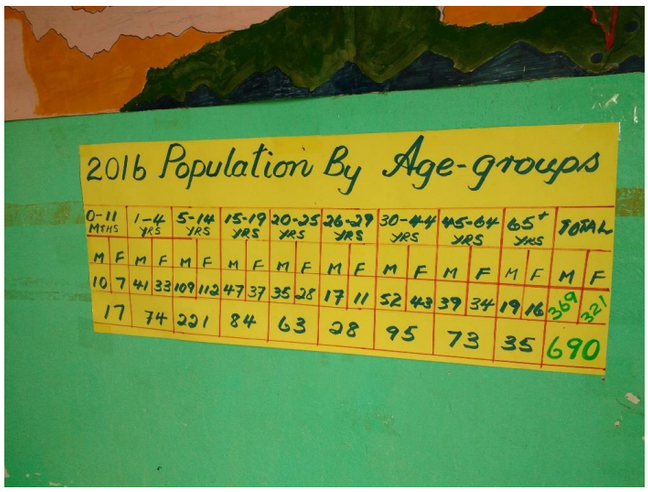


Figure 31 - How one community from Region 9 counts the population by age

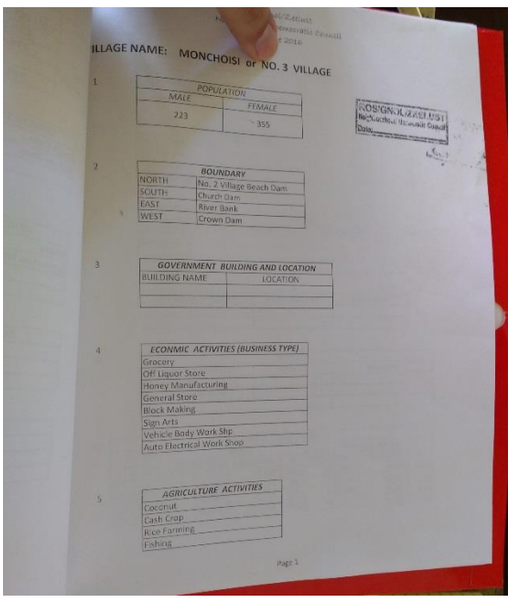


Figure 32 - How one community from Region 5 counts the population by gender

Figure 33 - How one community in Region 9 counts their population

(%)	Total (n=30)	Poor, Remote and Hinterland (n=6)	Poor (n=11)	Hinterland (n=2)	Hinterland and Poor (n=3)	Remote and Poor (n=8)
Children < 5 years	15	13	16	13	21	16
Children 5-15 years	35	23	37	25	21	27
Children-young adults 16-24 years	22	27	22	25	14	18
Adults 25-64 years	19	28	17	25	29	27
Adults 65+ years	9	9	8	12	15	12

Figure 34 - Overview of numbers of children and adults per location visited (in %)

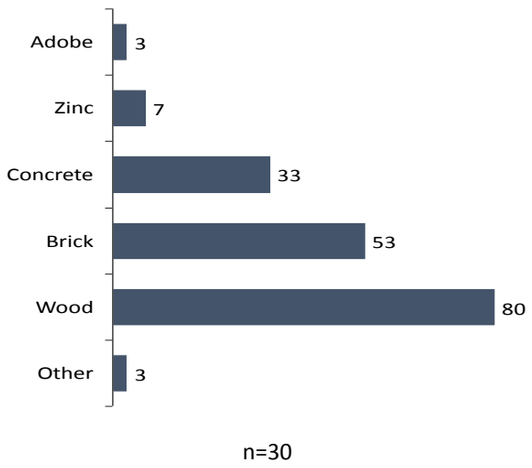


Figure 35 - Main materials being used to construct houses(%)

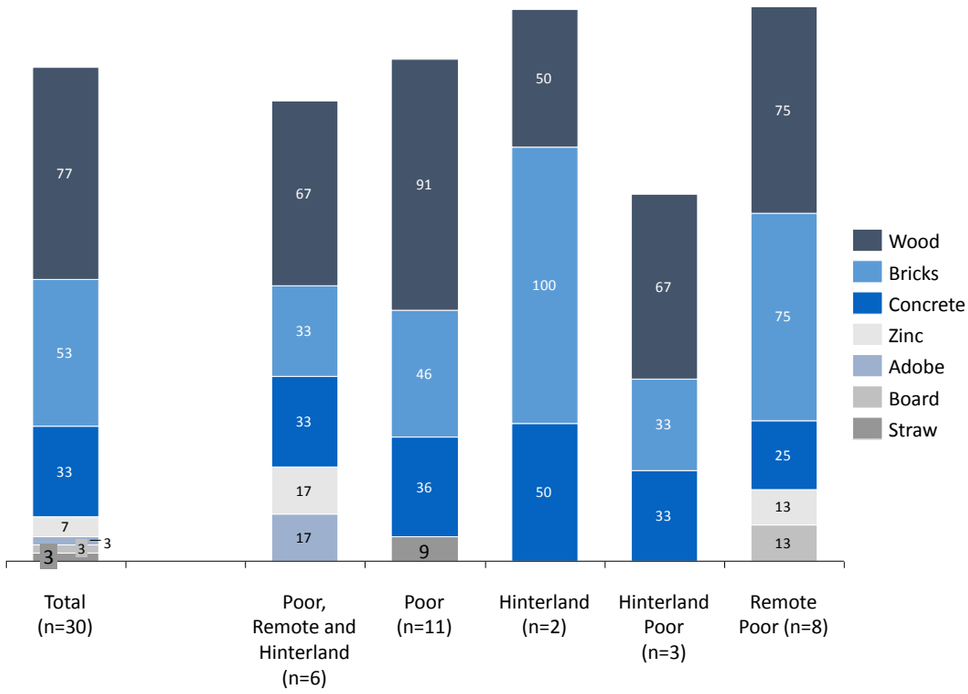


Figure 36 - Housing materials being used per community segments (in %)[50]

[50] For samples of size n> 30, called large samples, the best approximation to the sample distributions are normal curve. This approach improves the growth of n. When the sample size is n =<30 they are considered small samples and the statistical treatment is different. This report will consider the normal distribution.

Figure 37 - Houses made out of wood (Region 3)

Figure 38 - Houses made out of wood (Region 3)

Figure 39 - House based on concrete (Region 4)

Figure 40 - House based on concrete (Region 5)

Figure 41 - Houses made out of straw (Region 7)

Figure 42 - Houses made out of wood (Region 6)

Figure 43 - House construction with bricks (Region 1)

Figure 44 - Burned ground to clean the field

Figure 45 - Houses in Region 6

Figure 46 - Street in Region 8

Figure 47 - Street in Region 1

Figure 48 - Street in Region 10

4.2.3.4 Language/Ethnicity

57% of the sample speaks English as their main language. The second most used is Guyanese Creole English[51]. For those that do not have English as the main language, English is their second language (33%) and Creole being used as a second language for those whose main language is English (23%). English is the most spoken language in the hinterland and in hinterland and poor community segments (Figure 49).

[51] This documents the statement of the interviewed person and does not reflect a linguistic assessment of the spoken languages.

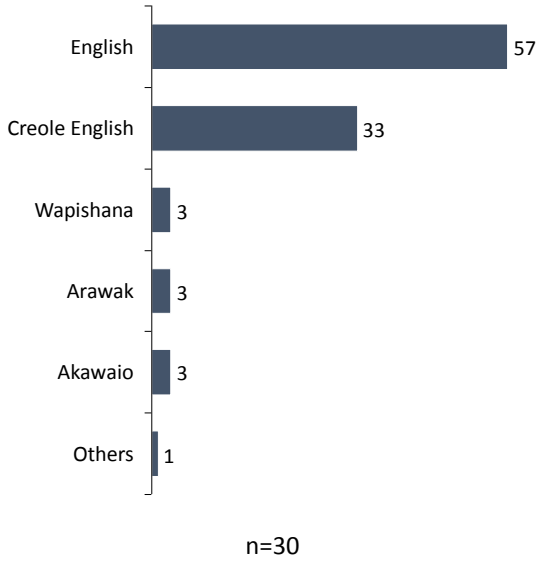


Figure 49 - Main language spoken in the communities (in %)

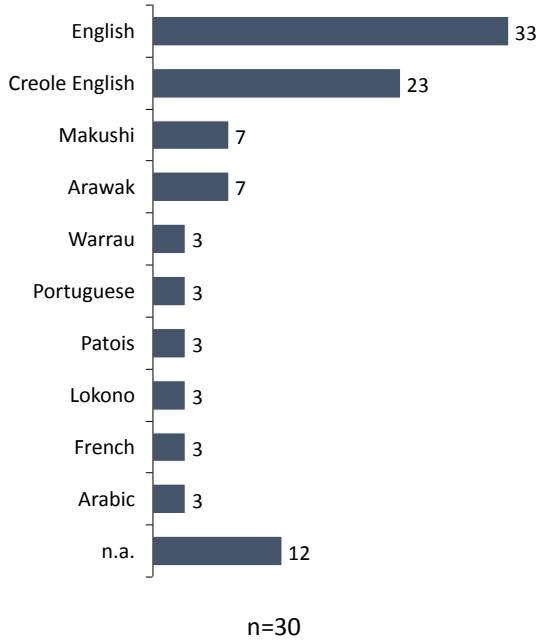


Figure 50 - Secondary language spoken in the communities – as stated by the interviewed person[52] (in %)

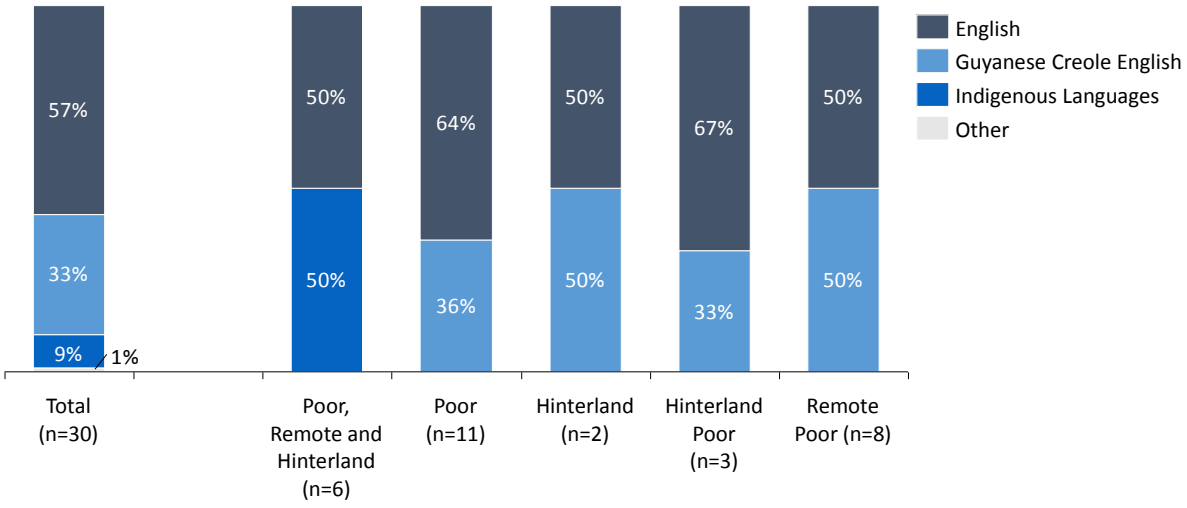


Figure 51 - Primary language spoken per community segment (in %)

The majority of the population in the sample is formed by Indigenous People (47%), followed by Afro-Guyanese (23%) and Mixed (17%). The Indo-Guyanese/East Indians group is less represented in the sample because the research focused on the hinterland, remote and poor areas, and etnicity was seen as secondary parameter.

52 Creole: A creole is a language that, through unusual intensity of contact, has been significantly restructured in a short period of time.
Patois: Patois is not a term of art in linguistics. It doesn't have any sort of consistent meaning, though it's frequently a localized language that is rarely if ever written by its speakers.

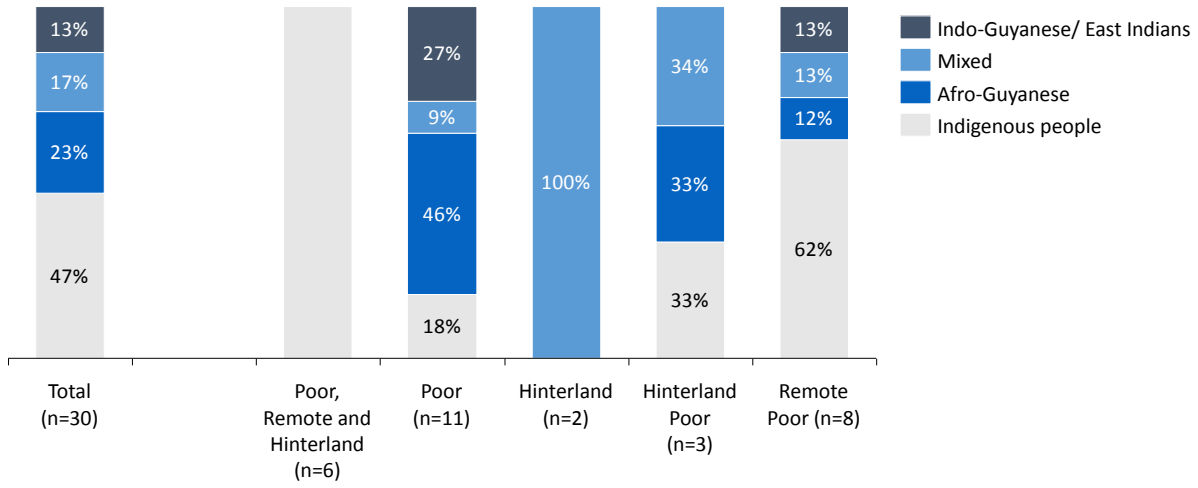


Figure 52 - Ethnicity per specific communities (%)

4.2.3.5 Public Infrastructure

4.2.3.5.1 Water Supply

71% of all households (domiciles) in the sample have piped water, especially in the hinterland's urban areas. The communities with less access to piped water are mostly located in the poor, remote and hinterland region with access to rivers/creeks (Figure 54).

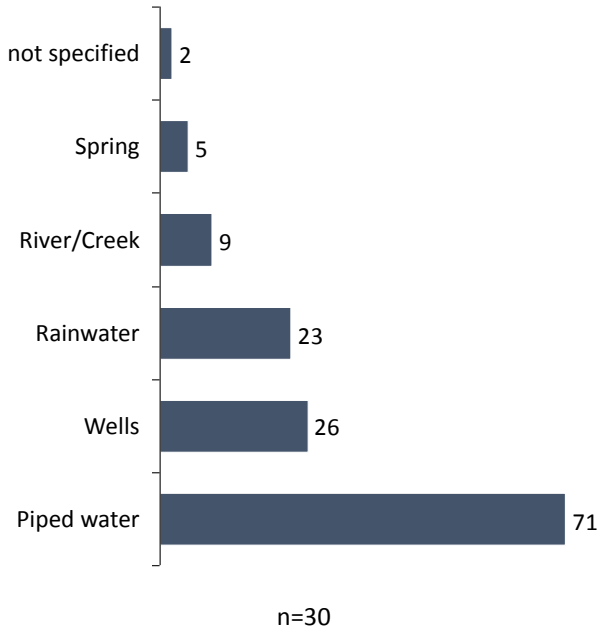


Figure 53 - Sources of water supply available (in %)

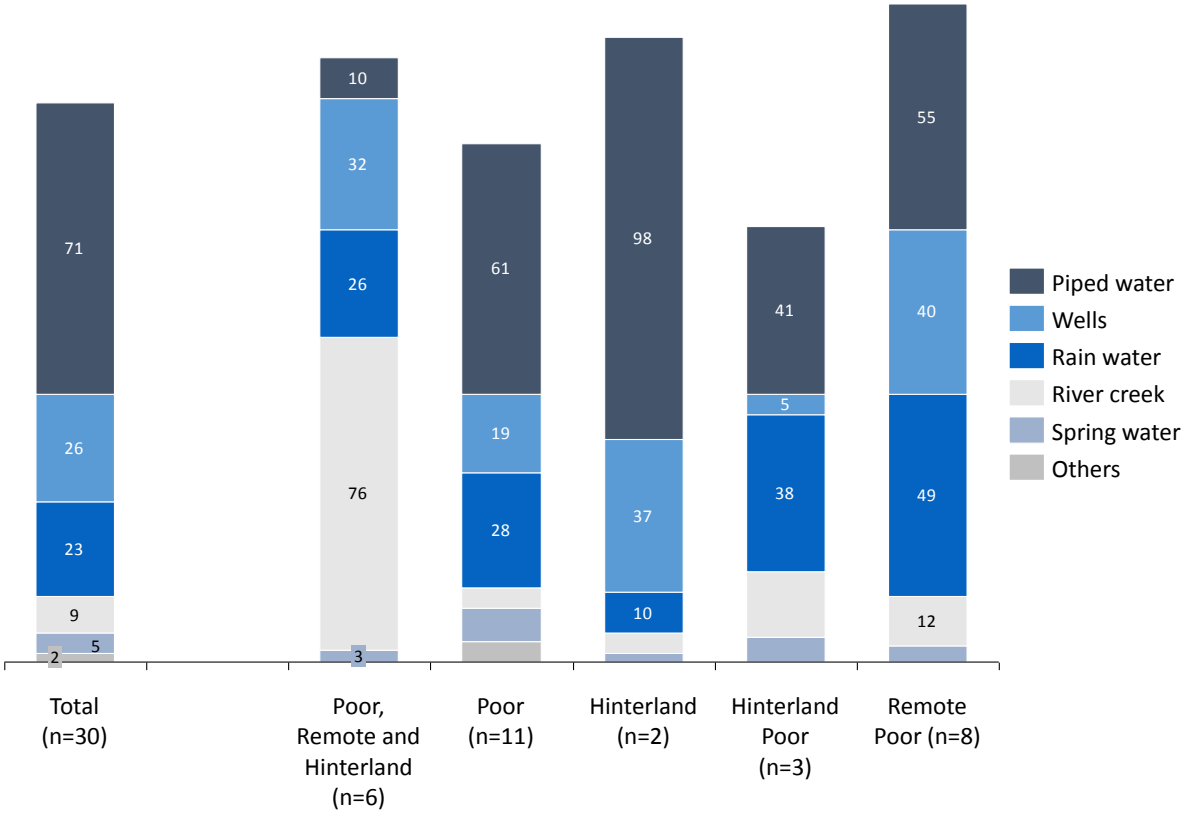


Figure 54 - Sources of water supply per community segments (in %)

Figure 55 - Water pump in Region 3

Figure 56 - Water pump in Region 4

Figure 57 - Rain water reservoir in Region 10

Figure 58 - Rain water reservoir in Region 4

Figure 59 - Well in Region 9

Figure 60 - Drilling for water (Region 4)

4.2.3.5.2 Sanitary Conditions

62% of the domiciles in the communities studies have access to septic tanks. Among the different community segments, the ones that belong to hinterland show the best toilet infrastructure. Only 7% of the sample has a disposal system linked to sewer. In the poor, remote and hinterland community segments the use of Pit latrine with slabs (Figure 62) is mostly used. 16% of population of Guyana don't have access to basic sanitation in Guyana according to UNICEF report[53].

53 84% of Guyana population use of improved sanitation facilities http://www.unicef.org/infobycountry/guyana_statistics.html#0

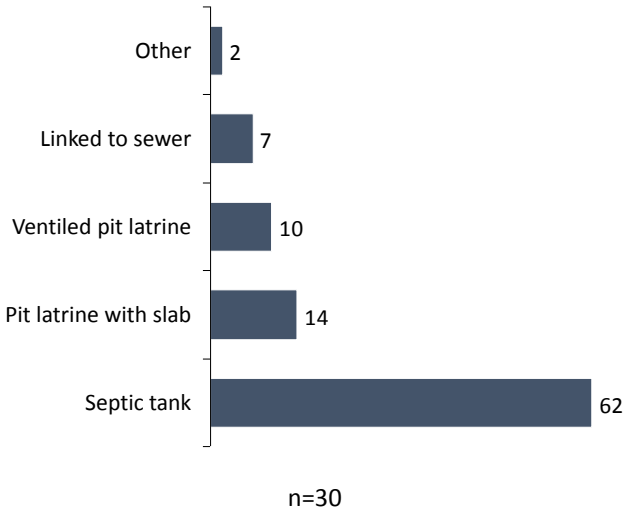


Figure 61 - Types of toilet used in the communities (in %)

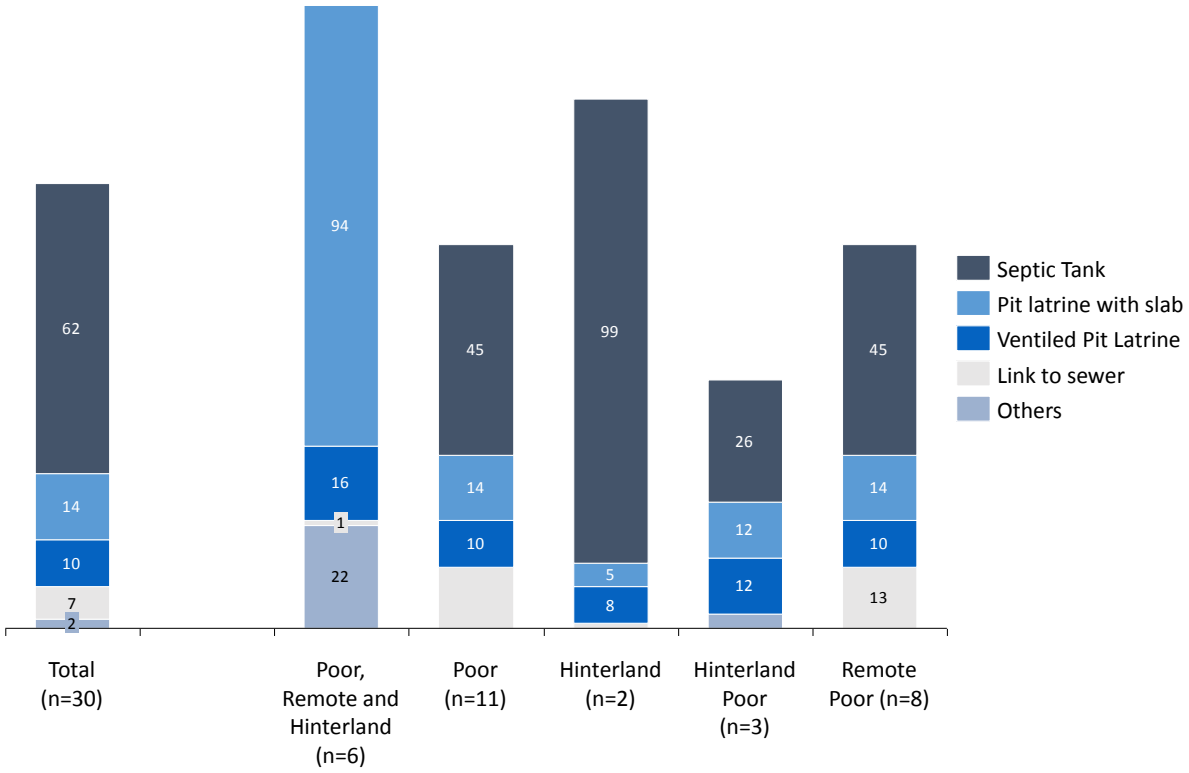


Figure 62 - Types of toilets per community segments (in %)

Figure 63 - Pit latrine with slab (Region 4)

Figure 64 - Toilet linked to sewer (Region 3)

4.2.3.5.3 Disposal of Garbage

60% of the sample use Garbage truck and Dumping on land as method for garbage disposal. The Hinterland mainly relies on the use of Garbage trucks, since these communities have a better-developed infrastructure. The Poor and Remote areas concentrates the use of Burying, and in the Poor, Remote and Hinterland areas almost everybody uses the method of burning the waste (Figure 66).

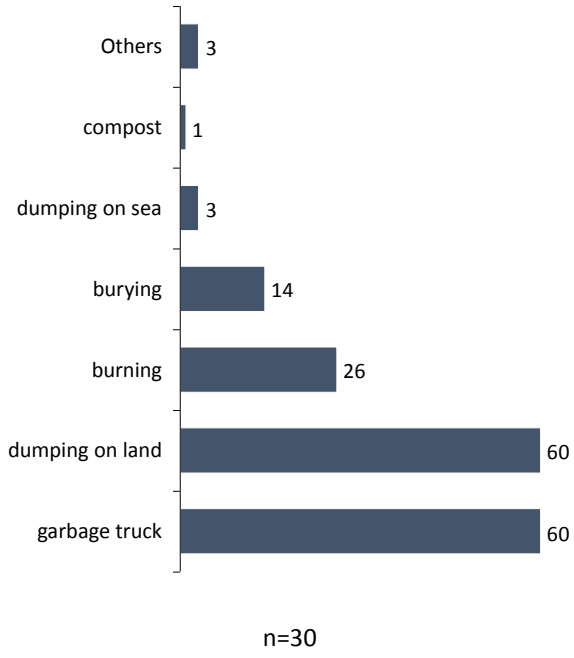


Figure 65 - Disposal of garbage in the communities (%)

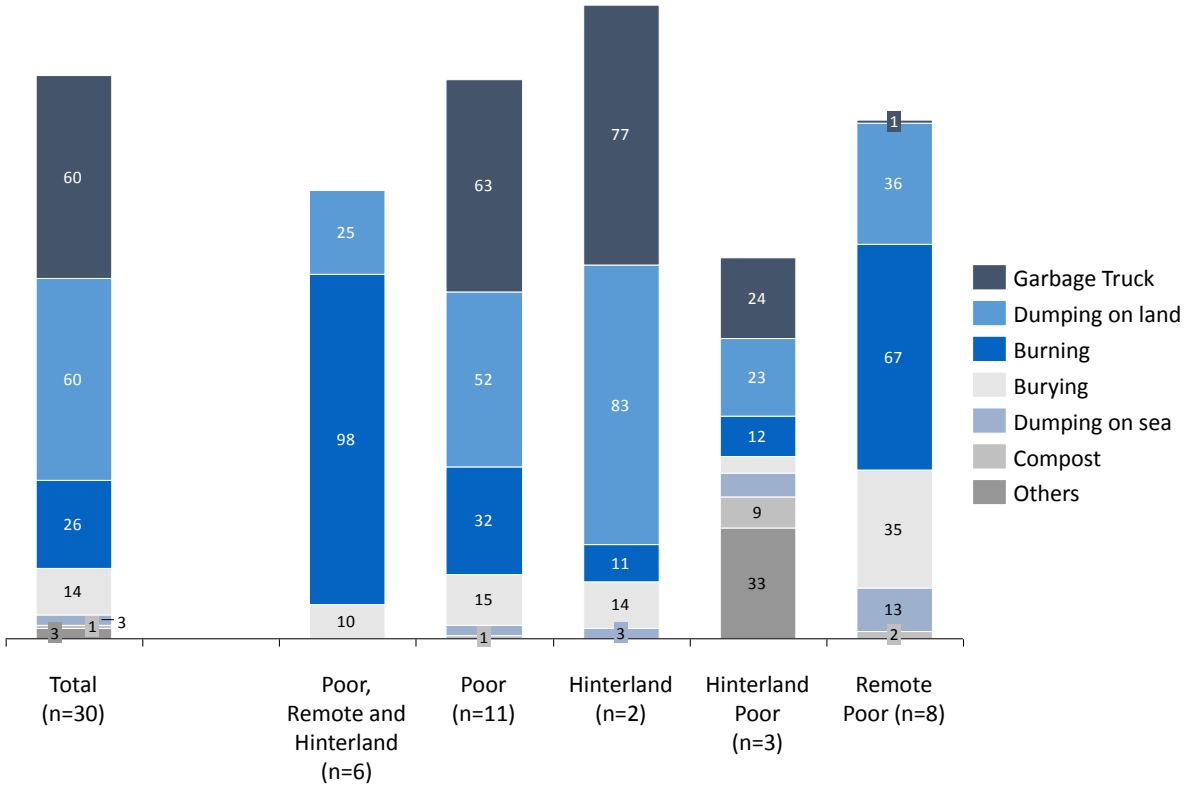


Figure 66 - Ways of garbage disposal per community segments (%)

Figure 67 - Burning the garbage (Region 3)

4.2.3.5.4 Public Institutions/Facilities Available

From the communities surveyed, the communities that are Poor, Remote and Hinterland, the communities that are poor as well as communities that are remote and poor display a lack of medical facilities (Hospitals and Medical post) and secondary schools. There are more public institutions and facilities in the urban area of the Hinterland. Despite the fact that the Poor, Remote and Hinterland do not have a good infrastructure, considering public institutions and facilities, the villages have several communal buildings as shown below. The poor communities in general have a higher number of religious facilities compared to the other community segments (see Figure 108).

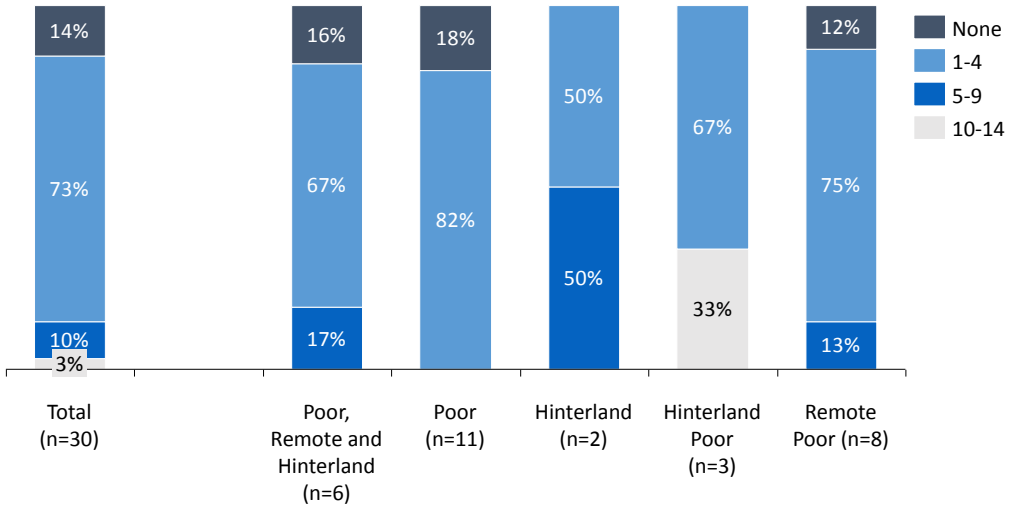


Figure 68 - Nurseries per community (%)

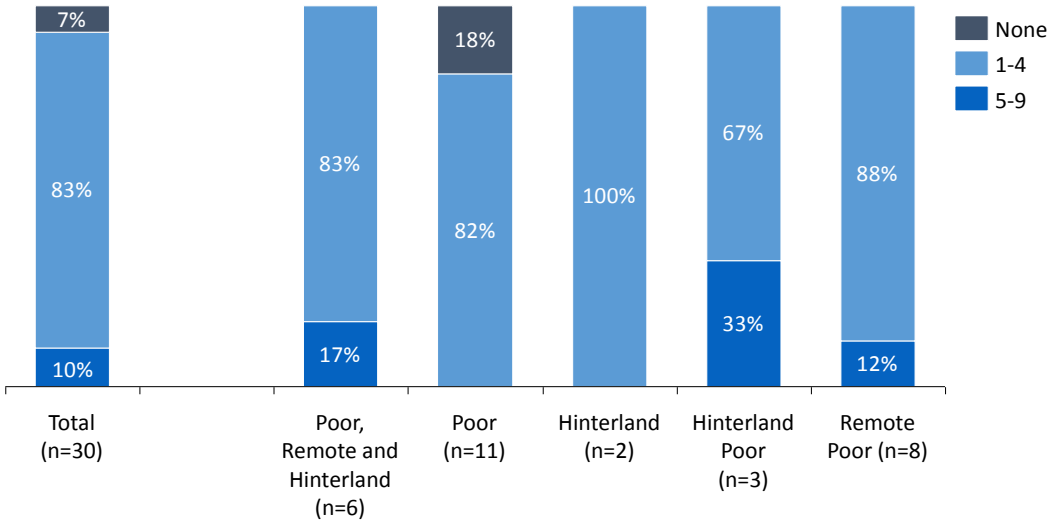


Figure 69 - Primary Schools per community (%)

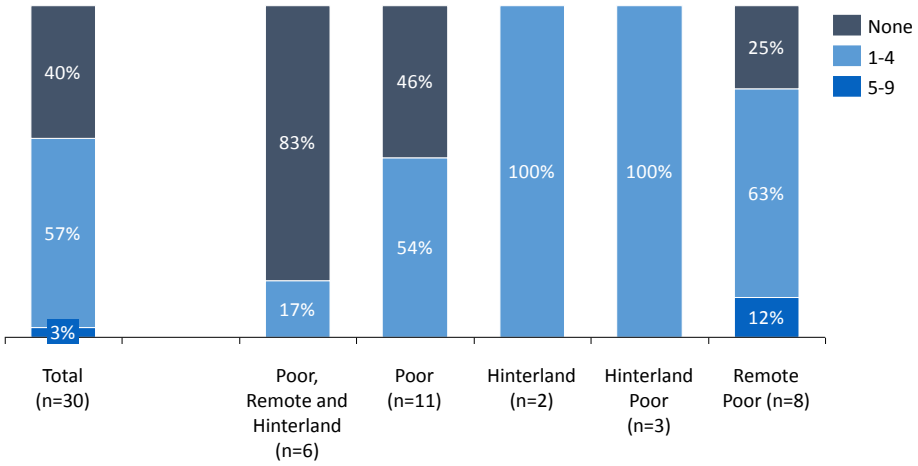


Figure 70 - Secondary Schools per community (in %)

Figure 71 - Nursery School (Region 2)

Figure 72 - Primary School (Region 2)

Figure 73 - Primary School (Region 10)

Figure 74 - Primary School (Region 4)

Figure 75 - Primary School (Region 9)

Figure 76 - Primary School (Region 3)

Figure 77 - Secondary School (Region 4)

Figure 78 - Secondary School (Region 4

Figure 79 - Secondary School (Region 1)

Figure 80 - Secondary School (Region 9)

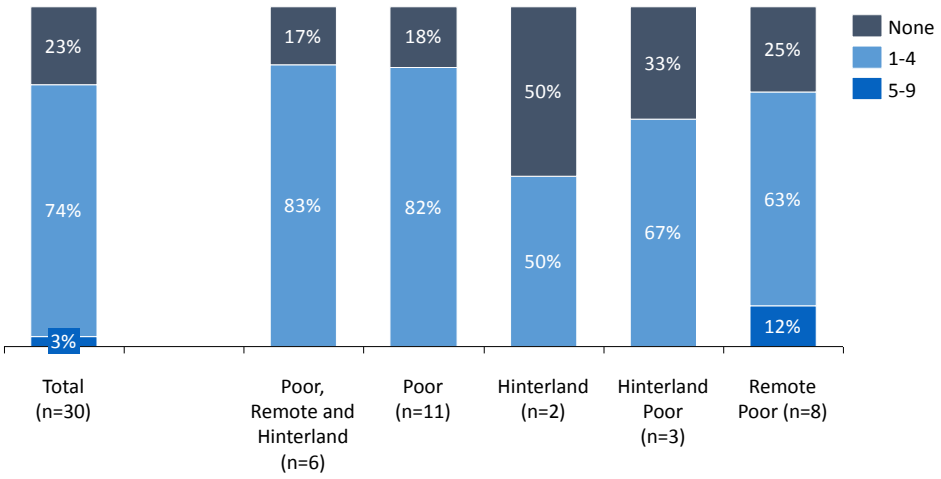


Figure 81 - Medical Hut / Health Center (in %)[54]

[54] **Medical Post / Health Post:** Unit designed to provide assistance to a particular population, with appointment or without, by mid-level professional with intermittent presence or absence of medical professional.
Medical Hut / Health Center: Unit to perform basic care and full time services to the population, with appointment or without, on the basic services and can provide dental and other top-level professional assistance. Assistance should be permanent and provided by general practitioner or specialist in these areas. May or may not offer: Support Service for Diagnosis and Therapy and 24 hours Emergency Service.
Hospital: Unit designed for the provision of care in the basic specialties, by experts and/or other medical professionals. May have Urgency/Emergency service. Must also have medium complexity Support Service for Diagnosis and Therapy. Being able to handle high complex procedures and systems.
Source: Brazilian Ministry of Health, Tipo de estabelecimento/ Type of establishment (DATASUS http://tabnet.datasus.gov.br/cgi/cnes/tipo_estabelecimento.htm)

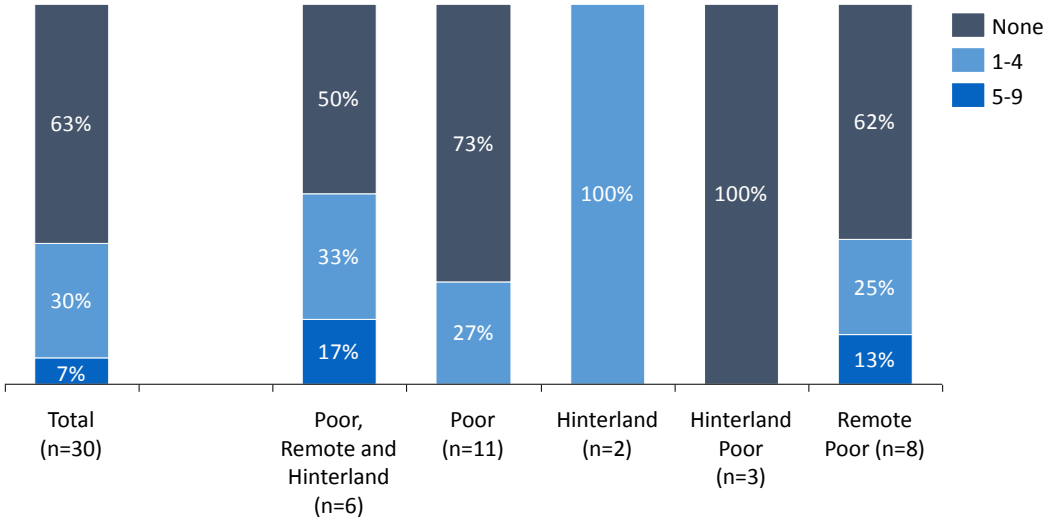


Figure 82 - Medical Posts per community (in %)

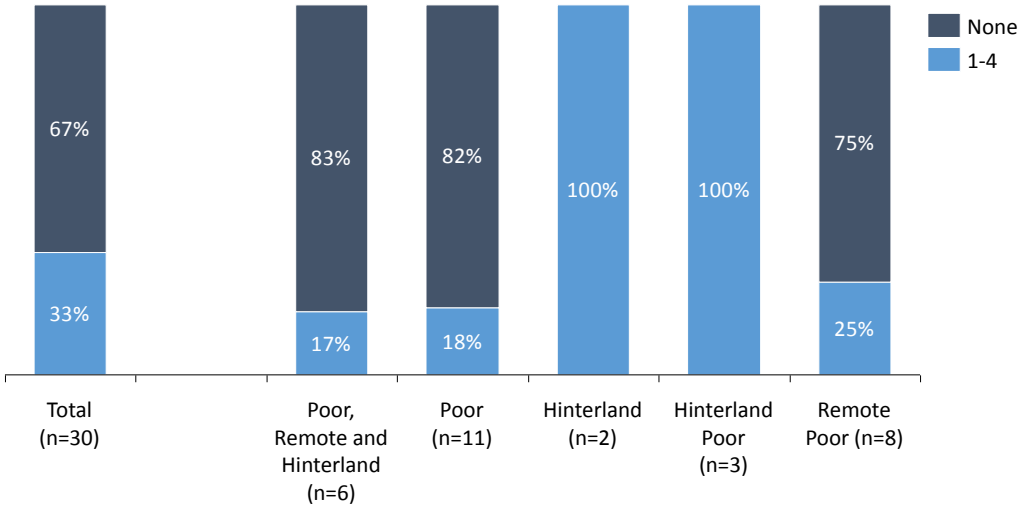


Figure 83 - Hospitals per community (in %)

Figure 84 - Health Center (Region 9)

Figure 85 - Health Center (Region 9)

Figure 86 - Health Center (Region 4)

Figure 87 - Hospital Bed at Health Center (Region 3)

Figure 88 - Health Center (Region 5)

Figure 89 - Health Center (Region 7)

Figure 90 - Health Post (Region 7)

Figure 91 - Patient related health care information (Region 10)

Figure 92 - Hospital (Region 10)

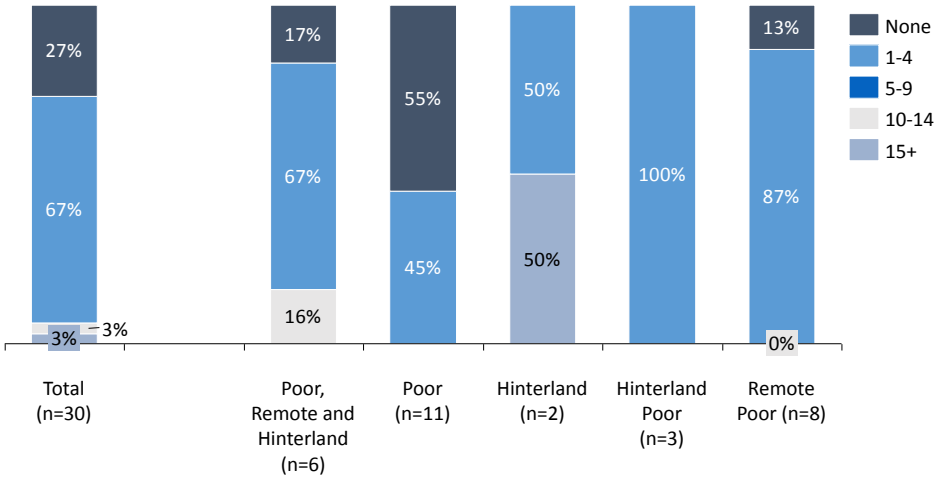


Figure 93 - Communal buildings per community (in %)

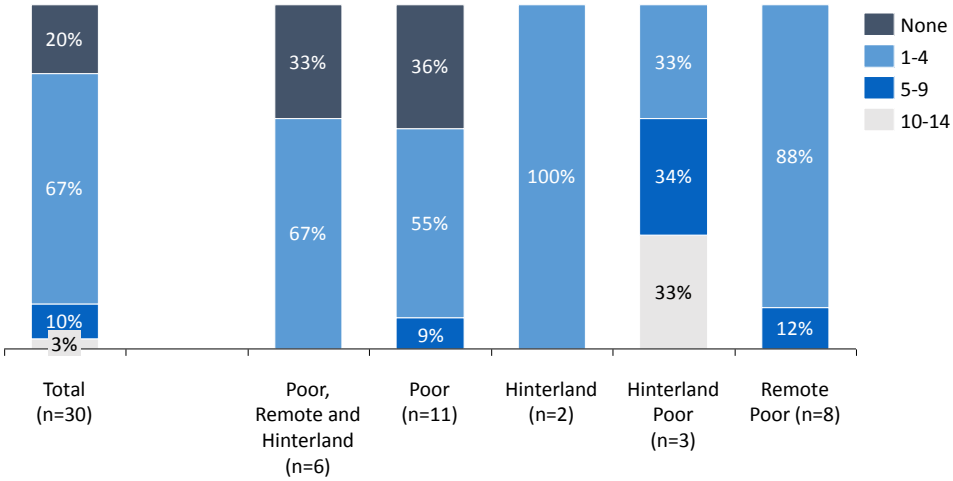


Figure 94 - Places of social gathering per community (in %)

Figure 95 - Communal building (Region 4)

Figure 96 - Multipurpose Center (Region 2))

Figure 97 - Social Meeting Place (Region 6)

Figure 98 - Example of a Meeting Hut in Napp (Region 9)

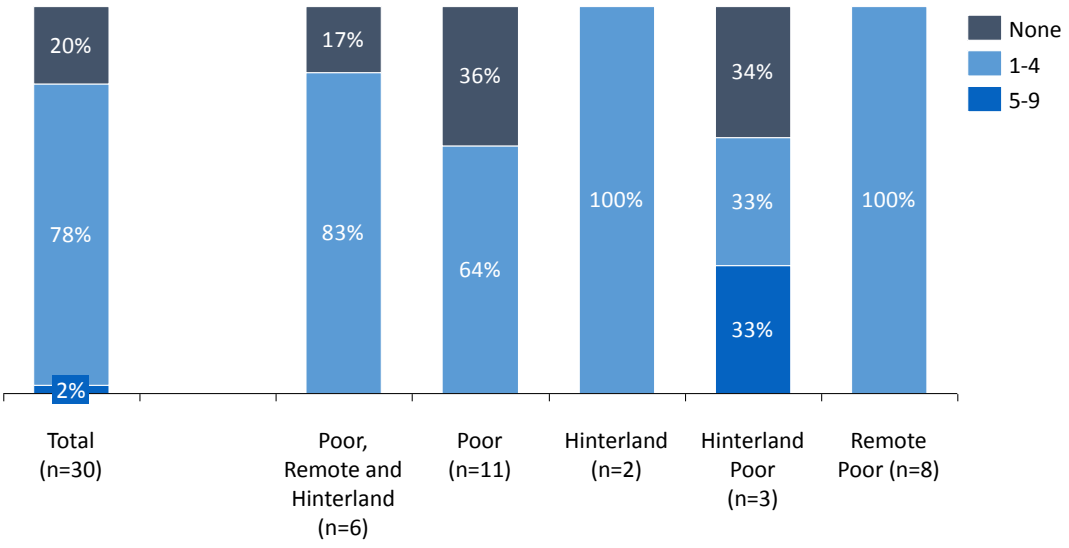


Figure 99 - Number of locations for sport activities per community (in %)

Figure 100 - Football (Soccer) field (Region 10)

Figure 101 - Football (Soccer) field (Region 10)

Figure 102 - Football (Soccer) field (Region 7)

Figure 103 - Basketball field (Region 5)

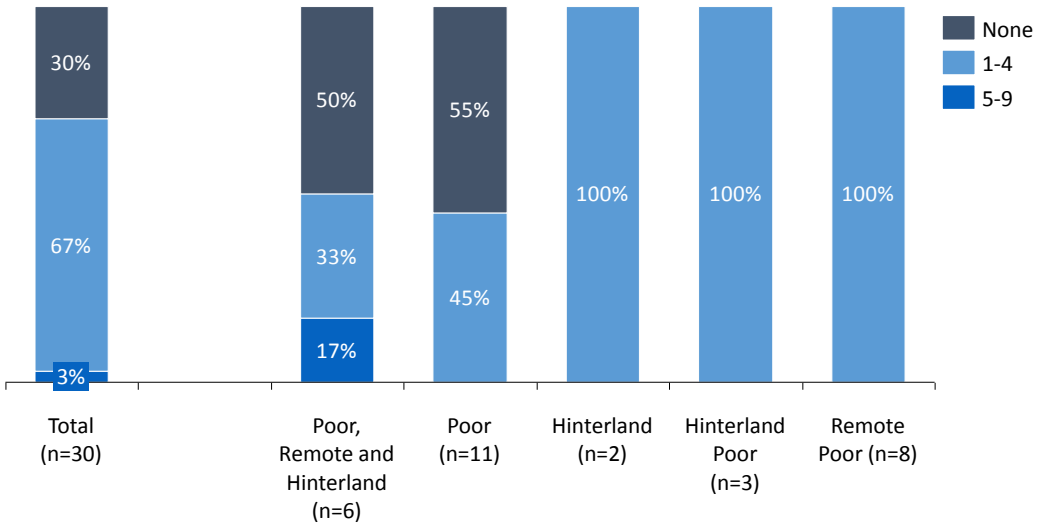


Figure 104 - Libraries per community segments (in %)

Figure 105 - Library inside Digicel office (Region 10)

Figure 106 - Library (Region 1)

Figure 107 - Library inside a school (Region 1)

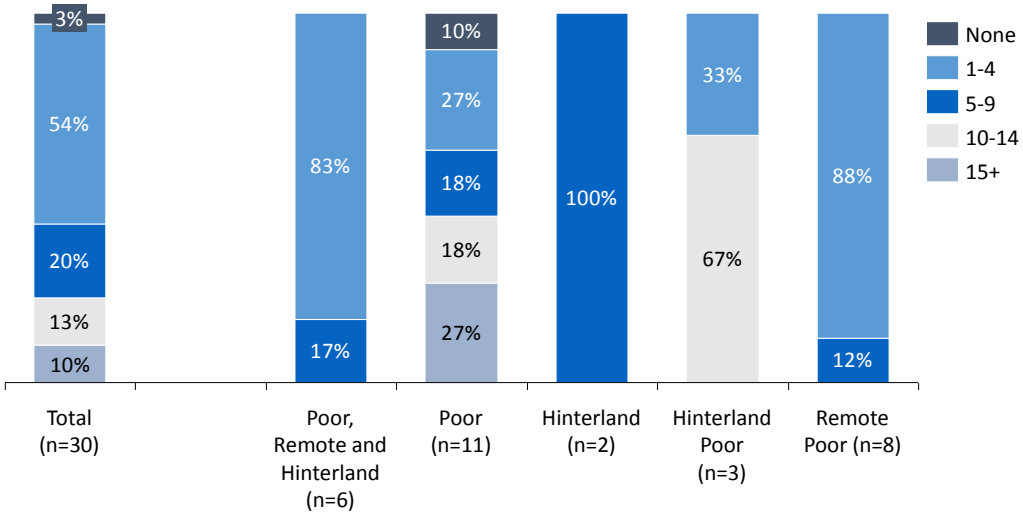


Figure 108 - Religious facilities per community segments (in %)

Figure 109 - Church (Region 4)

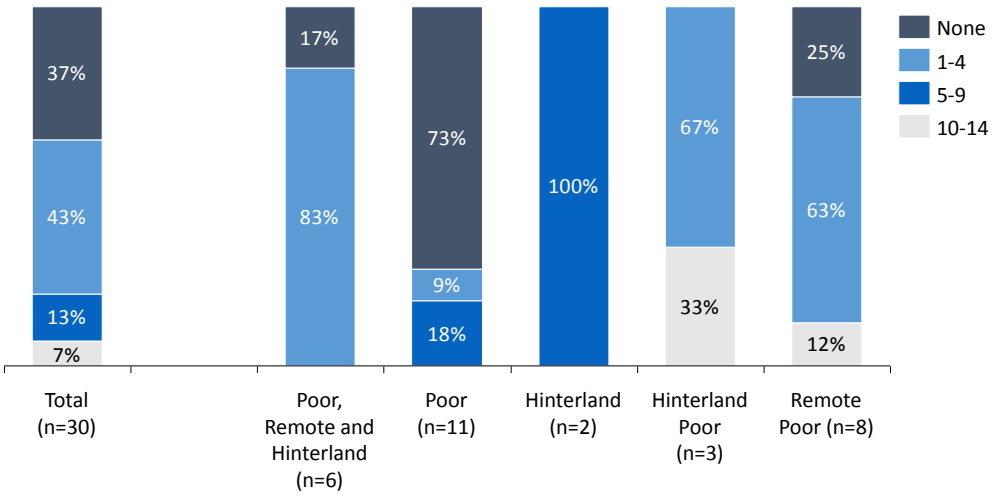


Figure 110 - Number of hotels per community segments (in %)

Figure 111 - Lake/Beach (Region 5)

Figure 112 - Guest House (Region 10)

Figure 113 - Resort (Region 2)

4.2.3.5.5 Communities' Problems

According to estimates of the interviewed community leaders, 3 out of 10 inhabitants of the surveyed communities are owing debts and have no steady income, especially the inhabitants of communities in the clusters "Poor, Remote and Hinterland" and "Poor and Remote". According to them, these problems are common where mining prevails as the main economic activity. In those communities, the largest portion of those who do not have a steady income are the mining workers. In other communities, this problem occurs mainly with young people.

The contagious diseases affect more the population of the “Hinterland and Poor”, as per information from the representatives as well as from the information gathered at the Ministry of Health (2012-2015). The same data from the Ministry of Health indicates that Poor communities have a high number of diseases caused by bacteria due to hygiene issues. 25% of the representatives confirmed this information. The Hinterland area, presumably because of the better-developed infrastructure, suffers less from hygiene issues but rather from problems related to violence and drug abuse.

Cases of reported violence usually occur in the family scope at events such as sexual molestation of children and domestic violence.

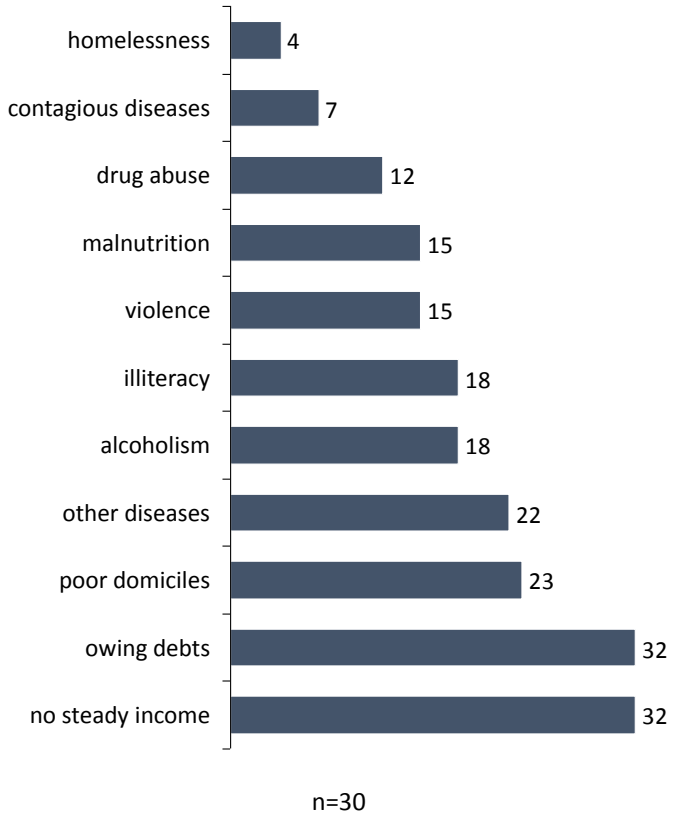


Figure 114 - Major communities’ problems stated (in %)

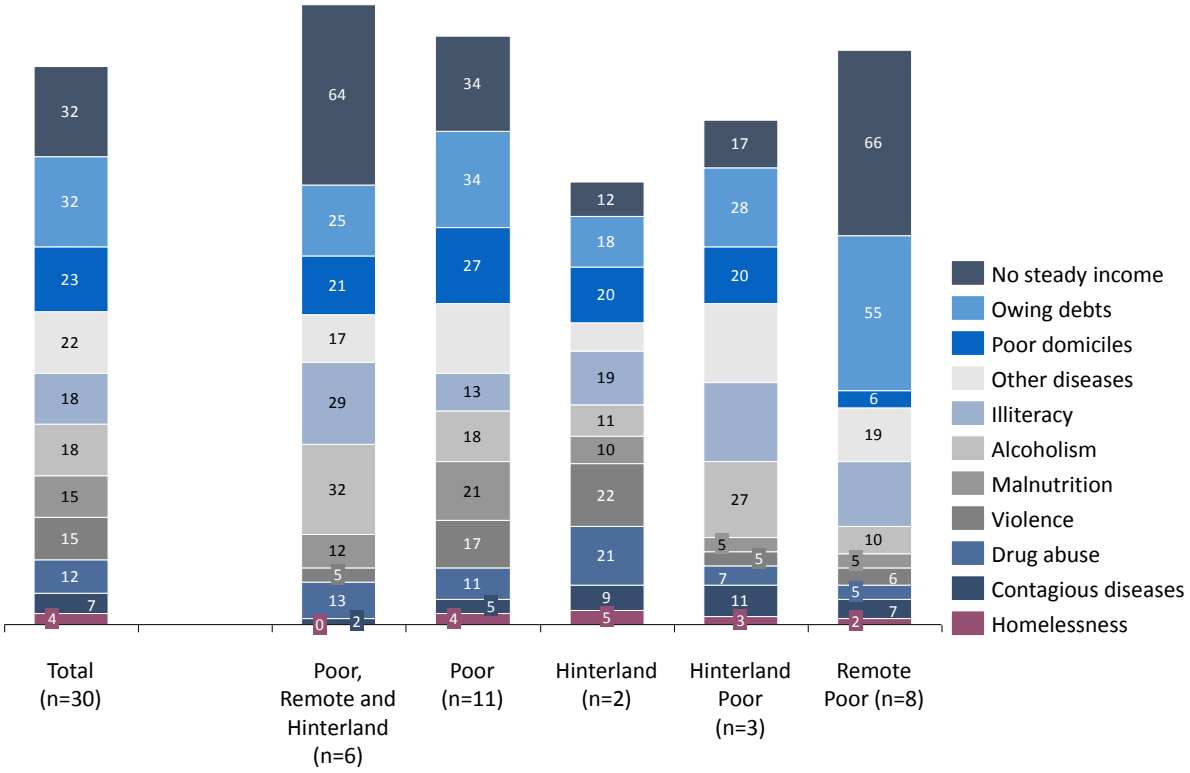


Figure 115 - Stated communities' problems per community segments (in %)

4.2.3.5.6 Electricity

More than two thirds of the communities surveyed have access to the electric supply via landline (power grid). Mainly in the "Remote and Poor" area the power grid supplies 90% of the communities in this segment. The "Poor, Remote and Hinterland" is the community segment less attended by the power grid service: 69% of the energy comes from solar panels. A quarter of the communities classified as "Poor, Remote and Hinterland" do not have access to any kind of electricity, according to the perception of their communities' leaders.

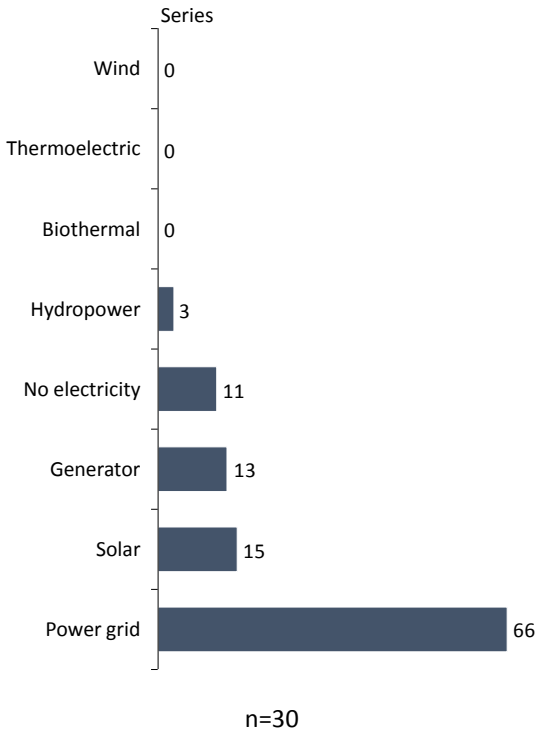


Figure 116 - Sources of electric power supply per community (in %)

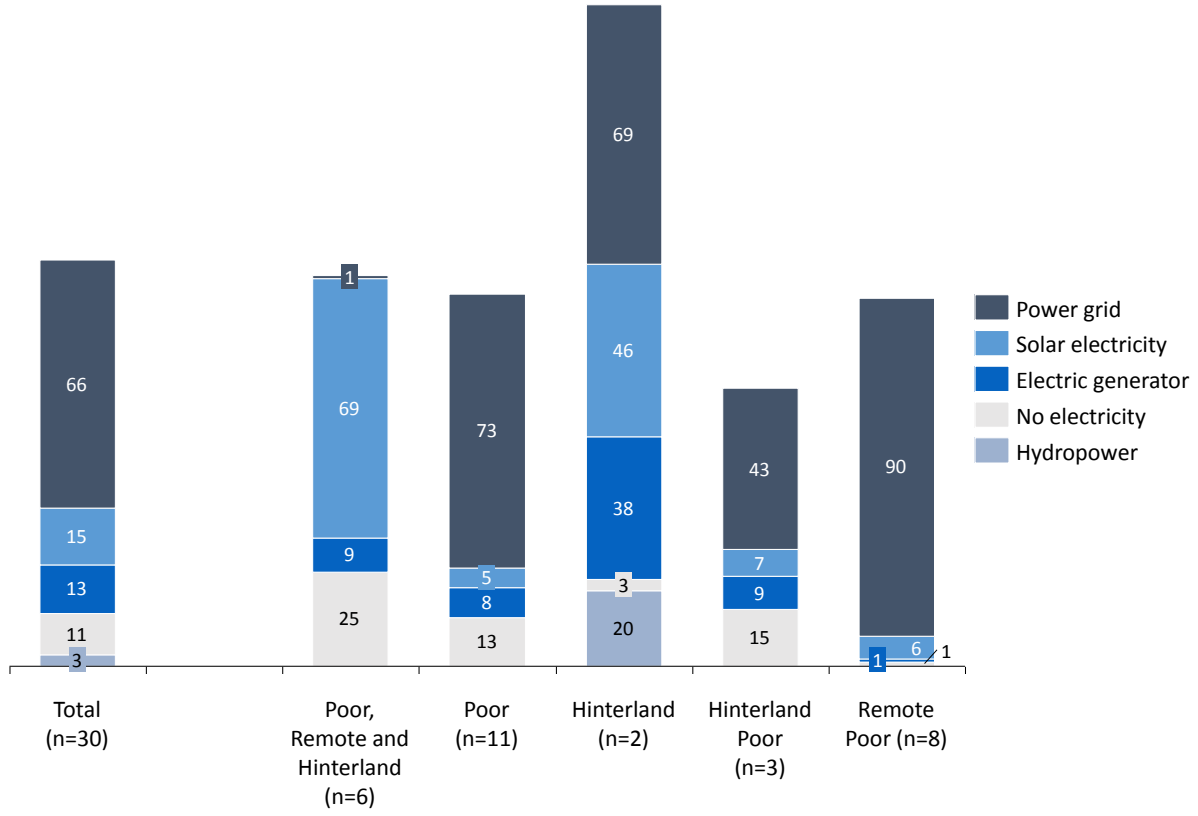


Figure 117 - Sources of electric power supply per community segment (in %)

63% of the communities have eletricity for more than 15 hours a day. A quarter of the communities classified as "Remote and Poor" have less than 5 hours of eletricity per day.

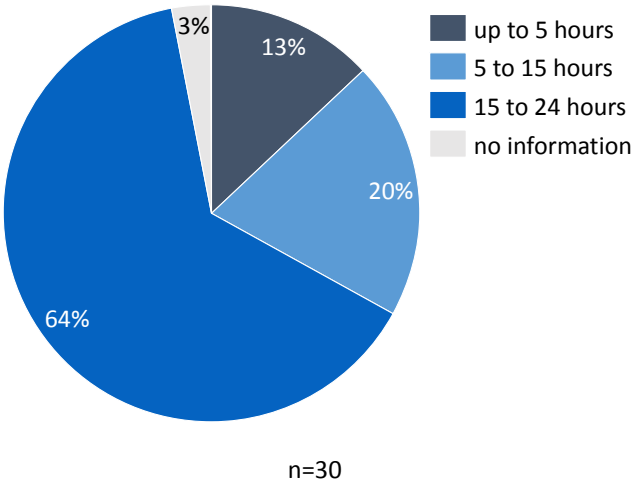


Figure 118 - Hours with electricity per community (in %)

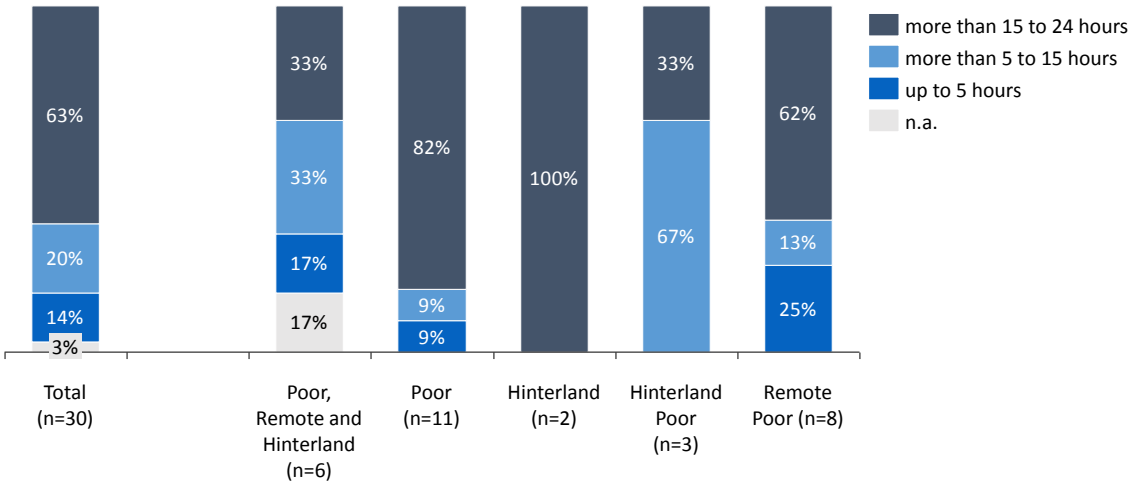


Figure 119 - Perceived average hours with electricity per community segments (in %)

Figure 120 - Generator (Region 9)

Figure 121 - Generator house (Region 9)

Figure 122 - Generator (Region 10)

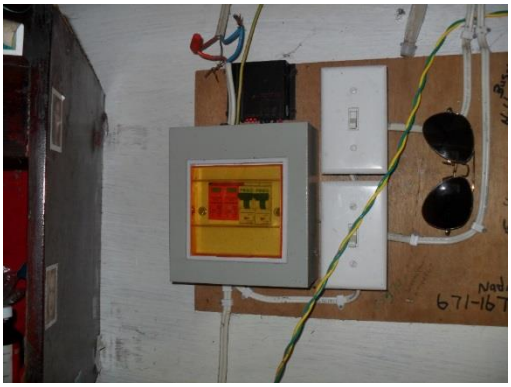


Figure 123 - Battery charged by solar panel (Region 9)

Figure 124 - Streetlamp (Region 9)

Figure 125 - Electric wiring (Region 4)

Figure 126 - Solar Panel (Region 2)

4.2.3.6 Economy

The economic situation of a community has a major impact of the adoption and usage of ICT Infrastructure and services.

4.2.3.6.1 Main Source of Income in the Communities

Almost half (14) of the thirty communities in scope of the survey mentioned subsistence farming as their main economic activity, followed by mining (10). Public servants/work for state, logging, agriculture, and other activities, were mentioned four times each. Sugar, fishing, and tourism, were quoted three times each. Sales, the culture of rice, and hunting, came twice. Finally, selling food, working on factories, participating in illegal trade, individual entrepreneurship, working at the Post Office, and cattle, were specified in only one interview each.

Figure 127 - Craft Center (Region 4)

Figure 128 - Small Shop (Region 4)

Figure 129 - Market (Region 1)

Figure 130 - Market (Region 1)

Figure 131 - Paddy field (Region 5)

Figure 132 - Farmer association building (Region 4)

Figure 133 - Mining Station (Region 8)

Figure 134 - Gold Nuggets (Region 8)

Figure 135 - Gold (Region 1)

4.2.3.6.2 Unemployment in the Communities

Many respondents mentioned unemployment as a major problem in their communities. Not having access to a steady income is also a concern commonly mentioned in the interviews.

In most of the communities, the general economic situation is considered to have worsened during the last years. Only two respondents considered local economic conditions to have improved or to be the same as in the past. The main perceived causes for this situation are a general lack of training and education and the overdependence of local economy on extractive activities such as mining and logging.

Respondents believe that improved education could help mostly young people to be more prepared to engage in different activities. Besides that, a few of them believe that better telecommunication infrastructure could boost the local economy, bringing more buyers to local products and allowing tourism to flourish.

4.2.3.6.3 Main Challenges/Difficulties for Generating Revenue/Income

When asked about the main challenges or difficulties for generating income, the responses are in tune with those presented in the section above (reasons for unemployment). The lack of proper education is seen as major problem, since even the few available opportunities cannot be availed by people from the community due to a lack of proper qualification. Bad infrastructure is also mentioned, alongside with the lack of markets to sell local products. The absence of natural resources is considered to be a problem, since few communities have industries.

4.2.3.6.4 Loans

Around 50% of the interviewees of "Poor, Remote and Hinterland" communities have received loans in the past ten years. A reason for these loans may be inferred by the fact that this is an area of poor infrastructure and more social problems. In this same community segment, half of those who have received loans in the past have had difficulties in paying them back. 30% of those who have received loans have used it for opening a business and 23% for building houses.

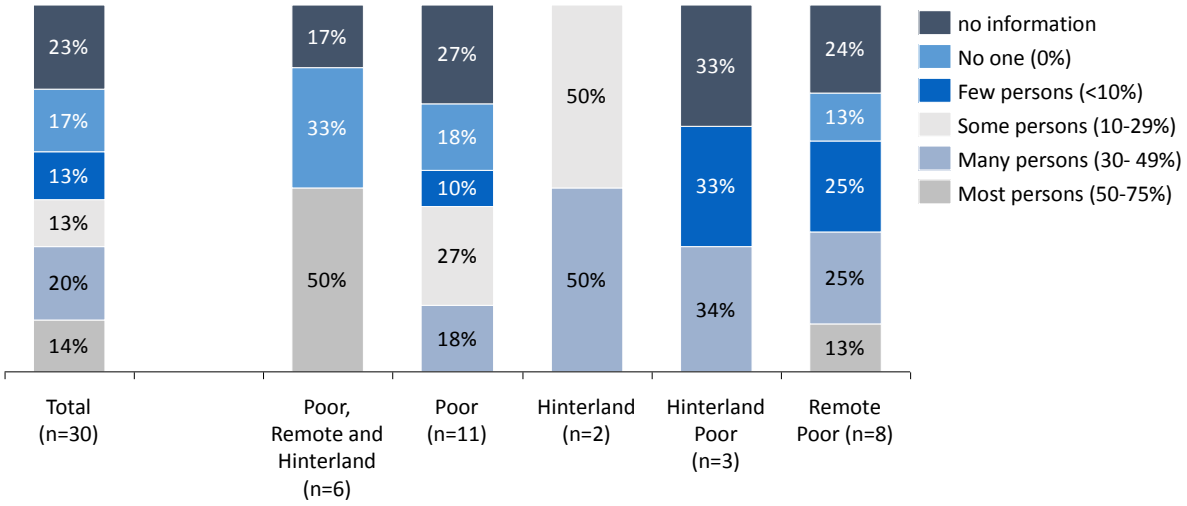


Figure 136 - Number of persons that received at least one loan in the past ten years per community segments (in %)

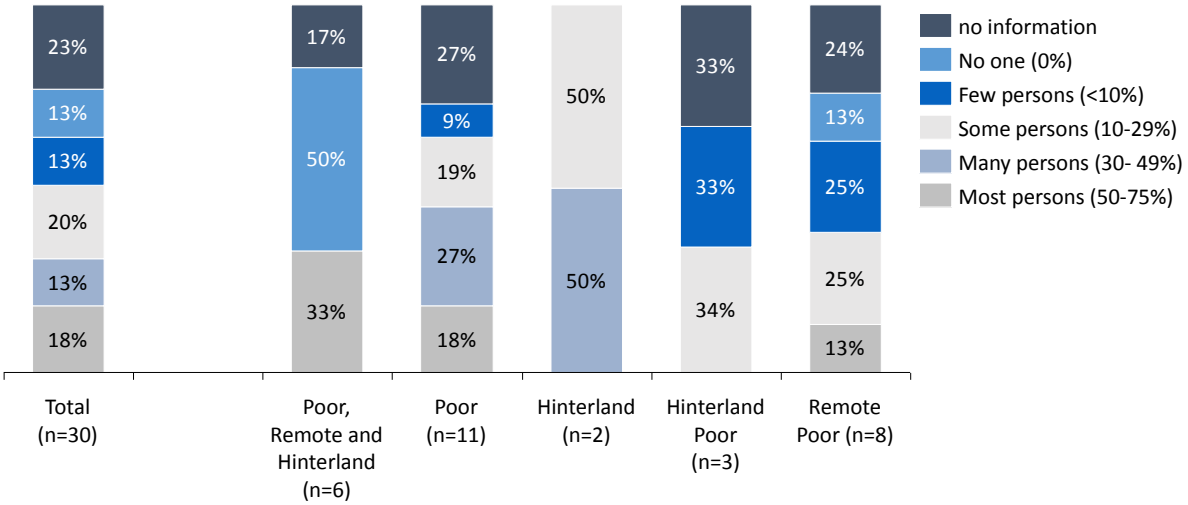


Figure 137 - Number of persons that paid back their loans per community segments (%)

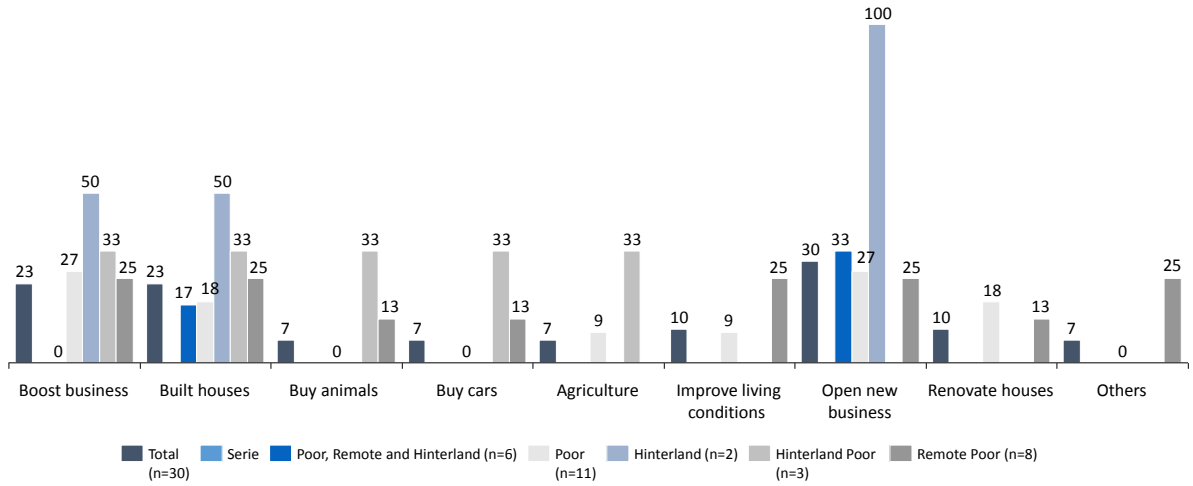


Figure 138 - Purpose of loans per community segments (%)

4.2.3.7 Communication and ICT

In the perception of the communities' leaders, 50% of the of the interviewees has access to private smartphones and private landlines. In particular in the community segments "Hinterland and Poor" and "Remote and Poor" the usage of smartphones as communication device is predominant. Landline is most common communication channel in Poor communities, but also very widespread in the communities classified as "Hinterland" and "Remote and Poor". The private cellphone is more used in the Hinterland area, where, according to their perception, almost 80% of the population use cellphones.

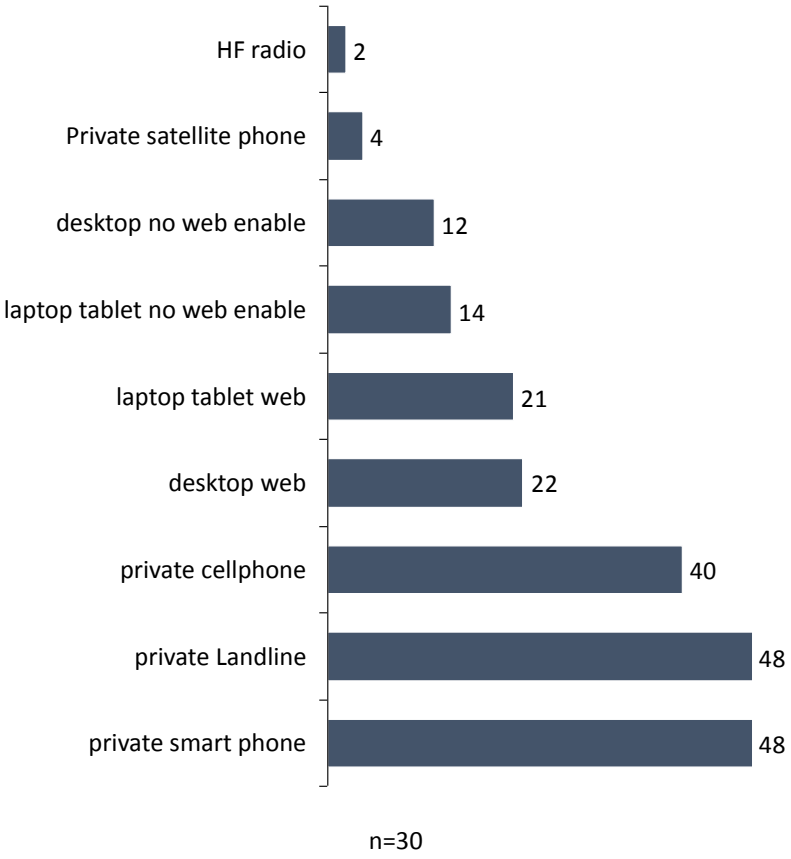


Figure 139 - People in the communities with access to communication devices. (%)

4.2.3.7.1 Device Analysis

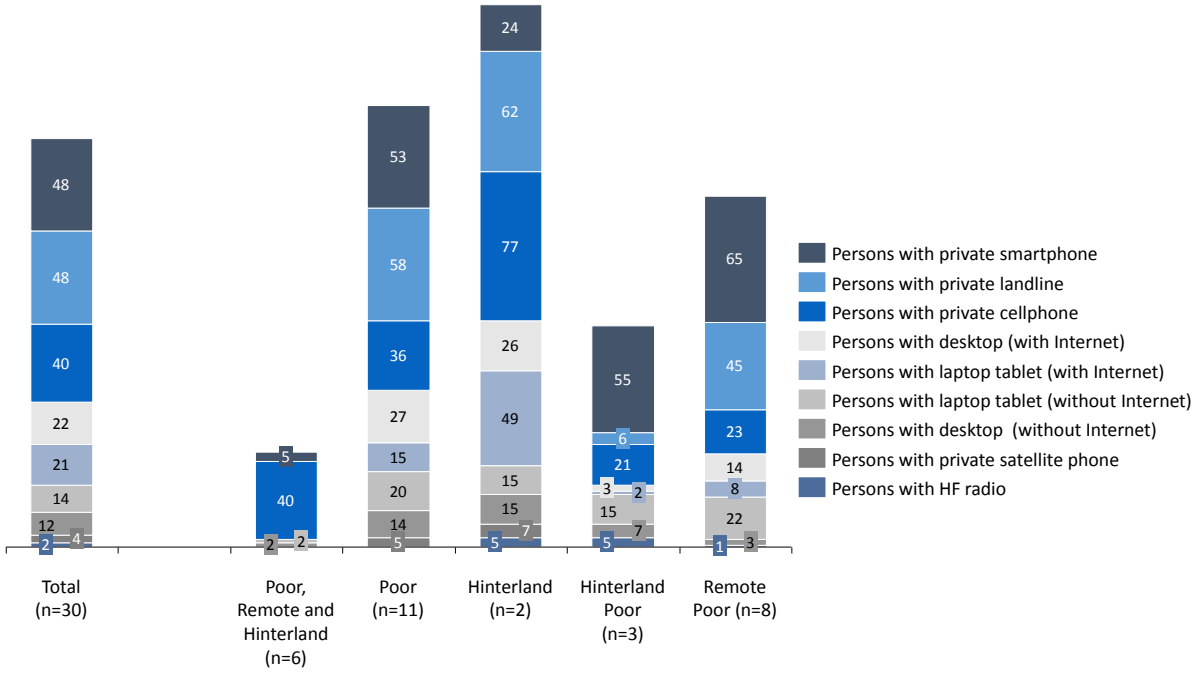
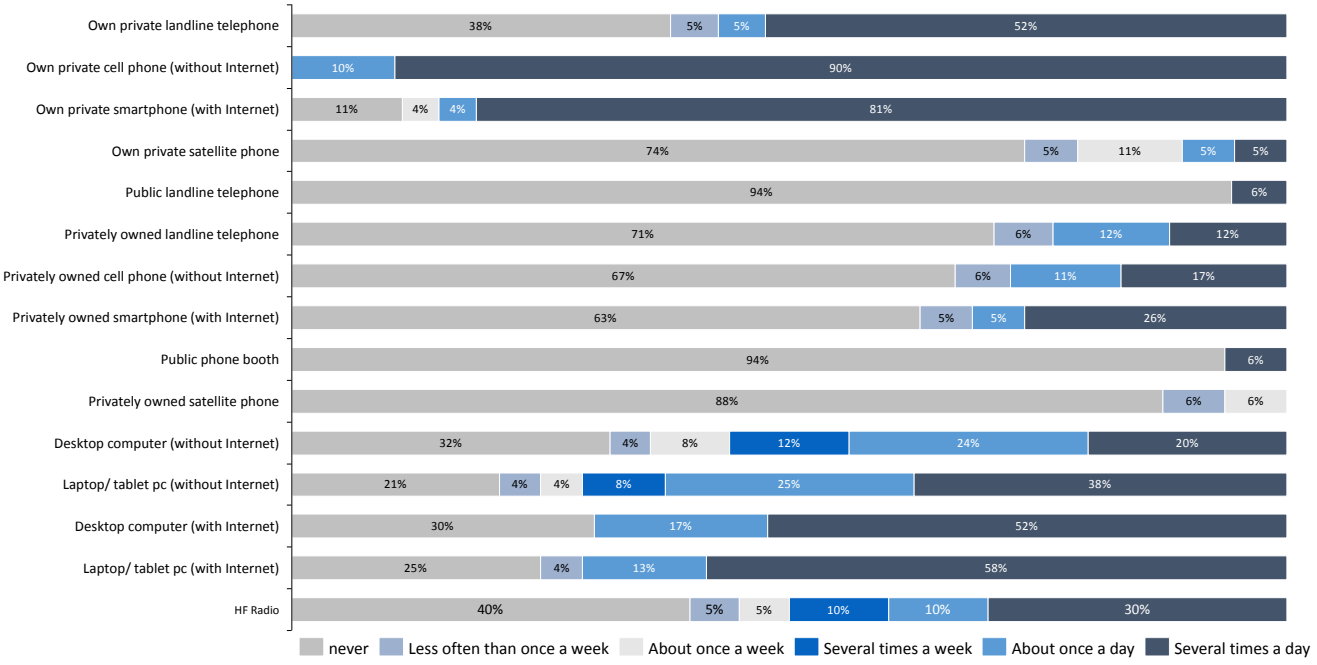


Figure 140 - Percentage of persons who own the respective communication devices per community segments (in %)

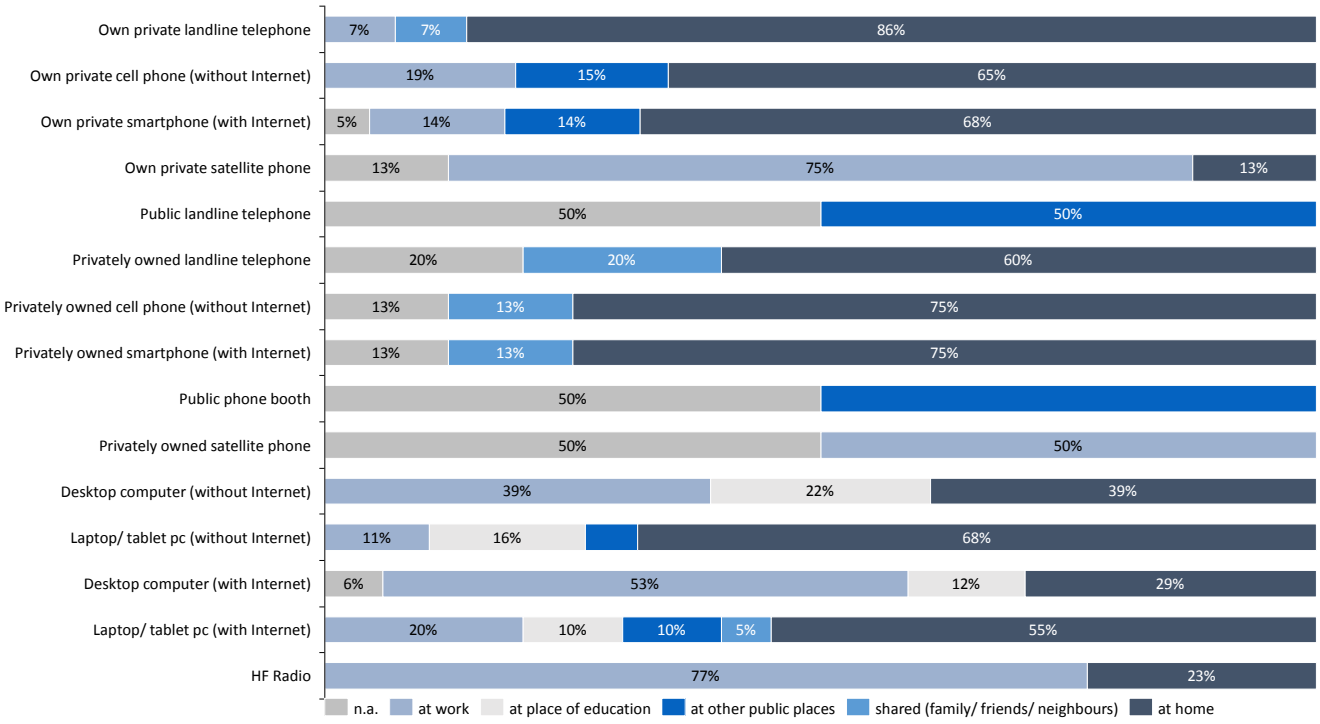
The most frequently used devices are private smartphones and private cellphones (81% and 90%, respectively). According to the perception of the communities' leaders, more than half of the private landline telephone, laptop (web-enable) and desktop (web-enable) users use these devices several times a day. The most common place of use is their houses (smartphone – 68%; cellphone – 65%). For the desktop computer (with internet access), the most common place of use is at work, as estimated by the communities' leaders.



n=30

Figure 141 - Frequency of use of communication devices[55]

[55] Usage of own private cellphone / smartphone / etc. means the person using the device is also the owner of the device. Usage of privately owned cellphone / smartphone / etc. means the person using the device is not the owner, but borrows it from another person.



n=30

Figure 142 - Location of use of communication devices

Figure 143 - Abandoned telephone booth (Region 6)

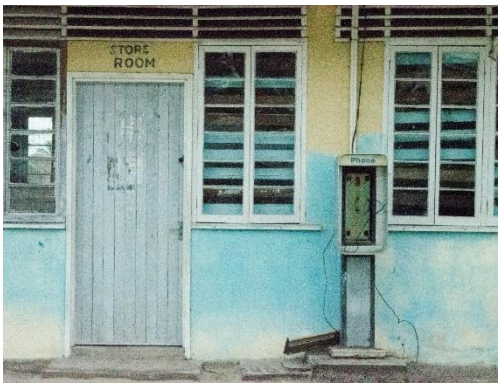


Figure 144 - Abandoned telephone booth (Region 4)

Figure 145 - Abandoned telephone booth (Region 6)

Figure 146 - Public telephone booth (Region 2)

Figure 147 - Public telephone booth (Region 2)

Figure 148 - Public Landline Phone at health center (Region 4)

Figure 149 - 2 hours away from Lethem (Region 9), the only place that phones get a signal

Figure 150 - 4 hours away from Lethem (Region 9), the only place with Digicel signal

Figure 151 - Signal spot (Region 7)

Figure 152 - Up the hill is a spot with signal for cellular phones (Region 2)

Figure 153 - Cellphone spot (Region 8)

Figure 154 - Advertisement for Free Wi-Fi instore

There are currently two mobile carriers operating in Guyana that provide fixed and mobile telecommunication services in the communities surveyed: Digicel and GT&T. In general, a slightly higher penetration of services provided by Digicel has been perceived, based on how the availability of services was evaluated by the interviewees.

In the communities categorized as “Poor, Remote and Hinterland” the perceived quality and availability of the mobile network signal is very limited: 67% of the interviewees stated that services from Digicel were available and 17% stated that services from GT&T were available. It is the poorest presence perceived compared to other community segments.

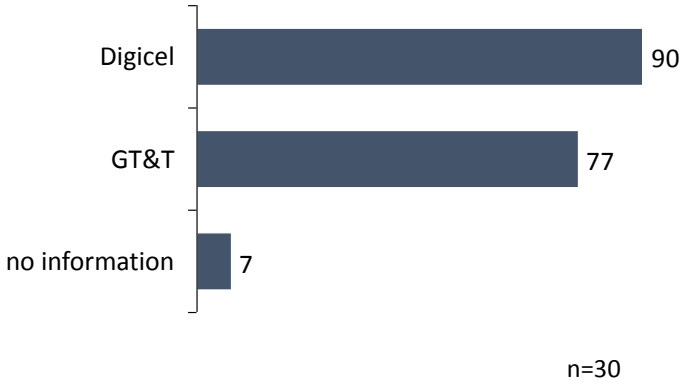


Figure 155 - Percentage of persons, confirming the presence and availability of mobile carriers' networks (in %)

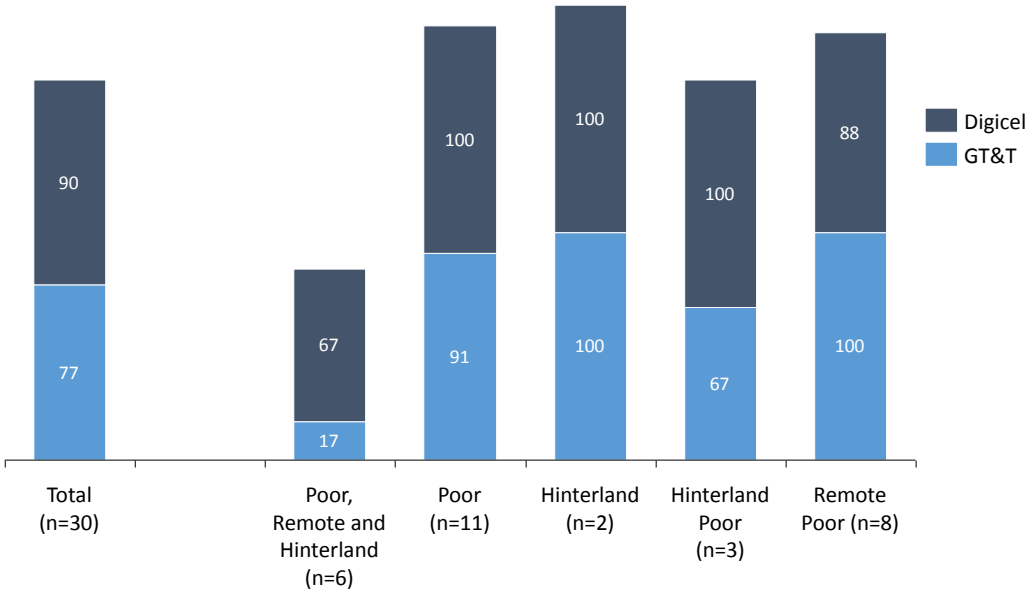


Figure 156 - Percentage of persons, confirming the presence and availability of mobile carriers' networks per community segments (in %)

Most of the interviewed leaders (54%) reported having at least one antenna installed in the community. 10% of these leaders of the communities stated, that there were 5 or more antennas or similar type of equipment in the community. However, 43% of respondents are not aware of such equipment installed in the place of their residence. Regarding only the communities categorized as “Poor, Remote and Hinterland”, 83% of the leaders state that there is no installation of antennas in their communities.

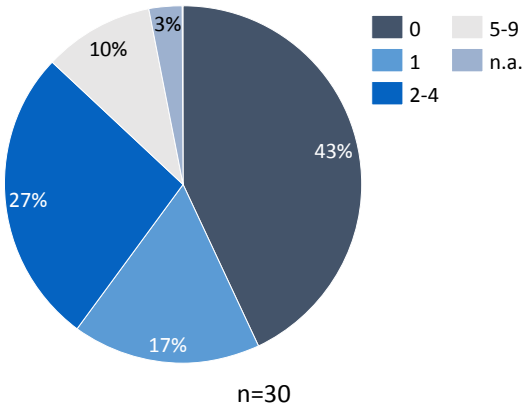


Figure 157 - Number of installed mobile network antennas per community as perceived by the leader of the community (in %)

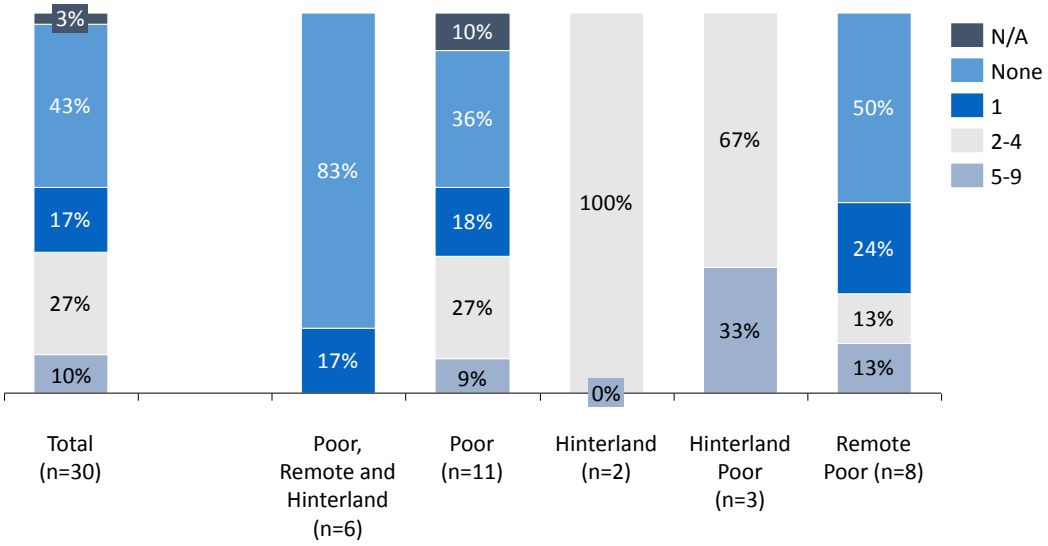


Figure 158 - Number of installed mobile network antennas per community segments as perceived by the respective leader (in %)

Almost 60% of the communities in the study have not received any previous ICT development projects. In the communities classified as “Poor, Remote and Hinterland” and “Poor” almost two thirds of the interviewees state, that there were no ICT projects for development in the past. Whereas in the communities “Hinterland and Poor” two thirds of the interviewees confirm the implementation of ICT projects for development in the past.

Amongst these previous projects, the following were named: “small donations”, “computer classes at the Secondary schools”, “a laptop per family from the government”, and “the internet”. Two of them consider the Digicel’s discounts in plans as a previous ICT project. The failure of these previous projects was due to, according to the interviewees: “*Digicel wanted to start something there, but it never happened. Not successful due to cost of logistics.”; “GT&T haven't ever done any work there.”; “It didn't work, because some of the computers were not internet ready. Too much politics disturbed the program.”; “They done several requests for improve the communication system there but no response*”. Almost 30% of the respondents believe that this sort of project would help to develop the region. Besides that, they also believe it would help the youth to have more access to information.

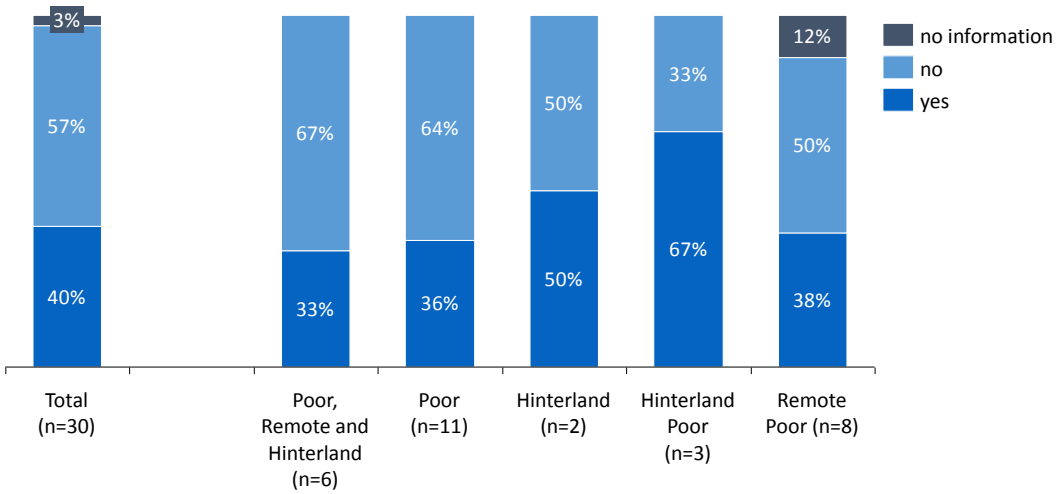
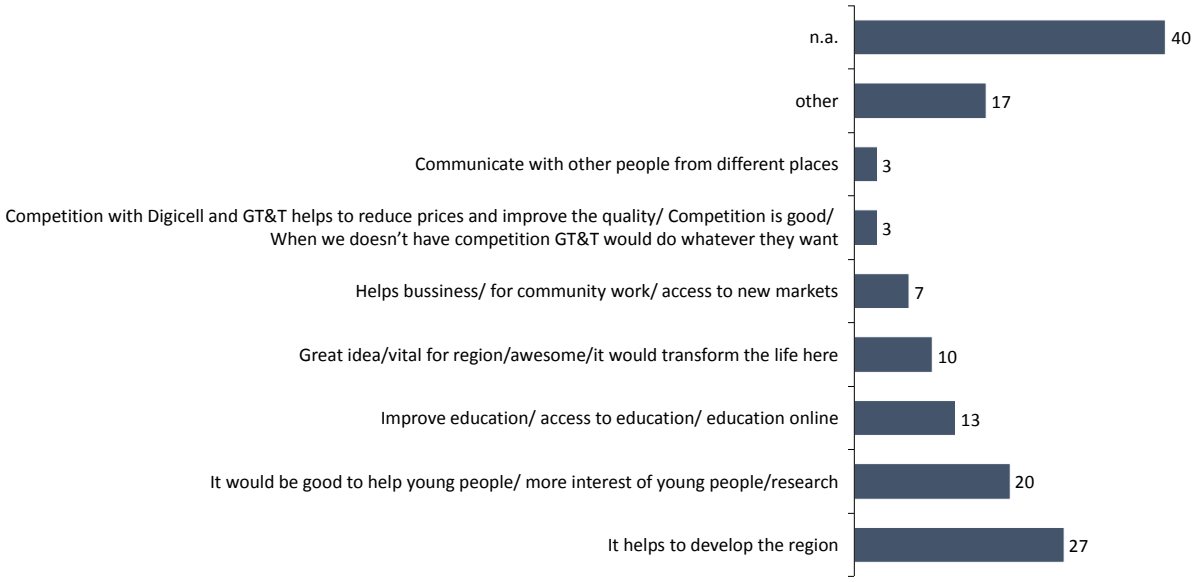


Figure 159 - Previous ICT development project per community segments. (in %)



n=30

Figure 160 - Opinion about the potential of future ICT projects

Figure 161 - Computers at school without internet access (Region 4)

Figure 162 - Boy with Tablet (Region 5)

Figure 163 - Laptop at store (Region 1)

Figure 164 - HF Radio inside Store (Region 9)

Figure 165 - HF Radio inside a store (Region 8)

Figure 166 - Defunct Satellite phone at health center (Region 4)

Figure 167 - Digicel Antenna (Region 4)

Figure 168 - Antenna (Region 10)

Figure 169 - Digicel Sat Dish (Region 9)

Figure 170 - Three towers (Region 9)

4.2.3.7.2 Usage per age segment and gender

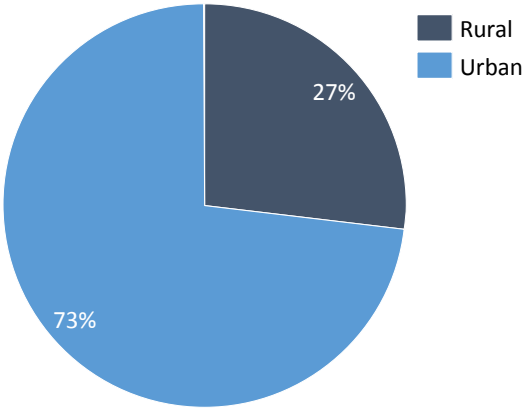
Another quantitative survey for this study was done by interviewing residents at the visited communities. The collected data helped to support the view from the representatives and provided additional figures and indicators for the qualitative study. Interviewees filled up the questionnaires by themselves without the supervision of interviewers. The sample reached a total of 142 completely filled and returned questionnaires.

The distribution of the interviewees is as follows:

Community	Male			Female		
Male	0- 24 yrs	25-54 yrs	55 yrs and older	0- 24 yrs	25-54 yrs	55 yrs and older
Hinterland	1	1	1	3	4	1
Poor	10	3	1	13	8	7
Hinterland and Poor	1	1	0	3	2	1
Remote and poor	8	5	7	10	8	7
Hinterland, poor and remote	6	6	3	8	5	7

Figure 171 - Study sample (n=142) overview

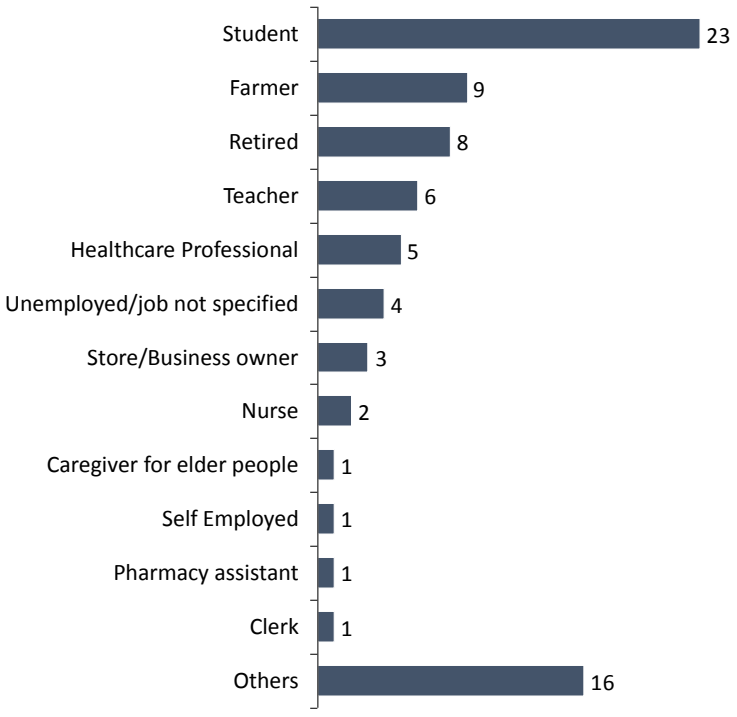
73% of the interviewees lived in communities in rural areas.



n=142

Figure 172 - Characteristics of visited communities

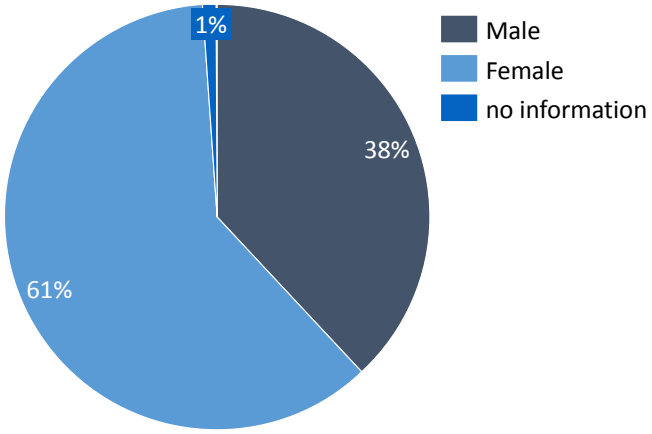
The majority of the interviewees were students, followed by farmers and retired people.



n=142

Figure 173 - Occupation of interviewees (%)

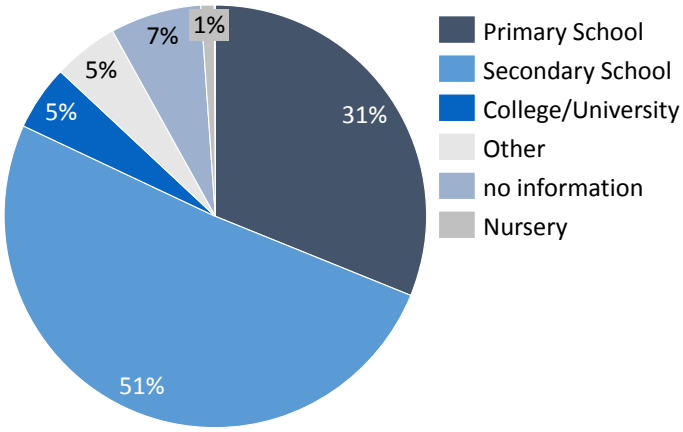
The slight majority of the respondents was female (61%)



n=142

Figure 174 - Gender distribution of respondents

More than half of the sample completed the secondary school education. 31% only had primary education.



n=142

Figure 175 - Highest level of education of the respondents (in %)

Most of the interviewees own private cellphones (without internet) and smartphones (with internet), 4% of the sample own five or more cellphones (without internet), 17% own a laptop (with internet) and only 28% of the interviewees had a private landline telephone.

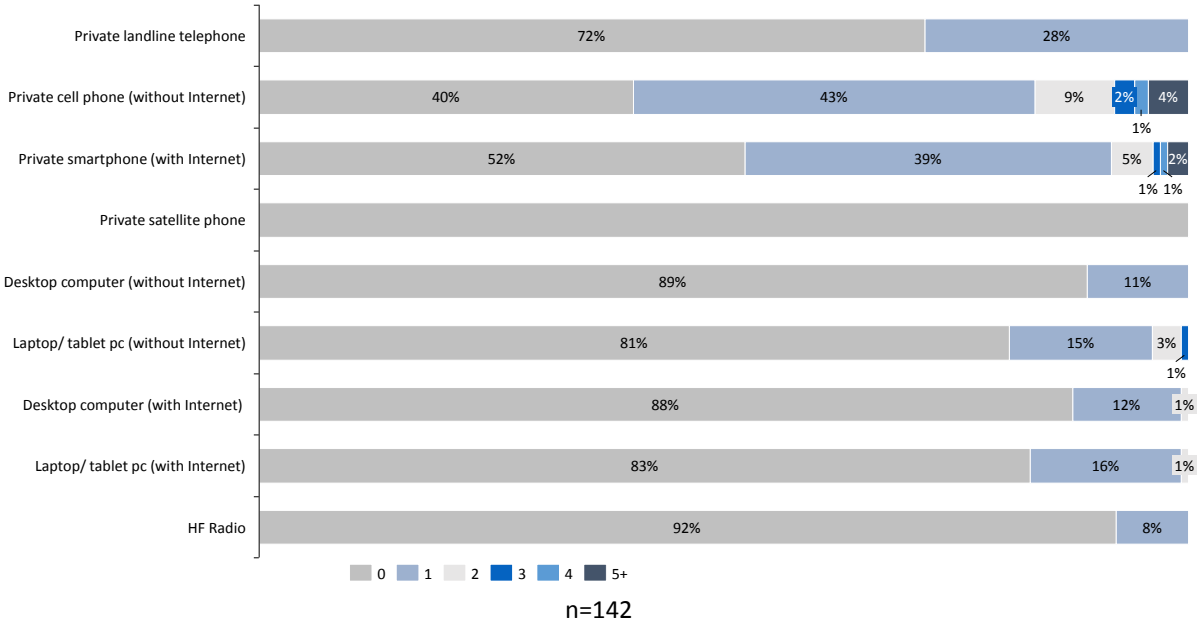


Figure 176 - Number of privately owned ICT devices (%)

There is a predominance of use of devices with access to the internet among young people under the age of 25 years, especially regarding the use of smartphones. 63% of respondents have at least one smartphone, compared to 44% among the persons in the age range of 25 to 54 years and to only 23% of respondents in the age of 54 years and above. Web enabled computers and laptop also mostly used among young people, but with a neglecting difference to the age range of 25 to 54 years. Among those between 25 and 54 years old, the high percentage of usage of mobile devices without internet access can be highlighted: 82% of them have at least one such device, almost double the rate among the segment of 0 to 24 years of age. The age segment of 25 to 54 years owns a noticeable number of possession of landline phones and HF Radios.

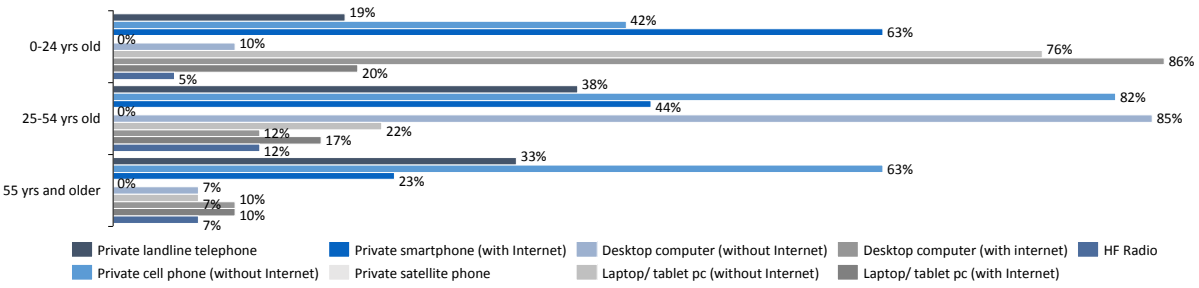


Figure 177 - Own devices (one or more) per age segment (in %)

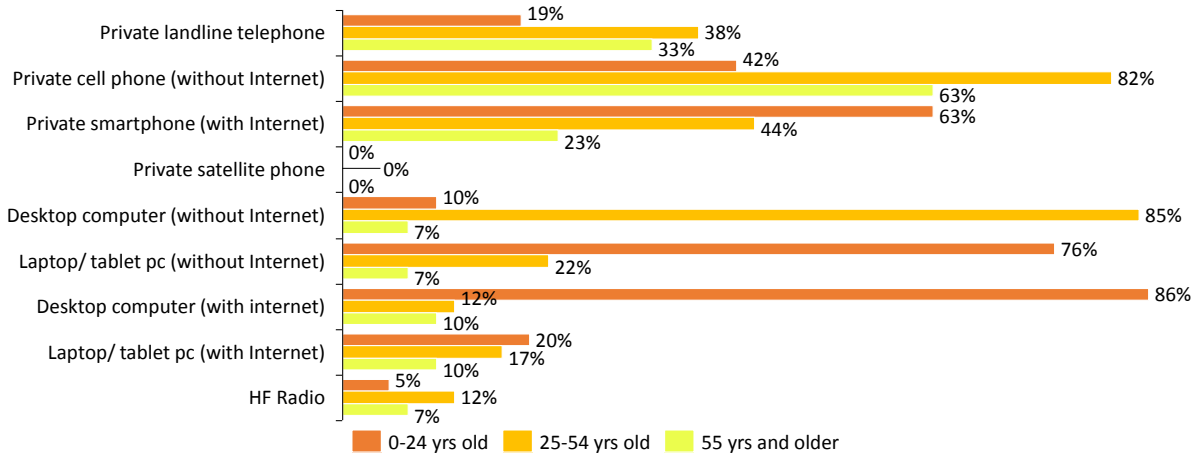


Figure 178 - Own devices (one or more) per device type and age segment (in %)

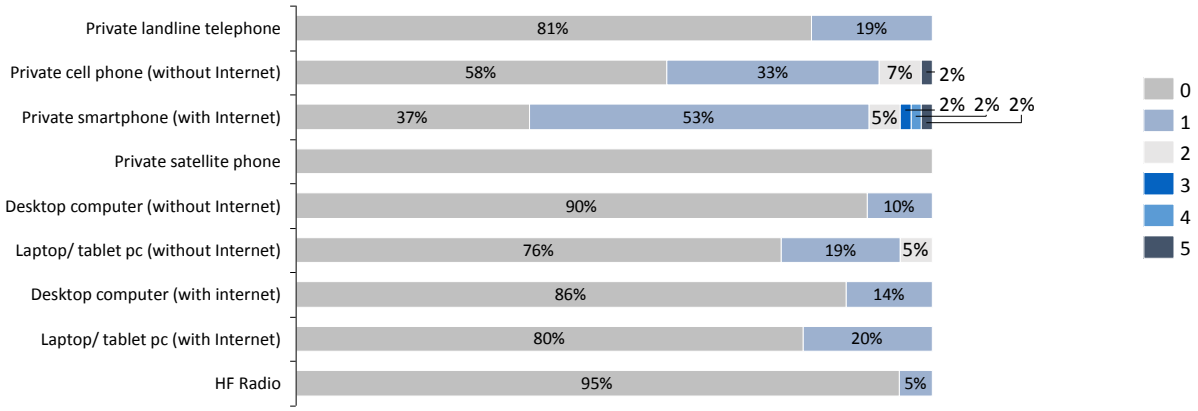


Figure 179 - Number of own ICT devices. Age 0-24 yrs. (in %)

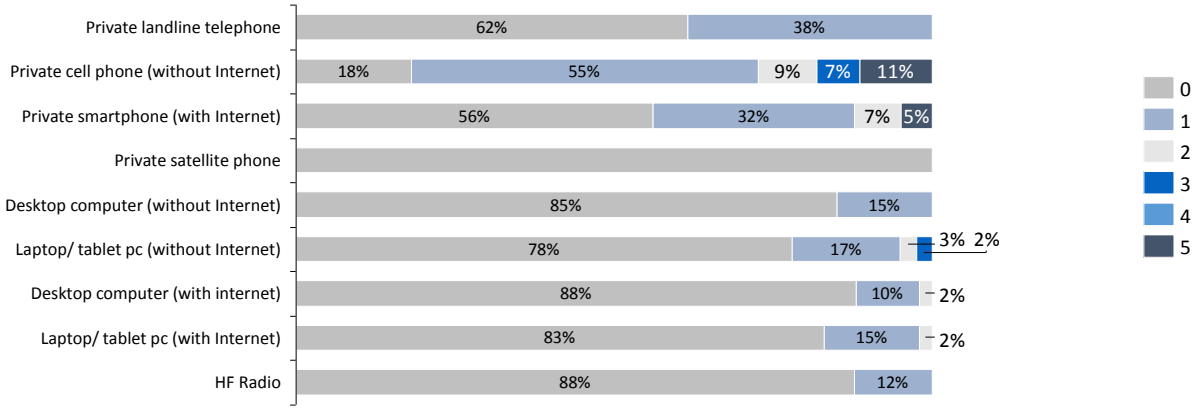


Figure 180 - Number of own ICT devices. Age 25-54 yrs. (in %)

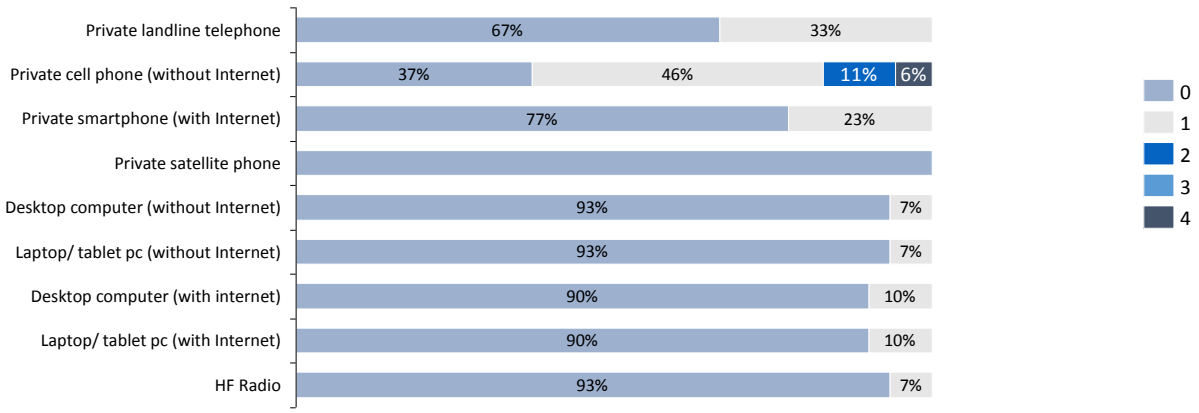


Figure 181 - Number of own ICT devices. Age 55 yrs. and older (in %)

Looking at it from a gender perspective, apparently women have a greater access to private landline phones (30%), private cellphones without internet (61%), desktop computer without and with internet (13% and 14% respectively). Men stand out in regards to smartphone ownership (50% own such a device compared to 46% of women). Among the other devices no significant difference can be stated by gender.

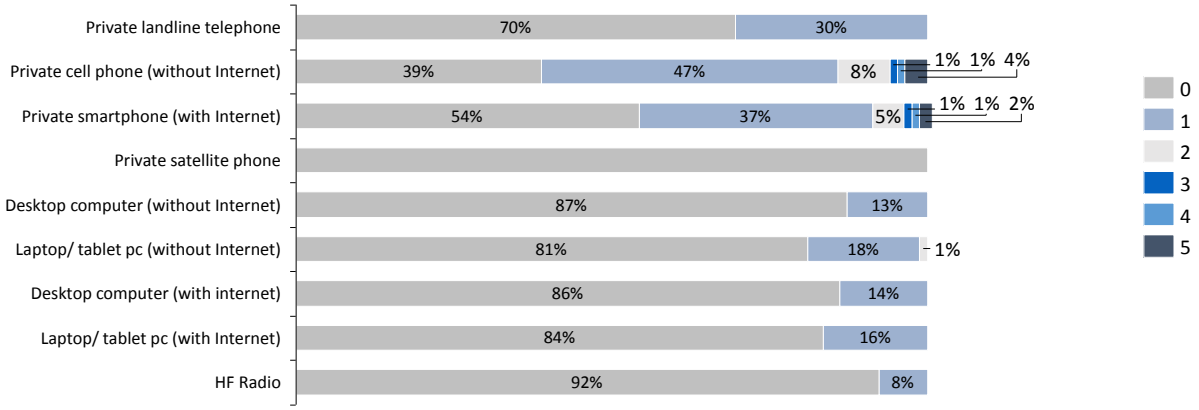


Figure 182 - Number of own ICT devices. Females

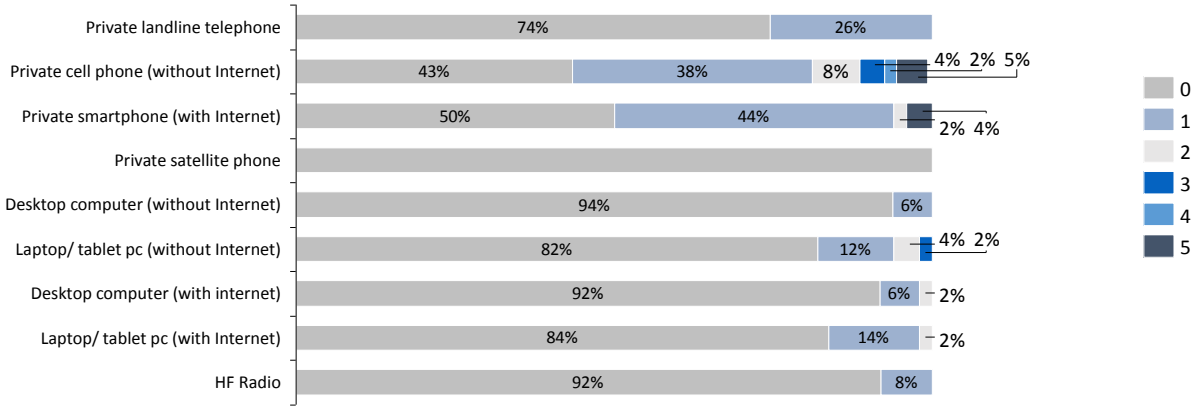


Figure 183 - Number of own ICT devices. Males

For almost half of the sample, the interviewees see have up to 10 cellphones (without internet) available in their community. 11% estimate an availability of more than 150 cellphones (without internet). The estimated percentage of privately owned smartphones is low – respondents said that almost a quarter of the people in the community own a smartphone. According to their perception, 70% of the communities do not own a public landline telephone. A general feeling of sufficient lack of means of communication in the communities can be stated.

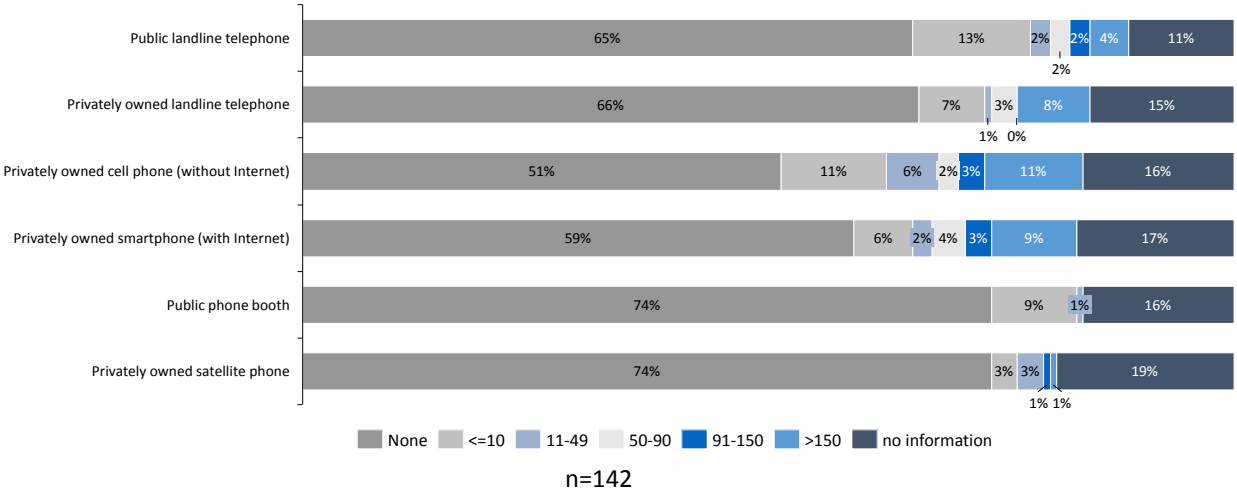


Figure 184 - Perception of available communication devices in the respective community (in %)

The vast majority of respondents perceive limited availability of ICT devices or access to them in the community, regardless of age.

Older people (age segment 55 years and older), perceived a higher level of lack of devices such as privately owned landline, cellphone and smartphone than younger people (under 54 years).

Access to devices in publicly accessible locations such as public landline phone and public phone booth is perceived as more restricted in the segment of 0 to 24 years of age.

In the view of the majority of those interviewees who reported the existence of ICT devices in their communities, their number has been estimated at not exceeding 10 units.

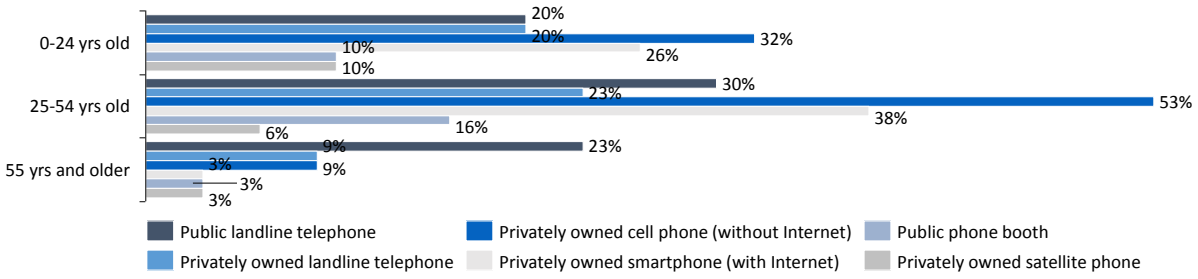


Figure 185 - Perceived number of available communication devices in the community per age segment

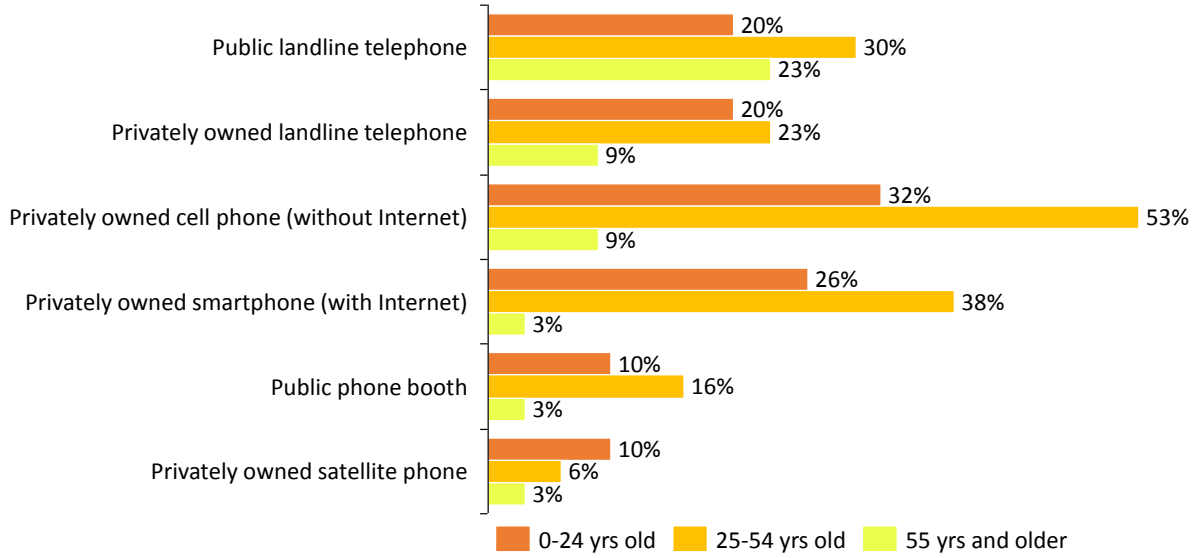


Figure 186 - Perceived number of available communication devices in the community per ICT device and age segment

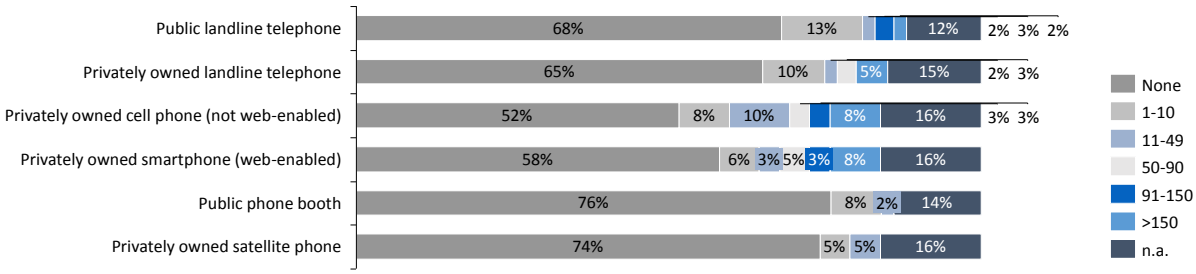


Figure 187 - Perception of available communication devices in the respective community, age group 0-24 yrs. (in %)

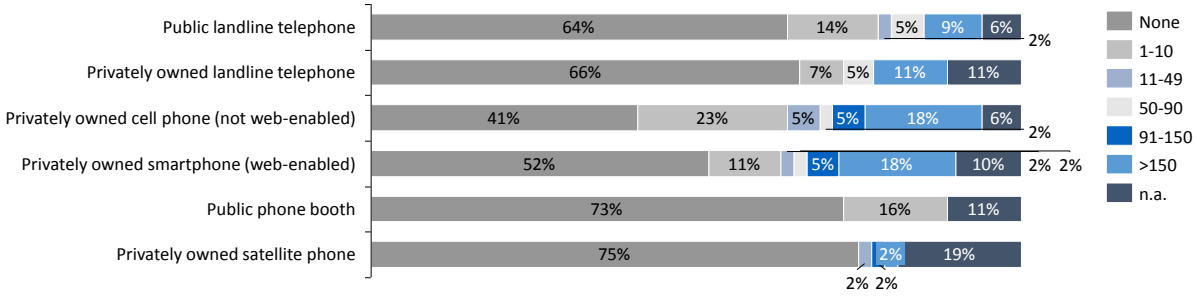


Figure 188 - Perception of available communication devices in the respective community, age group 25-54 yrs. (in %)

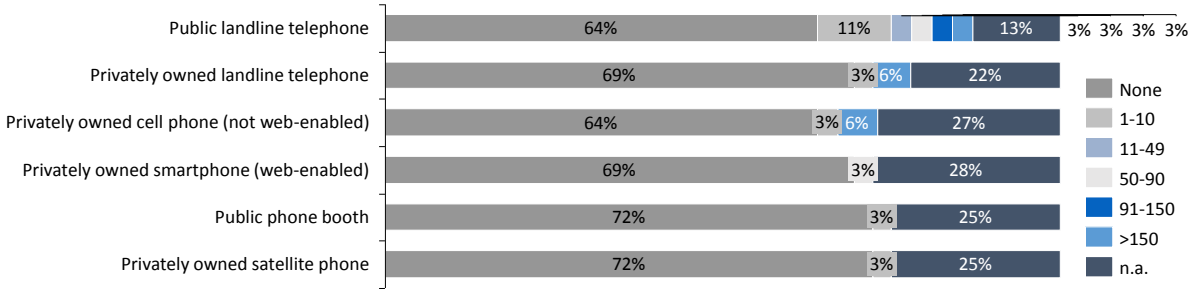


Figure 189 - Perception of available communication devices in the respective community, age group 55 and more yrs. (in %)

Most men perceived (compared women) the absence of ICT devices in their community such as Public landline phones (70%), privately owned cellphones (without internet) (56%), privately owned smartphones (with internet) (61%).

Interviewed women emphasized a lack of privately owned landline phones (68%) and public phone booths (75%).

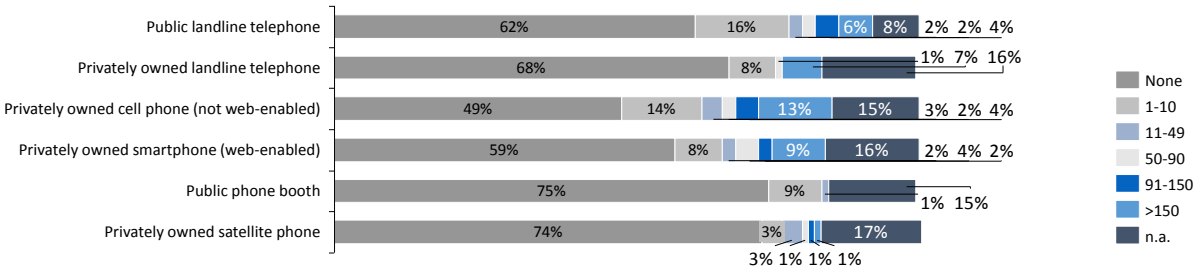


Figure 190 - Perception of available communication devices in the respective community, Females. (in %)

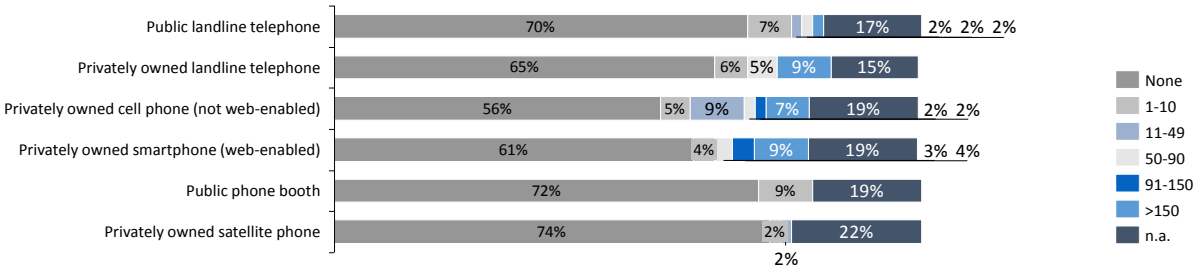
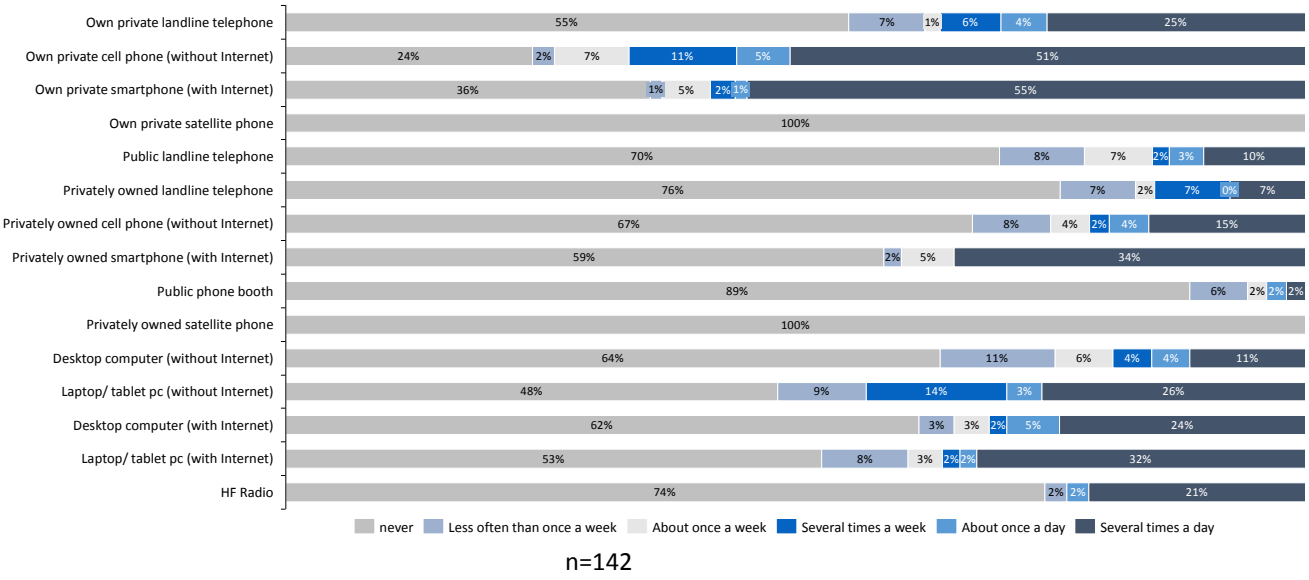


Figure 191 - Perception of available communication devices in the respective community, Males. (in %)

The frequency of use of cellphones (without internet) and smartphones (with internet) are superior to all other means of communication (54% use their smartphones several times a day).



n=142

Figure 192 - Frequency of use of ICT devices (in %)

Low access to devices often results in a high percentage of "never" use of any ICT device. This result is consistent over all age groups.

Comparing the differences between the different age groups, there is a higher frequency of use of devices with internet access. The same happens in the age group between 25 and 54 years in relation to not internet capable cellular phones.

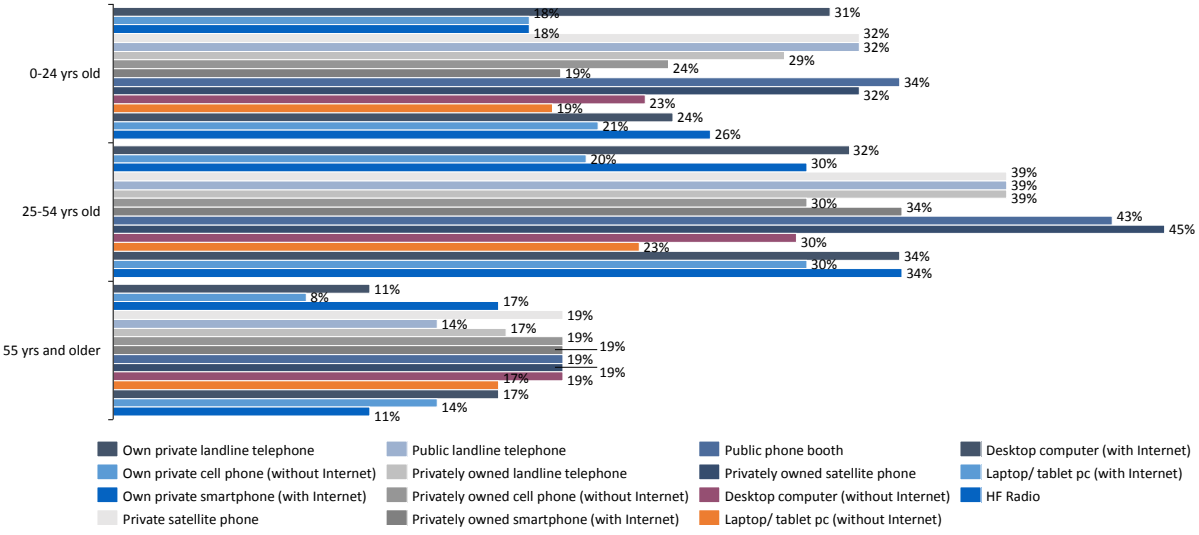


Figure 193 - Usage of at least one ICT device per age group

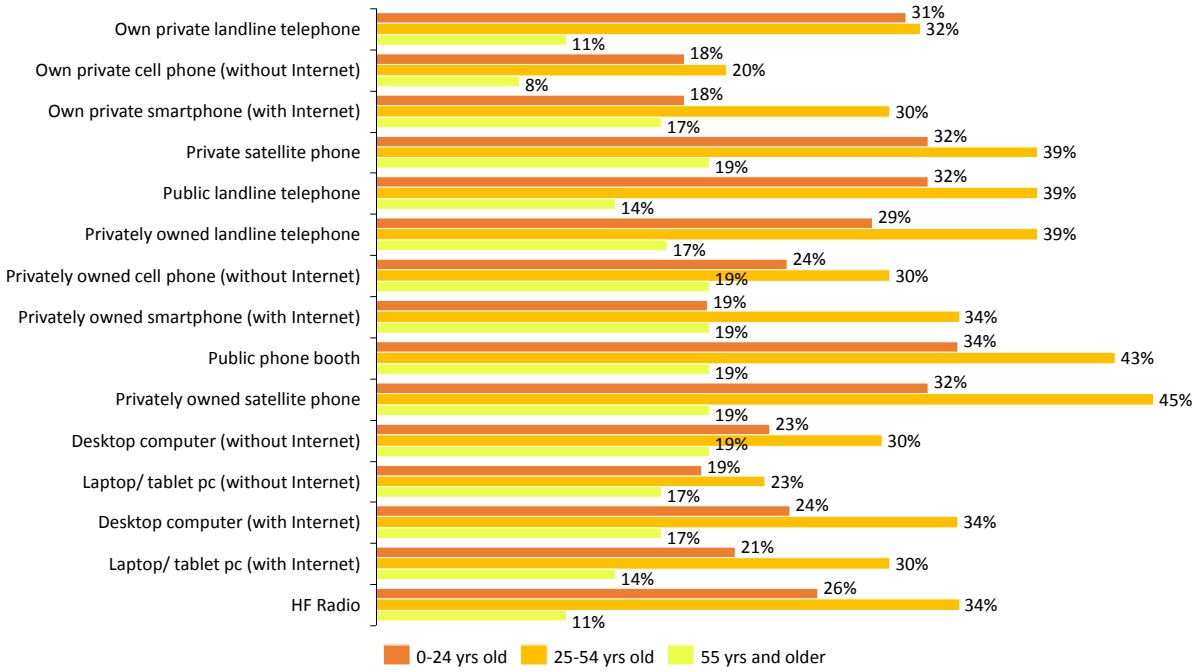


Figure 194 - Usage of at least one ICT device with specific age breakdown

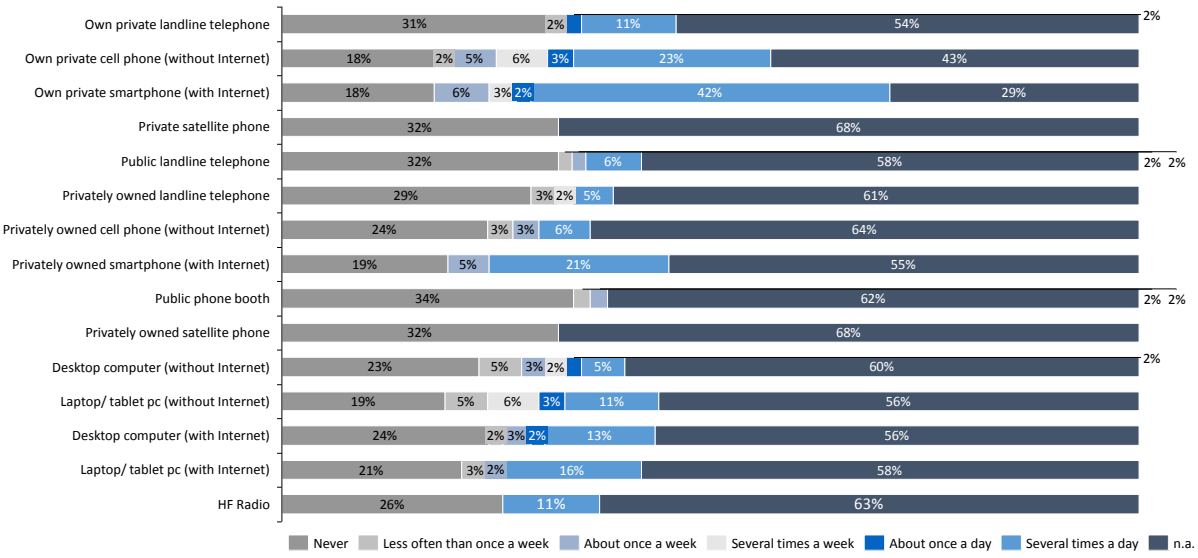


Figure 195 - Usage of ICT devices within age group 0-24 years (in %)

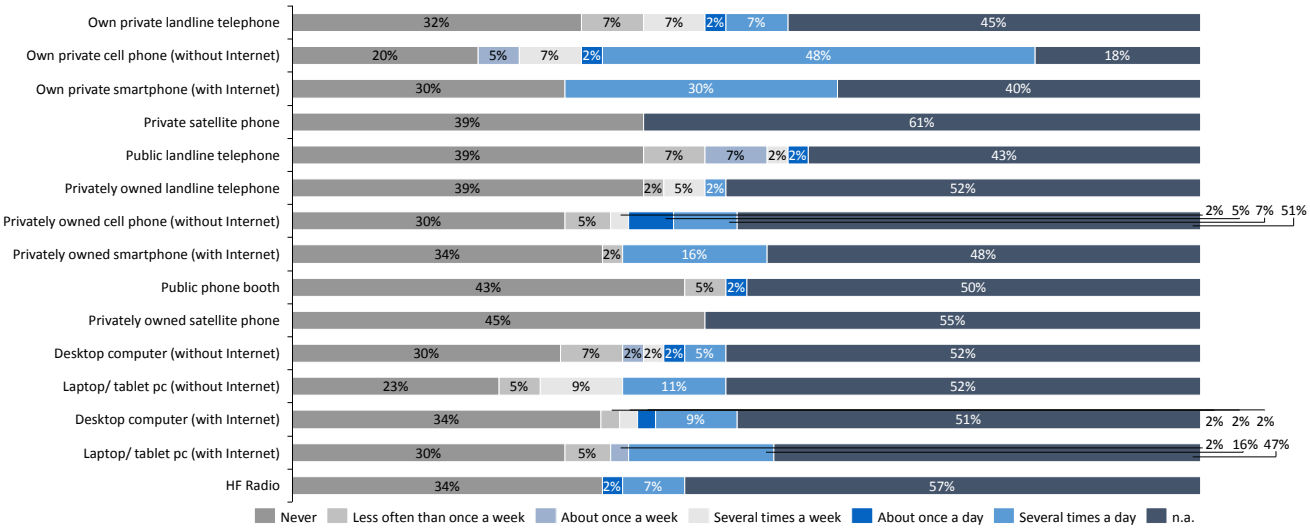


Figure 196 - Usage of ICT devices within age group 25-54 years (in %)

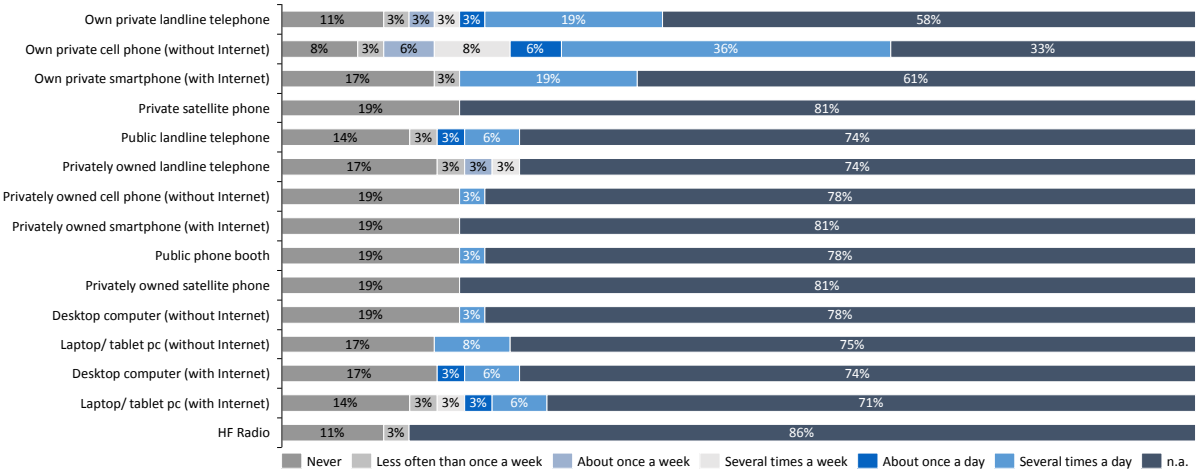


Figure 197 - Usage of ICT devices within age group 55 years and older (in %)

Women report a higher usage frequency then men (Several times a day) in regards to devices such as own private landline telephones (15%), own private smartphones with internet (33%), privately owned smartphone with internet (17 %), desktop computers with internet (10%), laptop/tablet pc with internet (14%) and HF Radio (8%). For other devices no significant differences were found regarding the frequency of use between the genders.

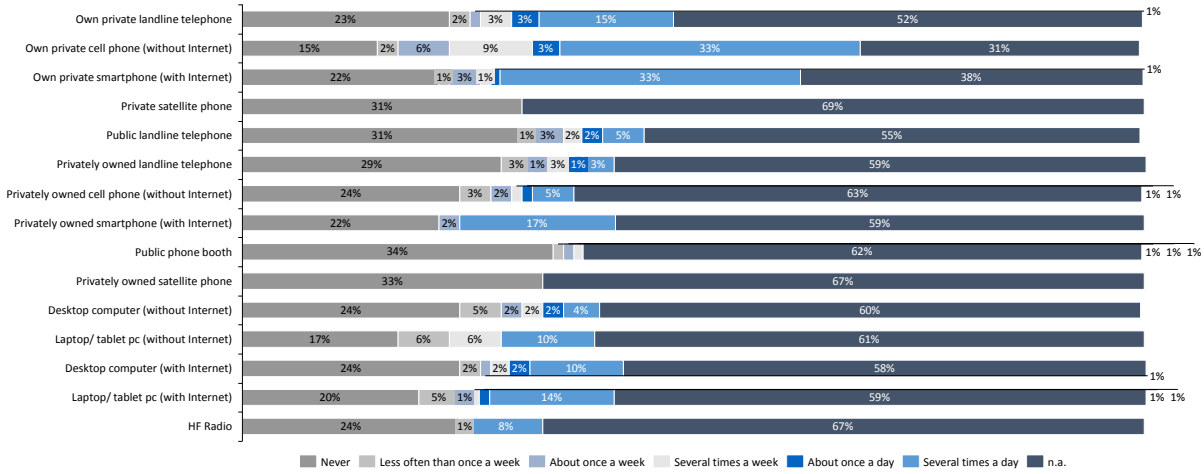


Figure 198 - Usage of ICT devices amongst woman (in %)

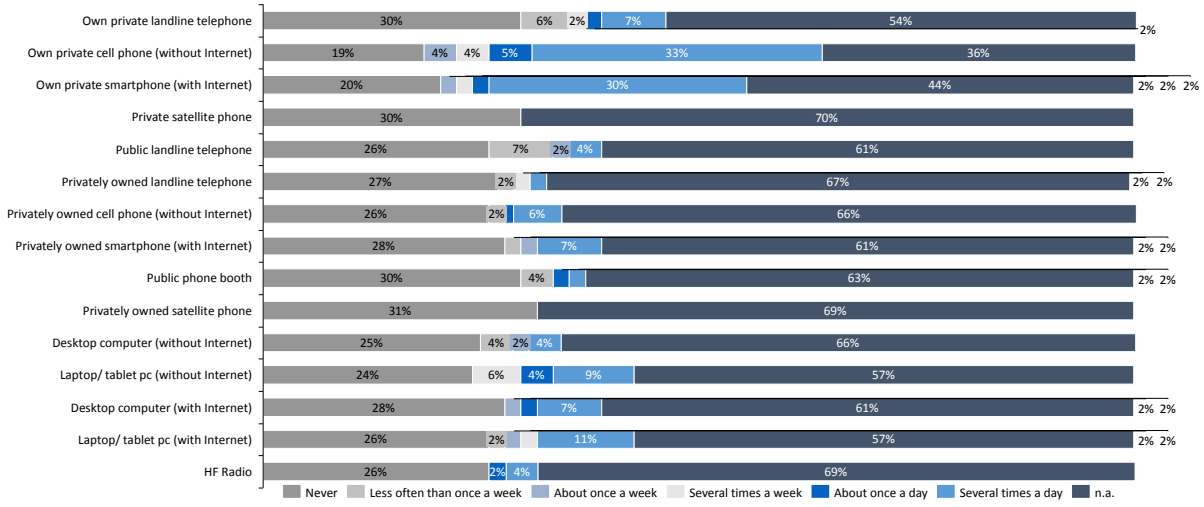
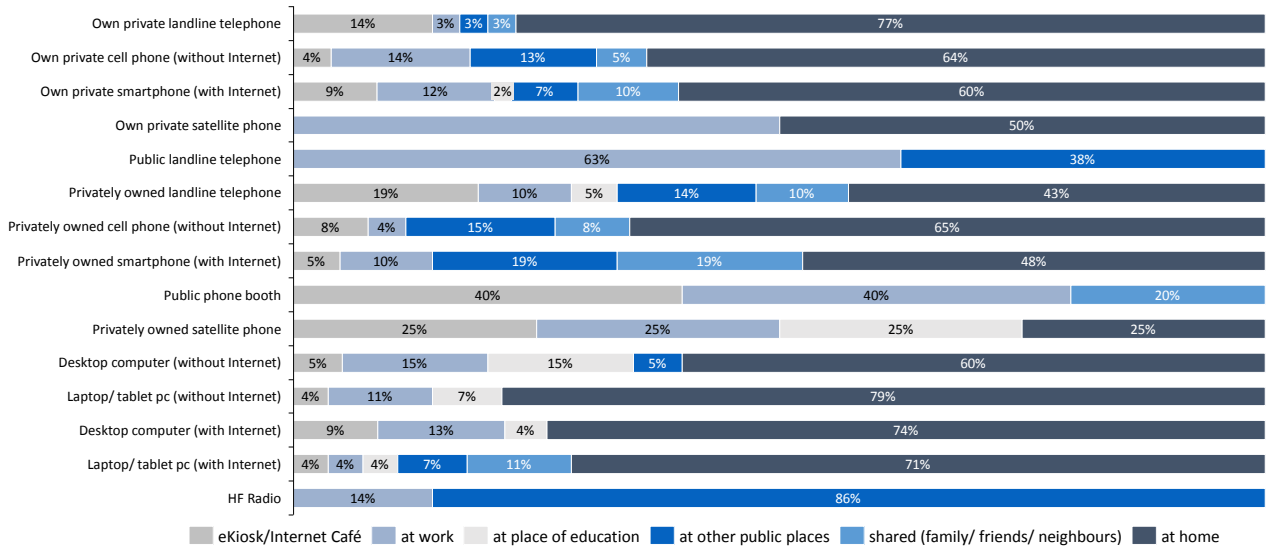


Figure 199 - Usage of ICT devices amongst men (in %)

The private houses are the most common place for usage of the greater part of communication devices. The usage at the place of work is greater amongst those who use public landline telephone or private satellite phone and public phone booth.



n=142

Figure 200 - Location of use of ICT devices (in %)

The private home is the place with access to a higher variety of devices, regardless of age and gender.

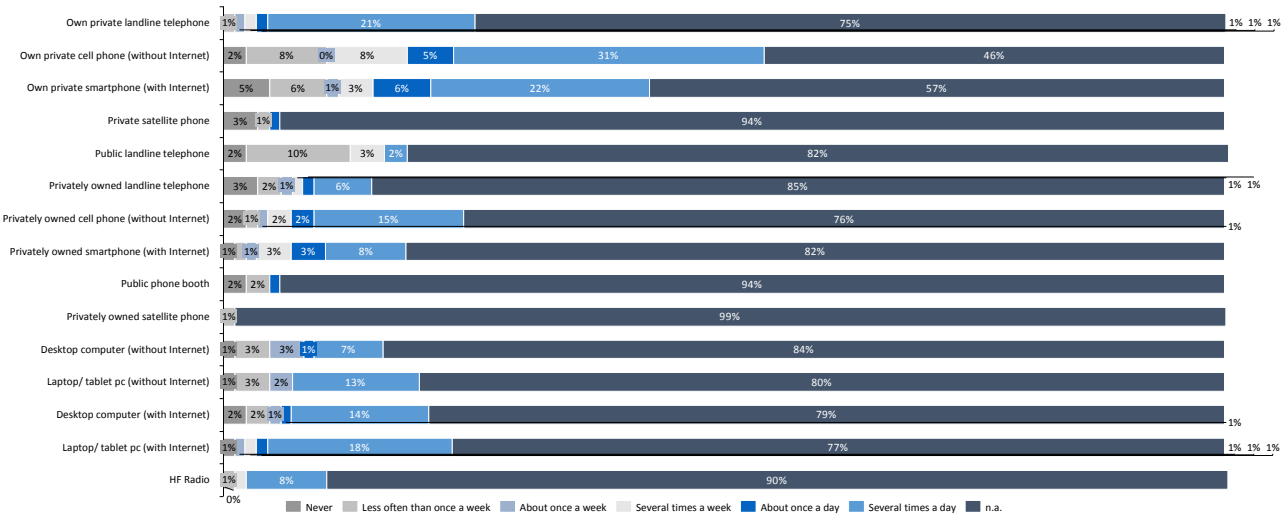


Figure 201 - Location of use of ICT devices by females (in %)

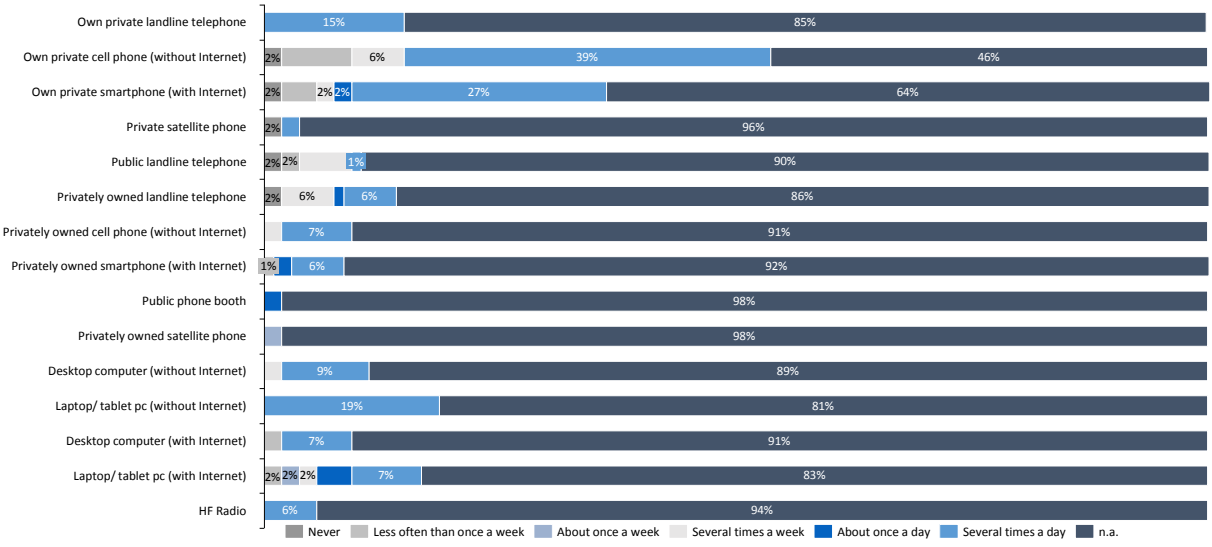


Figure 202 - Location of use of ICT devices by Males (in %)

Only 6% of the interviewed persons are aware that there are satellite services available in their communities. The general – and incorrect - perception is that Digicel and GT&T are the providers of this service.

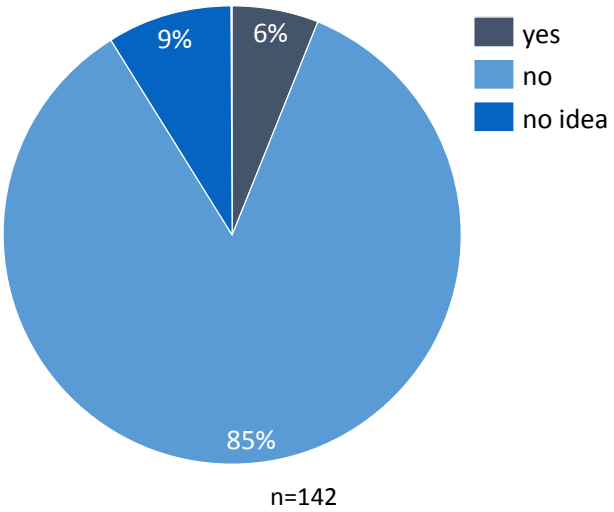


Figure 203 - Perception of satellite services available (%)

Majority of interviewed persons is not aware of the presence of such services in their communities.

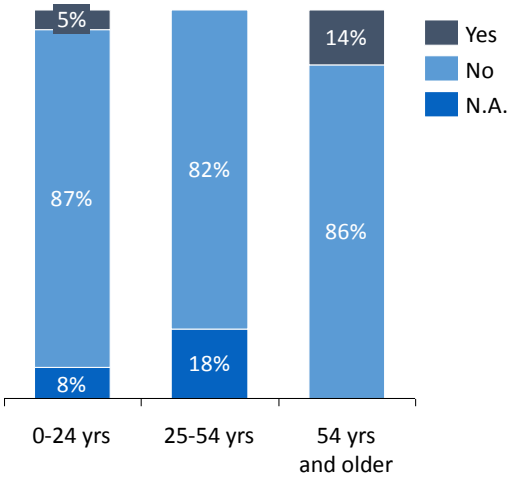


Figure 204 - Awareness of availability of satellite services per age groups

Only 7% of women are aware of the availability of satellite services what is still a higher percentage than in the group of men.

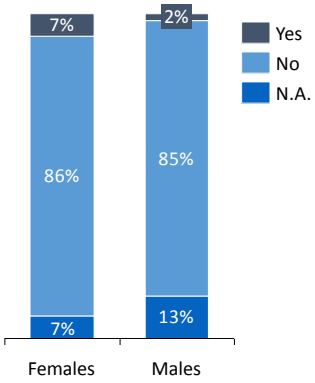


Figure 205 - Awareness of availability of satellite services per gender

The interviewees would be willing to pay up to GYD 10.000 per month to have access to internet at home (maximum). GYD 5.000 on phone calls, up to GYD 4.500 to have internet on their smartphones and up to GYD 1.200 for texting.

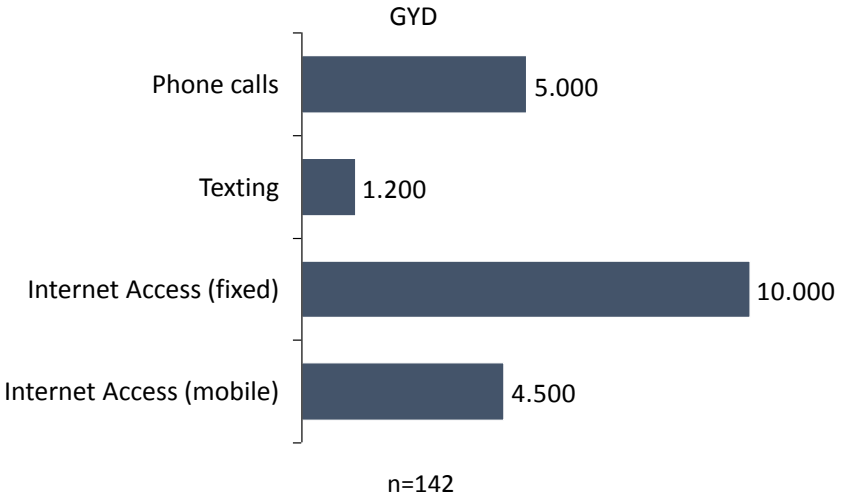


Figure 206 - Willingness to pay per month for ICT services in Guyana Dollars.

A breakdown shows the willingness to pay for the different services – reflecting to certain extend the consumer's experiences with current offerings and its prices. This might explain why the willingness to pay for fixed line internet is higher than for mobile internet services.

Low familiarity with telecommunication goods and services may have influenced the distortion of the average values the respondents of segments poor, remote and hinterland would be willing to pay mainly in relation to services such as texting or phone calls. In the latter, the average values to be paid for phone calls are more than twice the overall average price[56].

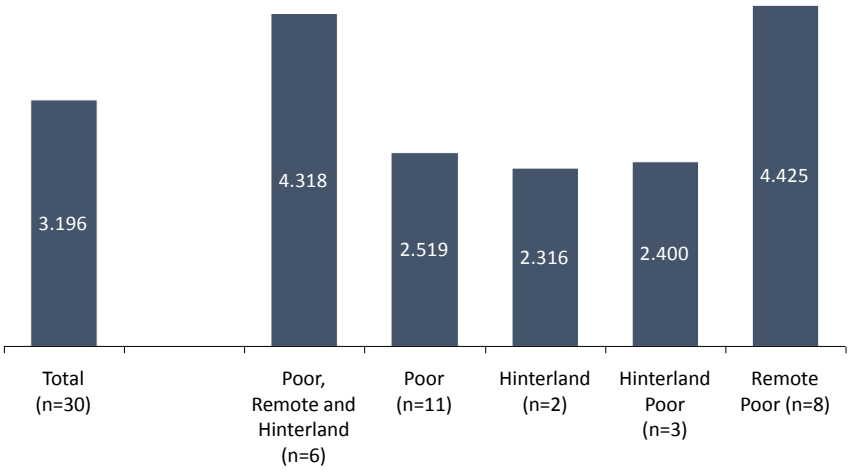


Figure 207 - Willingness to Pay: Mobile internet (in GYD)

[56] This might reflect the interviewee's experience with the price level of using satellite based communication services, even if they are not aware of the communication technology being used.

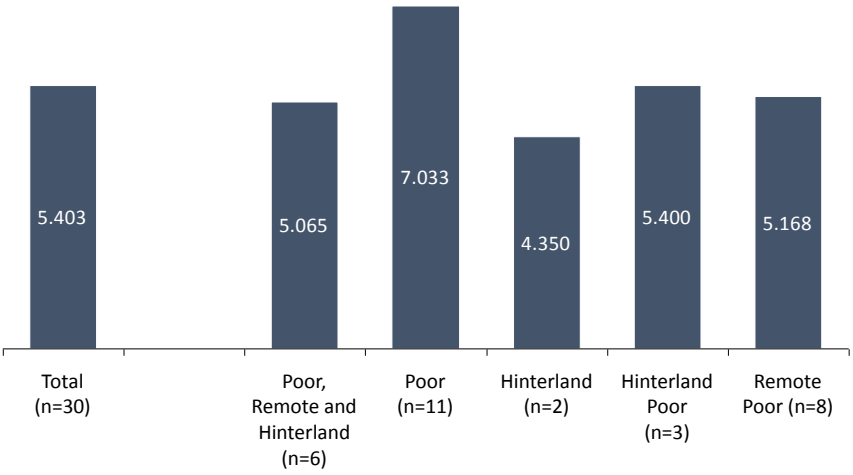


Figure 208 - Willingness to Pay: Fixed line internet (in GYD)

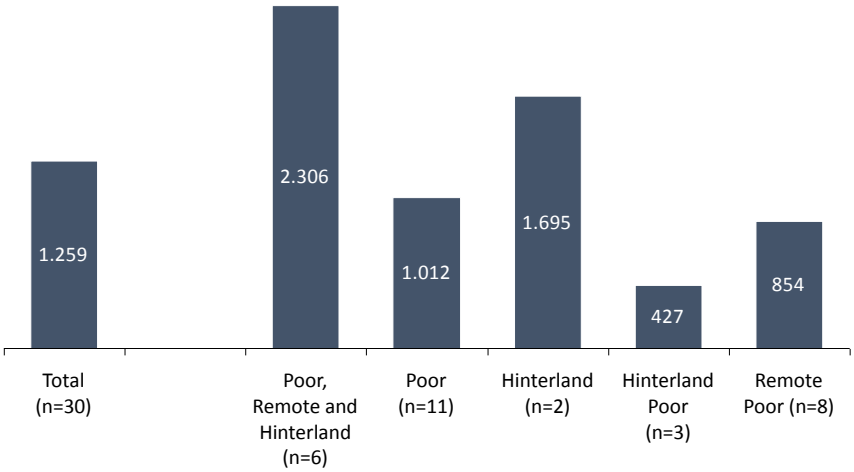


Figure 209 - Willingness to Pay: Texting (in GYD)

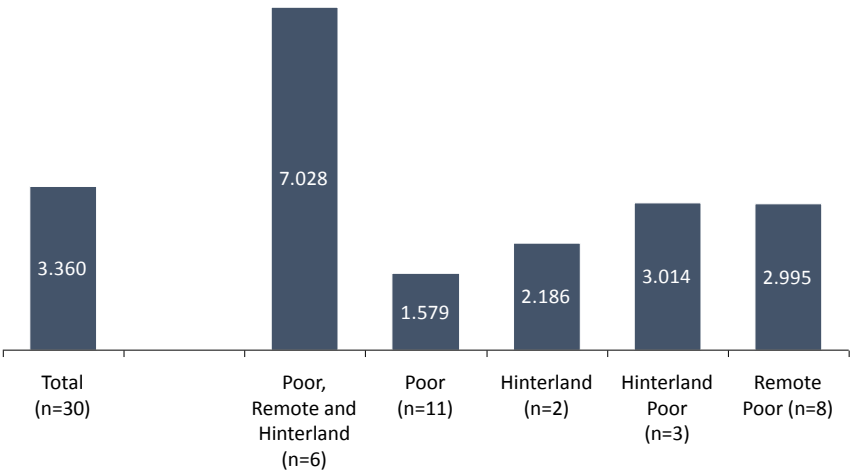


Figure 210 - Willingness to Pay: Phone Calls (in GYD)

The younger the interviewees were, the higher the average willingness to pay for internet services (landline and mobile) could be noted.

A different view can be identified in areas without internet access: the older the interviewee, the higher their respective willingness to pay for simple communication services like voice and texting.

A detailed view on the different age groups shows a greater willingness to pay for a mobile internet service if the users already own a Smartphone: 63% of young people under 25 years have at least one smartphone, compared to 44% of the sample between 25 and 54 years and only 23% of respondents over 54 years.

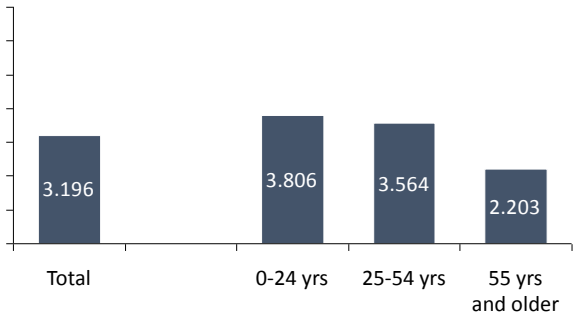


Figure 211 - Willingness to Pay - Mobile internet per age groups (in GYD)

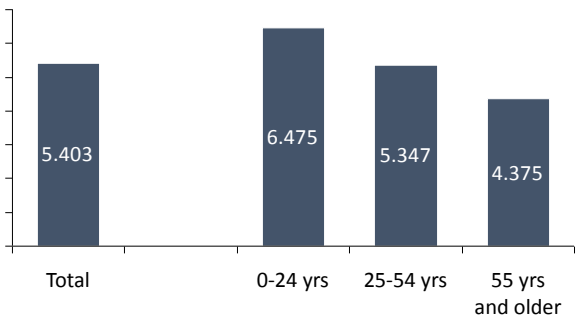


Figure 212 - Willingness to Pay - internet at home per age groups (in GYD)

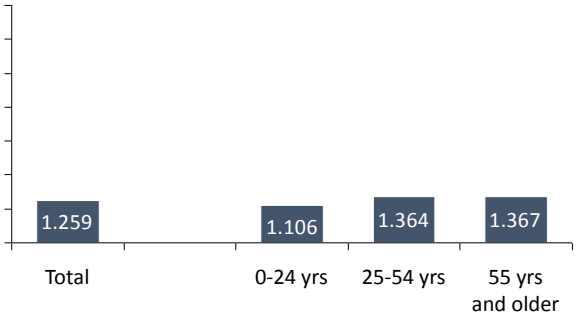


Figure 213 - Willingness to Pay - Texting per age groups

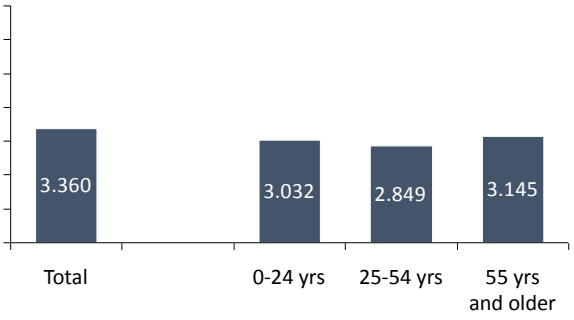


Figure 214 - Willingness to Pay - Phone Calls per age groups (in GYD)

Regarding gender split, there is clearly a willingness of men to pay more for all the services offered than women.

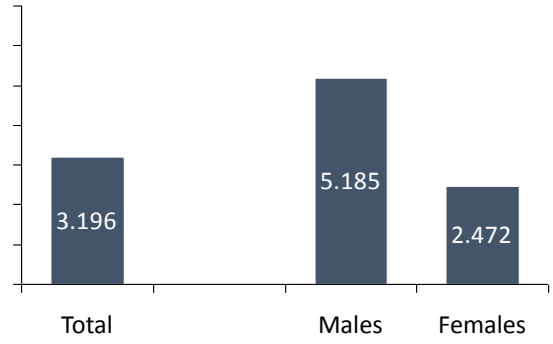


Figure 215 - Willingness to Pay - Mobile internet per gender (in GYD)

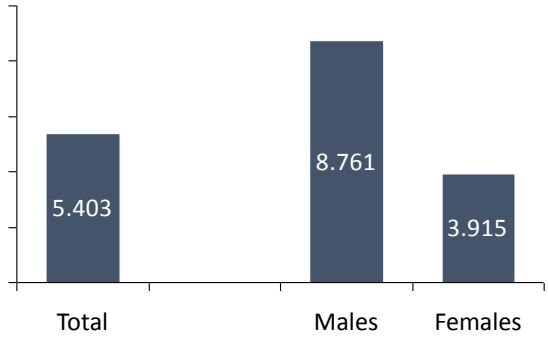


Figure 216 - Willingness to Pay - Texting per gender (in GYD)

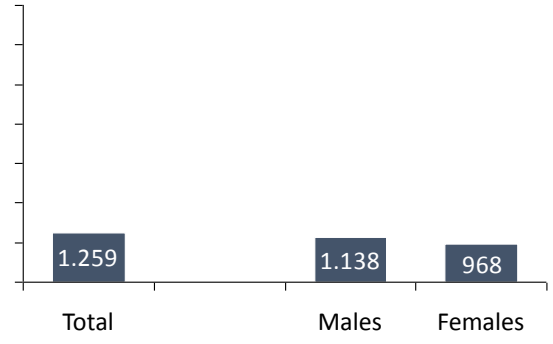


Figure 217 - Willingness to Pay - internet at home per gender (in GYD)

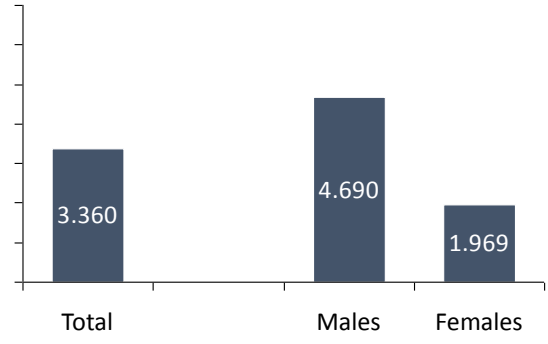


Figure 218 - Willingness to Pay - Phone Calls per gender (in GYD)

The cellphone is more used for local and national calls and the smartphone – using the internet for cheap and reliable VoIP calls – is used for international calls.

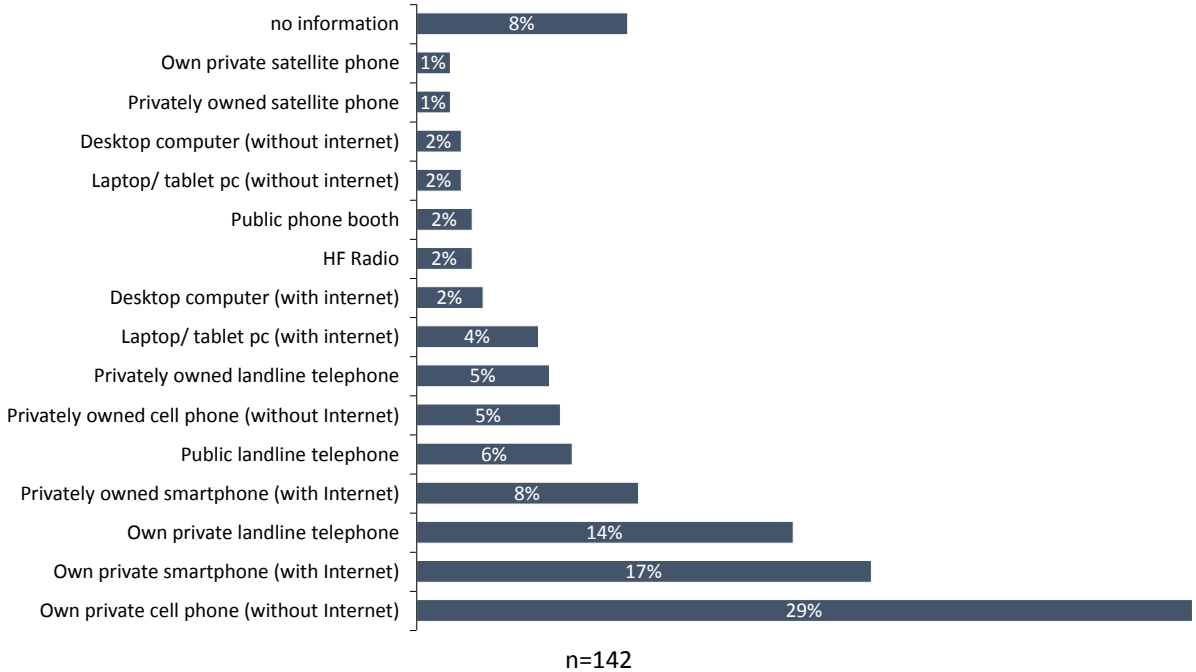


Figure 219 - Devices used for local calls (in %)

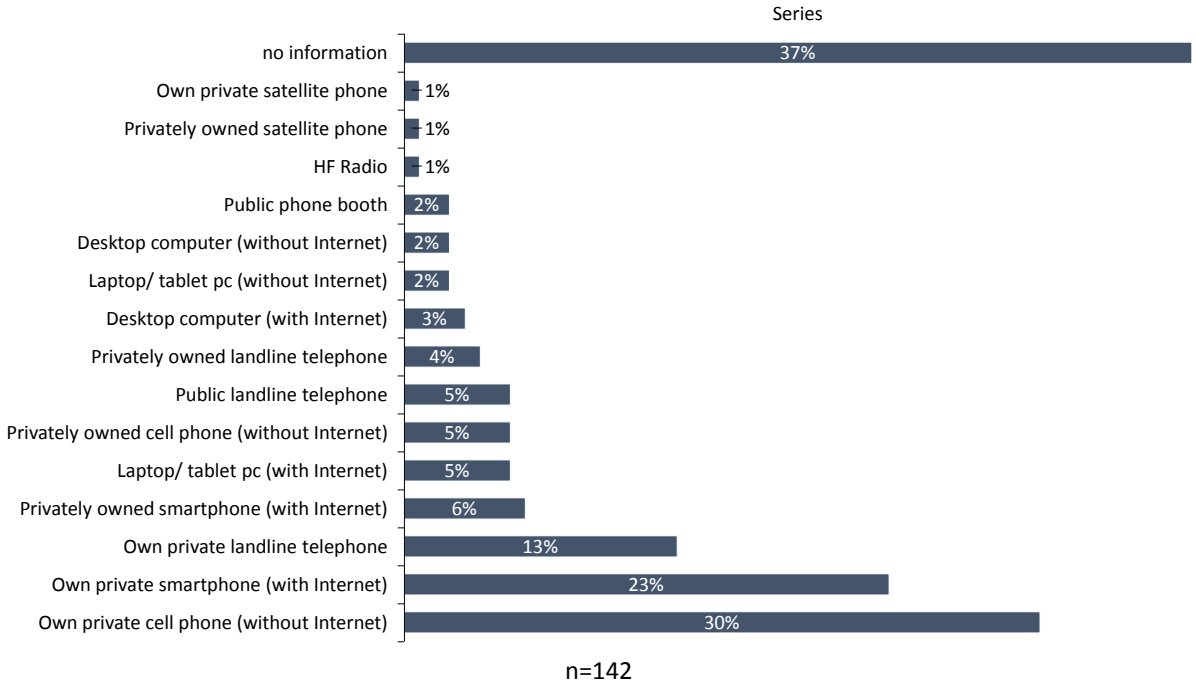


Figure 220 - Devices used for national calls (in %)

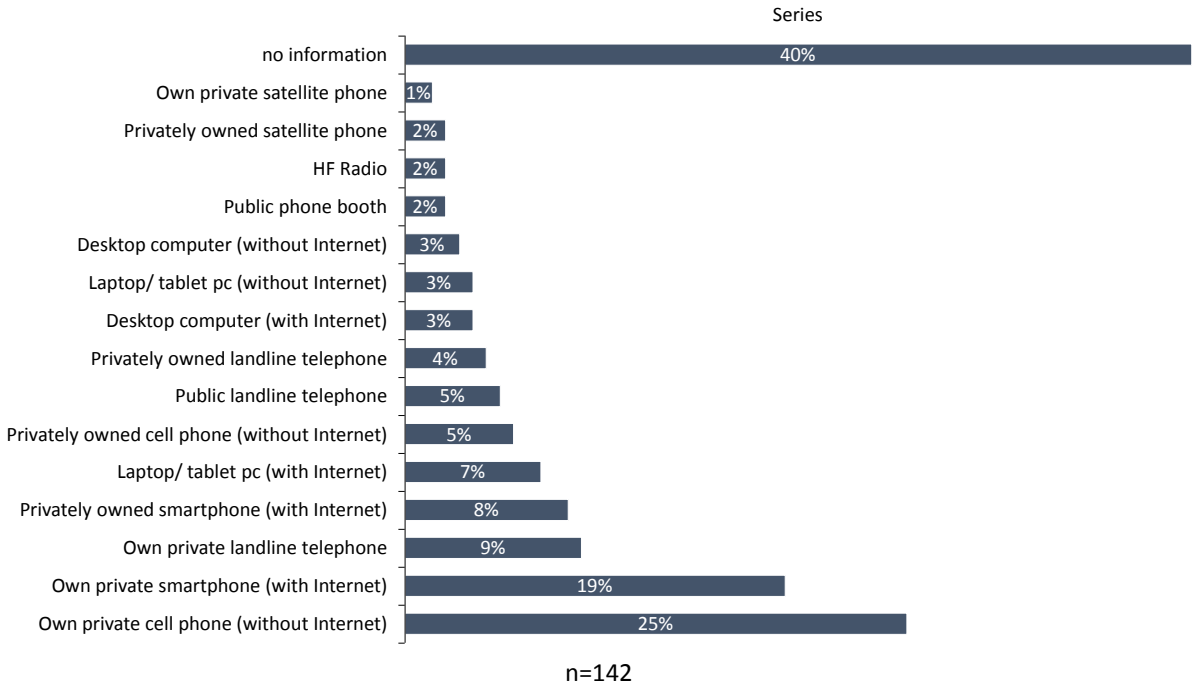


Figure 221 - Devices used for international calls

The age segment of 25 to 54 years shows the most diversified use of devices to make local, national and international calls. Comparing the age groups, they are the ones that use the highest number of different devices to make the calls.

Young people, however, stand out to in the segment to make local, national and international calls using their smartphones. For international calls they are also using more privately owned landline phone and laptop/tablet pc, web-enabled, in comparison to the other age segments.

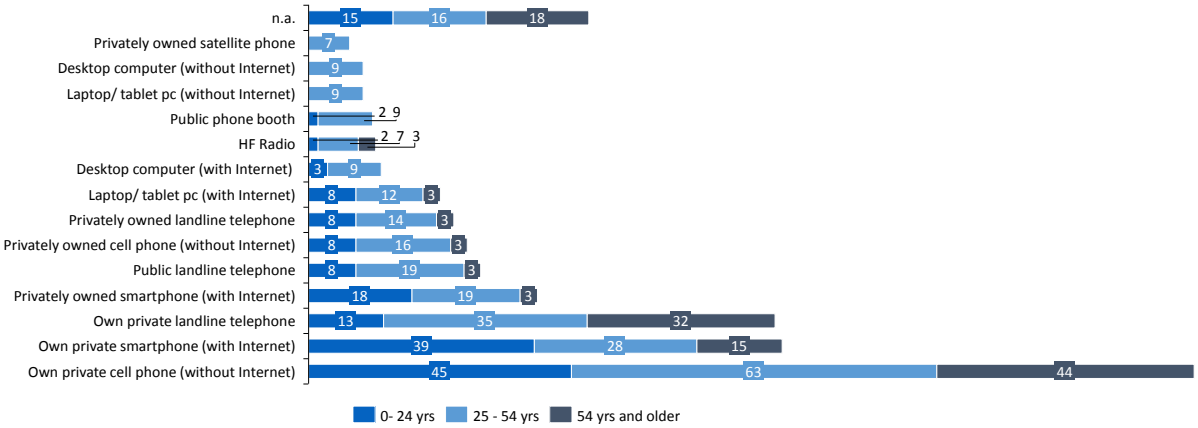


Figure 222 - Usage of different ICT devices in the community for local calls per age segments

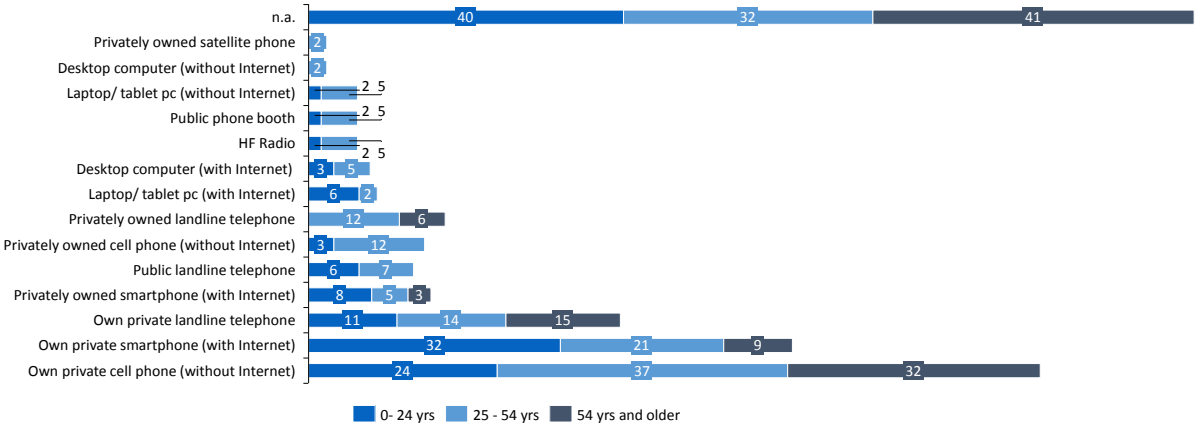


Figure 223 - Usage of different ICT devices in the community for national calls per age segments

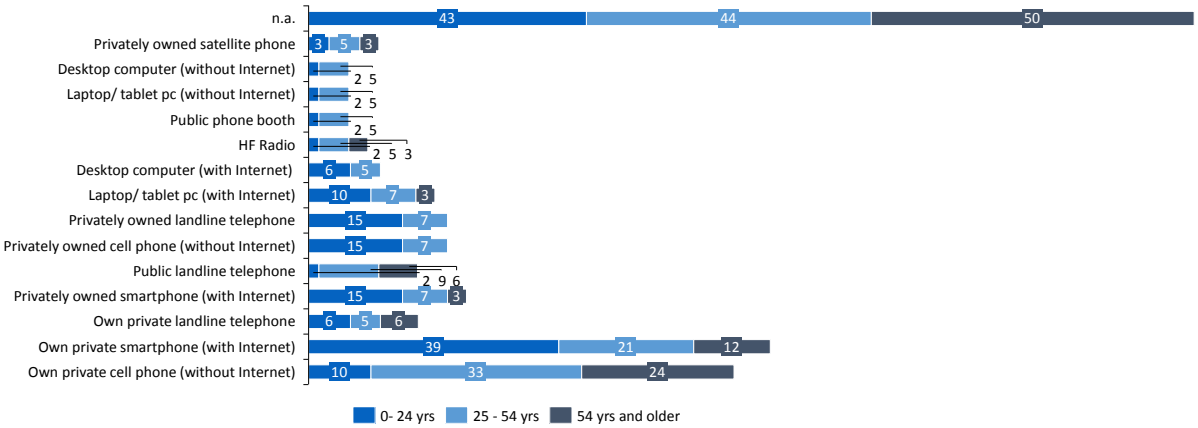


Figure 224 - Usage of different ICT devices in the community for international calls per age segments

For local calls women, more than men, use different devices. Mobile phones without internet and own private landline phone are the most used devices by them for this type of calls. On the other hand, men use the smartphone more often than women for such calls.

For other types of calls, only few differences in the usage pattern between the genders were identified. It is important to note that the use of privately owned smartphone for national and international calls is higher among women than among men.

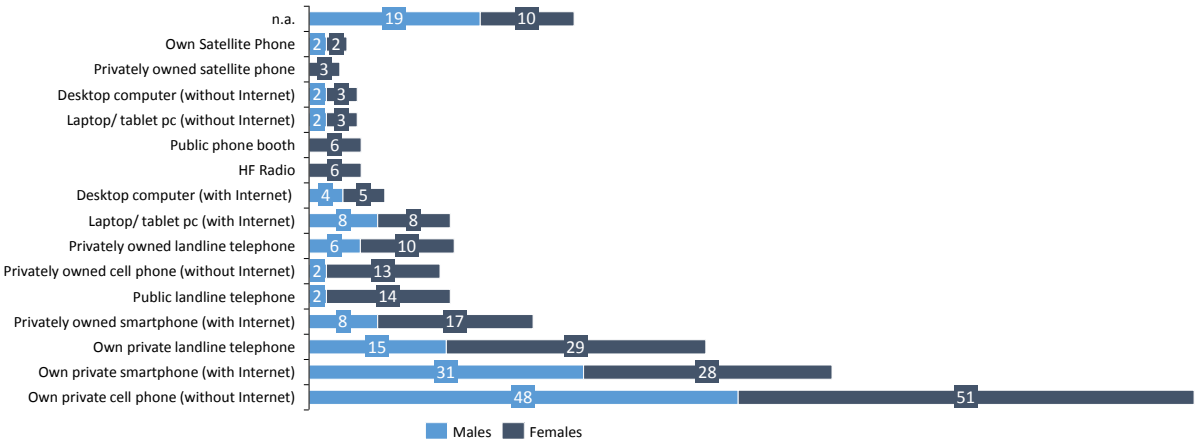


Figure 225 - Usage of different ICT devices in the community for local calls per genders

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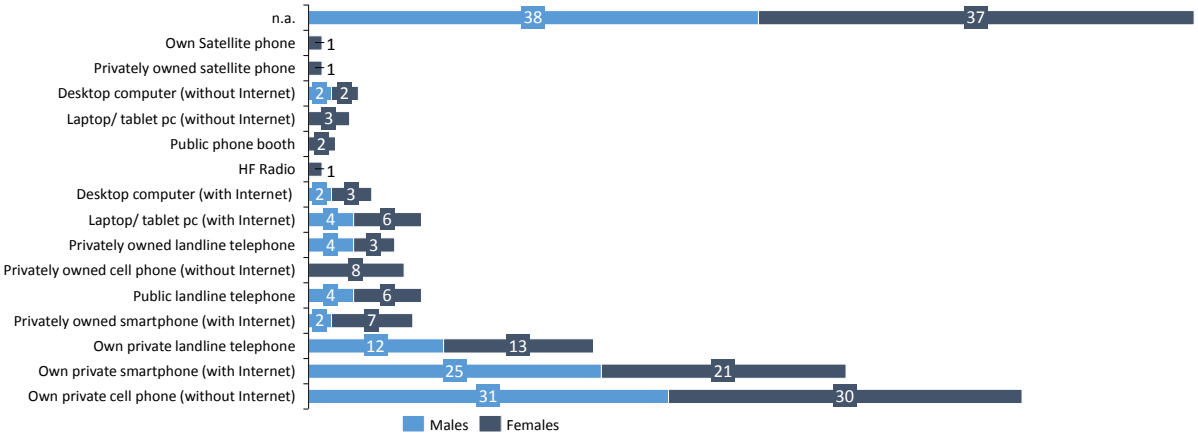


Figure 226 - Usage of different ICT devices in the community for national calls per genders

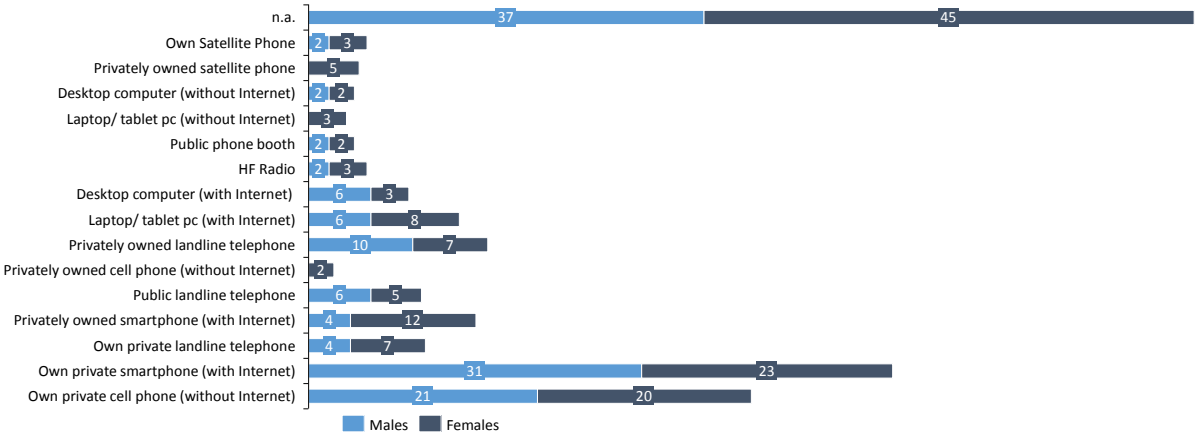


Figure 227 - Usage of different ICT devices in the community for international calls per genders

80% of respondents agreed that the internet would enhance the quality and level of education. They also believe it would improve health care and help the leader to manage the community.

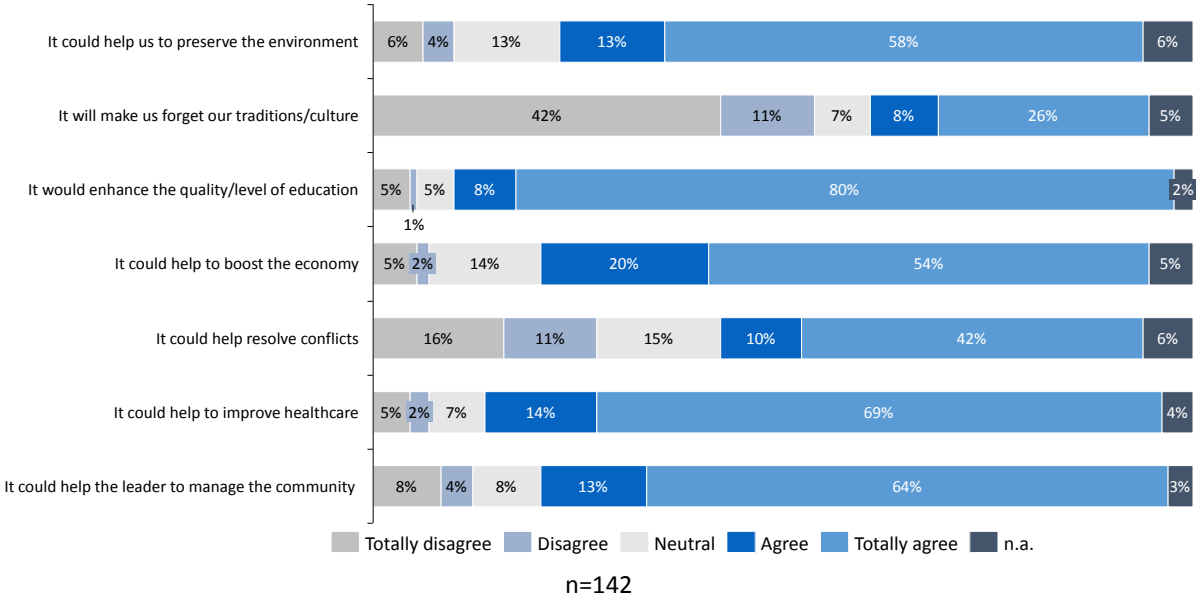


Figure 228 - Perceived implications of access to ICT technology

Among older interviewees (over 54 years old), it can be observed that on the one hand they are more conservative about their expectation of the internet's influence on the preservation of cultural traits: 48% of them believe that the use of this technology can make them forget things related to culture traditional. On the other hand, they show themselves as enthusiasts regarding the benefits brought by the introduction of the internet in different ways in communities. They agree more than other age groups that the use of internet can help to preserve the environment, that it would enhance the quality/level of education that it could help to resolve conflicts, that it could help to improve local healthcare services and that the technology might help the leader of the community to manage the community better.

The influence of the internet to develop business in a better way is felt especially among the interviewees in the age group of 25-54 years. For 71% of those, internet could help to boost the economy.

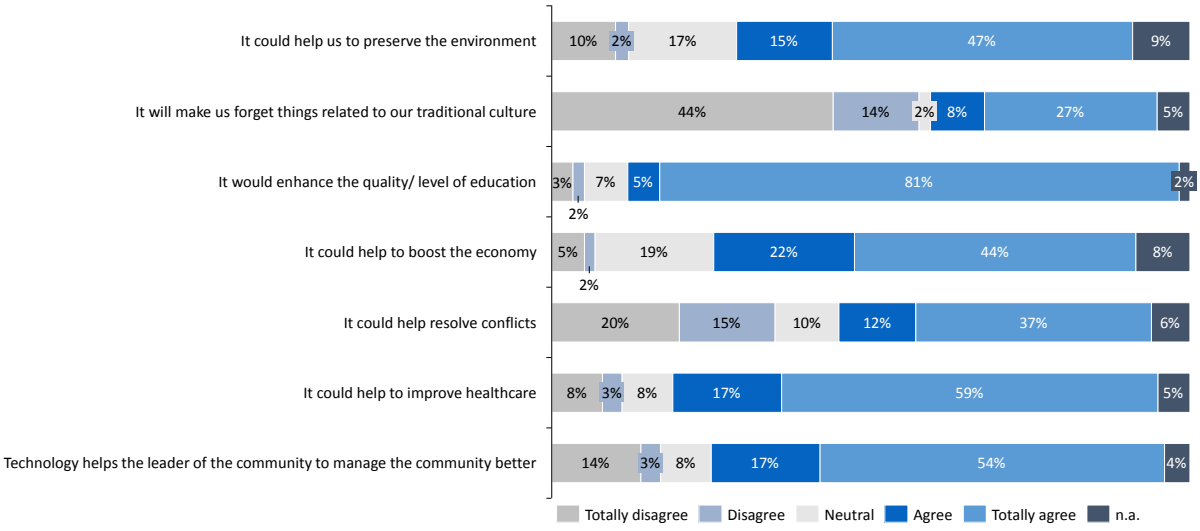


Figure 229 - Expected influence of ICT to the community per age segment 0-24 years old

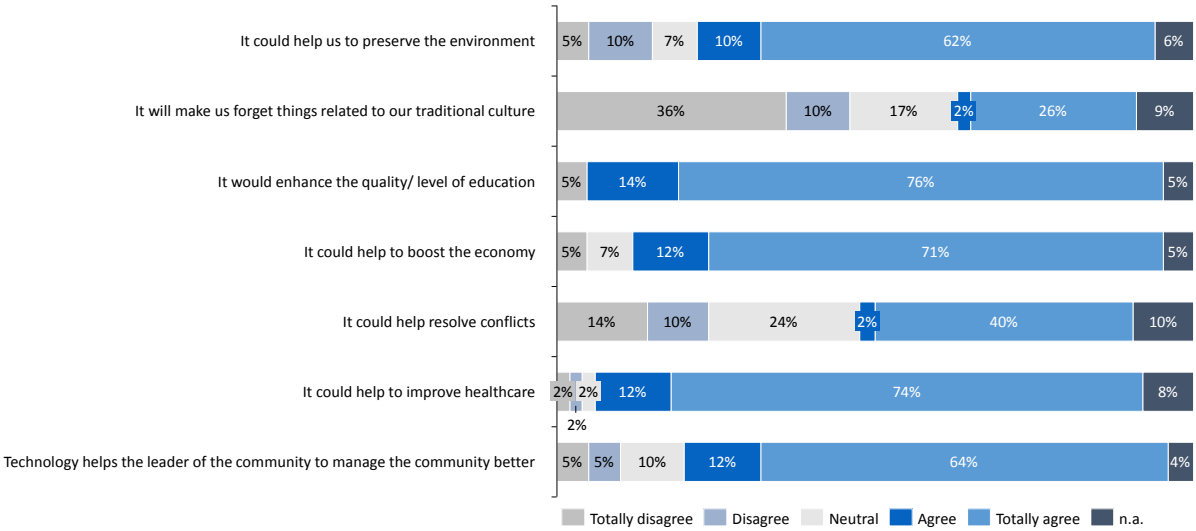


Figure 230 - Expected influence of ICT to the community per age segment 25-54 years old

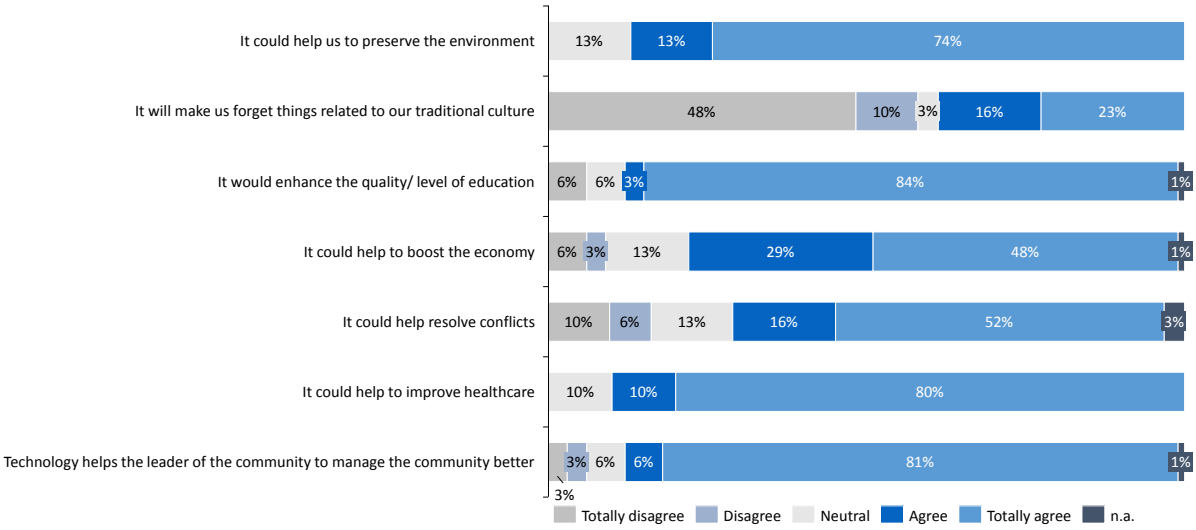


Figure 231 - Expected influence of ICT to the community per age segment 55 years and older

Men, more than women, see benefits to the community with the usage of the internet. Especially when it comes to education: 84% of men agree that the internet would enhance the quality/level of education, against 78% of women. Women show themselves as more conservative, nearly 30% stated that the internet will make us forget things related to our traditional culture.

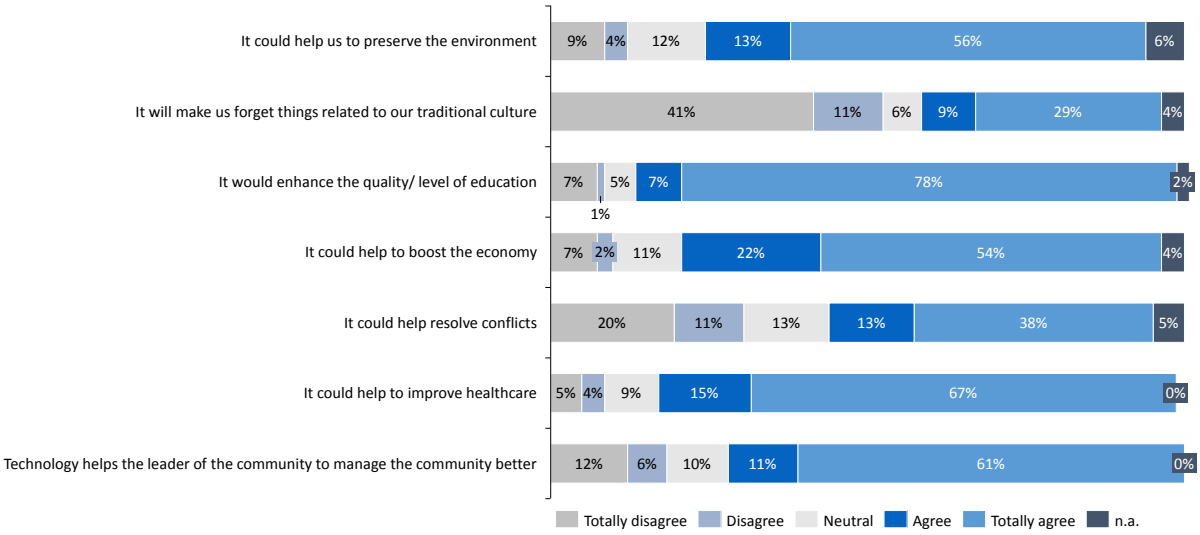


Figure 232 - Expected influence of ICT to the community (Females)

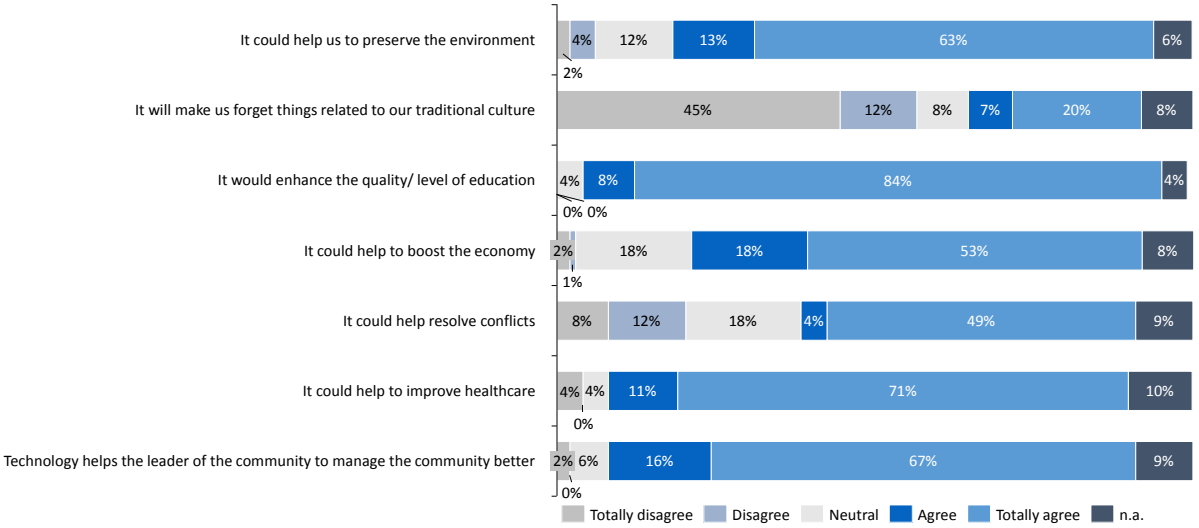


Figure 233 - Expected influence of ICT to the community (Males)

More than half of the respondents use the internet for web browsing and chatting. 48% use it for social networking.

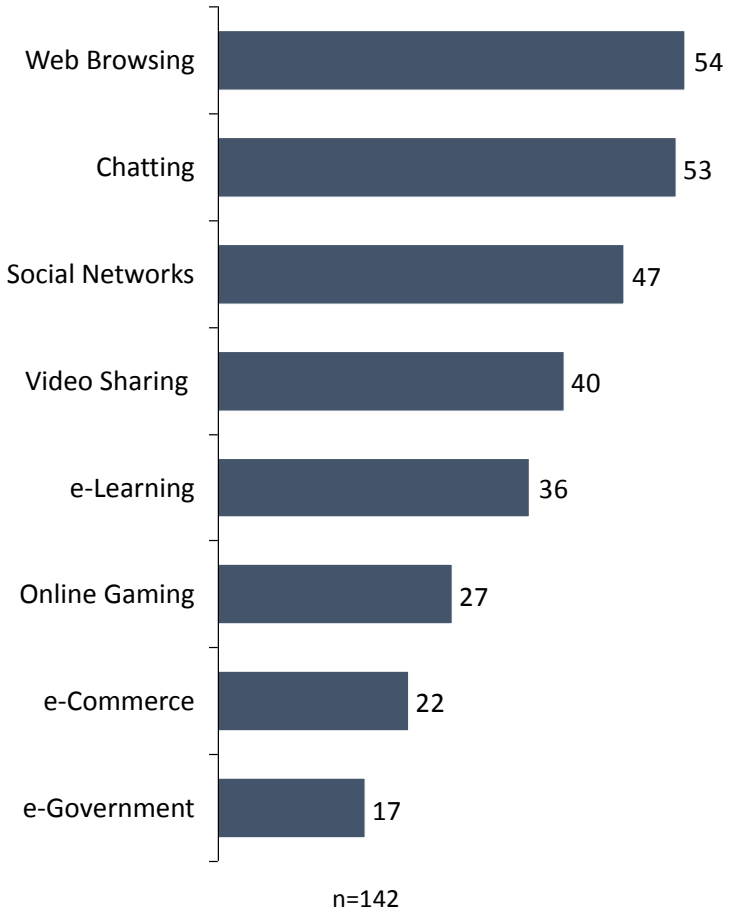


Figure 234 - Use of internet services

Younger people under 25 years old are the most widely respondents who use the services available on the internet.

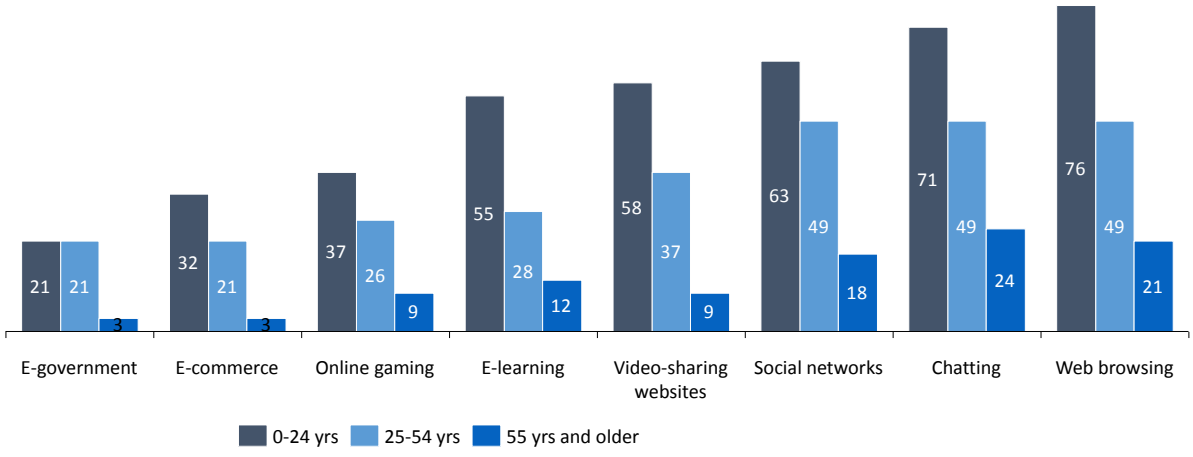


Figure 235 - Usage of internet-services per age segment (in %)

Men, far more than women, use different services offered on the internet. Especially social networks, chatting and web browsing.

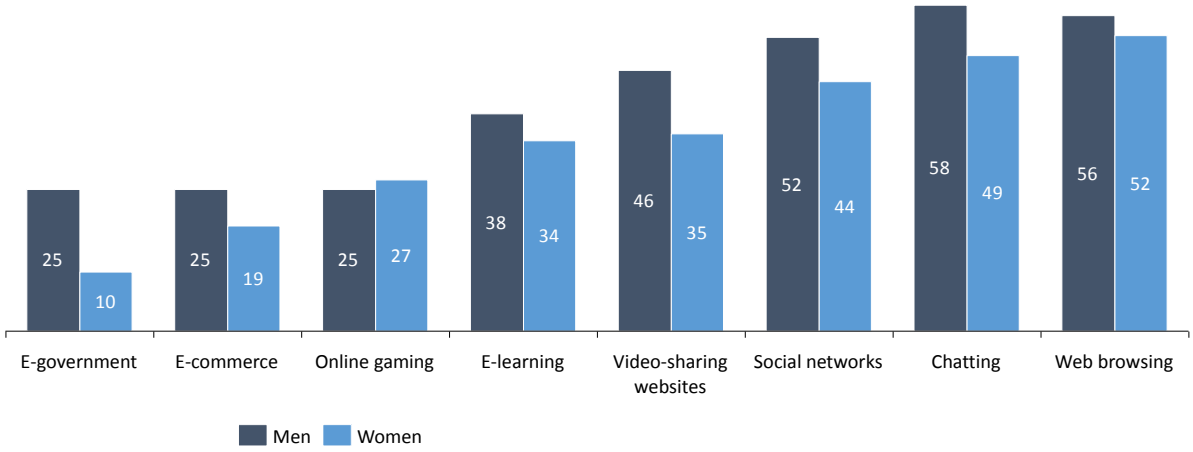


Figure 236 - Usage of internet-services per gender breakdown (in %)

4.2.3.8 Education

According to the communities' leaders, more than 75% of those who have started school, did not complete it, but dropped out. Financial difficulties is the reason most frequently mentioned by the respondents: Pupils often have to go to a nearby community in order to complete their studies. This is financially not affordable for them. Another reason mentioned is the necessity to give up school in order to work or help their families.

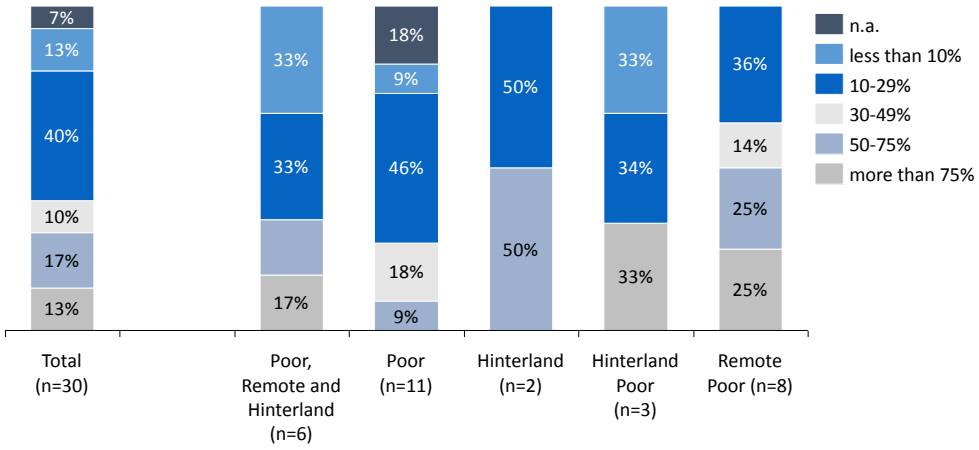


Figure 237 - Percentage of school dropouts per community segments (in %)

4.2.4 Interviews with Representatives of the Education Sector

Interviews have been conducted with experts in the communities from different sectors. This chapter provides the key findings from the interviews with experts from the education sector.

4.2.4.1 Overview

The research registers great variation in the access to information and the access to communication technology for education professionals. While most of the heterogeneity can be described in geographical terms, (e.g., variation through regions) important differences can be noted as other variables, such as race, etc.

One common feature of all analyzed communities, however, is the apparent dominance of cellular phones as the most commonly used mean of communication. With the exception of communities with nonexistent communication services (besides the HF radio), most interviewees define cellphones and Smartphones as prevalent not only in their own communication-related activities, but also in their communities in general. In places where internet services and landlines are not present, education workers even use their own personal cellular phones to do tasks related to their job.

On the other side computers, laptops and tablets, are not as common as they should be among education professionals – especially considering the specific needs of these professionals. While most teachers, head teachers, and education workers stated their wish for more access to communication and information technology, a similar amount complained about existing conditions. Lack of training, bad or non-existing internet and Wi-Fi services, as well as delayed delivery of promised equipment were the most frequently mentioned problems.

Nevertheless, in a more positive note, many professionals also mentioned current plans to bring technology access and develop computer literacy in their schools. They also recognized the potential of improved connectivity to improve access to information and services - helping both, students and teachers to complete a greater number of tasks, to acquire greater qualification, and also to connect with the world.

Interviews show that professionals in the education sector are generally optimistic about their country, even though they recognize some challenges in the path of future development. They tend to emphasize the common traces of Guyanese cultures, showing a propensity to cooperate with different races and ethnicities in order to improve their country and their community's situation.

Some interviewees demonstrated trust in the current government, while others externalized general skepticism and anxiety with politics. Besides that, the politicization of ethnicity was a concern mentioned in interviews. Indigenous people, for example, tend to express a feeling of alienation and marginalization from the Guyanese society.

Finally, almost all interviewees recognized the need to build a better telecommunication infrastructure. They stressed the role these technologies could play in making Guyana more developed, integrated, and culturally unified. Nevertheless, while ICT importance is widely recognized, full knowledge about its possibilities and working is not completely widespread. Therefore, it will be necessary to improve awareness and capacities in a targeted way - in such a manner that all Guyanese ethnicities, regions, and communities, can equally enjoy the possibilities of 21st century communication technology.

4.2.4.2 Communication over Long Distances

The time spans and distances registered in this question varied greatly. Most respondents state that they would not be willing to travel long distances to communicate face-to-face, as long as they can reach their families, friends, co-workers, or supervisors, easily through the cellphone.

Five respondents (as highlighted below), however, are prepared to travel longer distances in order to communicate face-to-face. This can be explained by two reasons. First, there are communities which do not possess possibilities for communication over longer distances. Second, interviewees believe that in certain conditions direct contact with counterparts is needed – such as emergencies and specific work situations. However, these conditions do not occur very often.

> *"I would go the distance, I would go the distance as long as it's important and I know that I can make an impact, I would go the distance. [Interviewer:] Do you have an idea about how long it would take or how many miles? [Interviewee:] Two hours.*
>
> *[Interviewer:] And how frequently do you encounter situations that you need to talk to people over longer distances without a phone? [Interviewee:] Not often. Twice a month. My brother is in Georgetown. [Interviewer:] Oh. Any other situation?*
>
> *[Interviewee:] For university."[Region 5, Rosignol , Female]*
>
> *"Well, depending on the person [she would travel] around Lethem, not too far, but in some instances it would still be far. (…) Let's say 2-3 hundred meters to contact with someone. It*

depends on the situation. If you need to make contact with parents or so. We rarely have such a case. (…) Around once a month if we get problems or so."[Region 9, Lethem, Female]

"Like every week, once or twice. In situations you really need, like for a relative, brother, sister, children. [For long distance communication, generally uses] a cellphone. When they have a cellphone, you can call, but if they don't, you have to go. Sometimes we have one but they don't, so we still have to go." [Region 4, Laluni, Female]

"Well, it depends on, like, the situation, like if it was for a work interview or, like, business, then I'd probably travel quite far... well, if it was just for a friend, I'm probably more likely to phone them than going to see them face-to-face." [Region 10, Kwakwani, Female]

"Well, mostly if somebody is far and I have to talk to them I'd do the calling. Instead of just travelling a long distance [to communicate] face to face." [Region 1, Port Kaituma, Female]

4.2.4.2.1 Frequency of Long Distance Communication

The frequency of communication over long distances also varies for professionals in the education sector. Individuals living in communities with regular to good communication infrastructure maintain contact more regularly with friends, relatives, co-workers, and supervisors living in distant locations.

Wherever the quality of this infrastructure and the personal familiarity with devices is lower, however, contacts via long distance communication become less frequent. In this sense, professionals living in worse-off communities - in terms of telecommunication services - generally communicate over long distances only on special occasions. The HF radio set can be used but mostly these professionals have to travel in order to obtain training or to communicate with authorities.

"Almost every day. (…) Like, to find out stuff… calling friends, speaking to relatives, my boss…[interviewer:] So, you'd say that is for personal reasons, like your friends or family that live far away, but also for job related things, you would reach out your supervisor, your boss… [Interviewee:] Yes. [Interviewer:] So, you need this every day, all the time, right? [Interviewee]: Yes." [Region 2, Charity, female]

"[Interviewer:] Oh, so you use it to communicate with your family. [Interviewee:] Yes. My family is far away… [Interviewer:] And regarding your work, do you have to […]. [Interviewee:] Regarding my work I speak with the officers… [Interviewer:] But do you have to communicate over longer distances… [Interviewee:] Yes… regularly." [Region 7, Kako, female]

"I'd usually use [the cellphone] for calls and when I come here, I'm making contact with people, so I have my sister, and if I don't have something really important to say, it's a casual visit, do you understand? (…) I would use my telephone twice a month (…), and sometimes not every month. I'm just giving you an example. Sometimes you have important workshops. You have to contact them, to know if it's still on. Sometimes you have to call here, because it's very expensive to travel." [Region 3, Saxacalli, female]

"When I'm calling home, I usually do that about once a month, so that's a long distance. Or I guess if I'm phoning friends or someone in the country, but that doesn't really happen often, it's mostly … or anything… [Interviewer]: I understand. So mostly for communicating with your family and regarding work, like to get some training here...[Interviewee:] Yeah, well, if I have any concerns about the work or anything like that then, yeah, I would have some communication with them." [Region 10, Kwakwani, female]

4.2.4.2.2 Means of Communication for Long Distance Communication

A common feature of the use of telecommunication throughout Guyana is the prevalence of mobile phones – whether "regular" cellphones (as some respondents refer to the cellphone without access to the internet) or

Smartphones. While in most[57] communities local residents intensely use the cellphone (if coverage permits), only one of the communities (Karasabai) relies on HF radio and satellite phone only to communicate with the outside world.

The mobile phone is used for a range of activities, from regular calls to chatting and social media. In many places they are the only devices with internet access, what makes them useful not only personally but also professionally. Again, computers, tablets, and laptops, are less used than they should be by education professionals. The lack of Wi-Fi networks in many locations, alongside with high prices and the absence of near places to buy it are mentioned as the main causes of this situation.

The mentioned devices are used in a number of situations. HF radios are used mostly in emergencies, while cellphones are employed in everyday communication. With few Wi-Fi spots, computers, tablets, and laptops, are rarely used for long-distance communication.

> *"The telephone. Mostly the mobile because the landline is out of order, a little over a year now. (…) [Interviewer:] So you generally use your phone, and your phone, does it have access to the internet? [Interviewee] No, this one does not have access to it. I have internet here [in the desktop computer]. [Interviewer:] When do you generally use your phone? When you are working? [Interviewee] Yeah when I am working, most of the time I'm working." [Region 5, Perth, Female]*

> *"Based on my, job, I'm not at home most of the time so to communicate with others I would use a cellphone. For the landline (…) I would use it like 4 times a day, but the cellphone it is like 8 times. [Interviewer:] And you have a cell, do you generally use it when you are working, you need to talk to your family or talking to the students' parents? [Interviewee:] Students' parents, other colleagues even the ministry of education if I need to clarify something, to call the ministry of education office." [Region 5, Rosignol, female]*

> *[Interviewer:] What means of communication do you typically use for long distance communication? [Interviewee:] The telephone. [Interviewer:] The telephone. The landline or the cellphone or Smartphone? [Interviewee:] I don't have a landline; I mostly use the cellphone. [Interviewer:] Do you have an ordinary cellphone or do you have a Smartphone? [Interviewee:] The ordinary one. [Interviewer:] And how often do you use your cellphone? [Interviewee:] Very often. [Interviewer:] And in which occasions do you use it? [Interviewee:] Like, to contact… at school, if we have to contact parents when a child gets sick or something like that, or when I'm home to contact my own children and other family members." [Region 2, Charity, Female]*

> *"[Interviewer:] So, normally… what means of communication do you use for long distances? In Karawabe, do you have a Radio too? [Interviewee:] Yes, there's a Radio there. [Interviewer] And do you use it for long distance too? [Interviewee]: Yes. [Interviewer]: For calling in the mines. Or other places… [Interviewee:] Yes. [Interviewer:] So, normally, you use the Radio and the cellphone as means of communication there, right? [Interviewee:] Yeah." [Region 2, Santa Monica, female]*

Regarding the use of devices for the entire community:

> *"Cellphone, actually for now everybody has got a phone just to call. Sometimes they call, their friends call, you know. We don't have a landline phone so we use the cellphone. So it is the main access to get contact, a phone. Because if you want something you call, if I want something, I'll call her." [Region 4, Laluni, Female]*

> *"[Interviewer:] And about the community, what kind of devices or means of communication are used for long distance calls? [Interviewee:] Normally people would use their cellphones. [Interviewer:] Do they have both, Smartphone and cellphone? Do you know? [Interviewee:] Yes." [Region 2, Mainstay, Female]*

4.2.4.2.3 Role regarding Communication Systems in Communities

[57] 25 of the 30 representatives of the communities surveyed stated that 50% or more of the people in the community own a smartphone or a cellphone. Mainstay, Albouystown, Phillipai, and Mabarumba have 30% - 50% smart-/ cellphone owners according to the interviewees.

When being asked about their role regarding (tele)communication systems in their community, professionals in education sector mention initiatives to bring computers to their schools. They recognize both the need to teach the younger generation how to operate computers, and the necessity to use these devices in order to fulfill complex tasks and to do school-related research.

Regarding points of contact with telecommunication, respondents can access telecommunication mostly at home. The workplace comes after, as interviewees mentioned that they use phones to communicate with co-workers and to coordinate joint activities.

4.2.4.3 Available Forms and Uses of Telecommunication Systems/Devices

Guyana's telecommunication system is characterized by an unequal distribution of service availability throughout its territory. It follows the following regional pattern: while the coastal areas have in general a better network coverage (mobile and fixed line networks), hinterland areas are less integrated into the national communication network. Regardless of this, there are also relevant differences within the different regions.

Taking into account variations in the level of access to information and communication technology, the set of surveyed communities were divided in three subcategories. The first one characterizes those that have 1) a more diverse number of available services and 2) widespread access to most of these services.

The second comprises communities with a limited number of services with moderate to good quality covering the living areas of a majority of the people. The third group includes communities with very few services available.

4.2.4.3.1 Landline Phone

A majority of communities that have been assessed in this study do not show fixed line services available to the population. If fixed line services exist, they are used in some places exclusively in public offices and facilities (such as hospitals and government offices). In others, landlines were once present in specific communities, but are due to lack of maintenance currently not working. Most of the communities have fixed line networks available are located in the more urbanized, coastal area.

Wherever fixed line networks are deployed and in operation, people generally use them for official purposes – like communicating with public authorities and performing business-related activities. In communities currently lacking fixed network services, respondents expect the landline service to arrive in their community mostly to get internet access, while others think the cellular phone already covers most of their needs.

> *"Few [landlines], because some houses still don't have a landline. [Interviewer:] Why they don't have it? [Interviewee:] Because before the cellphones, we were having landlines and they probably had a limited number of lines to distribute. Probably people also thought they had a cellphone, why buy a landline?" [Region 9, Lethem, Female]*

> *"[Interviewer:]: There's no landline here? [Interviewee:] Yes, the resort has... (…) [Interviewer:] There (at the resort) is the only place with a landline telephone? [Interviewee:] Working… yes. [Interviewer:] You said working… is it because there was a landline that was working and now it doesn't work anymore? [Interviewee]: Yes, at the factory… one time they used to have… when it was processing… but it's not processing now… [Interviewer]: How long has it stopped working? [Interviewee:] About three years." [Region 2, Mainstay, female]*

> *"[Interviewer:] The landline doesn't work? [Inteviewee2:] We don't have sufficient line phones in the community… [Interviewee1:] Not every home has one. [Interviewee1:] You have to apply and then you have to wait on the approval… it's a long process (…). [Interviewee2]: They say the area is overloaded, so they don't have landlines… [Interviewee2:] The circuit is overloaded because they say… the landline they have is the one with the [dish] (…) so what you have it's not the landline. [Interviewer:] You have a dish that allows you to have a landline, is that it? (…) [Interviewee2:] And if you have it, it's not working… this one here, our neighbor, we share with our neighbor, but it's not working." [Region 2, Charity, Females]*

4.2.4.3.2 Cellphone/Smart Phone

The cellphone is the primarily used mean of communication across the communities assessed in this study. The mobile network is widely used, not only for phone calls and SMS messages, but also for internet access. Most of the respondents use Digicel, but GT&T is also being used if the network is available in the respective community.

In more isolated communities, the research showed that the signal quality is not equally good in the whole community. Communities located outside of the main areas in certain villages are not covered at all. Other villages have only a few specific spots where the user can get a signal. 3G networks are not available in all communities. Villages with bad network and service quality are generally indigenous people communities in the hinterland regions.

Where a 3G network is available, Smartphones are the main devices used for internet browsing. Messaging apps, such as *Whatsapp*, and also social networks are generally used via the Smartphone. While the use of this kind of device is reportedly widespread among young people, they also manifested concerns about the capability of older people to operate them. Some of the respondents, even though living in places where internet is available through the Smartphone, do not feel the need to use the services[58].

4.2.4.3.3 Computers/Laptops/Tablets

Computers or laptops are available in almost all communities[59], even though, in the majority of the places, only a handful of the public reportedly has access to these devices. internet cafés and similar services are not common, and many interviewees described that the only way to do internet browsing is through the Smartphone with a 3G network.[60]

I the views of the respondents' one reason for this situation is the unavailability of connectivity and also financial constraints with the users. In order to buy computers, laptops, or tablets, the consumer who lives in more isolated locations needs to take into account not only the price of the device, but also the costs to travel to a place where these devices are available. Besides that, the absence of internet services can make the effort to acquire new ICT devices seem futile.

Education professionals interviewed during this research tend to recognize the benefits of using computers, tablets, and laptops. They frequently mentioned activities in which they could use these devices, e.g. to complete complex tasks or to add new training features to their classes. Nevertheless, many of them do not have proper access to devices and network connectivity to the extend what they consider necessary.

The lack of devices other than the Smartphones is also seen as a problem by the interviewed students. Teachers acknowledge that young people need to be in contact with new technologies in order to stay in the same pace as people with access to better telecommunication infrastructure. However, the teachers themselves do not feel comfortable when using the devices. Therefore, in order to implement programs to improve computer literacy in school, teachers would probably need to obtain extra qualifications.

4.2.4.4 Desire for different Forms of Communication

Respondents to the questionnaire do not acknowledge many other means of communication besides those directly mentioned during the interview (landline phones, cellphones, Smartphones, computers, tablets and laptops). An interviewee from an isolated community spoke about the HF Radio, since the one in her community was broken, leaving her without any means of communication.

However, most of the interviewees are willing to get better and are expecting less expensive services. Also in locations where communication networks are comparatively underdeveloped, people want to have access mainly

[58] See **Fehler! Verweisquelle konnte nicht gefunden werden.**and **Fehler! Verweisquelle konnte nicht gefunden rden.**

[59] Only in 3 communities nobody owns a desktop PC or laptop (with or without internet access) according to the communities leaders interviewed: Phillipai, Tumatumari, Plegt Ankor.

[60] In 20 of the 30 communities surveyed less than 30% of the people own a PC or a laptop (with or without internet access). Communities where 30 or more percent of the community members own a PC or a laptop are: Lethem, St. Cuthberts, Wismar, Coomaca, Bartica, Charity, Wales, Perth, Ithaca, and Mahdia.

to the internet. Their understanding is that even with the existing of a connected fixed line phone will allow them to browse and use the internet.

4.2.4.5 Case Scenarios[61]

The average response to the case scenarios demonstrated (for explanations see 4.2.4.5.1, 4.2.4.5.2, 4.2.4.5.3, 4.2.4.5.4) shows that the interviewees have a genuine wish not only for better telecommunication services, but also general interests in new and/or improved internet based services. They believe that e-services, such as e-commerce, e-learning, e-banking, and e-government not only can be more convenient, but also help people to significantly improve their living standards.

For instance, propositions in the four case scenarios, which were applied to all respondents, were generally well accepted. E-learning is welcomed as a viable option especially in the field of higher education and seen as a technology that could permit professionals and students to acquire additional qualifications more easily.

E-commerce is also well received. Respondents from villages where agriculture is the main economic activity are particularly enthusiastic. Firstly, interviewees believe that a local, government-run website could provide a service more in line with their direct needs and secondly, they think that having direct access to buyers would solve uncertainties they are currently experiencing.

E-banking is also seen as extremely convenient. Current options for money transfer are risky, expensive and require extra time and efforts. In this context, the idea of transferring money via mobile phone is generally well received by the interviewees.

Regarding e-government, the option of contacting public authorities and services through the internet is also well received. Particularly, registering newborns in a quicker, less bureaucratic way is considered to be an advancement compared with the current situation.

Notwithstanding, implementing these services will be a challenge for policy makers. The first and more obvious obstacle is the lack of proper telecommunication infrastructure in many of the communities analyzed in this study. E-services depend on reliable internet connection, which is currently not provided in many of the visited locations. The second obstacle would be a lack of familiarity with e-services in particular and ICT technology in general. Since computer illiteracy is a problem mentioned several times, computing lessons should be provided in such a manner that all customers can learn how to properly utilize new services.

4.2.4.5.1 E-Commerce

> *"I just… I would… [sell] in the market in another area. And then, if it has to go by road, I'd use a vehicle in transport, If it has to go by river, I'd transport through the river, the airplane is too expensive." [Region 1, Port Kaituma, female]*
>
> *"I would call Mahdia and inform to Mahdia business people, 'Ok, I have 2000 pounds (...) 20,000 of planting, a 1000 pounds of [something] and get access to the market for you. So let's say Mahdia is very much populated in terms of shops. So let's see a thousand shops will take a hundred farms and I would do that." [Region 8, Tumatumari, Female]*
>
> *"Well, the [beginning of the] process would be making contact. If I have a person I want to sell my goods, I make contact with them, make some sort of arrangement, if it's by boat or by bus, airplane. We would make the arrangements and would ship it to them." [Region 1, Mabaruma, male]*

"Now imagine the possibility of a government-run website that enables you to trade your goods on a national (or international) platform online. How do you feel about this?"

> *"[Interviewee1:] People would go on that… that would be nice… [Interviewer:] Do you think people would like that? [Interviewee1:] Yes. Because in that way you'd see a variety of things that you would want to buy or what other people are selling…things like that… [interviewee2:] So if you want*

[61] Note: the analyses were done considering an overall view, the quotes are displayed by topics as a way to highlight the aspects taken into consideration.

something you could go on the Net. Then you'd say "I want this book", right? And you're selling and I don't know, then I'd go on the Net and browse, then I see where I can find it with you." [Region 2, Charity, Females]

"I think a lot of people are interested in things like Amazon and eBay. But because Kwakwani is kind of removed from the coastal area, I think probably people [are] missing on that. So, if it was like a government-run thing it would probably be more accessible to people actually living in more remote areas." [Region 10, Kwakwani, Female]

"[Interviewee:] That's OK and that's a good idea, but then, I don't think maybe people would know how to do it. They don't know how to put this online or how to create a page or how to… Yes. They don't know how to do it. [Interviewer:] So, if there was such a service, do you think people should be educated? [Interviewee:] Yes." [Region 1, Port Kaituma, female]

4.2.4.5.2 E-Banking

"Through a businessperson, you know, you negotiate with that person if you want to send this down…yes, you can place order to it." [Region 8, Aishalton, teacher, female]

"For example, when children are far away we just send the money with people that are going out. For example, (…) any family member going out I send the money through them." [Region 7, Kako, Female]

"I normally use Western Union or my neighbor next door is a taxi driver, I'd ask him to take it." [Region 5, Rosignol, Female]

"Now imagine the possibility of transferring money via cellphone deposit. How do you feel about this?"

"I'd feel great if I could do it myself on the internet. It would save me some time and some cash. [Interviewer:] Would that be also easier maybe than traveling to Western Union? [Interviewee:] Yeah. To travel to both sometimes because when you get there, they're closed or they're not doing business that day. You won't even know if they're not doing business."[Region 5, Perth, Female]

"Really good. I'm not aware of this that you can send through your phone. Yeah, I'd use it." [Region 8, Aishalton, female]

"[Interviewee1:] Well, we're not familiar with that. (…) [Interviewee2:] It's a good idea but a few people would do it. Because they wouldn't know what are the rates, if it's cheap… [Interviewee1:] Ok, like… paying bills through the phone, through the Net? (…)Yes, yes… it's convenient, yes."[Region 2, Charity, Females]

4.2.4.5.3 E-Government

"That would be great, because for registering a newborn (…) you have to travel and spend a lot of money to get to the central community and the region to register the newborn and apply for marriage certificate and so on." [Region 1, Mabaruma, Teacher, Male]

"Well again, we get (…) to persons who are in that kind of arena, politicians in your community. You go and talk, so we can save the information, go somewhere to get that, to garner that information. With myself, I know this girl who works with these people, let me see if I can go and get the information." [Region 5, Perth, Female]

"Well... you sometimes get... (…) there's... like, some meetings and things, so, like, people could go on to meetings if they're open. Other than that, probably it would be online, researching it, or, like, asking friends for their opinions on things... like, I'm not sure how you would actually get the concrete information, probably would have to be online." [Region 10, Kwakwani, female]

"Now imagine the possibility of receiving this information or contacting governmental or public authorities (to register a new-born, apply for marriage, etc.) online. How do you feel about this?"

"I would be happy about that. When things are not going right with your school you can write to it. My ceiling fell the other day. (…) It fell overnight, not during the day. When we got there, it was done. But then I had to use the same phone to try to get the message over. Some people didn't get it, they say we

didn't call on time. When you call and don't get through, you've got to wait until you get through. So sometimes, two hours after, because you're far in and these phones, they are not so smart." [Region 5, Perth, Female]

"I feel more comfortable. Because right now I have a grandson that doesn't have a birth certificate… yes, it would be easy for us." [Region 7, Kako, female]

4.2.4.5.4 E-Learning

"[Interviewee:] Probably ask teachers for advice and information on... how to do... And other than that you'd have to go online and research the different universities and different options. But I think probably the first protocol would be a teacher. Like, whatever subjects you wanted to do, ask the teacher what kind of opportunities... [Interviewer:] And people do this often? [Interviewee:] Ah, a lot, not really... I think it are mostly probably families... Like, if someone has a family member who's gone overseas, then they're more likely to go overseas, because they've, like, seen the way to go about it. Yeah, the students do ask about... like, different universities abroad and, like, where can I do this, like, in Guyana there's not really anywhere to study drama, so I've had a lot of people asking me, like, 'Miss, where can I study drama', or like 'become an actress', and things like that. So yes, they do ask." [Region 10, Kwakwani, Teacher, Female]

"I'd have to go to the city to do it. Because we don't have it available online here." [Region 1, Port Kaituma, Female]

"Well, you'd do it once you have the finance. Some have the money and go abroad and study and so forth, but people who don't have money they would suffer. They wouldn't be able to have this education and they'd suffer from that." [Region 1, Mabaruma, male]

"Now imagine the possibility to get a degree from anywhere for yourself online. How do you feel about this?"

"I'd go for it. I'm learning about it from you, this is the first time I hear about it. I'd prefer to do that. If I have the opportunity to go to the university, I don't want to leave my family, which is the reason why I can't go to the university. So you are telling me, you are teaching me about the online classes or whatever you call it and I'd prefer that." [Region 8, Nappi, Female]

"Well, I feel more comfortable. That's a different moment. I have really no knowledge about these things (…)." [Region 7, Kako, female]

"I would like that, because actually not only my children, but for the community and the other young people, it would be really nice if they could get a degree from the internet. For at least, you know, you see the young people in the community develop instead of going down, they go up." [Region 4, Laluni, Female]

4.2.4.6 Cultural Identity and Belonging[62]

The final questions in the qualitative interview are designed to assess how respondents think about their own self-identification, how they evaluate the general situation of Guyana, and how do they see themselves as a part of a broader collectivity. It also intends to assess in which ways they think better telecommunication infrastructure could help developing Guyana from the perspective of "Nation Building".

Some issues mentioned in the questionnaire – mostly those related to politics – were considered sensitive and a few respondents refused to express their opinions about these questions. While many interviewees expressed trust in the new government, the fact that individuals are afraid to express their opinions over some subjects, in particular fearing retaliation, can be seen as a worrisome sign.

Politics are seen as the most divisive issue in Guyana. Many respondents think that partisanship is a big problem in their country. While ethnical conflicts are in generally seen to be fading away with the younger generations, interviewees mentioned that they still think that old problems are reenacted in specific situations. Again, indigenous people tend to express a feeling of alienation from decision-making in Guyana. They want not only to receive occasional aid, but also be consulted and included during the design of public policies.

[62] Note: the analyses were done considering an overall view, the quotes are displayed by topics as a way to highlight the aspects taken into consideration.

Nevertheless, the general tone of the interviews was one of optimism. As seen in previous sections, people actively and voluntarily engage in activities, which can bring development to their communities. They also see themselves as part of a bigger Guyanese community, and can identify cultural traces that unite all regions and ethnicities.

4.2.4.6.1 Cultural Identity

"I'm a Guyanese and an Indigenous People. The tribe that I belong is the Wapishana. I'm a proud Wapishana. (…) I was born in Guyana and I have lived here all of my life." [Region 8, Aishalton, female]

"I'd describe myself as a Guyanese. I'm a teacher… I'm a teacher for the school; I'd introduce myself like that. I'm a teacher… I'd introduce myself like that to the person and she or he would become my friend and we would get in touch every day" [Region 7, Kako, Female]

"I grew up in an East-Indian background, most would say, the rural part of Guyana, this part that they call hinterland. I went to school right around the area. Got married and live right around here. [Interviewer:] And you said… you used the word "background" to talk about your East-Indian aspect. Why would you say that? Do you see yourself more as Guyanese than as East-Indian? [Interviewee:] I'm Guyanese."[Region 2, Charity, Females]

4.2.4.6.2 Government and National Identity

"For me, I feel comfortable with them. Right? They're more people-oriented. Some of the issues that we're facing, they kind of try to tackle it at a level, they can do so much more, right? But they're getting there. Before, we had promises. This government is promising, too, but somewhere along the line they keep you up to date while they're in progress of doing it, you know. It's just like for our political gimmick because of the election time or whatever. They, they're getting there and we have to give them some time." [Region 5, Rosignol, Teacher, Female]

"Not at all, I'm not comparing the former and the present government. Even if I was living with the former government, regardless of either parts, I am still a proud Guyanese. Although both governments tried their best, they say 'I'll do this, I'll do that' but when it comes to it, both or all of them who promised you things, the computers, for example, the previous government promised us and up to now we haven't seen anything. Although they keep promising and promising all these things for us, we are still here and we are trying to do… whatever…we would like to see any government, whoever wins, trying to look into the affairs of all the Guyanese. As I said I'm a proud Guyanese, but I want them to show an interest in us too." [Region 8, Nappi, Teacher, Female]

"From what I've seen it is very mixed... like, some people love the new government and are so happy. They think that things are going to change and then a lot of other people just think that it is just going to stay the same and things can't get better. (…) Maybe, like, improving links between different areas, because, like the country is so... sparse, if you know what I mean, like, there's lots and lots of pockets of people (…). So maybe, like, improving links between different places would bring people together." [Region 10, Kwakwani, Teacher, Female]

4.2.4.6.3 Guyanese Unity

"Well we have to start from the top. The opposition and the government now need to put aside their differences and work collectively. Don't just say well my party or whatever worked. Listen to the ideas because the previous government, was there for 22 years, had to have some good ideas so you use them together, collaboratively and work towards the development of our country. And we as a people, seeing that, would follow that pattern. So through modelling, we can be united." [Region 5, Rosignol, Teacher, Female]

The people have to turn away from racialism, to me that is biggest thing. Politics is bringing a lot of division in the country. The politics… I think that our leaders, for me they are not doing a good job trying to bring the citizens together. Because if they are our leaders and we see them on TV always, you

know… they instigate and eventually this would affect us, it would pass on … because we are looking to them." [Region 2, Mainstay, Head teacher, female]

"[Interviewer:] Do you think there is something that could unite people even more? [Interviewee:] I'm not able to think about that, no. [Interviewer:] What would need to happen so that Guyana is even more united (…)? [Interviewee:] I don't want to say anything. (…)I could say, but I don't want to say. (…) I prefer not to say." [Region 3, Saxacalli, teacher, female]

4.2.4.6.4 Infrastructure and Identity

"Yes [because] you'd know more about what is happening at the coastland, than staying here and don't know what is happening. Maybe you can share your ideas with somebody and get in touch with maybe the Ministers or whoever." [Region 5, Perth, Teacher, Female]

"Yes. You'd know more about what is happening at the coastland, than staying here and don't know what is happening. Maybe you can share your ideas with somebody and get in touch with maybe the Ministers or whoever." [Region 8, Nappi, Teacher, Female]

"[Interviewee:] If we get more landlines that would be cheaper. [Interviewer:] Yes, but how would it help to have a more united country and reduce this discrimination? [Interviewee:] I think it can help, too. [Interviewer:] And how would it help? [Interviewee:] Making contact with them, I mean, distributing equally and let them know the benefits of it, you know. The purpose of the benefits and the purpose of having a network, you know. It could make people more united." [Region 9, Lethem, Teacher, Female]

4.2.5 Interviews with Representatives of Health Sector

This chapter shows the key findings from the interviews with experts from the health sector.

4.2.5.1 Overview

One major driver for the usage of personal cellphones was the lack of functioning landlines for personal and professional usage. Lack of sufficient and continous power supply results in poor services of telephone and internet access especially in some regions in remote areas.
Health area professionals have great need to use their own devices at their workplace. Currently they are paying these business related expenses from their own pocket and they don't see any improvement of this situation in the near future.

The interest of healthcare professionals for ICT in general and their demands for better products and telecommunication services are high. People living in more developed regions have started to use smartphones for multiple usage scenarios lik chatting, purchasing products, downloading videos, e-learning and social media.

A lack of knowledge in how to use more complex devices like tablets, laptops and smartphones results in a certain reluctance of understanding the benefits of a "connected device" and therefore no motivation in purchasing them. But once the ideas of scenarios as listed in this report were presented as examples for use cases, the intervwiees showed increased interest in acquiring and using these devices.

Helathcare professionals initally expressed only having a functional association with advanced devices as tablets, laptops and smartphones. The emotional "touch" in having a modern ICT device only begins as they start using these devices. The price of the device and even the physical access to stores to buy these devices are seen as major barriers in obtaining a new and more modern devices.

Two major factors are affecting the adoption rate of ICT devices across all intervewees: the level of personal income (example – talking to a physician and talking to a clerk who probably have different levels of salaries) and the location of the community where they live (remote areas vs urban areas).

The research showed that neither the specific population group of the interviewee nor its gener have signivicant impact on the evaluation of telecommunication possibilities. The only exception identified is that women – more than men - usually talk more about devices that can help their children with their education needs.

4.2.5.2 Communication over Long Distances

15-30 minutes is the maximum interviewees would consider walking to communicate with someone in person, regardless of regions, gender or specific population group.

> *"I guess it depends on the situation. If it is an emergency, maybe two kilometers… When you don't have credits on your phone. Sometimes we have to go to the patients. And we have to walk. I wouldn't say frequently because most times there is somebody available to take us. In situations there isn't someone, we must walk, but most times people send us messages. Most times the signal is poor. For example, in this health center there is a spot we call it the hotspot where we go to make calls." (Region 4-Demerara-Mahaica, St Cuthberts, Female*
>
> *"I would say more than 15 minutes walking more like half an hour" (Region 6, East Berbice-Corentyne, Orealla, Male)*
>
> *"The community here has no phone signal… the distance sometimes to a neighbor would take 30 minutes. Mostly, it is walking and sometimes it is by bicycle." (Region 9, Upper Takutu-Upper Essequibo, Karasabai, Male)*
>
> *"If I couldn't use a phone, I could walk really far, let's put it to this community, 30 minutes maximum. In Lethem, we never encounter situations in which we need to go this far to talk to someone, I'd say like 10 years back. At this present time, we can just pick up a phone." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)*
>
> *"Very far, because the village is very big and not everyone has a phone. Some areas are not quite developed, so you have areas where you don't have phones. The cables are probably having issues. Ages and ages of complains, every day they say that it will get better soon, but it is hard. I think communication is important and everyone needs a phone in the house, so most times you find people using their cellular… it depends on where you are living, because I'm living at the front part. The persons on the back, remember they don't have a landline phone in the area." (Region 5, Mahaica-Berbice, Rosignol, Female)*
>
> *"Usually if we are doing a visit to meet persons who can't come, walking would be like about 1 hour, but by car it would be like 10-15 min." (Region 6, East Berbice-Corentyne, West Canjie, Female)*
>
> *"I live on the east coast and my parents live about 20 kilometers away. And every day I will try to call them. I use the cellular service, mobile. And I use the internet, video calling via Skype or Facebook Messenger." (Region 4, Demerara-Mahaica, Buxton, Male)*
>
> *"Some of the areas you don't have access neither by plane, that are very difficult to reach, but not in Bartika." (Region 7, Cuyuni-Mazaruni, Bartika, Male)*
>
> *" If I have to walk to get in contact with my family, who lives in Matthew's Ridge, it would be approximately, roughly six hours if I have to walk from Mabaruma, which I can't walk."(Region 1, Barima, Mabaruma, Male)*

4.2.5.2.1 Frequency of Long Distance Communication

Communicating over longer distances for person working in the health sector is part of their job and it occurs very frequently. Most of interviewed experts say that do it on a daily bases, especially the ones working at emergency service facilities. For example, they have to contact someone from other health centers to transfer patients.

For some other cases, as in Region 7, health experts have to out to visit patients in remote areas.

> *"We go to Suddie because our hospital here is a district hospital, it's not equipped with an operating room, it just has basic emergency services and we work 24 hours a day. We have our midwives who would come from the Pomeroon, if it's the birth of the first baby we send them to Suddie because we have to be prepared for the complications… we don't know what they might be… so in case they have to go to the operating room… so, we don't take chances with them and high risk for mothers, when they come here… well, the nurses, the mid-wives and the doctors would assess them and then, they decide if we can handle it here or if they have to go out, so they would call Suddie and say "we are sending our patient"… whatever they suspect, maybe it's appendicitis or orthopedic … we don't have an orthopedic technician. We have to communicate with Suddie… so, they're coming with this or whatever… we stabilize them here and then we send them. We use the landline phone from the hospital, but many times our staff has to use their personal cellphone, because I don't give everybody the cellphone to make calls, just for official emergency calls." (Region 2, Pomeroon-Supenaan, Charity, Female)*

> *"It depends. We have a team that visits some remote areas on a quarterly basis." (Region 7, Cuyuni-Mazaruni, Bartika, Male)*

> *"It is pretty difficult, let me explain it to you. Where I'm living (Ithaca), there is a health center and I work at that health center and it doesn't have a phone, so if I have to communicate to a patient or if I have to call somebody for an emergency, I have to use my phone or the other staff members cellphone, but if none of them have credits, what do we do? Or if I have to ask a patient, who has no cellphone, to come to the health facility. That is so difficult." (Region 5, Mahaica-Berbice, Rosignol, Female)*

4.2.5.2.2 Means of Communication for Long Distance Communication

A simple cellphone is the device used by respondents, every day, very often – 5-15 calls a day. The signal for making calls has been perceived as better than the signal for smartphones.

HF Radios are used more frequently in some regions, mainly for working purposes but the signal strength is a great barrier of usage, the weather conditions sometimes make its use even worse.

Some of them would prefer using a landline phone at work, but there is no connectivity in many communities available or the lines they had were broken and have never been fixed.

They feel personally capable of using the broad range of ICT devices and they think that most of the people in their communities (especially younger ones) are capable of using them too. What restricts them to use Smartphones are the signal difficulties in the communities.

The capability to use a cellphone is based on the variety of applications / situations a person can apply these services, like talking, chatting using different apps, e-mail, research and the overall access to the internet.

> *"Every day, almost. For those persons who have a signal and are within a signal range, the cellphone is being used every day. "(Region 1, Barima, Mabaruma, Male)*

> *"99% the cellphone is used because radio [63]is ugly, very bad. "(Region 7, Cuyuni-Mazaruni, Bartica, Male)*

> *"Mostly we use the Radio Set, it's difficult to get on to them because of the weather and I can't get access to them. I use it every day, mostly during working hours". (Region 7, Cuyuni-Mazaruni, Kako, Male)*

[63] Radio here and in the following paragraphs means bi-directional communication using "HF Radio" devices.

"Most times it would be family, because during the job you have to use your cellphone. Other than the phone, the cafe, the internet café in Blairmont or Rosignol. The majority of the people have a phone with internet. When the landline phone was working, people were using it often, more often than the cellphone, because it is only if you are not close to a landline or if you are at work, you would use the cellphone. The landline is much cheaper than the cellphone." (Region 5, Mahaica-Berbice, Ithaca, Female)

"To be on the internet, to browse, I use my phone for everything. I use it every day, several times a day. It becomes a part of the person… researching, social media, chatting… I also have Facebook, Skype…Twitter is not working in Guyana. Not everyone can use a smartphone, the majority of the people use the phone without internet, of course because it is much cheaper. I don't have Wi-Fi in my house, so sometimes I need to buy a weekly plan, a day plan. "Are the plans expensive?" Yes, the data is used up fast and the Wi-Fi is really slow, really, really slow. The GT&T office over here is at the Region 6, in New Amsterdam. You have to cross the bridge to go there, it is about 20 min by boat and it is about 30 min by car." (Region 5, Mahaica-Berbice, Rosignol, Female)
"Mostly we use the landline because there's no signal. It's just easier to pick up the phone instead of searching for the signal. Actually this is the only place that has a land line. Everybody else uses cellphones." (Region 4-Demerara-Mahaica, St Cuthberts, Female)

"Since we don't have a landline phone here…it is basically the cellphone. Well, some people in the village have it, but we don't have it in the health center. "Do you have a landline phone?" No. Well, I have one, but due to the flooding sometime back, the water went into the line and it stopped working. The company GT&T tried to fix it but it just never came back on. I use the cellphone every day and I have a personal laptop when I have an assignment to type, not very much. I use my phone more." (Region 6, East Berbice-Corentyne, West Canjie, Female)

"When we're leaving from here to go all the way back to Anna Regina, there's a park where we're going that we don't get a signal at all in some of the phones. You mostly find the young people having a smartphone, because of the internet. And then, the children go to school and they would have to find things for school on the internet and get information, so most of them have Smartphone. Because, around here we don't have internet and we go to a place where we can get information for our kids or send our kids there. So now, parents buy a smartphone for their children so they can get some information for the school. You won't find them going on the internet, unless somebody teaches some of them… because sometimes they pick up the phones and play with it or something. But maybe it'll grow on them more and more, and if you have internet in your house and maybe teach them about it, they'll get to like it. Once the children grow older and start the secondary school, they'll want phones with internet, right? "(Region 2, Pomeroon-Supenaan, Mainstay, Female)

"Send messages on the phone to know if we have a better signal but because of the far distance that we live in, sometimes we don't get a proper signal. GT&T has a better signal. Let me say most families in the community could afford to buy a smartphone. "(Region 2, Pomeroon-Supenaan, Mainstay, Female)

"We just have cellphones in here. We could use Facebook or WhatsApp, or if they have an e-mail address, we'd send an e-mail to them. The internet in here is not good like in other areas, like Anna Regina or in Georgetown. We're living in a remote area. So, it's not really like it's out there. And sometimes, with some of the phones you could only use the Wi-Fi here. Most times it's not good. The tower is just for the resort. They have Wi-Fi, that's all. (Region 2, Pomeroon-Supenaan, Mainstay, Female)

"The phone is used most of times, many times per day, for meetings, to talk to the children. (Region 3, Essequibo Islands, West-Demerara, Wales, Female)

"Most of them want to skype, actually every day, 2-3 times a day. "Do you also use Whatsapp, Facebook?" Yeah, Whatsapp, Facebook, I have all. Every day, every minute, when we have a break at work we make calls and do stuff like that. I'm using it all the time." (Region 5, Mahaica-Berbice, Perth, Female)

Simple cellphones are the main communication device used in their community for long distance communication. At work they try to use it mainly for emergencies calls and during blackouts.

There are some communities with a better penetration of landline phones, available at health institutions but in general their availability is not frequent at all – and where they exist, sometimes there is a single line available for all professionals.

Using fixed line phones are preferred but limited in availability. Some health institutions have them just for work purposes and they still facing problems with the network. They understand that landline phones would be very useful, especially for emergencies as nowadays they have to use their own private cellphone, which is expensive for them.

In communities as Potaro-Siparuni (region 8) and Upper Takutu-Upper Essequibo (region 9), for example, the usage of HF radio at health centers is common and having a cellphone is not a real alternative for everyone because devices are locally not available for purchase or because the signal in the community is very low or nonexistent.

> *"Actually, I don't have my cellphone anymore, but the radio. I use it from Monday to Friday and on an emergency on Sunday and Saturday, the weekend. Mostly for the job, sometimes to message the village council, you know, communicate to other villages. Some people also come to communicate and I allow them to use the radio. They use the cellphone more than the radio. Half of the people have a cellphone." (Region 8, Potaro-Siparui, Nappi, Male)*
>
> *"I allow people to use the radio from the health center but just if it is an emergency. Every day." (Region 9, Upper Takutu, UpperEssequibo, Aishalton, Female)*
>
> *"Radio, this is the only mean of communication here. I use it every day, from Monday to Friday. When sending a message for far places, it is just the radio, no cellphone or nothing. Mostly related to my job and sometimes related to my friends and relatives who live far away. People here don't use the landline phone and don't use the mobile phone. They are willing to buy it, but most of us started to buy phones because we go out to Lethem. There is no signal, no internet or telephone signal in the community." (Region 9, Upper Takutu-Upper Essequibo, Karasabai, Male)*
>
> *"Especially in my working place, because there are times… sometimes when we have an emergency and we have no minutes on our phones and we have to leave here to see where we can get credits to put on our phones so we could make calls. No, we don't have a personal phone for the health post. We use our phone to do our job. To find things for our job, or if we have patients or an emergency patient, we'll call. If we have a pregnant woman and we have to labor, we have to call from our cellphones. But if we get a landline in here, it's gonna be better for us and we are going to communicate more with our supervisor. We just have the cellphone. Some people would use the cellphone with internet (smartphone). They would put a plan for a month, or maybe if they have something important to do, or a call to make, they just put a one-day-plan, just to send a message." (Region 2, Pomeroon Supenaan, Mainstay, Female)*
>
> *"A lot of people don't have access to the landline and you can go to the store and get a cellphone. And in GT&T you have to make an application and it goes through and through before you've been process to have a landline. In our compound we have one line for the whole hospital. The cellphone is easier to get. We face problems with the landline. Over two months we can't get calls or anything, it would sometimes receive but sometimes we cannot hear clearly what the other part is saying. Or sometimes they might not hear you. And we complained a couple of times to GT&T. They said they'd send their technician but I haven't seen anyone showing up" (Region 2, Pomeroon-Supenaan, Charity, Female)*
>
> *"There was a storm and we don't have the landline anymore, it is mute. (Region 8, Potaro-Siparui , Nappi, Male)*
>
> *"A few have landline too, not everyone has a landline. Mobile phone, almost everyone. Computer- a few people, most of the children and the people who need to access the internet and so on, they need to come out of the community and go to a private place, pay. Some of the villages have private places.*

Those laptops that the government has given, I don't know how to say…you won't find people doing educational things with them, they are small laptops and most of the people just play games and so on. Also they last for a particular time, they are small laptops and some of them started having problems" (Region 5, Mahaica-Berbice, Rosignol, Female)

"They go to the internet café and make calls …. Like 5 minutes driving and about 5 dollars a minute, it depends, some internet cafés take 5 some take 10 dollars a minute. Most people are improving in technology, so most people have smartphones and stuff like that now. The landline phone only started in my community about 3 to 4 years back. Most people used the phone for small uses, most people had a phone and didn't use the internet and so, most people have this high tech phone and so on, and they are improving it. The internet came after the landline." (Region 5, Mahaica-Berbice, Perth, Female)

"People have their private cellphones, but for work purposes they mostly use the landline. For example if it's work-related I won't use my cellphone, if there's a landline available. But I know that in some parts even in Georgetown, the landline phone call to cellphones. So the person would have to use their own phone." (Region 4-Demerara-Mahaica, St Cuthberts, Female)

If you want to get to your relatives you could use the internet. Let me say I have family in America, and if I want to use the internet it's just on Facebook to send them a message." (Region 2, Pomeroon-Supenaan, Mainstay, Female)

In some communities as Lethem, besides smartphone,people use a laptop, a tablet at home and a landline phone at work.

"I have a laptop. A tablet. Every minute, every 5 minutes. A majority of people have phones. I prepare the budget for the Region and as a result, we ask computers or we get donations to the health center." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)

4.2.5.2.3 Role regarding Communication Systems in Communities

The trigger for using different means of telecommunication is mostly work, i.e. caretaking of the patients in order to provide them medical assistance and support they need.

The problem the interviewees are facing in regards to communication is that the patient is often located far from a medical center and/or he needs help during a period of the day when it's impossible to physically reach out to him. Examples are people who live in the villages along the rivers where it's not possible to take a boat in the middle of the night to reach them. During those times, the doctor has to make a decision quickly if it is needed to rescue the patient by plane or if it's sufficient to give instructions via phone / video conference in order to handle the situation successfully.

4.2.5.3 Available Forms and Uses of Telecommunication Systems/Devices

Both access technologies, fixed line and mobile, are available in the country and to a different extend in the communities visited. The experience with dealing with the different devices and ICT infrastructure differs significantly from community to community.

4.2.5.3.1 Landline Phone

The main reason for communities to not haveing a landline are basically related to costs and that the operator do not provide connectivity at remote areas.

There are some business that had the same landline phone number for 10-15 years but now they have a cellphone number too.

"The landline used to be from GT&T but now opened up the market and Digicell…it might get improved. If you have competition it can be improved. Cellphones just few of them have at the hospital. The head of each department have the cellphone but the problem is the internet. " (Region 7, Cuyuni-Mazaruni, Bartica, Health, Male)

"Usually members of the community do not own a landline telephone because of the distance to the city, because we are in a remote area and it's costly to bring the landline" (Region 7, Cuyuni-Mazaruni, Kako, Male)

"I need my landline, because it is from January and the thing on it is: when you have a Digicel and call someone from the other provider and vice versa, your money disappears, it is very expensive, but with the landline no, you could auto manage your calls. Sometimes you would send letters upon letters, you know, but you just can't write everything. So they could just come out and make like a meeting and get things over. (Region 5, Mahaica-Berbice, Ithaca, Female)

4.2.5.3.2 Cellphone/Smart Phone

Most of the respondents have a personal cellphone in most of the communities, except in some communities as in Region 1, Barima. Their major complaints are about the coverage and the weak signal (if available) and that the pricing level for the services are perceived as too high, even for people who consider themselves as a person with a relatively high salary (e.g. doctor).

In most of the regions cellphones are available since almost 10-15 years and in the last 3-8 years people started to purchase them more often.

They feel themselves and the community capable of using the cellphone. But some of them are not allowed to use them at work (which would sometimes be the only place with a stable connection) as the persons working at a hospital kitchen.

Some regions are more developed in terms of using the smartphone with some applications as Whatsapp and Facebook and some others are mainly restricted to simple calls, esp. in communities without a good data connection.

The landline phone has been available for more than 10 years but it is not useful for the ones working in the fields.

Just some members of the communities own a landline telephone.

For some, having their own landline telephone at home would be cheaper in comparison to the cellphone.

For others, for example in some communities from Wales, in Region Essequibo Islands – West Demerara, the respondent mentioned that 90% have a landline telephone as it has been available for over 20 years in the community, but the people are now preferring to have their personal cellphones because of comodity and also because is easier to be purchased.

A landline phone is easy to manage for all the community, even for those people who cannot read.

There are few communities as in Region 3 - Essequibo Islands-West Demerara, where the respondent mentions to have classes where they are being trained in how to handle and operate computers.

Nevertheless, most of the respondents do not feel capable or trained enough for using computers or laptops and understand that a training would be very important as most of the population of a community has no knowledge of all its potentials.

Only in some communities as Wales, Lethem and Regions 4 (Demerara-Mahaica) and 5 (Mahaica-Berbice) people are used to have computers at home and sometimes at work and are more capable of using them but they percieved the internet connectivity and mobile phone signal are "Bad, *very bad".*

Smartphones are used every day, more than 5 times a day and for chatting and social media. Whatsapp is used for chatting and exchanging voice messages.

Messenger and Facebook are also common and just few of them use others social media applications such as Viber, Instagram, IMO, Snapchat.

Skype is not used by all the members but is very well known.

Smartphones are used for every occasion and some respondents would be willing to spend up to about 500-600 US on the device plus 50-75 US on the service. It is preferable for calling except to someone in far distance, for example, abroad, mainly because of costs associated with the international calling rate of the mobile operator.

Some occasions to use the smartphone that were highlighted are: taking pictures at parties, practising some sports; Talking / Chat at Whatsapp; Social Media as Facebook; Paying bills (only 1 mention in Region 9).

Shopping via your own smartphone is seen as desirable but not everyone can use shopping portals due to the need of an international credit card (in their understanding maybe as the only way of payment).

4.2.5.3.3 Computers/Laptops/Tablets

Generally members of some communities do not own computers and laptops. They are used mainly at offices and no children have free access to them. Some of interviewees don't see the relevance of it if they already have a cellphone.

Usually members of some communities own smartphones as they can do everything by phone and very few have plans to purchase a tablet. Price would not be the main problem as the respondent says people spends around 500 US with a smartphone. A cheap tablet would be starting at about 200 US$.

There are 5 main reasons most of the people probably don't own a tablet or a computer/laptop: 1) unawareness of it's capabilities and potential uses; 2) problem with availability - there are no stores selling them; 3) bad or no internet connectivity; 4) no electricity; 5) Price of services / packages.

Sharing the same device eg. desktop computer at the workplace would be a problem for some institutions as people are not well trained to use them. Also, some respondents cannot find another use for the computer / laptop beyond what is already covered with the smartphone applications.

Computers are mainly used to connect to the internet, for searching at Google for checking diagnostics, for emails and for writing a report.

A computer or a laptop is needed for PowerPoint presentations but if they users would be trained they could design their own communication/advertising materials.

Free internet access, faster internet connection and more availability of data connected are seen as needed.

4.2.5.4 Desire for different Forms of Communication

There are different opinions among the communities visited: The ones more developed would prefer to use more modern devices (tablets, smartphones) while the ones less developed would prefer to use devices like a computer or a smartphone.

In general, everything that might address and solve their specific needs:

- Save their time – example: computer to do the report and send it by e-mail
- Better internet signal (for data)
- Connection/Support – example: sending a case of a particular patient to the supervisor in order to faster processes or intercommunication – at hospital
- Access – related to prices/stores available in the community
- Education – for using computers and understanding the potentials of smartphones

4.2.5.5 Case Scenarios

All the case scenarios are considered valuable and they would consider using them all if available and in case the costs for an internet connection would come down.

For selling goods to remote areas the interviewees would like to use a smartphone to take a picture and send it to people, advertising on cable TV or making connections to people in each community by calling them to bring goods. If using an e-commerce platform operated by the government they see the benefits in savety and reliability in running the processes. Besides that, it would save their time, people would find what they need/ want to purchase and it is a way for growing and developing the business.

For sending money the interviewees have to go to the post office and bank or West Union/ Money Gram or in case it is in another community, sometimes asking someone to do it in person. E-banking idea is considered

practical, faster and easy – very valuable and very attractive. Also it seems to be less expensive and much safer than going in person.

Everything involving governmental activities is considerd as very bureaucratic and onvolving a lot of paper work, even resulting in emotional stress. The e-government idea sounds promising to provide easier and practical processes and is understood as extremely handful.

Health professionals face situations where they would need help to examine each patient carefully. Today they have to call someone using their cellphones, or ask someone in person or look at wikipedia/ medicine communities (single mention). Privacy concerns were also raised: One person mentioned that having a private conversation through e-mail would be better than using the personal Whatspapp or Facebook account, especially if talking about health issues, like in occasions when talking about diseases like HIV.

Studying abroad nowadays requires leaving the country, their families, friends and job. E-learning services are seen as a much way to bypass the challenge of physical relocation. Their only concern again is related to the price of the needed internet connection.

4.2.5.5.1 E-Commerce

"Well, now we can use a smartphone to take the picture and sell it to the other person."(Region 1, Barima, Mabaruma, Male)

"Now imagine the possibility of a government-run website that enables you to trade your goods on a national (or international) platform online. How do you feel about this?"

"I actually buy things from Georgetown. We call them and they bring it to Lethem and from Lethem they bring it here….That idea would be a good thing. That would be better because it can help you, because instead of going far to Lethem and spending money, you could access." (Region 9, Upper Takutu-Upper Essequibo, Male)

"I would save time and it would save you the energy of looking for someone to buy it." (Region 6, East Berbice-Corentyne, WestCanji, Female)

"I wanted some seatbelts for my car, because they are damaged, but I can't find any dealer here or anything, so somebody offered me to buy it online, from Georgetown. For things we don't have here, the only option is online, but I don't know how to do it myself, so I need to ask someone else. Of course it would be excellent, because, you know, everybody works and they are so busy, they would prefer to be able to purchase online and do not go to the store. "(Region 5, Mahaica-Berbice, Rosignol , Female)

"I guess it would be a bit more accessible and since it's the government involved I don't think the risk of being fraud, it would be less because a lot of these deals are done by a third party that is not the government and I don't think it would be a hundred percent, I don't know, legal? (Region 4, Demerara-Mahaica, Buxton, Afro-Guyanese, Physician, Male)

"I never do, but I know people who are buying clothes and sending money, stuff like that, through the internet. (Region 5, Mahaica-Berbice, Perth, Female)

"That would be good because the internet reaches everybody, they could make lots of connections. To get more customers. It's a way of expanding. So i think it would be a great help if they have a website so they can reach out to people. Far off from the community. National and international. "(Region 4-Demerara-Mahaica, St Cuthberts, Female)

4.2.5.5.2 E-Banking

"Now imagine the possibility of transferring money via cellphone deposit. How do you feel about this?"

"Well, we have the post office, that we use and we have a bank, but a lot of people don't really use the bank because a lot of people don't have this particular bank so they have to transfer and another option is Western Union. (Region 1, Barima, Port, Kaituma, Male)

"Well, if the person is living in Anna Regina I could ask somebody to take it to them, and if the person is living in Georgetown I could just send it through the post office or Western Union." (Region 2, Pomeroon-Supenaan, Mainstay, Female)

"I go to the post office, deposit and they fax it. I feel unsafe." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)

"We have the Western Union here, so I'd send it through Western Union, but if you are not using Western Union, you are probably sending it through someone who is going there by car. It could be done by credit and at time it is useful." (Region 6, East Berbice-Corentyne, WestCanjie, Female)

"If it is international, you need to send it through Money Gram or Western Union. If I give my number, maybe somebody can see it. I'm not sure if I'd use it to send money, to purchase maybe, but not to send money." (Region 5, Mahaica-Berbice, Rosignol, Female)

"In my bank I don't think we have the option but if we can wire money then we have to go to the bank to wire the money. There isn't like an app on our phone that the bank provides us with that would say "hey you want to send this amount". No we don't have that. "(Region 4, Demerara-Mahaica, Buxton, Male)

4.2.5.5.3 E-Government

"Do you generally go to the NDC (Neighborhood Democratic Councils)" well, that is a long story "have you ever needed something from the NDC?" thousand times "do they work fast?" no. "Do you have a lot of bureaucracy?" yes and a lot of paper work, you know, and there is no technology, there is a lot of paper work, everything is paper, there is not even a computer." (Region 5, Mahaica-Berbice, Rosignol, Female)

"Now imagine the possibility of receiving this information or contacting governmental or public authorities (to register a new-born, apply for marriage, etc.) online. How do you feel about this?"

" For example if we have an event here in the health center, old folks that don't have a phone or don't have internet, so we all have to go out in the community or write posters so the patients know and hopefully somebody gets the message to them. So that's how communication is being done here. They have to go all the way to Georgetown. I think it would be awesome. It's something i wouldn't get too excited about because sometimes these things are not possible. I can only imagine what this would be. Like to have internet in here. So many possibilities of what could be done. But the last time we thought we were getting it, there was a lot of disappointment when we didn't. But I think this would be really, really good for the community. Special need for the students in the school. For instance we have to send reports directly to Georgetown because we don't have internet. Because if we had we could just scan it and you just email it to the person. We are not that far away but imagine people that are far away and they could do it electronically, it would be so much easier." (Region 4-Demerara-Mahaica, St Cuthberts, Female)

4.2.5.5.4 E-Health

"Of course it would help me. "Have you ever lived a situation in which you wanted some help?" Yes, I had a patient with an abscess behind his knee and I wanted someone else to participate, to see it, but everybody was busy, so I had to go to the internet, to research it. This idea would be excellent and better for me, far better for me, because I'm in a remote area and it is the last village in. So imagine something happens, for example, in the middle of the night, look how remote I am. This is closed, that is closed, but I'm the only doctor in the area, so you can imagine that everybody would come to you and the nearest hospital is or in New Amsterdam or in a half hour way. That would be excellent, you know, if I can have, for example, this. If I had a program, where I can speak to someone to give me advices, of course that would be useful. They can instruct me, tell me what to do in some certain situations that would be good, because I'm in a remote area. (Region 5, Mahaica-Berbice, East Indian, Rosignol, Physician, Female)

"I'd say it *is having internet here. Because the pre-condition is to have internet. As i said before it would be much easier to get in contact if there's an emergency or if you need medical advice, you skype the*

person. It's much easier to talk to them. You see them face-to-face if there's something you cannot do. In terms of medical training, the program in continuing medical education. So there are these courses online but i don't have internet here. So we have to travel all the way there where you have the training, to get my credits. It would be much easier to do it online. And that's not only for me there a lot of people that would benefit from it." (Region 4-Demerara-Mahaica, St Cuthberts, Female)

4.2.5.5.5 E-Learning

"Recently I did look up for autoimmune diseases on Wikipedia or Netscape." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)

"Sometimes you get a person that comes with pressure "high blood pressure?" yes and I want to clarify, because sometimes they say they are using one medication that is not working, so I'd need to send them to the hospital, if I couldn't give them any contact. I'd call the doctor, but if it is a case that my other colleagues could handle, I'd call them." (Region 6, East Berbice-Corentyne, WestCanjie, Female)

"I'd say it is having internet here. Because the pre-condition is to have internet. As I said before it would be much easier to get in contact if there's an emergency or if you need medical advice, you skype the person. It's much easier to talk to them. You see them face-to-face if there's something you cannot do. In terms of medical training, the program in continuing medical education. So there are these courses online but I don't have internet here. So we have to travel all the way there you have the training, to get my credits. It would be much easier to do it online. And that's not only for me there a lot of people that would benefit from it." (Region 4-Demerara-Mahaica, St Cuthberts, Female)

"Now imagine the possibility to get a degree from anywhere for yourself online. How do you feel about this?"

"Great. Because not everybody would be able to leave to go probably to seek such help… So if you can do it online, through the smartphone, as I said, it's great. "(Region 1, Barima, Mabaruma, Male)

"I think it would be better. Because I think they could send information by e-mail. I mostly would use the internet to get to the doctor or supervisor to talk about a patient. The most you can get is through WhatsApp, to send a message to them. That's what I'd do. Maybe if we had an e-mail address for the office and you want to send a report or anything through, you could send it through their e-mail, right? So, you could e-mail that to the hospital and they would get it through there. Instead of using, like, Facebook. Because our supervisor, there's certain things that you can't tell her over the phone… maybe you could call her if it's an emergency and all, but there're things you can't tell her on the phone about a patient. Let me say like if a patient is HIV positive, you can't call them and say … I have to call a person there, she wouldn't accept that. So, maybe with the e-mail address…". (Region 2, Pomeroon-Supenaan, Mainstay, Female)
"I would use it if I have the opportunity, maybe soon. (Region 8, Potaro-Siparui, Nappi, Male)

4.2.5.6 Cultural Identity and Belonging

The Guyanese are proud of their nation in general. The fact of being born in Guyana unite them at first sight. To live close to their families makes them feel Guyana is their home.

4.2.5.6.1 Cultural Identity

The respondents feel themselves as a Guyaneses mainly because they were born in and live or lived in the country most of their time, they work here and have their families. Living with diversity is how they describe themselves and relate it to different cultures and beliefs, different races and different lifestyles. Very friendly people, patriotic with common interests e.g. cricket. The government supports some persons mainly in education (as scholarship for 7 years in Cuba).

Esspecially Indo-Guyanese feel emotionally linked to each other and perceive that the population is becoming more mixed and that the government is trying to unite all.

When talking to Mixed, Afro-Guyanese and Indigenous People, the impression is slightly different. They do not feel that the people are somehow united and they do not see any practical action from the government to change this situation. Besides discrimination based on the race, discrimination of women and homosexuals were mentioned.

All understand that the internet could help to integrate the Guyanese people and to drive the nation building process while conserving and highlighting their own diversity. Better communication infrastructure has been seen as one of the top 10 priorities, but only after education measures and improved health system.

4.2.5.6.2 Government and National Identity

"They are very cultural people, they are very educated, some of them, they are not really educated, but their life style is very different…you have six different races in Guiana…seven. Different cultures and beliefs, and different lifestyles too…. This government I see is trying to make a bit of a more modern Guiana" (Region 1, Barima, Port, Kaituma, Male)

"I have grown up here and I studied many years out of the community, but I still come back to serve my community, because I know that those people here, they need me here. So I don't forget where I came from. I'm from an indigenous community. I love my country because there are natural disasters, but not as you see in the other countries, there are flooding and so on. It is also peaceful, at least in my area. I think there are still discriminations, especially to the Indigenous people. (Region 9, Upper Takutu, UpperEssequibo, Aishalton, Female)

"I was born, grown and I live here and I got a job in Guyana. The birth certificate describes me as a Guyanese. (Region 9, Upper Takutu-Upper Essequibo, Karasabai, Male)

"Well, I'm very mixed. We are a multicultural society and I'm from South America, Guyana." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)

"This is my country, this is where I was born. I like my country here, here we get to interact and learn more about each other. During the elections we are less united "why?" because of the political differences and different races. "is the politic here linked to the race?" some. "And when is the country united?" it would be the Mashramni. "Mashramni?" yeah, the 23th February. "Any other time?" well, in some of the holidays, actually most everybody would come together, some people… some just continue their life, but the majority would be together during the celebrations. In common we have cricket, dance, soca music. I think actually all Guyanese like it. Put the races aside and just make us as one. Because it is just the hair that is different and probably the skin color. People could teach each other about differences, different personalities, and different backgrounds on the social media." (Region 6, East Berbice-Corentyne, WestCanjie, Female)

"I was born here, I got a scholarship from the government of Guyana to study medicine in Cuba, for 7 years. After high school, we had some examinations, with 5-7 subjects and we also have an interview." (Region 5, Mahaica-Berbice, Rosignol, Female)

"I'd say my culture is very like yours (Brazilian), but I have a lot of other cultures in me because we're not one race. Right? So if I was to say that I'm of one race would be a lie because, and this is everything for the rest of the country, everybody they eat, they dress, and they mix with other races. People here, they're very friendly despite what people might hear. Apart from being born as a Guyanese, I have that sense of pride and patriotism. (Region 4, Demerara-Mahaica, Buxton, Afro-Guyanese, Physician, Male)

"I'm a Guyanese by birth and I have lived here all of my life, never travelled to another country. Yes, because we live in love, you know. "what else?" people cooperate, we come together and get things done." (Region 5, Mahaica-Berbice, Ithaca, Female)

"I'm born a Guyanese and I study everything in my country and I'm a Guyanese. All of us Guyanese we live as one, but just that sometimes, you know, they do things that when you finish doing it, you start the next. Well, Guyanese are a blessed country, a nice country, a lovely country." (Region 5, Mahaica-Berbice, Perth, Female)

"I was born there and I live in Guyana. I went abroad to study but, I mean, it's my culture. It doesn't matter where I go or how long I live in another country, these are my roots. This is where I'm from,

where I was born. I think I'm a hundred percent Guyanese… Guyanese, in general are hard-working people. They love cricket." (Region 4-Demerara-Mahaica, St Cuthberts, Female)

4.2.5.6.3 Guyanese Unity

"You can have a separation between different people, but generally you are forced to live among different people, either it is the right choice or you are forced to be united. "(Region 1, Barima, Port, Kaituma, Male)

"Our region is vast, it's large, and having access or each community having access to communication would be something that would help improve our region as well as the entire country." . "(Region 1, Barima, Mabaruma, Male)

" I'm Indigenous, they try to reach out others … maybe there might be segregation at some times… maybe some people may not like this race or that race… but they try to reach out to every race in Guyana. So, they try to make you comfortable as an Indigenous person. Let me say, this month coming we are celebrating the Indigenous People, at least they let you have it… and you're Indigenous and you will not be ashamed for who you are. I always believe once the head is united, once you have the togetherness there, we'd work along with all the communities and this unity together. (Region 2, Pomeroon-Supenaan, Mainstay, Female)

"The way we speak, the culture, the way we care ourselves. The races need to be together because in a couple of years it would be a good thing to be one race, everybody would be mixed. You wouldn't have to point fingers, you're black, you're white, and that would be a very good thing. That's happening. As working here most people come and they are mixed races already. With a better communication infrastructure, people would interact more with each other, we'd get to understand each other better. (Region 2, Pomeroon-Supenaan, Charity, Female)

"Looking more to the Indigenous People, helping the Indigenous people. Be more concerned about us, you know and feel good about it. Sports could bring us together. They need to involve the Indigenous People. Get the Indigenous People involved in sports. This road here from Lethem to Georgetown, if it was a proper road, you'd get across in a short time. "And it could unite the people…"(Region 8, Potaro-Siparui, Nappi , Male)

"Love persons for who they are". (Region 3, Essequibo Islands-West Demerara, Wales, Female)

"If you had televisions you'd follow the news and have that information about what is going on in the country. Not only in television, but also in the newspaper, if you have the internet you could read the newspaper and so on." (Region 9, Upper Takutu, UpperEssequibo, Aishalton, Female)

"Mostly we - the Indigenous People - are united. "Yes, but what about the whole country and all races?" Yeah, all of us are united. "So everyone is united." Yes, everyone is united. We celebrate our culture, the heritage day and other national holiday. We have no communication here, it is only the radio. We need the internet and some other ways to communicate. If they put more internet or some other…hmmm, more communication could make the country more united because people would be talking to each other." (Region 9, Upper Takutu-Upper Essequibo, Karasabai, Male)

"People are not united. There is racism, religious differences and political differences. Cultural and social issues, education. If given the opportunities they always stand out. We deal with different people constantly so we should have the capability or the ability to handle certain problems and situations that arise, but on the other hand, due to the impact of low education, people are lacking simple educational practices. "Is there anything that all Guyanese are proud of?" I'd say the independence from the British. To unify, well, proper education, proper health care system, better opportunities and good salaries because it doesn't just link you with your neighbor, links you with the world and the world has a lot to offer and if you can make use of whatever opportunity given, that would be good." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)

"In terms of trying to put us united together, not so much racism. In terms of putting the system in place. People following rules and regulations, stopping crimes. It has been like this for years, you are still having people with views of racism. People need to stop thinking about race and start thinking about one race, which is the human race, you know… people have unity, but not that much unity. I

mean, when I started living in Cuba, I could see unity. Whatever happens everybody comes together. So for me, 'no'. Guyanese are friendly people, majority they try to help out. They may treat foreigners better than me, a local, especially if you can speak differently." (Region 5, Mahaica-Berbice , Rosignol ,Female)

"In terms of telecommunication, I think they are striving, they're headed in the right place and they're headed towards the right direction in terms of telecommunication. Also, you have a lot of uneducated people out here that they, and generally work hard but then I can't really go around the city, I don't want to, I can't go out at night to party, I can't do anything. I don't think we are united. I would say there are people from, both sides that still hold onto racism and that's what, divides us. The president now he's a black guy and the vice he is an Indian and the opposition, was the opposition also mixed. Guyanese women, they, they don't party so much. So they have a known quality to take care of their husbands, they're great at taking care of the home and stuff like that. So even though we find a lot of Guyanese men, they want to go overseas, a lot of them don't come back to marry a Guyanese woman. For example, the gay community, LGBT, those kind of things, aren't very accepted and it has a lot to do with our cultures and our religion. For Health Care, more infrastructure helps a lot, I can tell you that. What we do is, if you have a case, a medical case and I'm having a difficult time and I have my colleague he's a dermatologist and I need someone with a little bit more information to help with something I can't handle I would snap a picture and WhatsApp it saying "hey, I found this …." (Region 4, Demerara-Mahaica, Buxton, Male)

"The majority of the population is of East Indians, the minority is mixed and Indigenous People but as of lately there have been a lot of political issues that are trying to divide the nation ethnically but I know for sure that Guyanese people are generally united, but it's only when it gets to political issues that people tend to get divided". (Region 4-Demerara-Mahaica, St Cuthberts, Female)

4.2.6 Interviews with Representatives of Economic Activities

This chapter shows the key findings from the interviews with experts from the business and economic sector in the communities.

4.2.6.1 Overview

The market entry of Digicel as a new mobile carrier changed the market and the perspective of getting access to communication. Guyanese people support competition and seek more affordable costs for communication services, which can boost business and improve education. Competition can also stimulate an improvement of service quality provided as the current available communication services are percieved as not satisfactory.

4.2.6.2 Communication over Long Distances

Especially when Indigenous people of the Region 1 think about talking to someone in a distance, they remember the period prior to the access to communication media, when they had to move (usually miles) to communicate with someone else. Nowadays, they have access to devices like the mobile phone.

„Well, for now… the business that I'm involved is locally, here in the community… within the district and then nationally, with Georgetown… this used to be a problem before, but now, since we have access to cellphones, which were recently introduced, most of the problems have been solved. We can contact now…" (Region 7, Mahaica-Berbice, Kako, Male)

To others, this question focuses on the present situation, given that this "need to walk" still occurs quite frequently nowadays due to breakdown of the mobile operator's signal or lack of money to put credit on the cellphone and the absence of other means of communication.

„Because sometimes there is some difficulties and you are alone and you need assistance and sometimes a cattle or a cow or something gets lost or they stuck in the mood, so you need to

get assistance, you need to call somebody to come. So you have to leave the area, walk the 2 miles and get out of the road and get assistance back in the background. So it is very, very difficult, sometimes you have a phone, but you don't have credit so there is no other communication." (Region 5, Cuyuni-Mazaruni, Ithaca, Male)

There are also the persons walking for miles to find not the direct recipient of the message, but the device that connect them (internet somewhere or a phone booth) to the outside world. Others need to walk a significant distance to get a phone signal at all.

"Well, it's very often here because of our work. We're (from communication) and because the signal, it's a kind of bad, so we have sometimes to walk 5 miles or 7 miles we go to adjust the signal." (Region 6, Berbice Oriental- Corentyne, Orealla, Male)

"When I came here, we didn't have any phone. That was 20 years ago, so we used to get phone call through the telephone company, public phone booth. We had a limited number of landlines, there are still, I don't have landlines here and I used to walk around 1km to get to the phone booth." (Region 9, Essequibo-Ocidental Demehara, Lethem, Male)

4.2.6.2.1 Frequency of Long Distance Communication

The communication over long distances is frequent and has two purposes: social and professional. Normally, the communication with a social nature is focusing on visiting family and friends who live outside the community or, as it often occurs, even outside Guyana. Many have relatives and friends who left the country in search of employment opportunities and often talk to their relatives. This long distance communication happens mostly in places where there is a certain stable infrastructure for internet is mostly initiated by respondents who know how to use social media or video conferencing programs like Skype, mostly men.

„Yes. I have family in England, in America and stuff like that." "So, generally when you communicate over a long distance you are communicating with them, with your family?" "Yes. We could use IMO, we actually appreciate these apps, do you understand? Skype, right?" (Region 1, Barima Wani, Port Kaituma, Male)

"Very often, (unintelligible) relatives from the North…"Do you have many relatives outside of Guiana?" Yes. (Region 1, Barima Wani, Mabaruma,Male)

"My wife sometimes goes to Canada or the States and I'll be talking to her on the phone." (Region 2, Demehara-Berbice, Mainstay, Male)

However, most of the long distance communication done by this audience has a professional goal: contact with suppliers who are outside the community to purchase products or to inform co-workers and supervisors about how businesses goes or to ask for help or in cases of emergency[64]. No differences between genders and ethnicities could be identified.

"I use my phone every day. I'm employed at the sugar factory and use it to communicate to the others about the job situation, we also use the cellphone and we need a Smartphone at that time."

4.2.6.2.2 Means of Communication for Long Distance Communication

The use of mobile phones for long distance calls is prevalent among all Guyaneses. Telephone charges are affordable, but come often with bad quality (almost unanimously mentioned).

In most communities it has been mentioned that citizens have to wander around the community area in the search for the signal from the operator(s); This problem is apparently so prominent, that there is a significant willingness to even pay more to have a better quality of service: One of the respondents in Region 6 mentioned use the mobile signal from one operator out of Surinam that reaches to his community in Guyana, purchasing and using a Suriname SIM card and accepting the higher fees to call someone in Guyana as this is now seen as an international call. But according to his perception, he gets a better signal and higher voice quality, justifying the extra costs.

[64] One example mentioned was: What to do with the cattle that got stuck in the mud (farmer)

The use of cellphones is generally descripted as one on a daily basis, despite the difficulties of access.

Most complaints among those using smartphones were: poor internet signal quality available, instability of signal (in some places only work certain periods of the day) and expensive data plans with no transparency of when is charged how much for what (the person uses the device for a short time and already has to pay again without knowing how much he/she actually used). In addition, they have the impression that the speed of the advertised "4G service" is slow, not matching the expectation.

Many communities have none or very few landline phones, even in commercial facilities such as hotels, health centers and police stations. Even being less widespread and surpassed in use by cellphones, some respondents perceive a financial advantage in using landline instead of the mobile connections over long distances. "It's cheaper." In addition, there is the perception that the telephone companies would not profit much with the expansion of telephone landlines compared to the cellphone, because the monthly payment model for the landline is post-paid and the cellphone is prepaid.

Another advantage of the telephone landline reported by respondents is that through it they could have internet access, which is still not available for many homes and commercial facilities using mobile connections.

Interviewees from Regions 7, 8 and 9 make use of high frequency radios for communication over long distances.

According to respondents, the majority of the population of the communities have no mobile internet connection. As stated, it is cost effective, but is not considered cheap by most of the persons asked.

Despite complaints about the signal, they recognize the convenience of having a mobile device that "can be put in your pocket" - Easing mobility.

According to the estimation of residents, the percentage of those who own a mobile device with internet access or smartphones varies between 15% and 50% of the population. Most would like to own this type of device, but with a service that provides good quality connection, which at the moment is not a reality.

Respondents see the cause for the low percentage of use in the high prices for the service and internet access charged by the operators, especially in areas where there is high unemployment and residents with unstable income. In Region 5, there are reports of residents of a community who prefer to pay monthly fees to internet cafes rather than to a cellphone provider.

The youngest population is currently the leading consumer of smartphones in the communities.

There is also the use of satellite phones (Region 1), HF radios and landlines.

4.2.6.2.3 Role regarding Communication Systems in Communities

Some respondents (not the majority) have approached government agencies like Ministry of Indigenous Affairs and Local Government to request internet or simply any help to improve access to communication media in the communities. Among those respondents, the majority requested bringing internet access to schools. Access to youth research centers and the provisioning of digital information in schools is a strong demand among residents of the communities visited. Some haven't had success yet with their requests, but believe that the current government may drive the process of improving access, despite the recognized lack of funds for investments in this sector and despite the short time of the current government being in power to implement such demands.

The private companies that have been contacted by citizens to improve their services or install antennas in the regions did not meet the requests of the applicants as indicated by the interviewees.

> "*We always get promises, like the internet being provided, internet for schools, but that never so far materialized. I used to be a teacher at school and GT&T came and said that they would assist us with free internet, but it was 7 years ago and up today nothing happened*." (Region 9, *Essequibo-Demehara, Aishalton, Female)*

> "*No, because there's no competition. They know that and for whatever reason they are not doing anything. Nothing. They are promising. That's all you're getting. For five years all you get is promises*." *(Region 2, Demerara-Berbice, Mainstay, Male)*

*"**You said you tried to talk to Digicel to have… Digicel and GT&T to have a tower or improve their services."** " We do request, we do request, but I don't know if this are pulled up or whatever, but we do request… But they don't answer. They didn't reply for the call." **" How long has this happened**?"" Let's say 6 months ago we did some requests and the previous administration said they also did some requests." (Region 6, Berbice-Oriental-Corentyne, Orealla, Male)*

4.2.6.3 Available Forms and Uses of Telecommunication Systems/Devices

Both access technologies, fixed line and mobile, are available in the country and to a different extend in the communities visited. The experience with dealing with the different devices and ICT infrastructure differs significantly from expert to expert in the communities.

4.2.6.3.1 Landline Phone

Existing in some communities for over 10 years, the telephone landlines are in the perception of business people in the communities "out of use". They were popular (but not necessarily available) in the decades of the 1970s and 80s, but can still be found in some locations today. Their use is intuitive and easy, even for those who have never had previous access to the device.

Landline phones are considered, as stated earlier, a form of cheaper communication than the form of communication used by the majority (cellphones). Moreover, it is attractive for some to have a technology to access internet with services such as DSL, available in the capital Georgetown and selected other areas.

> *"(…) cheaper cost. As long as you have your landline, then you'll have access to internet, Wi-Fi or whatever and if you don't have a landline, it's hard, because you can only have a little internet on the smartphone…" (Region 6, Region 6, Berbice Oriental- Corentyne, Orealla, Male)*

In regions where a fixed line connection is available, it is a communication option when there are problems with the signal of mobile devices, in addition to providing the opportunity for sending and receiving fax.

In some places there are reports of theft of telephone cables to sell the copper illegally, without replacement of the stolen infrastructure by the operator, especially in Region 6.

4.2.6.3.2 Cellphone/Smart Phone

The use of cellphones, as mentioned above, is spread in all communities of Guyana. There are two types of devices: with no internet support and with internet support, so-called smartphones.

The largest portion of the population of the communities, especially the Indigenous People, own cellphones without internet, which according to their perception has been present in the country for a longer time (since between 5 and 10 years ago) than the smartphone.

The advent of the smartphone has been more recent – from a few months (quote from Region 8) up to 3 or 4 years ago. According to respondents' statements, its use mainly attracts younger people who use the device as an information source (Google), means of communication (Facebook, IMO, Whatsapp, Instagram) and photography (cameras). Its use is more valuable – than ordinary cellphones – as it combines several use cases/forms of interaction, communication and information gathering in a single device.

The ease of using the smartphone or any new form of technology is determined by three factors: Interest, skills/knowledge and the physical access to the device.

Everyone interviewed would be able to learn how to use new forms of communication. This applies even to the older population, as perceived by the respondents, despite the fact that they might have less interest in learning, lower ICT skills (usage of the devices less often and having trouble understanding it).

4.2.6.3.3 Computers/Laptops/Tablets

Computers and laptops have been used in the communities for a long time, but are not widespread. Many devices are not working any more as they are seen of little use without a working internet connection.

In some communities laptops were provided to families by the government (e.g. via the One Laptop per Family Programme), but many of them have been abandoned by the users and are not working any more.

Computers can most often be found in offices and some at homes in locations with better electricity and communication infrastructure, such as Region 1, for example.

The use of computers requires, according to the view of some respondents, greater specialization than the use of smartphones. So they see themselves depend on courses and learning, particularly aimed at older audiences, which have more difficulties in operating these types of equipment.

Respondents can see benefits in the use of computers at schools for education and for the information of children and young people. It would be a way to introduce younger audiences to a new technological environment. For businesses ICT devices have been seen as extremely useful, serving as a working tool.

One of the restrictions to usage of this type of device is the access to electricity. There are places where power supply is only available for a few hours a day and other communities where energy costs are very high as it needs to be produced locally. According to a resident of Region 2, the electricity in remote locations is much more expensive compared to the pricing level of Georgetown. This problem is exacerbated by the fact that in remote areas the population often has fewer financial resources compared to the capital. This limits the use of these devices in these regions further.

4.2.6.4 Desire for different Forms of Communication

Most of the mentioned desires are related to the use of the internet. Some respondents asked for more Wi-Fi hotspots, while others request services to simplify daily tasks as Mobile Money (banking application via internet and mobile phone). They also would like to have smartphones with good quality cameras for taking photos.

There are two operators in Guyana that provide commercial mobile phone services: GT&T and Digicel. The service levels provided by both companies are rated as “poor” by most respondents: unstable, weak, expensive and no transparency about the charges and use of credits. Also, in some localities, there is only one of the operators with available service.

The lack of a competitive market environment (only two service providers), makes as per the interviewee’s opinion, the consumers dependent on the services of those few providers, which don’t seem to be engaged in improving the services. On top of this they are perceived as sometimes not aware of the cultural differences or even not aware of certain limitations of the consumers. One of the Indigenous People communities complained that Digicel requests proof of address to allow the purchase of the SIM cards in a community that has no defined addresses compared to the well named streets in the coastal areas. As the residents are not able to provide this kind of information, they cannot get the provider's SIM cards (Region 1).

Despite these negative statements by the interviewees, some residents see the market entry of Digicel, after years of monopoly by GT&T, as a kind of liberalization. They associate Digicel’s image to “market opening”, although they think that Digicel still provides a poor service.

The introduction of mobile service in the communities is considered a milestone in the development of the individual quality of life in Guyana, even considering the perceived poor quality of services offered.

4.2.6.5 Case Scenarios[65]

This exercise has shown that regardless of religion, gender or age, the Guyanese lack good service and act creatively and with great effort within their capabilities and limitations.

To market their products or promote their businesses, they recognize the importance of marketing and advertising. They advertise using flyers, business cards or distribute small gifts. They are already using internet resources advertising on Ebay, Facebook, Youtube or specialized websites according to the business area. They promote through word of mouth in places with few inhabitants. In the hotel industry, they recognize an untapped potential of remote areas for tourism, but resent the lack of government support to advertise.

[65] Note: the analyses were done considering an overall view, the quotes are displayed by topics as a way to highlight the aspects taken into consideration.

As there is a great lack of financial institutions in Guyana, respondents typically use services as Western Union or Money Gram when available (greater access in coastal areas) to transfer money. Often they have to travel great distances to get to these institutions or risk losing their money by using somehow unreliable intermediaries to transport the money.

To receive news about the government it requires reading newspaper or news sites on smartphones. There are respondents in such remote locations, however, who need to wait up to a whole week until they get access to the printed news as the smartphone usage is not possible.

All the suggestions given were well received, especially in places where there is a shortage of opportunities to study, banking and other access to information. Respondents highlighted and proposed other uses for internet in the community, such as applications with regional information and chat to exchange local information, surgery monitoring in different places of the world for medical improvement, or even live follow-up through the internet of parliament debates and activities.

In the view of the respondents the internet would improve business, help to advertise goods and services, connect consumers not only of a region, but the country as a whole. For farmers, the online contact with the veterinarian would avoid travel time and often the loss of animals.

These technological innovations, however, require learning and a certain level of education and especially demands for a stable and fast enough internet connection. In addition, there should be a monitoring of the infrastructure in relation to technological development. Today some interviewees mentioned already using e-commerce for shopping, but delivery is slow and often costly because of the difficulty of logistics.

4.2.6.5.1 E-Commerce

> *„I have no computers yet on the resort and I plan to promote it trying to reach the tour operators across the country in the Suriname with some flyers, business cards, you know, because marketing is very important. And that is why the internet, the Wi-Fi or whatever, you know, all these things will be very important to the business.“ (Region 6, Berbice-Oriental-Corentyne, Orealla, Male)*

> *„I use Tripadvisor and another one that somebody recently told me about… it's not in my mind, but he said he's gonna link us up… so, I'm looking wherever you can link, so they know you exist so you can get clients here." (Region 2, Demerara-Berbice, Mainstay, Male)*

"Now imagine the possibility of a government-run website that enables you to trade your goods on a national (or international) platform online. How do you feel about this?"

> *"The online is not bad, but if the system is working perfectly. Then, you can go ahead with it." (Region 2, Demehara-Berbice, Charity, Male)*

> *"That would be nice, if I could go to the internet, access it from here, saving money, time. Maybe I could do all of that here. (Region 9, Essequibo-Demehara, Aishalton, Female)*

4.2.6.5.2 E-Banking

> *„Like I'm saying, for me to send money to Georgetown or any other part within region 1, the only available medium in terms of money transfer, we're talking in the region itself, right? It's the post office. But there's a post office at two of the sub-regions, in Mabaruma there's a post office, there's a post office in Port Kaituma, I don't think there's any post office in Matthews Ridge, so in case I need to send money there, I got to send it with somebody. That person, I trust them to send it, what if they don't carry the money to the receiver. There's no guarantee. That's a risk…" (Region 1, Barima-Wani, Port Kaituma, Male)*

"Now imagine the possibility of transferring money via cellphone deposit. How do you feel about this?"

> *"Perfect idea" (Region 2, Demerara Berbice, Charity, Male)*

"*It would be easier for me. I'd save time and that is also expensive to go Lethem, you know, go and come back. It would be less expensive." (Region 9, Essequibo-Demerara, Lethem, Female)*

"That's a great idea, but you see the thing about MobileMoney, I don't think that GT&T has taken the time to actually sensitize and educate persons on actual service, so I'm thinking of persons that might be willing to use their service, but because they don't get the time to educate the people on the service, you don't find people using their service." (Region 1, Barima Wani, Mabaruma, Male)

"Yes, I heard GT&T has this money something, mobile money. Which this service provides. But the GT&T came here and the Toshao said we already have a service. It is just bad. I'm not 100% sure, but what I was told is they came and were turned away. I don't know how true that is." (Region 9, Essequibo -Demerara, Aishalton, Female)

4.2.6.5.3 E-Government

"Well, because of smartphones, there's an app for everything you need, so I usually use this News 2 Go app and that would… I mean, the beauty of News 2 Go is that you read articles from all the major newspaper, the Guiana Times and things like that." *(Region 1, Barima Wani, Mabaruma, Male)*

"We used to get the information like this when we had the internet. It was easier for us to go to the internet and see the news. We had the learning channel, so when it was on, we used to see the news every day, like 7pm to 8pm." (Region 9, Essequibo -Demerara, Karasabai, Female)

"Now imagine the possibility of receiving this information or contacting governmental or public authorities (to register a new-born, apply for marriage, etc.) online. How do you feel about this?"

"That's a major development. The system in Guiana is broken because you may not believe me but I know persons here who are almost 60 and 70 who were born in this country and don't have a birth certificate, for one reason or another, but if that could be done or be extended online, that would be very good. I think it would be more efficient persons could stay right here, they don't have to travel to Georgetown." (Region 1, Barima Wani, Mabaruma, Male)

4.2.6.5.4 E-Learning

"*Well, that's very difficult, because of internet access. Like I have said to you even with 4G to do a course, I mean, on the cellphone would (unintelligible) but they would have the internet still, on the laptop, we have persons doing such, but that's because they already have an established internet source, what… it's not popular here, not because we don't have persons with intellectual ability to further their study, or even to develop what we already know, but it's all about the availability of an internet source. (Region 1, Barima Wani, Port Kaituma, Male)*

"I'd need to go to Georgetown. I went to Georgetown and did the exams online. But it was costly and I couldn't complete it. I had other commitments. If I had good internet access here I'd continue studying. Instead of leaving home… It costs a lot to travel and sustain yourself in the city. I'm studying accounting. I started in 2010 and stopped at 2011. I wrote to 2 exams and studied 4 papers." (Region 9, Essequibo -Demerara, Aishlaton, Female)

"Now imagine the possibility to get a degree from anywhere for yourself online. How do you feel about this?"

"That would be better, easier for us. Most of our young people would use it." (Region 9, Essequibo -Demerara, Aishlaton, Female)

"*Online studying. There is one or two universities in Georgetown that actually teaches you US programs, most of the persons in Guyana, most of the students were actually at*

overseas universities. We're in touch by online system" "One was a lack of access to computers at that time... Finances, basically." (Region 6, Berbice Oriental-Corentyne, West Canje, Male)

4.2.6.6 Cultural Identity and Belonging[66]

When describing their cultural identity, some respondents draw up a clear division: first and foremost they present themselves as Guyanese. Then they present their cultural heritage whether they are Indigenous People, Indo-Guyanese, or Afro-Guyanese. They are proud of their history and proud of their country.

Politics is a matter that does not please many of the interviewees. Many attribute a social split and lack of unity among Guyanese to the political scene.

Among those who wanted to talk about the government, it could be seen an optimism about the new government and a demand for greater attention by the authorities among Indigenous People.

Almost all respondents see themselves as Guyanese because they were born in Guyana. They consider their hospitality and their food as identity marks.

4.2.6.6.1 Cultural Identity

„As a Guyanese. That's it. I'm Guianese, we are a people of six races." (Region 1, Barima Wani, Port Kaituma, Male)

"Yeah, I was born in Guyana, but my ancestors came from India, so they are Indian ancestry, so we are Indo-Guyanese. Like, you have the Blacks, they are Afro-Guyanese. The only true indigenous people here is my friend, the captain. But we have a lot of mixture in here too, because we are so close to the coast, you know… and in any part in Guyana they have a lot of mixture. Before time, you couldn't go to a community like this without permission… now, you can go to any community in Guyana without permission." (Region 2, Demerara Berbice, Mainstay, Male)

"I'm Guyanese, because I was born and grew up here. "What else?" I have my Guyana ID card. I'm proud to be a Guyanese." (Region 9, Essequibo-Demerara, Karasabai, Female)

4.2.6.6.2 Government and National Identity

"What I have seen over the years, like, within my country, politics has divided us. Politics has divided us." (Region 1, Barima Wani, Port Kaituma, Male)

"Sometimes we feel left out because of the distance. But now they are coming a lot, yes, but they are coming to tax us, they never used to tax us before. Now we have to pay taxes. That is how they are making us feel that we belong to the country (person laughing). We need to pay taxes. Sometimes they tend to forget us. The money comes to us once a month. Sometimes you need to wait 1 month for the government workers to the supply for the government workers. "So they make you feel Guyanese making you pay taxes?" Yes, but this is a bad way, because not many people are employed in the village." (Region 9, Essequibo-Demerara, Aishalton, Female)

4.2.6.6.3 Guyanese Unity

„Yes. There's the racial part of it. Black and Indians, they are segregating each other." (Region 2, Demerara Berbice, Charity, Male)

[66] Note: the analyses were done considering an overall view, the quotes are displayed by topics as a way to highlight the aspects taken into consideration.

"I don't know. Cricket." "Is there any special food or celebration?" "The Amerindian Heritage." "But this is only related to the Amerindian people, what about something for the whole country?" "The Guyana Independence." (Region 8, Demerara-Mahaica, Nappi, Male)

4.2.6.6.4 Infrastructure and Identity

"Yes, yes, because from communicating that is how you would get persons united, from talking to somebody. Relationships could be built like that. Maybe if you had a bad thinking of another race, after speaking and communicating with that person you could see that person is different. Because sometimes the parents of the children would tell them not to talk with the other people, so they grow having fear. Sometimes that is what they teach to their children." (Region 9, Essequibo-Demerara, Aishalton, Female)

4.3 As-Is Analysis of Technical Infrastructure and Services provided

This chapter the perspective of the service providers offering ICT services and providing infrastructure within the country.

4.3.1 Introduction

The objective of this network and capacity as-is analysis is to obtain information regarding the existing telecommunications networks in Guyana and to analyze them in terms of the requirements of the project.

The analysis is based on a structured multi step approach, including a questionnaire for guided interviews to collect reliable and comparable information.

Several operators provide telecommunication networks and services within the country, e.g.:

- GT&T: former incumbent, operates fixed and mobile networks
- Digicel: operates a mobile network
- E-Government Unit: operates fixed and mobile networks accessible only for government units
- Several providers offer satellite based IP-based services (internet and VoIP-telephony):
  - IMON Wireless Solutions (http://www.imon-gy.com)
  - E-Networks (using WiMAX technology) (http://www.ewirelessgy.com)
  - Broadband Satellites (www.bbsatellites.com)
  - I-NET (http://www.inet.gy)
- Broadband solutions available in Brazil are used in border regions of Guyana to extend these services into the national territory

Figure 238 - Promotion for brazil-originating internet at Ogle Airport

It needs to be emphasized that all commercial service provider contacted highlighted their concerns in sharing internal information with the project team. The reason given by them is that they perceive the e-Government Unit as a competitor in developing platforms for basic ICT infrastructure in the highly populated coastal areas of

Guyana (where commercial service providers already operate their own networks) and eventually extending them to the public in the future, fearing that a 3rd mobile license might be given to e-Government unit.

4.3.2 Overview Technical Infrastructure

Information about the technical infrastructure was whenever possible collected in individual interviews with representatives of the companies and organizations listed in 4.3.1. If the companies and organizations have not provided certain information, additional research via the respective websites was undertaken. The information displayed and analyzed in this report reflect the status as of 1st of September 2016. The overall aim of this report is to give an indicative overview of services provided and the respective price ranges. The report makes no claims to completeness and exhaustiveness.

The general data regarding access to ICT services in Guyana show that penetration of households with wireline services (PSTN) is at level with the average of Latin America and the Caribbean Countries. Whereas population penetration with wireless services with 75 % (EoY 2015) is significantly lagging behind the regional average (119% EoY 2015).[67]

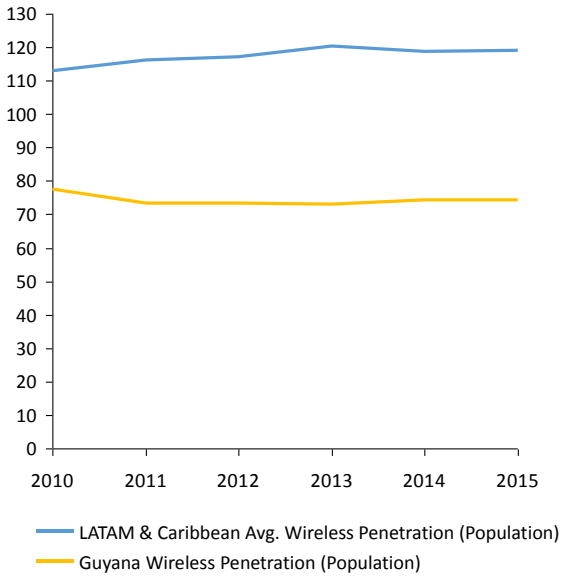


Figure 239 - Wireless Penetration in Guyana (in % of total population)

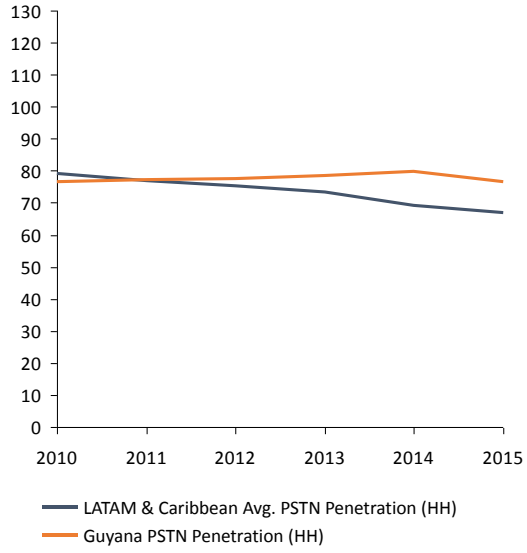


Figure 240 - PSTN Penetration in Guyana (in % of total Households)

4.3.2.1 GT&T

GT&T Guyana operates as a full service provider in Guyana, since 1991. It was founded in 1990 with a joint contract between Government of Guyana (GOG) and Atlantic Tele-Network (ATN). ATN purchased 80 percent of the issued share capital and the GOG retained 20 percent of the company[68].

The interview has been conducted with Mr. Justin Nedd, CEO of GT&T.

[67] Source: Telegeography 2016
Countries considered for Average of Latin America and the Caribbean: Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Curacao, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Saint-Martin, Sint Maarten, Suriname, Trinidad and Tobago, Uruguay, Venezuela, Virgin Islands (U.K.), Virgin Islands (U.S.)
[68] Source: http://gtt.co.gy/why-gtt/about-us

Guyana Telephone and Telegraph (GT&T, rebranded as GTT+ in late 2015), controlled by Atlantic Tele-Network (ATN), has a monopoly over fixed-line services, but it competes with Digicel in the mobile market.

GT&T's fixed-line monopoly was renewed for 20 years in December 2010, but before renewing it the government drafted a new Telecommunications Amendment Bill willfully to open the telecom sector to competition. The plan to amend the bill was abandoned in September 2011 shortly before the national elections, but is being taken up again and presented to the National Assembly. This time benefiting from inputs from both GTT and Digicel. It includes provisions to set up an Universal Services Fund through a tax on telcos' revenues.[69]

GT&T has been granted the only license to operate an international gateway. The license is valid until 2030.

As main challenges for their operation in the country the following points have been raised:

- High taxation level for telephone companies and high level of fees to the different agencies
- Complex and extremely time consuming processes to obtain permission for building new base stations in the country from public bodies.
- Uncertainty about the market development and the specific role of e-Government Unit as a government funded infrastructure provider in this environment.
- Existing legislation in the field of telecommunication is not fully applied.
- Lack of skilled workforce in Guyana.

4.3.2.1.1 Network Information

GT&T operates both fixed line network to supply customers in Guyana as well as a mobile network (including HSPA+, which is marketed as 4G to customers).

Additionally, GT&T operates together with Suriname Operator Telesur the Suriname-Guyana Submarine Cable System (SG-SCS) linking Trinidad&Tobago, Guyana and Suriname[70].

Infrastructure is mostly provided by hardware partners Ericsson and Cisco.

The current network capacities are adequate for handling the actual traffic load. But as data usage is increasing the traffic load will significantly grow in the future. GT&T aims to expand the network and to increase capacities constantly in order to meet the future demand.

150 power generators are in operation all over the country to provide power to local infrastructure.

4.3.2.1.2 Services currently provided

Basic fixed and mobile services are provided to Consumers and Business Customers as well as Add-on Services.

4.3.2.1.2.1 Fixed-Line Service

The consumer prices for GT&T landline plans consist in a one-time fee for installation and a monthly recurring rental fee. Voice minutes are charged separately depending on the amount consumed. All Prices are in GYD:

Main line installation	Monthly Rental
500$ per line for the first two lines	500$ per line for the first two lines
2,000$ per line for the third and all subsequent lines	1,000$ per line for the third and all subsequent lines

[69] Source: https://www.budde.com.au/Research/Guyana-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses

[70] Source: http://www.kaieteurnewsonline.com/2010/01/07/gtt%E2%80%99s-submarine-cable-operations-start-today-to-bring-cable-to-shore/

Costs per minute are as follows, based on the example of a call originating in Georgetown (from the Georgetown telephone exchange):

Destination	Peak-Rate	Off-Peak Rate
Georgetown	0.60	0.30
Cove & John	3.00	2.00
Timehri	4.00	3.00
Anna Regina	5.00	4.00
Lethem/Linden	7.00	5.00
Cellular	12.00	12.00

For further information see appendix.

To use the internet, the following rates apply for private land-line customers:

Plan	Speed	Monthly Price in GYD
Bronze	1.5 Mbps	4,999$
Silver	5 Mbps	9,980$
Gold	10 Mbps	14,979$

For business customers the following rates apply:

Plan	Speed	Incl. e-Mail Addresses	Monthly Price in GYD
Bronze	1.5 Mbps	5	9,999$
Silver	5 Mbps	10	19,999$
Gold	10 Mbps	20	27,999$

On top of these basic services, additional services like voice mailbox, conference calls, caller ID etc. can be added for a monthly nominal fee[71].

4.3.2.1.2.2 Mobile Services

For pre-paid Services the general price per voice minute is 26.00 GYD for domestic calls as well as calls to the USA and Canada. Additionally several pre-paid bundles exist, that provide a specified amount of voice minutes and SMs at discounted prices:

Smart Talk local pre-paid Mobile Services			
Validity after purchase	**Costs [in GYD]**	**Minutes**	**SMS**
1 day	180$	10	10
3 days	360$	20	20
7 days	720$	40	40

[71] Source: http://gtt.co.gy/shop/landline/plans

Data (internet) can be added at the following costs[72]:

Plan Name	Monthly Rate	Quota	Features*	Coverage
Daily Social Plan	$199	Unlimited	Free Facebook and WhatsApp	Local
Daily Plan	$220	80 MB	Rollover data	Local
Daily Plan Extended	$300	140 MB	Rollover data	Local
3 Day Plan	$499	300 MB	Rollover data, free Facebook and WhatsApp	Local
Weekly Plan	$999	800 MB	Rollover data, free Facebook and WhatsApp	Local
Monthly Plan	$2,299	2048 MB	Rollover data, free Facebook and WhatsApp	Local
Monthly Plan Extended	$2,999	3072 MB	Rollover data, free Facebook and WhatsApp	Local
Shared Family Plan	$3,499	3072 MB	Rollover data, free Facebook and WhatsApp	Local

Postpaid plans are as follows:

Post-Paid Voice:

Plan Name	Monthly rate in GYD	Included Minutes	Included SMS (local/int)	On-Net Call Rates	Coverage	Additional Features
Basic	$999	50	25	$17.40	Local	Rollover and Free Minutes
Standard	$2,999	150	50	$16.24	Local	Rollover and Free Minutes

[72] Source: http://gtt.co.gy/shop/mobile/mobile-plans

Gold	$4,999	250	100	$15.08	Local	Rollover and Free Minutes
Premium	$7,999	500	200	$13.92	Local	Rollover and Free Minutes

Data / internet is priced as follows:

Name Plan	Monthly rate in GYD	Included Data (MB)	Additional Data Price
Chat	$1,999	2048	$0.005 Out-of-Plan Rate per KB
Social	$2,999	3072	$0.005 Out-of-Plan Rate per KB
Connect	$3,999	4096	$0.005 Out-of-Plan Rate per KB
Professional	$4,999	6144	$0.005 Out-of-Plan Rate per KB

GT&T does not charge extra for usage of the 4G network capacities, i.e. faster internet connection, if available[73].

Mobile devices sold by GT&T reach from simple cellphones at affordable prices to high end smartphones: The "Plum Slick" is the cheapest available cellphone at a price of 3,250 GYD. It allows basic services such as, voice services, SMS, Bluetooth, FM radio, and MP3 / MP4. At the top range of devices there are the Samsung Galaxy S6 at a price of 129,999 GYD or the Apple iPhone 6 Plus at a price of 149,999 GYD (including one month of free data).

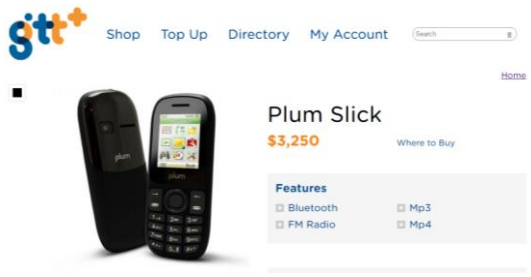


Figure 241 - GT&T Mobile Device Portfolio (example low-end device)

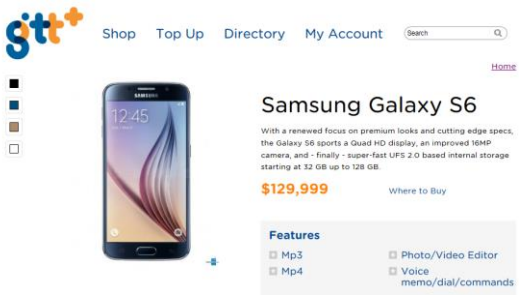


Figure 242 - GT&T Mobile Device Portfolio (example higher-end device)

4.3.2.1.2.3 Add-On Services

GT&T provides a payment services, called "Shop'n Go" that is being used not only to pay for GT&T services but also includes payments for 3rd parties as well as offering "Send&Receive Money" within the country[74]

[73] Source: http://www.stabroeknews.com/2016/news/stories/05/09/gtt-launches-4g-service/
[74] Source: http://mmg.co.gy/

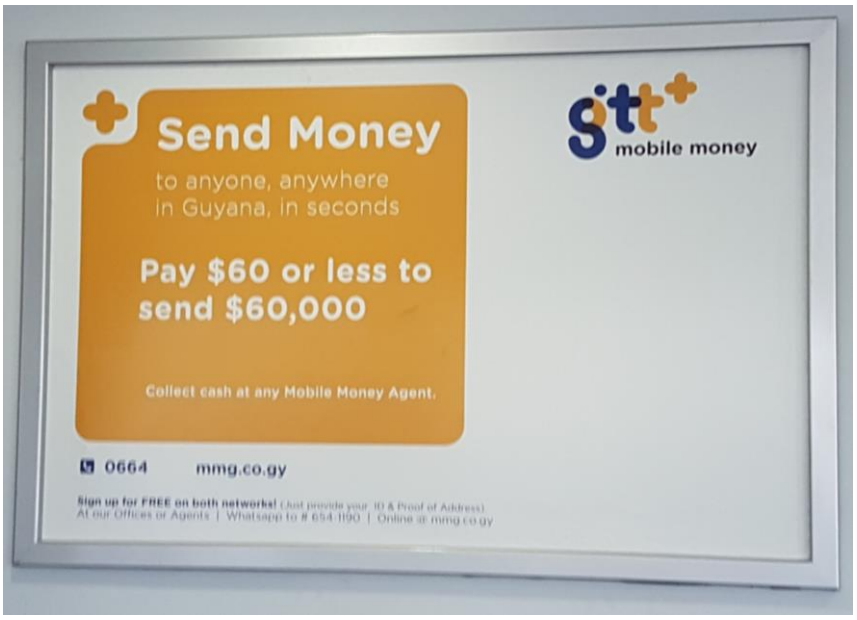


Figure 243 - Advertisement for the Mobile Money Transfer Service (Send & Receive)

This financial service falls under the regulation of the Financial Institutions Act.

4.3.2.1.3 Coverage

GT&T claims to provide the largest coverage for fixed internet. Currently region 1 is not covered by GT&T neither with fixed nor with mobile services.

Coverage maps for fixed and mobile services are not available on their website and haven't been provided yet by GT&T.

4.3.2.2 DIGICEL

In 2007 Digicel group acquired U*Mobile and rebranded it to Digicel Guyana. Since this year Digicel operates a mobile network in the country, currently covering, as stated by the Regional CEO, 98% of the population.

Interviews have been conducted with the Regional CEO, Mr. Gregory Dean, the CEO of Digicel Guyana, Mr. Kevin Kelly and the CTO, Ryan Sinclair.

As main challenges for their operation in the country the following points have been raised:

- High taxation level for telephone companies and high level of fees etc., resulting in Digicel Guyana having the highest costs compared to all national companies of Digicel operating in other countries.
- Complex and extremely time consuming processes to obtain permission for building new base stations in the country from public bodies, involving multiple agencies that would need a better alignment.
- High interconnection fees for international communication and data services
- Lack of surface rights to install needed infrastructure and effortful process to gather required permissions from the land owners[75].
- Uncertainty about the market development and the specific role of e-Government Unit as a government funded infrastructure provider in this environment.
- Uncertainty about future evolution of regulatory framework.

4.3.2.2.1 Network Information

[75] Mining companies currently need to give permission for installations and tend to handle this without any priority, delaying needed installations.

Digicel operates their own towers and transmission network needed to connect these towers. Only in very remote areas, towers are connected via satellite. 900 and 1800 MHz are used for GSM services, 850 MHz for LTE services. It is planned to extend the service using the 700 MHz spectrum for LTE services.

Main supplier for hardware as per group directive is Ericsson and Cisco (IP services).

4.3.2.2.2 Services currently provided

Digicel currently provides mobile services to Consumers (B2C) and commercial customers (B2B) in both payment options: pre-paid and post-paid.

4.3.2.2.2.1 Pre-paid in the national Networks

Pre-paid standard rates for voice minutes & text messaging in Guyana Dollars (as of Sept. 1st, 2016)[76]:

Destination	Peak	Off-Peak
Calls to Digicel mobiles	30.86	27.34
Calls to non-Digicel phones	33.64	31.32
Texts to Digicel mobiles	11.60	11.60
Texts to other mobiles	11.60	11.60

Prepaid standard data rate

Service	Rate (per KB)
Data Usage	1.0

Special data plans can be added to reduce the standard data rate[77]:

4G Data Plans				
Plan	Costs (GYD)	Minutes incl.	Data incl.	Text Messages incl.
Daily	350,00	0	80 MBs	0
Daily Plus	450,00	10	100 MBs	10
3 Days	700,00	20	300 MBs	20
Weekly	1400,00	30	700 MBs	30
Weekly Plus	1700,00	40	1024 MBs	40
Monthly	3800,00	80	2048 MBs	80
Monthly Plus	5000,00	100	3072 MBs	100
2G Data Plans				
Plan Duration	Costs (GYD)	Minutes incl.	Data incl.	Text Messages incl.
1 Day	280,00	0	120 MBs	0
2 Days	500,00	0	300 MBs	0

[76] Source: https://www.digicelgroup.com/gy/en/mobile/plans/prepaid-plans.html
[77] https://www.digicelgroup.com/gy/en/mobile/plans/prepaid-plans/data-plans.html

1 Week	1100,00	0	900 MBs	0
1 Month	2800,00	0	2355 MBs	0
Quarterly	8000,00	0	6144 MBs	0

In addition, special roaming plans and rates exist.

4.3.2.2.2.2 Post-Paid Rates in the national Networks

Pre-paid standard rates for voice minutes & text messaging in Guyana Dollars, excl. VAT. (as of Sept. 1st, 2016)[78]:

Plan Name	Monthly Fee	Cost per minute (off-peak)	Incl. voice minutes	Incl. text messages
Digicel Select 150	3,300.00	22.00	150	10
Digicel Select 200	4,000.00	21.50	200	20
Digicel Select 300	5,800.00	20.00	300	30
Digicel Select 400	7,000.00	19.00	400	40

For post-paid customers the following data plan options exist:

Plan name	Data Allotment
Select 75	800 MB
Select 150	1 GB
Select 200	1 GB
Select 300	1 GB
Select 400	1.2 GB
Select 1000	1.5 GB

4.3.2.2.2.3 Handsets

Currently, Digicel Guyana sells different mobile phones. Basic phones like the BLU Zoey II in a price range from about 4,900.00 GYD and Smartphones like the Huawei Ascend Y221 for 15,000.00 GYD or the Alcatel Idol Alpha for 65,000.00 GYD. In addition Digicel sells proprietary Smartphones like the Digicel DL1 Plus for 38,000.00 GYD.[79]

In the future it is planned that Digicel Guyana becomes a full service provider for ICT solutions, meaning they will offer fixed line services like telephony, internet and triple-play bundles (including TV) as well. Digicel Jamaica is already offering these kind of services.

4.3.2.2.3 Coverage

As stated by the CEO, Digicel Guyana is currently covering 98% of the population of Guyana:

[78] Source: https://www.digicelgroup.com/gy/en/mobile/plans/postpaid-plans.html
[79] Source: https://www.digicelgroup.com/gy/en/mobile/devices/handsets/smartphones.html

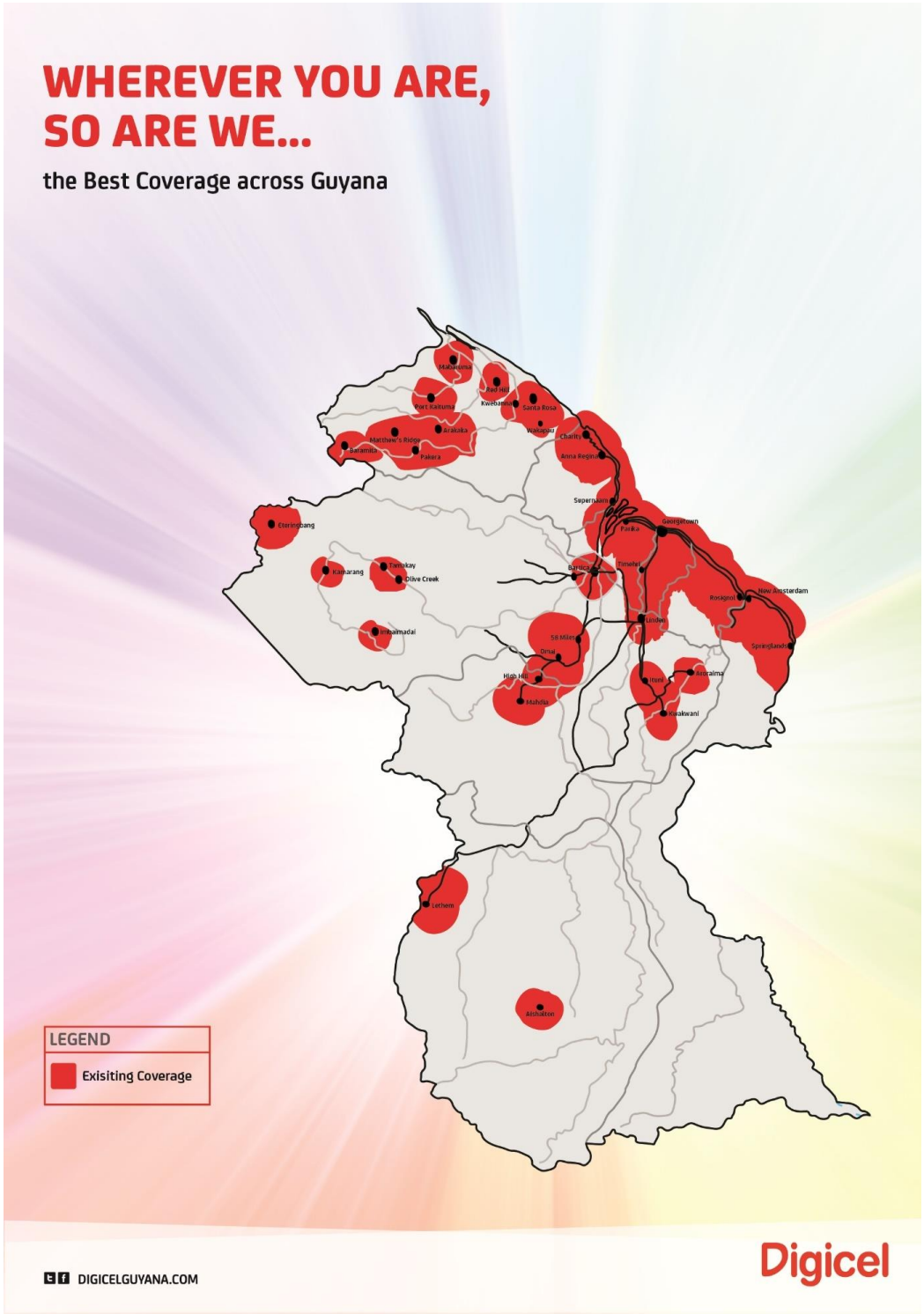


Figure 244 - Coverage map of Digicel Guyana (as of July 2015) [80]

4.3.2.3 I-Net

I-Net has been selected as an example for internet and communication service provisioning via Satellite. An interview has been conducted with the CEO of I-Net, Mr. George Melville.

4.3.2.3.1 Network Information

[80] Source: Digicel Guyana

Connectivity is provided via the Ku band on EUTELSAT 8 West A satellite, covering 100% of Guyana.

The termination of the IP traffic will be done at their earth station in the USA.

4.3.2.3.2 Services currently provided

They provide basic internet connectivity and additional VoIP[81] based telephony services.

For basic internet connectivity, currently eight different packages are offered:

Basic	Bronze	Silver	Gold
$7,999	$10,999	$16,999	$33,999
512 Kbps Download	1024 Kbps Download	2048 Kbps Download	4,096 Kbps Download
1 GB Data Cap	256 Kbps Upload	256 Kbps Upload	512 Kbps Upload
96 Kbps Upload	2 GB Data Cap	5 GB Data Cap	8 GB
SignUp	SignUp	SignUp	SignUp

Diamond	Platinum	Iridium	Tungsten
$41,999	$74,999	$99,999	$140,000
6,144 Kbps Download	10,240 Kbps Download	10,240 Kbps Download	10,240 Kbps Download
512 Kbps Upload	512 Kbps Upload	512 Kbps Upload	512 Kbps Upload
10 GB Data Cap	25 GB Data Cap	35 GB Data Cap	50 GB Data Cap
SignUp	SignUp	SignUp	SignUp

Figure 245 - Overview of packages offered

The telephony services are offered on a reselling model. This means that I-Net sells a bundle of voice minutes to a local reseller who then sells loaded scratch cards to the end customer.

I-Net provides the hardware that is required at the point of usage to provide this VoIP services: Customers can use I-Net- services via "rentals" at GUY $25,000 per month (US $120), on a 3 year contract. This covers all the necessary equipment: VSat, LMB, Modem, Cables etc. Alternatively, customers, respectively communities, can purchase the devices from I-Net for GUY $260,000 (US$ 1,120). This covers all the necessary equipment: VSat, LMB, Modem, Cables etc. Once the VSat unit is installed, customers will then choose which bandwidth package they wish to use.

[81] VoIP=Voice over IP

Figure 246 - VoIP Device

Figure 247 - Scratch card (front side)

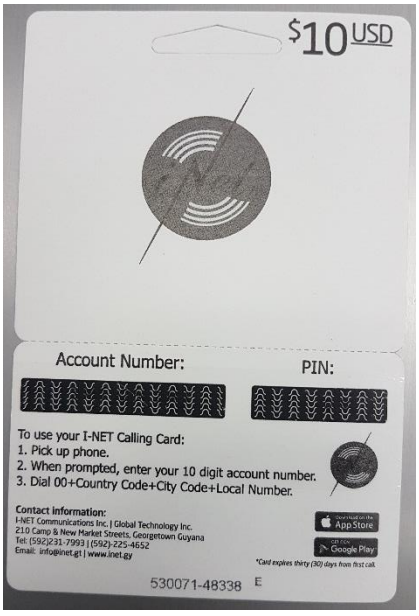


Figure 248 - Scratch card (back side)

The technical handling including call termination via their hub in the USA is being operated by I-Net.

4.3.2.3.3 Coverage

Due to the usage of satellite connectivity, 100% of the country can technically be covered, as long as electricity is available in the respective area.

Figure 249 - Coverage provided by I-NET[82]

[82] http://www.inet.gy/inet/terrestrial-coverage/

Services are currently provided in the following communities all over the country:

Figure 250 - Communities using I-Net service as of September 2016

4.3.2.4 E-Government Agency

The Government of Guyana (GoG) in collaboration with the Government of China (GoC), through Huawei Technologies Co. Ltd., jointly constructed the nation's e-government network. The functions as an essential enabler for Government to enhance its social influence and to contribute to continued prosperity of the country. The project was designed to meet current communication requirements and lay a solid foundation for future service evolution.

The Interview has been conducted with the CTO, Mr. Shaka Dow.

It has to be noted that the e-Government network doesn't fall under the current regulation in the country compared to the commercial operators as they are not providing services to the Public, in accordance with their mission statement: "Our mission is to develop and implement appropriate ICT solutions that will transform the delivery of Government services."

4.3.2.4.1 Network information

E-Government operates fiber, microwave links and LTE-access deployments:[83]

The e-Government network currently comprises a "capital ring"-network, microwave links, and a LTE access-network:

Georgetown – Fiber Ring ("capital ring")

The capital ring currently includes a fiber optic infrastructure that spans the geographic locations that encompasses 27km of fiber and is part of a network structure that delivers sufficient bandwidth for access nodes and avoids single point failures. It encompasses four (4) core sites (Dolphin Secondary School, Transport Sports Club, University of

[83] Source: Information provided by e-Government unit

Guyana and Castellani House) and one node site (National Frequency Management Unit - NFMU) with redundancy (see attached image) that eliminates service interruption caused by networking issues.

This ring provides a dedicated network for the government that can easily construct and maintain its official website and implement a business information platform.

The Transport- & Access-Network

The eGovernment's transport network consists of 54 towers, inclusive of four (4) core sites, a Data Center in Georgetown, 48 microwave links and an outside plant (OSP) comprising of East West and South chains totaling 54km of optical fiber. The LTE sites extend from Georgetown east to Skeldon, west to Parika then to Charity via a microwave link from Tuschen to Aurora on the Essequibo Coast. These sites themselves, are connected by microwave links node, and are limited to a maximum capacity of 360 Mb/s. While the microwave backhaul is capable of delivering 150 Mb/s per LTE towers.

Additionally, the unit is currently assessing the possibilities to provide VSAT services in several Amerindian villages, i.e. Mahdia, Annai, Lethem, Mabaruma, Kwakwani and Masikenyari. Minimum bandwidth requirements are 1mbps for the downlink and 512 kbps for the uplink.

4.3.2.4.2 Services currently provided

E-Government unit provides Government to Government (G2G) services for several ministries and state agencies.

Ministry of Business

E-Government unit supplies the network infrastructure in order to provide interconnectivity between certain locations of public bodies and one or more of the eGovernment network nodes. The network is operated on fiber to the Premises (FTTP) or/and LTE, allowing for communication within and across these ministries/agencies:[84]

- Commercial Registry
- Deeds Registry
- Land Registry
- Guyana Revenue Authority
- National Insurance Scheme
- Central Housing and Planning Authority
- Guyana Lands and Surveys Commission

Ministry of Finance

The MOF currently is expanding a wide area network (WAN) microwave infrastructure that spans several GoG ministries and departments. It furthermore provides access to the Integrated Financial Management and Accounting System (IFMAS) business solution via a direct virtual private network (VPN). With the fiber optic backbone infrastructure the MOF can now leverage the use of the system across the capital ring to integrate a faster and more secure network connectivity across ministries and Agencies.

For the implementation of the WAN and VPN following ministries were selected for pilot testing and are connected by now:[85]

[84] Currently ongoing project, expected to last 3 years until implementation finished

[85] The pilot testing has an incubation period of two (2) months, thereafter the remaining ministries and agencies will be phased in accordingly.

- Ministry of Finance
- Ministry of Education
- Ministry of Public Health
- Ministry of Public Security

Maritime Administration Department (MARAD)

The Maritime Administration Department is the primary organization for maritime policy and administration for the Government of Guyana. It performs several important functions: ship registrations, ship inspections and certifications, port state control functions, port security, implementation of international conventions and the examination and certification of seafarers. In addition the activities conducted by the MARAD are prerequisite to bring Guyana into compliance with international maritime requirements regarding the documentation of seafarers and the tracking of seafaring activities.

It is intended that the connection will support the goals of MARAD's mission as it requires ICT specialized solutions which will enable the workforce to efficiently collaborate. This process will also entail the restructuring of the existing IT workforce and incorporate a change management process to promote effective and efficient customer-focused service delivery.

All Ministries and Agencies

Ministries and Agencies are supported in the performance of their duties and responsibilities through the infrastructure and services provided by the eGovernment Unit. The central provisioning of colocation services hosted on eGovernment facilities and provided via the eGovernment transport network allows saving of costs by maintaining large and shared computing facilities while keeping availability high, e.g. by using a defined and shared disaster recovery procedure/technologies. Colocation facilities provide space, power, cooling, and physical security for the server; space in the facility is available for leased by rack, cabinet, cage or room.

Overview of other planned services and the respective projects under the responsibility of the e-Government unit:

Name of Project	Description	Target group
Citizens' Issues Reporting Solution "Tell Us"[86]	"Tell Us" will connect citizens directly to the entities responsible for providing services and responding to their particular needs. The web or mobile based application will facilitate citizens' reporting of issues directly responsible agencies. This would significantly reduce transaction times, improve accountability of those agencies, and encourage citizens' leadership and feedback in the delivery of public services.	This project is expected to benefit the agencies themselves by providing a means for system wide monitoring platform that will aid efficiency and effectiveness. Citizens will be able to take ownership in the continued enhancement of Government services.
Citizenship and Immigration Information System (CIIS)[87]	Comprising two sub-projects - online passport application processing and online visa applications - this will modernize	In particular this will benefit citizens who reside in rural or hinterland communities and those in the diaspora. The current costs

[86] The Project begun in April and is expected to be completed in October of this year 2016. It is expected that by the end of 2017 all Government agencies will be connected.

[87] This project started in June, 2016 and is expected to be completed by the end of the first quarter in 2017.

	the Immigration Information and Processing Systems through Guyana and significantly reduce the costs related to these services. In addition the project will help to streamline the business processes related to these services and give clarity to the agencies involved in the delivery of the services.	for these services to citizens is high and usual involves lengthy processing times, long travelling distances and sometimes unclear procedures. Moreover the authority responsibility will benefit from a centralized process.
Government Portal[88]	The Government of Guyana through its agencies provide a host of services to the public. Some of these agencies are not easily accessible and may have procedures that are not well known by the public. The Government portal is a project to provide a one stop clearing house for all Government services. The web and mobile accessible platform will provide information on the procedures for certain service and direct the user to the e-service centers of the respective agency where these exist.	Citizens, especially those in rural and hinterland communities are the primary beneficiaries. It is expected that citizens in the diaspora will also benefit and the Government of Guyana will accrue savings as a result of foregoing the costs of establishing outstations for some agencies as these services will not be e-based.
Community ICT Hubs[89]	This project is for the establishment of 24 community based public access ICT sites across Guyana (12 Hinterland & 12 Coastland), in the initial instance. The project involves building community relations and ownership of the spaces through the physical installation of the connectivity infrastructure, the provision of laptops and training of community members.	Citizens in the selected communities will be the primary beneficiaries of the project. It is expected that businesses, especially those in the identified communities, will be secondary beneficiaries.
Schools Connectivity[90]	The aim of this project is to connect 50 pilot secondary schools in the first instance into a private lease connection with the National Center for Education Research and Development. The connection will allow schools to can directly access a number of e-learning resources and to provide real time feedback to NCERD. Furthermore it will	Students and teachers of the pilot schools are the primary beneficiaries of this project. NCERD is expected to gain useful information on its e-learning Programme to improve the expansion of the Programme.

[88] The project commenced in March, 2016, and is expected to be completed in the last quarter of 2016.
[89] This project is ongoing with the initial installations and commissioning expected in the third quarter of 2017.
[90] The Programme which begun in April, 2016, if is expected to be completed in September of 2016.

	facilitate faster communication between NCERD and these schools and thus enable monitoring, reporting and problem resolving in the roll out of the Programme.	
Appoint Scheduling[91]	Generally, Government agencies see a large number of persons frequently because of the nature of their services. Usually this involves long queues. In an effort to improve the efficiency of these services and to reduce the costs for citizens, the Government of Guyana has embarked on a process to enable agencies to assign appointments thereby controlling both the intake flow and processing for services.	The passport office in Georgetown has been identified as the first agency to implement this system and will serve as a proof of concept for the scheduling tool through the public services sector.

Figure 251 - eGovernment unit's Cloud Service infrastructure

[91] The pilot project is expected to be implemented at the passport office in Georgetown within the third quarter of 2016 and implemented across other agencies in 2017

Figure 252 - eGovernment unit's ICT Infrastructure in Georgetown

4.3.2.4.3 Coverage

The current focus is on connecting government agencies along the coastline. Detailed information has been provided but has been declared as “confidential”. It is planned to extend the reach to the areas currently not covered by commercial service providers, where there is a certain need for communication services, but due to the remoteness or socioeconomics characteristics of these regions no commercial service offered.

Figure 253 - ICT Infrastructure

To prepare for higher traffic loads, e-Government unit is collaborating with Guyana Power & Light Inc. (GPL)[92] to make use of the dark fibers in GPL's fiber network. The intention is to utilize GPL's spare fiber capacity to connect the LTE sites which are in close proximity to the existing GPL fiber route and assist GPL in expanding its connection to other commercial and operation centers. In utilizing GPL's spare capacity, it will form e-Government's fiber optic backbone or primary operational network. E-Government's microwave network in return will serve both GPL and eGovernment operational redundancy needs.

[92] The GPL franchise area encompasses the entire three counties of Demerara, Berbice and Essequibo. It is entirely owned by the Government of Guyana.[source: http://www.gplinc.net/about/history]

4.4 Regulation of Telecommunication

Several regulatory bodies currently exist in Guyana:

- **The Public Utilities Commission (PUC).** It operates under the Ministry of Public Telecommunications and has the following objectives:
  - To establish and enforce rules and procedures for the regulation of public utilities, commensurate with internationally accepted regulatory standards.
  - To promote and regulate the efficient long-term provision of utility services for national development consistent with Government policy.
  - To provide a fair environment conducive to business interest, investment in the public utilities sector, and the interest of consumers.
  - To investigate and seek to resolve in a timely manner complaints filed with the Commission against any public utility.
  - To carry out its functions in a fair, transparent and independent manner.
- **The Competition and Consumer Affairs Commission (CCAC).** It operates under the Ministry of Business and Tourism. Its mission is:
  - For the Consumer Affairs unit: to bring businesses into full compliance with the Consumer Affairs Act.
  - For the Competition Policy unit: to enforce the Competition and Fair Trade Act, i.e. that there is maintenance of a level playing field for all enterprises, and that they all compete fairly.
- **The National Frequency Management Unit (NFMU).** It operates under the Ministry of Public Telecommunications and has the following mission:
  - To efficiently and effectively manage the electromagnetic frequency spectrum and to administer the number blocks for Guyana; being proactive, customer oriented, transparent and keeping abreast with global technological developments in the telecommunications sector, thereby fostering an environment conducive for investment and where the deployment and use of ICTs can be optimized for the social and economic development of Guyana.
- **The National Data Management Authority (NDMA).** It operates under the Ministry of Public Telecommunications and has the following objectives[93]:
  - The development of computer systems in the Public Sector to satisfy its information needs.
  - The establishment of guidelines for the Public Sector for the recruitment, remuneration and general conditions of service of the personnel employed in data processing.
  - The development of training and manpower programs in order to ensure that adequately trained personnel is available for the efficient operation of computer systems.
  - The authorization of the acquisition of all hardware and software for the Public Sector.
  - The establishment and maintenance of reliable communication linkages in the Public Sector in order to achieve optimal utilization and deployment of computer resources.
- **The Private Sector Commission (PSC)** as the leading advocate for the private sector on articulated and shared positions on national issues which will promote socio-economic growth and development through the creation of strategic partnerships with the Government and other stakeholders. Its objectives are[94]:
  - To advocate for, provide leadership and promote activities and projects for all members and stakeholders that will create a platform to foster development in Guyana.
  - To partner with all members and stakeholders to develop and sustain plans for increasing the competitiveness of Guyanese products and Guyana within the CSME and the related global arrangements.
  - To collect and share information to better inform the Private Sector and society as a whole.
  - To work towards ensuring that proper systems of Governance and Security are in place to encourage investments.

[93] Source: National Data Management Authority Act
[94] Source: http://psc.org.gy/

- To create the environment necessary to encourage and facilitate harmonization among members and to continue to build alliances nationally, regionally and internationally, including the Donor Agencies.
- To work with all stakeholders to develop policies and procedures that will reverse brain drain and provide adequate training to better serve the needs of the country.

As the New Telecommunications Bill is expected to be passed within the next months, several changes to this regulation ecosystem are expected to happen, esp. with the **creation of a dedicated Telecommunications Agency**, into which the NFMU will be incorporated. As the technical regulator of the telecommunication sector in Guyana the new Telecommunications Agency will be responsible for matters as[95]:

- Implementing the Minister's policy directives
- Receiving, reviewing, and making recommendations on applications for licenses and frequency authorizations
- Advising and supporting the Minister on matters related to policy, licenses, spectrum and international relations
- Monitoring and enforcing compliance with licenses and frequency authorizations
- Managing the spectrum (plan, supervise, regulate, monitor harmful interference) and other technical aspects of telecommunications including numbers;
- Administering the Universality Fund and universal access/services

Also in the adjusted regulatory ecosystem the **Public Utilites Commission (PUC)** will continue to present the economic regulator, standing next to the Telecommunication Agency in their responsibility as technical regulator. The PUC's responsibilities will include:

- Regulating wholesale and retail prices for telecommunications networks and services;
- Regulating interconnection and access
- Regulating number portability and equal access
- Enforcing competitive safeguards
- Resolving disputes involving operators and service providers
- Protecting consumers and resolving disputes between consumers and service providers program

4.4.1.1 National Frequency Management Unit

Interview has been conducted with the Managing Director of the National Frequency Management Unit (NFMU), Mr. Valmikki Singh and his team.

The NFMU is responsible for managing and overseeing the Spectrum Plan and the utilization of spectrum.

As per their policies they see themselves following a technological neutrality, meaning the frequencies will be allocated based on planned services only, not requesting or defining a specific technology to be used.

Frequencies are not auctioned as per current Government Policy. This is due to the specifics of Guyana as a country and economy, with a limited population and market. It is expected that the companies can spend that money better in their ICT infrastructure in the country, at the end contributing more to the wealth of the country then the auctioned license fees only.

Satellite service providers currently operate in a "grey" area, as they are required to obtain a license for their services, but do not fall under regulation for specific voice services as e.g. lawful interception or emergency call handling. It is expected that this situation will change once the new Telecommunications Bill has come into force.

[95] Source: Minister Catherine Hughes, MP, Telecommunications bill Second Reading June, 2016

The existence of one single oversea network only to connect Guyana with the rest of the world has been seen as a bottleneck for the development of ICT infrastructure and services in Guyana.

4.4.1.1.1 Band Plan for Narrow Band communication

Pursuant to the GFAT, spectrum for narrow band communication is assigned on a first come first served basis with the following

Band	3-30 MHz
Channel bandwidth	5 kHz
Band	136-174 MHz
Channel bandwidth	12.5 kHz (smaller bandwidths such as 6.25 kHz can be accommodated)
Band	401 – 430 MHz
Channel bandwidth	12.5 kHz (smaller bandwidths such as 6.25 kHz can be accommodated)

Table 14 - Band plan for narrow band communication

Assignments in the 450 MHz band are also accommodated once spectrum users accept that they may be required to cease using the said band (the 450 MHz band has been identified as an IMT 2000 Band) and move to another band at their expense after being given about 6 months notice.

4.4.1.1.2 Band Plan for Trunked Communication

Band	811 – 821 MHz paired with 856 – 866 MHz (analogue)
Channel bandwidth	12.5 kHz (smaller bandwidths such as 6.25 kHz can be accommodated)

Table 15 - Band plan for trunked communication (analogue)

This band plan and associated assignments for the analogue trunked system are expected to be phased out over the next two years or so. Digital trunked systems will replace the analogue system.

Band	821 – 824 MHz paired with 866 – 869 MHz (digital)
Channel bandwidth	12.5 kHz (smaller bandwidths such as 6.25 kHz can be accommodated)

Table 16 - Band plan for trunked communication (digital)

4.4.1.1.3 Band Plan for Mobile and Broadband Communication

While the approach of the NFMU is not to dictate what technology an operator should utilize (principle of technology neutrality), it is important to be aware of the capabilities of the various technologies/standards, the associated evolution/generation, the services they provide and the bands in which they operate. The following table summarizes these relationships.

Generation	Technology/standard
2G Capabilities (voice centric)	GSM 850, GSM 1900, GSM 900, GSM 1800
3G Capabilities (data centric)	UMTS 850, UMTS 1900, UMTS 1700, UMTS 2100, UMTS 900, UMTS 1800
4G Capabilities (data centric)	LTE 1700, LTE 2600, LTE 700, LTE 1900, LTE 2100, LTE 800, LTE 1800, LTE 2300

Table 17 - Summary of standards and technologies

The plan below sets out the bands identified for Mobile Broadband. Given the obvious overlaps and in order to maximize spectrum availability, the 1900 Band was not included in the plan. Notwithstanding, it has been included in the chart below to provide a broad overview of the various bands.

Spectrum assignments in the 850 MHz band and the corresponding implications for the adjacent bands require more work on the finalization of the mobile bands below 1 GHz. This information has to be incorporated accordingly and a decision has to be made on the way forward with this plan.

In order to facilitate competition, each band identified for mobile communications should accommodate three operators where possible.

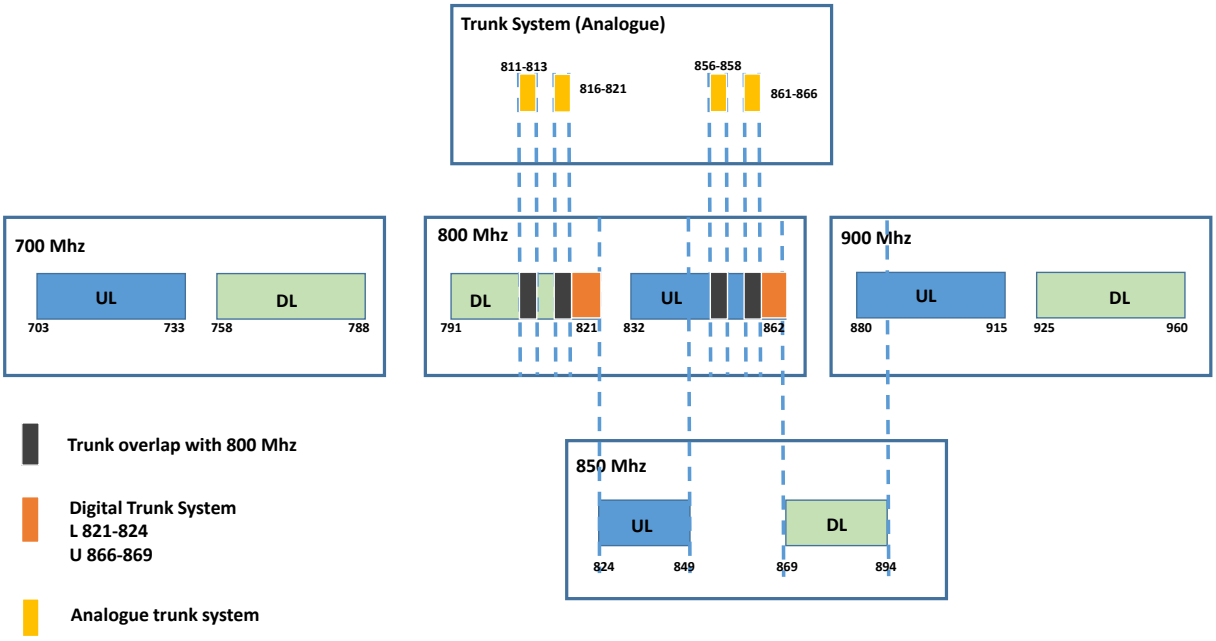


Figure 254 - Spectrum plan for 700, 800, 850, 900 MHz Bands

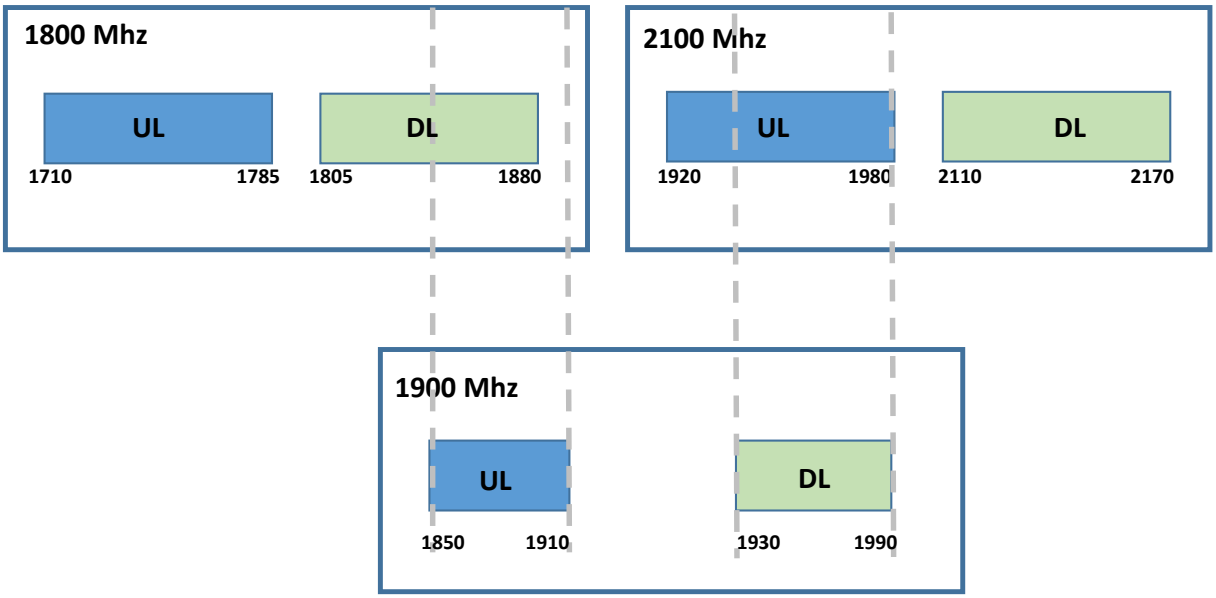


Figure 255 - Spectrum plan for 1800, 1900, 2100 MHz Bands

4.4.1.1.4 Allocations identified for IMT Services (IMT-2000)

450-470 MHz	Several assignments have been made for narrow band users. These would have to be refarmed when the need arises for this band when it will be used for broadband purposes.
698-960 MHz	This band has been identified for Mobile services. Only under special circumstances would it be used

	for Broadcasting on a temporary basis until the transition to Digital Terrestrial TV Broadcasting is completed.
1710-2025 MHz	There are no information about the planned utilization of this band available in the current draft of the National Spectrum Plan for Guyana.

Table 18 - Allocations identified for IMT Services

4.4.1.1.5 Microwave Band Plans (Point to Point Backhaul)

2 GHz Band Plan:

ITU Recommendation	ITU-R F.382-8
Band Range	1900 MHz – 2300 MHz
Channel Spacing	29 MHz
Separation between Rx and Tx	213 MHz

Table 19 - 2 GHz Band Plan

Lower 4 GHz Band Plan:

ITU Recommendation	ITU-R F.382-8
Band Range	3800 MHz – 4200 MHz
Channel Spacing	28 MHz
Separation between Rx and Tx	266 MHz

Table 20 - Lower 4 GHz Band Plan

Upper 4 GHz Band Plan:

ITU Recommendation	ITU-R F.1099-3
Band Range	4400 MHz – 5000 MHz
Channel Spacing	30 MHz
Separation between Rx and Tx	300 MHz

Table 21 - Upper 4 GHz Band Plan

Lower 6 GHz Band Plan:

ITU Recommendation	ITU-R F.383-7
Band Range	5925 MHz – 6425 MHz
Channel Spacing	29.65 MHz
Separation between Rx and Tx	252.04 MHz

Table 22 - Lower 6 GHz Band Plan

Upper 6 GHz Band Plan:

ITU Recommendation	ITU-R F.384-8
Band Range	6400 MHz – 6700 MHz
Channel Spacing	40 MHz
Separation between Rx and Tx	340 MHz

Table 23 - Upper 6 GHz Band Plan

7 GHz Band Plan:

ITU Recommendation	ITU-R F.385-10
Band Range	7110 MHz – 7900 MHz
Channel Spacing	7 MHz
Separation between Rx and Tx	161 MHz

Table 24 - 7 GHz Band Plan

8 GHz Band Plan:

ITU Recommendation	ITU-R F.386-8
Band Range	7725 MHz – 8500 MHz
Channel Spacing	14 MHz
Separation between Rx and Tx	266 MHz

Table 25 - 8 GHz Band Plan

11 GHz Band Plan:

ITU Recommendation	ITU-R F.387-10
Band Range	10.7 GHz – 11.7 GHz
Channel Spacing	10 MHz
Separation between Rx and Tx	530 MHz

Table 26 - 11 GHz Band Plan

13 GHz Band Plan:

ITU Recommendation	ITU-R F.497-7
Band Range	12.75 GHz – 13.25 GHz
Channel Spacing	28 MHz
Separation between Rx and Tx	266 MHz

Table 27 - 13 GHz Band Plan

15 GHz Band Plan:

ITU Recommendation	ITU-R F.636-3
Band Range	14.4 GHz – 15.35 GHz
Channel Spacing	14 MHz
Separation between Rx and Tx	490 MHz

Table 28 - 15 GHz Band Plan

4.4.1.1.6 Assigned Frequencies

GT&T and Digicel:

Frequency band	**Service**
850 MHz band	Data network

900 MHz band	GSM voice centric
1800 MHz band	GSM voice centric

Table 29 - Assigned frequencies to GT&T and Digicel

LTE bands:

Frequency band	**Operator**
2.3 GHz band	E-Government Unit
2.5 GHz band	E-Networks Inc
2.5 GHz band	Quark Communications Inc.

Table 30 - Assigned LTE bands

4.4.1.2 Public Utilities Commission

Initial conversation has been held with Mr. Prem Persaud, Head of the Public Utilities Commission and his team.

PUC highlighted difficulties to be expected in providing telecommunication services in the hinterland and remote areas like language barriers, i.e. people don't speak English very well, and the existence of barter communities.

As the Commission also has the power to initiate and conduct investigations into the operations and standards of service of any public utilities under its purview, it provides local offices where people can file their complaints with the different operators. Reports about the number of complaints and the respective topic are published on a monthly base.

4.5 Conclusion

Interviews with commercial operators showed certain concerns in the overall strategy of the e-Government unit potentially impacting their own core-business with eventually offering competing services in a long term perspective to their respective customers. These concerns were reflected in the feedback and the rather limited information the commercial operators shared with the project team.

Guyana information and telecommunication system is characterized by an unequal distribution of services throughout the territory, the teledensity in 2011 for fixed-lines was about 20%, while for mobile cellular it was 70% and for internet users 36.7%. An estimated data for 2014 indicated an increase in those numbers, for fixed-lines subscriptions it was estimated 22% of teledensity and for mobile cellular subscription 77%. Mostly, this variation follows regional divisions: While the coastal area is generally better covered, hinterland areas are less integrated in the communication network. The coastal area of Guyana, 5% of its territory, concentrates 90% of its inhabitants, while a few Indigenous People villages are located in the hinterland regions. Regardless of this, there are also relevant differences within the regions[96].

[96] Source: Information strategy, internet and e-commerce developed handbook. Strategic information, programs and regulation. Published by International Business Publication, USA, 2015.
Teledensity describes the number of telephone lines per population.

Consequently, the research registered a great amount of discrepancies regarding the needs of different communities. For example, in the coastal area, there were many complaints related to the quality and price of various communication services. At the same time, some hinterland communities are characterized by an almost complete lack of services – which brings completely different challenges for implementing new infrastructure and technology.

Interviews with respondents representing the three profiles of the inhabitants of the communities also showed significantly different information. While the availability of services tend to impose similar limitations to all respondents belonging to the same communities, some common features can be found in interviews from professionals with similar backgrounds.

This shows a discrepancy to the statements provided by the operators who claimed that they are currently covering 98% percent of the population – nevertheless even if a village had a mobile signal it mostly didn't cover the whole village, but only some spots of the community.

4.5.1.1 Variations across Regions

Taking into account variations in the level of access to information and communication technology, the set of surveyed communities were divided in three subcategories. The first one characterizes those that have 1) a more diverse number of available services and 2) widespread access to most of these services. The second comprises communities with a limited number of services with moderate-to-good quality accessible to a majority of the people. The third includes communities with very few services, which are available in a limited way.

Communities with Widespread Access to a Variety of Services

While problems regarding telecommunication systems and technologies were described in almost all communities composing the sample for this study, some of those presented a comparatively better situation than others. For instance, in communities such as Albouystown and Kwakwani services such as 3G, landlines, cellphone signal, and internet are widely available to the public.

Communities in this group presented 3 main problems:

First, many interviewees complained about the cost-benefit ratio for the services they used. 3G mobile internet, for example, was frequently described as intermittent and expensive. Even close to or in Georgetown, broadband internet services were described as slow and unreliable.

Second, the prices for some devices (mainly laptops and computers) were considered too high. This problem was even more marked in communities such as Kwakwani – which has telecommunication services, but no store or shop where it is possible to buy specific devices. Therefore, accounts for the costs must also include the time and money spent to go to Georgetown in order to buy such devices.

Third, some of the interviewees described difficulties to operate some devices (again, mainly computers and laptops). Frequently named as "computer illiteracy", this issue is thought to result from a lack of proper training and access to some technologies.

Communities with a Relatively Limited Number of Widely-Accessible Services

For this subset of communities, all the problems described in the section above were also registered. For instance, computer illiteracy, bad services, and high costs for both devices and services were mentioned by most interviewees.

The main specificity within this group relates to a lack of access to some specific services. For example, people in places such as Mabaruma and Port Kaituma (both in Region 1) use cellphones**,** Smartphones and 3G internet. Nevertheless, broadband internet is available only through costly satellite services. Landline phones are also relatively rare, being available almost exclusively in some public facilities.

Another problem is the coverage of the mobile network. While the central parts of villages within this group receives relatively good cellphone service, more distant sections have more difficulties in accessing mobile services. For

instance, one interviewee mentioned that in some regions near Mabaruma people had to climb trees in order to get proper signal for their cellphone.

Communities with Very Few, Very Unreliable, or Virtually Nonexistent Telecommunication Services

Some of the communities considered in this study are practically cut off from access to telecommunication and information technology. Kako – a community in the Cuyuni-Mazaruni region with more than 2,000 people – for example, has only a few spots where it is possible to get proper mobile phone signal. In the same region, the Phillipai village does not have any mobile signal or landline phone – with the high frequency radio being the only device used to communicate with other villages and regions in Guyana.

While interviewees from villages in this subset complained about the costs of the devices and the lack of available shops and stores to buy them, the main problem mentioned was the lack of services. Computer illiteracy was also mentioned. Some interviewees' highlighted problems related to the lack of proper telecommunication services, such as the inability to contact authorities in order to obtain or provide information. Healthcare and education sector professionals complained about difficulties to obtain training, and emphasized that internet access should be provided in order to enhance educational standards.

4.5.1.2 Variations across Professional Groups

As described above, geographical differences are the most relevant variables when considering discrepancies in the access to communication services across Guyana. In this sense, when living in the same area, the three professional groups interviewed tend to express similar sets of needs, habits, and perceptions, related to information and communication technology.

This homogeneity can be observed, mostly, in responses to questions I through VII (see Appendix chapter ?) . With a few exceptions, public officials and business persons generally report to have patterns of access to telecommunication services similar to those they describe in their communities.

Nevertheless, important variations are also registered across professional groups. The most salient is the difference regarding *how* these groups already use telecommunication and/or are willing to use better telecommunication services if they have access to it. For instance, while almost all respondents tend to generally recognize that utilizing the mentioned devices and services can significantly improve their living standards while making life easier, they describe types of usages of these services that are specific to their work.

For instance, when describing existing conditions, healthcare professionals from areas with a relatively limited number of widely-accessible services reportedly need to use their own privately owned cellphones to contact fellow physicians and patients, since there is no landline or Wi-Fi network for professional exchange available. Teachers from all regions complain about the instability and unreliability of internet access (when it does exist). Better and more reliable internet access could help students to find needed information in order to complete academic tasks. Business owners from communities with few, unreliable, or practically nonexistent telecommunication services reportedly have severe difficulties to sell their products, since sometimes they cannot contact possible buyers.

When considering the improvement of the telecommunication infrastructure and its possibilities, health care professionals, for example, emphasize how a better mobile network would help them to monitor the health conditions of patients without traveling long distances to do this. Education workers recognize that improved access to the internet would enable them to remain in touch with authorities from the Ministry of Education, to acquire more training, or to present specific academic activities (mostly involving research) to their students. Businesspeople, by their turn, are willing to use cellphones and e-commerce platforms to amplify their connections with different markets within their regions and communities, their country, and the world.

In this sense, the design and implementation of public policies to develop the telecommunication infrastructure in all regions of Guyana should also take into account the specific needs of different professional groups. Besides that, they should also be seen as partners in this process. Well-trained teachers, for example, could use schools as

platforms to improve computer literacy in their communities. When analyzing the information gathered from the interviews, it is possible to observe that most of them are already motivated to do so.

4.5.1.3 Networks & Technology

There is a significant overlap in telecommunication network infrastructure in the country. All operators assessed in this project cover the highly populated coastal areas with their networks with GT&T and Digicel reaching out to the more sparsely populated areas. Nevertheless, as stated above, the perceived quality of the signal in the remote and hinterland areas is quite poor.

Both commercial operators are preparing themselves for the expected deregulation related to the new Telecommunication Bill. They are preparing to launch new services, targeting first of all the highly populated areas in the country. Backbone networks still provide enough capacity to expand services within the country. The availability of only one Submarine Cable to connect Guyana to the outside world has been seen as a cost driver, negatively impacting the overall prices and quality for data and voice services.

Both operators claimed that Guyana shall provide a more investment friendly environment. The current environment has been described as significantly lacking long term stability of economical boundaries (e.g. legislation, regulation, taxation). At the same time complicated procedures for permissions etc. involving too many agencies lead to an extremely long planning and investment phase[97].

Satellite Services are provided and used in some communities of the Hinterland and in Remote areas, for voice as well as internet services. However the survey shows, that users sometimes are not even aware that they are using a satellite service. The advantage of satellite services is, that they don't require complex fix installed infrastructure on the ground. This allows the providers of satellite services to respond quickly to changing customer requirements especially in the case communities move to another location, which is common in the mining industry and with nomadic communities in the Hinterland. Nevertheless, due to the relatively high price and low performance (as of lower overall capacity and high latency of satellite links compared to e.g. LTE networks) the adoption of satellite services is very slow compared to other ICT services.

4.5.1.4 Regulation

Regulation of the telecommunication ecosystem in Guyana is currently facing significant changes, as the New Telecommunications Bill is expected to be passed within the next months. With the new law coming into force a dedicated Telecommunications Agency as the central technical regulator of the telecommunication sector in Guyana shall be established.

Commercial operators furthermore expect measures to promote the liberalization of the telecommunication market such as the opening of the fixed-line monopoly and the monopoly to operate the international gateway. In addition they hope for more transparency and legal certainty regarding the evolution of the telecommunication market (e.g. a long-term spectrum strategy).

It is expected that several services not explicitly falling under the current regulation (grey areas) will be addressed in the future (i.e. the evaluation of VoIP service providers).

[97] It has been highlighted that the duration to get all the needed permissions to build up a new antenna might take 4 times the time compared to neighboring countries like Trinidad & Tobago.

5. Technical Report (WP2)

5.1 Introduction

This report comprises the findings from the work stream 2 of the project "ICT Access and e-Services for hinterland, Poor and Remote Communities in Guyana". This work stream "Elaboration of the extensive Technical Report", aims to describe potential technologies suitable for the special conditions (environment and population density) in the hinterland and remote areas of Guyana and elaborates the best possible solution aiming to provide broadband connectivity to the hinterland, poor and remote areas of the country - the eGovernment Network. Besides the technical solution, the needed realization framework will be described. This includes the recommended business model to operate the eGovernment Network as well as describing the implications for Legislation and Policy Development needed to have the business model successfully implemented. The report concludes with a recommendation for the next steps in the context of the planned realization program.

The results from this chapter might update findings from the previous chapters.

5.2 Technology Strategy

5.2.1 Technology Assessment

There is a variety of technologies used within telecommunication business for more than 20 years, to transport services using point-to-point as well as point-to-multipoint connections. Most of the technologies will remain in the technology portfolio of operators for a long time, due to the relatively long lifetime of the hardware and due to the high invests involved. The main goal of this chapter is to give an overview of different technologies in all network domains and to provide a clear and comprehensive analysis of the communication technologies suitable for the specific needs and mission of Guyana's eGovernment agency. The analysis considers multiple aspects for the evaluation and selection of the most appropriate solution: such as feasibility to the local environmental conditions, cost effectiveness of the solution and alignment with the strategy of the eGovernment's e-services delivery.

In general, an end-to-end network can be broken down into several building blocks, that can be analyzed and assessed independently, always taking into account local specifics like, terrain, and demands claimed by the planned services:

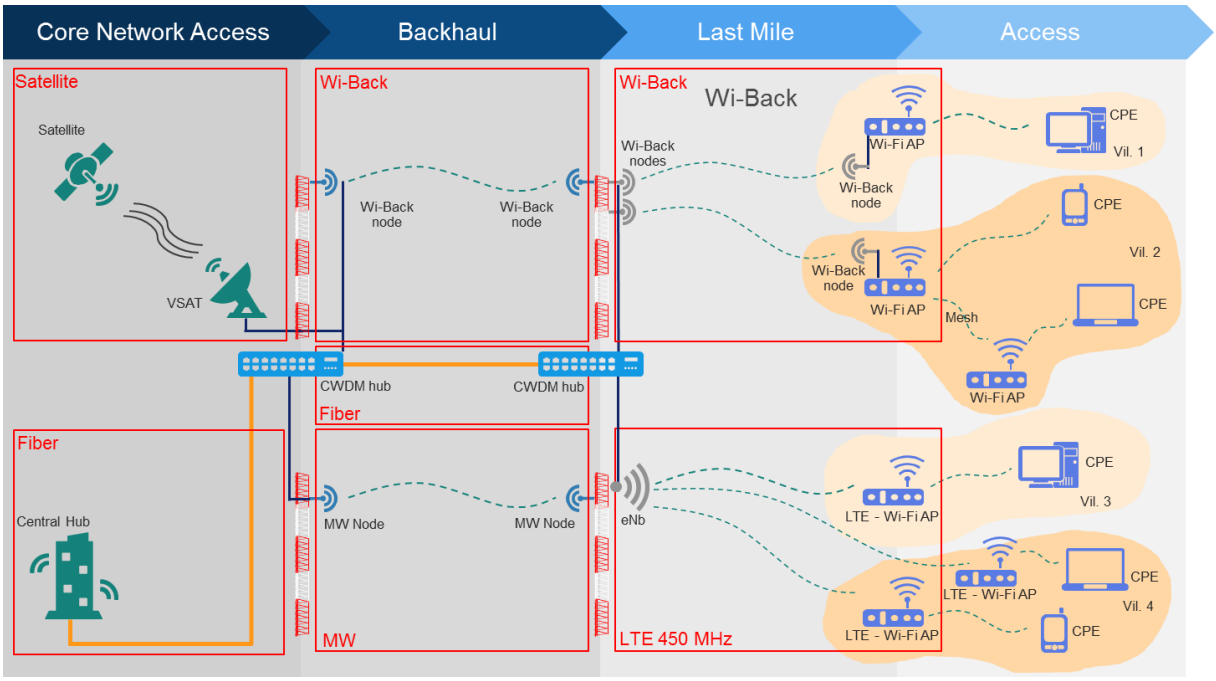


Figure 256 - Building blocks of a communication network

Core Network Access – Represents the fiber backbone or satellite access to central parts of a telecommunications, where the exchange of information between different sub-networks take place. Core network access technologies applied in the context of the current project are based on either fiber cable or satellite link. The goal of solution development is to find the most feasible way of bringing connectivity from the points of presence (PoP), i.e. the connection point to the backbone, to consumers within the country.

Backhaul– In a hierarchical telecommunications network like shown above a backhaul represents the portion of the network which comprises the next level of intermediate links between the points of presence and the small subnetworks at the "edge", i.e. the last mile, of the entire hierarchical network. Technologies used here are, e.g Microwave, Fiber and long distance Wi-Fi.

Last Mile– is the most challenging part of the network for the most operators worldwide. It refers to the portion of the telecommunications network chain that physically reaches the end-user's premises and compromises between throughput, coverage and number of the users. Various technologies like GSM, UMTS, LTE, WiMAX or other can be used in the last mile.

Access – is the only technology that in fact is visible to the service consumer, like the Wi-Fi Hotspot or phone cable at home.

The selection of the suitable technology is done according to the following steps:

Step 1 – Selection of the appropriate technologies based on the technology specifications and its deployment capabilities in Guyana according to local environmental conditions

Step 2 – Service based selection of the technologies according to the service requirement

Communication technologies, which are state-of-the-art and fit to all requirements determined after these two steps are used as building components of the possible solutions for network deployment in Guyana. Financial assessment will be done for all derived solutions in order to identify the most efficient solution.

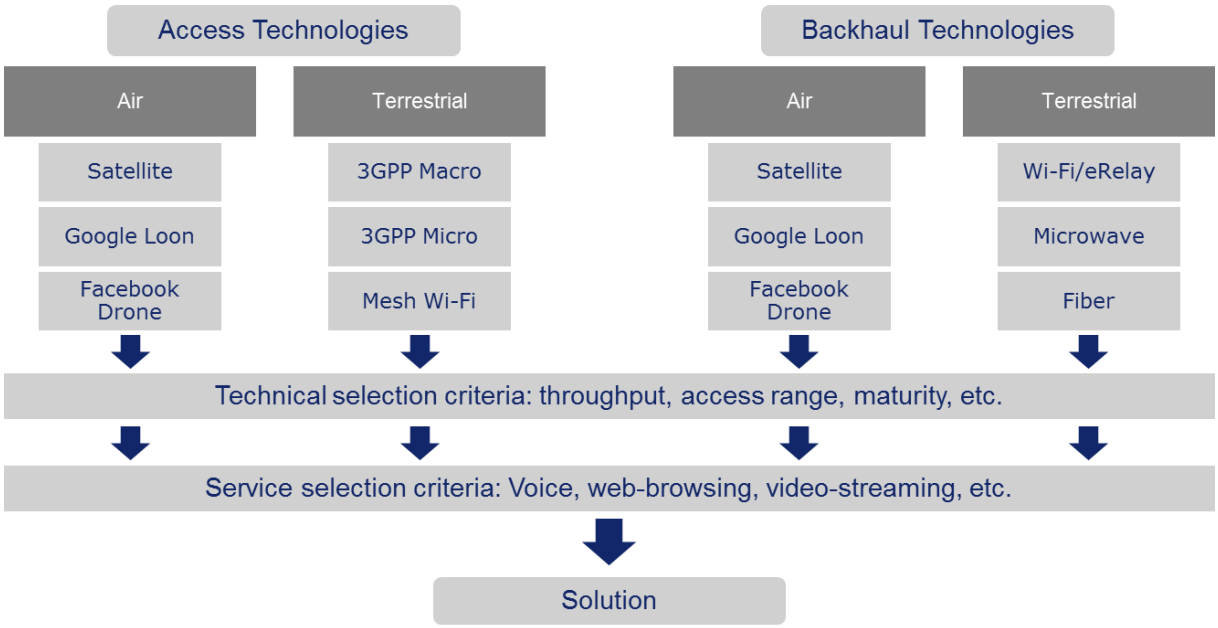


Figure 257 - General approach for selection of the best-fit technology set for the delivery of ICT services to communities located in the hinterland and remote areas

5.2.1.1 Backhaul Technology Assessment

There are four main criteria that are relevant to design the right backhaul network:

- **Accessibility, i.e. how to reach the location where physical infrastructure will be installed**
  - In case of limited accessibility (no road or rivers) no or only low towers can be built.
  - Satellite remains as low capacity option with maximum rates up to 10Mbps depending on load.
- **Availability of power, i.e. Green IT Solutions are preferred in the backhaul infrastructure**
  - In best cases, power grid access is available to connect the sites.
  - Use of Diesel generators will lead to higher OPEX due to the dependency on fuel price and the related logistical effort.
  - Solar panels and battery can be used at least as support option to reduce (in hybrid mode) the consumption of fuel.
- **Coverage targets and mobility of users, i.e. how many users can be reached at the same time**
- **Capacity, i.e. can the technology comply with the assumed and forecasted capacity needs**

5.2.1.1.1 Backhaul Network

Backbone connectivity will be dominantly provided via dark fiber. This can be an existing network, e.g. from GPL, build based on leased capacities from commercial operators or an own build eGovernment fiber or packet microwave network.

The requirements to a microwave link depend on the topology of the network, e.g. in which parts of the network microwave links are to be used and whether there are restrictions on the number of cascaded microwave links in the network. In principle, microwave links can be deployed in the licensed frequency bands 6L (6.2 GHz), 6U (6.8 GHz),

7.5 GHz, 8 GHz , 10.5 GHz, 11 GHz, 13 GHz, 15 GHz, 18 GHz, 23 GHz, 26 GHz, 28 GHz, 31 GHz, 32 GHz, 38 GHz, 52 GHz, 55 GHz.

However, considering the fact that Guyana falls into a zone where heavy rainfall can be expected, the usage of higher bands (above 18GHz) will be quite limited. It is recommended to apply a differentiated approach:

- For links up to 10km the high bands (13GHz to 18GHz) shall be used
- For links between 10 to 20km the low bands (6 to 11GHz) shall be used

Lower frequencies are recommended due to expected large distance to the next site. If a microwave link cannot be realized via a single hop, additional intermediate hops need to be introduced. For cost saving aspects, pure passive re-transmitters are to be considered. The usagservices

e of low band frequency in urban and suburban areas can be further precluded by already existing links used by the other Guyana operators. Depending on the available bandwidth the transmission capacity of the Microwave is in the order of minimum 240Mbps and up to 1,2Gbps or even up to 2,5Gbps if Co-Channel Dual Polarization (CCDP) technology.

All microwave links shall employ the adaptive coding and modulation so that high throughput is ensured in most of the time and during extreme conditions (wind, rain). The throughout is gracefully reduced by applying lower modulation but the link availability is not endangered.

New generation microwave systems offer CCDP (co-channel dual-polarization) operation with LAG as protection – often designated as 2+0 with LAG; In case of a failure of a transmission path, the system still offers 50% of the transmission capacity.

5.2.1.1.2 Microwave backhaul dimensioning

Microwave shall be used for the last-mile-connectivity to new and existing sites, if the fiber connectivity to the site requires investments in fiber infrastructure above a certain limit.

The basic features of these Microwave Systems are the following:

1. Multiple Modulation steps that can provide flexibility in capacity handling. The typical throughput versus modulation matrix is depicted below

Modulation	Width of the RF Channel			
	7 MHz	**13.75/14 MHz**	**27.5/28 MHz**	**55/56 MHz**
QPSK	≥ 10 Mbit/s	≥ 20 Mbit/s	≥ 40 Mbit/s	**≥ 80 Mbit/s**
16QAM	≥ 20 Mbit/s	≥ 40 Mbit/s	≥ 80 Mbit/s	**≥ 160 Mbit/s**
64QAM	≥ 30 Mbit/s	≥ 60 Mbit/s	≥ 120 Mbit/s	**≥ 240 Mbit/s**
128QAM	≥ 35 Mbit/s	≥ 70 Mbit/s	≥ 140 Mbit/s	**≥ 280 Mbit/s**
256QAM	≥ 40 Mbit/s	≥ 80 Mbit/s	≥ 160 Mbit/s	**≥ 320 Mbit/s**

Table 31 - Typical throughput versus modulation schemes

2. Adaptive Modulation to secure minimal data loss in adverse environmental conditions adds or removes capacity from best effort services by changing the modulation steps.
   - Normally, i.e. in about 99.9% of time, the link is operated with a high level modulation format with a high spectral efficiency.
   - In case of adverse weather conditions, the modulation format is switched to a more robust one with a lower required Signal to Noise ratio at the receiver. However, as a results of the more robust modulation format, the link can only transport a lower data rate than with the high level modulation format.

- Hence, instead of a hard outage threshold, microwave systems with Adaptive Modulation show a graceful degradation of the data rate under adverse weather conditions.

3. Nodal Concept: The indoor units of can be considered as "Microwave Nodes" because they are able to support more than a single direction (hop) and to switch or route the traffic between the various directions. Moreover, they offer multiple interfaces. In this way, space and cabling can be saved in hub sites.
4. QoS – Quality of Service. Adaptive Modulation requires that the microwave equipment must be able to support traffic prioritization; in case that the capacity of the hop is reduced, the high priority must not be affected, only packets of the best effort traffic can be discarded.
5. Radio Link Aggregation. Multiple physical links can be combined into one logical link. The typical application for microwave is a CCDP (Co-channel Dual Polarized) configuration in which the two links on orthogonal polarizations are combined in a Link Aggregation Group. The malfunctioning or outage of one of the physical links does not cause the logical link to go down. Please note that Radio Link Aggregation is only applicable for Ethernet traffic.

To transport the expected data rates in the existing frequency bands in channels with bandwidths of 14 MHz, 28 MHz and, in some cases, 56 MHz, the increase of the spectral efficiency in terms of bit/s per Hz is required. However, an increase of the spectral efficiency leads to a higher required Signal to Noise ratio at the receiver's side.

As the most efficient modulation scheme (256QAM) offers a capacity of ~160 Mbit/s (27.5MHz bandwidth), there should be no need for a future capacity expansion on the "last mile" serving a single mobile radio cell site[98]. For the connection to a relay site or to a microwave hub site, however, it is expected that a capacity expansion will be required. Basically, there are three possibilities for a capacity expansion which doubles the data rate on the link:

1. Cross-polar operation: Co-Channel Dual Polarized (CCDP)
    - Requires two-polar antennas – should be installed already in the initial phase
    - An additional outdoor unit (ODU) is needed at each end
    - An additional modem unit (different chassis) at each end is needed.
    - This solution offers the possibility for protection with using Link Aggregation (LAG)
    - Radio planning needs to consider the higher attenuation due to rain on horizontal polarization; one of the two links must therefore use the horizontal polarization.
    - The transmission capacity then is 2 x 405 Mbit/s = 810 Mbit/s
2. Use of 55/56 MHz wide RF channel (55 MHz in the 18 GHz band)
    - Radio planning shall consider the reduced system gain of the microwave link with the 55/56 MHz wide channel (3 dB lower than for 27.5/28 MHz wide RF channels)
    - The new channel shall be located in the same frequency band as the old channel. Otherwise the antenna must be exchanged (at least the feeder).
    - Even in the same band, it might be necessary to exchange the ODUs (e.g. if tuning range is limited or if it does not cover the whole upper or lower part of the frequency band)
    - Getting the Frequency License for the 55/56 MHz wide channel can be a problem in areas with a high density of microwave links due to high utilization level of this band
3. Use of a second 27.5/28 MHz wide frequency channel
    - Requires a 3 dB hybrid (symmetrical) power splitter/combiner on both ends of the hop. So the system gain is by about 7 dB reduced. A fact that must be considered in radio planning.
    - An additional modem unit (different chassis) at each end is needed.
    - This solution offers the possibility for protection with LAG (Link Aggregation)
    - Frequency License for a second 27.5/28 MHz wide RF channel could be easier to obtain than the license for a 55/56 MHz wide RF channel.

[98] Average capacities for LTE 2300 MHz : 3sectors*20MHz *1.5bps/Hz=90Mbps; LTE 450 MHz: 3* 5MHz*2bps/Hz=30Mbps

- Please note that there are restrictions on the channels which can be used – Ericsson states that the two ODUs (RAUs) must use the same sub-band. This means that the two RF channels must be close to each other in the RF band.

Option 1 is standard in most cases, mainly "2+0" configurations are built instead of "1+1". In "2+0" both links are active, while "1+1" the 2nd link is only activated for redundancy. Option 2 is feasible for high capacity short range bands (e.g. 18GHz). Option 3 is more common in long distance links, but requires splitters etc. reducing link performance.

5.2.1.1.3 Wi-Fi based backhaul (WiBACK)

WiBACK is a product developed by a spin-off of the German Fraunhofer Institute for Applied Information Technology. The aim of WiBACK is to support the backhauling of rural and poor unserved areas with low-cost equipment in the unlicensed ISM bands,, using only simple to use plug-n-play hardware and a software concept which makes maintenance easier for local technical staff without highly specialized skills required.

Figure 258 - Examples of WiBACK node deployment

WiBACK operates at low transmit powers and in a sparse utilization in time due to sporadic usage. This reduces the overall power consumption of the system to less than 20W. The low power requirements of WiBACK makes it more suited for the use with small to medium sized solar panel than Microwave and RAN equipment, that have much higher power consumption. The latter would require larger panels and as well larger battery-sizes, which currently are more expensive and feature higher duty cycles.

Figure 259 - Solar powered WiBACK node

In addition, the light weight of the overall equipment reduces the requirements regarding the stability of the tower equipment and consequently the price. Light towers are also used in Mobile Communications Networks, but also have a limited extendibility for further equipment for new bands. Mobile Network Operators in general tend to invest in more stable towers, anticipating potential future sharing of towers with competitors.

WiBACK advantages (According to WiBACK specifications)	Detecon comments
Low CAPEX / OPEX • Self-Configuration: Plug-n-Play Designed for low maintenance overhead and non-specialist operation • Self-Optimizing: Analyzes the radio spectrum to determine the best channels • Self-Healing: Establishes alternative links around failed or malicious damaged to a nodes • Energy-Efficiency: WiBACK nodes can be solar-powered due to their small energy foot-print • Cost-effective hardware components as well as overall design	• Plug-n-Play, self-configuration, self-organizing features are as well state-of-the-art of vendor solutions in mobile network, which are included in the software and license agreements. In this case the MNO experts benefit from the reduced maintenance by these features.
Flexibility • Unified management of available heterogeneous technologies Fixed Wireless (incl. Wi-Fi), Fiber, Coax/Cable, DSL, LTE, Satellite, etc. • Licensed & unlicensed spectrum; dynamic, highly varying link characteristics • Bridge long distances/NLOS situations i.e. Multi-hop or lower frequencies • Seamless integration into existing networks Infrastructure & cost sharing (Slicing/Multi-Tenancy, i.e. Open Access)	• The usage of unlicensed spectrum limits the effective use of the spectrum to currently unused areas (one of the reason why this technology has been considered in this project). • The use near coast and higher populated area might be possible, but is less recommended due to possible interference with other equipment using the same frequencies

WiBACK nodes can provide a simple Wi-Fi AP
• Integrated, no extra power needed
• Limited management capabilities
• Carefully consider location of node (one antenna back-haul, one for access)
  ○ Often Trade-off between suboptimal back-haul link (Line of Sight requirement) vs. access coverage
  ○ Long(er) antennas, cables (extra loss) required if node is mounted outside, but AP antenna is inside
	• WiBACK is an appropriate technology to connect larger distances of around 20km using higher towers.
	• WiBACK is also suited to distribute the signals on a lower level within the location (range around 5km). Here smaller poles can be used instead. (See Figure 3)
	• The final low range meshing should be done with standard Wi-Fi hardware at the rooftop of a house which has limited ranges (less than 300m) in case of omni-directional antenna usage as proposed as a part of the WiBACK solution.
	• Depending on the size of the uncovered areas the number of meshing nodes might increase significantly. Also the frequency and interference management will be influenced due to limited availability of free spectrum. Therefore a dedicated coverage planning with directional antenna is recommended.

Specifications
• Capacity per link up to 200 Mbps (up to 400 Mbps in next release)
• Up to 10 hops are supported
  ○ Range up to 200km. Latency under load <20ms; VoIP-ready
• Supports unlicensed as well as licensed frequency bands
  ○ 2.4GHz & 5.xGHz, but also 3.xGHz or other custom bands (i.e.TVWS)
• A Solar Battery (40+ Ah) and a 100W Solar Panel can power a WiBACK node in areas with regular sun-shine periods.
• Power consumption (secondary)
  ○ 5…10W (2-radio Node)
  ○ 6…13W (3-radio node)
  ○ 7…20W (4-radio node)
	• WiBACK supports around 90Mbps maximum per polarization (or MIMO-channels) with around 180Mbps peak throughput
	• Extensions would target higher modulations (as Microwave) but would also suffer from signal conditions under rainfall conditions; Whenever upgrading a WiBACK Installation it needs to be analyzed, what the maximum level modulation could have been to get the most efficient and stable connectivity.
	• The transmission capacity is not affected by any overbooking factors. Overbooking is only relevant when many users might be connected simultaneously. The signals of these users might be distributed over all Wi-Fi-access points of the considered links.

Table 32 - Commented WiBACK advantages

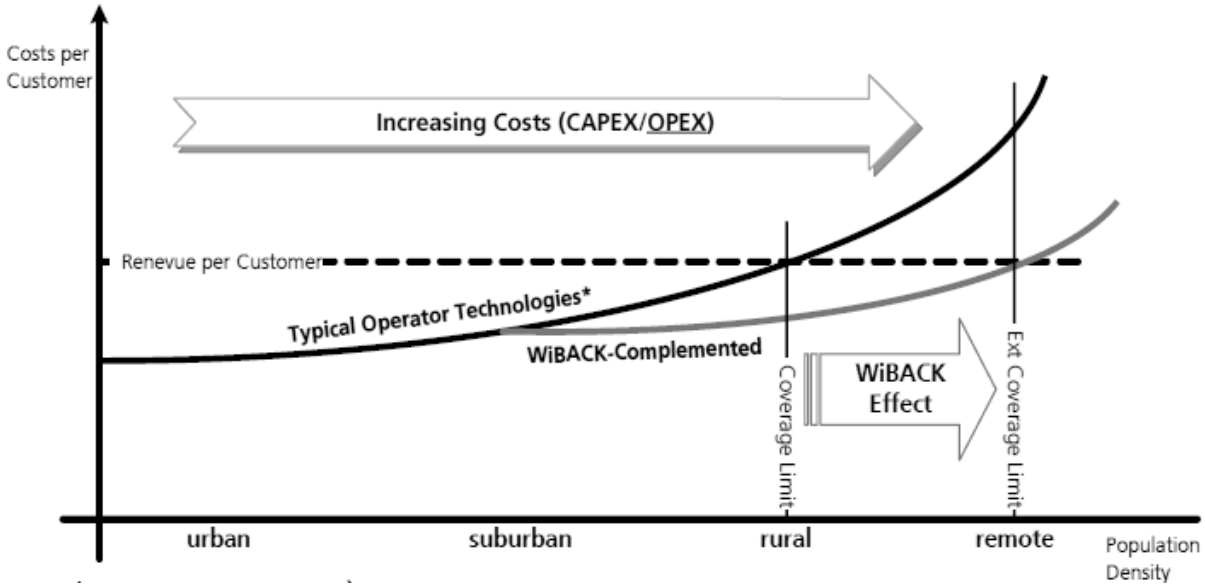


Figure 260 - Cost reduction of typical equipment enlarge coverage to remote areas (Source: WiBACK specifications)

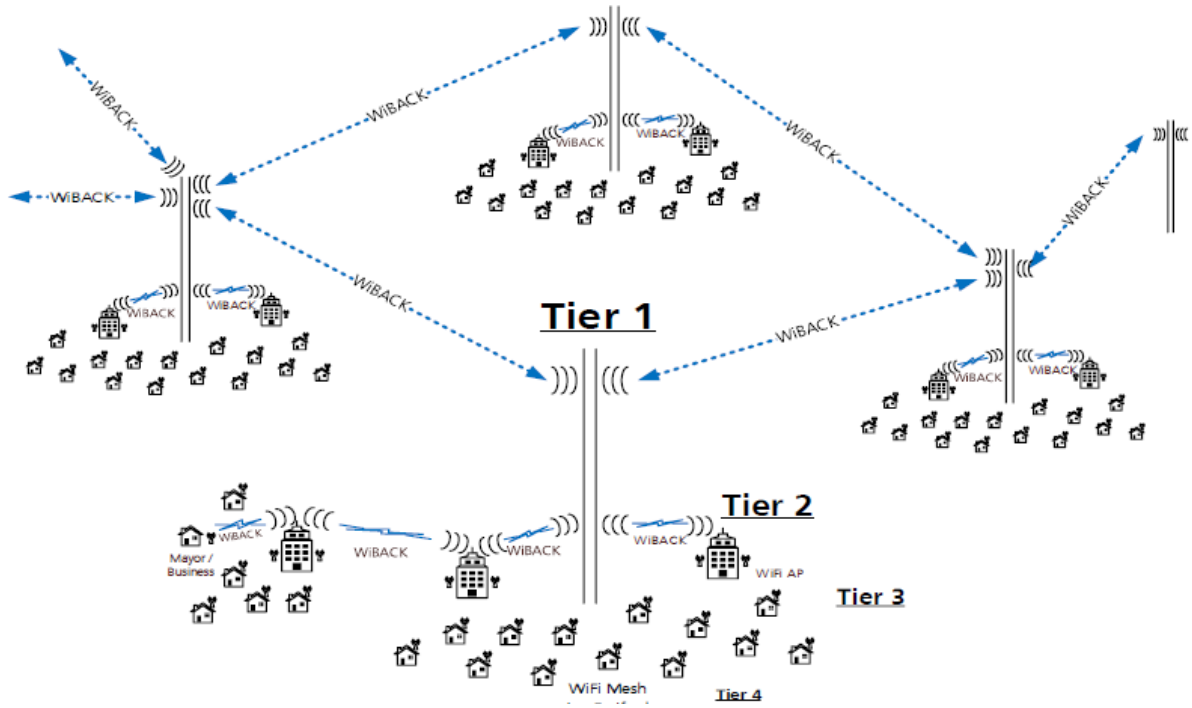


Figure 261 - WiBACK-principle of backhaul with Wi-Fi on different layers (Source: WiBACK specifications)

For 1st level long distance backhaul (<20km) higher towers, for 2nd level medium distance backhauling (<5km) poles and for the final Wi-Fi mesh network house mount antennas are needed. The latter 3rd level meshing grid is around 300m. For Guyana, it is expected to use 1st and 2nd level WiBACK-equipment to connect the schools and public buildings.

WiBACK Node I,
Dimension: 200mm x 140mm x 76mm;
Weight: 1.4 kg;
Power Consumption: Maximum 10 W, average 5W;
Interface specifications: 2x Wireless LAN High power backhaul radios

Figure 262 - Example WiBACK Node I

WiBACK Node II v2

Dimension: 300mm x 236mm x 72mm;
Weight: 2.1 kg;
Power Consumption: Maximum 16W, average 10W;
Interface specifications: 2x Wireless LAN High power backhaul radios

Figure 263 - Example WiBACK Node II

WiBACK is only one technical solution for long-distance Wifi backhaul. In the context of this study, it has been selected due to the level of information provided and the existence of use cases in the region with a comparable setting. Nevertheless other solution providers are:

- **Ubiquity**[99]: specialized hardware provider (antennas, routers) at low-cost. Solution does not provide MPLS support and only some QoS. It is not really carrier-grade and the specific network needs to be designed by third party integrator. Furthermore, the process of configuration is complex.
- **Zcomax**[100]: uses specialized Wifi hardware and used to support the RCP (rural connectivity platform)
- **Alvarion**[101]: Addressing mobile operators to extend their network with a Carrier-Wifi Solution
- **ALTAI Technologies**[102]: developed carrier-grade Wifi backhauling with QoS support and advanced MIMO

[99] https://www.ubnt.com/
[100] http://www.zcomax.com/
[101] http://www.alvarion.com/portfolio_item/carrier-wi-fi/
[102] http://www.altaitechnologies.com/wireless-backhaul/

5.2.1.1.4 Satellite Backhauling

Currently, satellite platforms serve only a small fraction of all broadband users. So far, satellites have only been considered as a favorable option to complement the terrestrial broadband infrastructure. Well into the early 1990s the growth of internet and VSAT matched each other but subsequently, the delivery of internet over the terrestrial networks became much cheaper and grew much faster because of the easy and cheap availability of modems, and other copper cable based access technologies.

SES ASTRA

- more than 50 GEO's
- C, Ku, Ka - Band
- 99% Coverage

INTELSAT

- more than 50 GEO's
- C, Ku, Ka - Band
- 99% Coverage

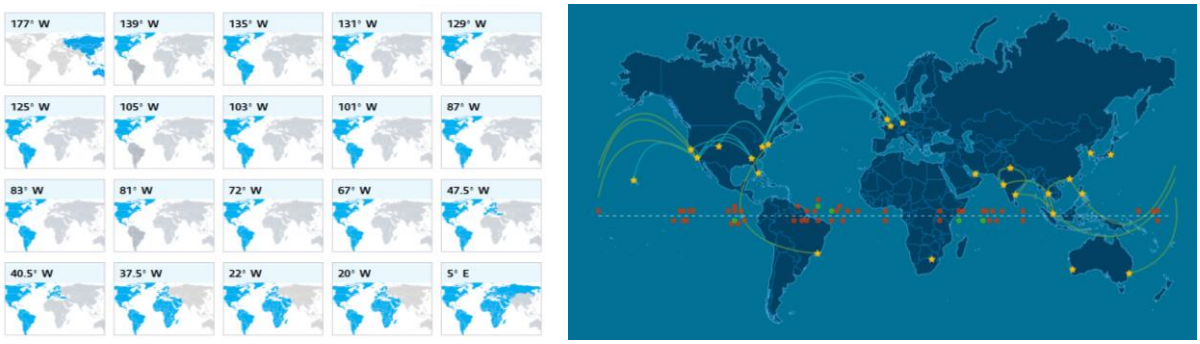


Figure 264 - Main GEO[103] satellite operator overview

Nevertheless, satellite terminals can be deployed very quickly to bridge the digital divide, and at least offer a temporary solution in cases where a cheaper long-term solution could be provided by terrestrial infrastructure at a later stage. Terrestrial broadband access costs depend on user density, but satellite broadband access cost is independent of user density. Among the different competing designs for the last mile solution, space systems exhibit strong flexibility. Satellite broadband access is available at any location in the satellite coverage area and the service quality is distance independent, but heavily dependent on weather conditions.

In an ideal implementation of satellite broadband, the satellite service element would see competing service providers leverage a common space platform with different ground segment (VSAT) equipment types to service consumers and enterprise level customers. The element of competition is very important in offering differing broadband capabilities, different contention rates on services to arrive at varying price points and capabilities to enable consumers to have a choice of broadband service offerings, download limits, equipment cost/ efficiency/reliability etc. Satellite access can be efficient for rural users. Broadband access platforms are shared by a large number of users who are not simultaneously active. The level of activity per user also fluctuates over time. These dynamics support the deployment of satellite as a shared solution which can be designed to support the specific demands of a particular country. Because the total satellite throughput is fixed, and the resource is shared between users, these systems are more efficient when they can take advantage of time-zone differences to even out the variation of service quality to users. Satellite systems often need to implement a fair use policy to restrict access or total usage for applications that require high throughput (like video streaming). Future technologies and developments (like smarter modems/set-top boxes, multicast capabilities, and prescheduled and predictive algorithms for pre-fetching of content) will contribute to enhanced user experience for satellite services.

[103] Geostationary Earth Orbit

Figure 265 - Thuraya Atlas IP router for private end-users

- Thuraya Atlas IP router is a fully-featured maritime satellite terminal.
- Supports voice and IP data connectivity at speeds of up to 444kbps.
- Built-in Wi-Fi.
- A range of features designed to enhance shipboard operations
- Automatic transfer of data from shipboard equipment and devices in support of M2M reporting routines.

Figure 266 - Satellite dish for stationary end users VSAT

Figure 267 - Satellite ground station for professional operators, also used as Sat-backhaul per site

C-band	Ku-Band
Downlink: 3.7 – 4.2 GHz Uplink: 5.9 – 6.4 GHz	Downlink: 11.2 – 12.2 GHz Uplink: 14.0 – 14.5 GHz
Main use for professional Service providers	Main use for private end users
Advantages: • Less disturbance from heavy rain fade • Cheaper Bandwidth	**Advantages:** • No interference from microwave links and other technologies • Operates with a smaller satellite dish (diameters from 0.9m) -> cheaper and more easy installation • Needs less power -> cheaper RF unit
Disadvantages: • Needs a larger satellite dish • Powerful and more expensive RF unit • More expensive mounting efforts • Possible Interference from microwave links	**Disadvantages:** • More expensive capacity • Sensitive to heavy rain fade (significant attenuation of the signal) / possibly can be managed by appropriate dish size or transmitter power.

Table 33 - Comparison of C-Band and Ku-Band

Conclusion: For satellite communications, the microwave frequencies of the C-band perform better under adverse weather conditions (rainfall, moisture, etc.) in comparison with the Ku band (11.2 GHz to 14.5 GHz), microwave frequencies used by other communication satellites.

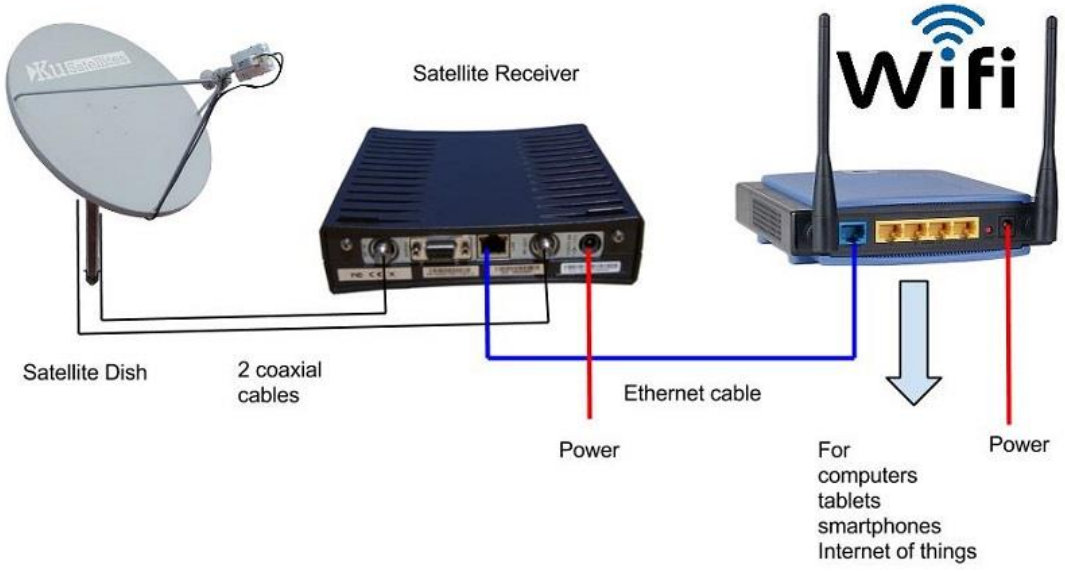


Figure 268 - Satellite communication chain with satellite receiver and Wi-Fi router in two units, but also in one unit available

5.2.1.2 Last Mile Technologies Assessment

5.2.1.2.1 Assessment Criteria

This chapter introduces the criteria to assess different access technologies from a pure technical perspective . For each criteria a certain value in the range from 0(bad) to 10 (very good) based on performance specification of the respective technology will be assigned. The following criteria are taken into account for the assessment of the respective technologies:

Technological Key Performance Indicators and valuations used for a high level evaluation and comparison of Mobile Access technologies:

- **LOS Range and NLOS Range:** This is basic characteristic for electromagnetic radiation based service. This criterion is necessary for assessment of the maximum line-of-sight and not-line-of-sight distance service.
- **LOS Throughput and NLOS: Throughput** This is a basic characteristic for evaluation of the communication technology performance in terms of speed of data transfer over the channel. Best value equals to the requirements as defined in the 5G standard
- **Latency:** Is the delay from input into a system to desired outcome. This parameter i**s** crucial for deployment of real-time services, such as voice, video conferences, etc.
- **QoS Support: It** means the ability of the system to differentiate different services and assign specific rules and prioritization to their respective data packages to be transmitted over the network for each of them
- **CPE Ecosystem: It** reflects the availability of user devices like feature phones, smartphones, USB-dongles, etc. on the market

- **Maturity**: It describes the market status and position in a technology lifecycle of the technology and gives an understanding of the technology confidence
- **Spectrum availability** explains the spectrum requirements of the technology and general assessment of the respective spectrum utilization

5.2.1.2.2 GSM/GPRS/EDGE

EDGE is an evolutionary development of the GSM packed data services introduced to boost network capacity and data rates. It was introduced first time in 2001. Up to now it is the most widespread technology on the market due to service provisioning of the 2G only capable devices (around 670 networks deployed worldwide). In developed markets all services based on GSM are planned to be replaced by LTE before the year 2020.

Technology Description

- Enhanced Data rate for GSM Evolution (EDGE) is considered a pre-3G radio technology and is part of ITU's 3G definition
- EDGE is standardized also by 3GPP as part of the GSM family (unofficially called 2.75G)
- EDGE increases capacity and coverage of the GSM/GPRS networks

Radio Features

- Supports 9 Modulation and Coding Schemes (MCS)
- EDGE uses in addition to GMSK high order 8PSK for the highest 5 MCSs (EGPRS2 with 16QAM and 32QAM)
- Fast ACK/NACK Reporting (FANR) and reduced TTI configuration (RTTI)
- Specified Mobile Station Receive Diversity Solution (MSRD)
- Downlink Dual Carrier Solution
- Typical throughputs 384kpbs (peak) and 200kbps (average)

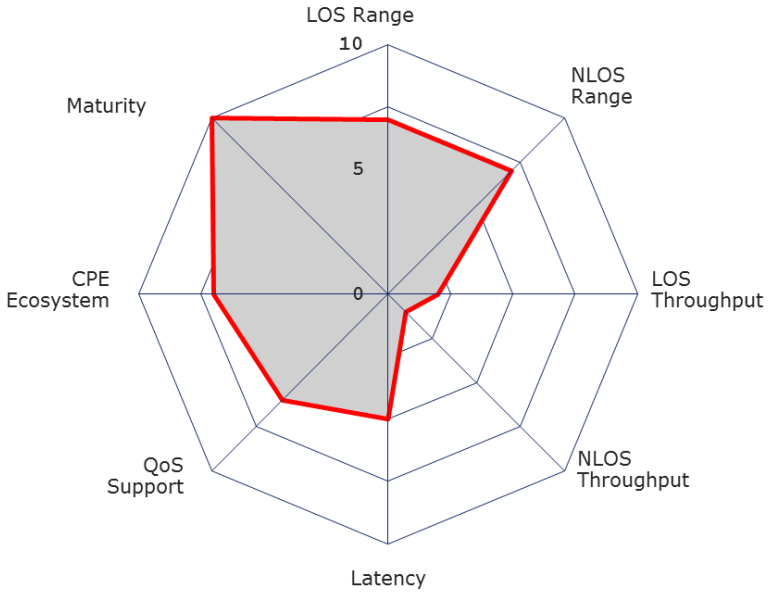


Figure 269 - Assessment of GSM/GPRS/EDGE technology

5.2.1.2.3 UMTS

UMTS was presented as a next step in mobile networks evolution and first time launched as commercial network in 2002. UMTS radio uses a wideband code division multiple access (W-CDMA) radio access technology to offer more bandwidth used in channels and increased spectrum efficiency comparing to second generation networks. UMTS standard consistently developed over releases R99 – R12 and evolved to HSPA+ technology. Around 514 UMTS Networks are deployed worldwide, 182 networks out of them provides up to 42 Mbps throughput with HSPA+ (Source: GSMA).

Technology Description

- HSPA+ incorporates technologies and features boosting HSPA downlink and uplink peak bit rates as well as the cell capacity.
- Whereas the first HSPA+ features are specified in the 3GPP TS release 7 (frozen in March 2008), the latest 3GPP TS (release 12 frozen in March 2015) still include new HSPA+ evolutions.
- The first HSPA+ features became commercially available in 2009, enabling a downlink HSPA peak rate of 21 Mbps. However, uplink HSPA+ features increasing the uplink peak rate (also made available in the 3GPP TS release 7) became commercially available only in 2012/2013 depending on the vendor.

Radio Access Features

- Higher order modulation
- MIMO transmission up to 4x4
- HSDPA multi-carrier (carrier aggregation)
- Continuous packet connectivity (CPC)
- Bands 0.85, 0.9, 1.5, 1.8, 1.9, 2.1 GHz (0.9 and 2.1 are the most popular)
- Satisfy the IMT-A requirements for 4G networks in R11

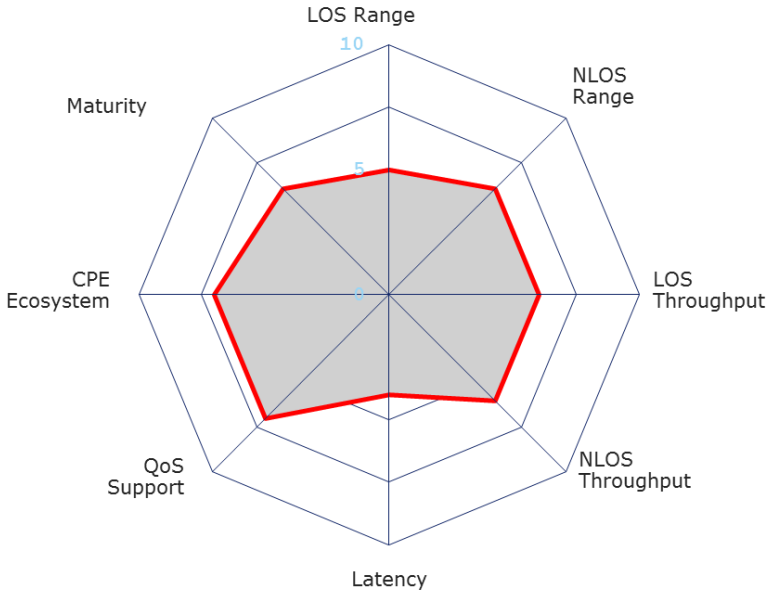


Figure 270- Assessment of HSPA+ Technology

5.2.1.2.4 LTE/LTE-A

LTE (Long Term Evolution) was selected as a major technology of the 4th generation of mobile network due to its potential to outperform HSPA+ and other mobile access technologies in regards to coverage and capacity.. The ecosystem around LTE is continuously growing. The early availability of high-frequency LTE bands greatly contributed to the current device ecosystem and operator rollouts. LTE is mostly deployed using 1,800 MHz (band 3) spectrum, currently exist more than 150 commercially life systems. LTE-Advanced (Long Term evolution - Advanced) is an evolution of LTE standard providing higher bandwidth than the original LTE.

Technology Description

- LTE was introduced with the 3GPP R8 and represents the access part of the Evolved Packet System (EPS). In the market since 2010
- 3GPP R10 is the first 3GPP release incorporating LTE-A features. Commercially deployed in 2013.
- Driven from the spectrum, bit-rate and cost reduction demand, 3GPP has set the targets and expectations for evolution of HSPA+. LTE/LTE-A:
    - significantly increased peak data rates
    - increases cell edge bit rates
    - improves spectral efficiency
    - reduces latency
    - supports scalable bandwidth
    - reduces CAPEX and OPEX

Radio Features

- All-IP based architecture for evolved UTRAN
- Simplified network reference model
- Advanced air interface and modulation for Downlink: OFDM and for the Uplink SC FDMA
- Variable spectrum allocation between 1.4 and 20 MHz
- Enhanced RAN Performance. Targets:
    - 1 Gbit/s Downlink for low mobility
    - 0.5 Gbit/s Uplink for low mobility
- Flexible bandwidth: 1.4, 3, 5, 10, 15, 20 MHz
- Up to 5 carrier aggregation for maximum bandwidth of 100 MHz
- MIMO (enhancements 8x8 MIMO)

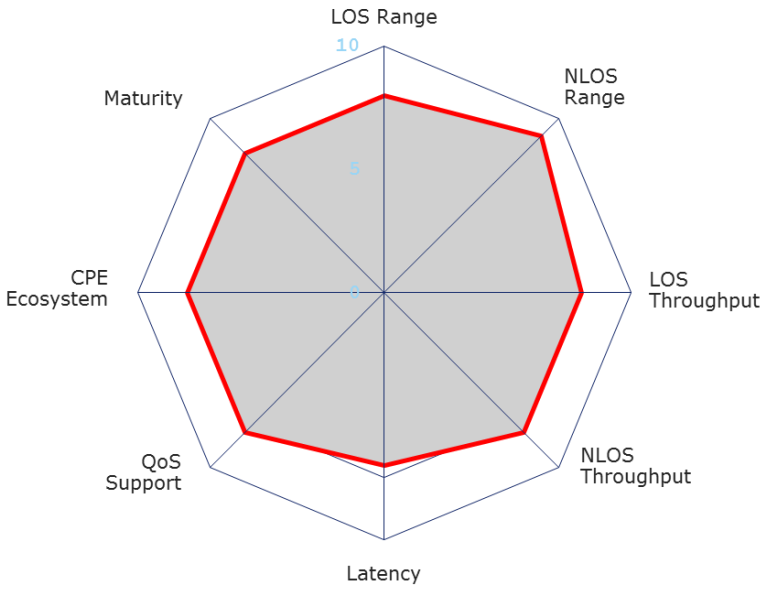


Figure 271 - Assessment of LTE-A Technology

LTE 450 MHz

3GPP completed the standardization process of the 450 MHz band in September 2013. The corresponding specifications of this brand-new band, designated Band 31, will become available as part of LTE Release 12 specifications, and will maintain backward compatible with all previous LTE Releases. The global standard for LTE450 is promising coverage in an area of around 30 kilometers, and defining appropriate technical characteristics for the deployment of 4G systems in sparsely populated areas.

3GPP standardization recognizes the use of LTE 450 MHz technology as an adequate solution for serving rural and sparsely populated areas. The 450 MHz band is used by over 20 million people worldwide using older technologies, who could benefit from advanced services based on LTE technology.

LTE 450 MHz technology has the potential to become an important tool for providing access to broadband services in rural and remote areas. This, in turn, can contribute to economic and social development, and promote digital inclusion in developing countries.

Specifying and deploying LTE 450MHz technology presents a number of challenges, most of which relate to interference management and system constraints to meet the need to provide extensive cell coverage.

Increased cell coverage: The deployment of cells with radii of the order of tens of kilometers places an additional burden on the development of LTE network equipment. Larger cells require higher transmission power, which directly

translates into more complex power amplifiers. The longer reach offered by the 450MHz band can compensate for part of this need, especially when high-gain antennas are used. As for the antenna, the designer should take into account aspects such as gain, radiation pattern, certification standards, ease of installation and, most importantly, physical dimension (recalling that the lower the operating frequency, the larger the radiating system).

In 2013, two companies (Huawei and Nokia) announced the availability of LTE equipment (base stations and terminals for both indoor and outdoor use) capable of operating in the 450 MHz band. The two manufacturers have been conducting interoperability tests with Brazilian carriers, and the first LTE 450MHz commercial networks are running in compliance with the ANATEL 4G auction requirements by 2014.

Figure 272 - Example one of life network measurement of LTE450 performance

Figure 273 - Example two of life network measurement of LTE450 performance

Two exemplary measurements in Brazil proofed, that under excellent conditions more than 30km coverage can be expected, always considering there would not be obstructed line of suight cases. Generally speaking it is expected , that ranges from 15-20km would be more realistic and valid for most cases. Therefore circles with a radius of aroud 20kms were assumed in the project as coverage range.

5.2.1.2.5 WiMax

WiMAX (Worldwide Interoperability for Microwave Access) is a family of wireless communication standards based on the IEEE 802.16 set of standards, which provide multiple physical layer (PHY) and Media Access Control (MAC) options. Mobile WiMAX was the first "4G-like" technology supporting all IP and OFDMA wireless broadband technology with advanced antenna systems

WiMAX 2 based on IEEE 802.16m standard follows the 4G requirements and replicates most of the LTE radio interface features

Technology Description

- WiMAX is based on the modern technologies of wireless access. Standard 802.16m is an evolutional development of the first mobile WiMAX standard 802.16e
- IEEE 802.16m is designed to support frequencies in all licensed IMT bands below 6 GHz and include TDD and FDD duplex schemes as well as half-duplex FDD (H-FDD)
- Currently around 360 WiMAX networks are in operation worldwide, only 2 of these networks follow the standard 802.11m, the rest are based on 802.16e.

Radio Features

- MU MIMO 8 Data Streams in DL and 4 Data streams in UL
- Enhanced Control Chanel design in UL and DL
- Improved open-loop power and closed-loop control
- Multi-Carrier support up to 100 MHz aggregation
- VoIP Capacity 80 calls/MHz (MIMO 4x2)
- Peak Throughput Downlink 300 Mbit/s / 20 MHz MIMO4x4; Uplink 135 Mbit/s / 20 MHz MIMO2x4;
- Interworking with other networks improved (3GPP, 3GPP2, Wi-Fi)
- Fractional frequency reuse (FFR) and segmentation

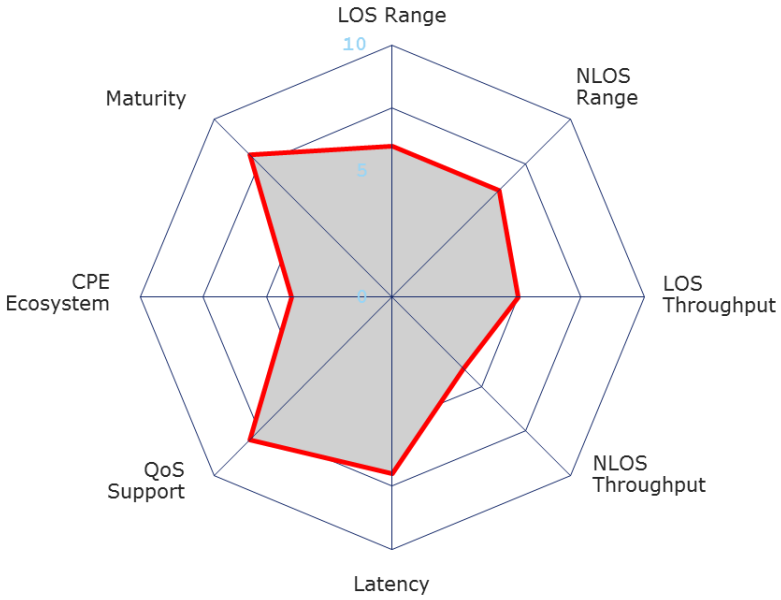


Figure 274 - Assessment of WiMax Technology

5.2.1.2.6 Wi-Fi

The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network" (WLAN) product based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards.[104] Wide usage of this standard all over the world has resulted in availability of Wi-Fi adapters in almost all consumer's electronic devices such as mobile phones, smartphones, notebooks, game consoles. Wi-Fi equipment mainly uses 2.4 and 5 GHz ISM bands. While currently deployed standards provide a limited bandwidth, sometimes even inferior to cable based LANs, the release of Wi-Fi standard 802.11ac applicable for home, enterprise and carrier grade deployment scenarios has actually the potential to exceed the 1 Gbps threshold in bandwidth.

Technology Description

- Wi-Fi uses unlicensed spectrum bands
- National regulations are needed for the utilization of specific sub bands to provide maximum transmission power.
- IEEE 802.11ac is an amendment to 802.11n and provides full backward compatibility to legacy client
- Wi-Fi Alliance's Hotspot 2.0 and 3GPP Rel.11 specifications allow to provide a future-proof solution for data offload meeting the requirements of mobile operators.
- Maximum Client Data Rate with three Spatial Stream (3x3) is around 1.3 Gbps.
- Signal range under ideal conditions is up to 70m indoor and up to 250m outdoor.
- General low power consumption of wi-fi devices.

Radio Features

- Channel Widths 20, 40, 80, 160 MHz
- 1 to 8 Spatial Streams for MIMO utilization (up to 4 per client). MU-MIMO supported

[104] Source: http://www.webopedia.com/TERM/W/Wi_Fi.html

- Modulation up to 256-QAM (OFDM)
- Output power 100 mW for 2,4 GHz band and up to 1000 mW for 5 GHz band

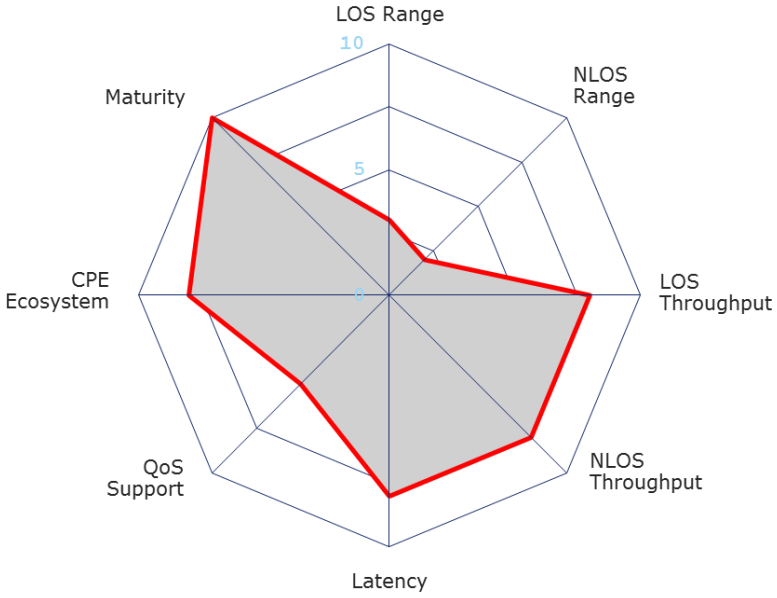


Figure 275 - Assessment of Wi-Fi Technology

5.2.1.3 Access Technology

As infrastructure costs are a critical factor in designing suitable solution, the solution outline described in this report assumes the final access using affordable Wi-Fi capable end user devices, which have access to one router device, either:

- Routers with LTE last mile access together with any other backhauling technology
- Routers with Satellite backhauling
- Routers with WiBACK-backhauling, which could also be the input part of a Wi-Fi mesh network

Wi-Fi Mesh solutions makes it easy to deploy professional, secure wireless networks at a fraction of the time and cost of traditional networks. Most of the Wi-Fi access points and enclosures are designed to work seamlessly together, support self-organizing network features such as self-deployment and self-healing. All nodes of the network can be remotely maintained via centralized operation and maintenance center. This significantly reduces requirements to the skilled personnel presence on the site during deployment and regular troubleshooting.

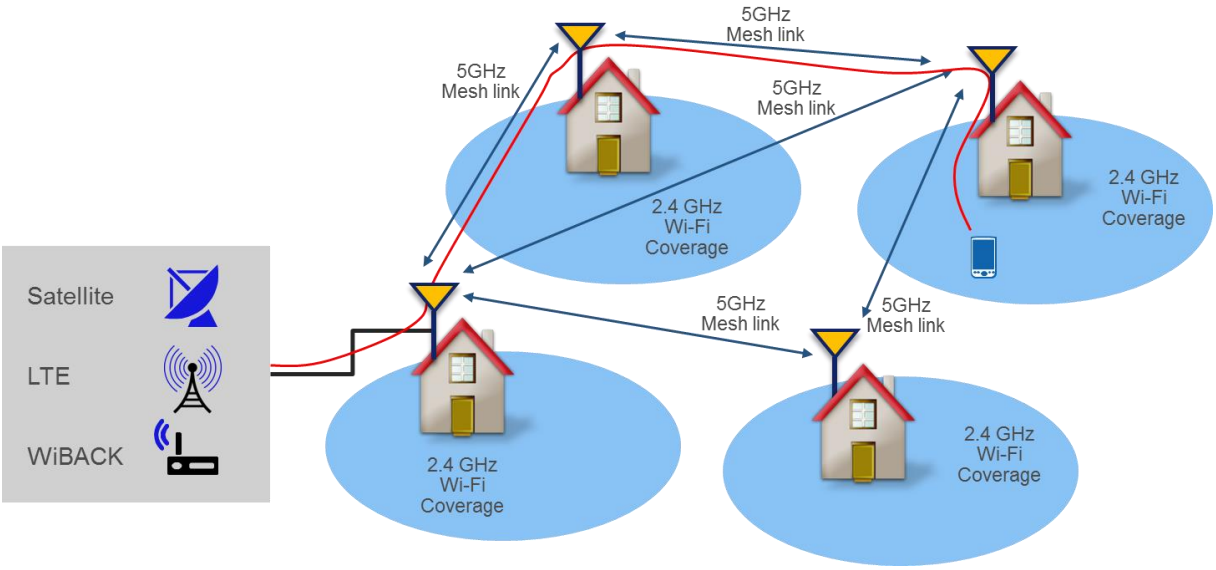


Figure 276 - Schematic overview of Wifi-Mesh Network

Mesh Access Points (AP) are the main components of the Wi-Fi Mesh network, which provides client access connectivity via 2.4 GHz radio and that creates mesh network for data backhauling to other APs via 5.8/4.9 GHz radio. One of the Wi-Fi Mesh networking solution vendors is the company "Open-Mesh"[105]. Description of the technology benefits and access points below are based on their product descriptions:

Wi-Fi Mesh features based on Open Mesh Solution

- Modular Compatible - with Open Mesh's line of modular enclosures for easy installations indoors and out.
- Cloud-managed - includes a free license for CloudTrax, Open Mesh's cloud-based network controller. Manage unlimited APs and networks with a few clicks - nothing to install on-site.
- Traffic insights – information about the traffic consumption for different services like YouTube, Facebook, web surfing, with application reporting at the network edge.
- Mesh technology enables access points to work together to form a self-organizing, self-healing wireless network.
- White label for systems integrators, resellers and IT consultants. No logos or links on boxes or access points.
- Support for 802.3af PoE and 12-24v passive PoE to power your access points up to 300 feet away over a single Ethernet cable.
- Multiple SSIDs allow to broadcast up to four unique networks, some as public hotspots and others private.
- Automated outage alerts by email if any access point goes down and doesn't come back up within an hour.
- Custom authentication with WPA2 or WPA-Enterprise security; charge for access
- Vouchers Suppor (selling internet access)t
- Bandwidth management allows to set upload and download caps on each user and block individual devices to ensure there is enough bandwidth - available for everyone.

Access Point Open Mesh MR1750

The Open Mesh MR1750 is a cloud managed, dual band, 802.11ac mesh-capable access point that includes hardware watchdog, standard 802.3af/at3 POE support and a single Gigabit Ethernet port. With the ability to support up to 50-100 simultaneous users, this access point is ideal for dense, high-traffic locations such as retail and office spaces, schools, shopping malls and hospitality venues. The MR1750 is cloud managed and includes a free license for

[105] http://www.open-mesh.com/company.html

CloudTrax, Open Mesh's cloud-based network controller. Future firmware updates will be able to unlock its performance potential with no hardware upgrades required. The MR1750 allows you to future-proof networks with 802.11ac hardware, with no increase in price over the 802.11n version.

Figure 277 - Picture of Open Mesh Device MR1750

Access Point Open Mesh OM2P-HS

The OM2P-HS 802.11n wireless mesh access point is ideally suited for providing robust internet coverage just about anywhere where there is a need to share a connection. Examples include hotels, apartments, neighborhoods, coffee shops, shopping malls, campgrounds, and marinas.

With 23 dBm power (200 mW) at even the highest speeds (5-8 dBi higher than most business class access points) and dual receive amplifiers, the OM2P-HS boosts incoming signals to provide exceptional range at twice the speed of the original OM2P. Since its dual antennas are internal (same 2 dBi gain as the OM2P), it fits into housings the OM2P can't, like the Ceiling and Ethernet Wall Jack enclosures. Even the outdoor enclosure is a cleaner, more sealed installation as the antenna doesn't protrude outside the housing.

The OM2P-HS is compatible with both passive 12-24v PoE and standard 802.3af PoE, so these access points can be powered with either Open Mesh's line of passive PoE injectors or standard PoE switches.

Figure 278 - Picture of Open Mesh OM2P-HS device

LTE 450 MHz Access Devices

CPE devices with LTE 450 MHz radio interface on the one side and Ethernet or Wi-Fi interface on the other side serves as a bridge to the internet for the Mesh Wi-Fi Network. The availability of 450 MHz LTE-capable devices is summarized as follows:

- The ecosystem for LTE in the 450 MHz band is evolving since 2014, nevertheless there are still not many LTE deployment using LTE450. Huawei is commercially offering LTE450 solutions in China, Brazil and Belarus.
- Depending on the operator's service strategy, the demand for fixed CPEs with only 450-470 MHz modem and Wi-Fi capability would be sufficient for the initial phase with a limited availability expected of other terminals. In addition, embedded solutions are more likely to be developed in the near future as LTE450 backhaul for general Wi-Fi connectivity will be used more and more.

At a later stage of deployment maturity, assuming higher traffic demands, there will be a need for multimode devices (fixed CPEs or smart phones) to enable efficient, traffic-steering mechanisms between different bands, especially in the case of usage between LTE450 and the other FDD LTE bands. At the moment no router supports LTE2300 and LTE450 in one chassis, which could be an interesting scenario for enhancing the coverage of the capacity and coverage with Carrier Aggregation of these bands.

Description of devices below based on the product description of two Huawei access devices available on the market.

Huawei B593s-31A

As a LTE CPE device, the B593s-31A enables home users to get access to wireless and wired networks. The B593s-31A supports LTE 450 MHz band and can serve as a gateway to the internet for the Mesh based Wi-Fi Access

Figure 279 - Exterior of the Huawei CPE B593s-31A

The following lists the main features and key specifications of the B593s-31A:

- Access to LTE wireless networks
- LTE downlink packet data service at a maximum transmission rate of 35 Mbit/s
- LTE uplink packet data service at a maximum transmission rate of 10 Mbit/s
- WLAN interface IEEE802.11b/g/n
- VoIP and Fax over IP
- Operational temperature 0°C to +40°C
- Dimension (H x W x D) 176 mm × 190 mm × 35 mm (6.93 in. x 7.48 in. x 1.38 in.)
- Weight About 500 g (power adapter excluded)

Huawei FDD B2131

Huawei FDD B2131 is an LTE wireless gateway customer premises equipment (CPE), which implements conversion between LTE wireless wide area network (WAN) data and local wired or wireless local area network (WLAN) data. Designed for outdoor deployment, the B2131 is composed of an outdoor unit (ODU) and an indoor unit (IDU).

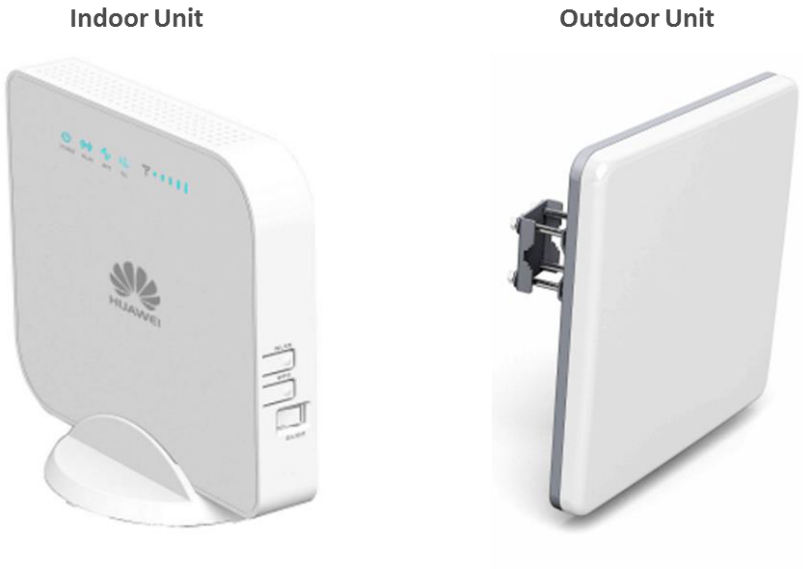


Figure 280 - Exterior of Huawei FDD B2131

Exterior of Huawei FDD B2131

- High-gain antenna
- Support of IP calls
- Indoor Unit provides the following ports:
  - Three RJ45 ports: used to connect home terminals, such as the PC and set-top box (STB)
  - One RJ11 port: used to connect common analog telephones
- Indoor Unit also provides 2.4G WLAN for wireless network connection.
- Power consumption less than 24W
- Dimensions (H x W x D)
  - Outdoor Unit 280 mm x 280 mm x 60 mm
  - Indoor Unit 159 mm x 130 mm x 24.6 mm
- Weight
  - ODU 1500 g
  - IDU 290 g
- Operating temperature
  - ODU –40°C to 55°C
  - IDU 0°C–40°C

5.2.1.4 Technology Selection for Guyana

Keeping the focus on the provisioning of related e-Services forecasted and the respective bandwidth needs derived for the next 5 years, several communication technologies such as GSM/GPRS/EDGE can be excluded from the list of optional technologies, as they do not satisfy the minimum requirements of the service demands. All other technologies can support forecasted e-Services and the needed bandwidth to the consumers.

In the following chart the main criteria for the selection of the right backhauling technology are shown and will be briefly summarized.

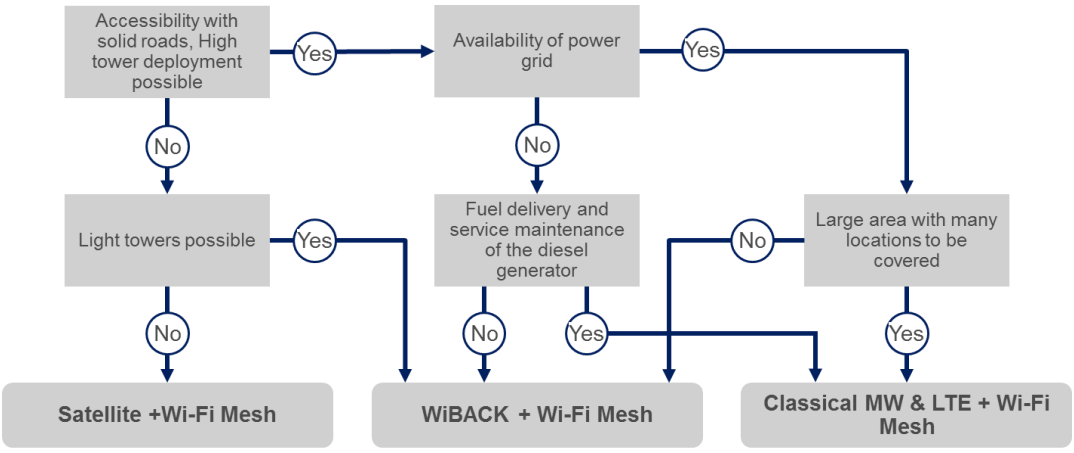


Figure 281 - Backhauling technology decision tree

Solar panels needs to be larger for higher power requirements (valid for classical Microwave and LTE)

Larger batteries are needed as well for Microwave and LTE. These larger batteries have higher maintenance and shorter replacement cycles and therefore higher OPEX.

Satellite and Wi-Fi based backhaul solutions have low power consumption.

In the special case of lower coverage requirements, LTE can also reduce transmission power and consequently power consumption. LTE also use energy saving modes in case of low utilization, but overall, the power consumptions remain higher compared to other technologies.

Coverage

LTE is more efficient to cover larger ranges and supports high mobility in case of mobile terminals or LTE is not affected by rain attenuation.

Wi-Fi based backhaul uses high gain directional antennas to compensate for the higher frequency propagation losses. Wi-Fi based backhaul is primarily focused to replace the conventional Point-To-Point-Microwave-links. The local distribution of the signals needs to be done via Point-to-Point connections. The final WiFi meshing grid of a range of 300m increase nodes and efforts of backhauling. Wi-Fi based backhaul is more favorable to connect stationary hotspots with high capacity density.

Capacity

LTE450 with 2*5MHz offers only a medium capacity for a relatively large area. In average each LTE450 antenna provides around 10Mbps resulting in 30Mbps per site. LTE700 with 15-20MHz bandwidth would offer 3-4 times more

capacity. LTE450 is able to reach up to 35Mbps under excellent conditions. With Carrier Aggregation of LTE 450 MHz and LTE 700 MHz higher peak throughput can be achieved.

Wi-Fi based backhaul has highest capacity density, which shows it as future proof solution for upcoming e-Services and their significant high bandwidth requirements. Wi-Fi based backhaul could cover large distances at low power consumption and with moderate backhauling capacities. Wi Back might connect the areas of poor accessibility and power with minimum coverage demands and will be considered as one option in the rollout for Guyana.

Comparison of the different technologies based on their specification reveals the following technologies to be recommended for Guyana:

- **For communities with relatively high population and/or communities that are located close to each other in the hinterland and remote areas**, as last mile LTE technology is recommended as the only future proof technology standardized for use in 450 MHz spectrum for areas where high number of communities can be covered with one single LTE base station. This band has been recognized as a best-fit band particularly for the aim of bringing coverage to very rural areas. For areas, where coverage with LTE is economically inefficient (e.g. less than 7 low populated communities covered with one base station) WiBACK deployment recommended. LTE450 provides last mile connectivity to the stationary WiFi-routers in hinterland and remote areas. In order to use LTE450 or LTE700/800 in the future, a connection to the existing core network is required, which is depicted in detail in Figure 19. In the coastal area this connectivity can be implemented together with existing infrastructure of LTE2300 connecting it to the core of the eGovernment Network.

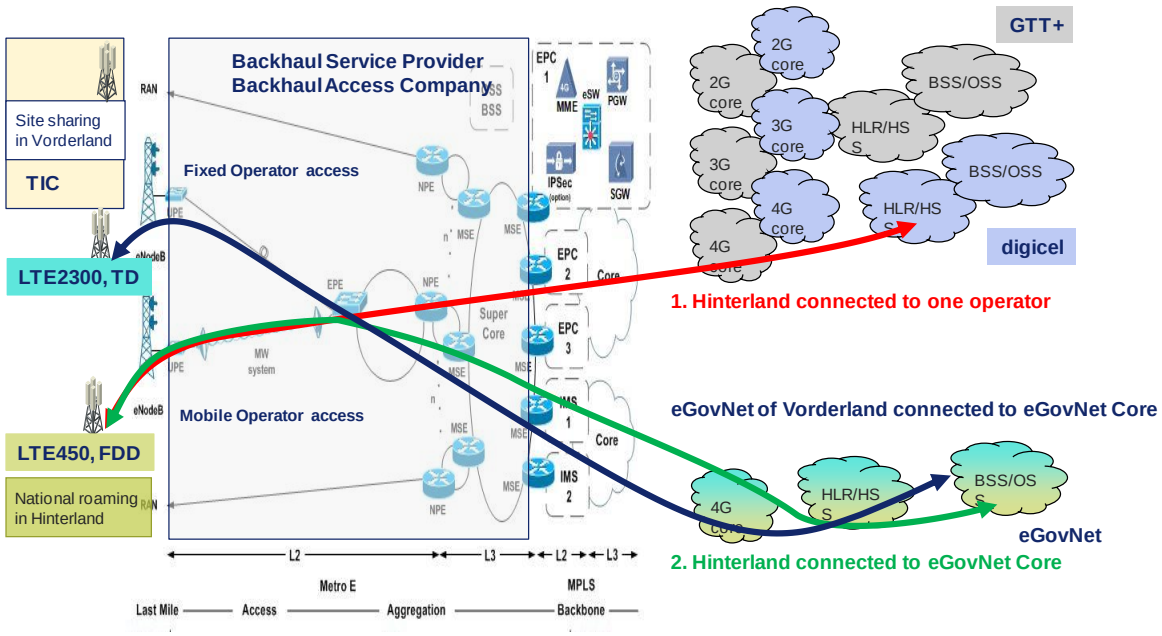


Figure 282 - Hinterland connection to operator's core (1) or eGovernment Network's core (2)

- **For small communities and communities that are located in relatively far distance from the next community,** for the Backhaul a Wi-Fi based backhaul is recommended due to support of long distance communication using ISM unlicensed bands as an extension of WiBACK Last Mile. . In Figure 20 one example of WiBACK deployment has been shown for Surama community. The central backhaul point is positioned close to the center of the community, e.g in Toshao office. In this example in total 4 WiBACK units are needed for providing access to the remote areas of this community. It has to be noted that for every location an individual assessment of the tower necessity and its respective height is required.

b

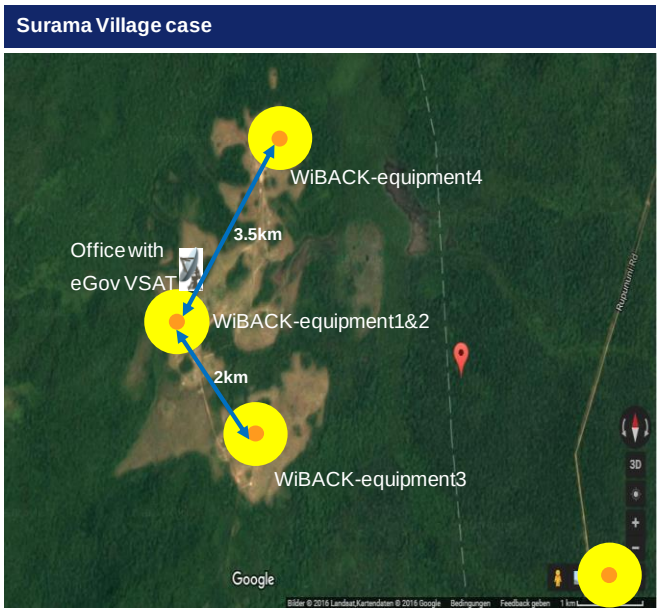


Figure 283 - WiBACK example in Surama

- **For remote communities where PoPs cannot be achieved via traditional backhauling**, satellite backhaul is seen as the only possible solution and represents a compromise between performance and difficulty to deploy the infrastructure. However rapid traffic growth in the last few years worldwide fueled by the introduction and the popularity of new devices like Smartphone, iPhone, Tablets will result in approaching the physical limits of the satellite network in the nearest future.
- Microwave technology with frequency 7GHz as a carrier grade technology with support of the similar distance as WiBACK, but with support of significantly higher throughput rates are recommended for deployment as **a backhaul for LTE base stations**

5.2.1.5 Outlook: Future Connectivity Options

Many countries around the world are challenged with unequal availability of access to broadband networks. Sill more than half of the global population currently has no access to ICT services[106]. This part of the population is predominantly living in hard-to-reach areas, hence areas where deployment of traditional access technologies is challenging and even inexpedient. Several initiatives have been launched by companies like Facebook, Google, etc. with the focus to assess future technologies that will help to achieve their vision "Bringing internet connectivity to every person on the earth". In this chapter, three solutions are being described, as Guyana's hinterland coverage case perfectly fits into the focus of these technologies. As they are currently not mature enough to be "commercially" deployable and their development and realization outlook is still not very clear, it is still too early to include them into the strategic development plan. However it can be expected that these technologies will provide viable options in a timeframe of 5 and more year to esp. replace traditional satellite technologies.

Google Loon (Project X)

Google Loon X has been launched by Google in the year 2013. The project plans to deploy high-altitude balloons placed in the stratosphere at an altitude of 18 km to 25 km to create an aerial wireless network with up to 4G-LTE speeds. All the equipment deployed on the balloon is highly-energy efficient and will be powered by solar panels. Each balloon can cover approximately 5000 square kilometers. Access from the ground will be realized with LTE

[106] Source: ICT Facts&Figures 2016 report

technology, the closes LTE ballon from the ground will serve as LTE base station. The signal travels through the balloon network from balloon to balloon, then to a ground-based station connected to an internet service provider, then onto the global internet. The most challenging part seems to be the operation and maintenance of the ballons. The air time of the balloons is expected to be around 100 days, after which a balloon should grounded in a controlled descent for maintenance reasons. During the tests, the solution demonstrated data transmission between balloons that are over 100 km apart in the stratosphere and subsequent downlinks to people on the ground with connection speeds of up to 10 Mbps, directly to their LTE phones.

Google's balloon-powered high-speed internet service began its first tests in Sri Lanka in February 2016. Sri Lanka's government announced, that it would take a 25 percent stake in a joint venture with Google designed to deliver a high-speed internet service powered by balloons. Sri Lanka is not investing any capital, but will take the stake in return for allocating spectrum for the project. A further 10 percent of the joint venture would be offered to existing telephone service providers on the island.

Figure 284 - Launch of a Google balloon[107]

Launch of a Google balloon

Facebook Aquila drones

With the same motivation, Facebook works on the development of a drones fleet. The difference between the Facebook and Google solutions is mostly in the way how these companies plan to keep the equipment in the stratosphere, albeit the idea of connectivity behind the equipment is almost the same. Facebook also proposes to use LTE as access technology and then transmit the data via their network of drones to the earth. Connectivity between drones will be laser based and supports up to 10 Gbps throughput rates. Coverage area of each drone is expected to be around 100 km in diameter and the airtime of a drone of around 90 days.

Facebook announced on 22 July 2016, that they had completed first successful test of their solar-powered Aquila drones.

[107] Launch of a Google balloon

Aquila drone fly test[108]

OneWeb LEO based constellation

The worldwide telecommunication market is as the time of writing of this report dominated by terrestrial solutions as the satellite based network deployments faces a lot of challenges. Even modern solutions based on GEO satellites equipped with sophisticated antennas for shaped beam area coverage and/or multi-beam coverage suffer from the obstacles such as a variety of proprietary solutions on the market, high cost of the end user devices, prohibitive link latency and very limited uplink budget.

This is likely to change within the next years, as several solutions are appearing that want to address and overcome these problems. Most remarkable of these solutions are new so-called "Mega Constellations" that are based on the use a considerably high number of Low Earth Orbit (LEO) satellites. LEO is the most simple and cheap orbit for satellite deployment. Due to low altitude of the satellites above the Earth, each of the satellite moves with a huge speed and can only cover a very small area with its signal. Therefore, for bringing full coverage to a designated area LEO constellations need to include a high number of satellites. One example of these LEO constellation projects is OneWeb driven by the vision "Broadband to the masses". The company plans to deploy a Low Earth orbit (LEO) constellation of approximately 900 satellites using the Ku-band to provide global broadband connectivity. Each satellite is expected to cost under US$500,000 to construct. The total program costs are expected to exceed US$6 billion[109].

- Satellite constellation of approximately 900 LEO's
- Orbit: 1200 km
- Partners: Qualcomm, Virgin, Airbus
- Frequency band used – Ku-band
- Data rate: up to 50 Mbps (6 Gbps/Sat)
- Latency less than 30 ms.
- Support of hybrid terminals - 4G / LTE, WLAN based

Under certain conditions (frequency, distance), a LEO link budget is comparable with a terrestrial link budget. Hence, similar system parameters can be applied. LEO latency is comparable with latest broadband wireless technologies with the exception of future 5G based networks. In the future satellite constellations are expected to provide the following features that can significantly improve network performance:

Self Organizing Constellations - based on the self-organizing networks concept with self-configuration, this includes features for self-healing and self-optimization functionality and adaptive interference mitigation

Automatic routing and handover – this improves the network throughputs and reduces latency

[108] https://www.facebook.com/notes/mark-zuckerberg/the-technology-behind-aquila/10153916136506634/
[109] Source: Satellite as an effective and compelling solution to overcome the digital divide

Standardization - will follow the mobile networks standards and use air interfaces based on 4G technologies (5G in future).

TV White Space

In telecommunications, white spaces refer to frequencies allocated to a broadcasting service but not used locally. It is a technology/concept that is still in an early stage of development and not considered for the case of Guyana due to the following reasons:

- IF 450Mhz bands are available, LTE450 is an established technology to use them
- Complex regulations need to be in place; takes long time to materialize
- Devices are expensive: need sensing capabilities, need to be able to access national TV spectrum database (GCAA, NFMU regulation), need special software defined radios (SDR), only few devices available
- Only reasonable when wireless spectrum in the area is already heavily used, i.e., in dense urban areas, or when lower frequencies (<600MHz) licenses not available, both cases not applicable for the hinterland and remote areas of Guyana

5.2.2 Design options for Guyana

5.2.2.1 Description of Solutions

Based on the selected technology options as described above and the assumed external parameter, the following realization options were developed:

- **Solution 1 "MW+LTE+Sat"**:This solution describes the details of the coverage in the target sample of the locations with useing only LTE 450 MHz base stations and traditional backhaul via microwave. Remote locations where no points of access exist to the planned network are connected via VSAT terminals.
- **Solution 2 "WiBACK+Sat":** Solution 2 is based on Wi-Fi based links, which are used in both the last mile domain and backhaul domain. Access for the very remote locations as in the solution 1 described is provided via satellite connectivity.
- **Solution 3 "Sat only":** Solution 3 brings a simple and flat network architecture by using the satellite links to get connectivity to the communities. Deployment numbers in this case represents only the number of satellite installations, which reflects the number of locations to be covered.
- **Solution 4** "**Combined":** Represents a best fit mix of the solutions described above, where every of these solutions is being deployed where they fit best. The selection of the technical solution for different locations has been made based on the landscape, capacity demands and the strategy of the Guyana ICT sector development.

5.2.2.2 Assessment of Solutions

Overview of the extensive assessment criteria				
Assessment criteria	**Solution 1** MW+LTE+Sat	**Solution 2** WiBACK+Sat	**Solution 3** Sat Only	**Solution 4** Combined
Simplicity –flat technology, no technology zoo.				
Future proof – flexible, ready for new services, capacity reserve available				
Frequency usage – quality of service management				
Green IT compliance - energy efficient solution and/or solar power based deployment				
Ease of Operation and maintenance - no skills required for network maintenance.				
Investment effectiveness – means the solution that is based on own infrastructure development				
Cost assessment – allows to select the cheapest solution				

Table 34 - Comparison of solutions

Comparing the different solution it shows that the major drawback for the "sat only" solution is their limited capabilities in providing the needed bandwidth, especially when considering the anticipated growth of bandwidth needs in the near future. Satellite internet therefore shall be seen as a quick and easy solution, that shall only be used when other backhaul technologies with high capacities are not available. WiBACK contributes significantly to a low carbon footprint due to its low power consumption in Solution 2 and 4. Nevertheless, solution 2 is not feasible as a stand alone solution as WiBACK is not suitable for highly populated areas.

5.2.3 Commercial Assessment of Solutions

5.2.3.1 Introduction

The purpose of the commercial assessment of the different technical solutions is to define the most cost effective way of offering the connectivity in the hinterland taking into account network development plans and service demands during the years 2017-2021. The high-level commercial assessment of the different technologies extends beyond the initial capital expenditures, maintenance and software assurance costs and considers all potential operational costs over the next 5 years.

Due to the fact, that the access network consumes a major part of the CAPEX of the whole telecommunication network during the deployment phase, network operators choose access network technologies based on a cost/benefit analysis.

Together with technical selection criteria and service selection criteria, cost analysis serves as one solution selection criterion and gives the outline of the potential investment needs in the upcoming years.

According to the current situation of the eGovernment service and infrastructure availability, all locations within the country can be assigned to one of the following groups:

- Populated coastal area, which includes locations where eGovernment Agency possesses its own LTE infrastructure, including fiber lines, towers and base stations and locations where service can be delivered by means of expansion of the existing LTE network by deploying an additional 450 MHz frequency layer.
- Other locations within the country in the hinterland and remote areas which currently have no access to the eGovernment infrastructure

The expansion of the network in the coastal area with an additional frequency layer of LTE 450 on top of the existing infrastructure is acknowledged as the most feasible solution for providing additional coverage of these locations and

to reach out to poor population pockets in that area. As this is a minor upgrading program of existing infrastructure and it has been understood that the supplier is already discussing upgrading options with eGovernment Agency, this activity is not included in the cost estimation for different solution targeting the hinterland and remote areas.

The initial approach of the cost assessments consists of the following basic steps:

- Create itemized list for all foreseen expenses
- Derive the real market price based on the similar projects worldwide using the Detecon benchmarking database
- Calculate the CAPEX and OPEX based on the yearly rollout plan numbers

5.2.3.2 Cost Components and Assumptions

The typical structure of cost components for the evaluation of expenses for telecommunication companies are listed below. Nevertheless, some cost components have been excluded from the scope due to fact that eGovernment Agency will not bear any expenses in these areas.

Solution Cost	
CAPEX	**OPEX**
Active Hardware	Licenses e.g. yearly fees
Installation	Rental fees
Feature activation and SW	Power e.g. electricity, fuel
Spare parts	Infrastructure Leasing costs
Civil work e.g. towers, etc.	Maintenance
Other infrastructure (power)	Repair services
Spectrum fee	Spectrum fee

Table 35 - Cost groups (CAPEX/OPEX)

The following cost groups have been considered for the evaluation:

CAPEX

- Active Hardware – Costs of the hardware components including radio access network, backhaul and transmission network
- Installation – One time fees required for the deployment and commissioning of the active equipment in the target locations
- Feature activation and software – fee to be payed to the equipment manufacturer for the activation of the required functionality of the equipment and for the licensing of the operational software

- Spare parts – Purchase of the minimum required components for all types of the active equipment to reduce mean time to repair in case of equipment malfunction
- Civil work – installation of the passive infrastructural facilities such as towers, protection fences, etc.
- Other infrastructure fees includes the purchase and deployment of different power supply systems, backup solutions, etc.
- Spectrum fee – Frequency license acquisition cost (currently out of scope, as eGovernment Agency as a public institution does not have any obligations to pay for the usage of any spectrum)

OPEX

- Yearly fees – periodical fee to be payed to the vendor of the active equipment for updates, bug fixes, support service (depends heavily on the frame contract conditions)
- Rental fee is a periodical fee to the owner of the land where equipment has been deployed (currently out of scope, as it has been assumed that as per eGovernment Agency policy, all infrastructure will be deployed on the territory of local public institutions)
- Power, electricity, fuel – monthly fees to the power companies and refilling of the diesel generators on the sites
- Infrastructure leasing costs – leasing of the existing telecommunication or other infrastructure from other operators (currently out of scope, as use of own infrastructure has been assumed for the proposed solutions)
- Maintenance – fees for periodical maintenance service of the site according to recommendation of the vendors including planned replacement of parts
- Repair fees – accidental service fees for functionality recovery of the sites after failures
- Spectrum fee – Periodical payments for operating of the frequency license (currently out of scope, as eGovernment Agency as a public institution does not have any obligations to pay for the usage of any spectrum)

All cost groups mentioned above have been combined to the following expenses domains:

- **Active equipment** domain includes expenditures of purchasing, installation, commissioning and operation of all telecommunication equipment such as antennas, radio signal amplifiers, baseband units, core equipment, transmission equipment, etc.
- **Towers and facilities** domain includes all costs caused by deployment of infrastructural objects such as towers for LTE and WiBACK equipment, diesel generators, solar panels, required maintenance атв fuel costs
- **User Access (UA)** domain represents all expenses caused by deployment of the Wi-Fi Mesh equipment in target locations and includes cost of the equipment, solar panel power for each access point, installation and maintenance costs

Service Consumption

Permanently increasing service consumption is one of the key drivers for overall network costs increase in the telecommunication world. Though considering the service estimation for the planned network deployment it is assumed that capacities of the initial deployment of the LTE, Microwave and WiBACK technologies will be sufficient until end of the calculated period. For differentiating the communities based on their size, three types of service requirements definitions were introduced:

- **Low requirements** – Communities with population 11-100 people
- **Medium requirements** - Communities with population 101-1000 people

- **High requirements** - Communities with population more than 1000 people

For communities with satellite-based backhaul connectivity deployment assumed the following capacity needs have been defined – in line with the proposed National Broadband Plan:

For the first three years

- Low requirements - 1 Mbps, traffic limitation 6 Gb
- Medium requirements - 3 Mbps, traffic limit 20
- High requirements - 6 Mbps, traffic limit 35 Gb

For the years four and five

- Low requirements - 1 Mbps, traffic limitation 18 Gb
- Medium requirements - 12 Mbps, traffic limitation 65 Gb
- High requirements - 12 Mbps, traffic limitation 100

For communities where LTE and WiBACK technologies have been proposed for backhaul and last mile, capacity of the initial deployment will be sufficient for the service provisioning during the first five years and no capacity extensions is expected to be needed during this period.

Unit Price

Two different sources of price information have been used for solution cost estimation:

- Prices provided by eGovernment and based on existing turnkey contract with Huawei Technologies Ltd. Since it is not possible to derive precise prices on detailed level for all components of the contract, provided information are used as indicative.
  This price information is considered to be confidential and cannot be distributed to the third parties without prior permission from eGovernment Agency.
- Information based on Detecon experience in the projects worldwide. Values calculated based on the Detecon price-benchmarking database, consider both network size, and expected equipment configurations for proper estimation.

OPEX prices specified in tables below are calculated with yearly recurring expenses**.**

Network Element	CAPEX			OPEX		
	Price eGovernment	Price Detecon	Description	Price eGovernment	Price Detecon	Description
LTE BS 3 Sector Outdoor 8 hours battery backup	$150,000	$35,000	Price per base station including all active, passive equipment, software, installation and commissioning	$3,000	$5,200	Yearly service fee including license fees, spare parts and maintenance of the base station
LTE BS 3 Sector Outdoor 24 hours battery backup	$175,000	$38,000	Price per base station including all active, passive equipment, installation and commissioning	$3,500	$7,400	Yearly service fee including license fees, spare parts and maintenance of the base station
Evolved Packet Core upgrade	$1,700	$2,000	Price for hardware including installation and commissioning (per Mbps)	$550	$100	Yearly software fees including updates, maintenance and spare parts (per Mbps)
Microwave backhaul link 7GHz	$20,000	$8,000	Price including 2 pieces of active, passive equipment and installation for realization of one link	$2,000	$350	Yearly service fee including license fees, spare parts and maintenance for one link
Satellite backhaul	$25,000	3000	Price including equipment and installation per backhaul link	$48,000	n/a	Yearly service fee per 1 Mbps purchased bandwidths (i.e. pure satellite capacity) without traffic limitations
Tower 30 m	$66,000	$22,000	Price including steel construction and installation	n/a	n/a	
Tower 60 m	$95,000	$76,000	Price including steel construction and installation	n/a	n/a	
Diesel generator approx. 17 KW for LTE, Microwave and/or satellite equipment	$47,500	$23,000	Price per generator including fuel tank and installation	n/a	$5,600	Yearly expenses for fuel purchase and maintenance of the generator
Solar panel for LTE, Microwave and/or satellite with batteries 24 hours	$90 (per Watt)	$68,000	Cost of the solar panel with battery and installation	n/a	$2,500	Price include regular site visit and maintenance
User Access devices	n/a	$900	Price per LTE Wi-Fi or Wi-Fi Mesh Access Point with solar panel and backup battery	n/a	$100	Reparation fee, spare parts and maintenance

Table 36 - LTE equipment and facilities unit estimated price list (all prices in USD)

Not that prices for solar panels in the table above are only listed for the reason of completeness as both price indications cannot be compared directly. eGov prices are per watt consumed by the equipment including batteries, the Detecon price includes only price of solar panel where watts value will be peak. This value provided by

eGovernment Agency indicates the full price of the solar based solution including solar panel, controller and batteries sufficient for uninterruptable powering of the equipment, which consumes 1 W. The value shown under "Price Detecon" indicates the cost of 25 kW solar panel without accumulators. In this case 25 kW is the peak power which solar panel can provide in ideal conditions. This solar panel expected to be sufficient for provisioning of the power for one LTE site including all auxiliary equipment. Average price for solar panels worldwide is approximately 2-4 USD per peak power 1 Watt.

Unit prices provided by Detecon are used for the commercial assessment and comparison of all the solutions as they reflect worldwide market prices for telecommunication equipment. In order to provide an overview of the supplier's price impact on the overall costs, for solution 4 "Combined" a cost estimation exercise has been performed based on both prices, the prices provided by eGovernment and the Detecon benchmark database prices.

Unit description	CAPEX		OPEX	
	Price Detecon	Description	Price Detecon	Description
WiBACK Link	$6,000	Price per link including all active, passive equipment, software, installation, commissioning and solar panels with batteries	$260	Yearly service fee including spare parts and maintenance of the WiBACK link
Wi-Back Core	$5,000	Price per network including hardware, software, installation and commissioning of the core equipment	$1,200	Yearly expenses for spare parts and upgrades
WiBACK Tower	$22,000	Price including steel construction and installation		

Table 37 - WiBACK Solution unit price list (all prices in USD)

Unit description	CAPEX		OPEX	
	Price Detecon	Description	Price Detecon	Description
Satellite link user 12Mbps, 100 Gb	$1,000	Installation of the power system for satellite access	$7,200	Yearly service fee including lease of equipment
Satellite link user 12M, 65 Mbps	$1,000	Installation of the power system for satellite access	$5,280	Yearly service fee including lease of equipment
Satellite link user 6Mbps, 35 Gb	$1,000	Installation of the power system for satellite access	$4,200	Yearly service fee including lease of equipment
Satellite link user 3Mbps, 20 Gb	$1,000	Installation of the power system for satellite access	$3,000	Yearly service fee including lease of equipment
Satellite link user 1Mbps, 18 Gb	$1,000	Installation of the power system for satellite access	$1,800	Yearly service fee including lease of equipment
Satellite link user 1Mbps, 6 Gb	$1,000	Installation of the power system for satellite access	$960	Yearly service fee including lease of equipment

Table 38 - Satellite subscription fees price list (all prices in USD)

5.2.3.3 Solution 1 "Microwave+LTE+Sat"

The following numbers of infrastructure and equipment deployments expected during the next 5 years for the Solution:

New Deployment	2017	2018	2019	2020	2021
LTE BS 3 Sector Outdoor 24 hours battery backup	0	25	0	3	0
Microwave backhaul link 7GHz	0	20	0	5	0
Evolved Packet Core (EPC) upgrade	0	750	0	90	0
Diesel generator approx. 17 KW for LTE, Microwave and/or satellite equipment	0	21	0	3	0
User Access devices	56	501	70	49	18
Tower 60 m	0	4	0	5	0
Tower 30 m	0	18	0	0	0
Satellite link user Low requirements	7	0	0	0	0
Satellite link user Med requirements	0	16	14	6	0
Satellite link user High requirements	0	0	0	3	9

Table 39 - Itemized deployment plan for Solution 1 "Microwave+LTE+Sat"

In the next table the expenses forecast for the next 5 years based on the rollout plan specified for this solution are shown:

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$7,000	$2,554,000	$14,000	$334,000	$9,000	$2,918,000
Towers and facilities	$0	$1,243,000	$0	$449,000	$0	$1,692,000
User access	$50,400	$450,900	$63,000	$44,100	$16,200	$624,600
					Sub-total	$5,234,600
OPEX Components						
Active equipment	$21,000	$309,800	$335,000	$539,430	$577,230	$1,782,460
Towers and facilities	$0	$357,600	$357,600	$374,400	$374,400	$1,464,000
User access	$5,600	$55,700	$62,700	$67,600	$69,400	$261,000
					Sub-total	$3,507,460
					TOTAL	$8,742,060

Table 40 - Overall cost expectations in USD for the solution 1 "Microwave+LTE+Sat"

This solution assumes the usage of LTE base station for the most cases. This lead to deployment of a large number of LTE base stations, towers and construction of the autonomous power system for the sites deployed in areas without power grid access. Cost expectation values in the table confirms that the most part of the investments come from the equipment and infrastructure deployment

Nevertheless, one of the benefits of this solution is that the investments contribute to the reliable carrier grade infrastructure in the country and permits future development of the e-Services and network.

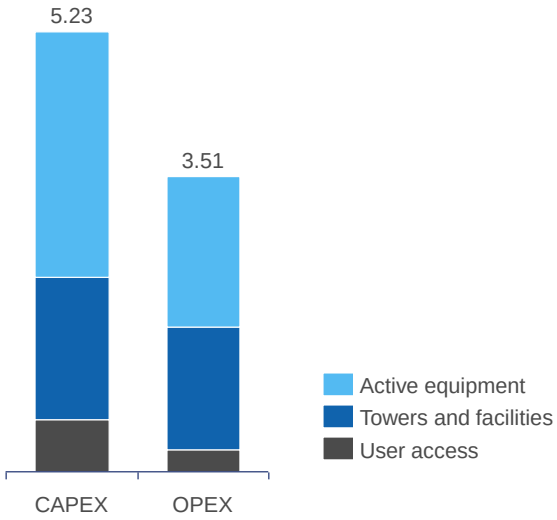


Figure 285 - CAPEX and OPEX (in USD) components comparison of solution 1 "Microwave+LTE+Sat"

5.2.3.4 Solution 2 "WiBACK+Sat"

The following numbers of infrastructure and equipment deployments expected during the next 5 years for the Solution:

New Deployment	2017	2018	2019	2020	2021
WiBACK Link	0	82	0	16	0
User Access devices	56	501	70	49	18
Tower 30 m	0	77	0	13	0
Satellite link user Low requirements	7	0	0	0	0
Satellite link user Med requirements	0	16	14	6	0
Satellite link user High requirements	0	0	0	3	9

Table 41- Itemized deployment plan in USD for Solution 2 "WiBACK+Sat"

In the next table, the expenses forecast for the next 5 years based on the rollout plan specified for this solution are shown:

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$7,000	$516,000	$14,000	$105,000	$9,000	$651,000
Towers and facilities	$0	$1,714,000	$0	$286,000	$0	$2,000,000
User access	$50,400	$450,900	$63,000	$44,100	$16,200	$624,600
					Sub-total	$3,275,600
OPEX Components						
Active equipment	$21,000	$120,320	$145,520	$327,760	$365,560	$980,160
Towers and facilities	$0	$80,000	$80,000	$80,000	$80,000	$320,000
User access	$5,600	$55,700	$62,700	$67,600	$69,400	$261,000
					Sub-total	$1,561,160
					TOTAL	$4,836,760

Table 42 - Overall cost expectations in USD for the solution 2 "WiBACK+Sat"

Wi-Fi based backhaul (WiBACK) is a relatively new technology aiming to be used mainly in developing country and sparsely populated areas. The main benefits of the technology are simplicity, low cost equipment and low power consumptions. This makes the technology effective for deployment in rural areas. However, this solution considers deployment of the WiBACK technology not only in hinterland, but also in the coastal area where a lot of communities located close to each other. As follows, the number of towers and accordingly the infrastructure investments dramatically increases to almost half of the total solution cost.

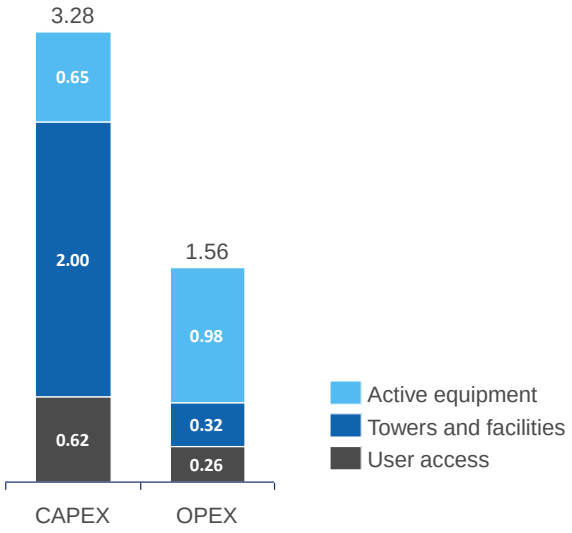


Figure 286 - CAPEX and OPEX (in USD) components comparison solution 2 "WiBACK+Sat"

5.2.3.5 Solution 3 "Satellite only"

The following numbers of infrastructure and equipment deployments expected during the next 5 years for the Solution:

New Deployment	2017	2018	2019	2020	2021
User Access devices	176	175	105	81	102
Satellite link user Low requirements	22	0	0	0	0
Satellite link user Med requirements	16	24	19	10	0
Satellite link user High requirements	0	0	0	49	0

Table 43 - Itemized deployment plan for Solution 3 "Satellite only"

In the next table the expenses forecast for the next 5 years based on the rollout plan specified for this solution are shown:

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$38,000	$24,000	$19,000	$59,000	$0	$140,000
Towers and facilities	$0	$0	$0	$0	$0	$0
User access	$158,400	$157,500	$94,500	$72,900	$91,800	$575,100
					Sub-total	$715,100
OPEX Components						
Active equipment	$94,800	$138,000	$172,200	$728,520	$728,520	$1,862,040
Towers and facilities	$0	$0	$0	$0	$0	$0
User access	$17,600	$35,100	$45,600	$53,700	$63,900	$215,900
					Sub-total	$2,077,940
					TOTAL	$2,793,040

Table 44 - Overall cost expectations in USD for solution 3 "Satellite only"

This solution shows to be the cheapest solutions even considering the usage of third party infrastructure, such as satellites and earth stations. Overall costs of the solution have a linear dependency on the service consumption (pay as you use model). The main obstacle against deploying a satellite-based connectivity in the country is the very limited bandwidth in low frequency parts of the satellite spectrum. Therefore considering satellite as a solely future-proof solution for the whole country is not recommended.

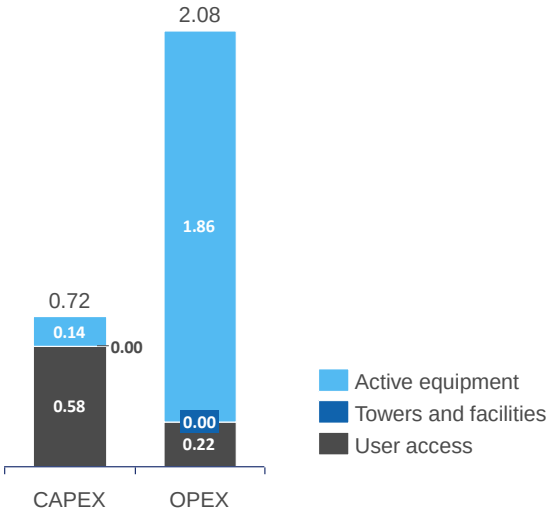


Figure 287 - CAPEX and OPEX (in USD) components comparison solution 3 "Satellite only"

It is evident that this solution is heavily misbalanced towards OPEX and doesn't require any heavy CAPEX investments during the whole lifespan period. Due to the low CAPEX investments, this solution cannot be considered as an infrastructure development of the hinterland, as it is mostly based on leasing of the capacities for a quick win, but without potential in the future.

5.2.3.6 Solution 4 "Combined"

The following numbers of infrastructure and equipment deployments expected during the next 5 years for the Solution:

New Deployment	2017	2018	2019	2020	2021
LTE BS 3 Sector Outdoor 24 hours battery backup	0	7	0	3	0
Microwave backhaul link 7GHz	0	2	0	5	0
WiBACK Link	0	20	0	11	0
Evolved Packet Core upgrade	0	210	0	90	0
Diesel generator approx. 17 KW for LTE, Microwave and/or satellite equipment	0	3	0	3	0
User Access devices	56	501	70	49	18
Tower 60 m	0	4	0	5	0
Tower 30 m	0	18	0	8	0
Satellite link user Low requirements	7	0	0	0	0
Satellite link user Med requirements	0	16	14	6	0
Satellite link user High requirements	0	0	0	3	9

Table 45- Itemized deployment plan for Solution 4 "Combined"

In the next table the expenses forecast for the next 5 years based on the rollout plan specified for this solution are shown:

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$7,000	$825,000	$14,000	$400,000	$9,000	$1,255,000
Towers and facilities	$0	$849,000	$0	$625,000	$0	$1,474,000
User access	$50,400	$450,900	$63,000	$44,100	$16,200	$624,600
					Sub-total	$3,353,600
OPEX Components						
Active equipment	$21,000	$162,300	$187,500	$394,790	$432,590	$1,198,180
Towers and facilities	$0	$336,800	$336,800	$353,600	$353,600	$1,380,800
User access	$5,600	$55,700	$62,700	$67,600	$69,400	$261,000
					Sub-total	$2,839,980
					TOTAL	$6,193,580

Table 46 - Cost expectations in USD for the solution 4 "Combined" based on Detecon prices

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$7,000	$1,570,000	$14,000	$769,000	$9,000	$2,369,000
Towers and facilities	$0	$1,142,500	$0	$857,500	$0	$2,000,000
User access	$50,400	$450,900	$63,000	$44,100	$16,200	$624,600
					Sub-total	$4,993,600
OPEX Components						
Active equipment	$21,000	$244,700	$269,900	$519,340	$557,140	$1,612,080
Towers and facilities	$0	$336,800	$336,800	$353,600	$353,600	$1,380,800
User access	$5,600	$55,700	$62,700	$67,600	$69,400	$261,000
					Sub-total	$3,253,880
					TOTAL	$8,247,480

Table 47 - Cost expectations in USD for the solution 4 "Combined" based on eGovernment Agency prices

This solution of blended technology options looks to be the most sophisticated one due to optimal selection and application of the technologies for each specific area within the country. It fully allows to utilize the benefits of each technology. Nevertheless, the mixture of the technologies in one solution requires having dedicated specialists for each of the technologies and makes maintenance, service and spare part management a bit more complicated.

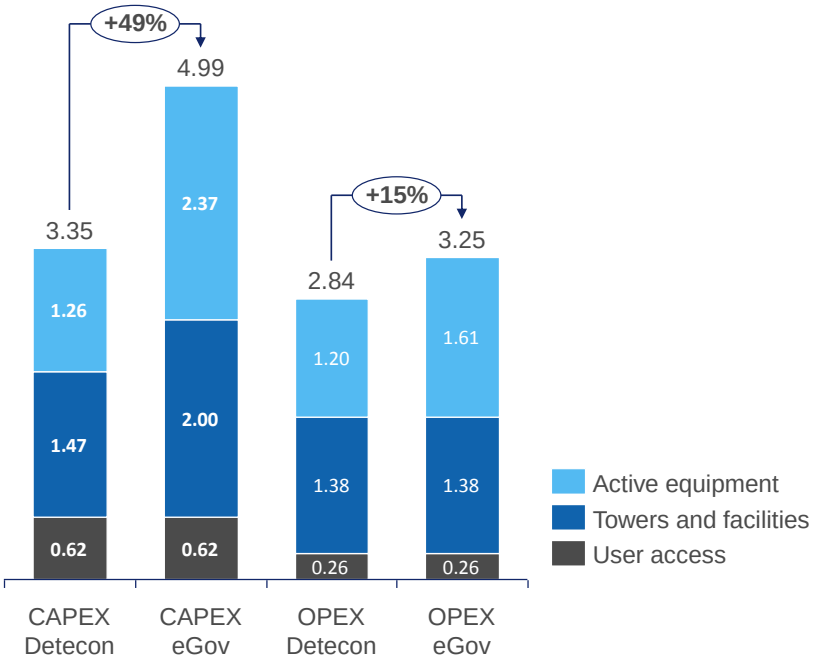


Figure 288- CAPEX and OPEX (in USD) components comparison of solution 4 based on Detecon and eGovernment Agency prices

Comparing the prices provided by eGovernment Agency with the prices provided by Detecon it is evident that prices valid in Guyana are in average 25% higher than prices in other countries worldwide. However, not only eGovernment Agency suffers from the higher equipment prices. Incumbent telecommunication service providers also indicate, that infrastructure deployment in Guyana requires more investment comparing to other countries in the region. One reason for this might be the absence of a significant competition between vendors. Therefore a proper price

negotiation strategy should be developed for the upcoming tenders to reduce the overall investments needed for the network.

5.2.3.7 Conclusion

Taking into account that the planned network deployment intended to provide non-commercial services, cost effectiveness can be a main criterion for the selection of a particular technology. Nevertheless, cost should not be the only parameter to considered – the holistic picture needs to be assessed. In the table below the overall expenses expected for the next five years for each of the solutions are listed:

CAPEX Components	Solution 1 MW+LTE+Sat	Solution 2 Wi-Back+Sat	Solution 3 Sat only	Solution 4 Combined
Active equipment	$2,918,000	$651,000	$140,000	$1,255,000
Towers and facilities	$1,692,000	$2,000,000	$0	$1,474,000
User access	$624,600	$624,600	$575,100	$624,600
Sub-Total	$5,234,600	$3,275,600	$715,100	$3,353,600
OPEX Components				
Active equipment	$1,782,460	$980,160	$1,862,040	$1,198,180
Towers and facilities	$1,464,000	$320,000	$0	$1,380,800
User access	$261,000	$261,000	$215,900	$261,000
Sub-Total	$3,507,460	$1,561,160	$2,077,940	$2,839,980
TOTAL	**$8,742,060**	**$4,836,760**	**$2,793,040**	**$6,193,580**

Figure 289 - Comparison of the estimated expenses for all four solutions (in USD)

It is obvious that solution 3 looks like the most attractive as it is mainly OPEX based. The solution is similar to a "Pay-as-you-grow" pricing model that allows operators to purchase capacity incrementally when it is needed while it is very convenient for deployment. However, several obstacles can be identified in regards to the operation under this model. For the eGovernment Agency, aiming at a long-term service provisioning, such a pure OPEX model is not recommended. After certain period of time leasing costs for the expensive satellite infrastructure exceed the expenses of most the CAPEX based models. Another disadvantage is a full dependency on the third party owning the network and therefore the lack of influence to the strategical planning of the network development.

Solution 2 has technological obstacles hindering deployment of the WiBACK in the coastal area, which were described in Chapter 3.2.2

Considering all factors, solution 4 is the most suitable one as it comprises the strategical development of the own infrastructure in combination with an effective application of the best fitting technology for each specific location.

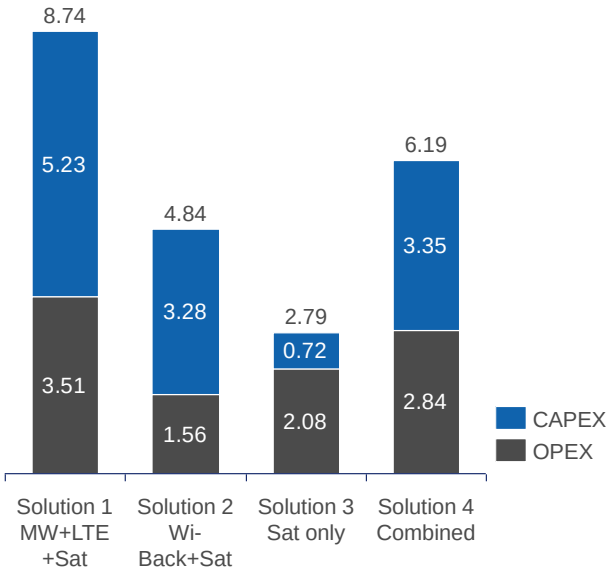


Figure 290- Cost comparison of the different solutions (in USD)

5.2.4 Proposed Guyana Solution

5.2.4.1 General Design Rules

The main design rules for the development of the network architecture are as follows:

- Vegetation and topology were considered based on information in maps from the Guyana Lands and Survey commission. It is recommended to update the maps in the next level of a detailed design phase (village by village).
- In areas with tall evergreen forest a reduced accessibility and reduced probability of tower deployments has been assumed. These areas remain for VSAT-rollout until higher demands and improved accessibility can be secured.
- It is assumed to use eGovernment-own towers and infrastructure as intensively as possible. This infrastructure is primarily concentrated in the coastal area, around Linden and Lethem. In other areas, new towers are needed. The same holds for power supply: In urban areas in Georgetown, Linden and between these cities, it is assumed that access to the power grid is possible, while for network components deployed other areas, e.g. Lethem and Barthica, independent power solutions were chosen, ideally solar power, but this might change due to cost considerations.
- In order to keep the rollout simple and to minimize the technology mix per connected area per phase, one backhauling technology has been proposed for each of these areas, according to their respective terrain:
    - For communities in hinterland and remote areas with relatively high population and/or communities that build geographical clusters as they are located close to each other, LTE is recommended as last mile technology. LTE is the only future proof technology standardized for use in 450 MHz spectrum. This band has been recognized as a best fit frequency band particularly for the aim of bringing coverage to rural areas, because due to the far reach and large cell sites a high number of communities can be covered with one single LTE base station. The LTE last mile will be connected to a microwave backhaul with 7GHz frequency as a carrier grade technology allowing also high throughput rates. This applies primarily to the cluster along the fiberline from Georgetown to Linden. As a result, one LTE-site would cover more than 10 locations. The LTE450 coverage was assumed in a radius of around 20km which is less than the design target in Brazil to be in average on safe side with reference to environmental factors like terrain.

- For small communities in hinterland and remote areas and those that are farther away from other settlements, WiBACK is recommended as last mile technology as well as for the backhaul. This is in particular recommended because deployment costs of WiBACK are lower than those of LTE resulting in better per capita costs. This does mainly apply to the South-West of Guyana near Lethem.
- For the backhauling of Lethem and the assigned WiBACK areas, the establishment of a fiber connectivity to Brazil is expected to be realized as soon as possible, ideally in 2017.

- The access network for all communities is based on WiFi-technology as it is low maintenance and compatible for the most common user devices.

5.2.4.1.1 Population and villages

The solution development is based on data provided by eGovernment taken from the Census 2012 data. The data set comprised 733 communities. Combining communities with the same coordinates resulted in 478 unique locations of communities. The population numbers in the data set sum up to 581,000. This presents around 80% of the total population of Guyana (723,000).

Only communities with a population larger than 10 people have been considered in the rollout planning based on the assumption that smaller communities don't have any public building and are therefore out of the current scope of eGovernment Agency's plan to connect public buildings first.

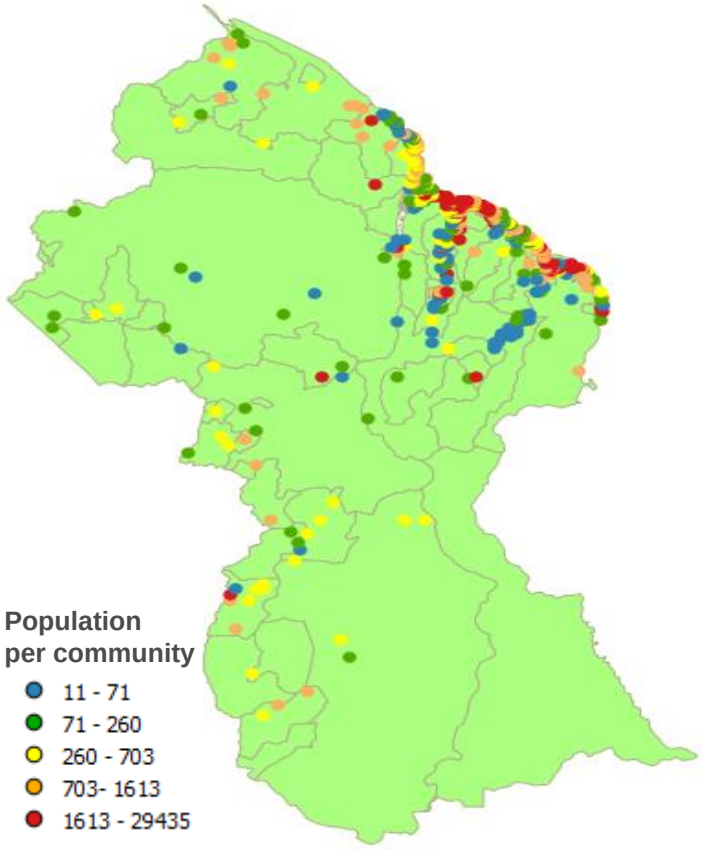


Figure 291 - Communities as baseline for rollout planning

5.2.4.1.2 National Backbone Evolution

Overall assumption is that a National Backbone is essential to provide a future proof backbone for any kind of telecommunication infrastructure across the country. To be future proof it needs to rely on fiber cable, as use of microwave technology in backbone is not a future-proof solution, due to the lower capacity this technology can provide. Nevertheless, it does not mean that this National Backbone, including connections to cables in neighboring countries needs to be realized at once. It is rather recommended to do it on a step-by-step approach.
It needs to be noted that there was already an attempt to build and operate a fiber line from Georgetown to Lethem – the Fiber Optic Cable Project. While the cable has been laid it has been damaged subsequently and the line has never been operational.

In the following, the different steps are highlighted and first indications for potential coverage areas are given that can be achieved in the respective steps[110]. The experience and reasons for failure of this project need to be analyzed and considered in the new planning of this fiber line. Nevertheless, even if the line will not be implemented in time, the design of the phases as described in chapter 5.2.4.2 consider microwave as a backup connectivity. This can be used as primary backhaul solution as long as the fiber line is not yet operational.

Design assumption "National Backbone step 1" – shared use of the GPL fiber network

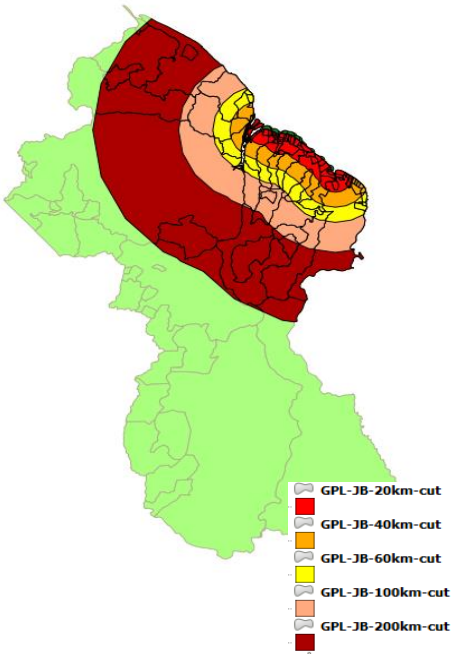


Figure 292 - National Backbone step 1

Connecting the GPL fiber along the coastal area with the eGovernment fiber network is an easy to implement first step to build a National Backbone – providing a high capacity backbone along the coast area quickly.
The colors illustrate the different belts of potential coverage assuming a radius of 20km, 40km, 60km, 100km and 200km - depending on the access technology deployed. It needs to be verified upfront in next phase, if the GPL-fiber access points are usable for the eGovernment Network backhauling in general. If no agreement with GPL of accessing their GPL fiber line can found, alternative options of establishing a national backbone along the coastline need to be considered: Using fiber from commercial operators or building up eGovernment Agency's own fiber ring would be potential options.

[110] http://www.stabroeknews.com/2014/features/12/29/fibre-optic-cable-project-another-colossal-failure/

Design assumption "National Backbone step 2" - Connect Lethem by fiber to the Brazilian Network

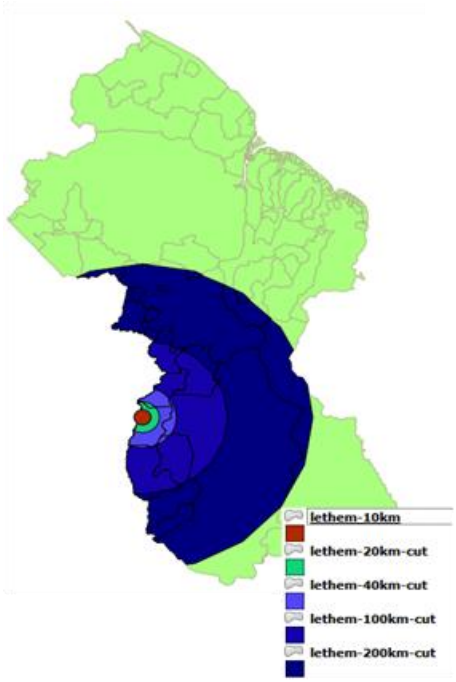


Figure 293 - National Backbone step 2

The next basic step, to provide broadband access to a major population quickly, is connecting Lethem to the fiber optical network available just across the river in Brazil (city of Bonfim).
The potential signal range around Lethem is illustrated with up to 200km, but the different terrains and mountains were neglected here in this first stage, but need be taken into account in more detailed design phase.

Design assumption "National Backbone step 3" – connect Annai to Lethem and Linden to Georgetown via fiber

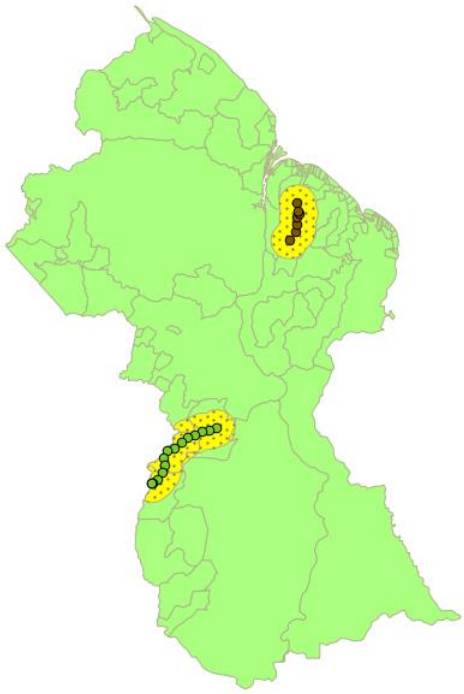


Figure 294 - National Backbone step 3

The communities of Linden will be connected via fiber reaching out from Georgetown. Annai will be connected via fiber line from Lethem – if fiber is not feasible as a first step to connect Annai, a WiBACK or microwave based solution can be deployed to provide connectivity quickly. This wireless network can later be used for redundancy when fiber will be deployed..

Design assumption "National Backbone step 4" – bridge the gap between Linden and Annai with fiber

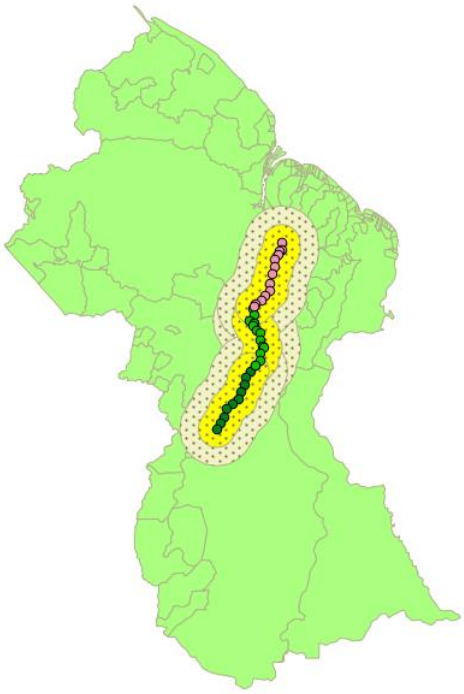


Figure 295 - National Backbone step 4

As next step the gaps in the national backbone will be closed, with fiber connecting Annai and Linden and also with a Microwave link for redundancy reasons. As a result a 40km belt can be build by 2nd Hop from the microwave-towers along the Annai to Linden road. This segment of the national backbone is expected to be the most critical part, because a larger part of it crosses the Iwokrama area with high dense forest and high trees. Also flooding will be an issue as it causes mutual bending of the ideally straight fiber line if not deployed and maintained properly. This would affect the reliability of the fiber line significantly, in worst case, the fiber will be ruptured and therefore redundancy using microwave is essential.

To ensure operational performance, it is recommended to extend the microwave redundancy not only up to Annai but also from Annai to Lethem.

5.2.4.2 Rollout Phases

The rollout is recommended to be realized in five yearly steps starting in 2017. It is expected that in 4-5 years new technologies (like Google Loon) will be available that might replace or supplement the service currently provided by VSAT operators. Phase 0 is not part of the hinterland and remote area broadband strategy, as it primarily addresses the populated coastal areas. Nevertheless, it is recommended to start with phase 0 to make eGovernment e-Services available for around 82% of the population of Guyana. This quick win enables eGovernment Agency to provide eGovernment to a large proportion of the population fast. It has to be noted that its mandatory to consult other stakeholders like the Guyana Civil Aviation Authority during the design of the rollout in regards to the desired exact location of towers to be build.

The following phases then rely on the subsequent installation of a high capacity National Backbone as a prerequisite outside the scope of this project.

The proposed rollout in the six phases described in the following chapters follow a conservative approach and relies on the parallel build up of the national fiber backbone. If faster setup and availability of basic connectivity is needed, renting data and access capacity from the commercial operators as an initial step or to extend current connectivity

footprint is always an option. It has to be noted that the provided data access might be limited in capacity due to the technologies being used by the commercial operators:

5.2.4.2.1 Phase 0 (2017)

Phase 0 is based on the first step of the National Backbone evolution. It is the initial phase to bring broadband coverage to the majority of Guyana's population including the poor pockets in urban centers. LTE450 coverage in the coastal area will be made available via 18 eGovernment-towers. The towers currently are connected using microwave technology, but will be connected to fiber backbone in the near future.

More than 84% of the population will have access to e-Services via LTE450 using upgraded eGovernment Network towers assuming 30km (yellow area) of coverage each, as a 30km range is proposed by the LTE450-standard.
If higher capacity is needed at a later stage, these 18 eGovernment towers in addition can be upgraded with LTE700 or LTE800 networks. The LTE700 / LTE 800 cells cover an area of about 10km radius around the eGovernment-sites and increase capacity in the respective areas, illustrated with red circles in the figure below. This is also shown in a larger scale in Figure 34 and Figure 35.

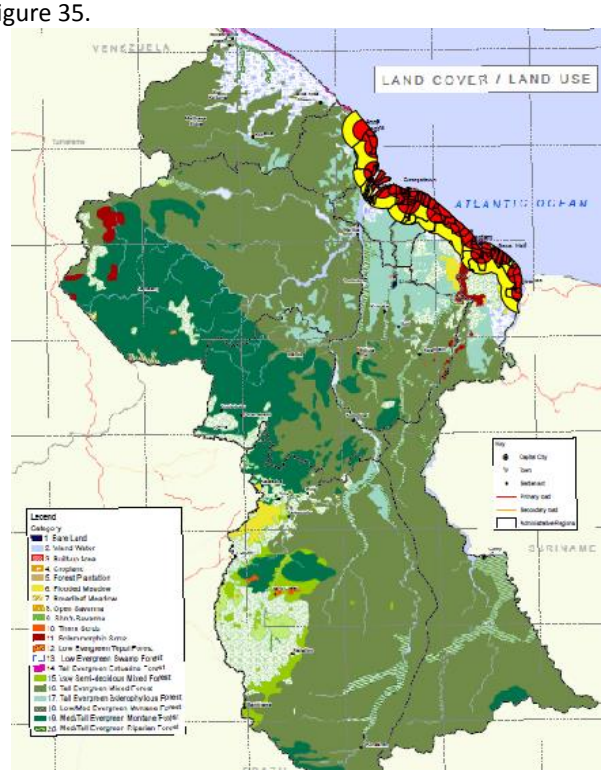


Figure 296 - Coverage as result of phase 0[111]

[111] Source: Guyana Lands and Survey commission: http://www.lands.gov.gy/mapatlas.html

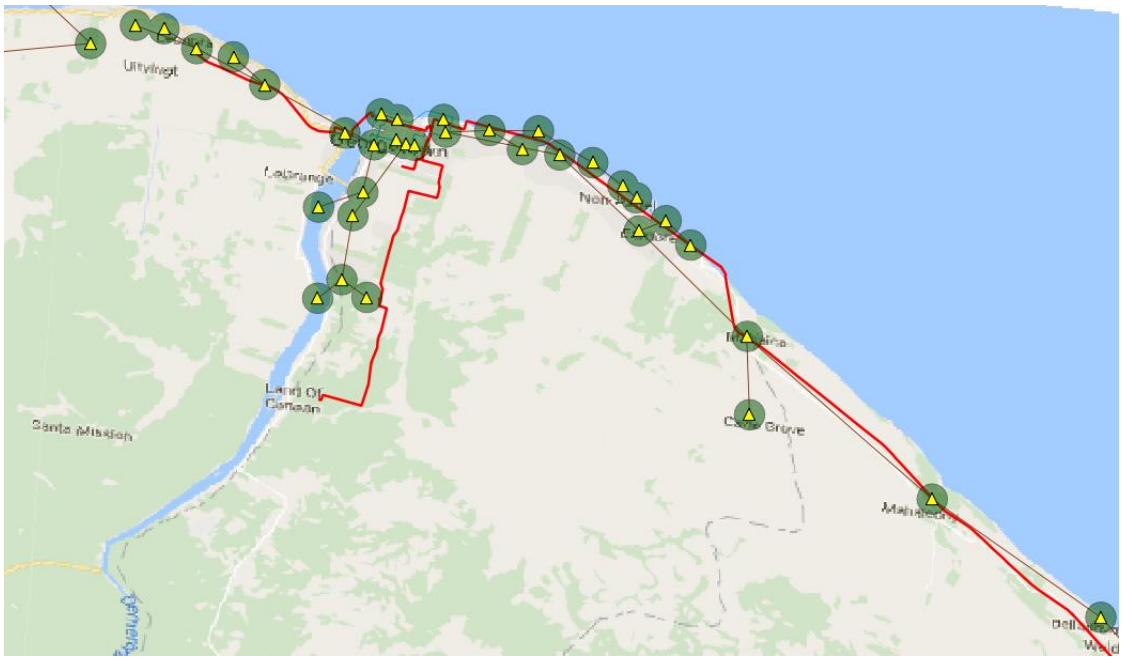


Figure 297 - LTE2300 coverage approximation

The yellow triangles in Figure 33 show on a larger scale the eGovernment towers with LTE2300 and green circles show the coverage approximations with 1km radius. The red line is the GPL fiber line, the black line shows the current microwave-backhaul, which would be used as backup in case the eNodeBs are connected to fiber.

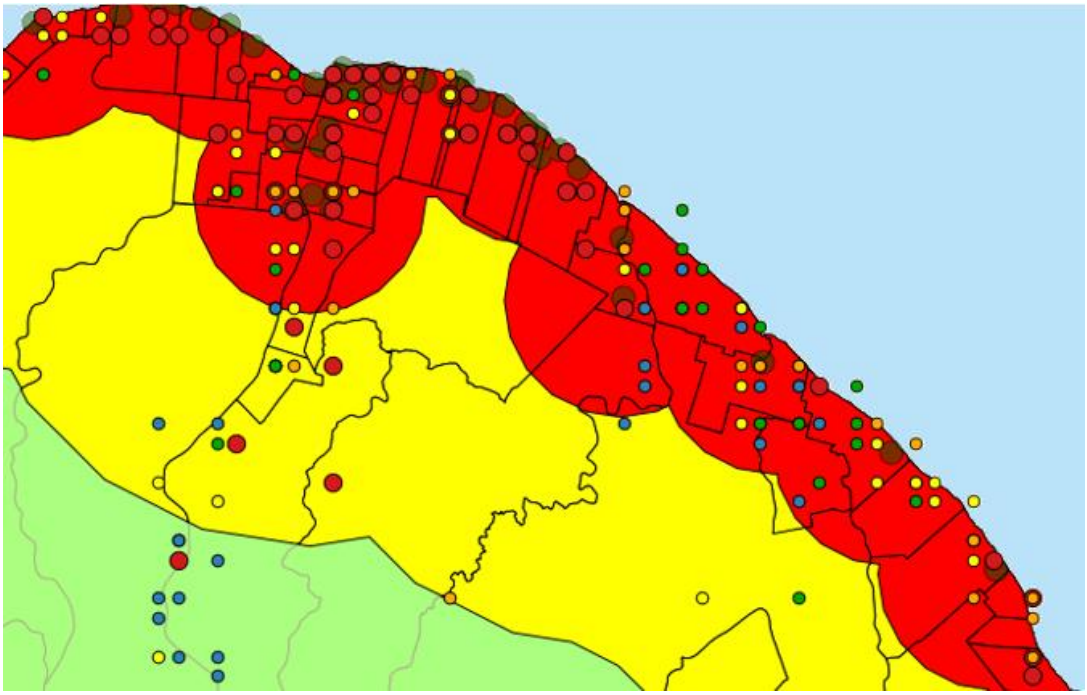


Figure 298 - LTE450 coverage approximation with 30 km range (yellow)

Figure 35 shows in the red area a 10km coverage approximation of LTE700 of the 18 upgraded sites, the yellow areas with a radius of approximately 30kms with LTE450 technology show more than 84% of population having access to e-Services.

5.2.4.2.2 Phase 1 (2017)

The major goal of Phase 1 in 2017 is to establish the connection of Lethem to the fiber line from Brazil (National Backbone step 2). In parallel, capacity building activities and negotiations with VSAT providers shall take place so that in the 2nd half of 2017 the 7 biggest communities[112] can be connected via VSAT. This will allow additional 14% of the hinterland and remote population to access broadband connections. Even if the limitation to 7 communities might look like quite a small number, it is recommended not to overstretch internal resources in this first year, but to use this phase to gain experience and capacities. This will help eGovernment Agency to roll out the service faster in the upcoming years!

5.2.4.2.3 Phase 2 (2018)

At start of Phase 2, it is assumed that Lethem has been successfully connected to the fiber network in Brazil and LTE450 is activated on the tower in Lethem. Additionally, in the first half of the year 2018, the fiber line from Georgetown to Linden will be build and activated (National Backbone step 3).

To cover the area from Georgetown to Linden, 8 LTE450 towers are needed (Lethem and Linden will reuse existing eGovernment towers, in addition 6 new towers are needed), which will go live assuming a "1-per-month" rollout speed.
This will result in around 60% of population in the hinterland and remote areas being connected latest end of the year 2018.

In case the fiber line to Annai is not completed in 2018, Annai will be connected to Lethem with WiBACK-backhauling. Even though this is a deviation from the overall architecture guideline of designing the fiber redundancy using microwave technology, in this case it is an appropriate and cost efficient to provide connectivity quickly and with sufficient capacity. It can be used as redundancy solution once the fiber line will be operational.

To cover the longer distance to communities around Aishalton it is recommended to use WiBACK technology with towers of moderate height.(blue diamonds in Figure 36), resulting in 18 new WiBACK towers that need to be built.
End of the year 2018 additional 8% of the population in the hinterland and remote area can have broadband access.

On top of this broadband coverage via eGovernment's own network, 16 communities will be connected to the internet using VSAT technology. This will result in an additional 11% of population in the hinterland and remote areas that will have the possibility to access broadband internet and eGovernment Services.

Taking the different technologies into account, the year 2018 will end with around 94% of the population the hinterland and remote areas having the possibility to access broadband services provided by the eGovernment Agency. From a technology breakdown perspective, this means 25% will use VSAT technology, 60% LTE and 8% WiBACK.

[112] All locations are listed in the appendix on a per year basis for each technology.

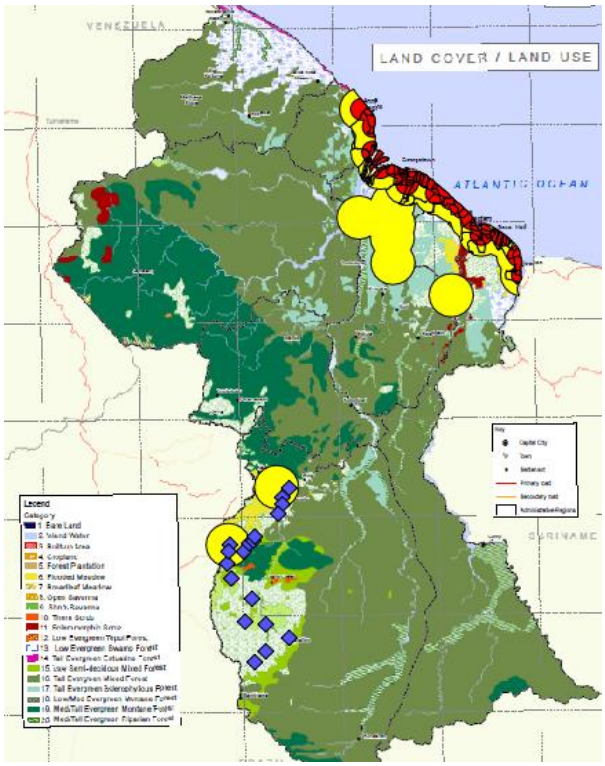


Figure 299 - Planning result of phase2

5.2.4.2.4 Phase 3 (2019)

In this year, the fiber from Lethem to Annai is supposed to be completed. This will permit to connect the LTE450-site in Annai with fiber in addition to the Wi-Fi based backhauling.
Fourteen communities with around 3800 people (4% of target population) will get access to the eGovernment service platform via VSAT.

5.2.4.2.5 Phase 4 (2020)

As in the long term the fiber line from Annai to Linden (National Backbone step 4) will be completed, the neighboring locations within a range of around 40km along this line (light green dotted area in Figure 38) can be connected using WiBACK or LTE450 technology. This needs to be decided on a on a case-by-case study assessing the special terrain conditions in the areas as eventually very high towers are needed (20m higher than the trees in this area).

Special solutions are needed for Tuchen De Vrierden, Madhia and Kwakwani:
Tuchen De Vrierden has been included in the LTE450-30km coverage area around the coastal area already in phase 0. As capacity needs will increase over the years, it is recommended to connect Tuchen De Vrieden to the National Backbone in this phase directly with own LTE and microwave infrastructure.

The communities of Madhia and Kwakwani will get own high towers for LTE450 using additional microwave hops to connect to the fiber backbone, that will being an increase of 6% of the hinterland and remote area's population to have future proof broadband access..

As the country wide coverage based on the National Backbone increases of the year, Phase 4 is also the year when first communities that accessed the eGovernment Network using VSAT previously will be shifted to eGovernment's own network, permitting significant higher bandwidth and better service quality.

With Annai now connected to the fiber backbone, a second WiBACKcluster can be deployed in the south-west (red diamonds) to cover that area. This will result in 8 new Wi-Fi based backhaul towers to be built in a difficult mountain area which needs special planning, reflecting the individual area profile.

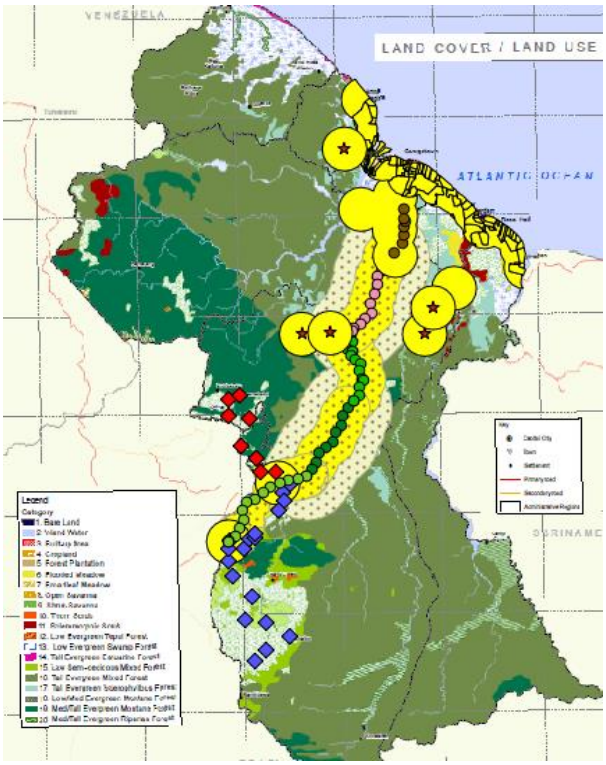


Figure 300 - Planning result of phase 4

5.2.4.2.6 Phase 5 (2021)

Remaining nine communities with around 300 people will get access to the eGovernment service platform via VSAT. Thus this will help to achive the goal of bringing eGovernment e-Services to all communities in the scope of this project.

At the end of the 5th rollout year, the population living in communities in the hinterland and remote areas will have broadband access to the eGovernment's service offering using the following technologies::

- 58.944 persons (66% of the respective population) using LTE450
- 17.865 persons (21% of the repective population) using VSAT
- 12.026 persons (13% of the respective population) using WiBACK

The evolution of the population using the different technologies within the 5 year rollout is shown in Figure 301. As described above, in the 4th year some VSAT-coverage is replaced by Wi-Fi backed backhaul in the mountainous areas as well as by LTE450 in the case of Madiha and Kwakwani.

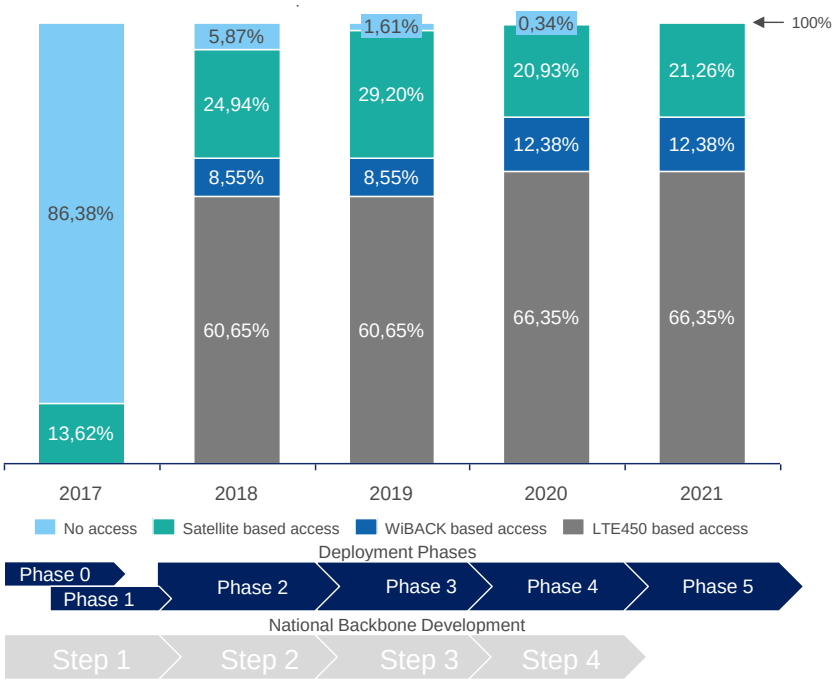


Figure 301 - Population in hinterland and remote areas with access to eGovernment network per technology

Further major cummunities can be connected to the fiberline after phase 5 has been completed. It is recommended nevertheless to to a critical cost benefit analysis before deploying this additional fiber line installations.

5.3 Realization Framework

5.3.1 Stakeholder Analysis

Stakeholders, respectively their active management are a critical component in the successful realization and implementation of any planned activity in the context of this project and in the context of the larger realization program. These are people and organizations who will affect, be affected by or perceive themselves to be affected by the eGovernment ICT program. It has to be noted that the list of stakeholders as well as their assessment can change over the time and needs to be revalidated on a regular base, as the program is being expected to have a relatively long runtime.

5.3.1.1 Introduction

Key principles of stakeholder management:

- Relationship: Try to build up trust with the different stakeholders.
- Communicate & consult: Ask questions and make sure that intended messages are understood.
- Plan it: Time investment and careful planning against it, has a significant payoff.
- Simple but not easy: Listen to the stakeholders and show your care.
- Managing risk: Stakeholders can be treated as risk and opportunities that have probabilities and impact.
- Compromise: Compromises are needed across the stakeholders' diverging priorities.
- Understand what is success: Explore the value of the project to the stakeholder.
- Take responsibility: Project governance is the key of project success

The stakeholder can be clustered along the building blocks that define sustainable ICT Services, highlighting their specific concerns as well as needs and their possible contribution to the program success:

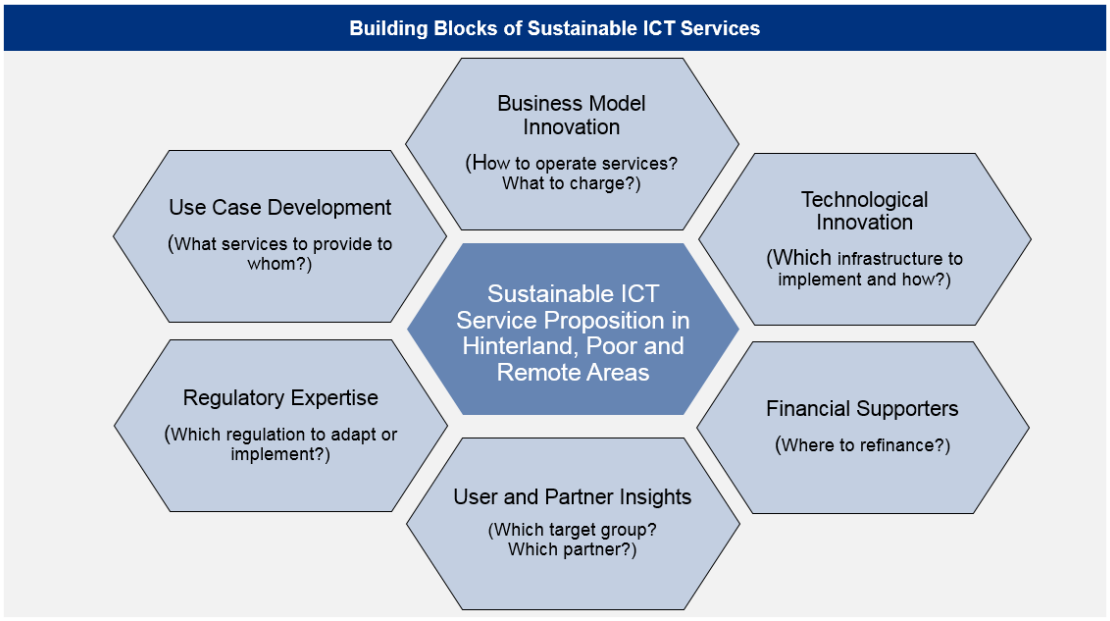


Figure 302 - Building Blocks of Sustainable ICT Services

The needs and concerns are described in the context of Guyana's ICT strategy and the vision of bringing broadband access and e-Services to the hinterland, poor and remote areas.

5.3.1.2 Technical Stakeholders

- **GPL: Strategic partner for eGovernment's fiber backbone.**
  An aligned roadmap in rolling out infrastructure might help to reduce costs in the context of eGovernment's infrastructure plans and time to market as well as secure better access to electric power where needed. If no direct alignment is possible, the support of the Ministry of Public Infrastructure can be helpful.
- **GTT+: Incumbent, provides fixed and mobile networks**
  Has certain concerns about the future role of eGovernment in the commercial market and the eGovernment's role in the provision of ICT infrastructure and might be therefore reluctant to cooperate. Operator might provide infrastructure that can be shared with eGovernment's network - fixed (DSL) and mobile, especially in areas where no eGovernment infrastructure exists. GTT+ might be interested in using eGovernment backbone to increase their own service offering and quality.
- **Digicel: 2nd mobile operator**
  Has certain concerns about the future role of eGovernment in the commercial market and the eGovernment's role in the provision of ICT infrastructure and might be therefore reluctant to cooperate.. Digicel might provide infrastructure that can be shared with eGovernment – especially towers in areas where currently no eGovernment infrastructure exists. Additionally, Digicel is interested in using eGovernment backbone infrastructure to increase their own service offering and quality.
- **eGovernment Unit: ICT operator for government entities in the country**
  Needs to provide adequate infrastructure in the country to offer government e-Services to government entities and to the citizens always in line with its mission to develop and deploy appropriate ICTs to support quality collaboration among Government Agencies.[113] As a government Agency it can be seen as a key player in achieving the country's ICT vision.
- **Guyana Civil Aviation Authority: Responsible for the development of civil aviation**
  Critical player to be consulted when planning the position of towers across the country as this agency might have concerns especially when placing towers near airstrips across the country. An integration of this agency at an early planning stage might result in a more efficient and faster overall rollout.

5.3.1.3 Legal and Regulatory Stakeholders

- **Ministry of Telecommunication: Defines the regulatory and legal framework for ICT landscape.** Aims to create and maintain a competitive market environment in the telecommunication sector. Sees ICT as a driver of welfare in the country.
- **National Frequency Management Unit (NFMU)/Regulation authority: Defines and oversees regulation in the ICT sector.**
  Needs to create and maintain a long-term vision and related activities to develop an ecosystem that provides planning safety for the operators and other players in the field. Responsible for the management of frequencies and development of the spectrum plan and for monitoring of the operators activities and its compliance with license obligations.
- **Public Utilities Commission (PUC): Oversees operation and standards of any public utilities organization.** Oversees the performance of the operators. Needs to have better/good access to monitor and check the operator's compliance with service obligations and service quality.

5.3.1.4 Financial Stakeholders

These stakeholders can provide additional funding for infrastructural activities in the hinterland and remote areas. In addition they can also benefit from the "ICT for hinterland, poor and remote areas"-program for the achievement of their own goals and targets.

[113] Our mission is to develop and implement appropriate ICT solutions that will transform the delivery of Government services. (Source: eGovernment Facebook Site)

- **UNDP: Drive Sustainable Human Development in the country.**
  Identify the right measures to reduce poverty. While ICT and related e-Services is seen as a major driver to reach the goal of supporting sustainable Human Development, the negative impact of ICT needs to be identified and addressed accordingly.
- **IDB: Support Guyana to achieve continued economic growth, while at the same time promoting the sustainability of the country's natural resource endowments.**
  Bridging the communication gap between coastal areas and hinterland. eServices are expected to increase transparency and the flow of information and to provide the potential to increase the social conditions in remote areas.
- **WWF: Stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.**
  The expectation in regards to new eServices is that they will contribute to an increased information exchange in a timely manner, securing access to the right information when needed.
- **Governmental special interest vehicles like USAid and CIDA: Support health, economic growth, and democracy and governance in Guyana.**
  Understands ICT as a mean to bridge the communication gap between coastal areas and the hinterland and remote areas. eServices are seen as viable solution to increase transparency and the flow of information and as well as a way to increase the social conditions in remote areas.
- **Inter-American Institute for Cooperation on Agriculture (IICA): Help to develop the agricultural sector in Guyana**
  Identified ICT as key to drive agricultural competitiveness and managing knowledge throughout production chains. eServices can help to achieve these ideas.

5.3.1.5 Services/Use Cases Stakeholders

These stakeholders are key target groups/potential users for specific eGovernment e-Services.

- **Ministry of Health: Responsible for health system and operates hospitals and health posts in the country.**
  Needs online and digital communication to regional hospitals and to smaller health stations. Needs ICT infrastructure as backup for their own e-Services.
- **Pan-American Health Organization: Supports Ministry of Health and steers projects to increase health situation.**
  Monitor health situation/diseases outbreaks. Needs real time date from regions for early identification of disease outbreaks; efficient drug control and forecast using real time date from hospitals; provide training classes trough online training.
- **Ministry of Education: Responsible for public schools and educational system.**
  Wants to provide distant learning services as soon as bandwidth is available. Furthermore the monitoring of schools in real-time (e.g. attendance) might be an additional service. Stable platforms (incl. redundancy) to run and operate services are needed.
- **UNICEF: Supports ministries to build a world where the rights of every child are realized.**
  Needs services in the field of education and health (esp. Disease detection). Increased communication and online reporting. Additionally, the need to educate people in the use of digital services showing them opportunities and risks is seen.
- **Ministry of Indigenous Peoples' Affairs: Help to develop a better quality of life for the indigenous peoples.**
  Wants to increase communication to and with villages while protecting the Amerindian culture including offering services to drive the culture.
- **National Toshao Council: Represents the indigenous communities and drives their development.**
  Services are needed to increase the economic situation in the villages, for better communication, learning and reporting to the ministry. Wants to provide services that support the use of Amerindian languages and that help to protect the Amerindian culture.

- **Ministry of Communities / CDCs: Represents communities on a national level.**
  Services are needed to increase the economic situation in the villages, for better communication, learning and reporting to the ministry.
- **Ministry of Business: Shaping the future of this country's economy by supporting the development of a strong, vibrant and competitive business sector**.
  Needs services to drive business and services that help local enterprises, including enabling services like payment services.
- **Ministry of Agriculture: Drive the development of the agricultural sector**.
  Needs digital communication services for the exchange of information in timely manner including to the ministry's agencies like Guyana Livestock Development Authority to provide technical and extension services to stakeholders of the livestock sector. Online training is seen as an important service as well.
- **FAO: Conserving biodiversity for food and agriculture and promoting its use in support of global food security and sustainable development, for present and future generations.**
  ICT based communication services are seen as a major building block and as enabler for multiple activities within the country.

5.3.1.6 Partners

Partners might help to drive the success of the project in different dimension, from enabling support in the political dimension to be interested in using specific e-Services.

- **Ministry of the Presidency: Increase quality of life of all citizens, regardless of their place of living in the county.**
  eServices should provide equal service quality regardless of location of the community in the country. ICT should drive ICT literacy and government. ICT should serve as incubator for the private sector services
- **Ministry of Public Infrastructure: Provides activities to maintain and improve public infrastructure.** eGovernment Infrastructure rollout should be aligned with infrastructure activities, e.g. road building. Ministry needs to support alignment between different government agencies like eGovernment and GPL.
- **Iwokrama International Development: Support sustainable forest management.**
  eServices are needed to increase communication and distant learning. It is expected that ICT infrastructure will drive the economic development in the hinterland and remote areas.

5.3.1.7 Business Model Stakeholders

Protecting the installation of infrastructure in the hinterland and remote areas and therefore of investments is achieved best by creating a feeling of "ownership" or responsibility for the hardware/infrastructure deployed locally.

- **Local community representative (eg. Toshao): Secures cohesion within a community as well as being responsible for keeping peace and order in the village**.
  Might serve as care taker of the installation in the communities. Their role has to be considered as eGovernment services/internet might have negative impact on the social life of the community members. eServices will increase the ability to communicate with other villages and support activities in the field of health, learning, farming etc.
  Toshaos also play a vital role in accepting ICT services within their respective communities. An early consultation of the Toshao in the planning of a rollout and the provisioning of the eGovernment services is essential to get his/her permission to implement the services in the respective community. This early consultation needs also to include a discussion about the potentials/benefits vs. the potential risks of using internet services.

5.3.2 Business Models

For the business model of providing broadband access and e-Services to rural areas mainly two dimensions must be considered:

Who are the relevant players involved and what part of the value chain will they cover?

What are the estimated cash flows and is additional funding required?

5.3.2.1 Business Models – Theoretical Framework

When it comes to deploying broadband infrastructure, public and social interests conflict with economic interest. The telecom operators act rationally when taking investment decisions, and the business case of deploying broadband infrastructure in dense urban areas is significantly better than deploying broadband in rural and/or remote areas: Lower investment is needed to cater a certain amount of users in dense urban areas because of higher population density and the purchasing power of customers often tends to be higher in cities / urban and dense urban areas.

But government strives for the maximization of socio-economic welfare and therefore also the provision of broadband services to the whole population. For remote areas the principle of (infrastructure-based) competition is deficient. Urban areas enjoy choice between two or three infrastructure networks, while large parts of rural areas have no broadband or advanced infrastructure at all, because private operators have lower incentive to invest in rural & remote areas. Therefore private sector operators are not always in the position of contributing to governmental broadband targets. Co-financing schemes for rolling out broadband are a common tool to ensure that on top of commercial aims also socio-economic interests are being attended. However, if public money has to be catered to projects in economically unviable areas, then the public sector acquires an interest in pushing towards socio-economic objectives rather than profit. Business models should be chosen in consequence. In theory six different co-financing schemes for rolling out broadband can be described:

1) **Pure Competition**
   A liberal market with competition between telco operators and/or cable companies: The competition can focus on infrastructure or services, depending on the market maturity and stage of development of the country. The government mostly relies on the market participants to push ICT Access and Service availability. To achieve high broadband penetration, strong customer demand is needed. The presence of remote or difficult-to-serve areas hinders the development of broadband penetration as commercial operators have little or no incentive at all to invest in these areas because of high CAPEX paired with low return of investment. There might be varying degrees of regulation facilitating this development, but a strong regulatory regime is always mandatory to enforce the regulatory measures.
   Under favorable conditions pure competition is highly efficient as no public funding is needed and the Broadband Roll Out is driven by the market players. But if demand is weak or population sparse the concept of competition will not be successful.

2) **Indirect Subsidies**
   The government does indirectly support the roll out of broadband via favorable interest rates or tax breaks. The success of this model depends on the market custom and the behavior of the market player: The operators must leverage subsidies and reply with investment. The right design of subsidies also is prerequisite: They must be designed to support the purpose of increasing broadband coverage in underserved areas.
   The advantages of this model are that there is only low direct government involvement and – similar to the pure competition – most of the infrastructure development and investment is left to the market. The downsides are, that the outcomes are hard to steer and depend strongly on how operators take-up the subsidies provided.

3) **Direct Subsidies**
   The government does provide financial or infrastructure resources to push the roll out of broadband. Subsidies are paid to operators or to local communities, dedicated initiatives or to special vehicles. For this

model to be successful the presence of a competitive market in most of the areas is beneficial: This will leave a significant part of the broadband roll-out to the market and limits the need for public funding to areas most at need. Still it is required, that subsidies are designed properly to address explicitly the designated areas (lack of service provision by commercial operators, difficult to serve, commercially less attractive). Furthermore the success of this model depends on the take-up by local initiatives. Countries with Direct Subsidy systems in general perform very well for fixed broadband penetration. But often these countries are wealthy countries, with high GDP per capita and middle-to high population densities.

4) **Public Private Partnerships**
A joint endeavor of a public body and a private entity where each party brings in specific skills: The public side provides infrastructure (e.g. frequencies) and favorable regulatory conditions and the private side brings in expertise, best practice knowledge, and/or financial strength. Public Private Partnerships require strict control of target achievement and costs. The advantage is that potential blockages from incumbent operators due to economic (dis)interests can be overcome. Still there are also some risks as citizens will continue to hold government accountable for quality of utility of services whilst both may strongly depend on the private party involved. The private sector will do what it is paid to do and no more than that – therefore incentives and performance requirements need to be clearly set out in the contract. Focus should be on performance requirements that are out-put based and relatively easy to monitor. Given the long-term nature of these projects and the complexity associated, it is difficult to identify all possible contingencies during project development and events and issues may arise that were not anticipated in the documents or by the parties at the time of the contract. It is more likely than not that the parties will need to renegotiate the contract to accommodate these contingencies. It is also possible that some of the projects may fail or may be terminated prior to the projected term of the project, for a number of reasons including changes in government policy, failure by the private operator or the government to perform their obligations or indeed due to external circumstances such as force majeure. While some of these issues will be able to be addressed in the PPP agreement, it is likely that some of them will need to be managed during the course of the project If there is a special vehicle with government share involved, the Public Private Partnership model is very similar to the Scheme of Public Infrastructure.

5) **Indirect Government Control**
The government defines targets for telco operators and enforces the achievement of these targets. This is often the case with wholly or partly state-owned operators. With state owned operators, the government can leverage its influence on the behavior of the market player and hence push the achievement of the targets defined. Furthermore a complete and exhaustive regulatory framework is required to prevent that operators use regulatory captures and delay the roll-out. Under the right conditions this model will limit the funding needs from official state budgets and leverage capacities and skills of the commercial operators as implementation is executed by the market players. Indirect Government Control systems are typical for developing countries.

6) **Public Infrastructure**
Infrastructure is solely provided by public bodies but can be realized in different approaches that can also be combined: A national company deploys and operates the network using existing public infrastructure, the government may buy operators assets, and the business might be organized as retail or wholesale business. The Public Infrastructure model requires strict control of target achievement and costs. The advantage is that potential blockages from incumbent operators due to economic (dis)interests can be overcome. Still there are the general risks for government projects as these commonly show delays or cost overruns.

The degree of government involvement varies for the different financing schemes: Lowest involvement of government is found in the case of Pure Competition leaving the development of the market to the independent players. Partial but increasing involvement of government is reflected in the schemes of Indirect Subsidies, Direct Subsidies, and Public Private Partnerships up to Indirect Government control. The highest degree of governmental involvement is the provision of Public Infrastructure.

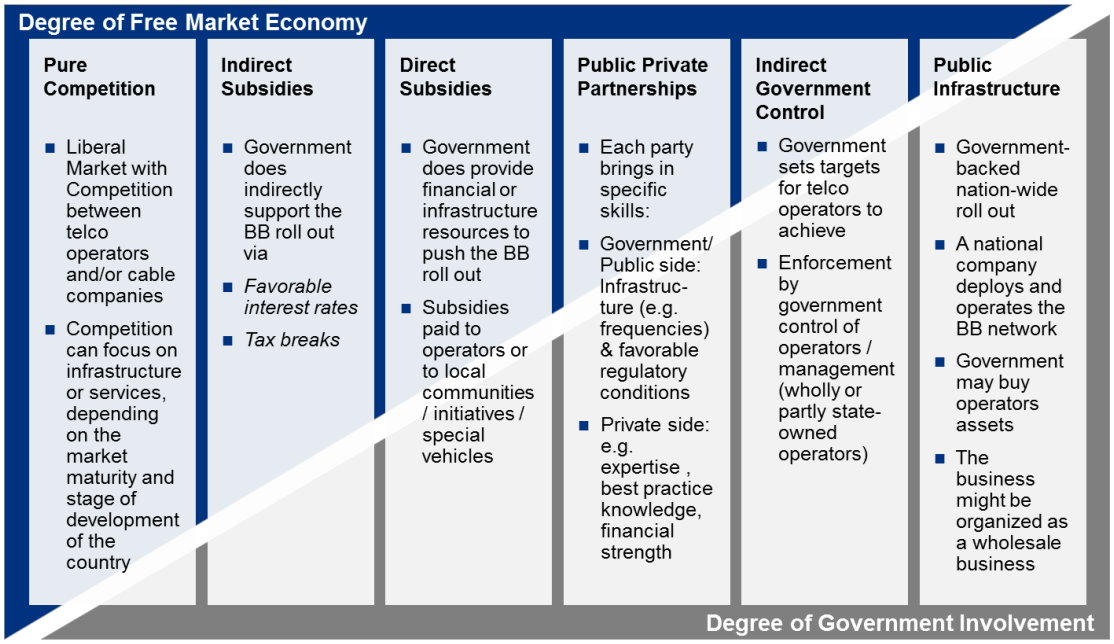


Figure 303 - Financing Schemes for Broadband Roll Out and ICT Access Development

In most countries, combinations of schemes are found. Usually commercially attractive areas are left to competition and only problem areas are publicly financed. For Guyana this is already being reflected in the current situation: The commercial operators focus their efforts on the commercially more attractive areas, such as the major cities and the coastal area, and deprioritize communities in the hinterland and remote areas esp. in the roll out of their broadband services - leaving them with lower coverage and less advanced services.

Beside the financing scheme, there are some other factors influence the success of broadband roll-out:

1) Fixed broadband penetration is positively correlated with GDP per capita. The higher purchasing power of the population makes rolling out broadband more attractive to private investors, and richer countries are also better able to afford public BB investment.
2) There is a general tendency for broadband penetration to rise with population density. This can be best explained by the fact that it is economically more attractive to roll-out broadband in densely populated areas. But there is wide variance for countries with low – to medium densities. Comparing countries with similar densities, broadband penetration is generally higher in countries with higher GDP per capita.
3) There is also a general tendency for Mobile broadband penetration to rise with per capita GDP, but the tendency is weaker than for fixed broadband. Potential reasons are the lower costs for Mobile BB, accompanied by lower speeds, and poorer, less developed countries use mobile broadband as a cheaper alternative to fixed BB roll-out.
4) Mobile broadband penetration is only weakly positively correlated with population density. Countries with high densities have also high fixed broadband penetrations, reducing the attractiveness of mobile broadband, and countries with low densities use mobile broadband as substitute for fixed broadband, resulting in a higher mobile broadband take-up.

Comparing case studies from countries worldwide you can say that GDP per capita, population density, and a culture of good governance and competent implementation of government programs seem more important for the success of national broadband strategies, than the choice of the financing model.

Furthermore there are different parts of the telecommunication value chain to be covered: Starting from the International Gateway via passive and active infrastructure to service provisioning. The business model shall also determine who covers which step of the value chain. Possible roles a market actor can take are e.g. passive infrastructure provider (dark fiber, towers, and facilities) network provider (core, backhaul, transport network, access

network) or service provider (provision of voice services, data services, and value added services to customers). A business model is referred to as a vertically integrated model when one market actor takes on all three roles. This is the case with all large telecom operators.[114]

Regulations can demand the opening up of network access to competitors, either at the passive or active layer. This means that the network owner designs the network to deliver its own services and gives access to its competitors in forms compatible with the network design.

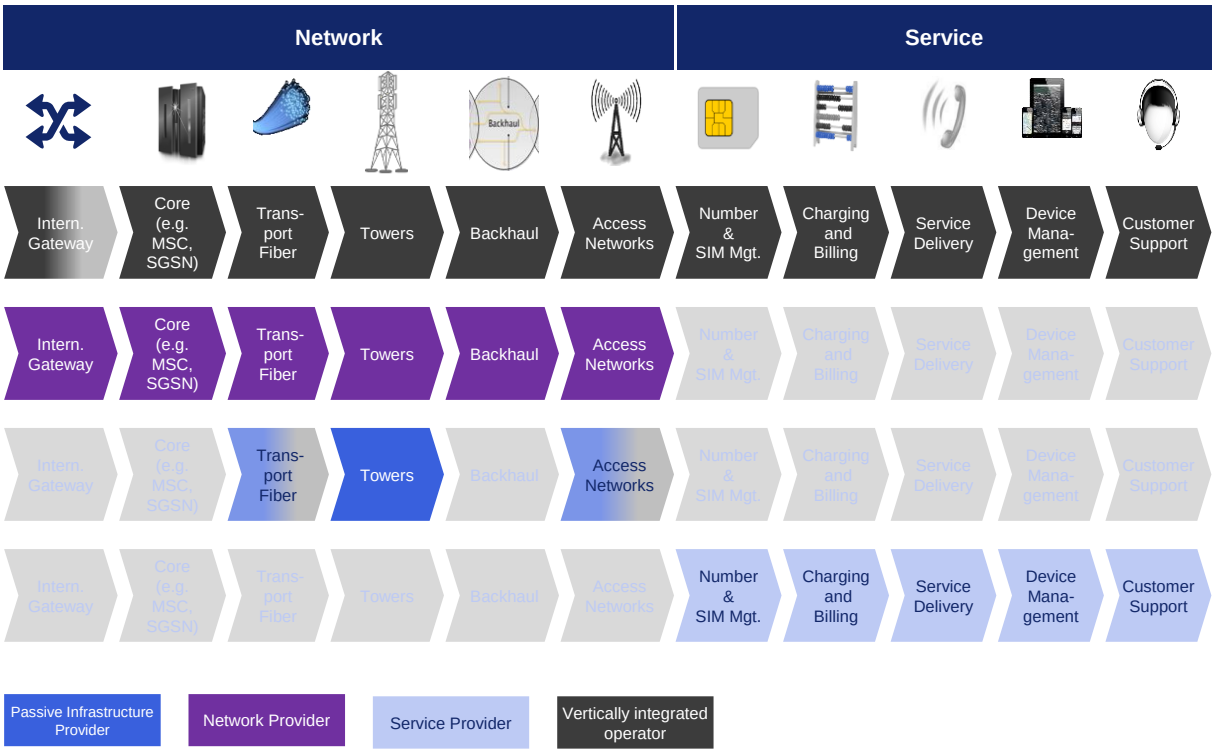


Figure 304 - The Telecommunication Value Chain

5.3.2.2 Case Studies

Australia: Nationwide government-funded Public Infrastructure brings broadband services to rural areas

Australia has a population of ca. 23 million and 7,682,300 sq km of land resulting in a population density of 3 people per sq. km of land area. The GDP per capita is USD 65,400 (2015 est.) ranking Australia at place 15 in the country comparison to the world. Following two decades of continuous growth, low unemployment, contained inflation, very low public debt, and a strong and stable financial system. The services sector is the largest part of the Australian economy, accounting for about 70% of GDP and 75% of jobs.[115]

Australia is perhaps the prime example for the government funding approach. This is a result of a strong visionary policy that believes having almost universal access to very high speed services will increase the overall economy. The aim is to give fiber to 93 per cent of premises and to use wireless and satellite for the others. This provides a wholesale-only service for network operators to use and compete with each other in the downstream markets. The

[114] Source: Socio-economic benefits of high-speed broadband, European Commission, 2015
[115] Source: The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/

approach directly tackles the digital divide: the entire country is served by a standard service. The approach is not a complete government-only monopoly of supply. The NBN Co (National Broadband Network Company) supplies the access services but downstream providers compete to deliver the end users' retail services. These are based on wholesale services from NBN Co with prices that do not have the variability by location that naturally follows on from when costs are the basis of the input price. This is the case if a vertically integrated provider were to build the fiber and also deliver the end services – the costs to itself will vary depending on the customer.[116]

The approach has had to address many issues such as how the deployment interfaces to existing operators. In fact the established commercial operators have or also had planned some fiber access networks – this creates public and private competition, but each have different investor-demands to meet. Setting up the project was a lengthy process for the Australian government:

The NBN Co was created in 2009 to provide the operational monitoring of the plan. Amongst its powers, NBN Co is responsible for taking care of the relationships with the various participants in the deployment of the future network and ensuring the fiscal and time monitoring of the plan. As part of this plan, long and exhaustive negotiations were conducted with the incumbent operator. In mid-2011, they led to the signing of an agreement between Telstra and NBN Co, by which the operator commits to giving privileged access to its passive infrastructure and assure priority to NBN's future wholesale service to provide its own future ultra-fast broadband services. In parallel, the national plan included the decommissioning of the copper and HFC (Hybrid Fiber Coaxial) networks of the incumbent operator as new NBN subscriptions are taken up (decommissioning of copper and cable networks to be effective within 18 months following implementation of the NBN in a given area). Thus, the NBN would pay Telstra to progressively use its infrastructure as the decommissioning of its copper network proceeds. Estimates were that the NBN would have to spend 9 billion AUD for the use of Telstra's pipes, poles, racks and other passive infrastructure. An agreement was also signed with Optus, another major player in telecommunications and cable in Australia, which also includes decommissioning of the operator's networks.

The second major challenge this approach had to face is to run the public infrastructure efficiently. This point follows from the general economic assumption that any service that is provided by government and is not open to competitive forces is likely to be inefficient. Either way, roll-out targets were delayed several times and estimated costs rise constantly.

[116] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

Brazil: Blended approach including Indirect Subsidies paired with Indirect Government Control complemented by Public Infrastructure

Brazil has a population of ca. 206 million and 8,358,140 sq km of land resulting in a population density of 25 people per sq. km of land area. The GDP per capita is USD 15,600 (2015 est.) ranking Brazil at place 103 in the country comparison to the world. Characterized by large and well-developed agricultural, mining, manufacturing, and service sectors, and a rapidly expanding middle class, Brazil's economy outweighs that of all other South American countries, and Brazil is expanding its presence in world markets.[117]

Although classed as an emerging economy, Brazil is among the top ten countries worldwide when ranked by total number of broadband users. At the end of 2010 Brazil was in 9th position, with about 15m fixed broadband subscribers, as well as 20m mobile broadband (3G) subscribers. This is not particularly surprising considering that Brazil is the world's fifth most populous nation, but due to the high levels of wealth disparity and the relatively large numbers of poor and rural inhabitants scattered across its vast terrain, broadband penetration in Brazil is lower than in other countries of equivalent income levels. Regionally, Brazil is slightly above the Latin American average in terms of penetration, but behind Chile, Argentina, and Uruguay. Speed of access follows a similar pattern – Brazil is better than the regional average, but below US or European levels. Likewise, Brazil has relatively good international fiber connectivity, although it is not as well connected as some of its neighbors. Similarly, prices for telecommunication and broadband access are lower than other countries in the region yet still relatively high compared to North America and Europe, especially outside the major cities. Phones, computer and telecommunication equipment are also significantly higher in cost, partly due to import duties on IT equipment, further reducing affordability of access among the lower-income groups.

Large variation in access levels: As reflected by the wide variation in income levels within the country, broadband access is very uneven. At one end of the spectrum there is a high density of access in the industrialized urban areas, mostly in the south east of the country. In these areas, Brazil has recorded some of the world's highest levels of internet use, and in particular, Brazilians have been early users of social networking services such as Orkut, and now Facebook. At the other end of the spectrum, there are the vast hinterlands of unconnected rural and remote areas, most particularly in the less wealthy north and west part of the country. For example in the North-East region, fixed broadband penetration languishes at 1.46%, while it is over 11% in the more industrialized Sao Paulo region in the south. The pattern of uneven access also repeats itself at the local level. Most cities have wealthy areas with high levels of domestic broadband access, while close by, in the informal townships (favelas), which house most of the country's poor, there is almost no fixed broadband and residents mostly depend on cybercafés or relatively slow and more expensive 3G connections. In the last 10 years, the federal government has had little success in disbursing its Universal Service Funds to address the digital divide, although a variety of state and municipal level initiatives have improved the availability of public access facilities to some extent.

Limited fixed infrastructure: The private sector has invested about USD80bn in telecommunications over the last 12 years, but Brazil's vast size and low population density in the rural areas has resulted in limited national pervasion of telecommunication infrastructure. This presents one of the biggest problems in broadening access to the internet. The relatively low level of fixed infrastructure, both in the long-haul, and in the local loop for DSL-based broadband services, is one of the key constraints. However the lack of middle-mile infrastructure necessary to ensure all 5500+ municipalities are connected to the national backbones probably represents the biggest challenge to ensuring equitable broadband access across the country. Competition in the fixed-line sector is low and fixed line penetration has actually been falling due to mobile subscriber substitution. With the relatively high level of penetration and competition between mobile networks, 3G services are expanding rapidly to fill the demand for broadband, especially among lower income households. As a result wireless access is likely to be the main growth area for broadband in Brazil, especially now that some of the constraints in access to radio spectrum have recently been addressed.

National broadband initiative launched: In an effort to help to improve coverage and reduce the cost of broadband access, the government has begun a major broadband infrastructure development initiative. The largest ICT infrastructure project ever carried out in Brazil, called the National Broadband Plan (PNBL[118]), it aims to ensure that broadband access is available to low-income households, especially in areas that have so far been poorly served. In

[117] Source: The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/
[118] http://www.mc.gov.br/plano-nacional-para-banda-larga

May 2010, when the project was officially announced, it was initially allocated up to R$1bn (US$600m) a year until 2014 to ensure broadband reaches the 4,000 cities and towns without broadband services, so that at least 40 million homes (or 68% of the population) have access to speeds equal to or greater than 1Mbps, for about USD20 per month. The new government, under President Dilma Rousseff, has re-affirmed its commitment to the PNBL which was originally developed under the previous President Lula da Silva's administration. To implement the program, the dormant former state-owned monopoly operator, Telecomunicacoes Brasileiras (Telebras), has been resurrected and given the task, working closely with the national regulator, Anatel, and the Ministry of Communications which has also set up a special secretariat to co-ordinate the PNBL in concert with the government's other digital inclusion programs.

The initial focus of the PNBL has been to address the deficiencies in the existing telecommunication operator backbones by bringing on the oil and electricity network operators' fiber networks to help fill in the gaps. Local access is now also being addressed through a variety of other measures, such as tax exemptions, reducing broadband license fees, accelerating efforts to make additional radio spectrum available, and other incentives to encourage the provision of broadband in rural areas. In May 2011, Telebras awarded three operators contracts worth USD43mn to provide transit, wholesale and broadband services in some states.

The internet sector in Brazil is also supported by a large number of industry, government and civil society groups, both monitoring and promoting access to ICTs. As a result the level of up-to-date information on broadband utilisation is high, and the debate over strategy is widespread.

The resurrection of the old public monopoly operator Telebras to compete with the private sector has not been without controversy, and the extent to which the poorest of the poor get access to broadband remains to be seen. But steadily rising economic prosperity for the less wealthy, along with the flurry of ICT investment made to prepare for the FIFA World Cup in 2014 and the Olympics in 2016, suggests there are much improved prospects wider adoption of broadband in Brazil. The strategies adopted and lessons learned from both public and private initiatives will be valuable for other developing countries planning to promote better access to broadband.[119]

[119] Mike Jensen, Broadband in Brazil: A multipronged public sector approach to digital inclusion. Washington, D.C: infoDev / World Bank. Available at http://www.broadband-toolkit.org.

Kenya: Use a Pubic Private Partnership as vehicle to increase international capacity and to decrease wholesale bandwidth costs

Kenya has a population of ca. 46 million and 569,140 sq. km of land resulting in a population density of 81 people per sq. km of land area. The GDP per capita is USD 3,200 (2015 est.) ranking Kenya at place 186 in the country comparison to the world. Kenya is the economic and transport hub of East Africa. Kenya's real GDP growth has averaged over 5% for the last seven years. Since 2014 Kenya has been ranked as a lower middle income country because its per capita GDP crossed a World Bank threshold.[120] Kenya has a natural geographic advantage, being strategically positioned on the East Coast of Africa.

Its government-led "build it and they will come" approach to broadband development has leveraged that advantage, and has played a major role in dramatically increasing fiber optic backbone capacity. Many of Kenya's milestones have been realized in less than five years – three cables had landed by the end of 2010 changing the face of the broadband market. The country has gone from relying on satellite for international capacity, to having access to almost four terabits over fiber from the three cables combined. Although the landing of the cables is merely a first step, it has already resulted in an 80 percent decrease in wholesale bandwidth costs. Lower prices and greater availability are expected to increase access to the internet as well as to promote the continued spread of sophisticated mobile applications and services and consequently improve opportunities for the creation of and access to information and knowledge. Affordable broadband is expected to increase Kenya's competitiveness, particularly in the Business Process Outsourcing (BPO) sector, and to encourage entrepreneurship and innovation.

With an estimated fixed and mobile broadband penetration rate of 2 subscriptions per 100 people in 2010, Kenya still has significant progress to make with respect to broadband uptake. Stimulating demand and usage by Kenyan citizens and the public and private sector remains a challenge. Kenya has, largely through the government, taken an innovative and pro-active approach to putting the user at the center and addressing the other elements of the broadband ecosystem, such as education, literacy, applications and content. This has been done through good regulation, the promotion of polices relating to ICT in education, the subsidization of relevant content and application projects, and facilitating creative Public Private Partnerships.

Much of Kenya's success is due to four important factors:

- A clear national vision articulated in Vision 2030
- Strong leadership and direction
- Leveraging the strength of the public and private sectors through Public Private Partnerships
- A credible regulatory, policy and institutional framework

With the new modern ICT policy framework the regulator encourages amongst other things facility sharing and co-location agreements which are to be commercially negotiated, however CCK has the right to intervene in case of a dispute. This is also reflected in the Kenyan Licensing Regime[121]:

Like its regional counterparts in Rwanda, Uganda and Tanzania the CCK has adopted a technology neutral unified licensing framework (ULF). Network operators and service providers are licensed under a market structure consisting of the following broad market segments:

Network Facilities Provider (NFP**)** - Licensees under this category can own and operate any form of communications infrastructure (based on satellite, terrestrial, mobile or fixed). The NFP category is further divided into National NFP and International NFP. Investors who wish to land a submarine cable in Kenya require a Submarine Cable Land license while those interested in building system for the provision of international voice/data services are required to get a license for international Systems and Services. An International NFP (Incl. submarine cables and international gateway facilities) costs KHS 15 million as an initial fee, and the higher of 0.5% of Annual Gross Turnover or KES 5 million (US$ 60,170) per annum. The spectrum fee payable is based on bandwidth and coverage.

[120] Source: The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/

121 Source: Msimang, Mandla, 2011. Broadband in Kenya: Build it and They Will Come. Washington, D.C: infoDev / World Bank. Available at http://www.infodev.org/publications

National NFP are described based on the use of spectrum. National NFPs are further identified as Tier 1 (exclusive use of spectrum countrywide), Tier 2 (exclusive use of spectrum regionally) and Tier 3 (exclusive utilization of spectrum by Administrative District). The initial license fee for Tier 1 and Tier 2 NFP licenses is KES 15 million; the fee for Tier 3 NFP licenses is KES 200,000. (US$ 2,400) In addition a spectrum fee is payable based on bandwidth and coverage.

Applications Service Provider (ASP) - Licensees under this category are permitted to provide services to end users using the network services of a facilities provider (NFP). The initial license fee is KES 100,000, and an annual fee of the higher of KES 100,000 (US$1,200) and 0.5 percent of Annual Gross Turnover is payable.

Content Services Provider (CSP) - Licensees under this category can provide content services material, information services and data processing services. The initial license fee is KES 100,000 (US$1200) and an annual fee of the higher of KES 100,000(US$1,200) and 0.5 percent of Annual Gross Turnover is payable.

Mexico: [122] Pooling of public infrastructure and (spectrum)-resources with financial power and capabilities of private investors in a Public Private Partnership to create a single wholesale shared nationwide 4G network

Mexico has a population of ca. 123 million and 1,943,945 sq km of land resulting in a population density of 65 people per sq. km of land area. 22% of the population are living in rural areas. The GDP per capita is USD 17,500 (2015 est.) ranking Mexico at place 119 in the country comparison to the world. Mexico's $2.2 trillion economy has become increasingly oriented toward manufacturing in the 22 years since the North American Free Trade Agreement (NAFTA) entered into force. Per capita income is roughly one-third that of the US; income distribution remains highly unequal. [123]

In 2013, the Mexican Government and main political parties agreed to a constitutional reform changing the legal framework of the telecom sector. The major objectives of the reform were to give Mexicans access to better and cheaper telecommunications services and to raise the competitiveness of the Mexican economy. The reform introduced an individual right for the Mexican citizen to have "access to timely information from multiple sources and to seek, receive and impart information and all types of ideas by any means of expression." This right includes that "the State shall guarantee the right of access to communication and information technologies, as well as broadcasting and telecommunication services, including broadband and internet access." The institutional framework was changed. The old regulatory body has been dissolved, and a new "Federal Telecommunications Institute (IFT)" has been created to improve the predictability and enforceability of regulatory decisions. In addition an antitrust commission (COFECO) and specialized courts for ICT cases have been founded. The status of IFT as an independent and autonomous body has been fixed in the constitution (Art. 27 & 28). Any IFT decision can only be appealed through juridical review, the decision taken by the authority is not suspended for the duration of the court case.

To ensure universal access two projects are under way - a shared mobile network (Red Compartida) and a fixed network program (Mexico Conectado) improving connectivity in schools, hospitals and other public areas on a municipal, provincial and federal level.

The cornerstone of the reform will be the project Red Compartida. Red Compartida is the constitutional mandate to create a shared network through a wholesale-only operator providing services that are unbundled and non-discriminatory. The Minister of Transport and Communications clearly stated: "Doing business as usual, mobile services will not reach unprofitable markets. Red Compartida's model will allow coverage in otherwise unserved or underserved areas."

The Model is based on the three pillars:

- The vision of the project is to provide broadband access for all.
- The mission is to deploy a shared wholesale network that enables the provision of telecom services through existing and new service providers.
- The goals are to increase coverage of mobile broadband services, to promote competitive prices, and to raise quality to international standards.

The concept of a mobile wholesale LTE network: Red Compartida will be implemented as a Private Public Partnership, where the State is represented by Telecomm and the newly created entity OPRITEL. The private developer will be selected through a request for proposals. Nonetheless, Red Compartida is envisioned in its essence as a private venture, where the Mexican Government will not be part of the shareholder base nor will it be involved in network design, deployment or its commercialization. OPRITEL is a special organization within the Ministry of Communications which will receive the spectrum license from the regulator (IFT) and pay the spectrum fees. OPRITEL together with Telecomm will close a Public Private Partnership contract with the developer, lease the spectrum to the developer, take receipt of the leasing fees, and control the wholesale and coverage obligations of the developer. The developer will eventually consist of the operator and its equity partners and possibly other retail operators. Red Compartida will have a license for 20 years.

- The major input from the State is the allocation of a premium, unencumbered contiguous spectrum on the 700 MHz band (703-749MHz X 758-803MHz).

[122] Source: Future Telco III, Detecon International GmbH, 2016

[123] Source: The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/

- In addition Red Compartida will get the right to use a fiber pair from the Federal Electricity Commission's fiber network mounted to the power grid as a backbone service. The total fiber network length is about 30,000km.

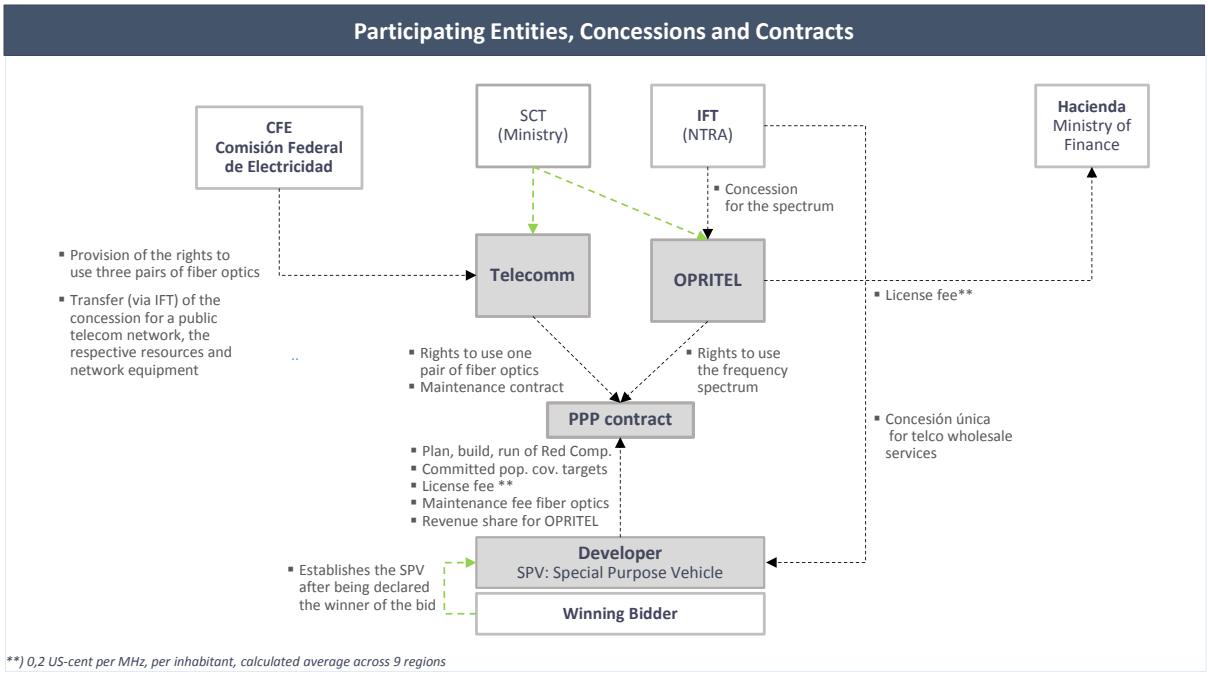


Figure 305 - Mexico Case Study: Participating Entities, Concessions and Contracts

Red Compartida will not be allowed to sell directly on the retail market. Its customers are therefore the existing Mobile Network Operators (MNOs) (who may need additional coverage and capacity), fixed line operators who need to close "4-play" portfolio gaps using MVNO services, and other private and public MVNOs. It is the mandate of Red Compartida "to share its entire infrastructure and the unbundled sale of services and capacities, exclusively to marketing firms and telecommunications network operators under conditions of non-discrimination and competitive prices." Major services will be:

- National Roaming services for MNOs (providing capacity and filling rural and indoor coverage gaps)
- Hosting MVNOs on the Red Compartida network. These can be differentiated into two groups: "Full MVNOs" like fixed operators with a portfolio gap in mobile will build a complete network infrastructure except radio access and mainly buy access services. "Light MVNOs" like retail chains that sell SIM cards with their own logo will buy a number of additional network services from RC, including internet gateway access, transport, billing etc.
- Sharing of transport network and Radio Access Network with other operators may also be a part of RCs portfolio, but certainly with a minor revenue potential.

As compensation for the roll-out requirements and the prevented direct access to the retail markets the Government has decided to sell the spectrum at 0,002 USD/MHz/inhabitant, which is well below international benchmarks. The Government expects a minimum total roll-out obligation of 85% population coverage after five years, with annual milestones before that. The first milestone is a population coverage of 30% by the end of first quarter 2018. In fact the final population coverage will most likely be much higher than the obligation, as this target is the winning criterion for the applicants.

The concept has a number of advantages:

a) A single operator who gets an unsliced portion of the whole 700MHz spectrum should have the lowest cost for covering the country. The cell size in this band is substantially larger than in bands with higher frequencies and therefore for customers on the move (along roads etc.) and in low density rural areas fewer cells have to be constructed to provide coverage. This saves substantial CAPEX.
b) With a larger amount of bandwidth compared to sliced smaller spectrum lots a single wholesale operator can offer higher data rates per cell than several operators could. Broadband targets can be achieved much easier.
c) The 700MHz spectrum penetrates walls much better than spectrum in higher frequency bands, therefore in-house coverage is less costly to achieve.

While these advantages of a “natural monopoly” on the physical network side can be achieved, service competition in the retail markets will be intensified. The smaller MNOs will get relatively cheap and fast access to currently non-covered areas at much lower cost than they have to pay to the incumbent. Red Compartida is a specialized network to host all types of MVNOs. This will lead most likely to a boost of the MVNO market in Mexico with increased competition in price and quality for specific customer segments.

South Africa: Using Public Infrastructure to fill the gaps from Competition

South Africa has a population of ca. 54 million and 1,214,470 sq km of land resulting in a population density of 45 people per sq. km of land area. The GDP per capita is USD 13,200 (2015 est.) ranking South Africa at place 118 in the country comparison to the world. South Africa is a middle-income emerging market with an abundant supply of natural resources; well-developed financial, legal, communications, energy, and transport sectors; and a stock exchange that is Africa's largest and among the top 20 in the world.[124]

South Africa[125] has identified a need to fill gaps that were not being addressed by commercial operators. On 6 December 2013 the government published a new national broadband plan for South Africa. The policy and its associated strategy is collectively dubbed 'South Africa Connect', and outlines a number of activities to improve broadband within the country. In particular, the overall vision of the policy is to give every South African access to a broadband connection at a cost of 2.5% or less of the average monthly income. The new policy has also revised the methodology used to define broadband speeds, opting to use targets that are reviewed annually rather than a fixed speed.

ICASA, the national regulatory authority, will supplement these targets, the policy states, by specifying quality of service (QoS) standards, download and upload speeds, latency, waiting time for installation and fault clearance. The initial target is to offer 90% of South Africans a minimum speed of 5Mbps by 2020, with 50% of the population set to have access to 100Mbps broadband. Among the areas of concern highlighted by the policy are: a duplication of civil work to roll out networking infrastructure and a need for the speedy assignment of spectrum. The policy also calls for the appointment of a broadband council and the creation of a wholesale open access network. It goes on to acknowledge that the scale and scope of intervention to be undertaken in South Africa requires investment from both the public and private sectors. Further, ICASA discusses several options for potential spectrum allocations in the 450MHz-470MHz band, which will be used to boost coverage in underserved areas. In order to release spectrum for the 'South Africa Connect' initiative, the migration process for rural areas is planned to start in 2016, with existing spectrum holders required to vacate the band in rural areas no later than the end of 2018. For urban areas, existing licensees will be obliged to migrate out of the band by the end of 2022.

The broadband roll out was pushed by the state-owned company Broadband Infraco: In December 2012 Broadband Infraco was appointed as interim chair to drive the implementation of the Infrastructure Project, with its main goal being to 'expand access to communication technology'. Infraco chief executive Puleng Kwele noted: 'The project aims to provide 100% broadband coverage to all households by 2020 by establishing core PoPs in district municipalities. It seeks to extend fiber-optic networks across provinces linking districts, establish PoPs and fiber connectivity at local level, and penetrate the network into rural areas'. Meanwhile, Infraco has an obligation to connect to all six neighboring countries in order to 'address ICT infrastructure requirements'. Hence the operator by now deployed fiber-optic network extensions to Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe, with a link to Botswana completed in 2014. In June 2015 however Broadband Infraco was directed by the DTPS to undertake a valuation exercise in preparation for its possible sale. The cash-strapped enterprise – which posted profit (of ZAR22.6 million) in only the first year of its operations (2008) – subsequently made several unsuccessful submissions to the state for funding, the most recent one in September 2015, when Broadband Infraco requested ZAR243 million to continue operations (in addition to a further ZAR932 million in funding until 2019). The deputy director-general for state-owned companies' oversight, was cited as saying: 'Broadband Infraco has sustained persistent losses in its history, and has an obsolete network infrastructure … Indirectly, if the government gives these money allocations and guarantees, it will be subsidizing the commercial contracts that Broadband Infraco has.' As of January 2016, the operational status of Broadband Infraco remained unclear.[126]

[124] Source: The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/

[125] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

[126] Sourcce: Telegeography, 2016

5.3.2.3 Recommendations for Guyana

Guyana has a population of ca. 730,000 and 214,969 sq. km of land resulting in a population density of 3 people per sq. km of land area. The GDP per capita is USD 7,500 (2015 est.) ranking Guyana at place 151 in the country comparison to the world. [127]

When looking at the overall broadband penetration in a country, population density and GDP significantly correlate with high broadband penetration, even more when the market is left to pure competition. The choice of the business model for Guyana must consider, that Guyana features very low population density as well as low GDP.

5.3.2.3.1 Financing Scheme

For the financing scheme for Guyana several models must be applied and a blended approach is recommended:

- For more densely populated areas (Georgetown and the more densely populated coastal area) the principle of Pure Competition between the commercial operators Digicel and GTT+ is working for the deployment of infrastructure. Access to e-Services is available to a large extent, but services are perceived as too expensive and costly. To decrease retail prices and make services more affordable also in the poor pockets of this region, several measures can be taken (see chapter 0). Regarding the financing scheme, it is beneficial to provide Indirect Subsidies in forms of tax incentives for basic e-Services to the commercial operators. Currently the operators bear a tax load of 40% what is at comparable level of other commercial sectors, even though the ICT sector requires much higher investments than e.g. retail, transportation or agriculture. Mapped against the theoretical framework of financing schemes for broadband roll out these high taxes rather hinder than foster the evolution of e-Services.
- To bring ICT access and e-Services to the communities located in the hinterland and remote areas a different approach is needed. The pure commercial roll-out of broadband networks in Guyana started in the major cities and then slowly penetrated smaller cities along the coastline until it also reached remote and hinterland areas. This typical development also left some unprofitable regions as “white spots” or underserved areas. To connect these areas a commercial approach is not viable. If any financing scheme is appropriate it is the Public Infrastructure. The advantage of the Public Infrastructure model is, that the government is fully in control of the target achievements and can bypass slow infrastructure roll out from GTT+ and Digicel in the commercially less attractive areas. The challenge for the government will be the foresighted development of the infrastructure roll out and management of the costs. A plus is that existing public infrastructure, such as transport network, backhaul and towers can be leveraged to set up the new network without building it from the scratch. Funding for the CAPEX will come from the GRIF fund[128] and the national budget.

  The Public Infrastructure model can be supplemented by the provision of Direct Subsidies to commercial operators to expand network coverage and capacity at a later stage. The challenge here is the appropriate design of the subsidies: They must on one hand address explicitly the hinterland and remote areas and on the other hand must be so attractive, that operators take them up. The provision of frequency usage rights in the 900 Mhz band does meet all these requirements. It is well suitable to provide mobile ICT access and services as fixed wireless or even mobile broadband services in rural areas, as the cell size in this band is substantially larger than in bands with higher frequencies and therefore for customers in low density rural areas fewer cells have to be constructed to provide coverage. For the commercial operators this implies less CAPEX but high (geographical) coverage.

[127] Source: The World Factbook, https://www.cia.gov/library/publications/the-world-factbook/
[128] Guyana REDD+ Investment Fund http://fiftrustee.worldbank.org/Pages/grif.aspx

Financing scheme	Favorable conditions to promote success	Applicability to Guyana	
Pure Competition	• Strong customer demand • No remote / difficult-to-serve areas • Strong regulatory regime	There is strong customer demand, but population is sparse in hinterland and remote areas and the majority of the communities in scope fall under the category of "difficult-to-serve areas", either because of their geographic position, challenging terrain or poor infrastructure access (e.g. power supply, roads). This model is only appropriate for dense urban and economically well developed areas of Guyana, that are already being covered by commercial operators	✗
Indirect Subsidies	• Functioning market with operators that react to subsidies with investment • Right design of subsidies	The outcomes are hard to steer as they depend strongly on how subsidies are adopted by the commercial operators. As Guyana's government has the concrete goal to develop ICT in communities in hinterland and remote areas indirect subsidies are not the most effective approach.	✗
Direct Subsidies	• Competitive market that serves most areas • Strong civil society creating local initiatives	There is competition between mainly GTT+ & Digicel in many areas, especially the more densely populated ones. The communities in the hinterland, poor and remote areas show strong interest in the ICT program and would probably be willing to support the process. Direct subsidies are appropriate and beneficial for the development of ICT in the communities in the hinterland and remote areas that currently do not benefit from any competitive market structure. But subsidies must be designed properly to address explicitly the designated areas (lack of service provision by commercial operators, difficult to serve, commercially less attractive).	✓
Public Private Partnerships	• Strict control of target achievement and costs	Public Private Partnerships can help to overcome a potential blockage by incumbent operators, but requires firm and persistent control and enforcement. As Guyana has recently gone through political change this model is a big challenge for the public authorities and will take long time to be implemented due to the lengthy tender process and negotiations with private sector to elaborate the Public Private Partnership contract.	✗
Indirect Government Control	• Strong government influence on operators (total or partial state ownership) • Complete and exhaustive regulatory framework	The commercial operators in Guyana are private enterprises and act rationally and independently following their economic interest. The government influence on their behavior is limited to the formal legislative and regulatory framework. As legislations and regulation in the telecommunication sector is currently being revised and amended, this model is not appropriate to support the government in the short- to mid-term realization of its goal to enhance ICT in the hinterland, poor and remote-communities.	✗
Public Infrastructure	• Strict control of target achievement and costs	Public Infrastructure can help to compensate the rather hesitant approaches of GTT and Digicel to build ICT-infrastructure in the hinterland and remote communities. Self-reliant and sustainable management of costs and target achievements can be carried out by a dedicated public body. The new regulator can monitor as second instance.	✓

5.3.2.3.2 Potential Partnerships

"Look at the "layers" in the value chain of the broadband economy and identify where resources need to be focused. Developed countries may focus more on the lower level investments and bottleneck supply of the access network. Emerging economies are likely to have to consider other parts of the chain. Regulation or funding inputs, may be needed to enable the other service layers to become fully established (after which they are de-regulated and become totally privately funded)."[129]

Currently Guyana is facing the challenge that there is very limited access to e-Services in the hinterland and remote areas. As discussed before, this is mainly because commercial operators have low incentives to build cost-intense infrastructure in rural areas. This gap in infrastructure deployment is to be filled by the eGovernment Agency.

Looking at the market participants, they are covering different parts of the value chain as depicted in the following image:

Figure 306 - Guyana's Operators' Positioning along the Value Chain

GTT+ and Digicel are both vertically integrated operators. But unlike Digicel, GTT+ does operate the fixed network and has the monopoly on the International Gateway. Both provide services nationwide to consumers and businesses. The eGovernment Agency operates an own network connecting ministries, schools and other public buildings. iNet

[129] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

provides services via satellite and covers the whole country. hinterland and remote regions, that are not catered by GTT+ or Digicel use iNet's services to connect to the internet. In addition there are several ISPs (internet Service Providers) offering services to consumers and businesses. They don't provide connectivity. GPL's main focus is power supply, but it also has a transport fiber in the coastal area.

5.3.2.3.2.1 GTT+

GTT+ is the incumbent and offers fixed and mobile services. The fixed-line monopoly was renewed for 20 years in December 2010. GTT+ has been granted the only license to operate an international gateway. The license is valid until 2030.

- ~250k subscriber
- No 4G network yet, but 4G-services by HSPA+ network extensions
- Ericsson for RAN, for microwave backhaul and for Core; Cisco for IP-switches
- Underutilized utilization of backhaul capacity

5.3.2.3.2.2 Digicel

Market leader, mobile services, but plans to provide full services for ICT solutions, meaning fixed line services like telephony, internet and triple-play bundles (including TV).

- ~300k subscriber
- Ericcson as main Vendor due to group decision
- Underutilized utilization of backhaul capacity

5.3.2.3.2.3 eGovernment-Net

It has to be noted that the e-Government network doesn't fall under the current regulation in the country compared to the commercial operators *as they are not providing services to the Public*, in accordance with their mission statement: "*Our mission is to develop and implement appropriate ICT solutions that will transform the delivery of Government services*."

The Guyana eGovernment Network Project consists of an IP/MPLS network, OTN/DWDM/RTN Transmission Network, LTE Network and Enterprise Network

The IP MPLS Network is divided into four districts to which PE Routers are assigned based on their connectivity to P Routers as illustrated in Figure 45. The eGovernment IP MPLS Network consists of four P Routers (NE40E-X8) which are interconnected via a pair of 10G Optical links. IP/MPLS network implements Diff-serv model QoS. Initially, QoS will not be deployed on the Guyana eGovernment IP/MPLS Network but will be deployed in the future as the network matures and Services are defined.

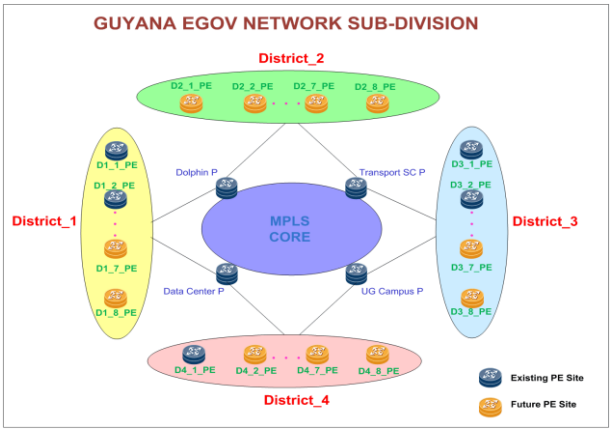


Figure 307 - Guyana eGovernment IP MPLS Network Sub-Division

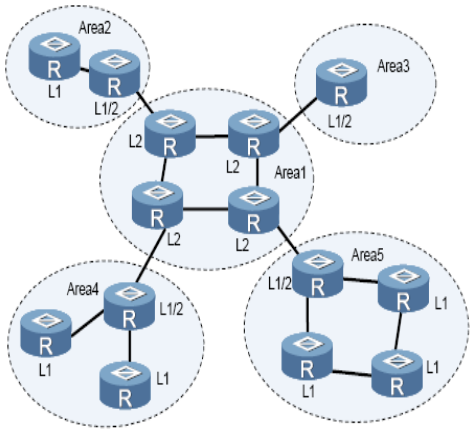


Figure 308 - Router illustration

The eGovernment's transport network consists of 54 Towers, inclusive of four core sites, a Data Center in Georgetown 48 microwave links and an outside plant (OSP) comprising of East West and South chains with in total 54 km of optical fiber. The sites themselves, are connected by microwave links, and are limited to a maximum capacity of 360 Mb/s, while the microwave backhaul is capable of delivering 150 Mb/s per LTE towers. Details on the eGovernment towers are:

- 31 towers of 36m, 16 towers of 42m, 3x 54m, 3x 60m
- Tower time to construct by Chinese standard is 28 days, actual time is 35 days. Since the project was turn-key, the costs cannot be estimated per tower.
- Solar power only in rural, but extension planned
- Urban power by GPL, generators as backup/redundancy

The capital ring currently includes a fiber optic infrastructure that spans the geographic locations that encompasses 27km of fiber. This ring provides a dedicated network for the government. eGovernment's involvement is to provide the network infrastructure in support of interconnectivity of the identified entities via fiber to the Premises (FTTP) or/and LTE to one or more of the eGovernment network nodes.

eGovernment in collaboration with GPL can make use of the dark fibers in GPL's fiber connection. The intention is to utilize GPL's spare fiber capacity to connect the LTE sites which are in close proximity to the existing GPL fiber route and assist GPL in expanding its connection to other commercial and operation centers. In utilizing GPL's spare capacity, it will form eGovernment's fiber optic backbone or primary operational network and eGovernment's microwave network in return will serve both GPL and eGovernment operational redundancy needs. This would significantly reduce the high capital investment cost for a new infrastructure; maximize the use of GPL's spare fiber optic network capacity and enhance network maintenance between the two parties.

Additionally, the eGovernment-Agency is currently assessing the possibilities to provide VSAT services in several Amerindian villages, i.e. Mahdia, Annai, Lethem, Mabaruma, Kwakwani and Masikenyari. Minimum bandwidth requirements are 1Mbps for the downlink and 512 kbps for the uplink.

A feasibility study[130] has been elaborated to assess the options to reactivate the broken fiber line leading from Georgetown via Linden to Lethem. A different and probable solution to be assessed as will is the option to replace that fiber cable with a microwave connection.

[130] Status of this study at the time of completing this report is still "under internal review" and therefore has not been shared with the project team.

5.3.2.3.2.4 i-Net satellite network

Satellite communication is a good opportunity for areas with poor access, but is also limited to low to medium data rates in general (<400kbps in DL in average).

i-Net in Guyana has

- 39 satellite HUBs, one central satellite server in network operation center NOC
- IP traffic is terminated at earth station in US
- Ku band usage, 100% coverage of Guyana
- Telephony services are offered on a reselling model
- Unlimited FreeZone from (11pm GMT+1–6am GMT+1) ⇔ 5pm to 11pm in Guyana. Data downloaded during FreeZone is not counted as part of the download allowance.
- Mass Media Content Management: Edge servers store (limited) number of frequently requested internet content
- Platform with flexible infrastructure, based on WiFi-access-routers with satellite access:
  I-Net provides the required hardware at the point of usage to provide this VoIP services: Customers can either use I-Net-services via "rentals" at GUY $25,000 per month (**US $120**), on a 3 year contract, or can purchase the devices from I-Net for GUY $260,000 (**US$ 1,120**) covering all the necessary equipment (VSat, LMB, Modem, Cables etc.). In addition, a bandwidth package needs to be selected according to usage demands.
- Up to 10Mbps in DL with 100ccm antenna dish

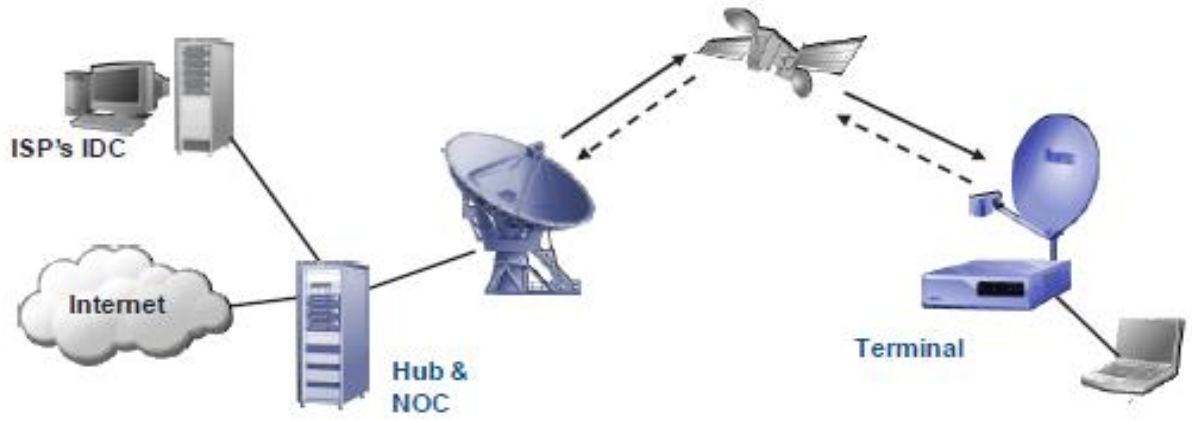


Figure 309 - i-Net satellite network schema

5.3.2.3.3 Business Model and Commercial Relations

In the future setting, eGovernment Agency shall built and deploy ICT Access infrastructure to the currently underserved communities in hinterland and remote areas. The overarching goal is to connect public buildings (Schools, Post Offices, Health Stations, Benabs, Police stations). In line with its mission the eGovernment Agency is not supposed to provide commercial services to the public (see also chapter 4.1).[131]

The eGovernment Agency will focus on the provision of e-Services and connectivity to the above listed public institutions and buildings. The eGovernment Agency shall not focus on the monetization of the connectivity by selling it directly on the retail market, but leave the market to the commercial operators. To facilitate the engagement of operators in the hinterland and remote areas, we suggest to apply a wholesale model: eGovernment Agency will connect the public buildings and provide e-Services to support education and social development. At the same time eGovernment Agency will grant access to its network to the commercial operators, ISPs, and other interested enterprises, enabling them to commercialize connectivity and sell services to the consumers. That can be realized in form of eKiosks and internet vouchers for example.

> *"Minimise costs, even if this might reduce some aspects of competition. Sharing of infrastructure such as masts and duct might reduce competitive investment but it lowers overall costs: the short term benefit may be better than the longer term gains from competitive infrastructure. This is probably most true in emerging and small economies."* [132]

This approach brings several advantages: On one hand the people in the HPR communities can also buy ICT access and services beyond the basic connectivity and according to their individual needs and willingness to pay. On the other hand some costs of eGovernment's network deployment can be covered by the wholesale revenues. The aim is to cover at least parts of the OPEX related to hinterland with this model. The cost gap remaining (if so) must be closed from the national budget. OPEX comprise:

- Power consumption, operations & maintenance of RAN (Radio Access Network) and Microwave Links
- Battery backups, fuel
- Security services to prevent fraud and violation
- Backhauling transmission costs
- OSS (operation support system) and billing costs

Furthermore opening the access network to several service providers will increase competition on the service and price level what is beneficial for the consumers.

Essential for the successful implementation of the wholesale model is the proper design of prices: The retail prices (prices commercial operators charge to the consumers) must not be too high as purchasing power in the HPR communities is low. To ensure that services are still affordable prices shall be monitored and potential regulatory measures (especially ex-post price regulation) shall be considered (see also chapter 4.3.2). Prerequisite for affordable retail prices are appropriate wholesale prices. The charges of eGovernment Agency to commercial operators / ISPs must be non-discriminatory and lower than the retail prices. They must allow the commercializing enterprises to cover their costs and to still make some profit.

As eGovernment Agency's mission is also to facilitate extensive ICT adoption and usage by citizens, basic connectivity shall be provided to the consumers:

- Free internet access via WiFi is granted to the people in the currently underserved areas by the eGovernment Agency. The volume per individual is limited to max. 100 MB overall data allowance. If 100 MB data allowance is recognized as significantly too little to carry out basic communication needs, the volume can be expanded to 200 MB per person per month. The idea is to enable access to basic information and

[131] "Our mission is to develop and deploy appropriate ICTs to support quality collaboration among Government Agencies. This whole-of-government approach is intended to facilitate extensive ICT adoption and usage by citizens, which will encourage continuous improvements and expansions of the reach of Government services across Guyana."

[132] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

communication services, but to still leave potential for the commercial enterprises to sell their services. The free access at limited volume allows basic communication and can also stimulate ICT adoption, motivating people to buy additional services from commercial enterprises if needed. [133]

- Access to content is managed and monitored by basic filter in the core network to ensure fulfillment of educational mission of Guyana's government.
- Government websites are not counted against data allowance.

The volume cap of 100 MB data allowance is based on the average traffic load generated by a blend of communication and information services. The calculation estimates usage of email with and without attachments, chats and web browsing as indication for the overall traffic load. The split between the services is exemplary and varies for different user profiles. Two exemplary compositions are displayed in the tables below presenting on one hand more private usage and on the other hand a more business oriented usage.[134]

Service	Amount (per month)	Data load
Email (no attachments)	80 mails	2 MB
Email (with attachments)	40 mails	4 MB
Web browsing	10 hours	88 MB
Chat	10 hours	6 MB
Government pages	Unlimited usage	
Total data volume		**100 MB**

Table 48 - Estimation of data traffic, mainly private usage

Service	Amount (per month)	Data load
Email (no attachments)	600 mails	9 MB
Email (with attachments)	440 mails	42 MB
Web browsing	5 hours	44 MB
Uploads of documents	5 documents	5 MB
Government pages	Unlimited usage	
Total data volume		**100 MB**

Table 49 - Estimation of data traffic, mainly professional usage

As mentioned the retail price and the affordability are essential to push the adoption of ICT services in the HPR-communities. Increasing competition is the main lever to reduce prices. In addition a more liberal regulation at the service level allows more players to take part in the market and to monetize ICT business. Retail-resellers can significantly drive the adoption of services and establish a small business:

> *"**Allow retail re-sale.** A general regulatory rule is to reduce controls and restrictions. Most retail services could be re-sold to create some end-user market options. In the case of broadband this might allow a 100 Mbit/s customer to share this with neighbors or to allow local Wi-Fi or internet shops. It is unlikely that restrictive regulation in this area will have significant benefits. By allowing resale, it enables more users access to broadband and this starts the cycle of benefits."*[135]

Applying the wholesale model to Guyana will open new business opportunities: The commercial operators can piggyback on the eGovernment's future network and wholesale offering. The local provision and reselling of internet access based on eGovernment's backhaul capacity can happen via a so called eKiosk model. The operation and management of eKiosks can be outsourced to local entrepreneurs. Community members would in this case source connectivity, hardware, services and support, and backend functions such as billing from the commercial operators and resell internet vouchers or scratch cards to the people in the community.

[133] One example of this stimulation of ICT adoption has been highlighted by eGovernment engineers: eGovernment placed a Wifi-equipped car near a gathering at the seawall in Georgetown. Feedback from users who accessed that Wifi-Hotspot via their mobile phones was, that they now experienced the first time what it means to have mobile broadband and that they would now add a mobile broadband package to their own mobile phone contract.

[134] Source: Data traffic calculator: http://www.cableone.net/Docs/datacalculator.html

[135] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

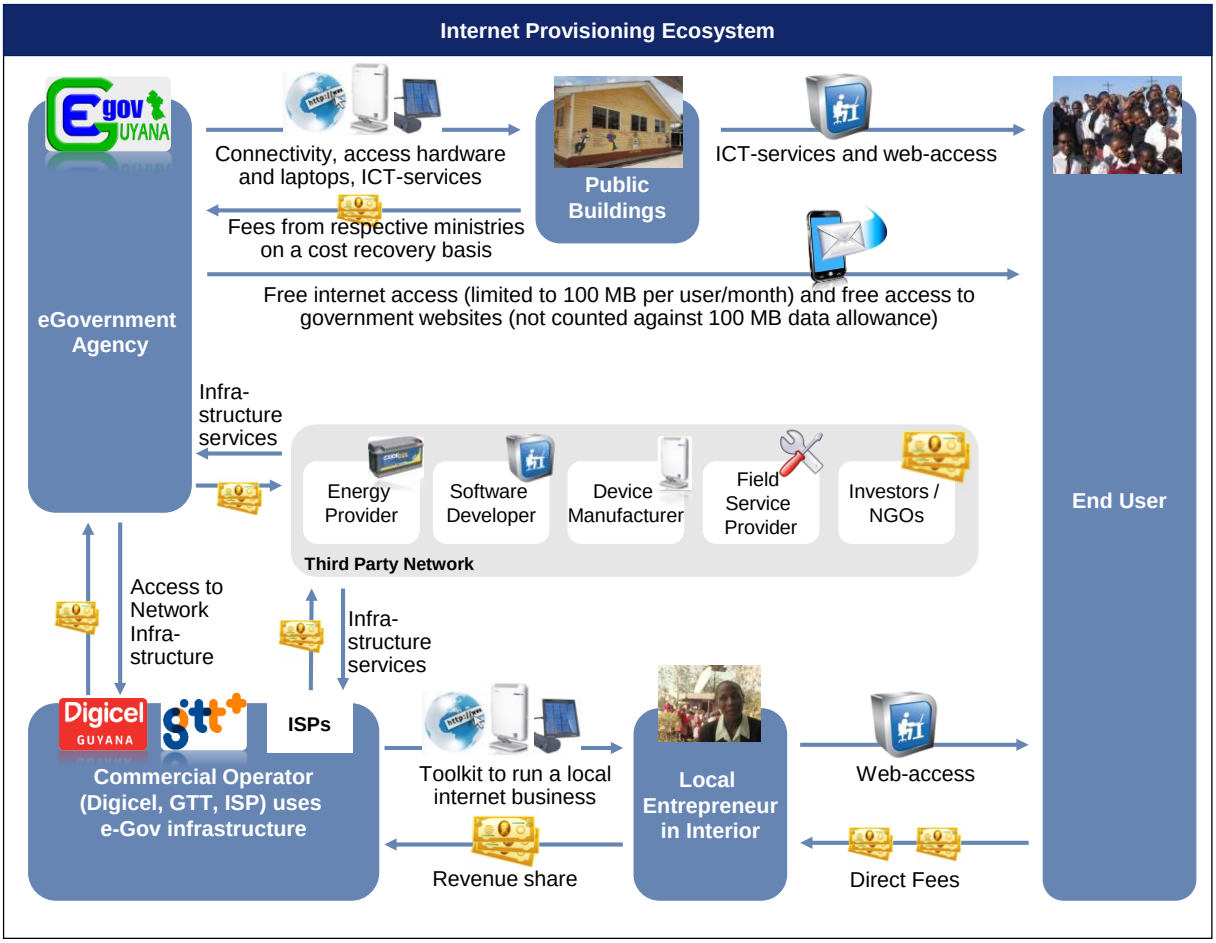


Figure 310 - Rural internet ecosystem with eKiosk model

An eKiosk can be implemented in various business models. The commercial operators can capture different parts of the value chain. For Guyana it is recommended to implement the model of the “Virtual internet Service Provider” in general. In case that the local entrepreneurs are tech savvy the “Reseller” model is also feasible.

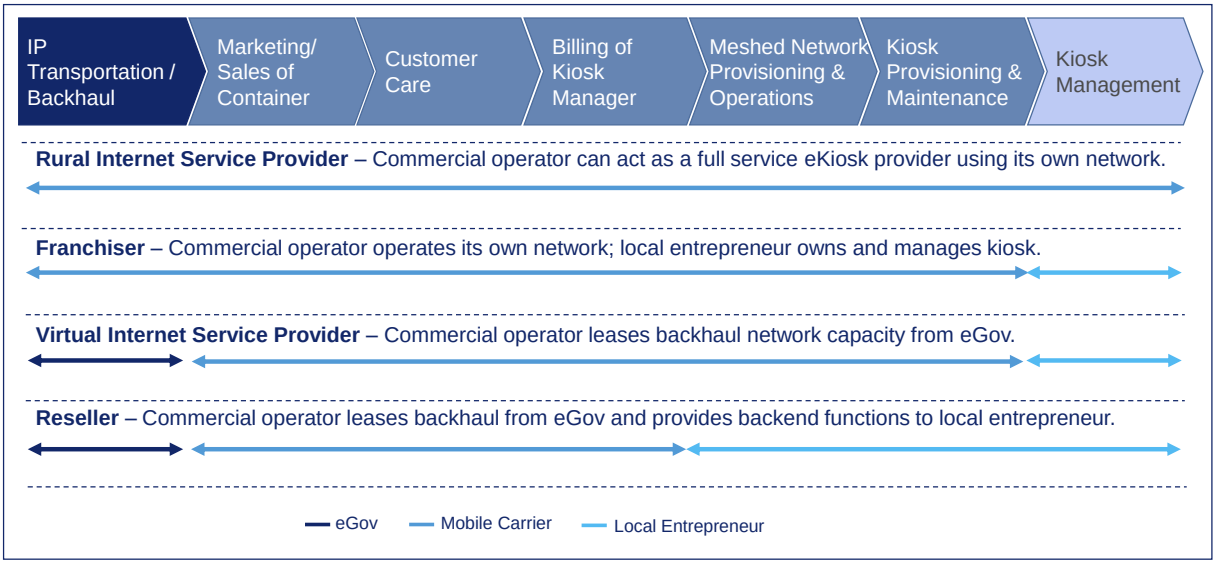


Figure 311 - The eKiosk business model in four versions

The whole business model and all relationships between the eGovernment Agency and the other players is depicted in the following illustration.

Figure 312 - The business model canvas for the eGovernment wholesale model[136]

[136] Business Model Canvas template is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported License. To view a copy of this license, visit: http://creativecommons.org/licenses/by-sa/3.0/ or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

The business model canvas is an established strategic management and entrepreneurial tool that allows to design and to describe a business model covering all aspects and giving a comprehensive picture at one glance. It is a visual chart with elements describing an organization's or product's value proposition, infrastructure, customers, and finances.[137]

5.3.2.3.4 Implementation Model

The planning, building, operation and maintenance of the ICT network requires dedicated resources and skills. The eGovernment Agency can follow different approaches to realize this endeavor:

- Built and operate the network: eGovernment Agency does the planning, building and the operation of the network on their own
- BOT (built-operate-transfer): eGovernment Agency contracts a private entity to build and operate the network for an explicit time. Afterwards operations are transferred from the subcontracting unit to eGovernment Agency.
- Buy the turnkey model: eGovernment Agency engages a vendor to build the network and to out it into operation. The operation and maintenance is done by eGovernment Agency.

The BOT approach is most suitable for the context and specifics of Guyana. By outsourcing the development and deployment of the network eGovernment can overcome potential shortages of resources but has still full control over the assets and the target achievement. Furthermore a prolonged period of transfer and training will significantly contribute to capacity building at eGovernment Agency for the future operation and maintenance of the network.

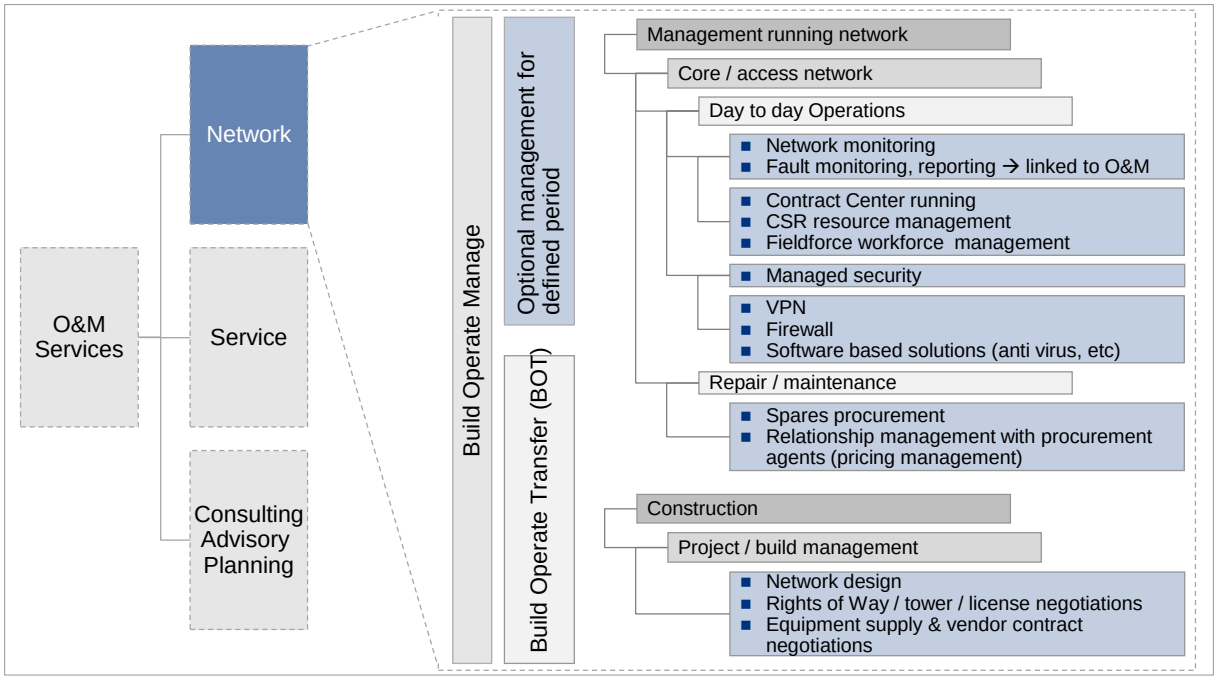


Figure 313 - Build-Operate-Transfer approach to create the future network

[137] Source: Business Model Generation, A. Osterwalder, Yves Pigneur, Alan Smith, and 470 practitioners from 45 countries, self published, 2010

5.3.3 Implication for Legislation and Policy Development

With the move to the deployment of broadband networks, the telecom regulator's fundamental roles and the aims of regulation do not change. These should be technology-agnostic. However, there are a number of broadband issues that have posed new questions for regulators. The approach must balance the needs of consumers, dominant players and competitors and yet still fulfil the overall policy aims. Regulation is easier in areas where market entry is simple and competition can flourish. In extremis, regulation can eventually be completely removed. Creating many voice competing services over multiple core broadband networks or even over one or two dominant player's core networks is relatively easy to accomplish. Once competing retail service providers are established, retail price regulation might be removed. The access to the non-competitive wholesale markets, controlled by only one or two broadband providers, will still need to be regulated. Similarly, competing ISPs can be encouraged to deliver multiple retail internet services: regulation can ensure these ISPs have the required wholesale access to the broadband infrastructure. Voice, internet and other service-level competition is ensured by: [138]

- Define and stipulate concrete targets in terms of coverage and speeds and sketch the evolution plan defining also the mid-term ambition level.
- Create an environment to facilitate invest in ICT-development and in efficient allocation of scarce resources.
- Promote competition: enable service providers to access the broadband network at the lowest possible physical levels and combine them with their own networks. Where competition fails regulatory measures shall be imposed, such as price regulations, to ensure affordability of basic services.

5.3.3.1 National Broadband Plan

To realize the business model as described above, it is necessary to establish an adequate regulatory framework that will foster the development of the market. As the current situation in Guyana is dominated by two market players (GTT+ and Digicel) and still lacks broadband penetration esp. in remote and hinterland areas and service quality, public intervention is necessary. The public intervention shall comprise both: policy making and/or funding. The commonly used instruments for this are Digital Agendas and National Broadband Plans (NBBPs):

A Digital Agenda comprises targets and measures for obtaining economic and social benefits from ICT and addresses the roll-out of networks, the creation of content and the provision of services. Broadband plans are one of the available measures to push the roll-out of networks. They stipulate specific plans for broadband roll-out, coverage goals, and available speeds. Often targets are differentiated for specific criteria:

- Different targets for fixed and for mobile broadband with mobile speeds being generally lower
- Geographical differentiation between rural and urban (rural speeds are set lower), sometimes definition of priority areas with especially high speeds

They contain in general minimally a target year for achievement, sometimes there is a more detailed roll-out schedule.

There is no commonly applied definition of broadband as technology innovation constantly boosts transmission rates. Hence newer policy documents normally stipulate higher broadband speeds than older documents: "Broadband" often starts at 144 Kbps, fast broadband is frequently defined as above 20 – 30 Mbps and Ultra-Fast broadband starts at 100 Mbps.

Hence the National Broadband Plan shall stipulate specific goals or ambition levels including a) coverage by population, households or buildings of special interest and b) specific data rates to be provided for a certain date or point in time.

Countries at different stages of ICT development tend to have different priorities and scope for their National Broadband Plans. Countries in a relatively early stage of ICT development tend to focus on infrastructure availability and measures to encourage adoption and internet take-up. On the other hand, countries in a relatively more

[138] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

advanced stage of ICT development are more likely to have a greater focus on demand-side initiatives and qualitative issues, such as security and privacy. Local contextual factors can also be highly influential in the scope of National Broadband Plans. For example, countries that have already achieved significant ICT integration in key sectors (sometimes as a result of previous National Broadband Plans) do not necessarily need to continue to focus on these sectors. In other cases, the governmental or organizational framework of a country can lead to broadband initiatives being structured as local or sector plans rather than as an overarching national plan. While, at face value, all National Broadband Plans seem to cover all levels of ICT targets (deployment, adoption and integration), in practice, the scope of the plans varies considerably, particularly in the breadth and depth of demand-side targets and implementation.

5.3.3.1.1 National Broadband Plans (Reference Cases)

Initiatives to boost broadband have been started in several countries in the last years. Some of the dedicated coverage and capacity goals as described in the respective National Broadband Plans are laid out in the tables below:

Deadline	Counties serviced (%)	Download rate (kbit/s)	Upload rate (kbit/s)
30/06/2014	30	256	128
31/12/2014	60	256	128
31/12/2015	100	256	128
31/12/2017	100	1024	256

Table 50 - 4G license requirements in Brazil [139]

Target	Penetration measure	Baseline (2013)	By 2016	By 2020	By 2030
Broadband Access in Mbps (user experience)	% of population	33.7% internet access	50% at 5 Mbps	90% at 5 Mbps 50% at 100 Mbps	100% at 10 Mbps 80% at 100 Mbps
Schools	% of schools	25% connected	50% at 10 Mbps	100% at 10 Mbps 80% at 100 Mbps	100% at 1 Gbps
Health facilities	% of health facilities	13% connected	50% at 10 Mbps	100% at 10 Mbps 80% at 10 Mbps	100% at 1 Gbps

[139] Source: ANATEL, 2012

Government facilities	% of government offices		50% at 10 Mbps	100% at 10 Mbps	100% at 10 Mbps

Table 51 - National Broadband Targets for South Africa[140]

Broadband targets for Vietnam[141]

In recent years, Vietnam has issued several breakthrough directives to promote the development of the ICT field. In that respect some have been institutionalized, including Decision No. 1755/QĐ-TTg dated September 22, 2010 of the Prime Minister "Approving the Scheme to Early Make Vietnam a Country Strong in Information and Communication Technologies." This directive sets out the country's vision and targets for becoming a leading ICT nation by 2020. It envisions several economic and social goals including:

Human resources:

- By 2015: 30% of information technology, electronic and telecommunications graduate students will be professionally qualified and have good command of foreign languages so as to be able to participate in international labor markets. The rate of internet users will reach over 50% of the population;
- By 2020: 80% of information and communication technology graduate students will be professionally qualified and have good command of foreign languages for participation in international labor markets. The total labor in the information technology industry will reach one million, including personnel working in the country and personnel as guest workers. The rate of internet users will reach over 70% of the population.

ICT industry:

- By 2015: Vietnamese enterprises will be fully capable of designing and manufacturing equipment with gradual substitution of import parts, stepping up research into the manufacture of integrated circuits, mastering the designing and production of a number of information and communication technology hardware products bearing Vietnamese brands to meet domestic consumption and export demands. Vietnam will be among 15 countries leading in the provision of software and digital content processing services. The sizes and professionalism of Vietnamese software, digital content and information technology service enterprises will be raised so that they can compete in the domestic market. To create a number of hardware, software and digital content products bearing Vietnamese brands for the domestic market, then export
- By 2020: To form strong information and communication technology research and development organizations, especially technological research and development organizations of enterprises, which will be fully capable of conducting new hi-tech product research and development. Vietnam's software industry and processing services will strongly develop, putting the country among 10 countries leading in software and digital content service provision. Vietnamese software, digital content and information technology service enterprises will dominate the domestic market and participate in export. Many products and solutions to serve the State's and enterprises' application of information technology will be researched, developed or localized from free open-source software.
- Information technology industry, especially software industry and information technology-based services, will achieve the highest growth rate among techno-economic sectors and represent a high GDP ratio.

Broadband infrastructure:

- By 2015: To basically complete the broadband network in communes and wards nationwide, connecting internet to all schools; to cover 85% of the population with broadband mobile information waves; Vietnam will be ranked among 65 countries on the ranking list of the International Telecommunications Union (ITU)

[140] Source: Department of Communications, Republic South Africa, Government Gazette, 6th December 2013

[141] Source: Tuan, Tran Minh, 2011. Broadband in Vietnam: Forging Its Own Path. Washington, D.C: infoDev / World Bank. Available at http://www.broadband-toolkit.org/
Decision No. 1755/QD-TTg of September 22, 2010:
http://www.moj.gov.vn/vbpq/en/lists/vn%20bn%20php%20lut/view_detail.aspx?itemid=10749

- By 2020: To complete the broadband network in almost all villages and hamlets; to cover 95% of the population with broadband mobile information waves; Vietnam will be ranked among 55 countries on the ranking list of the ITU (in the one-third group of leading countries).

Universalizing information

- By 2011: Almost all households will have telephone sets;
- By 2015: 20-30% of households nationwide will have computers and access broadband internet; over 90% of households will have television sets, of which 80% will be able to watch digital television by different modes;
- By 2020: Almost all households nationwide can use digital services; 50-60% of households nationwide will have computers and access broadband internet, of which 20-30% access optical cable broadband; almost all households will have television sets and be able to watch digital television by different modes.

Application of ICT

- By 2015: To provide almost all basic online public services to people and enterprises at degrees 2 and 3 (receipt of dossier forms via internet and exchange of information, sending and receipt of dossiers via internet). Eighty percent of enterprises and social organizations will apply information technology to management, administration, production and business activities. To universalize information technology application in the education and health care systems. To step up the application of information technology in the fields of defense and security;
- To initially apply information technology to the settlement of important socio-economic issues of wide impact, covering application of information technology to urban traffic management, food hygiene and safety, weather forecast, etc
- By 2020, Vietnam's e-government will rank good in the world. Vietnam will rank among the 1)3 group of leading countries in the United Nations' ranking list on e-government readiness. Almost all basic public services will be provided online to people and enterprises at degree 4 (payment of service charges, receipt of service results via internet). All national key industries, enterprises and social organizations will apply information technology to management, administration, production and business activities.

Developing the information and communication technology market

- To raise the efficiency of production and business activities of Vietnamese information communication and technology enterprises and groups such as Vietnam Post and Telecommunications Group (VNPT), the Army Telecommunications Group (Viettel), the Multi-Media Communications Corporation (VTC), the FPT Joint-Stock Company and the CMC group joint-stock company, in both service provision and industrial production. To form the Vietnam Multi-Media Communications Group (VTC)
- To support and encourage the emergence of small- and medium-sized information and communication technology enterprises and boost the formation of big information and communication technology enterprises with efficient business and high competitiveness to become strong business groups, incrementally entering regional and world markets and establishing the "Vietnam information and communication technology brand"
- By 2015: To develop information technology enterprises and groups of ASEAN level and scale, conducting business activities on the international market, including a number of enterprises each having turnover of over USD 10 billion
- By 2020: Many Vietnamese information technology enterprises and groups will conduct business activities with efficiency, reaching the world level and scale, including some enterprises each having turnover of over USD 15 billion.

In addition to these objectives the directive also establishes several broadband targets:

	Up to 2015	Up to 2020
Nationwide Broadband Network	Complete the broadband network to communes nationwide	Complete broadband network to most of the villages

Mobile Broadband Access	85% of population covered by mobile broadband signal	95% of population covered by mobile broadband signal
Fixed Broadband Access per Households & availability of devices	20 - 30% of households have computer and broadband internet access	50 - 60% of households have computer and broadband internet access, in which 25 - 30% use fiber optic cable
Schools	Connect all schools to internet	
Public services	Provide most of basic online public services to citizens and enterprises (download forms, interchange information and send/receive records through the network)	Most of basic public services are online provided to citizens and businesses at level 4 (service fee payment, receive results of service online).

Table 52 - Broadband targets for Vietnam

5.3.3.1.2 Recommendations for Guyana

"Many strategies aim for too low an access speed. Surely an aim for 10 Mbit/s access by 2018 is too low a figure for a 2013 strategy – even for an emerging economy. Demand for capacity is never-ending and so, setting a target for something that is merely "good for today," will be overtaken by events. Such a strategy locks in a lag behind other economies and ensures an emerging economy will never catch up. The additional cost of additional speed is low, so building-in future capacity into the plan ensures the strategy is future proof." [142]

The National Broadband Plan for Guyana should be developed as part of the overall regulatory strategy. There must be considered, that there is a significant difference in terms of ICT access and service quality between the densely populated coastal areas and the hinterland and remote areas. Hence the National Broadband should stipulate dedicated targets for each of these area clusters. Based on the current situation and the network solution design the following targets for the hinterland and remote areas are recommended:

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Communities >1000 people	20% covered at 6Mbps	85% covered at 6Mbps	85% covered at 6Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	50% covered at 100 Mbps 50% covered

[142] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

										at 50 Mbps
Communities with 101-1000 people	-	80% covered at 3Mbps	95% covered at 3Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	100% covered at 12Mbps	50% covered at 100 Mbps 50% covered at 50 Mbps
Communities with 11-100 people	-	70% covered at 1Mbps	70% covered at 1Mbps	70% covered at 1Mbps	100% covered at 1Mbps	30% covered at 6 Mbps 70% covered at 1 Mbps	60% covered at 6 Mbps 40% covered at 1 Mbps	100% covered at 6Mbps	50% covered at 12 Mbps 50% covered at 6 Mbps	100% covered at 12Mbps

Table 53 - Recommended broadband coverage targets for hinterland and remote areas

The recommendation is based on the following principles:

- All targets count for the status achieved by 31st of December of the respective year
- All targets present minimum requirements
- Total sample is the same as comprised in the technology solution design and the data base of 163 communities in hinterland and remote areas in scope of this assessment
- Coverage is prioritized over bandwidth: first general coverage shall be ensured, required data rates are to be increased over the time
- Coverage targets are per community not per individual. A community has full coverage if the public buildings have access to ICT service with the respective bandwidth stipulated. The public buildings comprise: secondary schools, primary schools, post offices, hospitals, health stations, health huts, benabs, police stations
- Larger communities are to be covered before smaller communities to connect as many people as fast as possible
- The roll out must be supplemented by the provision of devices to be used by the people in the communities in the respective public buildings connected. When a community is covered, adequate computer labs shall be installed and working especially in schools, hospitals / health stations / health huts and benabs. Ongoing governmental projects, such as the “One laptop per teacher” or the “ICT hubs” can be leveraged to achieve this goal.

In addition to the targets stipulated it is recommended to establish a process to review the targets annually and to adjust to a more ambitious level if necessary. This is to ensure the ambition is at level with ongoing technology and industry innovations.

5.3.3.2 Affordability

Affordability is a central issue for all stakeholder involved. The operators must afford the investment and the services must be affordable for consumers. ITU suggests various levers to address this: sharing of broadband (including resale); transfer of customer pre-paid credit; low cost end user devices; selective subsidies; careful use of universal service funds or obligations; avoiding unreasonable tax burdens; promotion of competition; and the targeting of aid and government investment, can all help with affordability especially in developing economies.

The findings from the baseline data collection (WP 1, Baseline Report) show that interviewees would be willing to pay up to GYD 10,000 per month to have access to internet at home (maximum), GYD 5,000 per month on phone calls, up to GYD 4,500 to have internet on their smartphones and up to GYD 1,200 for texting. The following figures illustrate the willingness to pay (WTP) for services by age splits and by community segments based on the data collected in the baseline analysis.

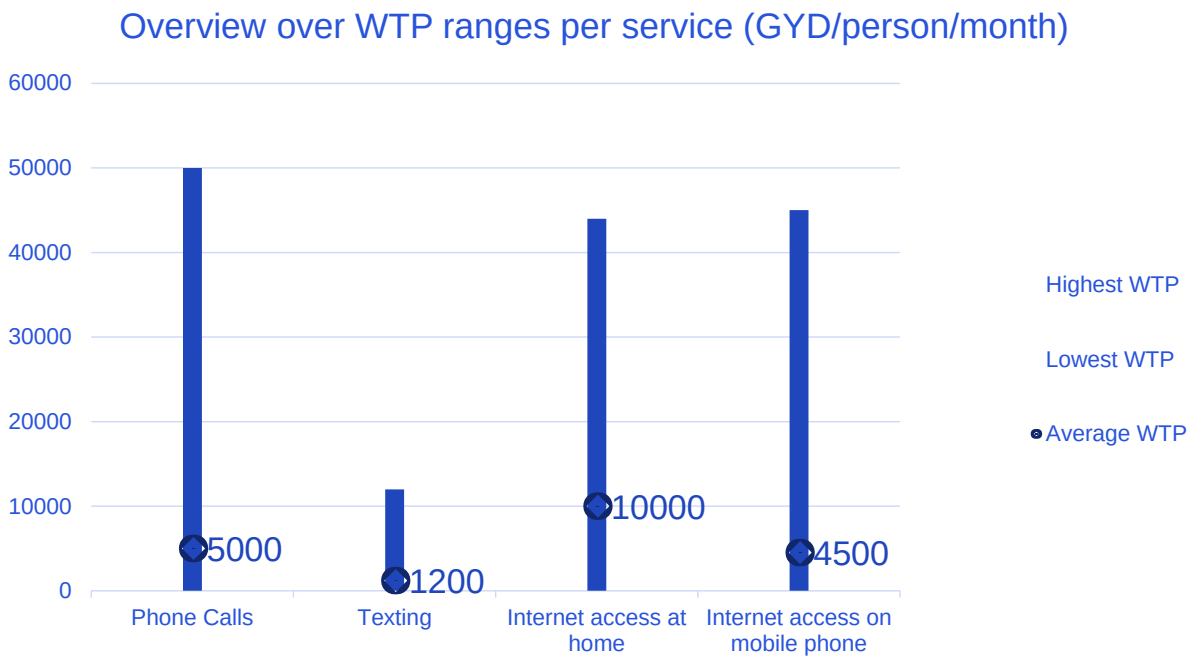


Figure 314 - Willingness to pay per month for ICT services in Guyana Dollars

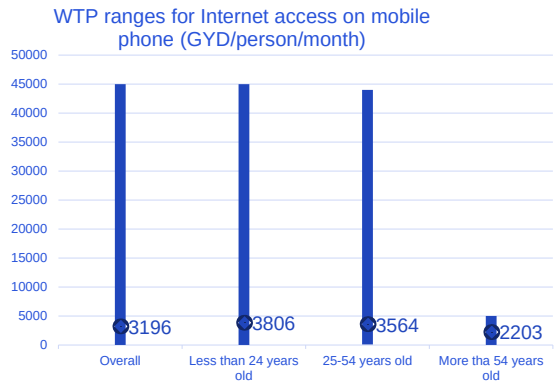


Figure 315 - WTP for internet on mobile phone by age

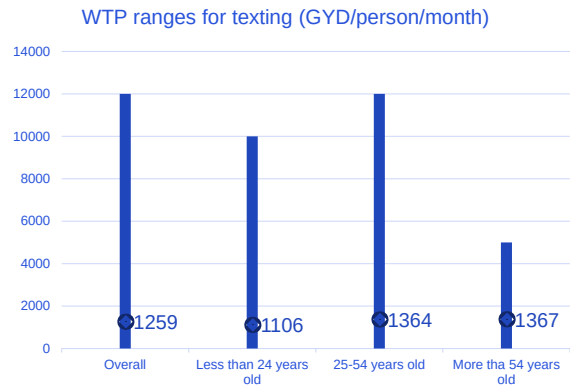


Figure 316- WTP for texting by age

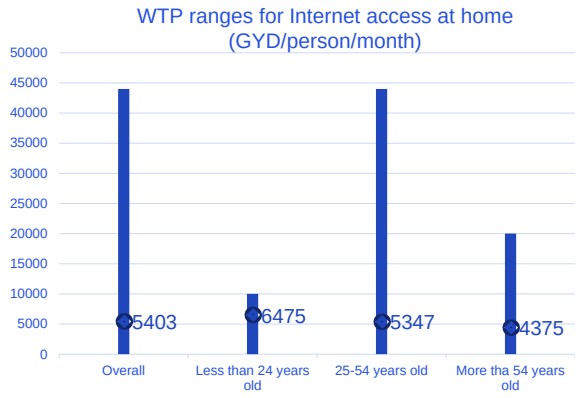


Figure 317- WTP for internet access at home by age

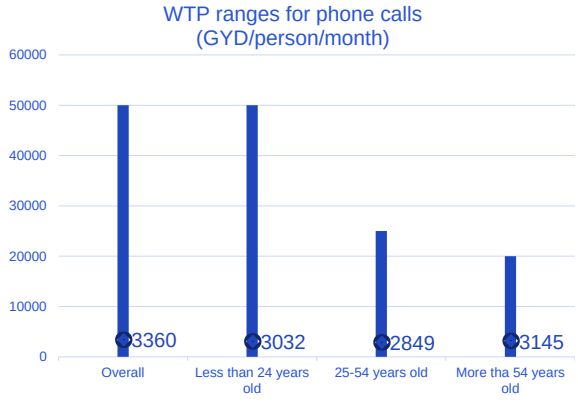


Figure 318- WTP for phone calls by age

A breakdown shows the willingness to pay for the different services – reflecting to certain extend the consumer's experiences with current offerings and its prices. Low familiarity with telecommunication goods and services may have influenced the distortion of the average values the respondents of segments poor, remote and hinterland would be willing to pay mainly in relation to services such as texting or phone calls. In the latter, the average values to be paid for phone calls are more than twice the overall average price. In some remote and hinterland areas ICT services are only available via satellite, but at higher price levels than services transmitted via mobile or fixed access technologies. This might also be a reason why the willingness to pay overall is rather high.

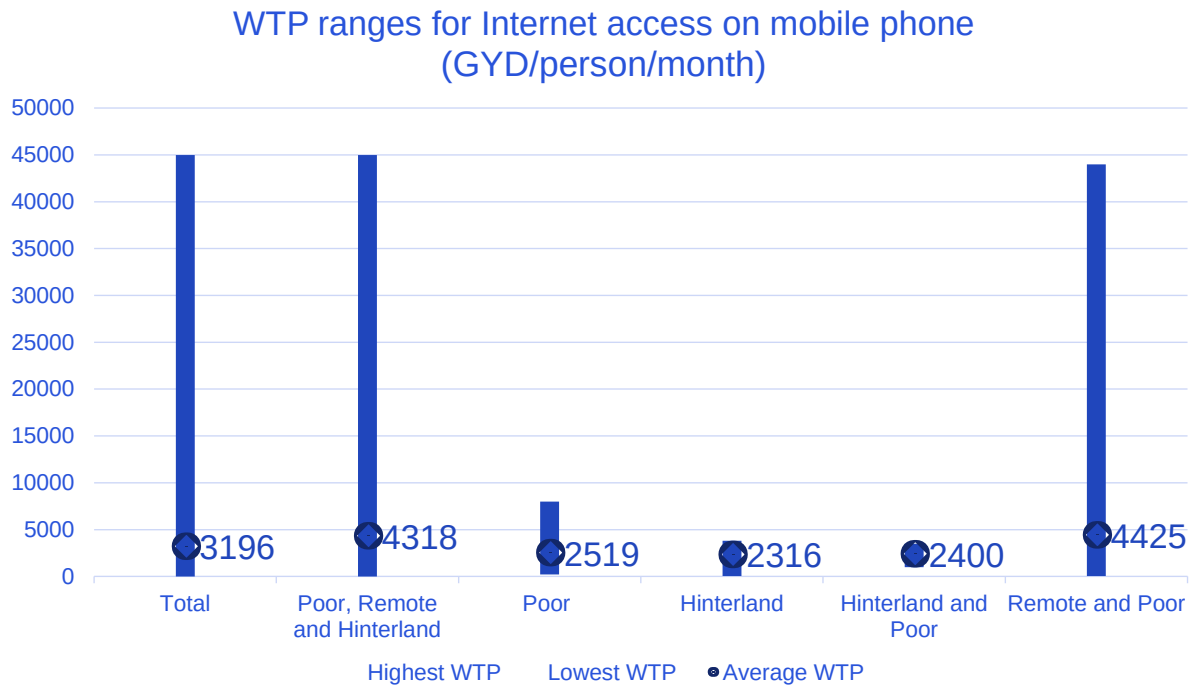


Figure 319- WTP ranges for internet access via the mobile phone

As the willingness to pay is always influenced by the market prices perceived, the willingness to pay as stated by the interviewees in the primary research is only one indicator for setting the right price point. To determine appropriate prices it is also necessary to analyze average income per capita and cost of living to cover at least basic needs in the respective regions and communities. The remaining budget can be spend for ICT services but should still leave some room for other spending, savings or invest.

In South Africa the overall vision of the policy is to give every South African access to a broadband connection at a cost of 2.5% or less of the average monthly income.[143]

Potential policy initiatives could yield a reduction in prices and tariffs. As it has been considerably researched, the development of competition is one of the major tools for affecting a reduction in telecommunications service pricing. The theoretical basis of competition is the notion that, in the telecommunications market, multiple operators can compete among each other and generate sufficient benefits for consumers in terms of price-reductions, while guaranteeing an appropriate rate of innovation.

A competitive market structure has a positive influence on the reduction of broadband prices. For example, in Latin America, the average monthly price of a basic fixed broadband price declined from US$21.06 in 2010 to US$17.46 in 2012 (a reduction of 17% in two years). The following table presents price reductions in the region across fixed and mobile broadband plans

[143] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

	Plan	2Q2010	2Q2011	2Q2012	Decline
Fixed Broadband	Basic plan with 2GB cap	$ 21.06	$ 18.71	$ 17.46	17%
	Least expensive 2.5Mbps and 6GB cap	$ 77.98	$ 53.05	$ 44.14	43%
	Least expensive 6.0Mbps and 6GB cap	$89.73	$78.48	$82.70	8%
Mobile Broadband	Least expensive PC plan with 1GB cap	$19.59	$17.60	$14.39	27%
	Least expensive smartphone plan with 250MB cap	$17.68	$12.79	$9.24	48%
	Least expensive smartphone plan with 1GB cap	$23.07	$18.71	$16.33	29%

Figure 320- Latin America: Broadband Average Monthly Subscription Prices (2010-2012) (in USD) [144]

5.3.3.2.1 Infrastructure Sharing

Infrastructure sharing describes the setting that telecommunication operators jointly use certain components of a telecommunication network. This happens when either one operator opens its network to competitors and charges a wholesale price for the usage of the respective network components or when several operators jointly build infrastructure for common usage. There are two basic categories of mobile infrastructure sharing: passive and active. The former refers to the sharing of physical space, for example by buildings, sites and towers, where networks remain separate. In active sharing, elements of the active layer of a mobile network are shared, such as antennas, entire base stations or even elements of the core network. Active sharing includes mobile roaming, which allows an operator to make use of another's network in a place where it has no coverage or infrastructure of its own.

Policy-makers and regulators must examine the role that mobile network sharing can play in increasing access to information and communication technologies. The focus is on how this could generate economic growth, improve quality of life and help to meet the objectives of the Sustainable Development Goals defined by the United Nations.

Passive infrastructure sharing should be encouraged for Guyana: As the deployment of tower infrastructure is highly cost intense especially in the hinterland and remote areas because accessibility of sites is limited, sharing of tower facilities could significantly reduce the CAPEX for the operators. From a macro-economic perspective sharing of towers especially for sparsely populated areas is rational as redundancies are reduced and the overall invest in building infrastructure is significantly lowered. The approach recommended in chapter 4.2.3.3 to build public infrastructure and to provide wholesale access to commercial operators is the first step towards a more efficient network deployment. Still for the networks of the commercial operators the decision should be taken individually by the carriers as this does strongly depend on their corporate strategy and business rationales. An obligation for the commercial operators to share towers with the competitor can rather hamper the expansion of network than support it: The tower infrastructure requires a significant part of the overall CAPEX, resulting in long return on investment terms, especially for low ARPU regions with few inhabitants. When towers are shared, the revenue potential is also shared among the commercial operators which results in prolongation of the payback period. Hence commercial operators can abandon respective roll out plans, when being obliged to share their infrastructure, because business case is not attractive anymore.

When deciding to share tower facilities, the carriers could profit from lower CAPEX and broader coverage. The sharing of towers does also provide more advantages: Wireless communication masts and antennas can be unsightly and local communities may object to the construction of new sites because of the visual impact or because of the fear of public exposure to electromagnetic fields around masts and antennas. Site sharing can limit such concerns and

[144] Dr. Raúl Katz, 2012. Includes Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic, Uruguay, and Venezuela.

potential negative effects. Another beneficial aspect of site sharing is the amount of energy that can be saved when operators share electrical power, which is often in limited supply in developing countries.[145]

The legal basis and regulatory prerequisites for infrastructure sharing are stipulated in the new Telecommunications Bill 216, Part VI section 41 et seq.

5.3.3.2.2 International Gateway

There are many advantages to local routing of internet traffic via a common exchange point, including substantial cost savings by eliminating the need to put all traffic through more expensive long-distance links to the rest of the world. In addition, local links are faster because of the reduced latency in traffic, which makes fewer hops to get to its destination.

In Guyana currently GTT+ holds the monopoly on the international gateway. As the example from Kenya (see chapter 4.2.2) shows, bringing competition to the international exchange layer can considerably reduce prices at the wholesale and retail layers of the value chain. For Guyana it is strongly recommended to remove the monopoly and to establish additional international exchange points.

5.3.3.2.3 Price regulation

Price regulation in any market is most commonly used as a tool of competition policy. This is because, in the absence of price regulation, service providers with significant market power may increase prices beyond the levels they would otherwise be if the market was competitive, or set prices that are anticompetitive leading to many problems for consumers and competitors. Examples of possible anti-competitive pricing practices include price discrimination, excessive pricing, predatory pricing, margin squeezes and price fixing. However, to add to the complexity of the issue, not all price discrimination or below-cost pricing is necessarily anti-competitive and may actually have pro-competitive effects in some circumstances.[146]

The regulation of prices can occur as ex-ante or ex-post regulation with ex-ante being the more intrusive measure:

Ex ante regulation is anticipatory intervention that uses government-specified controls to:

- prevent socially undesirable actions or outcomes in markets; or
- direct market activity towards socially desirable ends.

Ex ante regulation is mainly concerned with market structure; that is the number of firms and level of market concentration, entry conditions, and the degree of product differentiation.

Ex post regulation addresses specific allegations of anti-competitive behavior or market abuse and aims to redress proven misconduct through a range of enforcement options including fines, injunctions, or bans. Ex post regulation is mainly concerned with market conduct – the behavior of a firm with respect to both its competitors and its customers.[147]

In any case, before applying price regulation a detailed assessment of the market and potential impacts from regulation needs to be done, e.g. by following the European Commission's three criteria test of whether a market is susceptible to ex ante regulation.

For the business model described in chapter 4.2.3.3 the following points should be considered and analyzed: There are different markets that are susceptible to price regulation: The wholesale offering of access to the public infrastructure network and the retail prices for basic ICT services in the hinterland, poor and remote communities.

- For the wholesale offering the application of ex-ante regulated prices is very likely, because reliance on ex post competition laws alone is only realistic where there is effective competition. Competition is not the case for the underserved communities in hinterland and remote areas. The proper definition of the price

[145] ITU, ICT Regulation Toolkit, http://www.ictregulationtoolkit.org/2.6.6#note2
[146] ITU, Regulating Broadband Prices, 2012.
[147] ITU, ICT Regulation Toolkit, http://www.ictregulationtoolkit.org

points is essential and different methodologies can be used for this. The use of an incremental cost standard such as the long run incremental cost (LRIC) that includes an appropriate mark up for common costs can further economic efficiency. Those common costs relate to the ordering and provisioning of access to civil engineering infrastructure, operating and maintenance costs for IT systems, and operating costs associated with wholesale product management. The wholesale prices set through regulation should not be higher than the cost that would be incurred by an efficient operator, so Guyana's regulatory authority should ideally evaluate costs using a bottom up model. The European Commission for example advises regulators to 'regulate access prices to civil engineering infrastructure consistently with the methodology used for pricing access to the unbundled local copper loop', which was LRIC[148].[149]

- At the retail level regulatory intervention in general should be avoided, but is only to be applied if there is sustainable market failure and consumer prices are too high to allow broad access to ICT services. This is the case especially for the communities identified as poor. Baseline analysis showed, that the major problem in the usage of ICT services are the high prices. With regards to these communities price regulation is considered necessary to protect the interests of the consumers, but it should be of limited scope and avoid distorting the development of the market.
  An innovative way to achieve this difficult task is to apply retail price controls only to entry-level broadband services and leave all other retail prices unregulated and determined by market forces. The regulated product might be a basic broadband lower capacity service that a dominant service provider is obliged to offer at a specific price, or it could be a standardized product that all broadband service providers are obliged to offer as a minimum. This approach has the virtue of ensuring that an acceptable minimum broadband service is made available at an affordable price, thereby stimulating greater adoption. It also has the virtue of being a building block in the construction of a universal broadband service policy. At the same time it encourages competition among the higher speed services to which most consumers will upgrade after entering the market. In this way, policy objectives relating to broadband affordability and adoption can be met with minimal distortion to competition and to the development of the retail market.[150]

5.3.3.2.4 Device Affordability

Broadband access requires devices capable of accessing the internet, ranging from computers supplemented with a modem (called USB modem, dongle, or air card) to smartphones, netbooks, and tablets. Beyond service pricing, broadband economic adoption obstacles are linked to device prices. Specific policy initiatives can contribute to reducing the purchasing cost of such devices. [151]

Three types of programs have been implemented to overcome the personal computer ownership barrier:

- The first one focuses on the provision of subsidies, such as vouchers or the provision of lower priced devices for qualifying segments of the population (e.g. students)., to reduce the acquisition price of devices. The target in this case could be either households at the lower end of the socio-demographic pyramid, students all the way from primary school to university, and SMEs, especially micro-enterprises.
- The second program is typically targeted at students in primary education, with governments distributing "one Computer per Child". In this case, computers are provided free of charge to students in public schools. In 2011 the government of Guyana has tailored this approach to the local specifics and started the "One

[148] LRIC (long run incremental cost) includes all the directly assignable variable economic costs of a specific increment of service. From a public interest perspective – i.e., an efficient economic outcome where society's scarce resources are allocated to their highest-valued purpose – the price of every unit demanded should equal or exceed its marginal cost (MC). Otherwise, if price were set below MC, a customer would consume units of service whose cost to supply exceeded the value of what the consumer gave up to consume the unit of service. Such consumption would be wasteful, and the consumer would be induced to consume too much of the service.
[149] ITU, Regulating Broadband Prices, 2012.
[150] ITU, Regulating Broadband Prices, 2012.
[151] The World Bank, Broadband Strategies Handbook, 2012.

Laptop per Child" program. Today this initiative is revived, but with a slightly changed focus and runs as the "One Laptop per Teacher" Program.

- The third type of initiative entails a reduction of the access price by eliminating or decreasing taxes paid at time of purchasing. Levies affected by this measure could range from sales tax, import duties, and even sector-specific levies.

These programs are more prevalent with regards to computer distribution, although they could be extended to other broadband access devices such as smartphones.

As Guyana has already initiatives for the free distribution of devices in place, the reduction of taxes and provision of subsidies should be considered as additional levers.

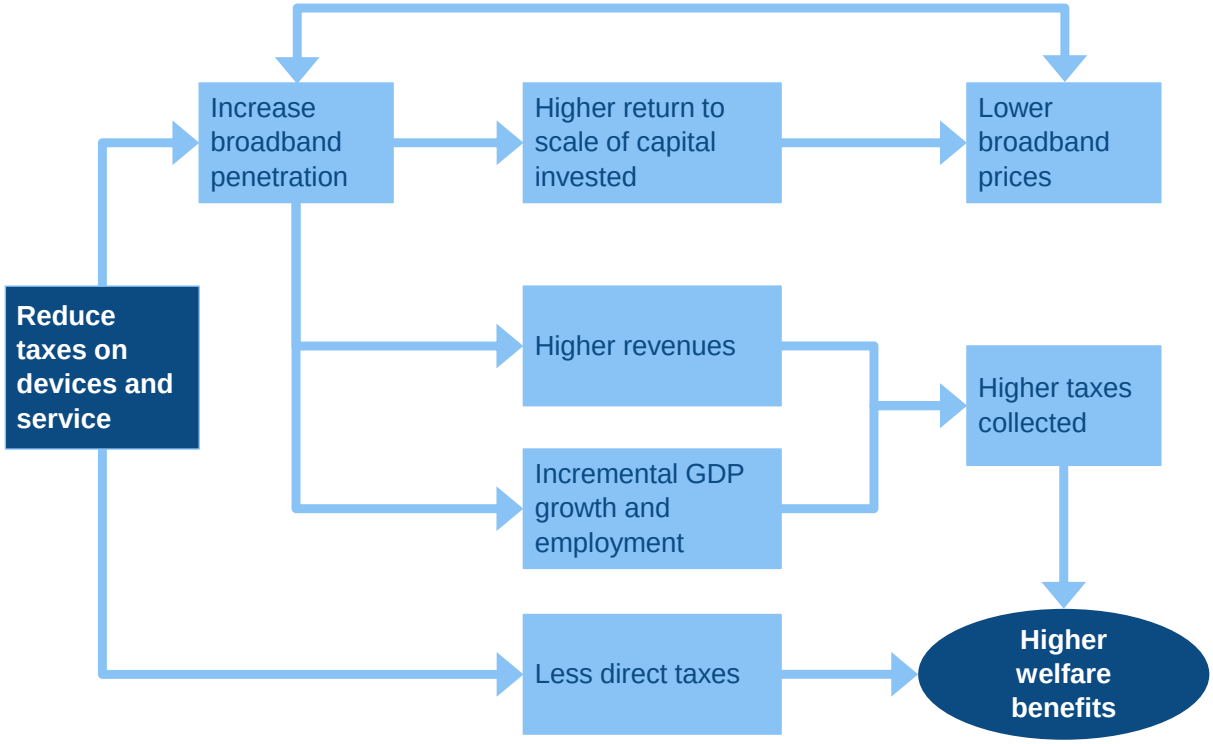


Figure 321 - Virtuous circle of tax reduction on broadband devices, equipment and services

As Figure 321 indicates a reduction of taxes on devices and service has a positive impact on broadband penetration. The increase in broadband penetration improves the number of broadband subscribers per infrastructure deployed. This increase in penetration enhances the return on the network capital invested. A higher return on capital allows the broadband service provider to lower prices, which in turn has a positive impact on penetration. At the same time, an increase in broadband penetration has direct and indirect effects. On the direct side, it means an improvement in the revenues of broadband operators and ISPs. On the indirect side, it enhances the contribution of broadband to economic growth and employment. Both effects increase the taxable base, which in turn grows the collected taxes beyond the amount foregone by reducing taxes on broadband devices and services. This effect yields higher welfare benefits.

For Guyana, this would result in an equal treatment of ICT devices facilitating broadband access including laptops, tablets, smartphones, and feature phones. For those devices, reduction in or exempt of VAT and import duties is recommended.

Some countries have reached the conclusion that while foregoing tax collections in the short run, a tax reduction strategy can result in additional adoption of devices and broadband usage, and consequently enhanced economic benefits in the long run.

Example from Pakistan: Computer Purchase Program

To promote economic growth and sustainability within its country, the government of Pakistan committed to increasing ICT and broadband access through a universal service policy. The policy, which launched in 2007 and reflects a partnership with public and private companies, stressed affordable voice and data services, increased broadband access, and the development of telecenters. Funding comes through operator revenues, access promotion charges for mobile networks, and proceeds from spectrum auctions. Amongst other projects enacted through the fund, the computer purchase program made the home computers more affordable for students, government employees, and military personnel. For instance the Allama Iqbal Open University aims to foster a 1:1 e-learning environment. In doing so, it launched a computer purchase program offering all of its 700,000 students – including its many remote distance-learning students – below-market-rate loans for Intel-based laptop computers. The program, which was created by the Higher Education Commission and Intel, works with local banks to finance the loans. In 2011, Intel partnered with Meezan, an Islamic bank in Pakistan, to launch "Laptop Ease." In its first four months alone, the program, which offers a "large-scale hire-purchase scheme for personal computers," provided 400 laptops to citizens with a 3 – 24 month repayment schedule. By 2012, the program aimed to increase this number to 250 laptops per month.[152]

The advantage of such a program supporting reduced rate loans for the purchase of ICT devices is, that emotional connection to the device purchased at own costs is higher compared to devices that are given to users without any invest required. To complete the "One Laptop per Teacher" program it is recommended to introduce subsidized loans for the purchase of ICT devices to increase broadband accessibility among the population of communities in the hinterland, poor and remote areas.

The advantage of such a program supporting reduced rate loans for the purchase of ICT devices is, that emotional connection to the device purchased at own costs is higher compared to devices that are given to users without any invest required. To complete the "One Laptop per Teacher" program it is recommended to introduce subsidized loans for the purchase of ICT devices to increase broadband accessibility among the population of communities in the hinterland, poor and remote areas. Still the distribution of subsidized devices – and may it be by low-rate loans – always carries the risk of being abused from resellers leveraging the arbitrage business. In order to ensure that people in in the hinterland, poor and remote communities can actually benefit from the subsidized devices instead of any arbitrage dealers, a control mechanism and close monitoring should be started. Access to subsidized loans and devices should be conditioned by certain requirements such as, one device per person only, proof that device is being used by the respective person by tracking of IMEI and IMSI/SIM card[153] for one year after purchase.

5.3.3.3 Monitoring

Broadband service providers often advertise broadband speeds that are higher than the bandwidths actually experienced by the user. Differences between advertised and actual speed can affect users' confidence in the quality of broadband services. This lack of confidence can be overcome through regular reporting of service quality levels.

[152] Source: Pakistan Expands Broadband Connectivity and ICT Services to Bridge the Digital Divide. Rep. N.p.: Intel World Ahead, 2008.
"Intel Offers Laptop Loans in Pakistan." Reuters, 19 Oct. 2011. http://www.reuters.com/article/2011/10/19/intel-sharia-pakistan-idUSL3E7LJ14920111019

[153] Or the MAC Address in the case of a laptop to be used as an identifier.

The most common method of reporting is collection of data from the network operators. This buries the risk that data are glossed over and do not reflect the performance as perceived by actual user's. To overcome this dilemma Bahrain and Brazil took different approaches:

Bahrain: Create transparency about broadband performance

The Telecommunications Regulatory Authority of Bahrain publishes quarterly results of its broadband quality of service monitoring (Bahrain, Telecommunications Regulatory Authority 2011). It carries out a predefined set of tests around the clock. The results are stored in a centralized database. Actual versus advertised speeds for different ISPs are tested based on access to local and international websites. The measurements supplement information already available to consumers with respect to prices and advertised speeds.

Brazil: Monitor broadband speed via crowd sourcing

Brazi's National Telecommunications Authority is also striving to monitor and benchmark the quality of available broadband services. In mid-2011 Anatel proposed the establishment of a broadband speed test service which was made available to subscribers directly via the web site NIC.br[154]. However Sinditelebrasil, the national lobby group of telecom operators and service providers, has objected to using this as a benchmark because it believes that the variable capacity of the end-user access devices will distort the test and make it unreliable in providing an accurate assessment of broadband quality. Sindibrasil has made an alternative proposal that the ISPs should provide speed measurements directly.[155]

To establish a regular and sustainable monitoring for Guyana it is recommended to apply a two sided approach: The base data shall be collected from the operators and ISPs on a regular base (e.g. quarterly). In addition information from users about real network performance at the point of usage shall be recorded and measured against the data base from the commercial operators.

5.3.3.4 Laws affected

The sustainable development of the telecommunication sector requires a forward-looking legal framework. The most important issues to be addressed are listed in the following table:

Measure	Reasoning	Law affected
Facilitate sharing of infrastructure	The deployment of access network and backbone is very cost intense and payback can be low especially in sparsely populated remotes areas. This might result in a negative business case preventing operators from expanding the network to such areas. The sharing or joint building of infrastructure reduces the overall CAPEX and allows more competition in the service layer.	Telecommunications Bill (addressed in Part VI section 41 et seq. of Telecommunications Bill 2016)
Coordinate access to rights of way	Obtaining the rights-of-way necessary to deploy broadband infrastructure can be a complex process, adding to costs and delaying deployment. Canada's Telecommunications Act includes provisions to facilitate operators' access to public property.[156]	Telecommunication Bill

[154] The Brazilian Network Information Center (NIC) is a non-profit civil entity that implements, since December 2005, the decisions and projects designed by the Brazilian internet Steering Committee.
[155] Mike Jensen, 2011. Broadband in Brazil: A multipronged public sector approach to digital inclusion. Washington, D.C: infoDev / World Bank. Available at http://www.broadband-toolkit.org.
[156] "ICT Regulation Toolkit: Practice Note, Sharing Rights-of-Way," http://www.ictregulationtoolkit.org/en/PracticeNote.aspx?id=3245

Establish internet exchanges	There are many advantages to local routing of internet traffic via a common exchange point, including substantial cost savings by eliminating the need to put all traffic through more expensive long-distance links to the rest of the world. The presence of several (more than one) international exchange points promotes competition and will lead to price decrease especially for data services and long distance voice services.	Telecommunication Bill
Impose price regulation to encourage affordability	Affordability of services is essential to obtain broad adoption of broadband ICT services. Creating a level playing field and promoting competition is the preferred approach. When competition is deficient price regulation can be imposed, preferably in wholesale markets, leaving price regulation in retail markets as second choice.	Telecommunications Bill (addressed in Part V section 38 et seq. and section 41 of Telecommunications Bill 2016)
Leverage tax reductions to promote device adoption	The purchasing prices of devices can present a barrier to the adoption of ICT services. Reductions of VAT and/or import duties for all kind of ICT-access devices (computer, laptops, tablets, smartphones, web-enabled radio phones) can help to overcome this barrier.	Tax act
Support secure e-transactions	Online transactions are an important part of the broadband environment. Transactions must be secure and legal to encourage the development of two-way interactive e-commerce, e-government, and telemedicine applications. This means that legal systems need to recognize electronic signatures and transactions. Information security such as encryption technologies and antihacking software, are also critical for a stable and safe broadband atmosphere.	Ecommerce legal framework
Implement reasonable intellectual property protections	One enabler of content and media development is the creation of an intellectual property rights regime that protects creators' interests while enabling others to use and improve those creations. Such rights need to balance the interests of creators with the larger goals of enabling knowledge sharing, fair use, and adaptation. This is particularly relevant for the development of e-learning and distance education applications.	Intellectual property rights
Address content and security concerns	Many users are leery of broadband internet access because of objectionable content and security concerns. These concerns can be alleviated through programs that educate users about perceived risks, child online protection, and how to use the internet safely. The regulator in Qatar has created a site for children, teenagers, teachers, and parents providing tips for safe online surfing.[157]	Youth protection

Table 54 - Assessment of the impact of legislation

[157] See ictQATAR's, "Stay Safe Online," http://www.safespace.qa/csk/en/home.aspx.

5.4 Implementation Plan

5.4.1 Overview

The previous chapters outlined the high-level technology architecture proposed for hinterland and remote regions as well as a feasible business model to finance, build, operate, and manage the infrastructure in a sustainable way. The next step in the overall rollout needs to be the detailed plan for infrastructure implementation. This plan is being created in the next phase of the e-Government and UNDP program. The following section serves as a guideline for the activities that need to be performed during the in-depth planning phase.

The final goal of the implementation phase is providing the first set of hinterland and remote communities with internet access. Therefore, the implementation partner needs to be chosen and in parallel the target business model needs to be defined and agreed with all stakeholders. Regulatory frameworks need to be adapted or introduced potentially for both, implementing as well as wholesaling the technology infrastructure for hinterland and remote communities.

5.4.2 Next Steps towards a detailed Implementation Plan and Technology RfP

The detailed implementation plan needs to focus on three dimensions:

IV. Technology – all aspects of the technical infrastructure solution
V. Business Model – operations, processes, governance, financing, partnerships
VI. Regulation – needed adjustments to the legal framework to enable business model

In each of these dimensions there are a number of activities which need to be planned. The following checklists will guide the planning phase.

Technology

- ❑ Validate list of villages in hinterland and remote areas to be connected: exact naming convention, delineation of village boundaries, exact location (lat/lon), exact population number (if possible by age group), exact number of public buildings (schools, health care facilities, town hall, benab, community center, post office, ferry terminal, police station, …)
- ❑ Revise the high-level rollout plan as proposed in chapter 5.2.4.2.: detail prioritization criteria (e.g., village social needs, cost optimization, special needs, economic impact on particular village, rollout synergies, etc.) and select a subset of villages for rollout in the subsequent years.
- ❑ Define which of the public buildings should be connected in which order and with which data speeds: align with stakeholders as referred to in Sec.4.1.
- ❑ Validate the estimation of needed throughput capacity and volume for each selected village based on requirements of the planned e-Services, adjust if necessary: alignment with e-Service providers is needed to create buy-in and to come up with a realistic estimate
- ❑ Perform a site survey of the selected villages: map location of public buildings, map and list of power supply locations and alternative solutions, investigate right of way challenges, assess climate, surrounding terrain and natural obstacles, refine the needed e-Services based on interviews with local residents and institutions, inform residents about plan
- ❑ Create the detailed technology design for backhaul and access networks for each village: based on the available technology options as per Sec.3.2, a subset needs to be selected per village and dimensioned as per the individual site survey.
- ❑ Create the Request for Proposal (RfP) for the planning and building of the network: describe the context of the infrastructure rollout project (general conditions), the currently installed e-Government infrastructure in coastal regions, available resources, detailed target architecture for villages, incl. Bill of Quantities BoQ (technical conditions), any SLA requirements, pricing input form (commercial conditions), etc. A Request for Information (RfI) or Request for Quotation (RfQ) could proceed the RfP phase to receive more information during the architecture design phase.

- ❑ Create tender strategy and launch tender phase: choose best tender format (limited, one, two stage bidding), set pre-qualification criteria, select an appropriate channel to float the tender, set the tender guidelines, solicit responses from all appropriate vendors. This step has to be performed by an external and independent partner with in-depth knowledge of tendering approaches in general, incl. financial expertise as well as broad knowledge of the different vendors/suppliers.
- ❑ Manage vendor inquiries: hold Q&A sessions, manage information flow from and to vendor, create answer sheets
- ❑ Evaluate tender and select shortlisted vendors: define tender evaluation criteria, benchmark the received proposals, SWOT analysis, weighting scenarios, balance score board, ranking. Sample evaluation criteria:
    - **Technical**: specifications, performance and extendibility, features, applications and functionality, system operability, training & system documentation, implementation management and schedule, experience and references
    - **Commercial**: general conditions, total price (incl. equipment, spare parts, prices for training and other services, installation costs, shipment costs), offered discounts, projected O&M costs, warranty, payment schedule, price benchmarks, equipment availability and delivery schedule
- ❑ Enter vendor negotiations and select final vendor: based on selected tender strategy there are a few rounds of negotiations necessary.
- ❑ Plan the rollout project and execute rollout: there are three main phases which need to be executed:
    - **Rollout preparation**: check project schedule and rollout plan, verify project contract conditions, check vendor procedures, processes and resources, set reporting and controlling guidelines
    - **Technical review**: review alignment of planned to contracted for architecture design, network topology, integration strategy, BoQ estimation, dimensioning assumptions& planning methodology, service plan
    - **Rollout supervision**: inspect, report and control the project implementation w.r.t. progress and performance, QoS, monitor risks, follow up with change requests, monitor SLAs, run smooth integration, update project plans and documentation

Business Model

- ❑ Decide on the final implementation model: review the proposed BOT model and compare with alternative rollout and operations models, e.g. built and operated by e-Government Unit, turnkey model by vendor, etc.
- ❑ Align all stakeholders required for implementation model: create project structure and set up communication plan towards stakeholders, see also technical project setup and alignment
- ❑ Clarify governance with implementation partner (systems integrator): ownership and financing options need to be discussed, funds need to be secured in governmental budget
- ❑ Align all new processes with existing process framework at e-Government unit: any new process needed for maintenance of the infrastructure and end user equipment needs to be compliant with the existing process framework.
- ❑ Define training needs and execute training: existing staff needs to be able to effectively support the network and end user devices. The systems integrator should provide training to familiarize e-Government staff with the new equipment, monitoring and servicing.
- ❑ Create staff job descriptions to prepare for takeover of operations: work with the systems integrator to understand the needed skills and quantities of staff for effective infrastructure operations

Regulation

- ❑ Develop the regulatory strategy and roadmap: Define the overall vision, mission and targets for Guyana w.r.t. ICT and derive policies to support these targets.

  "Define a policy and define a plan. This should be debated and all parties should participate. Over time the policy and resulting approaches specified in the broadband plan may need to be

adapted, but countries that are leading with broadband do have some direction and policy. No policy is likely to result in no change or else monopoly provision of services in only a few areas."[158]

- Define the Digital Agenda and National Broadband Plan for Guyana! Validate and detail the coverage targets recommended in chapter 5.3.3.1.2. Develop and introduce a regular process to revise these targets on an annual base.

  "Ensure the national policy covers all of ICT. Next Generation Networks (NGN) and broadband may be the key investment area and are where the main telecoms issues reside, but all other aspects should be linked in to obtain the wider social benefits of a broadband economy." [159]

- Define price floors & price ceilings for wholesale & retail prices: Define relevant retail and wholesale markets and identify need for regulatory intervention especially with regards to affordability of services. Define price floors for wholesale costs in markets susceptible to regulation based on cost assessments and incremental costs e.g.LRIC (long run incremental cost)

6. e-Service Readiness Assessment and Roadmap (WP3)

6.1 Introduction

This report comprises the findings from the work stream 3 of the project "ICT Access and e-Services for hinterland, Poor and Remote Communities in Guyana". This work stream aims to describe the current situation in regards to existing e-Services provided by the different stakeholders as well as describing potential e-Services suitable for the context of Guyana, based on the feedback provided by the stakeholders. Additionally these e-Services are put on a roadmap for the next five years, also identifying needed "enabling services" that e-Government Agency must have in place to be in the position to deploy additional e-Services to the stakeholders. Cost estimation for the services are given The chapter ends with recommendation towards capacity building and selected reorganization activities for the e-Government agency, putting that agency in the position to drive the deployment of the described and potentially other e-services in the near future.

The results from this chapter might update findings from the previous chapters.

6.2 Situation Analysis of hinterland, poor and remote Communities

The economic situation of a community has a major impact of the adoption and usage of ICT Infrastructure and services. In the baseline data collection, many respondents mentioned unemployment as a major problem in their communities. Not having access to a steady income is also a concern commonly mentioned in the interviews.

In most of the communities visited, the general economic situation is considered to have worsened during the last years. Only two respondents considered local economic conditions to have improved or to be the same as in the past.

[158] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013
[159] Source: Strategies for the deployment of NGN in a broadband environment, ITU 2013

The main perceived causes for this situation are a general lack of training and education and the overdependence of local economy on extractive activities such as mining and logging.

Respondents believe that improved education could help mostly young people to be more prepared to engage in different activities. Besides that, a few of them believe that better telecommunication infrastructure could boost the local economy, bringing more buyers to local products and allowing tourism to flourish.

The general interest and demand for better products and telecommunication services increase, as in some regions people have started to use smartphones for multiple functions, such as: chat, purchasing products, downloading videos, online courses and social media.

Access to internet is much desired: According to 27% of the respondents, internet inclusion would help to develop their region and to improve education.

Taking into account the findings from the survey, there are several barriers to be overcome in order to improve ICT access for Hinterland, Remote and Poor regions:

Dealing with some infrastructural barriers:

- poor electricity access
- poor internet access/ data service
- poor access to devices in the communities (phone/computer stores)

Dealing with consumers' barriers:

- Lack of knowledge of usage of the devices
- Unawareness of all functions of the devices
- Low emotional connection to the devices
- Prices not affordable/inappropriate to economical profiles of respondents
- Lack of feeling of unitedness, even though respondents feel Guyanese – requires different communication approach

6.2.1 Important Service Needs – A Wish List from Citizens and Institutions in the Interior

The baseline data collection showed, that respondents to the questionnaire do not acknowledge many other means of communication besides those directly mentioned during the interview (landline phones, cellphones, Smartphones, computers, tablets and laptops). An interviewee from an isolated community spoke about the HF Radio, since the one in her community was broken, leaving her without any means of communication.

However, most of the interviewees are willing to get better and are expecting less expensive services. Also in locations where communication networks are comparatively underdeveloped, people want to have access mainly to the internet.

Respondents have approached government agencies like Ministry of Indigenous Affairs and Local Government to request internet or simply any help to improve access to communication media in the communities. Among those respondents, the **majority requested bringing internet access to schools**. **Access to youth research centers and the provisioning of digital information in schools is a strong demand** among residents of the communities visited. Some have not had success yet with their requests, but believe that the current government may drive the process of improving access, despite the recognized lack of funds for investments in this sector and despite the short time of the current government being in power to implement such demands.

The private companies that have been contacted by citizens to improve their services or install antennas in the regions did not meet the requests of the applicants as indicated by the interviewees.

> "*We always get promises, like the internet being provided, internet for schools, but that never so far materialized. I used to be a teacher at school and GT&T came and said that they would assist us with free*

internet, but it was 7 years ago and up today nothing happened." (Region 9, *Essequibo-Demerara, Aishalton, Female)*

The interviewees have a genuine wish not only for better telecommunication services, but also for also general interests in new and/or improved internet based services. Once more concrete ideas for use the of e-Services are explained to them, they believe that e-services, such as e-commerce, e-learning, e-banking, and eGovernment not only can be more convenient, but also help people to significantly improve their living standards.

Interviews with public institutions showed, that the major demand to use e-Services for basic reporting, such as digital submission of documents to the respective headquarter in Georgetown, the general exchange of information, and the replacement of paper based communication.

6.2.1.1 e-Learning

According to the communities' leaders, more than **75% of those who have started school in the visited communities, did not complete it**, but dropped out. **Financial difficulties is** the reason most frequently mentioned by the respondents: **Pupils often have to go to a nearby community** in order to complete their studies. This is financially not affordable for them. Another reason mentioned is the necessity to give up school in order to work or help their families.

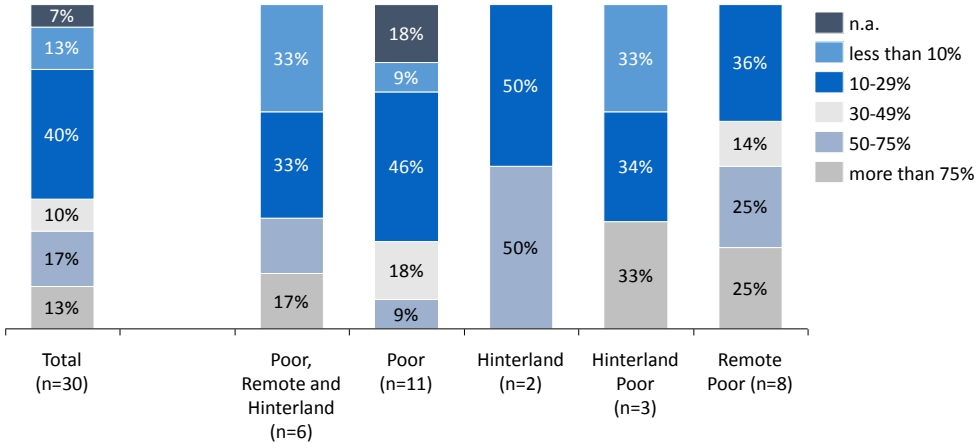


Figure 322 - Percentage of school dropouts per community segments (in %)

The availability of e-learning services, such as online classes or virtual classrooms would contribute to improve this situation.

In all analyzed communities, cellular phones are stated as the most commonly used mean of communication. With the exception of communities with nonexistent communication services (besides the HF radio), most interviewees define cellphones and Smartphones as prevalent not only in their own communication-related activities, but also in their communities in general. In places where internet services and landlines are not present, education workers even use their own personal cellular phones to do tasks related to their job.

On the other side computers, laptops and tablets are not as common as they should be among education professionals – especially considering the specific needs of these professionals. While most teachers, head teachers, and education workers stated their wish for more access to communication and information technology, a similar amount complained about existing conditions. Lack of training, bad or non-existing internet and Wi-Fi services, as well as delayed delivery of promised equipment were the most frequently mentioned problems.

Nevertheless, in a more positive note, professionals also mentioned current plans to bring technology access and develop computer literacy in their schools. They also recognized the potential of improved connectivity to improve access to information and services - helping both, students and teachers to complete a greater number of tasks, to acquire greater qualification, and to connect with the world.

> *"Based on my, job, I'm not at home most of the time so to communicate with others I would use a cellphone. For the landline, (…) I would use it like four times a day, but the cellphone it is like eight times. [Interviewer:] And you have a cell, do you generally use it when you are working, you need to talk to your family or talking to the students' parents? [Interviewee:] Students' parents, other colleagues even the ministry of education if I need to clarify something, to call the ministry of education office." [Region 5, Rosignol, female]*

Education professionals interviewed during the baseline data collection tend to recognize the benefits of using computers, tablets, and laptops. They **frequently mentioned some activities in which they could use these devices, e.g. to complete complex tasks or to add new training features to their classes**. Nevertheless, many of them do not have proper access to devices and network connectivity to the extent what they consider necessary.

The interviewed students also see the lack of devices other than the Smartphones as a problem. Teachers acknowledge that young people need to be in contact with new technologies in order to stay in the same pace as people with access to better telecommunication infrastructure. However, the teachers themselves do not feel comfortable when using some devices. Therefore, in order to implement programs to improve computer literacy in school, teachers would probably need to obtain extra qualifications.

E-learning is welcomed as a viable option especially in the field of higher education and seen as a technology that could permit professionals and students to acquire additional qualifications more easily.

Quotes from baseline report:

"Now imagine the possibility to get a degree from anywhere for yourself online. How do you feel about this?"

> *"I'd go for it. I'm learning about it from you, this is the first time I hear about it. I'd prefer to do that. If I have the opportunity to go to the university, I don't want to leave my family, which is the reason why I can't go to the university. So you are telling me, you are teaching me about the online classes or whatever you call it and I'd prefer that." [Region 8, Nappi, Female]*
>
> *"Well, I feel more comfortable. That's a different moment. I have really no knowledge about these things (…)." [Region 7, Kako, female]*
>
> *"I would like that, because actually not only my children, but for the community and the other young people, it would be really nice if they could get a degree from the internet. For at least, you know, you see the young people in the community develop instead of going down, they go up." [Region 4, Laluni, Female]*

Studying abroad nowadays requires leaving the country, their families, friends and job. E-learning services are seen as a much way to bypass the challenge of physical relocation. Their only concern again is related to the price of the needed internet connection.

Interviews with public institutions showed, a specific demand for the following services:

- E-Learning for all ages incl. adults, but also for the teachers
- Management/reporting of facilities
- Management of resources
- Access to databases/research
- Connect to abroad/distant learning
- Learning in indigenous languages

6.2.1.2 E-Health

Contagious diseases affect more the population of the "Hinterland and Poor", as per information from the baseline data collection as well as from the information gathered at the Ministry of Health (2012-2015). The same data from the Ministry of Health indicates that poor communities have a high number of diseases caused by bacteria due to hygiene issues. 25% of the representatives confirmed this information in the baseline data collection interviews. The Hinterland area, presumably because of the better-developed infrastructure, suffers less from hygiene issues but rather from problems related to violence and drug abuse. Cases of reported violence usually occur in the family scope at events such as sexual molestation of children and domestic violence.

Major health issues Guyana is facing are high rates of maternal mortality, infant mortality and non-communicable diseases such as diabetes and cardio vascular diseases.

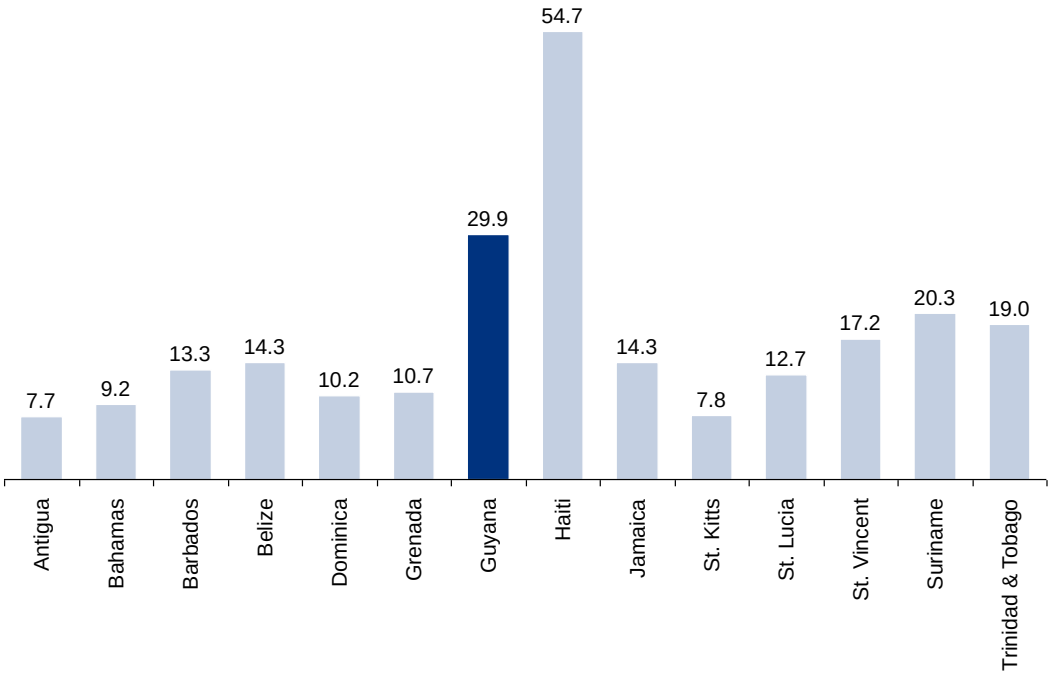


Figure 323 - Infant mortality rates per 1,000 live births in 2014[160]

[160] UNDP, Caribbean Human Development Report, 2016

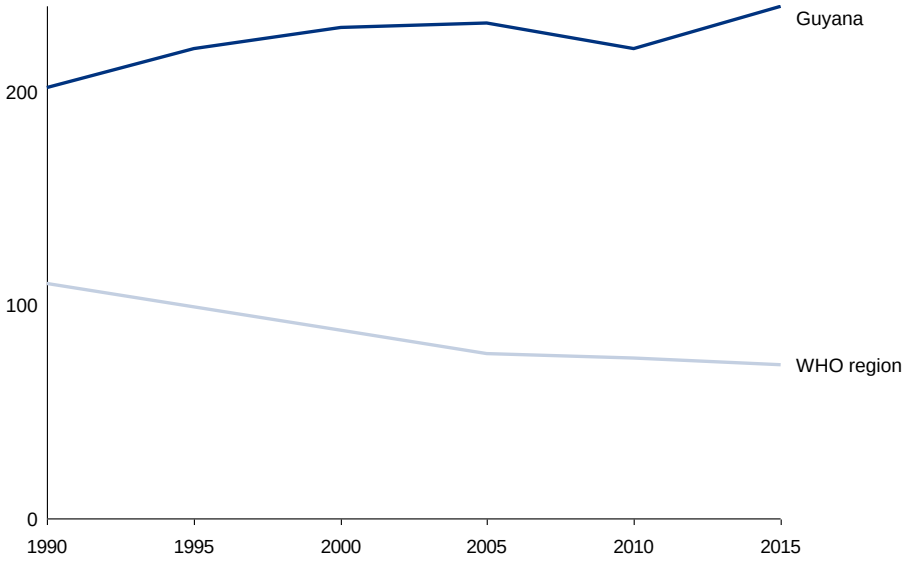


Figure 324 - Maternal mortality rates per 100,000 live births[161]

Simple e-Services are already being used by the Ministry of Public Health to increase awareness for and knowledge about chronic non-communicable diseases, such as text messages being sent as push-service to cellular phones via the commercial operators' networks.

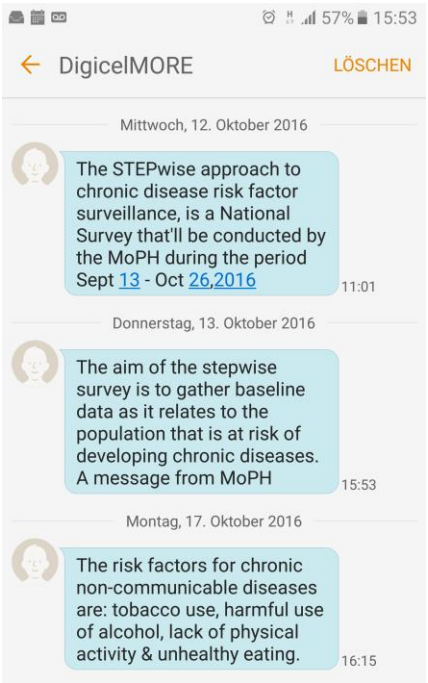


Figure 325 - Text messages from MoPH to educate about non-communicable diseases

Communicating over longer distances for person working in the health sector is part of their job and it occurs very frequently. Most of experts interviewed for the baseline data collection say that they do it on a daily bases, especially the ones working at emergency service facilities. For example, they have to contact someone from other health

[161] Country statistics and global health estimates by WHO and UN partner, Guyana: WHO statistical profile, 2015

centers to transfer patients. The trigger for using different means of telecommunication is mostly work, i.e. caretaking of the patients in order to provide them medical assistance and support they need.

The problem the interviewees are facing in regards to communication is that the patient is often located far from a medical center and/or he needs help during a period of the day when it is impossible to physically reach out to him. Examples are people who live in the villages along the rivers where it is not possible to take a boat in the middle of the night to reach them. During those times, the doctor has to make a decision quickly if it is needed to rescue the patient by plane or if it is sufficient to give instructions via phone / video conference in order to handle the situation successfully.

Another situation would be, that they would need help to examine a patient carefully. Today they have to call someone using their cellphones, or ask someone in person or look at wikipedia/ medicine communities. Privacy concerns were also raised: One person mentioned that having a private conversation through e-mail would be better than using the personal Whatspapp or Facebook account, especially if talking about health issues, like in occasions when talking about diseases like HIV.

> *Quotes from baseline report:*
>
> *"Of course it would help me. "Have you ever lived a situation in which you wanted some help?" Yes, I had a patient with an abscess behind his knee and I wanted someone else to participate, to see it, but everybody was busy, so I had to go to the internet, to research it. This idea would be excellent and better for me, far better for me, because I'm in a remote area and it is the last village in. So imagine something happens, for example, in the middle of the night, look how remote I am. This is closed, that is closed, but I'm the only doctor in the area, so you can imagine that everybody would come to you and the nearest hospital is or in New Amsterdam or in a half hour way. That would be excellent, you know, if I can have, for example, this. If I had a program, where I can speak to someone to give me advices, of course that would be useful. They can instruct me, tell me what to do in some certain situations that would be good, because I'm in a remote area. (Region 5, Mahaica-Berbice, East Indian, Rosignol, Physician, Female)*
>
> *"I'd say* it *is having internet here. Because the pre-condition is to have internet. As I said before it would be much easier to get in contact if there is an emergency or if you need medical advice, you skype the person. It is much easier to talk to them. You see them face-to-face if there is something you cannot do. In terms of medical training, the program in continuing medical education. So there are these courses online but i don't have internet here. So we have to travel all the way there where you have the training, to get my credits. It would be much easier to do it online. And that's not only for me there a lot of people that would benefit from it." (Region 4-Demerara-Mahaica, St Cuthberts, Female)*

Health area professionals have great need to use their own devices at their workplace Currently some of the interviewees highlighted that they are forced to cover these business related expenses from their own pocket and they don't see any improvement of this situation in the near future. The interest of healthcare professionals for ICT in general and their demands for better products and telecommunication services are high.

In general, everything that might address and solve their specific needs is highly welcome:

- Save their time – example: computer to do the report and send it by e-mail
- Better internet signal (for data)
- Connection/Support – example: sending a case of a particular patient to the supervisor in order to faster processes or intercommunication – at hospital
- Access – related to prices/stores available in the community
- Education – for using computers and understanding the potentials of smartphones

Furthermore, **surgery monitoring and assistance in different places of the world for medical improvement has been named explicitly as needed e-health service.**

A lack of knowledge in how to use more complex devices like tablets, laptops and smartphones results in a certain reluctance of understanding the benefits of a "connected device" and therefore no motivation in purchasing them.

However, once more concrete ideas were presented as examples for use cases, the interviewees showed increased interest in acquiring and using these devices.

There are different opinions among the communities visited: The ones more developed would prefer to use more modern devices (tablets, smartphones) while the ones less developed would prefer to use devices like a computer or a smartphone.

Interviews with public institutions showed, a specific demand for the following services:

- Heath Information exchange, document management, digital patient file
- Warehouse management and forecasting of needs (where is which drug and when does it expire?)
- Disease forecast: in-time reporting of exceptional regional outbreaks of illnesses

6.2.1.3 E-Government

To receive news about the government it requires reading newspaper or news sites on smartphones. According to the findings from the baseline data collection, there are people in remote locations, however, who need to wait up to a whole week until they get access to the printed news as the smartphone usage is not possible.

> *Quotes from baseline report:*
>
> *"Well, because of smartphones, there's an app for everything you need, so I usually use this News 2 Go app and that would… I mean, the beauty of News 2 Go is that you read articles from all the major newspaper, the Guiana Times and things like that." (Region 1, Barima Wani, Mabaruma, Male)*
>
> *"We used to get the information like this when we had the internet. It was easier for us to go to the internet and see the news. We had the learning channel, so when it was on, we used to see the news every day, like 7pm to 8pm." (Region 9, Essequibo -Demerara, Karasabai, Female)*

Everything involving **governmental activities** is considerd as very bureaucratic and involving a lot of paper work, even resulting in emotional stress. The eGovernment idea, namely the option of contacting public authorities and services through the internet, is understood as extremely handful and promising in order to provide easier and practical processes. Particularly, registering newborns in a quicker, less bureaucratic way is considered an advancement compared with the current situation.

> *Quotes from baseline report:*
>
> *"…for registering a newborn (…) you have to travel and spend a lot of money to get to the central community and the region to register the newborn and apply for marriage certificate and so on." [Region 1, Mabaruma, Teacher, Male]*

"Now imagine the possibility of receiving this information or contacting governmental or public authorities (to register a new-born, apply for marriage, etc.) online. How do you feel about this?"

> *"I would be happy about that. When things are not going right with your school you can write to it. My ceiling fell the other day. (…) It fell overnight, not during the day. When we got there, it was done. But then I had to use the same phone to try to get the message over. Some people didn't get it, they say we didn't call on time. When you call and don't get through, you've got to wait until you get through. So sometimes, two hours after, because you're far in and these phones, they are not so smart." [Region 5, Perth, Female]*
>
> *"I feel more comfortable. Because right now I have a grandson that doesn't have a birth certificate… yes, it would be easy for us." [Region 7, Kako, female]*
>
> *"That's a major development. The system in Guyana is broken because you may not believe me but I know persons here who are almost 60 and 70 who were born in this country and don't have a birth certificate, for one reason or another, but if that could be done or be extended online, that would be very good. I think it*

would be more efficient persons could stay right here, they don't have to travel to Georgetown." (Region 1, Barima Wani, Mabaruma, Male)

The possibility to follow-up through the internet of parliament debates and activities in real-time has been explicitly named as welcome e-Service during the interviews.

Interviews with public institutions showed a specific demand for the following services:

- Provide carrier grade platform to all "customers"
- Provide enabling services, e.g., ID management, document management, common data models, security and payment services
- Steer planning of software and support its cost efficient sourcing, i.e., support product lifecycle management, demand management
- Establish the right frameworks to work efficiently between the different ministries and agencies, especially in regards to the digital exchange of data

6.2.1.4 Other Economic Activities

Interviews with representatives of economic activities showed, that most of the long distance communication done by this audience has a professional goal: contact with suppliers who are outside the community to purchase products or to inform co-workers and supervisors about how businesses goes or to ask for help or in cases of emergency[162].

Quotes from baseline report:

"I use my phone every day. I'm employed at the sugar factory and use it to communicate to the others about the job situation, we also use the cellphone and we need a Smartphone at that time."

To market their products or promote their businesses, they recognize the importance of marketing and advertising. They advertise using flyers, business cards or distribute small gifts. **They are already using internet resources advertising on Ebay, Facebook, Youtube or specialized websites according to the business area**. They promote through word of mouth in places with few inhabitants. In the hotel industry, they recognize an untapped potential of remote areas for tourism, but resent the lack of government support to advertise.

Quotes from baseline report:

„I have no computers yet on the resort and I plan to promote it trying to reach the tour operators across the country in the Suriname with some flyers, business cards, you know, because marketing is very important. And that is why the internet, the Wi-Fi or whatever, you know, all these things will be very important to the business." (Region 6, Berbice-Oriental-Corentyne, Orealla, Male)

„I use Tripadvisor and another one that somebody recently told me about… it's not in my mind, but he said he's gonna link us up… so, I'm looking wherever you can link, so they know you exist so you can get clients here." (Region 2, Demerara-Berbice, Mainstay, Male)

E-commerce is also well received. Respondents from villages where agriculture is the main economic activity are particularly enthusiastic. Firstly, some of them believe that a local, government-run website could provide a service more in line with their direct needs and secondly, they think that having direct access to buyers would solve some uncertainties they are currently experiencing.

Quotes from baseline report:

"Now imagine the possibility of a government-run website that enables you to trade your goods on a national (or international) platform online. How do you feel about this?"

[162] One example mentioned was: What to do with the cattle that got stuck in the mud (farmer)

"Well, now we can use a smartphone to take the picture and sell it to the other person."(Region 1, Barima, Mabaruma, Male)

"I wanted some seatbelts for my car, because they are damaged, but I can't find any dealer here or anything, so somebody offered me to buy it online, from Georgetown. For things we don't have here, the only option is online, but I don't know how to do it myself, so I need to ask someone else. Of course it would be excellent, because, you know, everybody works and they are so busy, they would prefer to be able to purchase online and do not go to the store. "(Region 5, Mahaica-Berbice, Rosignol , Female)

As there is a great lack of financial institutions in Guyana, respondents typically use services as Western Union or Money Gram when available (greater access in coastal areas) to transfer money. Often they have to travel great distances to get to these institutions or risk losing their money by using somehow unreliable intermediaries to transport the money.

Quotes from baseline report:

"How do you transfer money usually?"

"For example, when children are far away we just send the money with people that are going out. For example, (…) any family member going out I send the money through them." [Region 7, Kako, Female]

"I normally use Western Union or my neighbor next door is a taxi driver, I'd ask him to take it." [Region 5, Rosignol, Female]

"Well, if the person is living in Anna Regina I could ask somebody to take it to them, and if the person is living in Georgetown I could just send it through the post office or Western Union." (Region 2, Pomeroon-Supenaan, Mainstay, Female)

"I go to the post office, deposit and they fax it. I feel unsafe." (Region 9, Upper Takutu-Upper Essequibo, Lethem, Male)

„Like I'm saying, for me to send money to Georgetown or any other part within region 1, the only available medium in terms of money transfer, we're talking in the region itself, right? It's the post office. But there's a post office at two of the sub-regions, in Mabaruma there's a post office, there's a post office in Port Kaituma, I don't think there's any post office in Matthews Ridge, so in case I need to send money there, I got to send it with somebody. That person, I trust them to send it, what if they don't carry the money to the receiver. There's no guarantee. That's a risk…" (Region 1, Barima-Wani, Port Kaituma, Male)

"That's a great idea, but you see the thing about MobileMoney, I don't think that GT&T has taken the time to actually sensitize and educate persons on actual service, so I'm thinking of persons that might be willing to use their service, but because they don't get the time to educate the people on the service, you don't find people using their service." (Region 1, Barima Wani, Mabaruma, Male)

"Yes, I heard GT&T has this money something, mobile money. Which this service provides. But the GT&T came here and the Toshao said we already have a service. It is just bad. I'm not 100% sure, but what I was told is they came and were turned away. I don't know how true that is." (Region 9, Essequibo -Demerara, Aishalton, Female)

"Now imagine the possibility of transferring money via cellphone deposit. How do you feel about this?"

"I'd feel great if I could do it myself on the internet. It would save me some time and some cash. [Interviewer:] Would that be also easier maybe than traveling to Western Union? [Interviewee:] Yeah. To travel to both sometimes because when you get there, they're closed or they're not doing business that day. You won't even know if they're not doing business."[Region 5, Perth, Female]

"Really good. I'm not aware of this that you can send through your phone. Yeah, I'd use it." [Region 8, Aishalton, female]

E-banking is also seen as extremely convenient. Current options for money transfer are risky, expensive and require extra time and efforts. In this context, the idea of transferring money via mobile phone is generally well received by the interviewees.

Most of the mentioned desires are related to the use of the internet. Some respondents asked for more Wi-Fi hotspots, while others request services to simplify daily tasks as Mobile Money (banking application via internet and mobile phone). They also would like to have smartphones with good quality cameras for taking photos. In the view of the respondents the internet would improve business, help to advertise goods and services, connect consumers not only of a region, but also of the country as a whole. The following are the services being mentioned:

- applications with regional information and chat to exchange local information,
- the online contact with the veterinarian would avoid travel time and often the loss of animals for farmers

For **selling goods** to remote areas the interviewees would like to use a smartphone to take a picture and send it to people, advertising on cable TV or making connections to people in each community by calling them to bring goods. If using an e-commerce platform operated by the government they see the benefits in savety and reliability in running the processes. Besides that, it would save their time, people would find what they need/ want to purchase and it is a way for growing and developing the business.

For **sending money** the interviewees have to go to the post office and bank or West Union/ Money Gram or in case it is in another community, sometimes asking someone to do it in person. E-banking idea is considered practical, faster and easy – very valuable and very attractive. Also it seems to be less expensive and much safer than going in person.

Interviews with FAO showed a specific demand for the following services:

- E-Learning and training material
- Access to new markets to buy and sell products
- Access to basic information like weather, news and statistics
- Improve collaboration between farmers in the same region (know who has what, consolidated shipping to reduce individual shipment costs)
- Mobile payment (to reduce crime)

6.2.2 Status Quo of e-Services Readiness Today

This section looks at the current availability of and future plans for e-Services by government agencies and ministries in Guyana and outlines the status quo of need frameworks to provide these services by different Agencies and organizations. It is based on interviews and desk research done during the month of October 2016[163].

In summary, the e-Learning domain shows to be the most advanced with many support documents and tools available for teachers and students – all information available from a well-structured website of the Ministry of Education. E-Government services through the eGovernment Agency is already planned through a good set of projects, however there is no relevant service accessible by communities in the interior yet[164]. A new website has been launched in October 2016, which is being populated step by step and which yields great potential for hosting requested services described below. Special skills to operate these e-Services have been build up in the organization. The e-Health domain shows currently the most potential for improvement concerning serving hinterland and remote hospitals and health stations as no significant e-Services are being provided. Additionally, it has been highlighted that the number of skilled IT experts are limited and not sufficient. In the field of agriculture and business, the situation looks comparable to the health domain: while simple websites are being maintained the potential of e-Services are not yet fully used – partially as the connectivity to communities in remote areas is limited or non-existing.

The eGovernment Agency, as the core ICT service provider for e-Government services, currently focuses the available skills of the team around the provisioning of connectivity and e-Services. As the role and tasks of the agency will grow and extend during the next years significantly, additional skills as well as supporting processes are needed. This will

[163] This assessment needs to be understood as not exhaustive as the documented results are based on feedback received from selected ministry employees only and information shared with the team.

[164] Primarily due to the absence of online connectivity in these areas.

primarily address the domains of service delivery and provisioning as well as the controlled alignment of Business and IT.

The overall e-Services readiness can be described as "**Online Communication**," based on the maturity model put forward in Section 6.3.1. There are government-wide Email, Calendar and document exchange available, even though they are not used by all ministries and agencies yet. Further, these tools need to be made available to hinterland and remote outposts of the respective ministries.

6.2.2.1 E-Learning

The Ministry of Education (MOE) in Guyana is handling the topic of bringing learning online. There exists a special department NCERD – National Center for Educational Resource Development, which is tasked with finding new ways of conveying learning content, among others also fostering the use of ICT in schools and the ministry itself.

This unit is already engaged in e-Learning for a long time: the interviewed employee has been testing electronic means of learning since 2000 and is very closely connected to many international universities and other education institutions. Thus, there are many initiatives ongoing concerning providing electronic learning resources to teachers and students. As evidence, the website of the Ministry of Education holds very good information and is well structured for easy access.

The focus of activities lies on three target groups: 1) Teachers, 2) Students, and 3) Adults, for which there are specific e-Learning (or e-Education) solutions.

Teachers: there is a program in place to enhance the Teacher's ICT competency through a MoU with the UNESCO, Microsoft, and the Commonwealth Secretariat. All graduating teachers are versed in ICT tools through the mandatory ICT classes anchored in the university curriculum. Currently, teachers are supplied with laptops to be used in classes to ease access to teaching materials and familiarize students with ICT.

Students: The software SuccessMaker by Pearson Publishing has been successfully trialed in grades 3-6 education. A wider rollout is currently being planned. Further, the ministry website holds textbooks and more information on a range of subjects.

Adults: The need to include adults in ICT education has been identified. However, the focus was on children so far.

Through cooperation with external organizations, the ministry (via NCERD) is launching many pilot projects to test software and hardware support systems. For example, Samsung has equipped one classroom in Georgetown with technology (tablets, projector, screen, server, software, etc.) to enable teachers and students to engage in modern learning activities[165]. This "Smart Classroom" initiative should be extended to schools in the interior.

Teacher availability is a concern across the educational system in Guyana. A pilot project was launched beginning of 2015 to offer remote interactive classrooms, effectively multiplying a teacher's lecture with geographically distant classes in real-time[166]. This important use case is further described below in this document.

At the time of writing requested, more detailed information was still forthcoming. Only NCERD has been taken into account. There might be other e-Learning activities ongoing in Guyana.

[165] http://www.kaieteurnewsonline.com/2015/11/19/samsung-launches-us40000-e-learning-school-pilot-project/
[166] http://www.kaieteurnewsonline.com/2015/03/03/smart-classrooms-could-address-teacher-shortage-manickchand/

6.2.2.2 E-Health

The Ministry of Public Health (MoPH) in Guyana has identified the use of ICT as an important next step to increase healthcare quality and reach. It has set up a Management Information System (MIS) department within the ministry to look after the ICT infrastructure and end user devices. This department is mainly concerned with maintenance and repair of the equipment and to a lesser extend with setting the vision and agenda of a comprehensive e-Health implementation.

A good network between health institutions in Georgetown has been set up in the previous decade, which relies on wireless technology to connect the different locations. However, this network does not extend into hinterland or remote communities. For data collection, the MIS staff rely on USB sticks as transfer methods for epidemiology and other data. Only a sporadic exchange of information with the regional hospitals takes place and health stations are even less frequently involved in data monitoring.

Together with its development partners, such as the Worldbank, IDB, PAHO and a Canadian healthcare institute, the MIS department has set up a first e-Health application in 2007, which is still being maintained and used. It was meant to support Malaria and HIV/AIDS initiatives through incident gathering and analysis. After the project ended in 2012, this system has been kept in place, however due to limited staff availability and skills in the MIS department new features which were requested from within the MOPH could not be realized. For instance, nurse training cannot be sufficiently handled with the current system, so an additional, external system (PALTEX[167]) has been proposed by PAHO.

The minister has expressed his desire to expand the e-Health activities to also include hinterland and remote communities through Telehealth and Telemedicine initiatives. There is currently an initiative underway to review the existing ICT landscape in the ministry and create a vision and plan of action for the coming years. Especially, the definition and implementation of a comprehensive Health Information System (HIS) based on the existing application is being considered.

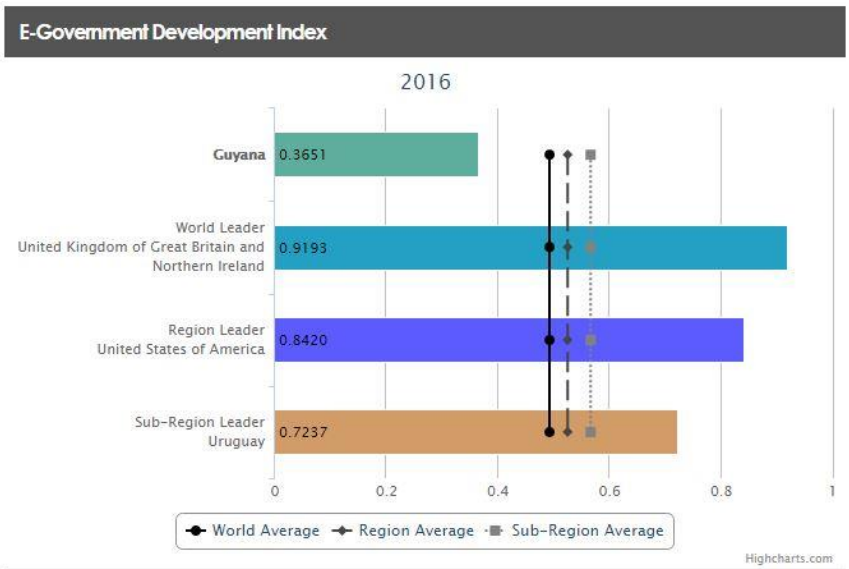
The eGovernment Agency is tightly involved in this ongoing review and offers its support for the implementation phase. Since the MIS has a multitude of specialized databases, it is foreseen that it keeps the responsibility for maintaining those, whereas the eGovernment Agency supports in hosting and infrastructure connectivity.

6.2.2.3 E-Government Services

The eGovernment Agency had been established by the Guyanese government with the vision to bring equitable access to government services to all Guyanese, no matter their physical location, income level or ethnicity. However, throughout the last years the level of government services available online in Guyana has been declining. This development has especially hindered the hinterland, poor and remote communities in taking advantage of government services and participating in public opinion-shaping processes.

As an objective, external assessment, the UN eGovernment Development Index (EGDI) shows that Guyana has steadily decreased its eGovernment maturity since 2005. See Figure 326 below. Guyana dropped from rank 89 in 2005 down to rank 126 in 2016 in a worldwide comparison of nations.

[167] http://www.paho.org/paltex



EGDI Rank	2016	2014	2012	2010	2008	2005
Guyana	126	124	109	106	97	89

Figure 326 - UN eGovernment Survey 2016 – Guyana's ranking declined steadily. [168]

To counter this trend, the current government has put more emphasis on e-services and, in turn, the eGovernment Agency has created many projects with the aim to bring the current government services closer to people by offering them online. Many of these services will be thus available to hinterland and remote regions for the first time without the need for extensive travel. The following tables show the planned projects.

Enabling Services

Name of Project	What is being done	When will it be ready
Correspondence Management	Source and implement an appropriate application with the basic features that can enhance correspondence management.	Information not available
Financial Management System - LTE Info Processing System	Computerized and comprehensive financial management software that will manage the Inventory and Accounting activities.	Information not available
National eID Project	To transform the existing ID system into a single unique identification system for citizens and residents.	Information not available
Training & Capacity Building	Develop and Implement a Training and Capacity Building Program for the eGovernment Unit 2016	Ongoing

[168] Source: UNPAN, EGovernment Survey 2016, https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/72-Guyana/dataYear/2016

Captive Portal Project	Creation of Captive Portal for Public internet Access	Information not available
Center of Excellence in IT Project	Design and Implement a Center of Excellence in Information Technology (CEIT) together with the Government of India	Information not available
eGov Critical Services	Deployment of IaaS, PaaS and SaaS solutions for Cloud-based Email, web portal, captive portal, appointment scheduling, …	Information not available
eGov NDMA Project	To secure legal mandate and establish the institutional framework for the eGovernment Unit. National Data Management Authority Act	Information not available
Enterprise IT Infrastructure	To procure, install, configure & test a complete enterprise IT infrastructure, network monitoring and helpdesk solution (Solarwinds)	Information not available
Gov Official Calendaring Solutions	Implementing Bitrix 24 content management systems to support the calendaring and scheduling solution for eGov.	Information not available
LTEPS Project	Development and implementation of the SIM and Mobile Device Tracking Manager software.	Information not available
Policy Frame Project	Development of a Policy Framework for the eGovernment Unit, Ministry of the Presidency.	Information not available

Table 55 - eGovernment enabling services and projects (as of Sept. 2016)

Government to Government Services (G2G)

Name of Project	What is being done	When will it be ready
internet Access via eGovNet	Agencies can access the internet at broadband speeds available via LTE in the coastal region.	Available now
Email service	Professional corporate email service available to all requesting agencies. Not all agencies are hosted yet.	Available now
Doing Business more efficiently - Ministry of Business	The following services and agencies will be supported by digital means: Commercial Registry Deeds Registry Land Registry Guyana Revenue Authority National Insurance Scheme	Ongoing; available in several parts in the coming three years until 2018

	Central Housing and Planning Authority Guyana Lands and Surveys Commission	
Integrated Financial Management and Accounting System	More efficient financial accounting in government agencies. Pilot will be done with these ministries: Ministry of Finance, Ministry of Education, Ministry of Public Health, Ministry of Public Security	Ongoing; available in several ministries in the coming three years until 2018
MARAD connectivity and services	Connectivity services as well as support for the following MARAD activities: ship registration, ship inspection, certifications, port control functions, port security	Full transformation by end of 2019
Colocation data center services	Offer equipment, space, power, bandwidth, cooling, physical security, disaster recovery to government entities and businesses.	Ongoing; no date set
UG Teleconferencing	Installation of Huawei Telepresence and Videoconference at The University of Guyana, connecting Turkeyen and Tain Campuses	Ongoing

Table 56 - eGovernment G2G services and projects (as of Sept. 2016)

Government to Citizen Services (G2C)

Name of Project	What is being done	When will it be ready
Citizens' Issues Reporting Solution "Tell Us"	"Tell Us" will connect citizens directly to the entities responsible for providing services and responding to their particular needs. The web or mobile-based application will facilitate citizens' reporting of issues directly responsible agencies. This would significantly reduce transaction times, improve accountability of those agencies, and encourage citizens' leadership and feedback in the delivery of public services.	October 2016; rollout until end of 2017

Citizenship and Immigration Information System (CIIS)	Comprising two sub-projects - online passport application processing and online visa applications - this will modernize the Immigration Information and Processing Systems through Guyana and significantly reduce the costs related to these services. In addition, the project will help to bring streamline the business processes related to these services and give clarity to the agencies involved in the delivery of the services.	Q1/2017
ICT access and eServices for hinterland, poor and remote communities – UNDP	Enhancing equity in the access to ICT and Government of Guyana services and is the main aim of this project. In particular, the focus is on hinterland, poor and remote communities as the most underserved with greatest need. The project will see the installation of infrastructure, which will enable connectivity in these communities, provision of equipment (laptops) at designated public spaces and training of community members.	Q1/2017
Government Portal	The Government of Guyana through its agencies provide a host of services to the public. Some of these agencies are not easily accessible and may have procedures that are not well known by the public. The Government portal is a project to provide a one stop-clearing house for all Government services. The web and mobile accessible platform will provide information on the procedures for the identified service and direct the user to the e-service centers of the respective agency where these exist.	Q4/2016
Community ICT Hubs	This project is for the establishment of 24 community based public access ICT sites across Guyana (12 Hinterland & 12 Coastland), in the initial instance. The project involves building community relations and ownership of the spaces through and the physical installation of the connectivity infrastructure, the provision of laptops and training for community members.	Ongoing; First installations Q3/2017
Schools Connectivity	The aim of this project is to connect 50 pilot secondary schools in the first instance into a private lease connection with the National Center for Education Research and Development those that these schools can directly access a number of e-learning resources and provide real time feedback to NCERD. The connection will facilitate faster communication between NCERD and these schools and thus enable monitoring, reporting and problem resolving in the roll out of program.	Rollout starts in September 2016
Appointment Scheduling	Generally, Government agencies see a large number of persons frequently because of the nature of their services. Usually this involves long queues. In an effort to improve the efficiency of these services and to reduce the costs to citizens, the Government of Guyana has embarked on a process to enable agencies to assign appointments thereby controlling both the intake flow and processing for services.	Pilot Q3/2016; rollout throughout all agencies in 2017

Table 57 - eGovernment G2C Services and Projects (as of Sept. 2016)

An Inter-Agency Service Level Agreement (SLA) exists between the eGovernment Agency and the other ministries and agencies to govern the business and technical aspects of eGovernment Network and internet access services as well as Email and calendar services. These were the first services to be offered and any additional service needs another SLA.

6.2.3 Status Quo of e-Services relevant Frameworks

While the eGovernment Agency shows experience in deploying and operating e-Services, the current organization and skills do not reflect sufficiently the needs in regards to the future ICT service provisioning and deployment. This includes standardized project management skills as well as the skill set of operating a "telecommunications carrier".

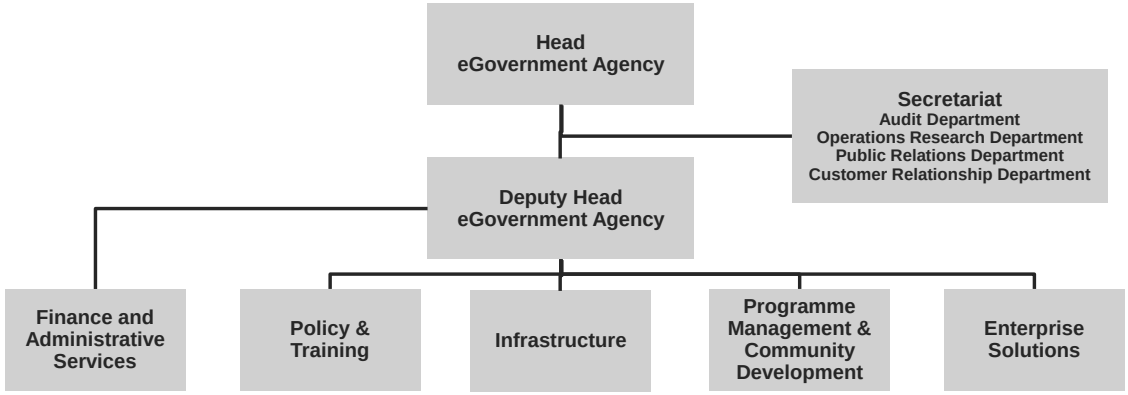


Figure 327 - Current Organization of eGovernment Agency

The following observations can be made in regards to the different elements of the organization

Policy and Training Division

- Strong focus on purely IT topics. If this Center of Excellence should fulfill the tasks to train and operate the regional training hubs and their trainers, the resources listed here are not sufficient.
- Liaisons experts to align with the communities especially in remote areas are missing. The need to increase the alignment in ICT rollout and e-Services deployment has been highlighted by interviewees (see baseline report).

Enterprise Solutions Division

- Misses a team of account managers that are the entry points for demands by the ministries and agencies. This is essential to promote own activities and services as well.
- A team to deal with vendors or potential solution providers is missing.

Program management & Community Development Division

- This division currently oversees a lot of tasks and two key activities that require both significant number of resources but with a different skillset.
- The Program management division needs to expand its resources in the field of experienced project managers (small and large, especially infrastructure-centric, projects)

Infrastructure Division

- OSS/BSS subdomain is missing. This would include the responsibility of Operation Support Systems (OSS) as well as Business support systems (BSS) to be in the position for the eGovernment Agency to extend and scale their service offering as described and proposed in the ICT needs Assessment.
- Operational framework design and implementation is currently not reflected in the organization. This would include responsibilities to design new processes, e.g., based on ITIL.

A strategic planning division directly reporting to the CEO and aligning between IT and strategic needs is missing.

Adjusting the legal framework to the requirements of e-Services is a prerequisite for the broad adoption of the services. Following issues must be considered in the legal framework:

- Data security and privacy
  Universal rules and policies for collecting, storing, processing and deleting data with special focus on personal data or such regarding the privacy of natural persons. This does also comprise distinct criteria to classify personal data, meaning data related to the private sphere of a person. Personal data about health and medical issues of a person as well as about their religious or political orientation shall have greater protection than other personal data, as misuse of this information can have stronger impact on the respective person. Privacy and data security is also relevant concerning e-Learning as personal data of students such as results from exams and information about absence from school will be collected and electronically processed.
- Electronic legal transactions
  Electronic communication media and e-Services must be established as legally effective, legally binding and must be accepted before court in case of legal disputes regarding such contracts closed by electronic communication media. For example, private contracts can be closed by electronic declaration of intent, electronic signatures shall comply with the legal requirements of contracts drawn up in writing and signed in ink and paper.
- Consumer protection
  Consumer protection should be expanded to contract law and cover commercial electronic transactions. Consumer protection rules must include e-commerce and the increased potential of fraud or failure by addressing the following issues: obligations for commercial sellers to instruct consumers about terms of contract and consumers rights, special conditions to apply right of withdrawal and choice of law clause.
- Cybercrime
  With the widespread use of e-Services and electronic media, there is an increased risk of offences committed via electronic media. Criminal law must consider these new technical issues and define respective offences and sanctions.
- Special laws
  Wherever specific circumstances regulated by special laws, adjustment of these laws is required. Laws regarding the health sector must cover the circumstances that medical consultation will in future be provided via e-Services. The processing of information ranging from simple communication between patients and medical staff to complex sharing of data between care institutions is integral to good health care. Hence, the legal context for health care will have to be able to accommodate secure transfer of information between health facilities and patients' homes and a range of stakeholders in the public, private, and international sectors.

The Cybercrime Bill of Guyana (Draft 2016)[169] addresses all issues related to cybercrime, including violation of privacy and personal data protection rights. To promote the introduction of e-Services and to mitigate risks related to e-Services it is essential to pass the Cybercrime Bill and put it into force in the near-term.

Special e-Service categories and their legal requirements must be considered in the respective special laws, such as an e-Government legal framework and an e-Health legal framework.

The e-Health framework shall consider:[170]

- Classification of (personal) data
  Data related to health must be classified and enjoy higher protection levels than other data. Special requirements regarding data privacy and data security must be determined.
- Health data to be included in EHRs

[169] Draft of Cybercrime Bill, posted on March 09, 2016 via the Website of the Ministry of legal affairs http://mola.gov.gy/bills/draft-bills

[170] Milieu Ltd & time.lex, funded by the Health Programme of the European Union: Overview of the national laws on electronic health records in the EU Member States and their interaction with the provision of cross-border eHealth services, July 2014 / 63

In order to share health information, the EHR systems used by healthcare providers should have a minimum level of interoperability. In more and more countries, healthcare professionals are therefore requested by mandatory legal rules to share health data in EHR systems created by national or regional authorities.

- Requirement placed on the institutions hosting EHR Data
  Data Applicants must provide extensive information demonstrating that their hosting system is secure and sophisticated enough to ensure that the rules on EHRs (e.g. consent, access, confidentiality) are fulfilled and that health data is well protected, especially considering the risk.
- Patient consent
  Informing the patient about the consequence and the functioning of shared EHRs prior to the consent is highly recommended as a prerequisite for the public acceptance of the shared EHR system. A three-step approach has been adopted by some EU member states and has proven successful:
    - When a patient visits a healthcare professional in order to receive care, this professional has the duty to keep a record of at least a minimum set of data related to the identity of this patient and related to the care provided; no additional implicit or explicit consent of the patient or even an opt-out possibility is thus needed at this stage.
    - When, based on national or regional law, public authorities decide to make available EHRs for exchange among healthcare professionals (e.g. in order to avoid unnecessary public healthcare costs), such EHR sharing systems can be established and include available individual EHRs without additional explicit consent of the patients. Member States are however free to introduce opt-out possibilities for this stage. This viewpoint corresponds to the one expressed by the Working Party in its opinion of 2007.
    - When a patient visits a healthcare professional who wishes to receive or access health data collected from this patient by other healthcare providers (by means of the EHR sharing system), such access will require prior explicit consent of the patient concerned. This consent constitutes, at the same time, proof that this patient has engaged into a therapeutic relationship with the healthcare professional.
- Creation, access to and update of EHRs
  Only authorized health professionals shall gain access to information for legitimate purposes related to the patient, because possibility of abuse is significant and the risk increases when systems become more interconnected. Hence it is required 1) to establish certainty on the categories of healthcare professionals who can have access to patient summaries, and 2) to establish trustworthy official registers of those categories of professionals which can be used for authentication purposes and that need to be accessible on-line.
- Secondary use of health data
  The eHealth legal framework shall specify under what conditions and circumstances secondary use of health data is legally permitted, e.g. if the secondary use is not incompatible with the purposes for which the data have been collected, or the secondary use is for historical, statistical or scientific purposes. The same level of data protection levels must apply to secondary uses.

The e-Government framework shall consider:[171]

- Provide electronic access to governmental services
  Public authorities and institutions shall be obliged to open up a point of access for the transfer of electronic documents.
- Information on authorities and their procedures in publicly accessible networks
  Public authorities shall make information on its work, its address, its business hours and its contact details for postal, telephone and electronic communications generally available in via the internet. They shall furthermore provide information about their activities under public law.
- Electronic means of payment

[171] Based on an analysis of the Act to promote electronic government and to amend other legislation (Federal Law Gazette I 2013 no. 43, published in Bonn, Germany on 31 July 2013, pp. 2749 - 2760)

Where charges or other fees arise in connection with an administrative procedure carried out by electronic means, the authority shall enable payment of such charges by participating in at least one adequately secure payment procedure that is customary in the area of electronic business transactions.

- Electronic record-keeping
  Public authorities should keep their records in electronic form, unless those authorities for whom keeping electronic records is not economical in the long term. Where records are kept in electronic form, appropriate technical and organizational measures are to be undertaken in accordance with the state of the art to ensure that the principles of orderly record-keeping are observed. Where public authorities keep electronic records, they should keep electronic copies of such records on file in electronic form, instead of keeping paper documents.
- Access to files
  Where a right to inspect files exists, public authorities, which keep files in electronic form, may grant access to files preferably by electronic means i.e. displaying the electronic documents on a screen, transmitting electronic documents or permitting electronic access to the content of the files. If this is not feasible, access can be granted by providing a printout of the files concerned.
- Electronic forms
  Where a legal provision stipulates the use of a certain form providing a signature field, the electronic form shall be accepted as equivalent and corresponding electronic form requirements should be applied (e.g. digital signature.

6.3 Vision for e-Services offered by Government Agencies

This chapter describes the vision for a framework of government services that are to be offered online. It comprises a possible future state of all e-Services and use cases in a 5-year timeframe as well as a description of the needed stakeholders to implement the e-Services. Furthermore, hints on a governance between the stakeholders are given.

6.3.1 Overview and Definitions

There are many reasons for fostering an eGovernment initiative, such as the increased effectiveness and efficiency of the public sector and the improved quality of government services provided to citizens (G2C), the business sector (G2B) and within the government agencies (G2G), which inevitably lead to economic growth and improved gross domestic product.

Provisioning these government services online needs a close cooperation of all involved agencies and units, including a common vision, mission and strategy as well as a work split and clear mandate for the work to be done.

The eGovernment Agency has already defined its goals and their actions are guided by the following postulates:[172]

Vision

To be the ICT vanguard that enables equitable digital citizenship for all Guyanese.

Mission

Our mission is to develop and implement appropriate ICT solutions that will transform the delivery of Government services.

Other ministries and agencies such as the Ministry for Public Health or the Ministry for Education will have to create their individual vision statements with regards to online services, if not already done.

[172] http://www.egov.gy/index.php/en/Site-Info/about-us.html, accessed on 03.11.2016

Thereby the eGovernment Agency defines its key directions of providing digital government services as follows.[173]

eGovernment

…the development and provisioning of online government services to the citizens and businesses. EGovernment therefore, represents a vital approach in addressing Public Sector efficiency and achieving whole-of-government collaboration in accelerating development and enhancing security nationally.

A well-established and functioning eGovernment system comprises the necessary infrastructure as well as a set of digital services, which are provided based on this infrastructure. The maturity of the digital services offered by the government can be assessed according to the following five phases:

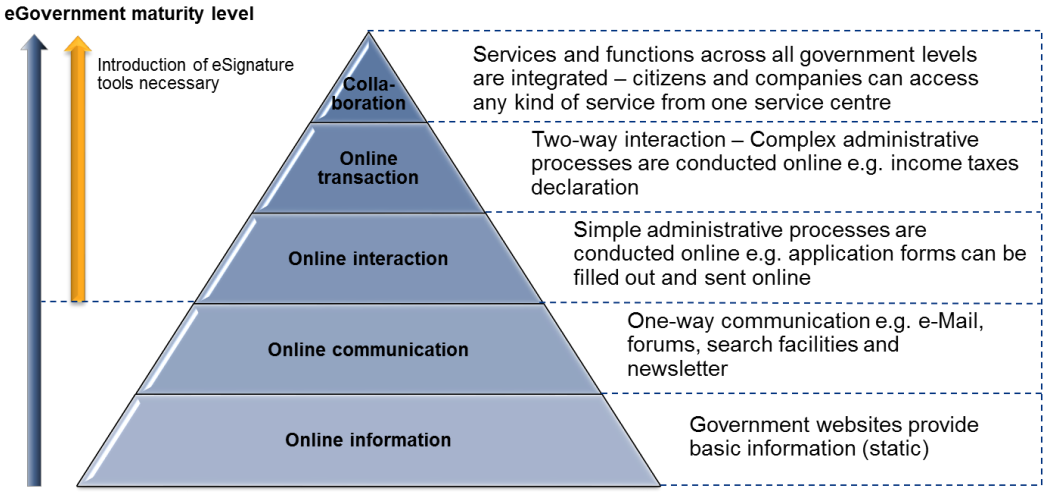


Figure 328 - e-Services maturity model – From information to seamless collaboration between all stakeholders

Online Information: This phase will involve simple provision of government information through electronic means. In this stage, Government organizations will be expected to be providing one-way information to their clients in a static format.

Online communication: This phase involves adding dynamic communication means to the e-Services portfolio that enable limited interaction, such as dedicated government Email, document management systems (DMS), and interactive, moderated forums for discussions, edited newsletters for specific target audiences or search facilities which cover important legislative and executive topics.

Online Interaction: In this stage, Government organizations are expected to be able to use ICT to provide some degree of online interaction with their clients. For instance, citizens can be able to enter requests, complaints, or job applications online, and expect to obtain an appropriate response. In this stage, secure transactions such as financial or confidential transactions that require a high degree of security-clearance authorization and audit capacity are not expected. However, the nature and capacity of each government organization will determine the degree of sophistication in each services provided.

Online Transaction: This stage is characterized by the provision of secure transactions with high level of authorization. Government organizations are expected to be able to provide capabilities and features that will allow clients to

[173] http://www.egov.gy/index.php/en/Site-Info/about-us.html, accessed on 03.11.2016

complete their transactions in full without the necessity of visiting Government offices. Such services may also allow the Government to function in a 24/7 mode. Typical examples may include one-stop online centers for citizens to apply for passports, permits or licenses, allowing them also to make payments online.

Collaboration: In this stage, government organizations are expected to have been well joined and working together at all levels. The achieving of this stage will allow Government clients to interact with one Government instead of individual Government organizations. This phase require collaboration to bring together suppliers, consumers and the whole government itself into a seamless network focused on increasing value creation.

The introduction of eGovernment services progresses along these phases. An e-Service and use case roadmap needs to reflect this evolution.

These e-Services will address the needs of all citizens, regardless of their location, i.e., in the hinterland, poor and remote areas as well as in the economic hotspots along the coast. Special e-Services will target hinterland and remote areas and increase the ability to communicate with the coastal areas, e.g., remote classrooms where specialized teachers are not available or Tele-Consultation for regional hospitals where healthcare experts are lacking. It should be emphasized that all e-Services provided by government agencies are essentially free of charge, especially the e-Government services use cases. Citizens do not have to own the equipment to use e-Services, but will use provided PCs, laptops or other hardware for performing the tasks. Thus, all e-Services are independent of personal wealth or incomes, i.e., also benefit the poor communities.

The extension of reach of selected e-Services to people living abroad might be considered at a later stage.

6.3.2 House of Government-Provided e-Services

In the context of e-Service provisioning by all government agencies and ministries, a target picture of a complete service portfolio can look like Figure 329 below. It comprises all necessary components for effective eGovernment and shows exemplary use cases for the domains of e-Learning, e-Health and other additional e-Services.

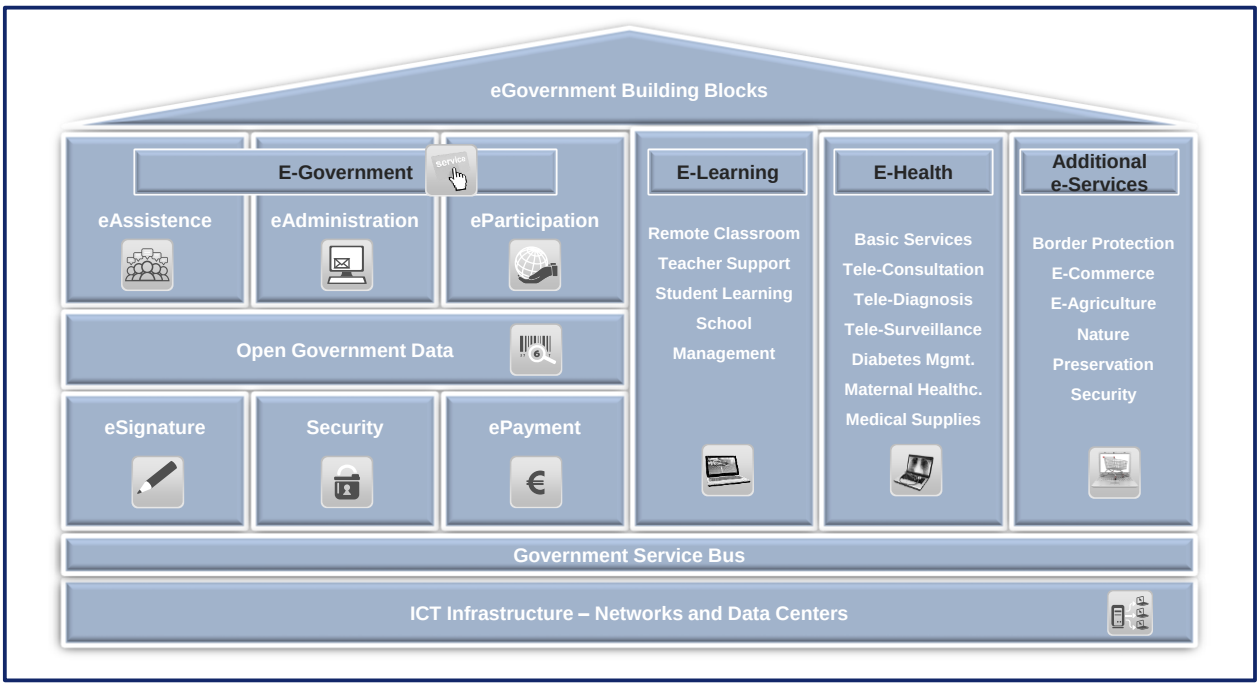


Figure 329 - Major building blocks of the government's e-Service portfolio

eAssistance: Provides general information concerning the public administration or government. This includes, for instance, opening times, contact numbers, staff information, forms or general description of government agency tasks. It can also be seen as self-marketing of the institution. The advantages for citizens are service improvement (quality and cost) and reaching the agency through multiple channels.

eAdministration: These are the typical public administration tasks and processes that have to be done by citizens or businesses. Existing processes are handled digitally and possibly through a well-defined electronic workflow with minimal personal face-to-face visits. Examples include applications for all kinds of government issued licenses, electronic censuses, application for social welfare, registration in a new community, or electronic tax declaration.

eParticipation: This e-Service domain comprises online surveys to include the citizens and enterprise in the political process, eCommunities (electronic discussion arenas), internet petitions, or creation of government/agency wikis. Examples are the information about potholes on streets, general feedback about government performance (see: "Tell Us" project) or Q&A sessions with elected officials on government portals.

Open Government Data: All data, which is not expressly categorized as confidential, is proactively and completely published to make it accessible to other government agencies and the public. Open data enables new business models between government, citizens and businesses, but it also constitutes a major cultural and paradigm shift.

eSignature: This enabling service makes it possible to establish the identity of an individual remotely and securely. It is generally a challenge to administrations to guarantee the end beneficiary is truly the one s/he claims to be. Registered email systems or electronic national IDs with special encryption functions can serve as an electronic signature tool.

Security is a paramount guiding principle which also needs to extend into the digital domain. This can be achieved by adhering to the ISO 27000 guidelines and a certification process.

ePayment is needed for some of the e-Services that involve monetary transactions and generally makes handling money more secure. A collaboration with existing payment systems by commercial providers might be prudent.

A **Government Service Bus** connects all administrative domains and ensures the availability of relevant data to all government stakeholders. Databases need to be harmonized and every citizen and business needs to be identifiable by a unique ID, e.g., the social security number or tax ID.

e-Learning, **e-Health** and **additional e-Services** are offered by ministries and agencies on top of the government ICT infrastructure.

6.3.3 Stakeholders and Governance

The Information and Communication Technologies have facilitated the design of solutions to deliver government services for social development at the doorstep of rural poor. Understanding the stakeholders and their needs are essential to deploy the right e-Services.

The stakeholder can be clustered along the building blocks that define sustainable ICT Services.

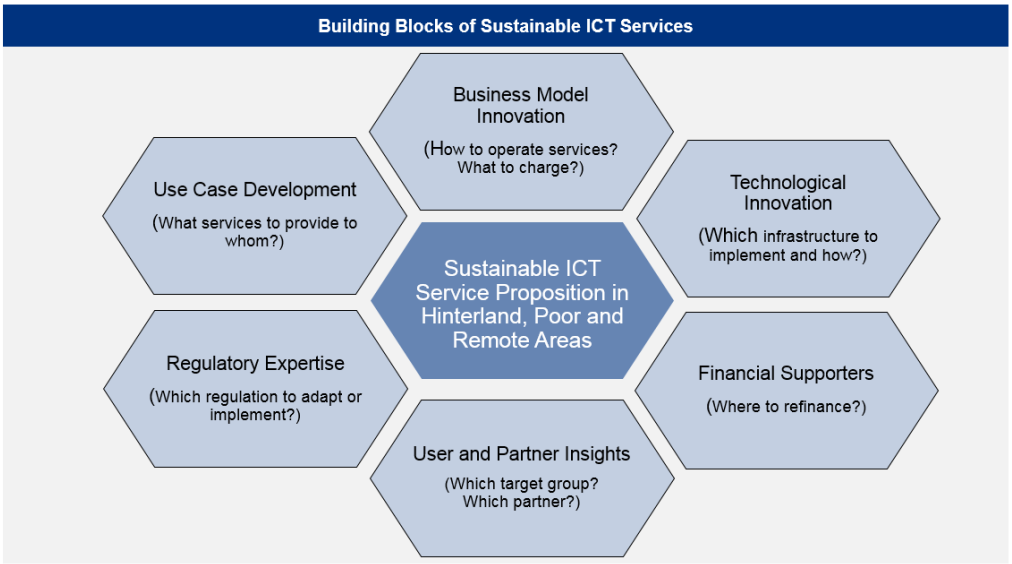


Figure 330 - Building blocks for sustainable ICT Services

All stakeholders that have interest in using e-Services have expressed their needs for basic communication. Beside these generic interests a detailed look along the building blocks reveal the following interest and needs:

Technical Stakeholders, e.g. Operators like Digicel and GTT+: can provide platform services for eGovernment services. EGovernment Agency can license either the complete platform and operate it then on their own premises or just use a with label version of the service provided by the stakeholder.

Legal and Regulatory Stakeholders, e.g. Ministry of Telecommunication: has needs for services in the field of collaboration, document management and dissemination of information.

Financial Stakeholders, e.g. UNDP and IDB: have interest in deploying services that increase the wealth especially in disfavored regions of the country. This might include, besides the above mentioned basic communication services, services that foster the development of local business in these remote areas.

Services/Use Cases Stakeholders, e.g. Ministries and UN agencies like PAHO and FAO: beside the needs for basic communication services, e-Services that are more sophisticated are needed esp. for ministries (like document management, passport application)

Partners, like foundations, NGOs and companies that provide Corporate Social Responsibility Programs: They can be a source for cheap licenses e.g. for e-learning tools.

Business Model stakeholders (e.g. Toshao, community head) hold in many cases the sole rights to grant access to the respective communities and hence deployment of ICT-infrastructure and provision of e-Services depends on their consent. Early involvement of them in the planning of the ICT network and decision making process is crucial. In addition protecting the installation of infrastructure in the hinterland and remote areas is achieved best by creating a feeling of “ownership” or responsibility for the hardware/infrastructure deployed locally. These local “owners” shall be members of the respective communities, ideally with a strong standing. They are also essential multipliers in regards to the adoption and acceptance of ICT services especially in remote areas.

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Setting the right ownership and responsibilities when operating e-Services is of great importance. The eGovernment Agency is the catalyst for e-Service introduction, but also serves the role of gatekeeper and organizer of agency cooperation. It needs to oversee, steer and streamline all efforts towards e-Services, however leaving enough room for individual agencies to pursue important special projects by themselves. Generally, all applications shall be hosted by the eGovernment Agency. However, in specific cases each of the Ministries or Agencies can host and operate the applications itself. The eGovernment Agency should target to host and support about 80% of the services offered online.

6.3.4 Guiding Principles

Guiding principles for developing eGovernment initiatives and services should be chosen to complement the eGovernment vision "*To be the ICT vanguard that enables equitable digital citizenship for all Guyanese.*" In general, these guiding principles can be identified as:

1. **Service Innovation**: The use of eGovernment must be geared towards introducing new work methods by conceiving new operational processes and changing current processes, as well as by changing the Government's relationship with the public.
2. **Equal Access**: The implementation of ICT in government processes must ensure that all citizens will have equal access; for this purpose, factors such as geographic location, the issue of time, and diversity must be taken into account.
3. **Ease of Use**: Applications that are to be implemented must be oriented towards citizens and, hence, be user friendly. Requires: providing user-friendly Citizen-Care and Business-Centric services for all.
4. **Security and Privacy**: When implementing applications, consideration should be given on using security and privacy mechanisms to ensure the proper use and handling of personal information and transactions.
5. **Partnership and Outsourcing**: The private sector can assist the State in providing eGovernment solutions, as well as in training government employees.
6. **Interoperability**: Each government department will be responsible for maintaining its electronic services and data sets, as well as for ensuring that newly implemented systems leverage existing systems and aligned with eGovernment Agency guidelines and standards set.
7. **Involvement of All Stakeholders**: Applications should ensure that the benefits obtained by citizens from using eGovernment services will be greater than those from visiting government offices in person. Thus, eGovernment investments need to be justifiable in terms of how they help citizens and taxpayers.

6.4 Description of Selected e-Services

This chapter describes those e-Services in more detail, which are considered fundamental in addressing the needs of hinterland and remote communities as outlined in Chapter 2, namely e-Learning, e-Health and e-Government services. Special emphasis is given to e-Learning as it is considered as the underpinning of all activities and the platforms can be leveraged in other government domains. For every e-Service, there are proposed use cases, which were selected according to the previous needs analysis.

Furthermore, a few additional e-Services are being addressed which can be offered to the Guyanese public, but are not regarded as essential from the start of the program.

6.4.1 E-Learning – Engaging Teachers and Students Remotely

This section describes the reasons for developing e-Learning and shows when e-Learning is preferred over classroom instruction. It outlines challenges and solutions for the special context of hinterland and remote communities. Further, case studies are given and specific use cases proposed which fit into the Guyanese context.

6.4.1.1 Overview and Definitions

Many organizations and institutions are using e-Learning because it can be as effective as traditional training at a lower cost. Developing e-learning is more expensive than preparing classroom materials and training the trainers, especially if multimedia or highly interactive methods are used. However, delivery costs for e-learning (including costs of web servers and technical support) are considerably lower than those for classroom facilities, instructor time, participants' travel and job time lost to attend classroom sessions.

Moreover, e-Learning reaches a wider target audience by engaging learners who have difficulty attending conventional classroom training because they are:

- geographically dispersed with limited time and/or resources to travel
- busy with work or family commitments which do not allow them to attend courses on specific dates with a fixed schedule
- located in conflict and post-conflict areas and restricted in their mobility because of security reasons
- limited from participating in classroom sessions because of cultural or religious beliefs
- facing difficulties with real-time communication (e.g. foreign language learners or very shy learners)

E-learning can offer effective instructional methods, such as practicing with associated feedback, combining collaboration activities with self-paced study, personalizing learning paths based on learners' needs and using simulation and games. Further, all learners receive the same quality of instruction because there is no dependence on a specific instructor.

e-Learning in this document is defined as follows:

E-Learning can be defined as the use of computer and internet technologies to deliver a broad array of solutions to enable learning and improve performance.

This definition caters to a wide audience, since an integration of all relevant stakeholders in a national e-Learning strategy is recommended. For example, sharing an e-Learning platform developed by the Ministry of Education also with the Ministry of Health to provide health-related trainings leads to overall synergies and reduction of double-work for the government ministries.

Further, e-Learning on a national scale should not be restricted to students in K-8 or K-12 schools alone, but be open to adult learners also. This broadens the uses for an e-Learning platform to external development partners as well, such as FAO, PAHO or UNDP, to provide assistance to remote communities.

Some questions to ask when choosing among e- learning, face-to-face instruction or other types of informal or on-the-job learning include:

> What is the relative cost of each type of training?

> Is learning best delivered in one unit or spread out over time?

> Does it address a short-term or a long-term learning need?

> Do participants have access to needed computer and communications equipment?

> Are participants sufficiently self-motivated for e-Learning or self-study modes of learning?

> Do target participants' time schedules and geographic locations enable classroom-based learning or other types of synchronous learning?

In general, e-Learning is preferred over other forms of instruction (e.g., in-class learning) when the following elements are given:

- there is a significant amount of content to be delivered to a large number of learners
- learners come from geographically dispersed locations
- learners have limited mobility
- learners have limited daily time to devote to learning
- learners do not have effective listening and reading skills
- learners have at least basic computer and internet skills
- training aims to build cognitive skills rather than psychomotor skills

e-Learning is not ideal for all learning purposes, so it will most likely not replace in-class instruction completely. However, if e-Learning is used to complement traditional teaching and training to reach more learners, a good balance between cost and impact can be achieved.

6.4.1.2 Challenges in hinterland, poor and remote Schools

The challenges that hinder educational research in the rural schools include the following:

- *Insufficient educational material:* The educators feel the material they have available for educational research is insufficient. For instance, a school has no videos, televisions, or enough books to support educational research. Moreover, relying on parents is limiting, as this depends on what they know or have experienced.
- *No library:* There is no library that serves any of the schools in the area, which the teachers emphasize as a negative characteristic of most rural schools. The limited numbers of books they have are often packed in boxes in the staff rooms, which the students are unable to easily access.
- *Challenges associated with computer reliability*: internet access was unavailable at a school for a number of months. The teachers at the school felt this was a challenge as they were unable to use online material (usually accessed via the Google search engine) to support the learning process, which they had become dependent on. Furthermore, some computers do not work, often freeze, or are too slow.

- *No computer room at School A*: Currently, the computers at a school are kept in the staff room. The staff room is the only secure room in the school, and consequently teachers are unable to teach computer literacy to a whole class. Often, only a small group of students can enter the staff room to do occasional research for the class, with the teacher's supervision. One solution would be to raise funds to secure one of the classrooms at the school, for future computer literacy training.
- *Plagiarism:* Students who use the internet to research often plagiarize their findings. The teachers do not know how to handle or deal with plagiarism in the school. They appreciate the resourcefulness of the internet, but plagiarism influences their confidence in encouraging their students to use the internet for their research.
- *Slow delivery of textbooks and books:* The schools often make orders for books and textbooks from bookshops, through the Ministry of Education (MoE). However, the bookshops often fail to deliver, and the MoE is expected to make a follow-up, which hardly occurs. There may be a lack of communication to follow-up on rural school orders, or an approach for responsible officials to account for the orders. On the other hand, the interviewee felt that the delivery of textbooks had actually improved, as a delivery is made at the end of each year. It is the responsibility of teachers to travel all the way to the next big town to collect textbooks, which proves to be a challenge with limited transport available.

6.4.1.3 Customization Strategy based on hinterland Village Context

The special context of hinterland and remote communities demands a review of how learning can be made more attractive, sustainable and impactful. There are a few observations, which can lead to more effective e-Learning projects; among others are the following.

- *The development of a library to serve local schools*: Currently, some schools already have libraries included in their facilities or in the village. Nevertheless, many teachers still feel the location of the libraries will pose a challenge for surrounding schools that hope to benefit from the library, because of the lengthy distance and transport limitations for students.
- *An increase in computers*: This was a recommendation made by a school, to support the introduction of computer literacy as a subject at the school. However, they are still aware that the key requirement for this is to secure a classroom that can be used.
- *Improved access to funds*: This is a recommendation from a school to improve classroom infrastructure and prepare a classroom to house computers for literacy training. Furthermore, the school management is keen to purchase new computers or apply for some through the government.
- *Use of ruggedized equipment*: for example, special laptops and PCs, projectors that can withstand the enormous climatic and other environmental stress in the interior. It is recommended to spend more on initial CAPEX than to have to replace the equipment constantly, which also leads to frustrations and demotivation of the users.
- *Simplification of software and hardware*: a software interface should be made as self-explanatory and user friendly as possible. There are specialists – user experience (UX) designers – who should be employed to tweak interfaces for kids and unskilled adult learners such that it is enjoyable to use the computers and other tools. Hardware needs to have as little interfaces as possible while still serving its function. The Apple iPhone is a good example for this minimalistic approach.

Teacher Training

- The duration of training should be improved: Sufficient time should be allocated to training sessions to allow teachers to understand the programs and clarify any aspects they do not understand. It was suggested that teachers should at least be provided with training over 1 or 6

months, and apply what they have learned over a longer period of time. This would be more effective than short courses, which are hurried and difficult or impossible to apply.

- Training needs to be conducted locally: Local training would support teachers significantly, as they would use the time available to clarify aspects they do not understand. It would also save on transport costs, and allow more time for teaching, as lessons do not have to be cancelled in order to attend training programs (time is spent travelling and returning from Idutywa, with limited transport availability).
- Appropriate and sufficient documentation should be provided for training programs: Training documentation provided needs to be sufficient for all teachers and easily useable by rural teachers.

6.4.1.4 Case Studies and Examples of e-Learning Projects

The following examples give a short overview of effective tools and projects from around the world. These can be evaluated in an implementation phase, but also show what is possible in e-Learning today.

6.4.1.4.1 Learning platform for K-12 Schools (Maths): Khan Academy

Khan Academy is a non-profit organization whose mission is to change education for the better by providing free world-class education to anyone, anywhere. The Khan Academy's materials and resources are available to anyone — completely free of charge. The growing library of 3000+ videos covers a wide variety of academic topics, including math, science and the humanities. Khan Academy has received widespread media coverage and over five million students per month use the resources worldwide.

Targeted user group: Grades 1 – 11. However, best suited for higher grades.

Application: After school program (group and individual), resource for instruction during class time, computer lab hours, out-of-school program

Teachers view functionalities (Figure 331):

- Manage students
- Students' progress
- Skill progress
- test preparation (e.g. MAP assessment)
- Select predefined missions (amount of exercises and videos for specific levels)

Student's functionalities (Figure 332):

- Dashboard (see their progress, their missions/tasks)
- Video learning
- Exercises

Subjects:

- Math
- Science & engineering
- Computing
- Arts & humanities
- Economics & finance
- Test prep

Success factors:

- Get teachers on board

- Align the curriculum to the predefined content and learning concept
- Get students motivated
- Basic ICT skills of teachers and students

Estimated time to implement:

- Easy to implement because it is a web based solution.

Needed ICT connectivity: The material is available offline, so you do not need internet connection, you can still proceed with the program if the internet is down (KA Lite - Running KA Lite as a local server, you can watch Khan Academy videos, do Khan exercises, and track student progress -- all without needing an internet connection)

Challenges:

- Predefined math concept need to be understand and aligned with the curriculum

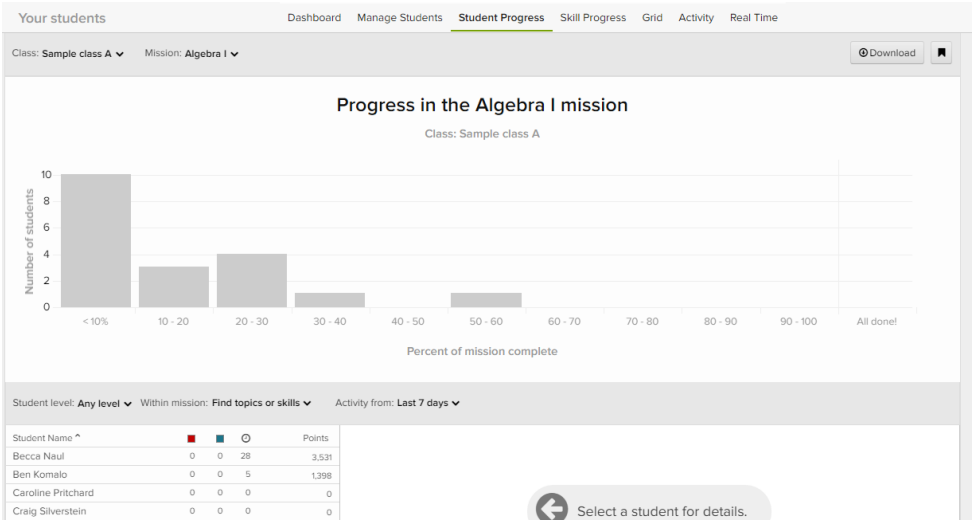


Figure 331 - Kahn Academy – Teachers View

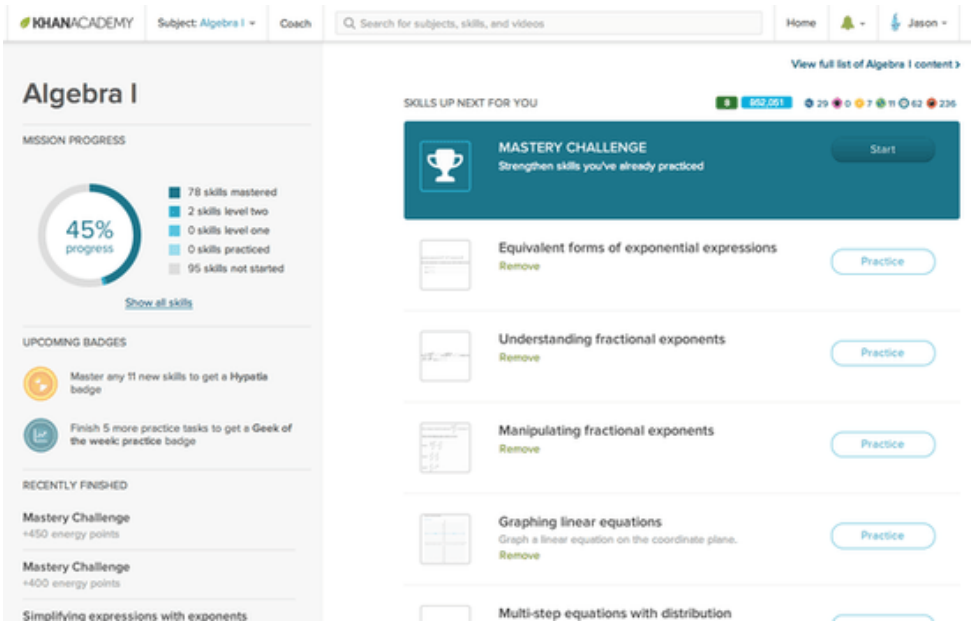


Figure 332 - Kahn Academy – Student view

6.4.1.4.2 Gamification: Play2Learn by BlazingSoft

Play2Learn[174] is an educational game platform that is a supplement to improve students' early academic experience. This platform utilizes an interactive 3D role-playing game that teaches, reviews and assesses the student's curriculum materials. Using role-playing game, unlike competitors, connects all curricula together to effectively promote overall interest rather than having only 1-2 favorite games that keep a student interested in particular topics. The game is designed to encourage high academic performance by offering in-game rewards that enhance game play after successful completion of curriculum modules.

Targeted user group: Grades 1 – 11. However, better suited to students with affinity to computer gaming.

Application: After school program (group and individual), resource for instruction during class time, computer lab hours, out-of-school program

Teachers view functionalities (image 1):

- analytics, such as graphs, charts, percentages, and values, for students' academic progress
- average academic performance of the class
- Teacher can create exercises on their own.
- Customize lesson plans
- Prepare homework and tests

Student's functionalities (image 2):

- spotlights different mini-games that are creatively designed to teach a student through exploration, puzzles, and in-game interactions
- students are instantly rewarded for solving academic problems, which are cleverly integrated into the game, with points and items

Subjects:

All the content is in Spanish and is included with the platform. English's educational content is charged separately in case of being needed.

- Science
- Social studies
- Language (Spanish)
- Math

Success factors:

- Get teachers on board
- Align the curriculum to the predefined content and learning concept
- Get students motivated
- Basic ICT skills of teachers and students

Estimated time to implement: depends on desired functionality. Initial setup can be done within a few days. Demo version accessible immediately online.

Needed ICT connectivity (see image 3): Low-bandwidth internet connection once needed for log-in. Afterwards stand-alone operation is possible. Teacher updates to curriculum can be done immediately if student online, or else once internet connection is available again.

Challenges:

[174] Source: http://blazingsoft.com/en/

- Creating the content
- Older students might not be addressed by the kind of the game
- ICT skills (students+ teacher)

Server requirements:

- Operating system: Ubuntu Server
- Web Server Ngix
- Database: PostgreSQL. Can be run on an external server.
- Python 3.5
- Platform Play2Learn web

Play2Learn Platform: Django 1.8, Gunicorn

Client computer minimum requirements:

- Windows 7 (x32 or x64)
- Dual core processor 1.6GHz or similar
- 2GB available hard disk space
- 3GB RAM
- Screen resolution: 1366x768
- Graphics card HD Graphics 4400 or similar

	Login	Academic Content Index	SAVE GAME	Activities	Question without Images	Question with Images
UP	2 KB	1 KB	50 KB	1 KB	1 KB	1 KB
DOWN	45 KB	150 KB	1 KB	50 KB	1 KB	(50 KB - 2000 KB)
TIMES	1	1	Every [1-5 min]	Every [1-5 min]	Every [5 -30 sec] in Question Mode	Every [5 -30 sec] in Question Mode
Question Mode		Solve 10 academic questions. Usually you enter in this mode every [5-15 min].				

Table 58: Play2Learn – Network requirements (Download Rates)

Figure 333 - Play2Learn - List of tasks to be accomplished. Every task represents a learning exercise.

Figure 334 - Play2Learn scorebook – Learning progress is represented by gold coins.

Figure 335 - Play2Learn gameplay – Interactive game keeps children motivated and involved.

6.4.1.4.3 Mobile Learning (Literacy): Yoza Cellphone Stories

The Yoza Project, originally known as m4Lit (mobile phones for literacy), set out to explore the viability of using mobile phones to support reading and writing by youth in South Africa (SA).

Targeted user group: Students at all levels

Goal of project:

- Yoza enables reading, writing and engagement via mobile phones
- Short stories and classic literature are published on mobile phones (MXit and on a mobisite)
- Highly interactive: users can comment, vote, enter writing competitions, review stories
- Started in South Africa, initially funded by the Shuttleworth Foundation

Why?

- 51% of South African households own no leisure books

- 7% of public schools in South Africa have functional libraries of any kind High uptake of phones – up to 90-100% amongst urban youth … with about 70% internet-capable handsets
- South Africa has excellent mobile infrastructure and coverage
- Relatively low charges for mobile data (but expensive voice and SMS charges)
- A common complaint: “teens don't read and write enough, teens love their mobile phones” -- so make phones part of the solution!

Project owner or sponsor: Shuttleworth Foundation

First story

- Workshopped with teens – it’s gotta be “real and relevant” for them
- Published on a mobisite with no marketing – very little uptake
- Published on MXit with Tradepost messages and Splash Screens – 63000 subscribers in a month!
- English and isiXhosa … most reads were in English

Yoza today

- 28 m-novels
- 5 Shakespeare plays
- 11 poems
- Genres include teen issues, romance, soccer, adventure, “classics” such as Shakespeare, poetry
- Some stories are serialized (a chapter a day) and every chapter of every story has a comment prompt or vote prompt
- Stories found in English, Afrikaans and isiXhosa
- Stories are free but costs for mobile data (about 1c US per chapter)
- On MXit all comments are moderated before going live

Yoza stats (from August 2010 to August 2011)

- Complete reads of m-novels, stories and poems: 300,000
- No. of comments: 40,000
- No. of unique visitors: >145,000
- No. of MXit subscribers to Yoza: 69,000
- No. of page views: >5,400,000
- No. of votes: >44,000
- No. of competition entries: >8,500

Technical realization:

The content is free; the only charge is for the data transfer of the content paid to your service provider. On a mobile phone that costs between 5c and 9c per chapter (South African Rands). Note: Cell C customers in South Africa do not pay any data charges when accessing Yoza on MXit.

Figure 336 - Yoza content on MXit social network (left) and on a mobisite (right)

6.4.1.4.4 In-Classroom Teacher Support: CyberSmart Africa

CyberSmart Africa, a digital learning social enterprise, has been working with The Earth Institute and teachers and students in Potou, Senegal since 2011 to actively test and refine a whole-classroom learning technology solution that has the potential to achieve massive scale throughout sub-Saharan Africa. Practiced in Poutou Elementary School, and in eight other Senegalese elementary and middle schools over time

Goal of the project:

- Delivering previously unavailable instructional materials — maps, photos, videos and up-to-date quality content—to directly support classroom learning.
- Addressing the needs of the 80% of schools in sub-Saharan Africa without electricity and the millions of children that need to be educated.

Target Group:

- Primary/secondary school students

Technical realization:

- A complete system, the CyberSmart Learning Platform includes an Android computer, an energy-efficient super-bright projector, interactive whiteboard capabilities, solar rechargeable batteries, speakers loud enough for classroom use, advanced 3-D capability, cooling fans, and a unique dust filtration system, quality learning content, and ongoing teacher training.

Key features of the CyberSmart Learning Platform:

- operates without wires or the need to connect to the internet
- lightweight and portable between classrooms
- consumes very little power and integrates a solar-chargeable battery
- heat and dust resistant
- interactive whiteboard capability
- can share content with smartphones and tablets

Financials:

- Estimation: Designed for massive scale, we estimate that the cost can be as low as $US1 per student/month.

References:

https://www.wise-qatar.org/edhub/cybersmart-afric

http://csd.columbia.edu/2015/01/20/the-grassroots-rise-of-a-new-learning-technology/

http://mcneilfoundation.org/digital-learning-in-potou-senegal/

Figure 337 - Using multimedia to separate domestic from wild animals

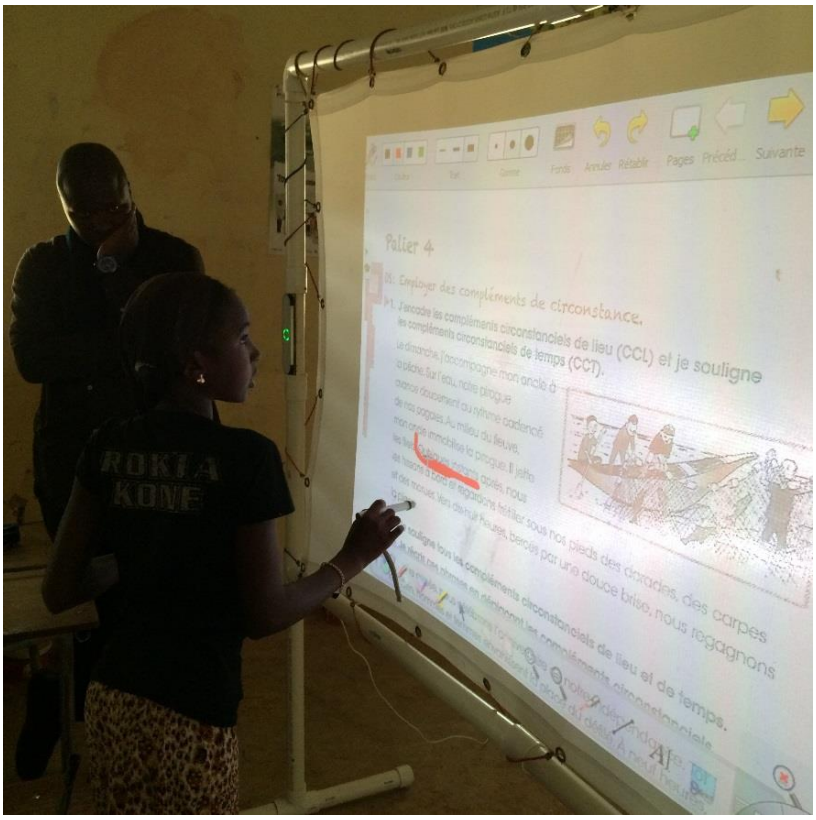


Figure 338 - It is easy and practical to annotate over a scanned textbook, in this case for reading instruction

6.4.1.4.5 Remote Classroom Training with a Live Instructor over the internet

Echo360 is a lecture capture and personal capture solution used at many universities. Using this service, instructors can capture audio, video, and content in classrooms or on personal computers, and then distribute that content on the web or in Canvas. It is also possible to stream the lecture in real-time on the internet while a teacher holds the lecture in front of an audience.

Goal of the project, e.g. at Indiana University:

- Give Students Access to Echo360 Recordings through Moodle
- With classroom-based capture, you have the option to record activities on your computer desktop; room/system audio, including your voice; documents via a document camera; media playing through the classroom audio/visual rack; video of you, the lecturer.

Target Group: remote students taking the class

Technical realization:

- Personal Capture Software:
  - Software application that can be installed on Windows 7, Windows 8 and Mac OS X 10.7 and above.
  - This software application allows instructors to record audio, webcam video and screen sharing video.
  - Screen sharing video captures the movements and activities on an instructor's computer.
- Lecture Capture Classroom:

- This is a classroom that has been equipped with special hardware to accommodate the digital capture of an instructor-led class.
- The classroom includes an installation of the Echo 360 Personal Capture Software on the podium computer, along with special microphones and cameras to record the faculty member and any materials displayed through the projector.

Key features of Echo360 (students view):

- You can access recordings through the Echo Center, either using a direct link provided by your instructor or through the Echo360 tool in Canvas.
- Echo360 recordings are retained for one year.
- All recordings are available for download at any time during this one-year period, if permitted by the instructor.

While viewing a presentation or watching a video, there are several tools that students can use when they access the classroom toolbar.

- Asking questions
- Responding to questions
- Bookmark content
- Flag content as confusing

Key features of Echo360 (teachers view):

- Editing: Browser-based editor supporting the editing.
- Instructor Dashboard (Analytics of behavior of their students)
- Echo Lecture Capture (Classroom Computer) and Echo Personal Capture (Your Computer) available
- Integrate classroom activities

A study conducted by the solution provider shows the following interests and applications for using the solution:

Item	SD[175]	D	N	A	SA	% A&SA
A1.3 Revise and prepare for examination	5	2	24	119	94	87.3
A.1.2 Replay and revise key concepts	4	7	22	136	75	86.5
A1.4 Gather information for assignments	2	4	36	130	72	82.8
A1.1 Revise notes that were made in classes	5	9	29	135	67	82.8
A1.6 Cover-up for missed lectures due to other commitments	12	14	43	79	96	71.7
A1.5 As an alternative to traditional physical lecture attendance	18	15	48	89	74	66.8
A1.8 Collect feedback given by lecturers on assessments	12	27	63	89	53	58.2
A1.7 Acquire presentation skills	12	43	79	73	37	45.1
A1.9 Want to experience what a real class feels like	28	31	95	57	33	36.9

Figure 339 - Usage scenarios for Echo360 Remote Classroom

[175] SD= strong disagree, D= disagree; N= neither agree nor disagree; A= agree; SA = strongly agree; %A&SA= total percentage of agree and strongly agree

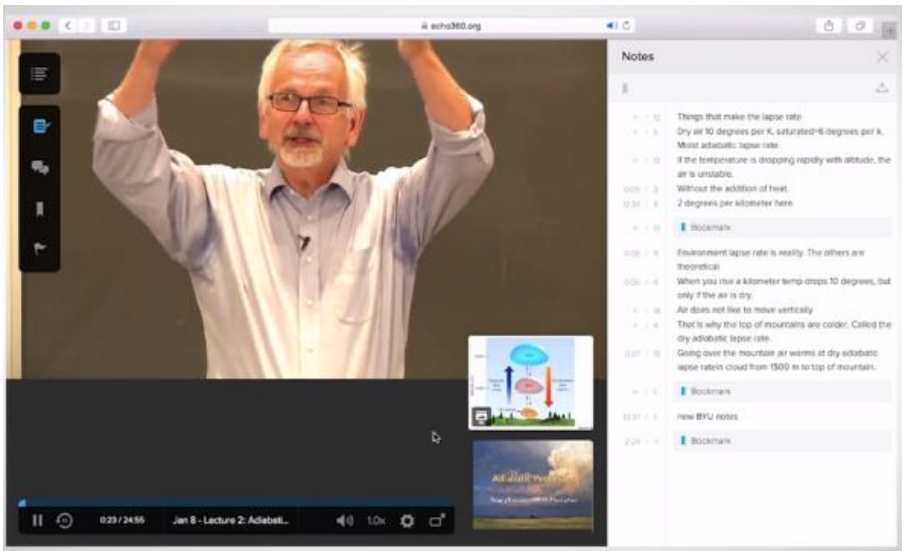


Figure 340 - Echo360 - Recordings are available on demand

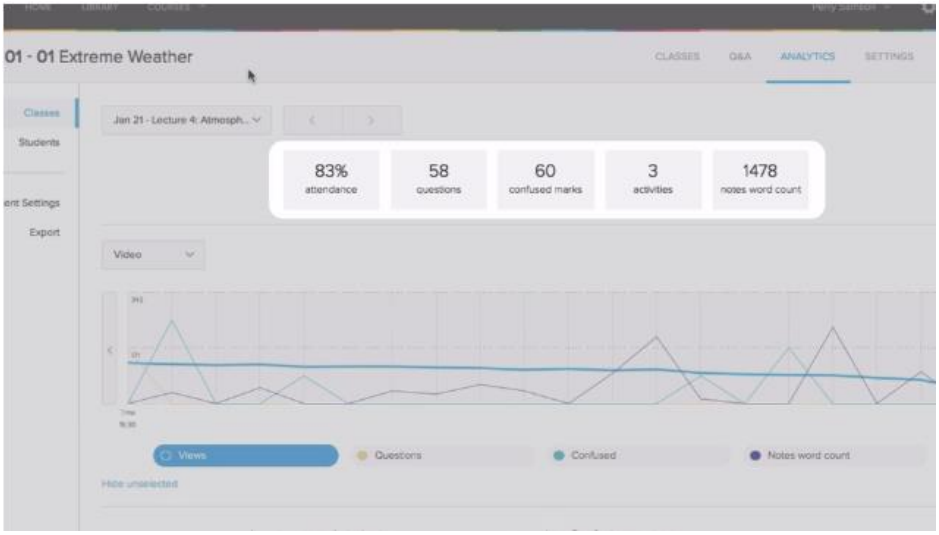


Figure 341 - Echo360 Analytics Dashboard

Segment[176]	Use Case	Echo360 PRO	Echo360 POD	Classroom Capture	Personal Capture
Lecture Hall	• Large Lecture Hall • Projector + PC + HD camera(s) • Complex AV equipment (switching/audio) • 2 or more inputs, live streaming required • Fully scheduled capture typically	●	○	○	○
Smart Classroom	• Medium sized lecture hall / large classroom • Projector + PC in room + Digital Camera • 1 or 2 inputs, live webcasting required • Ad-hoc or scheduled capture equally used	◐	●	●	○
Standard Classroom	• Small classroom • Projector in room, no fixed PC or Camera • 1 Laptop input typically • Ad-Hoc capture typically	○	●	○	◐

Figure 342 - Echo360 – Selection criteria for the capture hardware

References:

http://www.ascilite.org/conferences/sydney13/program/papers/Fei.pdf

http://blog.echo360.com/echo360-solutions-for-every-classroom-learning-situation-and-budget

6.4.1.5 Proposed Use Cases for e-Learning in Guyana

The following use cases have been chosen based on the needs expressed by individuals and institutions as outlined in Chapter 6.2.1. A use case describes the general and abstract concept of the solution without elaborating the detailed implementation or operational aspects of the final e-Service.

6.4.1.5.1 Teacher support

The most effective way to bolster the educational system of a nation is to support its teachers appropriately. The Guyanese government has recognized this and the "One Laptop per Teacher" program has been started. These laptops already come with a slew of different materials, such as curriculum ideas, governmental forms and electronic textbooks. However, this material is static in nature and there is no means of updating it. A much more flexible way of supporting teachers can be delivered online through specialized learning management applications (LMS), the availability of special support forums for knowledge exchange and mutual support and the subsequent use of electronic media in the classroom.

Learning Management System (LMS)

An LMS is an essential tool for e-Learning professionals and it provides a dynamic and flexible learning platform to be used by both the teacher and the student. It holds learning materials such as textbooks, tracks a student's progress or provides completely online courses, which can be taken by the student independently. There can also be curriculum examples, blogs, textbooks, online chat between teachers and other modules added to a flexible LMS. The most

[176] Legend: ●= primary usecase; ◐=supported usecase; ○=unsupported usecase

prominent Open Source LMS is by far Moodle, while SAP SuccessFactors is a good choice for a paid software. The vendor selection should be executed carefully with a good analysis of what the real needs are.

With regards to learning in native indigenous languages, special focus should be laid on the possibility of localization of the LMS. This enables all software menus, descriptions and manuals to be used by indigenous people and thus preserve their culture and heritage. The same holds true also for the other learning tools later in this chapter.

In-classroom electronic learning aids

Some learning topics are very conducive to electronic equipment in the classroom, e.g., geography or music, and they would make learning much more enjoyable for the children. For example, a simple PC with a projector can be used very flexibly to illustrate various topics. A class clicker (even when used on a smartphone) can give valuable feedback if a topic has been understood by most or not. Especially in combination with real-time online access to learning materials (incl. multimedia content), these tools can be a big help to teachers.

6.4.1.5.2 Individual Student Learning

In the case of hinterland and remote schools where special subject teachers are very few, students can engage in direct learning with special subject-based applications or gamification platforms that convey specialized knowledge. In addition, these systems are useful when topics need to be re-learned or a student has special needs, which cannot be satisfied in the regular classroom interactions. The demand from MoE and other Guyanese institutions has been uttered. Applications and online services such as Khan Academy, Play2Learn, SuccessMaker, Apple iTunes-U, Coursera, MOOCs like MIT's OpenCourseware or MITx via EdX and other tools and platforms need to be available via online connections to be most effective.

Figure 343 outlines how a remote learning system can work which is based on pre-recorded and even externally supplied content. Teachers or specialized editors populated the content management system (mostly an LMS) with training lessons while students take the lessons at their own pace. A monitoring function tracks student progress and informs teachers which students still need additional attention.

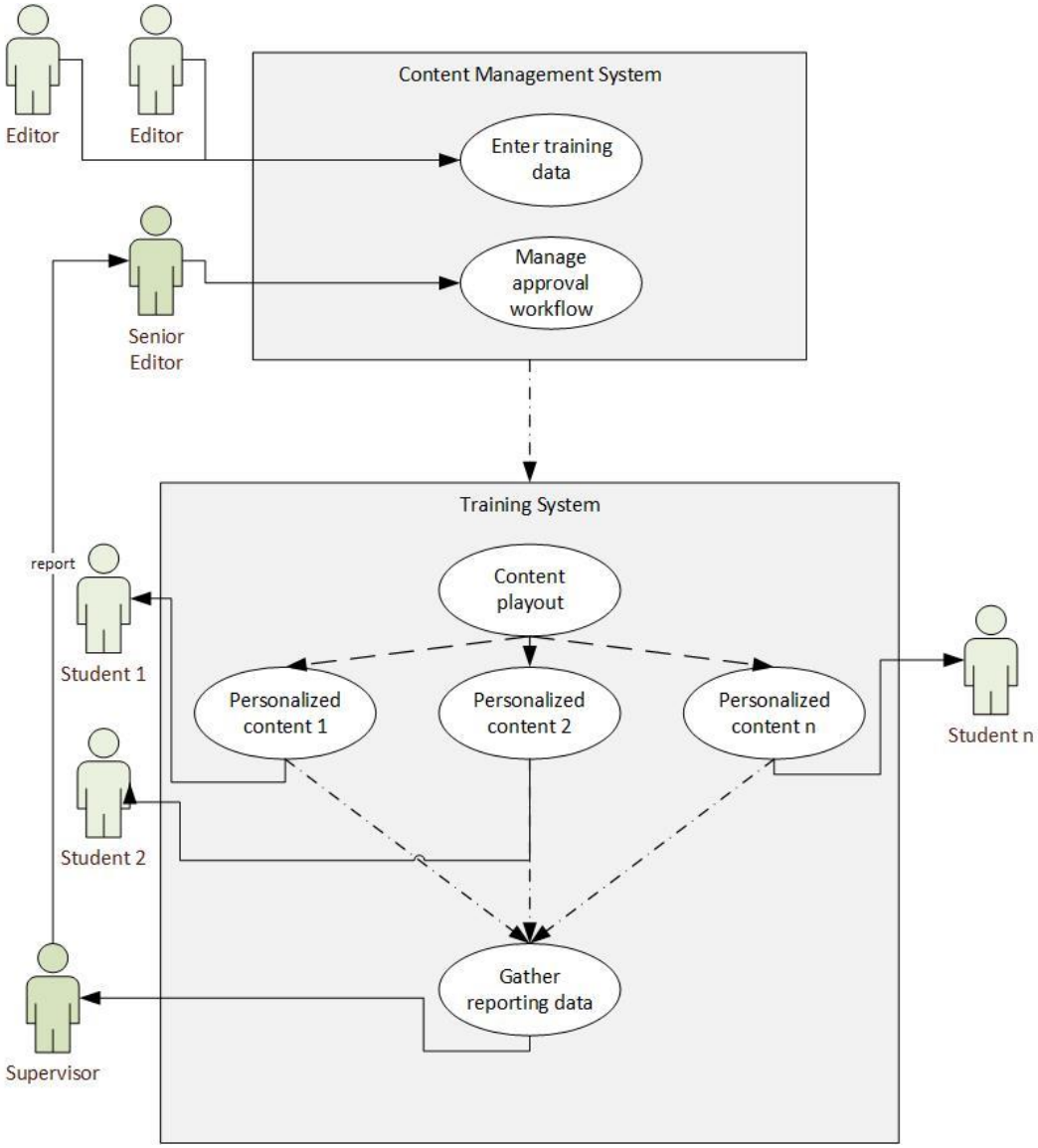


Figure 343 - Learning Management System – Students learn at their own pace based on pre-shared content

Another aspect of individual student learning is access to knowledge databases for research tasks. This should be distinguished from internet access and Google searches in that very specific databases can be queried. This is especially true for specialized fields like medicine, law or business topics. Appropriate databases can be hosted in local datacenters and offered on the eGovernment Network for free.

6.4.1.5.3 School management application

The hinterland and remote primary and secondary schools are located far away from Georgetown and are hard to reach with long car rides or taking plane trips. Still, there is a need to track and control these schools to elevate them to a standardized school system and curriculum. The national school authority needs a reliable way to communicate with the interior school staff and exercise steering control. Thus, an application which makes it possible to chat with teachers and administrative staff (either text chat or video), gives remote access to schools attendance records and other school statistics, helps in class schedule preparation, and can track school inventory would be a very helpful service. Figure 344 below shows a high-level interaction diagram for a possible service. These are by far not all needed

or possible support tasks and only a detailed analysis by the Ministry of Education and related stakeholders can reveal the requirements of a school management platform.

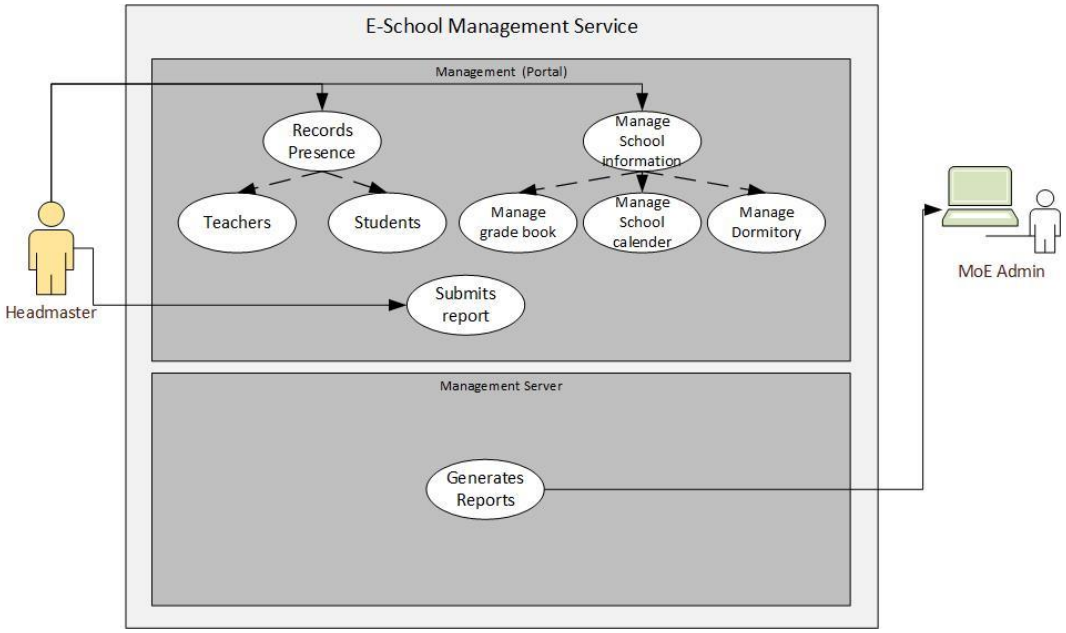


Figure 344 - School management system – Tracking & reporting of administrative school events and statistics

6.4.1.5.4 Remote Classroom

When there is a shortage of teachers for a certain subject, it is very useful to multiply a teacher's impact via real-time tele-education. This is the case for remote classroom, where a single class is recorded in one location and transmitted to multiple locations in real-time. In this classroom-based training with a live instructor over the internet the students get to:

- Participate in class from anywhere in the world with a compatible computer and reliable access to the internet
- Interact with the instructor and other students through a virtual classroom interface
- Perform course lab exercises through the remote classroom software environment
- Receive world-class training courseware when partnering with other institutions

The ways in which schools are leveraging synchronous remote classroom technologies are expanding every day. Popular tools like **Skype** and **Google Hangouts** are increasingly being employed to bring students, guest lecturers, panel participants, and others into the physical or online classroom. There are also a growing number of education-specific apps like **WizIQ** and **e-Lecta** to facilitate virtual classroom participation. Web-based audio or video conferencing apps enable this functionality, and options like chat, online whiteboards, and file sharing can enhance the experience.[177] However, for rendering a professional service, an advanced recording and streaming system with hardware-supported video stream generation is indispensable. The Echo360 (see case study in Section 6.4.1.4.5) or other commercial products are more expensive initially, but will deliver great results, be easy to install and handle and save costs in the long term.

Figure 345 outlines the general idea of a remote synchronous classroom: a teacher holds a lecture in front of an audience while the recording is being shared in real-time with remote students. **Fehler! Verweisquelle konnte nicht**

[177] http://www.emergingedtech.com/2013/04/applications-to-facilitate-synchronous-remote-classroom-participation/

efunden werden. shows a real-life setup including the specially equipped classroom (multiple video cameras, special lighting, large-screen TV and neutral background walls) as well as the editing workplace where the video stream is generated and sent out.

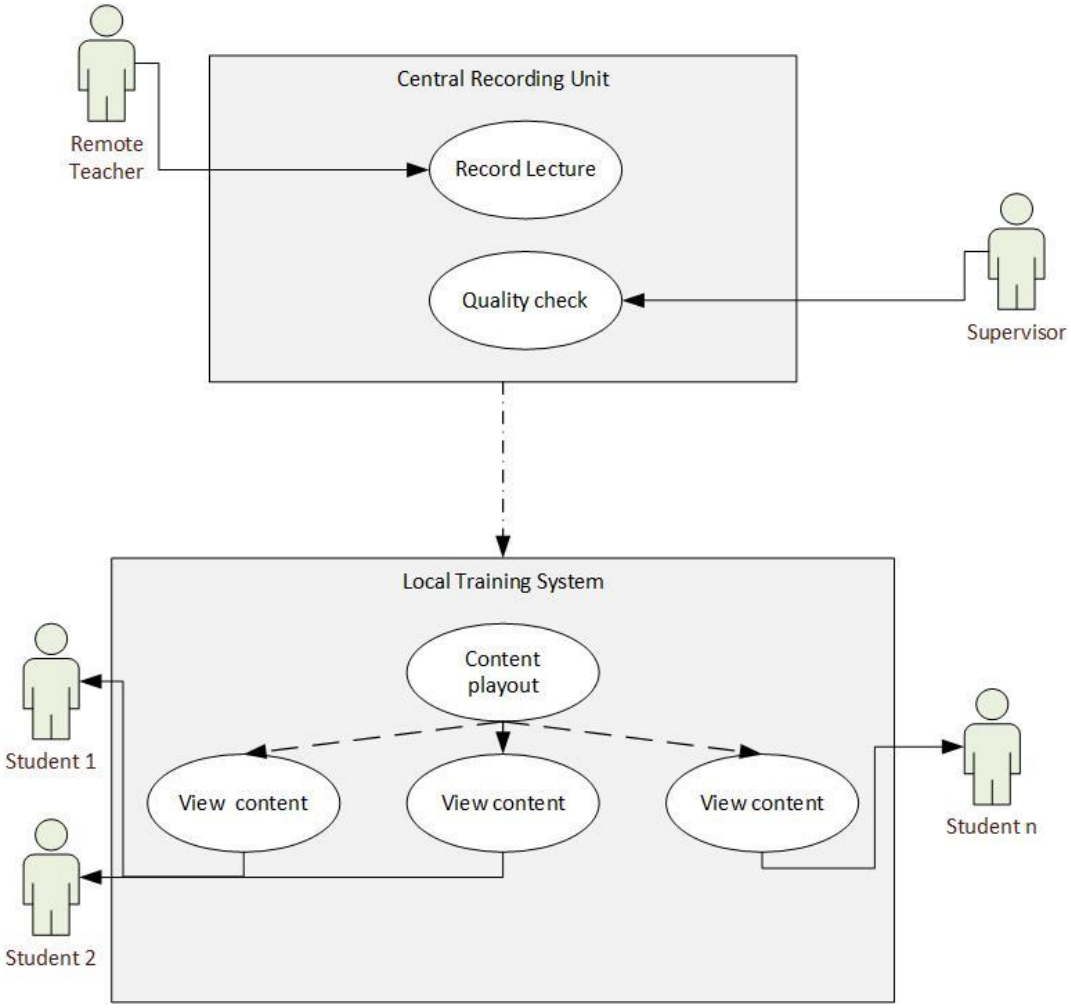


Figure 345 - Remote classroom – addressing the teacher shortage by streaming lectures to remote schools

These systems should not only be used by the Ministry of Education, but also by any other government agency, which has the need for remote education. For instance, the Ministry of Public Health could leverage this tool to launch nurse training programs. This has to be taken into account when designing the systems requirements.

Another use case for this application is the integration into training and information activities in relation to the Amerindian Land Titling Project: briefing and information sessions can be recorded and distributed to multiple indigenous communities at the same time.

Teachers can and need to be trained as well, e.g., in regards to updates and changes in the curriculum. The “one laptop per teacher project” can help teachers to get access to dedicated trainings provided by the Ministry of Education. This training content can be provided on demand and / or in real time (broadcasted) via the eGovernment network.

Figure 346 - Remote synchronous classroom – A technician records a live lecture and streams it online[178]

WizIQ

WizIQ is a widely used application for learning and teaching online. With WizIQ, you can take or attend online classes from your home, office, internet café, library, or even while traveling. It is a powerful tool for collaborative online learning and teaching. People can also use WizIQ smart phones and tablets devices. WizIQ enables synchronous distance learning with tools like real-time virtual classrooms with multi-way audio, multiple live video streams, integrated chat, online whiteboard, application sharing, breakout rooms, and more.

e-Lecta Live

e-Lecta Live is also used to carry out remote participation and collaboration solution for online teaching session. e-Lecta Live offers features including whiteboards, video, presentations, text chat, screen and files shares, and it has smart phone tablets support. The software offers a teaching environment that is led and managed by the instructor. e-Lecta Live is especially designed for online universities and schools to manage multiple teachers for hours, to take more than one class in the same time and control students activity. Their 'benefits' page suggests various approaches to leveraging the functionality the application offers.

6.4.1.6 Potential for Collaboration and Partnerships with Private Sector

It is important to recognize that E-Learning development and delivery are best carried out collaboratively, involving interdisciplinary teams across institutions and at a later stage even countries. There should be adequate recognition and incentives for faculty and institutions to engage in the collaborative design and development of E-Learning services and content.

To promote e-Learning the government of Guyana focuses on the development of a national infrastructure on open knowledge resources. Activities, platforms and services are funded by the government and organizations that are part of the knowledge and education infrastructure as well as by independent NGOs. They serve a social mission, and

[178] Source: CAETE classroom and technical supervision desk at University of Colorado at Boulder

the proposed structure is seen as an effective and efficient way to serve society.[179] After initial transition costs, the revenues are related to better education for people in hinterland, poor and remote communities especially for second and tertiary education. In the long run better education will contribute to more new businesses and overall economic growth.

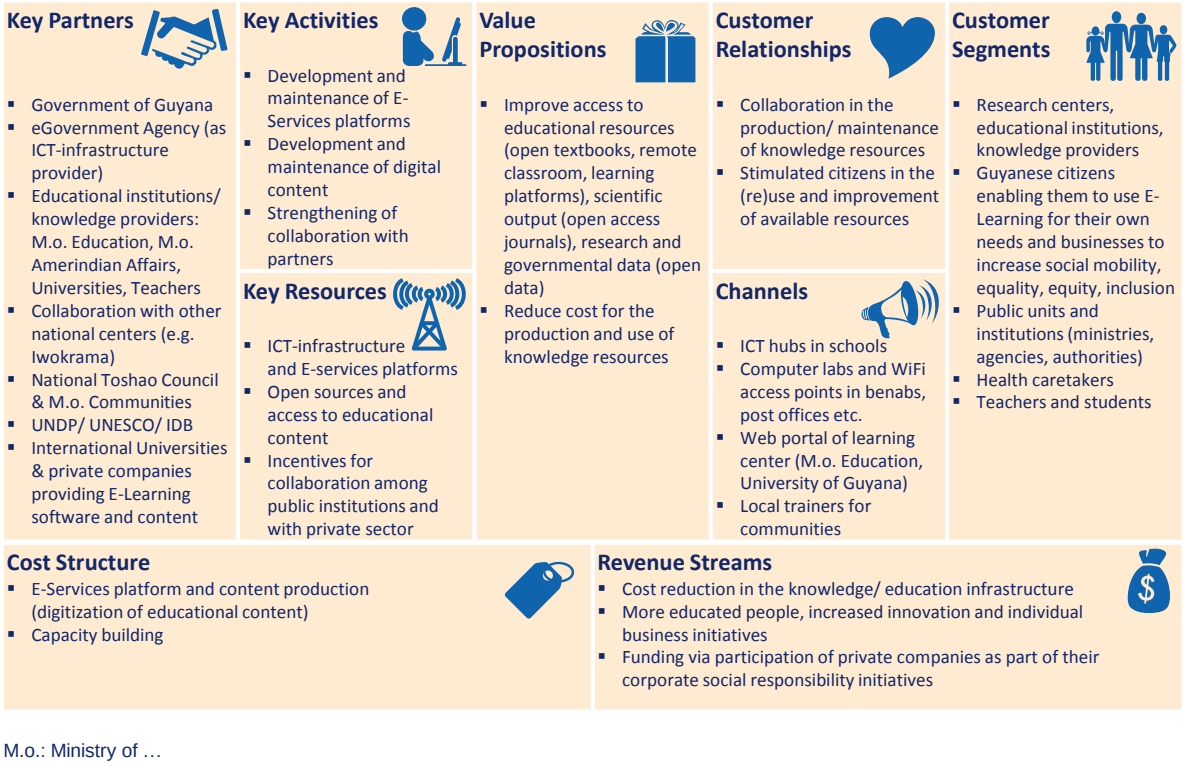


Figure 347 - Business model for E-Learning in Guyana

There is broad potential for collaboration and partnerships with the private sector:

- Educational Institutions
  Educational institutions are the essential resources for the provision and development of educational content. In Guyana, this refers specially to the Ministry of Education and the NCERD – National Center for Educational Resource Development, which is tasked with finding new ways of conveying learning content, among others also fostering the use of ICT in schools and the ministry itself. Furthermore, in the development of content and E-Learning curricula teachers and head teachers of the different regions of Guyana should be involved. Furthermore, any institutions with special knowledge for a specific sector is a relevant stakeholder in the provision of E-Learning content.
  International partnerships with educational institutions such as trainings centers and universities shall be established to enrich the content available for e-Learning. Especially for further training after secondary education, synergies can be realized with such partnerships. Access to digital libraries and research centers facilitate education in special interest fields. A partnership with international universities and research centers can become more appealing if joint research programs are used as incentive (e.g. support international research programs on environmental protection / socioeconomic studies / cultural and

[179] Based on: Mariana Patru and Venkataraman Balaji for UNESCO, Making Sense of MOOCs – A Guide for Policy-Makers in Developing Countries, 2016.

linguistic studies of the Amerindian culture in Guyana). What is more is that international educational institutions can share their experience with E-Learning systems with the Government of Guyana and thus speed up the introduction of successful E-Learning Services.

- International private sector companies
  International private companies can have multifold interests in a collaboration in the field of E-Learning. The major motivation is corporate social responsibility (CSR) programs. Their contribution can consist in the funding of financial resources, provisioning of devices, provisioning of software or maintenance of platforms. For example, Microsoft's CSR program includes the Microsoft Affordable Access Initiative. The initiative aims to empower the billions of people worldwide who do not have affordable access to the internet through partnerships, grants, investments, education, and advocacy—to create technology solutions, business models, and policies that help close the digital divide.[180]

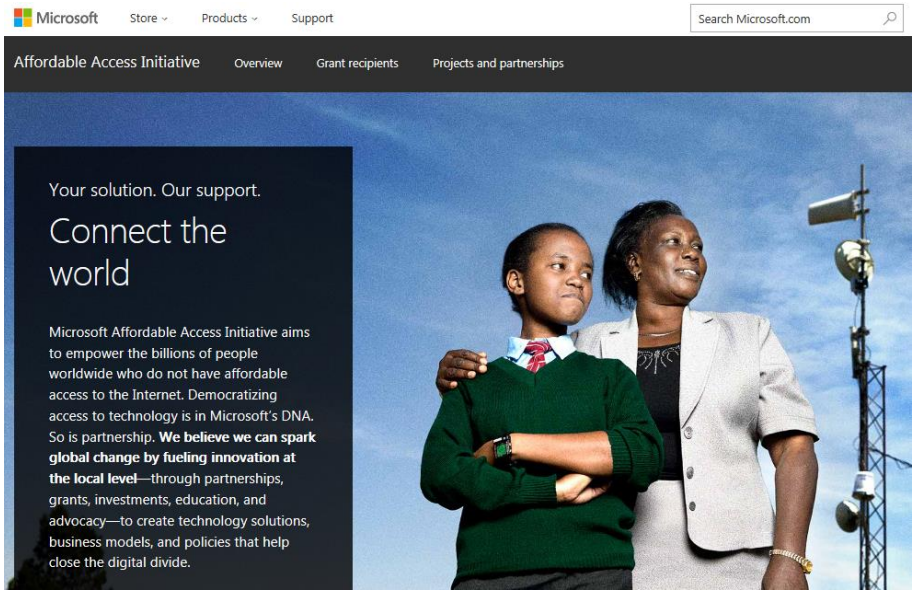


Figure 348 - Microsoft corporate social responsibility program: Affordable Access Initiative

IBM for example is according to its CSR strategy dedicated to helping further education and workforce development through programs created to assist […] teachers and students.[181] IBM's STEM-program has the aim to help teachers teach and students learn:

"The first letter of "STEM" stands for "science," yet far too few teachers are prepared to teach it effectively — particularly in the earlier grades. That is why IBM created Teachers TryScience, a global resource for science lessons and support for front-line educators. The Teachers TryScience website offers 589 lessons in 15 languages (including 116 new lessons in four new languages added in 2015 alone), along with 69 pedagogical videos and tutorials. IBM developed each resource in collaboration with master science teachers.

The program made an especially strong impact in Southeast Asia and sub-Saharan Africa in 2015. In Vietnam, the website proved so effective that the Sóc Sơn district in Hanoi integrated Teachers TryScience's lessons and active learning methodologies into the official secondary school curriculum. And in Kenya, IBM established a partnership with the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) — the Ministry of Education's professional development agency for STEM teachers — to train 100 education leaders from urban, rural and arid regions how to integrate Teachers TryScience into their classrooms. This effort helped engage nearly 15,000 students throughout 2015. In 2016, CEMASTEA and IBM plan to train 200 educators in 10 counties — part of a three-year rollout of Teachers TryScience in Kenya.

Teacher Advisor, Powered by IBM Watson was created by teachers, for teachers. Now in development, it will serve as a virtual mentor to educators. Teacher Advisor will help teachers enhance their content knowledge, strengthen their lesson-planning skills and improve their overall instructional practice. Best of all, it will be

[180] https://www.microsoft.com/en-us/affordable-access-initiative/home/
[181] http://www.ibm.com/ibm/responsibility/initiatives.html

available whenever a teacher needs it — discreetly, confidentially and totally free. Teacher Advisor will launch as a pilot in August 2016, and will be available to all teachers during the 2016 — 17 school year."

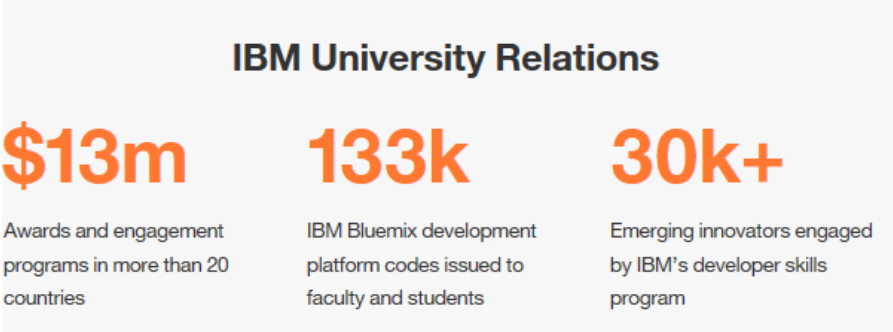


Figure 349 - IBM corporate social responsibility program: University Relations

Samsung has a dedicated Smart School initiative aiming to bring digital classrooms to schools all over the world in order to bridge the digital divide. In 2015 Samsung rolled out the program in North Ruimveldt Multilateral Secondary school in Guyana. The program let some 120 students benefit from an e-learning experience. CSR also is an important building block of Google's corporate strategy, Google supports a broad variety of programs all over the world amongst others the "Equal Opportunities Schools" and the "Get Schooled platform", an online hub that will provide free college prep information on scholarships, standardized tests, class requirements, and other academic milestones, and the Khan Academy[182]. SAP donates hardware (laptops and tablets) to charitable organizations and selected markets as one part of the CSR program[183]. Cisco[184] does also support multiple initiatives all over the world with expertise, technology, and financial resources. Cisco's CSR programs focus on access to education, connected health care, economic empowerment, and disaster relief. Oracle focuses on the support of education: The Oracle Education Foundation[185] is a non-profit organization funded by Oracle to support education starting with hardware donations to US-schools and now providing online learning platforms amongst others. The Raspberry Pi Foundation[186] is a UK-based non-profit organization that aims to provide low-cost, high-performance computers as well as education in computing to people all over the world.

- NGOs
  Additional collaborations with NGOs can be beneficial in terms of funding as well as knowledge transfer. UNDP and IDB are active supporters of the development of Guyana. UNESCO is another important institution to collaborate with especially in the field of education, as the Government of Guyana can benefit from the experiences and learnings of projects to build E-Learning Services in different countries all over the world.

6.4.1.7 Recommendation for Next Steps to Create an e-Learning Program

The most important goal of any e-Learning initiative is to benefit the target audience in the long-term, i.e., to be successful. There are three essential requirements for making e-Learning initiatives successful:

- Effective leadership and governance (educator-led programs);
- High standards of quality assurance; and

[182] https://www.google.org/global-giving/global-impact-awards/#tab=awardee-tab-education
[183] http://go.sap.com/about/social-responsibility.html
[184] http://csr.cisco.com/pages/csr-programs
[185] https://www.oraclefoundation.org/
[186] https://www.raspberrypi.org/about/

- Sufficient capability in terms of systems, people and infrastructure.

The practical next steps have to address these points and make the initiative tangible for impacted stakeholders. Among the topics to be addressed are:

- Creation of an "e-Learning board" which comprises all relevant government stakeholders. This will drive the initiative and make sure sharing of platforms can occur later.
- Assigning the leadership structure for the initiative and scheduling regular meetings. This will give authority to the work stream leaders and enable periodic reviews.
- Assessing the current processes, platforms and ongoing initiatives (as is analysis). There are many independent (silo) efforts underway, which need to be consolidated in a first step. The drivers behind these efforts need to be part of the e-Learning board for the overall e-Learning initiative.
- Assessment of detailed needs and requirements of the stakeholders in the future e-Learning platform(s).
- Filling of appropriate positions within the eGovernment Agency and Ministry of Education. The new hires need to be skilled and experienced enough to lead infrastructure implementation and software training efforts. Collaboration with external vendors also needs to be steered.
- Selection of communities (schools) to be connected to the e-Learning platform(s) and start of interaction and discussion with the local leaders and educators.
- Tendering Phase: writing RfP with detailed technical and procedural requirements, launching tender, evaluation of responses, negotiation with short-listed vendors, closure of contract
- Setup of a dedicated program management office (PMO) to drive and oversee the implementation
- Setup of needed infrastructure centralized as well as in the respective communities.
- Trial runs of selected vendors' platforms
- Full-scale rollout of e-Learning platform(s) in hinterland and remote communities
- Launch of training measures for teachers, students and administrative staff (see separate report on Capacity Building).
- Use synergies with exiting learning platforms, e.g., the Guyana Learning Channel. Information broadcasted on that channel can be redistributed and made available as "on demand content" via the e-Learning platform.

6.4.1.8 Special Network and Device Requirements

There are many e-Learning settings and technologies available to use in schools, each with their own advantages and applications. Often the best solution is a combination of technologies depending on the particular need, use case and learning environment.

While broadband internet or Intranet access is needed for effective collaboration and streaming services, there are many use cases, which can be operated stand-alone. What all of them have in common is that they rely on electronic equipment in the school itself. Following is a description of typical equipment that can be used in a classroom.

Multimedia Classroom

In a multi-media classroom, educational content is delivered to students in a one-to-many approach. This is cost efficient per pupil, and can provide a large amount of educational resources to students. Classrooms would be equipped with a projector, screen (or large LCD), speakers and a classroom computer. The teacher could display various types of content that is housed either on the classroom computer or on the teacher's laptop or other device. The teacher would be able to adapt and project various content (e.g., videos, PowerPoint slides, augmented reality, multimedia presentations, the teacher drawing a graph, etc.). A connected classroom would have wireless or wired communications to a "cloud" of resources. The teacher would thus have access to a wide range of content from the library on the cloud. The computer housing the content could be locally based at the school (which would obviate the need for inter-school communications, and be reliable), at a district or national educational headquarters, or elsewhere.

Connected multi-media classrooms would permit distant classroom teaching, in which a teacher in one school or from a studio could deliver live, interactive lectures to classrooms in other schools. The distant classrooms would need to be outfitted with video cameras and microphones, as well as projectors and speakers, to communicate with the distant teacher.

Computer Lab

A computer lab is among the most recognizable form of e-learning technologies. A computer lab usually consists of many single personal computer stations. This is a common arrangement found in schools throughout the world. Many educational software packages available could be installed for student use. Separate stations permit individual students to move at their own pace through material. Teachers can also lead students or student teams through guided exercises, with each following on their own station. Free computer time itself is a valuable educational resource. Installing separate computers is an easy to set up, since it is simply single stations behaving independently. Computer labs can be, however, more expensive per student due to the individual computers and software licenses. They may also have higher power consumption demands, depending on the computer or device, necessitating low-cost power solutions. Multi-seat computing consists of using one powerful personal computer with extra video cards to support up to eight independent “seats” (each with its own monitor, keyboard and mouse running separately). They can be put in a computer lab for students or teachers to use, or in classrooms. There are several commercially available multi-seat operating system software options including by Microsoft and Linux. This system has the advantage of using much less power than other options. It is usually the least expensive per user as well.

Single Station, Personal Computers

Varieties of types of single station devices are available.

1) Personal computer (PC). A PC is a common approach for using computers in homes and offices. It consists minimally of a computer, one or two monitors, a keyboard and mouse. Each computer has its own operating system and software programs. From a setup and maintenance standpoint, this type of system is advantageous. It is easy to maintain and does not generally require a specially trained computer technician to fix most hardware and software problems. However, if each student were to have a computer, this would be among the more costly options to implement, particularly in rural areas reliant on solar power. This would be useful particularly for teacher stations or single stations in the back of classrooms.

2) Micro Computer. A microcomputer is similar to a standard single station except that is uses a small form factor case with a generally slower processor. Power consumption can be much lower than a single station and thus suitable when power is limited. The computers are, however, difficult to repair and may be prone to theft and overheating; the lifespan of these devices is not yet known. Software maintenance is similar to a standard single station.

3) Laptop or notebook. Laptops and notebooks are among the easiest educational solution to set up. They usually come with software preinstalled and only a power outlet is needed to begin using the system. The power consumption is low compared to a personal computer. Hardware maintenance can be difficult, but software maintenance is standard. One of the disadvantages is product lifespan; they are easy to steal and are prone to accidents (a spill on the keyboard can easily destroy it; new rugged laptops reduce this risk). New design and battery technologies are lengthening battery life in some machines. Laptops may be an excellent solution for teachers. Teachers could bring a laptop to work from home, and then connect it to the classroom projector.

Small, Personal Devices

Small, personal devices such as **tablets**, **smart phones** and **e-readers** are similar in that they are all relatively new technologies. They are rapidly gaining popularity due to their declining price, large number of web-based software applications, powerful graphics, and enjoyment of use. Educational uses could include listening to audio lessons or audio books, gaming, watching videos, and reading. Writing is more difficult if the device does not have a keyboard. Schools and teachers can develop teaching material applications for mobile devices using existing software.

Penetration of **mobile cellular internet** is rising rapidly in the Americas and other developing countries because of the availability and relatively low cost of internet access, text and voice through cellular networks, especially compared to broadband internet. Because of this, the World Bank, USAID and other donors are actively investigating the potential role of mobile phones and e-learning devices in education. Nevertheless, the maintenance requirements

and lifespan of smart phone and other small devices in difficult environments are not yet known. Similar to laptops, they can be easily lost or stolen, and are prone to accidents. A difficulty in adapting educational software is that the various brands and styles have different operating systems and screens, and each may require separate configuration. Their batteries need to be frequently recharged, but individual external solar panels could be used.

1. Tablet. A tablet personal computer is similar to a laptop but with a touch screen, and often a smaller hard drive and screen. Tablets may or may not have a keyboard. A touch screen permits a new form of human-machine interaction, the uses for which are becoming increasingly apparent. As educational software is developed to take advantage of touch screens, tablets may become useful for e-learning.

2. Mobile Phone/Smart Phone. Today, cellular internet coverage is often available, even in rural areas (especially compared to broadband). With the rapidly declining cost and increasing features of mobile phones, there is potential to use mobile phones as a web-based e-learning technology. They can also, for example, be used by students in the classroom as a virtual clicker (to answer questions teachers ask in class), or for games or quizzes by using text messaging interfaced to an instructor's computer or phone. They may be used as an e-reader, or for communicating with other students or teachers.

3. E-Readers. E-Readers are becoming popular as a relatively low power, inexpensive replacement for traditional textbooks. Their purchase price is declining. One e-reader could contain multiple textbooks or other readings, and the content could be easily updated. E-readers often have high resolution, monochrome screens making them good for reading text but not for multimedia applications. Where books are expensive, hard to find or need to be frequently updated, e-readers may be very useful. It would be easy to upload in-class "handouts" to student e-readers as well. Copyright agreements and revenue sharing would need to be arranged with the book's publisher.

General Affordability Challenge and Solution Approaches

Broadband access requires devices capable of accessing the internet, ranging from computers supplemented with a modem (called USB modem, dongle, or air card) to smartphones, netbooks, and tablets. Beyond service pricing, broadband economic adoption obstacles are linked to device prices. Specific policy initiatives can contribute to reducing the purchasing cost of such devices.

Three types of programs have been implemented to overcome the personal computer ownership barrier:

- The first one focuses on the provision of subsidies, such as vouchers or the provision of lower priced devices for qualifying segments of the population (e.g. students)., to reduce the acquisition price of devices. The target in this case could be either households at the lower end of the socio-demographic pyramid, students all the way from primary school to university, and SMEs, especially micro-enterprises.
- The second program is typically targeted at students in primary education, with governments distributing "one Computer per Child". In this case, computers are provided free of charge to students in public schools. In 2011 the government of Guyana has tailored this approach to the local specifics and started the "One Laptop per Child" program. Today this initiative is revived, but with a slightly changed focus and runs as the "One Laptop per Teacher" Program.
- The third type of initiative entails a reduction of the access price by eliminating or decreasing taxes paid at time of purchasing. Levies affected by this measure could range from sales tax, import duties, and even sector-specific levies.

These programs are more prevalent with regards to computer distribution, although they could be extended to other broadband access devices such as smartphones.

Some countries have reached the conclusion that while foregoing tax collections in the short run, a tax reduction strategy can result in additional adoption of devices and broadband usage, and consequently enhanced economic benefits in the long run.

Example from Pakistan: Computer Purchase Program

To promote economic growth and sustainability within its country, the government of Pakistan committed to increasing ICT and broadband access through a universal service policy. The policy, which launched in 2007 and reflects a partnership with public and private companies, stressed affordable voice and data services, increased broadband access, and the development of telecenters. Funding comes through operator revenues, access promotion charges for mobile networks, and proceeds from spectrum auctions. Amongst other projects enacted through the fund, the computer purchase program made the home computers more affordable for students, government employees, and military personnel. For instance, the Allama Iqbal Open University aims to foster a 1:1 e-learning environment. In doing so, it launched a computer purchase program offering all of its 700,000 students – including its many remote distance-learning students – below-market-rate loans for Intel-based laptop computers. The program, which was created by the Higher Education Commission and Intel, works with local banks to finance the loans. In 2011, Intel collaborated with Meezan, an Islamic bank in Pakistan, to launch "Laptop Ease." In its first four months alone, the program, which offers a "large-scale hire-purchase scheme for personal computers," provided 400 laptops to citizens with a 3 – 24 month repayment schedule. By 2012, the program aimed to increase this number to 250 laptops per month.

The advantage of such a program supporting reduced rate loans for the purchase of ICT devices is, that emotional connection to the device purchased at own costs is higher compared to devices that are given to users without any investment required. To complete the "One Laptop per Teacher" program it is recommended to introduce subsidized loans for the purchase of ICT devices to increase broadband accessibility among the population of communities in the hinterland, poor and remote areas. Still the distribution of subsidized devices – and may it be by low-rate loans – always carries the risk of being abused from resellers leveraging the arbitrage business. In order to ensure that people in in the hinterland, poor and remote communities can actually benefit from the subsidized devices instead of any arbitrage dealers, a control mechanism and close monitoring should be started. Access to subsidized loans and devices should be conditioned by certain requirements such as, one device per person only, proof that device is being used by the respective person by tracking of IMEI and IMSI/SIM card for one year after purchase.

6.4.2 E-Health – Remote Patient Care, Education and Health Data Management

6.4.2.1 Overview and Definitions

Healthcare is one of the most important and prominent indicators of economic growth and sustainability of a country. Guyana has seen a good growth of economic activity in the last decades and proportionately has spent more on healthcare. However, due to the special geographical expanse and vegetation of the landmass, the hinterland and remote areas are less served with modern healthcare than the more affluent and compact coastal region.

To mitigate this imbalance one can think of the following situations:

- There would be better care given and utilization of resources improved if patients and medical staff in one region could consult experts in another region. Physical travel would be minimized.
- The range and quality of medical procedures performed in a health station could be widened if lesser skilled health workers could be trained to handle more complex tasks without a trainer having to travel physically to the respective health care site. The trainer could as well train multiple health station simultaneously.

- The spreading of a communicable disease could be contained or halted if the respective communities and health workers knew about an epidemic before it hits their remote communities. Effective epidemiology depends on timely gathering and exchange of information from far-flung locations.

The use of ICT is the most effective way to enable the above use cases and bridge the divide between coastal institutions and hinterland and remote regional hospitals and health stations without physically moving resources. It also strengthens the availability of skilled human resources with varying levels of competency.

The following terms are used in this report to describe the use of ICT in remote healthcare (source: WHO and Health Resources Services Administration, USA).

E-Health is the use of information and communication technologies (ICT) for health. Examples include treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health.

Telehealth is the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration.

Technologies include videoconferencing, the internet, store-and-forward imaging, streaming media, and terrestrial and wireless communications.

Telemedicine is defined as the use of information and communication technologies (ICT) to deliver healthcare services from a distance. Information transmitted can be utilized by healthcare professionals for patient diagnosis, treatment and monitoring.

E-Health, in general, refers to the use of digital media and ICT in healthcare independent from the location of the caregiver or patients.

Telehealth is different from telemedicine because it refers to a broader scope of remote healthcare services than telemedicine. While telemedicine refers specifically to remote clinical services, telehealth can refer to remote non-clinical services, such as provider training, administrative meetings, and continuing medical education, in addition to clinical services.

Telemedicine has applications in a number of clinical settings that include primary healthcare and emergency care facilities. Telemedicine relies on two basic types of communication: synchronous and asynchronous communication.

- Asynchronous transfer is based on a store-and-forward concept. Information is first obtained and saved. It is forwarded to the doctor or specialist only when required.
- Synchronous transfer is real-time, which relays images and clinical information to the doctor as it is received. It can take the form of video conferencing

Synchronous transfer of information (e.g., video and audio) requires higher-bandwidth communication infrastructure and high quality of service. Asynchronous data transfer is independent of available bandwidth and quality of service parameters and even sustains interruptions of the connection. Thus, asynchronous means of telehealth provisioning can be deployed easily while the infrastructure and services are being tested. At a later stage when the infrastructure works flawlessly, synchronous services can be added successively.

6.4.2.2 Case Studies of effective e-Health Projects

Project Summary	
Project Name	MOM Pilot project in Padang (Indonesia)
Goal of Project	Decrease the maternal mortality rate in Padang Region by: ▪ Performing antenatal risk stratification, ▪ Receiving diagnostic assistance, and ▪ Assessing a patient's progress via a mobile device to facilitate a public-private partnership of midwives and ObGyns (Obstetrics- Gynecology).
Project Owner	▪ Government of Padang ▪ Philips community life center
Target User Group	656 Pregnant women in the region of Padang (rural area in Indonesia)
Implementation Partner(s)/ Stakeholders	Philips Healthcare
Year of project launch	2011
Description of Methodology	1. Remote monitoring by ObGyns of high-risk pregnancies facilitated by home visits of midwives 2. data collecting
Time to implement	2 years (2011-2012)
Needed hardware and ICT connectivity requirements	▪ Laptop ▪ Mobile phone ▪ Apps (MOM application) ▪ Medical mobile devices

Project Summary	
Project Name	STARsystem-Diabetes management's platform for Canadian' diabetes patients
Goal of Project	▪ Web- based diabetes support platform to inform, monitor, support and enable diabetics to better take control of their health. ▪ The platform is free anywhere, anytime for diabetics who purchase Sanofi's blood glucose monitors (BGStar, iBGStar)
Project Owner	▪ SANOFI Canada ▪ TELUS Health
Target User Group	Diabetes patients
Implementation Partner(s)/ Stakeholders	▪ SANOFI Canada ▪ TELUS Health
Year of project launch	March 2012

Description of Methodology	1. Questionnaire based self-assessment to identify the diabetic's know how and suggest relevant educational content and activities. Access to tailor educational and self-management health tools via personalized dashboard. 2. Monitor Blood glucose either via standalone device (BG Star) or adapter for iPhone/iPod (iBGStar) each connected to the platform. 3. Free personalized Diabetes Coaching sessions by phone or online
Time to implement	N/A
Needed hardware and ICT connectivity requirements	▪ Insulin Pen ▪ Blood Glucose monitors (BGM) ▪ Adapter for iPhones

Project Summary	
Project Name	Telemedicine project in Bonsaaso (Ghana)
Goal of Project	Reduce unnecessary transportation and improve the referral system in rural areas.
Project Owner	Novartis Foundation
Target User Group	Health professionals
Implementation Partner(s)/ Stakeholders	▪ Agroyesum District Hospital, ▪ Earth Institute at Columbia University, ▪ Ghana Health Service (GHS), ▪ Ghana Medical Association, ▪ Ghana Ministry of Communications, ▪ Ghana Ministry of Health, ▪ Local hospitals & health centers & patient groups, ▪ Medgate, Switzerland, ▪ National Health Insurance Authority, Ghana
Year of project launch	2009
Description of Methodology	1. Healthcare personnel are trained in the use of mobile technologies to perform health consultations from a distance. 2. This training enabled personnel to communicate via mobile phones within their peer group for coordination and informal tele-counselling.
Time to implement	N/A
Needed hardware and ICT connectivity requirements	▪ mobile phone

Project Summary	
Project Name	mDiabetes Project in Senegal
Goal of Project	Preventing and combating Diabetes and non-communicable diseases
Project Owner	NA
Target User Group	Population and health professionals

Implementation Partner(s)/ Stakeholders	▪ Government of Senegal: Minister of Health and Social Action, ▪ the Minister of Communication and Digital Economy, ▪ ASSAD (Senegalese Association for the Assistance and Support of Diabetes Patients), ▪ International Diabetes Federation, ▪ UNFM (Université Numérique Francophone Mondiale), ▪ Marc Sankalé Diabetes Center, ▪ Alcatel Lucent ▪ Sonatel, ▪ Orange ▪ BUPA (global international health insurance and services company)/Sanofi (Pharma) ▪ WHO & ITU ("Be Healthy, Be Mobile"Initiative).
Year of project launch	N/A
Description of Methodology	1. with appointment reminders, lifestyle and dietary advice, and the proper observation of treatment to limit risks of complication 2. Train health professionals and implement tools for prevention, screening, diagnosis, treatment, monitoring, etc.
Time to implement	NA
Needed hardware and ICT connectivity requirements	Mobile phones (SMS and voice messages)

Project Summary	
Project Name	Diabetes Management pilot in US
Goal of Project	The extension of HCN's (Health Choice Networks) Diabetes Management platform with mobile health applications from Microsoft
Project Owner	Health Choice Networks
Target User Group	100 diabetics in the US
Implementation Partner(s)/ Stakeholders	▪ Microsoft ▪ TracFone ▪ Health Choice Networks
Year of project launch	August 2014
Description of Methodology	1. During the pilot 100 Medicaid diabetes patients will be equipped with the phones and free special smart communications services from TracFone. 2. Patients can communicate securely with their doctors and nurses based on HIPAA compliant (privacy rules) communications and information exchange. 3. HCN's applications will help participants provide consent, deliver and receive reminders, ensure treatment plan understanding, and aid in disease self-tracking for blood sugar levels and other vital health information. 4. Personal health record platform that brings disparate data together in a secure environment
Time to implement	N/A

Needed hardware and ICT connectivity requirements	Smartphones

Project Summary	
Project Name	DiabetesManager
Goal of Project	Provide a mobile-health platform that allows patients and caregivers at Alere to manage patients' type 2 diabetes using WellDoc's mobile DiabetesManager software
Project Owner	Alere = Health management services company, devices for diagnostics
Target User Group	Patients' type 2 diabetes
Implementation Partner(s)/ Stakeholders	▪ Alere, Health Management Services company, devices for diagnostic ▪ Welldoc = mobile application provider for diabetes management ▪ AT&T
Year of project launch	N/A
Description of Methodology	1. Patients enter blood glucose readings and medication data into DiabetesManager's health application on their compatible mobile device or the Web. 2. The software provides automated real-time feedback and behavioural coaching for people with type 2 diabetes. 3. In addition to real-time coaching, DiabetesManager enables Alere nurses, case workers and doctors to communicate directly with patients = USP of Welldoc's application
Time to implement	N/A
Needed hardware and ICT connectivity requirements(laptop needed /special hardware needed/mobile phone only)	▪ Web ▪ mobile app

Project Summary	
Project Name	Remote Blood Glucose Monitoring
Goal of Project	Improve diabetes treatment via remote blood glucose monitoring
Project Owner	▪ Telcare ▪ Telenor connection
Target User Group	Parents of children with diabetes and those caring for elderly people with diabetes
Implementation Partner(s)/ Stakeholders	▪ Telenor Connexion ▪ Telcare
Year of project launch	End 2012
Description of Methodology	1. Connected Blood Glucose Meter instantly transmits a patient's readings to a private online database, which can be accessed by the patient or, with permission, by a doctor, caregiver or family member

	2. The system charts the results to highlight trends and spot problems, and can be accessed via a web browser or an iPhone app.
Time to implement	N/A
Needed hardware and ICT connectivity requirements	▪ Wireless glucose meter ▪ Web browser or iPhone app

Project Summary	
Project Name	Innovative telemedicine in Nigeria
Goal of Project	▪ To improve the care of people with hearing loss in Africa ▪ To perform accurate hearing tests in remote regions in future. ▪ Enable the transfer of audiological knowledge via the establishment of a telemedicine network
Project Owner	Three physicians from Nigeria, Malawi and South Africa
Target User Group	Hearing loss people in Africa
Implementation Partner(s) / Stakeholders	▪ Children Care Consortium ▪ Hear the World Foundation
Year of project launch	2012
Description of Methodology	Experienced experts will monitor and check the test results over the internet, guaranteeing that patients receive professional care, without the need for an expert directly on site.
Time to implement	N/A
Needed hardware and ICT connectivity requirements	▪ KUDU wave a mobile device for taking audiometric measurements

6.4.2.3 Proposed Use Cases for e-Health Services in Guyana

The availability of Telehealth to hinterland and remote areas is almost inexistent. Many day-to-day activities, like filling out questionnaires, submitting health records, acquiring additional health training or soliciting help from an expert in a specialized hospital, can either not be performed at all or need an extraordinary amount of time and effort. E-Health activities are currently concentrated in the coastal areas due to the lack of a plan and dedicated resources to implement it.

Based on the responses of individual health care workers in the HPR communities (see WP1) as well as the interviews of institutional stakeholders (PAHO, MOPH, eGovernment Agency) it can be concluded that brining basic internet infrastructure with even limited connectivity to the hinterland and remote communities and offering very basic asynchronous services can improve the quality of care given and data collection ability dramatically.

Furthermore, once a comprehensive HIS has been installed in the central hospital in Georgetown, including electronic health records (EHR), disease information and electronic educational materials, these should be made available to all connected HPR communities.

Once the basic services are rolled out and staff has acquired good skills in ICT, the next phase of synchronous services can be launched. These include interactive medical training in a remote classroom setting, consultations of health workers with remote experts and remote diagnoses when patients interact with doctors directly. In addition, the collection and tracking of vital bodily information should be considered for prevention of illnesses.

Private hospitals and health institutions have a strong standing in Guyana, hence they shall also be leveraged to use eHealth-services provided by the Ministry of Public Health. This leads to these specific design requirements for e-Health services:

- E-Services needs to be designed that they run on infrastructure in private hospitals and can access central servers provided by e-Government Agency or by the Ministry of Public Health
- Design of interfaces used to exchange information between public and private institutions must be openly accessible so that private institutions can adapt their software accordingly. The legal framework must designed accordingly that it permits the exchange for information between private and public institutions
- Exchange of information needs to be encrypted to secure privacy of the data shared.

Basic Asynchronous Services

Even implementing simple communication services can make a big impact on the operation of the healthcare services in the hinterland and remote communities. A survey of healthcare workers and interviews with institutions revealed that the **timely transmission of data** from regional hospitals to the national hospital in Georgetown would greatly increase the data collection capacity. Furthermore, important disease information and government forms, which are available on simple websites, can speed up patient treatment and administrative processes. Learning can be accomplished if healthcare workers can interact freely online. For these reasons, the following asynchronous services should be on the top of the implementation list:

- A robust, unified email system (as already planned and partially offered by the eGovernment Agency)
- Websites which can be updated quickly (e.g., Wordpress) and include static, downloadable forms
- Web browser-accessible forums for knowledge exchange which are moderated by experts
- Document repository, e.g. a Document Management System for shared access and collaborative creation of documents and other data

Warehouse management for medical supplies: Medical stores management at central-level stores and at regional district-level stores is a widespread problem in Guyana's hinterland and remote health centers. Oftentimes the inventory levels are unknown and drugs are kept (and used) well beyond their expiration dates. A common system for creating transparency and aide in drug management should be implemented.

There is a trend towards a decentralized model supported by an efficient IT system and a well-organized supply chain. This should be investigated further and an appropriate IT system should be acquired. The WHO provides a guide to medical store management w.r.t. processes, regulations, organization and IT systems.[187] This serves as a good starting point for system design and vendor evaluation.

HIS – Health Information System: A HIS can be described as any system that captures, stores, manages or transmits information about the health of individuals or the activities of institutions that work within the health sector. A strong HIS is the backbone of an effective healthcare system. An EHR (electronic health record) is used to capture all relevant information based on a unified patient identifier. This system has to be developed for the entire healthcare system in Guyana and is not special to the HPR communities. However, it should be extended into regional hospitals and health stations as soon as they are reasonably well connected.

There need to be facilities to capture the patient's clinical data through normal workflow. Both paper-based records and film-based records data entry need to be supported, whereas all the medical records generated while using the

[187] Medical stores management, WHO, http://apps.who.int/medicinedocs/en/d/Js19621en/

system such as clinical prescriptions, laboratory reports, diagnostic snaps, and vital signs, can be automatically stored in the system.[188] The key HIS components are as follows:

- Clinical Notes
- Administrative System Components
- Laboratory System Components
- Pharmacy System Components

Implementing an HIS is a long-term undertaking and requires close cooperation of healthcare and government stakeholders. It is recommended to pilot this system in the coastal areas and then migrate to the hinterland and remote areas once the system is working flawlessly.

Tele-Consultation: Teleconsultation means obtaining the professional opinion of an expert who is not physically present at the location where the patient and/or the local health worker are. (WHO, 2011)

A common misconception of Tele-Consultation is that it is a video conference where the patient sits down in front of a camera, connects with the doctor and shows his ailments. This type of Tele-Consultation only presents a small part of the market. The majority of Tele-Consultations are likely to be more functional and focus on capturing patient information through interactive forms, questionnaires and photos, rather than a direct interaction with a physician. For example, patients with symptoms of an illness like allergies or acne would complete an online form and send a photo if needed and then receive a diagnosis and a prescription, if necessary.[189]

Tele-consultation takes many forms. A doctor at a health station calling a senior colleague at another hospital to get his opinion regarding a difficult case is practicing one form of tele-consultation. A senior specialist at the national Hospital School of Medicine, providing live consultation through video-conferencing to a medical team performing surgery on a 4-year-old boy's stomach is another form of teleconsultation.

Figure 350 - Tele-Consultation – A paediatrician seeks advice from a remote colleague

Tele-Diagnosis: This form of telemedicine is defined as a "diagnosis that is made at a remote location and is based on the evaluation of data transmitted from instruments that monitor the patient and a transfer link to a diagnostic center."[190] Typical forms of remote sensor data include Digital Stethoscope (General Medical), x-ray scans (Radiology),

[188] http://telesehat.com/rits/real-time-interactive-telemedicine-system.html
[189] http://www.zipnosis.com/faq
[190] American Heritage® Stedman's Medical Dictionary

Ultrasound (Gynecology, Sonology), Digital Notepad (Prescription Writing), ECG (Cardiology), Digital Iriscope (Eye), Digital Dermascope (Dermatology), or Digital Otoscope (ENT). This form of telemedicine is not necessarily real-time, since the evaluation of the submitted information can take some time and be distributed among many experts. This is in contrast to tele-consultation, where results are expected to be available in short period of time.

Figure 351 - Tele-Diagnosis – An expert analyzes an x-ray photo to give a remote diagnosis

A special field of diagnosis is the measurement of effectiveness of a particular treatment. A novel type of ingestible sensor can be used to obtain information about body functions from within the digestion tract throughout the day of a patient. The system Proteus is one possible way to do this. A small ingestible sensor communicates with a sensor patch and an application on a mobile device to track vital bodily functions. Healthcare providers and caregivers can access the recorded data[191].

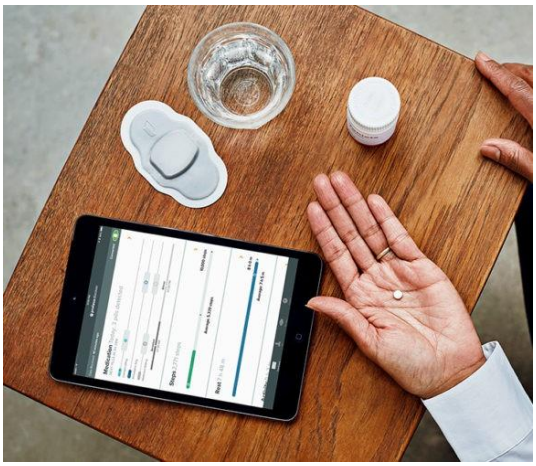


Figure 352 - Proteus System – Monitoring drug effectiveness via ingestible sensor and smartphone

Tele-Surveillance and Early Outbreak Detection for Disease Containment

In order to fight communicable diseases effectively and curb their spreading, accurate and timely field data is necessary. Therefore, health workers consolidate weekly health record statistics gathered from the field at the health stations level and send it to the regional level. They in turn will prepare location and week wise disease count details and share it with the national hospital and MoPH. It takes a long time to communicate the disease count details from

[191] http://www.proteus.com

the interior locations to the state level and mostly only quarterly updates are available. MoPH and PAHO would like to reduce this turn-around time for early intervention.

This can be addressed through an ICT system (see schematic rendering in **Fehler! Verweisquelle konnte nicht efunden werden.**) that incorporates the collection of clinical information for the purpose of detecting disease outbreaks before reaching epidemic states. Web-based data entry on PCs at health stations can be a first step towards an electronic filing of health data. However, if the healthcare worker is often in the field at home visits if might be more effective to switch to a smartphone app for data collection. Information like village name, patient's name, age and sex, date & time of visit, diagnosis, symptoms, prescription can then easily be entered on the spot.

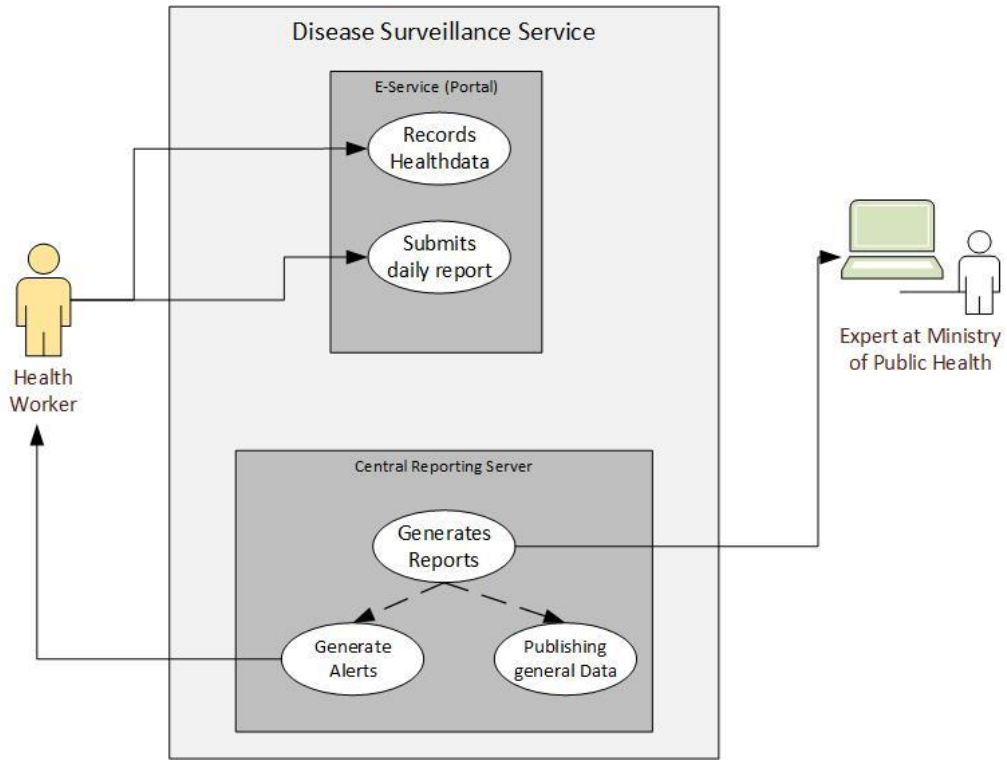


Figure 353 - Tele-Surveillance system for clinical data collection and early disease outbreak detection

Diabetes Management

Diabetes has become an increasing problem for hinterland and remote communities. An effective monitoring and management of diabetes (type I and type II) can make the lives of diabetics much easier and convenient in terms of tracking and analyzing their glucose levels. Meanwhile, there are a few mobile solutions available on the market, which address this task. Diabeto of India or MySugr of Germany have been very successful examples of how a simple system can look like and how big of an impact it can have on diabetics. It is recommended to implement a similar system in the Guyanese healthcare landscape or partner with one of the existing providers.

Figure 354 - Diabeto – track diabetes with your smartphone and an add-on hardware dongle

Figure 355 - mySugr – Diabetes management with just a smartphone app

Maternal Healthcare

One statistic from the World Health Organization shows that more than 800 women die globally every day from preventable circumstances related to pregnancy and childbirth. Almost all of those women live in developing nations. Major complications accounting for most of these maternal deaths include severe bleeding, infections, high blood

pressure during pregnancy, complications during birth and unsafe abortions.[192] Given more education and more access to healthcare workers, there is a good chance to reduce the mortality rate in remote communities.

In Guyana, the problem of maternal mortality is very prevalent in the interior, so much so that the MoPH and PAHO have made this problem to one of their key topics to address. A strong and reliable ICT infrastructure can be the basis for implementing a solution to address pregnancy complications. There are a few information apps for smartphones already available, which can serve as a first step towards this goal, e.g. GiftedMon, maymay, Safe Delivery, Safe Pregnancy and Birth. However, there needs to be a strong network of healthcare workers and support processes in place to eradicate maternal mortality. Some existing projects can serve as guidelines on how to establish these networks, e.g. MAMA – Mobile Alliance for Maternal Action, Zero Mothers Die, Mobile Midwife, auxiliary nurse midwives (ANM) with help of the Suyojana app.

It is recommended that Guyana introduces similar projects based on the eGovernment Network and data center infrastructure.

Fixed VoIP

Communication in remote areas of the country relies heavily on HF radio. Privacy rights of the patients are not taken into account as these conversations are publicly accessible and the transmission is not encrypted. Furthermore, atmospheric disturbances do affect the audio quality.

It is therefore recommended to provide a basic fixed Voice over IP service within the health sector to permit a real time communication between health stations in the hinterland and the regional hospitals as well as with the health related installations in Georgetown. It should be limited to the health sector and not made be available to the public as to not interfere with any potential privately offered telephone service.

6.4.2.4 Special Network and Device Requirements

The required network speeds depend on the use case to be implemented. The least demanding use case is basic asynchronous services, which only needs connection speeds of less than 100kbps and no special QoS. The most demanding use case is tele-consultation with real-time video steaming, potentially of HD quality. This will need between 512kbps and 2Mbps. If multiple PC stations are assumed per hospital with various use cases, a bandwidth of 3Mbps on average should be implemented. Of course, an overbooking factor is possible since not all stations are active at the same time.

The range of possible specialized equipment for e-Health use cases is very large. There can be x-ray machines, ultrasound and ECG apparatuses, stethoscopes and iriscopes for Tele-Diagnoses. However, on a simplified basis the following devices can be identified.

Basic asynchronous services (Email, web site access, forum access and document management systems):

- A stationary PC in every connected hospital or health station, incl. printer, scanner, webcam, monitor

Tele-Consultation:

- A stationary PC with high-resolution monitor, webcam, microphone, loudspeakers
- (possibly) a laptop for traveling doctors with separate webcam for high-resolution images

Warehouse management:

- A portable device like tablet with barcode scan functionality
- (possibly) a stationary PC with monitor and separate barcode scanner

[192] "8 apps revolutionizing maternal health care in developing nations", http://mashable.com/2016/03/13/apps-maternal-health/

Tele-Diagnosis:

- A basic setup can involve a smartphone for taking pictures and an application which sends the picture to the central evaluation hospital/expert
- Further devices depend on specific functional requirements.

Tele-Surveillance:

- A stationary PC with monitor is sufficient to enter relevant clinical data

Diabetes management:

- A simple smartphone which can run the required application; glucose monitoring device

Maternal healthcare:

- A simple smartphone to run the application

6.4.3 E-Government Services - Linking the Government to its Citizens

6.4.3.1 Overview and Definitions

The relationship of citizens to their government around the globe is generally strained by a number of subjective impressions: a lot of paperwork, bureaucracy, cramped spaces, long queues and a lot of frustrations. While the demands of citizens are growing, the government needs to change to deliver in a timely manner and in an acceptable quality. Many governments are addressing this issue by re-engineering their processes and updating their infrastructure.

With the introduction of information and communication technologies (ICT), there is the chance to further improve this situation. The role of **eGovernment** (the use of ICT to deliver government services) is to facilitate the interaction between the government and its stakeholders, including the citizens (G2C), business communities (G2B), and the public administration itself (G2G). In Guyana, the introduction of eGovernment specifically means an extension of government services into the currently underserved hinterland and remote communities to help the government engage and enhance the relationship with its constituency through digital services.

However, the simple introduction of ICT to the government is not enough. Through **e-Governance** the real goal should be to stimulate change in the society towards more democratic processes, transparency in the governing process, true interaction between government and citizens (including feedback mechanisms where the voice of the citizens can be heard), and finally the transformation towards a digital society.

> *"**E-Governance** … is an important innovation for enhancing good governance and strengthening the democratic process and can also facilitate access to information, freedom of expression, greater equity, efficiency, productivity, growth and social inclusion. Successful eGovernment initiatives can have demonstrable and tangible impact on improving citizen participation and quality of life as a result of effective multi-stakeholder partnerships. (…) Governments need to develop policy frameworks, supported by legislation for e-Governance, that are linked to strategic development objectives."*[193]

The following sections will outline a few examples of eGovernment services and initiatives as well as propose the required use cases to fulfill the needs of the hinterland and remote communities.

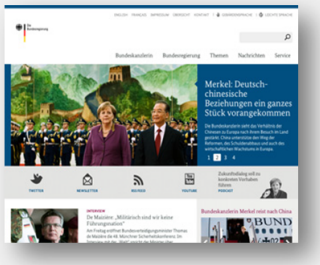
[193] Fourth African Development Forum (ADF IV, 2004)

6.4.3.2 Case Studies of e-Government Initiatives

For each of the e-Government building blocks mentioned in Section 6.3.2 there exist many implementation examples around the world. Some of the most notable are listed in this Section.

eAssistance

"Die Bundesregierung" provides eAssistance in Germany



- "Die Bundesregierung" (German government) focuses primarily on the **provision of information** with the support of **web 2.0**
- It includes news from across the government, links to laws, policy documents, **thematic websites in particular policy areas, and links to all government ministries**.

Government goes Google in Mexico

- Gob.mx is a portal but simply speaking, it is a **search engine with integrating services** that respond to users' specific search criteria
- The site also contains **statistical information on the questions and comments an agency executive has received** as well as how many times he/she has responded.

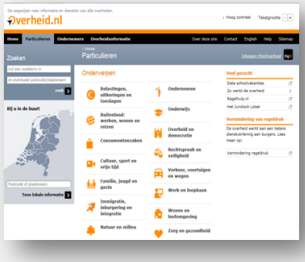
Figure 356 - Examples eAssistance services

eAdministration

World leading government portal, Republic of Korea

- The main **government portal** is a **gateway to services** through multiple channels, by theme and subjects.
- Citizens can have a **customized channel** by inputting their own age, gender and services of interest.
- **Back-office integration** brings together a powerful search engine offering advanced categorizing function, which can list results by websites, services, and news, including at the local level.

Overheid.nl, Netherlands



- The Netherlands' services portal is the gateway to the entire public sector and provides access to an enormous amount of information and services.
- An **efficient user interface** with **effective streamlining of public sector departments.**

Figure 357 - Examples eAdministration services

eParticipation

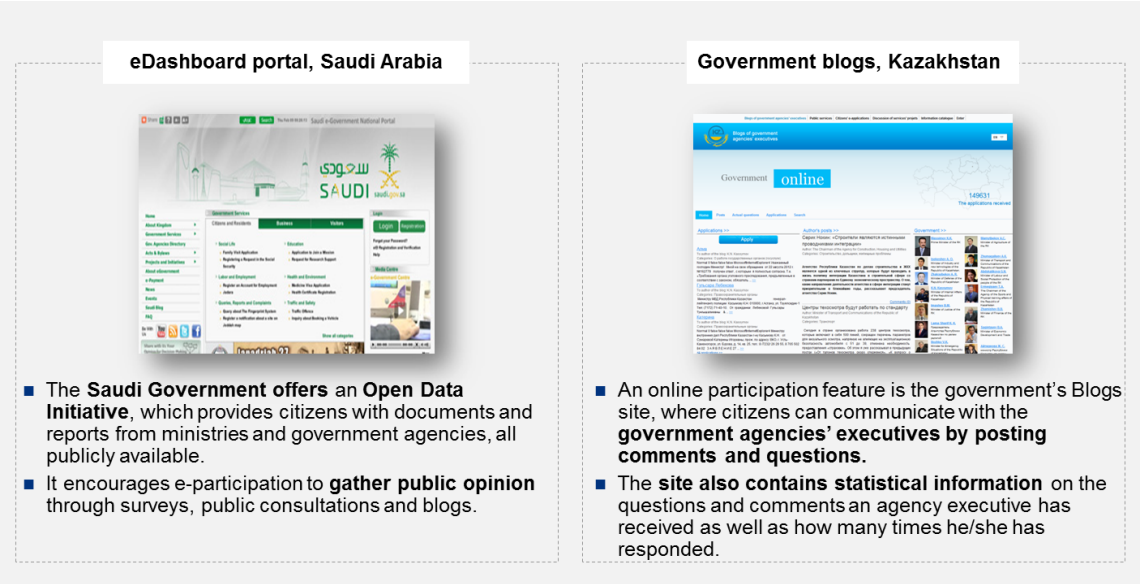


Figure 358 - Examples eParticipation services

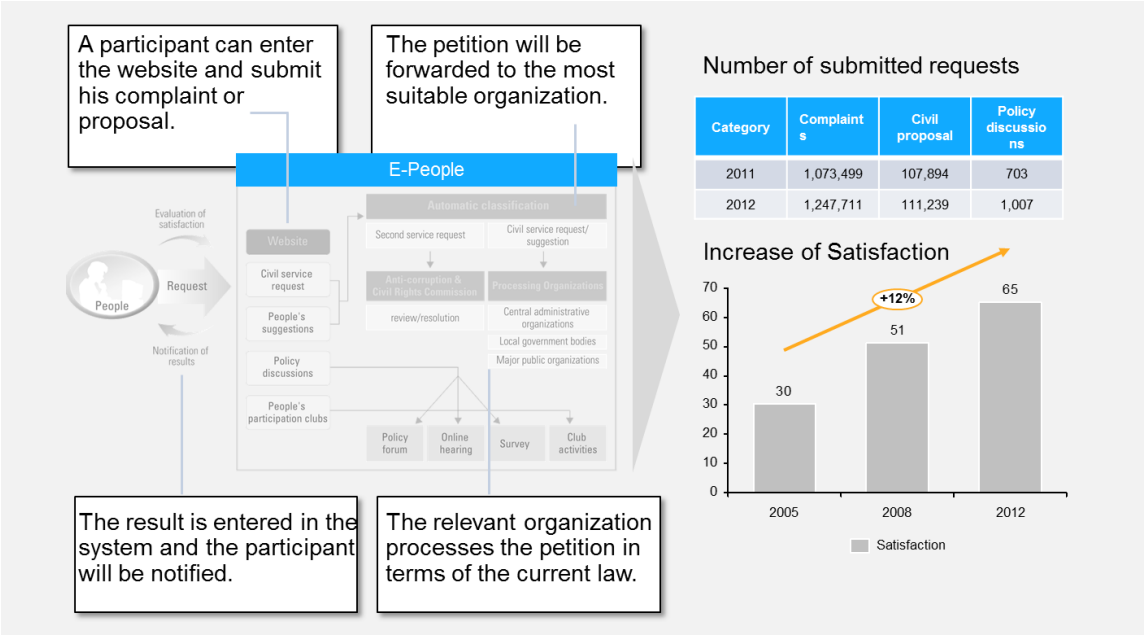


Figure 359 - Example e-People (Korea)

6.4.3.3 Proposed Use Cases for e-Government Services in Guyana

The overall aim of the eGovernment Agency is to provide solutions, i.e., services and platforms, in a carrier-grade quality to all "customers". These customers are ministries and other agencies in the case of G2G services and the citizens of Guyana in the case of G2C services. At a later stage, the target group of G2C services will include Guyanese people living abroad, i.e. the Guyanese diaspora.

The following services should be deployed with a high priority:

Document Management (as well electronic document handling)

- **Rationale:** To handle documents digitally and to exchange them between different relevant users, a document management system (DMS) needs to be deployed. It represents an IT tool that is used to track, manage and store documents digitally.
- **Realization:** The following components that need to be deployed are part of a DMS:
    - Capture: The capturing of the information can be done via two option, a) the manual entering of information via a computer and guided by information on the screen and b) by automatically optical character recognition of documents.
    - Metadata: Metadata may, for example, include the date the document will be stored and the identity of the user storing it. The DMS may also extract metadata from the document automatically or prompt the user to add metadata
    - Storage: Store electronic documents. Storage of the documents often includes management of those same documents; where they are stored, for how long, migration of the documents from one storage media to another (hierarchical storage management) and eventual document destruction.
    - Retrieval: Retrieve the electronic documents from the storage. Although the notion of retrieving a particular document is simple, retrieval in the electronic context can be quite complex and powerful. Simple retrieval of individual documents can be supported by allowing the user to specify the unique document identifier, and having the system use the basic index (or a non-indexed query on its data store) to retrieve the document. More flexible retrieval allows the user to specify partial search terms involving the document identifier and/or parts of the expected metadata. This would typically return a list of documents, which match the user's search terms.
    - Distribution: A published document for distribution has to be in a format that cannot be easily altered. As a common practice in law regulated industries, an original master copy of the document is usually never used for distribution other than archiving. If a document is to be distributed electronically in a regulatory environment, then the equipment tasking the job has to be quality endorsed AND validated.
    - Security: Document security is vital in many document management applications. Compliance requirements for certain documents can be quite complex depending on the type of documents. If one single DMS for multiple tenants, the strongest security requirements need to be fulfilled. This is especially the case when dealing with health related information.
    - Workflow: Workflow is a complex process and some document management systems have a built-in workflow module. There are different types of workflow. Usage depends on the environment to which the electronic document management system (EDMS) is applied. Manual workflow requires a user to view the document and decide whom to send it to. Rules-based workflow allows an administrator to create a rule that dictates the flow of the document through an organization: for instance, an invoice passes through an approval process and then is routed to the accounts-payable department. Dynamic rules allow for branches to be created in a workflow process.
    - Collaboration: Collaboration should be inherent in an EDMS. In its basic form, collaborative EDMS should allow documents to be retrieved and worked on by an authorized user. Access should be blocked to other users while work is being performed on the document. Other advanced forms of collaboration act in real time, allowing multiple users to view and modify (or markup) documents at the same time. The resulting document is comprehensive, including all users additions. Collaboration within Document Management Systems stores the various markups by each individual user during the collaboration session, allowing document history to be monitored.
    - Searching: Searching finds documents and folders using template attributes or full text search. Documents can be searched using various attributes and document content.

Basic Email System

- **Rationale:** Ministries and government agencies need to use emails following an aligned domain model provided by eGovernment Agency for the government. For security reasons as well as to support a certain "corporate identity" of the country, the usage of free email providers for professional emails shall not to be accepted.
- **Realization:** central email servers need to be deployed to provide services for all ministries and agencies. The structure of these email addresses shall follow a harmonized and structured approach. Political willingness and pressure is needed to migrate official email usage from public free email services to the eGovernment service.

Birth / Marriages / Death Certificate Provisioning

- **Rationale**: Citizens shall be able to use government services online, especially to reduce their needs to travel to the next physical government location. This applies to the only request for birth certificates as well as the submission of marriage and death related information.
- **Realization**: A special customized version of the DMS shall be deployed. The citizen can enter the relevant information online.

Passport application

- **Rationale:** Currently citizens needs to travel at least twice to the passport agency: once to submit their data and one when they receive their passport. The passport applications allows the users to enter all their personal data online, meaning they only have to travel once to the passport agency or never if the whole process documentation can be signed digitally and the passport sent back to the citizen via mail.
- **Realization:** A special customized version of the DMS shall be deployed. The citizen can enter the relevant information online.

To be able to provide these services several enabling services need to be developed and deployed as well:

ID/Account Management / digital signature

- **Rationale:** Trust worth accounts of users are essential to use eGovernment services. This account helps to prevent the misuses of the services, e.g. claiming a passport under false ID. With a digital signature, the citizen can sign digitally official documents. Managing digital identity is essential for all eGovernment activities to operate as a platform for economic development and social progress.
- **Realizatio**n: The digital signature can be deployed using a signature program or via a smart card or digital signature information stored on a national ID card. The management of digital IDs and of its lifecycle generally involves several processes that need to be implemented by the responsible entity:
  1. *Registration process*: In order to be known by the system, the user (citizen, government employee) must first register with it and the conditions related to his/her identity or identity attributes must be checked so he/she can be provided with a set of credentials. This verification of identity requires access to a single governmental database that holds the information about all users free of errors and with a unique identifier (including correct spelling of person's name, community name, street name). This step may also require access to personal information stored at other governmental entities and the respective permission to access and use them. If this single governmental ID database not existing, it needs to be set up.
  2. *Authorization process:* once registered, when accessing an e-service, appropriate permissions and privileges to access the –service's resources must be assigned to the individual.
  3. *Authentication process:* to access resources, the individual makes an identity claim that can be verified: he/she logs into the system with the credentials provided during the registration process. This process establishes confidence in the user's identity.
  4. *Access control process:* The result of the authentication process is used whereby the system checks that the user has the appropriate authorization to access the requested resources.
  5. *Revocation process:* when the user is not associated anymore with the system this process secures that the user's credentials are rescinded.

To realize this service, a clear national strategy for digital identity management is essential. It should aim to benefit the society at large, including businesses, citizens and the government, and minimize the risks that undermine trusted

interactions online. The process for developing the strategy should be inclusive of all stakeholders with a view to identify and take into account their needs. To establish trust, digital identity management practices and requirements should be proportionate to the level of risk in the interactions between the parties involved. The potential impact on privacy of digital identity management practices should be assessed and addressed as appropriate. A clear mandate should be given to one government agency to manage these national identities continuously.

Digital identity management practices should respect legal privacy protection requirements. The development and implementation of digital identity management systems should include privacy protection, including data security, from the outset. Taking advantage of the potential for the technology to support both privacy and security, innovative technical protection measures should reinforce privacy protection requirements[194].

Common Data model to facilitate the digital exchange of information between the different ministries and organizations

- **Rationale:** To increase the usage of digital information and to ease the exchange of information between different governmental entities, a unified and harmonized data model as a foundation for all digital data needs to be developed and enforced by the Government
- **Realization:** As an informational model, the Common Data Model provides consistent definitions for managed resources such as (where a resource is any 'thing' in a customer environment) applications, facilities, buildings, assets, servers, network, storage, processes, people, and functions. It utilizes the Unified Modeling Language (UML) and is designed to work seamlessly with other development efforts based on metadata that is produced from UML. To foster integration among developed solutions, the Common Data Model is in use as the basis of data modeling for interactive/integrated designs. Because the CDM is an information model, solutions are able to maintain existing database schemas while utilizing the Common Data Model. When integrating with other products, CDM definitions and terminology are in use. This fosters consistent, one-time integration function that is re-usable across multiple solutions.

Carrier grade service provisioning and hosting

- **Rationale**: Services provided by the eGovernment Agency needs to be available for the customers 24hrs a day, 365 days a year
- **Realization**: the IT infrastructure and their architecture at eGovernment Agency needs to reflect this approach. This includes automatic stand by power supply as well as a redundancy of the data center.

6.4.3.4 Special Network and Device Requirements

Services need to be designed that they follow the to-be-developed eGovernment framework and standards, especially in regards to applied data models and interfaces. This will help the maintenance of these services and the integration into new service environments.

Services need to put a special focus on the design of the User Interface (UI) and the User Experience (UX). The menus needs to be easy to understand and intuitively usable. Usage of pictures instead of words will additionally lower the service acceptance barriers. Furthermore, the usage of local indigenous languages for the User Interface and the content should be supported.

Services shall be able to run on multiple devices like Laptops and mobile phones and support multi-channel capabilities.

Service platforms need to be robust and reliable, securing a 24/7 availability of the services running on these platforms. This includes that the data centers are operated on a redundant level.

[194] It is recommended to align these activities with the CARICOM eGovernment Strategy if possible. If technical standards are available and can be used it will help to extend e-Services on a regional level at a later stage.

6.4.4 Potential Future e-Services – From Banking to Nature Preservation

6.4.4.1 e-Commerce

e-Commerce is the trading or facilitation of trading in products or services using computer networks, such as the internet. E-commerce businesses may employ some or all of the following:

- Online shopping web sites for retail sales direct to consumers
- Providing or participating in online marketplaces, which process third-party business-to-consumer or consumer-to-consumer sales
- Business-to-business buying and selling
- Marketing to prospective and established customers by e-mail (newsletter)
- Support of online payment

Rationale: An e-Commerce platform can help companies in Guyana to extend their customer base, locally, nationwide and internationally. This applies especially to companies and farmers in the remote and hinterland areas who currently have no access to commercially deployed e-Commerce platforms.

Solution: eGovernment Agency operates the e-Commerce platforms. The responsibility for the content provided and the services offered are within the respective Ministries or agencies. Payment options can be offered in collaboration with established financial institutions and/or using own payment services.

6.4.4.2 Border Surveillance and Protection

The surveillance and protection of Guyana's borders takes one of the top spots on the government's agenda. There are many tasks, which could be supported by an ICT system, e.g., monitoring and thwarting intrusion into the country, reporting border violations, monitoring goods transfers across the border, enforcing regulations. If supported by ICT, all of these tasks would have in common the need for a data backhauling and transport network via fiber, LTE or some other wireless solution (see technology report WP2). What would be very different are the means of collecting the data, which depends on the specific system used. There could be visual surveillance via cameras, intrusion detection via a distributed sensor network, which monitors infrared signals or pressure on the ground.

However, the easiest and most applicable way is still to deploy human border patrols and equip them with voice and multimedia communications. In addition, the local border communities should be included in national security, making them the first level of surveillance and alarm. Outposts can be created with communications equipment, which is being used by locals to notify police forces.

In special circumstances, it might be advantageous to deploy autonomous vehicle systems, e.g., drones or terrestrial vehicles, to supplement human capabilities. These systems can be controlled via either LTE, Wifi or special frequencies and only need a command center for monitoring and recording purposes.

The use if ICT is generally limited to an "observer" role in these circumstances and the exact use case needs to be well defined together with local law enforcement agencies.

6.4.4.3 Public security

Fighting crime in Guyana has been identified as a top priority. Activities have already been launched by the Citizen Security Strengthening Program (CSSP) in collaboration with the eGovernment Agency like the "Safe City Project", a CCTV surveillance project integrated with patrol management[195].

The roll of ICT and mobile apps can be used esp. in the field of communicating GPS coordinates to friend and police as well as getting and sharing extra information (e.g. planed walking route). This might lead do e-Services like the following, all using a Smartphone as the user device:

- Increase Minibus/Taxi security: by scanning the number plate of a minibus/Taxi with an app the user can get information about the accident/safety record and history of the respective minibus. The taxi cooperation can also send information about the booked taxi to the requester.
- Emergency Button App: if a user presses this emergency button on his mobile phone app, the position will be shared with police officers close by (e.g. in a radius of 3km). Additionally, the next police station is being informed automatically.
- Share your route app: users can share their planned route with named friends. As the current position is being tracked, these friends always see where the user currently is located. This app can be combined with emergency button app.
- Enhanced "Tell Us": A crowdsourcing app users can assess the perceived security situation in an area and share this information with the community. They can share information about the existence of police in the streets etc.

The best app can contribute significantly more if it can connect to an established IT infrastructure of the police, including direct access to an emergency room, connectivity to the next police station. This connectivity can be provided by eGovernment Agency.

6.4.4.4 Nature Preservation

Almost 80 percent of the Cooperative Republic of Guyana in the northeast of South America still consists of near-natural tropical rain forest and tropical wet savannah where there is still minimal human influence. Guyana hosts many types of Amazon flora and fauna. One reason such large areas of the natural environment remain intact is the low population density: with only 3.7 inhabitants per square kilometer of land, Guyana has the lowest population density in South America.

In 2011, the Guyanese parliament passed a law to set up three conservation areas to be managed by the newly created Protected Areas Commission (PAC). One of the areas is the Kanuku Mountains conservation area in the south of the country, measuring over 6,000 km2. The completely forested Kanuku Mountains are up to 1,100 in height and are uninhabited. They are located in the heart of the Rupuni savanna but directly about the vast rain forest in the east. The Kanuku Mountains are one of the most ecologically diverse areas in Guyana; they include savanna and gallery forest in the lowlands and rain forest in the mountainous area.[196]

The main activities for the Protected Area Commission in the nature preservation are:

- Setting up the Guyana conservation area system
- Establishing administrative and monitoring systems for the Kanuku Mountains conservation area
- Update management plans and draw up monitoring plans and biodiversity surveys

[195] http://newssourcegy.com/news/more-cctv-cameras-to-be-added-to-city-streets-to-aid-crime-fight/
[196] Frankfurt Zoological Society, Conservation project covering tropical rain forest and wet savannah, https://fzs.org/en/projects/kanuku/

- Liaising with representatives of other interest groups such as indigenous communities, Conservation International and regional planning authorities

E-Services can significantly contribute to facilitate the nature preservation activities, especially for the monitoring and conduction of biodiversity surveys. Furthermore, the liaising with indigenous communities will benefit from improved access to e-Services in the remote areas. The indigenous communities play an important role in the conservation of the area, because they report information about the status quo and potential violations of the Protected Area Rules to the respective agencies in charge. Activities such as illegal mining or an illegal road being constructed in the protected area is often first observed and reported by the local indigenous communities.

In a first step, simple text messaging or email will facilitate and speed up the reporting of information about the protected areas from the indigenous communities to the Protected Area Commission. Email and text messages shall be free of charge for the indigenous communities. In a second step, a tailored smartphone app should be implemented, enabling representatives from the local communities to report monitoring data and violations of the protected area rules directly and immediately. The app can follow a similar approach as the "Tell Us" Project[197] from the eGovernment Agency.

6.4.4.5 e-Payment Service

An e-payment service is needed to settle fees for government e-services online but also as a service to enable business and to transfer money between citizens, esp. in the hinterland and remote areas. This service, which allows for online money transfer and payments, can improve the user experience of e-Services a lot. Especially the improved security and reduced threat of theft in hinterland and remote communities makes this a much-wanted feature. Furthermore, online banking saves long trips to the next banking outlet, which is oftentimes located in a far-away town. Online payments serve also as enabler for further online commercial activities such as online auctions or marketplaces.

While the current banking system in Guyana is still heavily relying on paper-based documents, the National Bank of Guyana is aiming to modernize the payment system aiming to digitize it. These digital workflows are essential to provide any electronic banking services. E.g., the Bank of Guyana along with the commercial banks engaged in discussions on the introduction of Electronic Funds Transfer. This system will facilitate the transmission of payment instructions in electronic form and will result in funds being available to the beneficiary within the same day. The Bank has been upgrading the payments system through the electronic clearing of checks while making preparations for electronic funds transfer. This project is expected to be completed by April 2017. [198]

Looking at the e-payment ecosystem, the eGovernment Agency can take over two roles to drive the deployment of this service, the Trusted Service Manager (TSM) and the Payment Solution Company:

[197] "Tell Us" will connect citizens directly to the entities responsible for providing services and responding to their particular needs. The web or mobile based application will facilitate citizens' reporting of issues directly responsible agencies. This would significantly reduce transaction times, improve accountability of those agencies, and encourage citizens' leadership and feedback in the delivery of public services.
http://www.egov.gy/index.php/en/Site-Info/assets-2.html#cirs

[198] Bank of Guyana, Half Year Report 2016

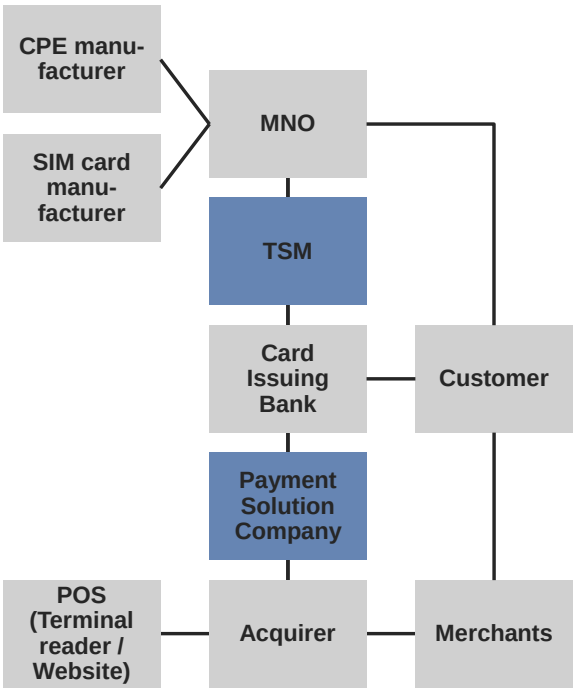


Figure 360 - Digital (mobile) payment ecosystem

The role of the different players in this ecosystem is described below:

Customer

The customer needs to be able to be identified. Therefore, he is required to be a subscriber of a mobile network operator or have a digital ID. The customer enters into a service agreement with a Card Issuing Bank for the e-Payment service.

Merchant

The merchant is the provider of the goods and services being purchased by the customer at the point of sale (POS) (either a terminal in a shop or a special website). The merchant has a contract with a merchant acquirer that allows the merchant to accept credit and debit payments, which are then processed over the appropriate payment-processing network.

Acquirer

The acquirer maintains the merchant account that permits the merchant to accept online payment transactions. The acquirer also provides the interface to the processing network for the authorization and clearing of the merchant's transactions.

Card Issuing Bank

The Card Issuing Bank (CIB) provides the overall payment service and is responsible for the associated customer care. The CIB is responsible for the issuing of the payment application and the customer's personalization data. The CIB is also responsible for establishing the formal agreement with the customer for the payment service.

Payment Solution Company

The payment solutions companies (such as Visa, MasterCard, American Express, or Service Company's setup by local banks) maintain their payment networks, and provide other services to its banks such as approval and certification. They also define payment specifications and provide transaction-processing services to support them. To support Pay-Buy-Mobile, no significant change is anticipated to these payment networks or other national payment networks. In case no payment solution company exists in Guyana to provide this functionality for the planned e-Service, e-

Government Agency should evaluate, together with the Central Bank of Guyana and other stakeholders from the financial sector, how this payment solution company can be installed.

Mobile Network Operator

The mobile network operator (MNO) is a key addition to the ecosystem in a mobile payment ecosystem. The role of the MNO is to:

- Provide and maintain the network infrastructure that enables the secure OTA delivery and maintenance of the payment application to consumer's CPE.
- Provide the Security Domain for the payment application on the CPE, which is then controlled by the TSM or CIB
- Provide the customer with relevant CPEs permitting e-payment services
- Provide mobile services customer care. The MNO brings the assets of a mobile customer base, smart card and network infrastructure to the relationship.

Trusted Service Manager

The Trusted Service Manager (TSM) is one of the new additions to the payment industry. This entity is primarily responsible for securely distributing, provisioning and life-cycle management of the e-Payment application and other services to the mobile network operators' subscriber base on behalf of the service providers. The TSM will have business relationships with both the mobile network operators and the service providers. The role of the TSM as a neutral institution should be maintained by e-Government Agency.

POS Terminal Manufacturer

The role of the terminal/reader manufacturer is to provide terminals/readers and/or CPEs to the merchants and acquirers.

SIM Card Manufacturer

A SIM Card provides the unique identifier for the Mobile Network Operator and therefore for the e-payment service. A digital ID card can also service as an identifier for the e-payment service when not using a mobile device.

CPE Manufacturer

The role of the CPE manufacturer is to provide standardized handsets or devices that will be used for e-Payment, e.g. mobile devices.

It should be noted that in the e-payment value chain, existing players like the CIBs, the merchant acquirer and the payment network will continue to play their main role in the transaction processing. If these roles are not yet sufficiently operational in Guyana, e-Government Agency should align with the stakeholders how these roles can be implemented.

To rollout this services the existing legal frameworks need to validated how they can support (or hinder) the successful rollout of an e-payment service. This applies eg. To the fields of contract laws (is a digital contract binding, are there any contracts that have to excluded from a settlement via e-payment, usage of digital signatures), retention of documents (how are the legal requirements to retain information and can it be stored electronically?), Data security (what happens if the e-payment service has been used illegally?)

Next steps for the realization of this e-Service:

- Align with stakeholder to create the digital financial ecosystem, including with the Bank of Guyana and promote potential service with merchants and consumers (to generate a critical mass of interested users from the beginning)

- Setup the missing functions and respective ICT-systems in the ecosystem like TSM and Payment Solution Company and validate if currently available electronic banking service be used, e.g., partnering with GT&T in Guyana
- Assess the existing legal framework to permits and support ePayment services. This also includes laws securing and regulating payments in general and extending customer protection to this new channel.[199]
- Asses if a regulation of the Interchanges Fees are needed if they are too high and represent a barrier for a development of this service.

6.4.4.6 e-Agriculture

e-Services in the context of agriculture shall address two major challenges farmers in the hinterland and remote areas are facing and that have been raised during the interviews with several stakeholders: 1) access to all kinds of information in real time and 2) increase the business opportunities. Taking down the high costs for transportation of goods is also an often voiced request[200], however short of introducing a new logistics concept (e.g. involving unmanned aerial vehicles[201]) or organizing shared transportation, there is little an ICT infrastructure can do to help streamline physical transportation.

Sharing of information comprises the following use cases:

- **Information exchange**
  Rationale: farmers need access to real-time information about weather conditions and market prices
  Solution: a central server hosted by the eGovernment Agency provides relevant information (content). This content is being maintained by the Ministry of Agriculture and/or FAO
- **Collaboration support**
  Rationale: collaboration can help the exchange of information between different farmers (building of virtual communities). This direct exchange of information can provide faster solution of local problems (if another farmer experienced similar problem in the past) as well as serve as an early indicator for the ministry if the posted questions/problems are systematically analyzed. This can also extend the content provided via the TV program "Farmer's connection".
  Solution: a central server hosted by the eGovernment Agency serves as the platform for the sharing of the information provided by the users. This user generated content needs to be monitored by an expert at the Ministry of Agriculture.
- **E-Learning and access to training material**
  Rationale: e-Learning platform and access to online training material can help the farmers to increase their farming knowledge. This can also extend the content provided via the TV program "Farmer's connection"
  Solution: a central server hosted by the eGovernment Agency and maintained by the Ministry of Education serves as the platform for the e-Learning services. The hardware investment can be shared between the ministries. The content of this platform needs to be provided and maintained by the Ministry of Agriculture or an associated agency.

Increase the business opportunities by introducing the following use cases

- **Consolidated Shipping**
  Rationale: Shipping/transportation costs are often prohibitively high for a single farmer. This leads to the situation that very often farmer are forced due to economic reasons to leave their harvest on the fields instead of selling them. Tackling down the high costs for transportation of goods is therefore an essential factor to increase the economic situation of the farmers. This service permits several farmers in a similar

[199] See http://ec.europa.eu/finance/payments/framework/index_en.htm for an overview about the approach followed by the European Union.

[200] Transportations are sometimes prohibitively high resulting in farmers to need to destroy their harvest on the fields as this will be a cheaper option than paying for the transportation to sell them.

[201] Unmanned airplanes are being used in Rwanda to deliver medical supplies to remote health stations.

location to share shipment resources e.g. containers resulting in a significant reduction of the individual costs for transportation of goods to the next larger community or harbor.
Solution: A consolidated Shipping services will be developed by eGovernment Agency and operated by the Ministry of Agriculture. This service aligns the request for transportation by the different farmers, considering the kind of good and its volume to be transported.

- **e-Selling Platform**
  Rationale: Especially non-perishable goods can be sold via additional sales channels like an e-Selling platform. This gives the farmers to develop additional customer groups and eventually bypass intermediaries along the value chain, resulting in a higher income.
  Solution: an e-Market platform will be developed by eGovernment and maintained by the Ministry of Agriculture. Payment services provided by eGovernment can be used as payment option.
- **Mobile Payment**
  Rationale: Having a large amount of cash especially in remote areas brings a high risk of theft and crime. The reduction of physical cash helps to reduce the crime level while increases the ease of use as mobile payment does not require to anticipate the amount of money that is needed for any transaction.
  Solution: Opening of eGovernment payment platform to 3rd parties or partnering with an existing electronic payment provider (see Section 6.4.4.5). The payment process is done via an app on the mobile phone or via text message.

6.5 Implementation Roadmap and Cost Approximation

6.5.1 GAPs between Vision and Status Quo and Challenges

To achieve the goals as outlined in the e-Government vision and mission it is essential to understand the current situation of services being deployed by the Agency as well as to understand what challenges need to be addressed.

The current status of the different domains of a comprehensive e-Government service offering is reflected as a heat map, with the colors reflecting different level of “e-Services readiness”:

Green - Several services and technologies are already available to implement e-Services in the respective domain

Yellow – a limited number of services and/or enabling technologies are available to be used

Red – No services or technologies are currently being used and/or deployed in a specific domain.

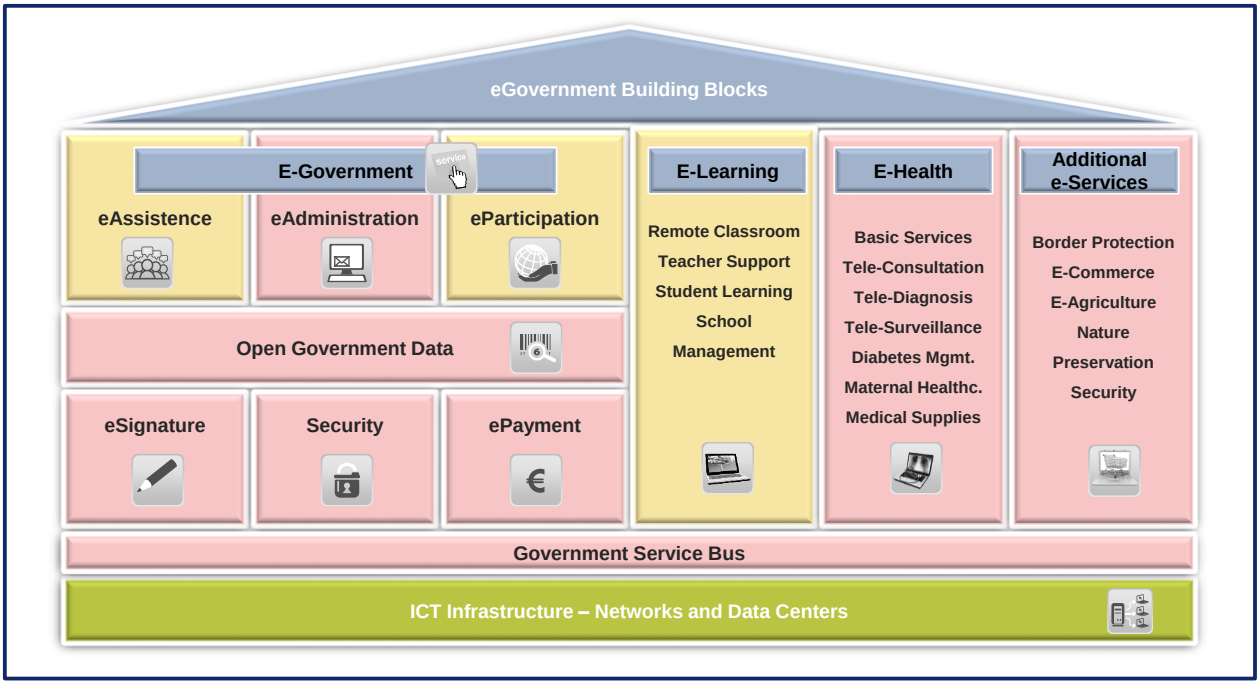


Figure 361 - Heat Map eGovernment Readiness per Domains

In the following domains, services with a different extent and maturity level were identified:

Green Domains

The existing ICT Infrastructure has been assessed as suitable to provide e-Services. This includes the availability of capacity in data centers (albeit they need to be extended under the requirements of zero outage) and the planned extension of existing connectivity towards the hinterland and remote areas as well as the increase of connected public buildings along the coastline as outlined in WP2. Other services in this domain are “Enterprise IT Infrastructure” and “internet Access via eGovNet”.

This does not yet include special skills needed to operate services, like Operations Support & Readiness and Billing & Revenue management.[202]

Yellow Domains

The services domain “e-Learning” contains several services and activities launched by the Ministry of Education, respectively the National Center for Educational Resource Development (NCERD) in the field of e-Learning.

The services domains “eParticipation” and eAssistance comprise services currently being implemented by the eGovernment agency, like “Tell Us”, “MARAD connectivity and services” and “Government Portal.”

Besides the technical planning and solutions being currently operated or rolled out, other challenges have to be addressed: They have to be tackled during the early implementation phase of the next step:

- Need of adequate number and expertise in ICT human resources, especially in the field of process management and operation
- Need of suitable policy, legal and institutional frameworks for eGovernment
- Attitude and cultural challenges in the use of ICT w.r.t. hinterland and remote communities
- Enhance service delivery infrastructure and less fragmented delivery channels (online and off-line)

[202] For a complete business process framework see eTOM 16.0

- Bridge eGovernment initiatives across multiple ministries
- Secure sustainability of ICT adoption in the public service
- Increase awareness of eGovernment opportunities
- Drive the buildup of integrated information systems
- Develop and deploy a framework to leverage private sector resources and community participation
- Overcome limited research and innovation on eGovernment in Guyana by cooperation with research institutes and solution providers on a national and international scale.

6.5.2 e-Service Prioritization and Roadmap

In order to create a roadmap and detailed implementation plan, the above-mentioned e-Services and their respective use cases have to be prioritized. The goal of this section is to detail the prioritization criteria and propose a roadmap of use cases to be implemented between 2017 and 2021.

Prioritization Criteria

There are a number of criteria, which can be used for prioritizing the use cases, grouped along three main categorization areas.

- **Impact**
  - number of potential users, frequency of use
  - perceived importance of service by user
  - potential for creating economic value
  - potential hassle reduction for end user
- **Readiness**
  - Users' willingness to switch to solution
  - Target group availability
  - Ministries/agencies: resources and existing IT infrastructure, readiness to change processes
  - Delivery: complexity of process, suitability of process for alternative channels, need for personal interaction, dependency on other not yet digital processes
- **External factors**
  - Experiences from previously launched e-Services
  - Limitation in number, scope and depth to remain manageable by the team
  - Boundary conditions for service prioritization/pilot programs

A first prioritization is suggested in the next section, however the final set of criteria used and the order of implementation needs to be decided by the project team once all parameters have been checked prior to project start.

Roadmap for e-Services and Use Cases

Based on the described prioritization criteria the following roadmap was derived. It is advised to perform **pilot projects** with a number of communities and government agencies to validate the assumptions and enable the stakeholders to adopt an "online mindset." Special care should be taken to not only implement the online components of the use case, but also provision for the offline business processes and resources which are required to fulfill the requested government service. A well-established **Business Process Redesign (BPR) Methodology** can be used by a specialized team. This requires a deep understanding of the current status for processes in the organization to provide a basis for developing the services/processes framework and set the change boundaries.

A Pilot Project…

…must have a wide audience

- Affect a large number of citizens
- Affect a large number of government units

…must have compelling reasons to adopt

- saves time
- saves money
- avoids dealing with corruption
- enforced by law

E-Learning Roadmap

Finalizing and extending the One Laptop per Teacher program is the most important initiative. School management does not affect students as much as individual learning programs, thus it should be de-prioritized.

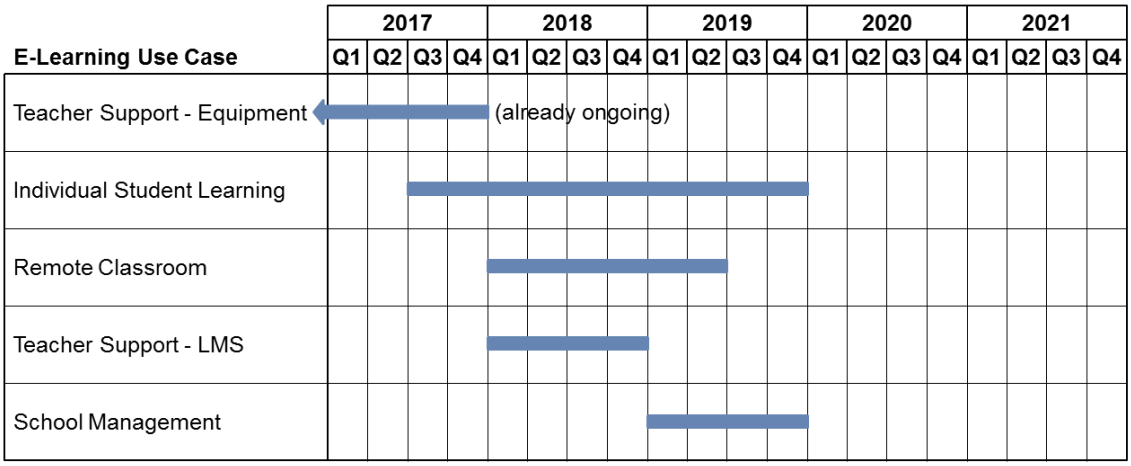


Figure 362 - Proposed rollout of e-Learning services

E-Health Roadmap

The basic services such as internet access via a stationary PC and communication availability and providing for enhanced maternal healthcare should be the focuses for the next years. Tele-Surveillance enhances the data gathering capacity and is important for disease control and early intervention capability. Tele-Diagnosis and Tele-Consultation rely on fairly stable and high-bandwidth connections, thus should be deployed when those are ready.

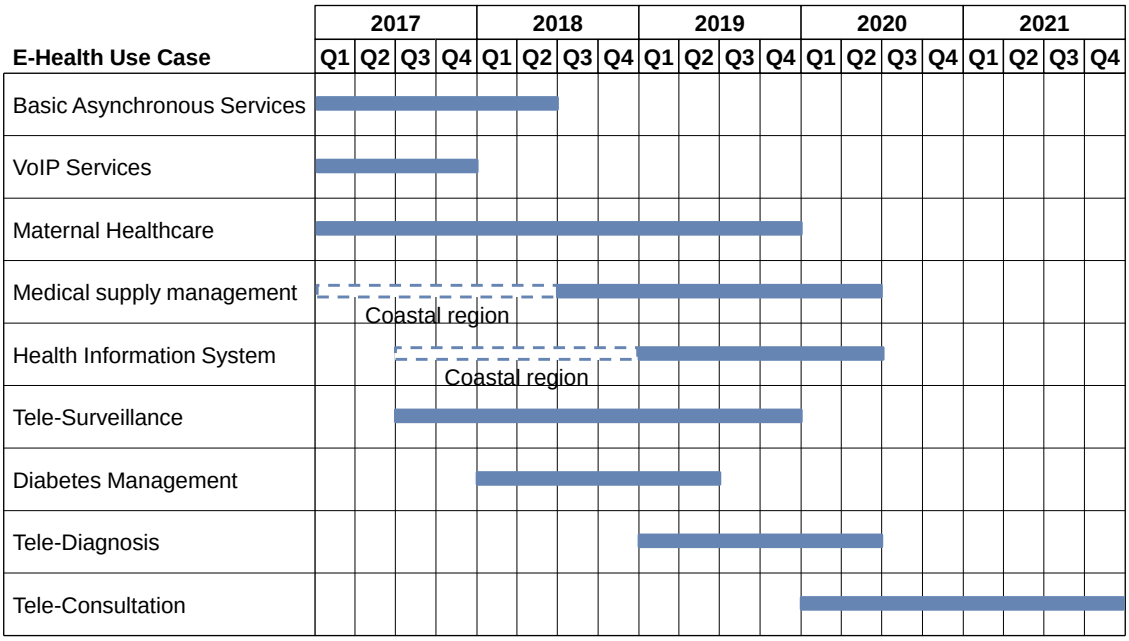


Figure 363 - Proposed rollout of e-Health services

E-Government Roadmap

The programs which are already partially in place (email, DMS, calendar) should be expanded and made into enterprise-grade services. In addition, extending the website hosting capability should be tackled in the first year. The most demanding enabling services like eSignature and ePayment can be implemented at a later stage as prerequisites for complete online transaction services. It should be noted that all service delivery processes need to be re-engineered for being provided online. There is mostly also an offline component (backend) involved, which needs to fall into place as well.

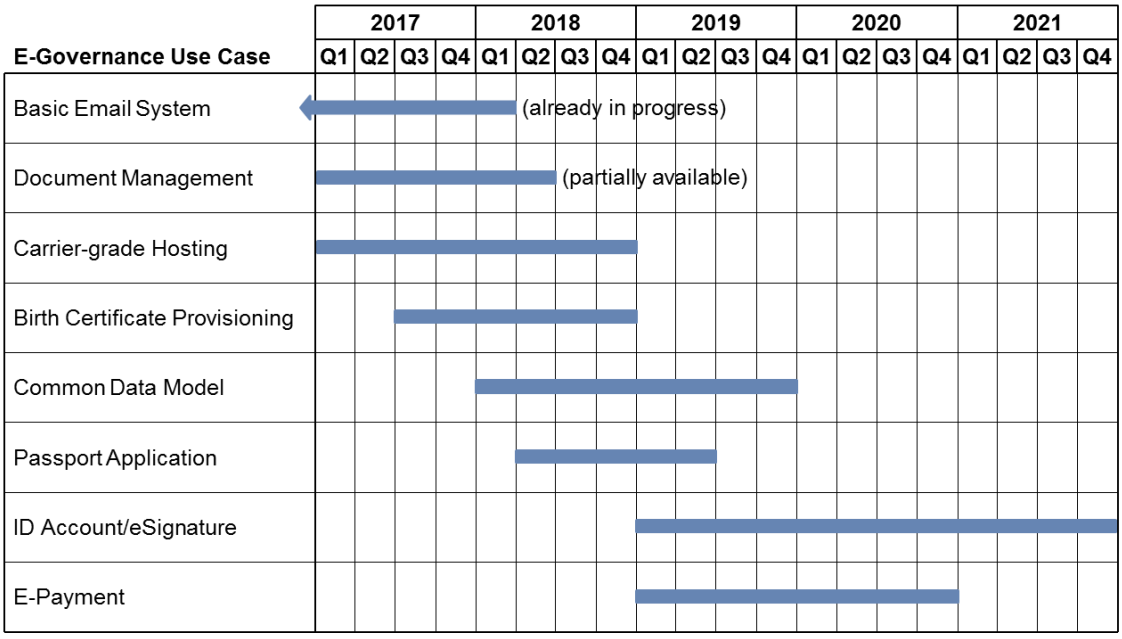


Figure 364 - Proposed rollout of e-Government services

Further e-Service use cases (such as the ones mentioned in Section 6.4.4) should be evaluated by their impact on the eGovernment Agency's delivery capability and planned and rolled out on an on-demand basis.

In addition to the e-Services and use cases for other government agencies, the eGovernment Agency should include other projects such as: applications for generic services that are not bound to one agency and integration projects to facilitate and support all other projects and applications across Guyana.

Next Step– The Action Plan

A detailed Action Plan is the next step towards successful implementation of the roadmap. It should contain a detailed description of all major projects to be implemented and the steps to be taken within the eGovernment Agency. It needs to be at a level of detail that is sufficient to follow up on reaching milestones and objectives.

An Action Plan can have the following structure:

- Vision and objectives for eGovernment initiative
- E-Services projects to be implemented
- Infrastructure projects to be implemented
- Roles and responsibilities
- Timeline with well-defined milestones
- Budget, incl. planning on which funding mechanisms are planned to be applied

After these points have been clarified and agreed upon by the stakeholders, the individual e-Service projects can be launched using a traditional project management methodology.

6.5.3 High-Level Cost Approximation

This Section outlines an approach to estimate the costs for aforementioned use cases for e-Learning, e-Health and e-Government services. The goal is to approximate the rollout costs for the next 5 years, following the roadmaps shown above.

The costs for e-Services are broken down in backend and frontend costs for IT equipment and software. The pure network connectivity is assumed given at a public building and is not taken into account here.

Since all government services will be rendered from a public building, which is connected to the eGov Network, it is prudent to assume each of these buildings will evolve over time with regards to the available equipment and electronic services offered. Many e-Services can be run on the same frontend hardware, e.g., a stationary PC, but require an upgrade or new installation in the backend. The cost estimation on one hand focuses on each public building to be fitted with equipment, e.g., regional hospitals, and on the other hand shows what approximate costs arise on the backend for each service. The total implementation costs can then be assumed by fixing the number of public buildings to be fitted and multiplying this number with the unit costs per public building, plus adding the one-time backend costs.

For this estimate, it is assumed the e-Services will be rolled out in specific public buildings:

e-Learning: secondary schools and primary schools

e-Health: regional hospitals and health stations

e-Government services: post offices and community buildings (like benabs for Amerindian villages)

Some use cases are more suited for specific public buildings, while others should be uniformly available. The following tables show the proposed matching.

e-Learning services		
	Primary School	Secondary School
Teacher Support – Equipment	✓	✓
Individual Student Learning	✗	✓
Remote Classrooms	✗	✓
Teacher Support – LMS	✗	✓
School Management	✗	✓

Table 59: e-Learning uses cases matching to primary and other schools

e-Health services		
	Health Station	Regional Hospital
Basic asynchronous services	✓	✓
Fixed VoIP	✓	✓
Maternal Healthcare	✓	✓
Medical Supply Management	✗	✓
Healthcare Information System	✗	✓
Tele-Surveillance	✓	✓
Diabetes Management	✗	✓
Tele-Diagnosis	✗	✓
Tele-Consultation	✗	✓

Table 60: e-Health uses cases matching to health stations and regional hospitals

e-Government services		
	Community building	State building, e.g. Post Office
Basic Email Services	✓	✓
Document Management System	✓	✓
Birth/Marriage/Death Certificate	✓	✓
Passport Application	✓	✓
ID Account / eSignature	✓	✓
e-Payment	✓	✓

Table 61 - e-Government uses cases matching to Community buildings and other state buildings (e.g. Post offices)

The enabler services of "carrier-grade hosting" and "common data model" mentioned in Section 6.4.3.3 are general backend functions and do not impact the cost of a public building directly.

The individual use case frontend and backend costs can be estimated as follows.

e-Learning services			
	Frontend (FE)	Backend (BE)	Comments
Teacher Support – Equipment	$2,000	$0	FE: Fixed PC to prevent theft (not private property of teacher), projector, printer, class clicker, smartphone BE: none
Individual Student Learning	$6,500	$7000	FE: 10 fixed PCs, Play2Learn client license as learning software (example) BE: Play2Learn blade server hardware + server license (5yrs)
Remote Classroom	$500	$17,000	FE: client license 5yrs; hardware already present BE: Echo360 appliance, server license (5yrs)
Teacher Support – LMS	$0	$17,000	FE: hardware already present, client is browser BE: Moodle blade server, extended coding
School Management	$500	$4,000	FE: client license BE: blade server h/w, server license

Table 62 - Estimated costs for e-Learning services (in USD for 5 years)

e-Health services			
	Frontend (FE)	Backend (BE)	Comments
Basic asynchronous services	$1,100	$22,000	FE: fixed PC, monitor, printer BE: Email server extension, Web server extension, DMS server + licenses, coding
Fixed VoIP	$300	$35,000	FE: Cisco VoIP phone, router, cabling BE: Cisco BE6000, User Connect Licenses, implementation
Maternal Healthcare	$5,000	$15,000	FE: simple smartphone, app BE: partnering with external provider, setup, integration
Medical Supply Management	$200	$23,000	FE: client license, PC already present BE: blade server, license 5yrs, integration, coding
Healthcare Information System	$50	$24,000	FE: client license, PC already present BE: blade server, licenses 5yrs, integration
Tele-Surveillance	$0	$22,000	FE: browser-based, own eGov platform BE: blade server, integration, coding
Diabetes Management	$5,100	$15,000	FE: simple smartphone, app BE: partner with Diabeto or mySugr, integration
Tele-Diagnosis	$8,000	$17,000	FE: HD photo camera, ECG device, iriscope, ultrasound device, excl. x-ray BE: blade server, integration, coding
Tele-Consultation	$1,500	$10,000	FE: HD video camera, client license BE: Cisco BE6000 (present); integration, coding

Table 63 - Estimated costs for e-Health services (in USD for 5 years)

e-Government Services			
	Frontend (FE)	Backend (BE)	Comments
Basic Email Services	$1,100	$22,000	FE: fixed PC, monitor, printer BE: Email server, website server, coding, integration
Document Management System	$100	$10,000	FE: DMS client license BE: blade server hardware for DMS, server license, implementation
Birth/Marriage/Death Certificate	$0	$22,000	FE: PC (already existing), software on own platform BE: blade server, coding (own platform), integration
Passport Application	$0	$18,000	FE: PC (already existing), software on own platform BE: blade server, integration, coding (own platform)
ID Account / eSignature	$750	$20,000	FE: biometric and/or passport/ID reader BE: blade server, server license 5yrs, integration, coding
e-Payment	$0	$72,000	FE: browser-based, eSignature needed, own platform BE: blade server, partner integration, coding

Table 64 - Estimated costs for e-Government services (in USD for 5 years)

Taking the assignment of use cases to public buildings into account (as described above) and assuming the number of buildings to be covered between 2017 and 2021 as below, the total e-Service implementation costs as shown in the following table. The number of schools is taken from Ministry of Education website, the number of post offices from the Guyana Post office Corporation website[203].

[203] http://guypost.gy/gpoc/

	Cost block	#	unit cost	Total
e-Learning	Primary Schools	434	$ 2.000	$ 868.000
	Secondary Schools	111	$ 9.500	$ 1.054.500
	Backend	1	$ 45.000	$ 45.000
				$ 1.967.500

	Cost block	#	unit cost	Total
e-Health	Health Stations	200	$ 6.400	$ 1.280.000
	Regional Hospitals	10	$ 21.250	$ 212.500
	Backend	1	$ 183.000	$ 183.000
				$ 1.675.500

	Cost block	#	unit cost	Total
e-Governance	Community building	249	$ 1.950	$ 485.550
	State building (post)	67	$ 1.950	$ 130.650
	Backend	1	$ 164.000	$ 164.000
				$ 780.200

Total	$ 4.423.200

Table 65 - Summary of e-Services implementation cost for 2017-2021 in USD

6.6 Key Success Factors for eGovernment Service Implementation

6.6.1 Organizational Setup and Required Capacities

From the organizational structure perspective, the following recommendations can be made. The chart below shows the organizational changes in the eGovernment Agency in blue:

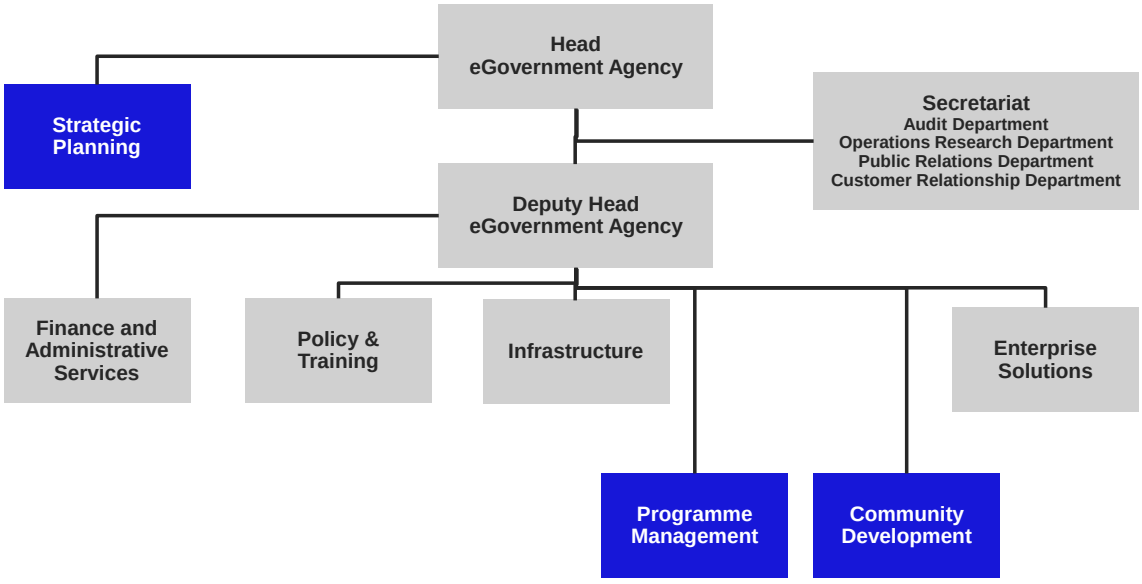


Figure 365 - Proposed New Organization of eGovernment Agency

Policy and Training Division

- Extend the knowledge beyond the current focus on IT topics. If this Center of Excellence should fulfill the tasks to train and operate the regional training hubs and their trainers, additional skills especially towards e-Services need to be implemented.
- Liaisons experts to align with the communities especially in remote areas need to be implemented.

Enterprise Solutions Division

- Establish a team of account managers to serve as entry points for demands by the ministries and agencies. This is essential to promote own activities and services as well. It has to be verified if certain customer relations managers currently under “Secretariat” can be moved to this account management team.
- A team to deal with vendors or potential solution providers needs to be set up. This vendor management team is responsible for aligning with procurement departments within the government as well.

Program management & Community Development Division

It is recommended to split up this division. Program and project management should be a dedicated division with the focus on execution of projects within the eGovernment Agency, while the future Community Development Division focuses on aligning with communities and promoting the strategy and aims of the eGovernment Agency. The liaison experts can be anchored in this division as well.

- The Program management division needs to expand its resources in the field of experienced project managers (small and large, especially infrastructure-centric, projects)

Infrastructure Division

- OSS/BSS subdomain is missing. This would include the responsibility of Operation Support Systems (OSS) as well as Business support systems (BSS) to be in the position for the eGovernment Agency to extend and scale their service offering as described and proposed in the ICT needs Assessment.
- Operational framework design and implementation needs to be reflected in the organization and therefore build up. This would include responsibilities to design new processes, e.g., based on ITIL.
- Division needs to build up extended skills in network infrastructure implementation and maintenance

A strategic planning division needs to be set up as well. This includes primarily the tasks of direct strategy development and execution but should also include, at a later stage, an Enterprise Architecture management team. Their responsibility would be to define the rules of enterprise architecture management and secure the alignment

between strategy and IT. It also provides the role of a strategic demand management process to prioritize and forecast new projects.

It has to be noted that a balance between the headcount of administration/management on the one side and the number of experts in the different fields on the other side has to be aligned. The hierarchies should be as flat as possible and reasonable. This will help to keep costs for administration low and helps to drive the overall performance if the experts are empowered to take decisions under their own responsibility. It is therefore recommended to implement one management level below the CEO only (mid-term perspective).

Needed capacities

The following breakdown gives an overview about selected different roles needed and their respective skills to extend the service offering of e-Government Agency:

Infrastructure

- Engineering Manager
  - Role Definition
    - Department manager for the Network Engineering Section assumes functional and administrative leadership responsibilities to department staff.
    - Responsible for technology trend scouting, strategic network architecture design, equipment and platform tendering and vendor relations.
    - Support to top management in formulation of technology strategy.
    - Definition of technical standards and guidelines for network planning, implementation and operation.
    - Close cooperation with strategy department for the definition of features, capabilities and capacities of the network technology in order to define the most economical technical solution to “business” requirements.
  - Knowledge
    - Good and proven experiences in developing Network Strategy (fixed, mobile and Satellite)
    - Advanced knowledge of architecture and network equipment
    - Deep knowledge of international standard and guideline for network planning
  - Functional Skills
    - Ability to formulate the network strategy
    - Ability to translate technology trends into network architecture
    - Overseeing and contributing to development of guidelines and standards for network planning, implementation and operation.
    - Ability to analyze complex systems and to derive appropriate recommendations and solutions
  - Soft Skills
    - Ability to lead a team
    - Ability to decide and to take appropriate risk
    - Advance communication and negotiation skill
    - Stakeholder management
    - High degree of service orientation
    - Goal and performance orientation
    - Advance cost awareness and efficiency

- Engineering Specialist
  - Role Definition
    - Execution of network engineering and strategic technology design.
    - Execution of technology trend scouting, strategic network architecture design, equipment and platform tendering and vendor relations in respective network domains (e.g. Access, Core, IN/VAS, Transmission, Ancillary systems).

        - Definition of technical standards and guidelines for network planning, implementation and operation.
        - Close cooperation with strategic department for the definition of features, capabilities and capacities of the network technology in order to define the most economical technical solution to “business” requirements.
    - Knowledge
        - Experiences in developing Network Strategy
        - Advance knowledge that regard to architecture and network equipment
        - Knowledge of international standards and guidelines for network planning
    - Functional Skills
        - Ability to formulate the network strategy
        - Ability to translate technology trends into network architecture
        - Overseeing and contributing to development of guidelines and standards for network planning, implementation and operation.
        - Ability to analyze complex systems and to derive appropriate recommendations and solutions
        - Ability to execute proposed solutions and related measures
    - Soft Skills
        - Advanced execution skill
        - Ability to decide and to take appropriate risk
        - Advanced communication and negotiation skill
        - Stakeholder management
        - High degree of service orientation
        - Goal and performance orientation

- Network Planning & Optimization Engineer
    - Role Definition
        - Execution of network planning and performance optimization tasks based on the different applied technologies.
        - Planning of network elements and related components (hardware and software) in term of architecture, dimensioning, capacity and functionality for all applicable network domains, i.e. Access, Core, Transmission, VAS/IN and other systems as required.
        - Analysis of commercial- and business requirements in order to provide network configuration and -dimensioning in line with technical standards and guidelines.
        - Analysis of network performance measurements and deduction of mitigation measures to optimize network performance towards maximum service experience.
        - Utilization of electronic tools and scientific metrics for network planning and performance optimization.
        - Preparation of work orders for network configuration in order to achieve integration of new network elements, -components or -capacity as well as implementation of optimization measures.
    - Knowledge
        - Advance Knowledge on RF Planning, link budget and pass RF advance training courses.
        - Expert knowledge in network planning tool (or has training course on network planning tool)
        - Expert knowledge in network KPI and Service Quality Management (SQM).

- Network Implementation Manager
    - Role Definition
        - Department manager for the Network Implementation Section, assumes functional and administrative leadership responsibilities to department staff.
        - Planning and execution of implementation- and modification projects exceeding the configuration of existing network elements.

        - Liaison with vendors and service providers for site design-, acquisition-, permitting- and construction tasks as applicable.
        - Approval of site designs and passive support structures (e.g. housing, towers, duct systems) to accommodate the implementation of active network elements and -equipment.
        - Steering and management of internal and external service providers for construction and implementation of active and passive network components.
        - Specification and maintenance of appropriate documentation for all projects (new sites, alterations, decommissioning).
    - Knowledge
        - Proficient knowledge on overall Mobile network but expert knowledge in Radio Access Network
        - Expert knowledge in SLA management and network KPI
        - Knowledge in dealing with communities in remote and hinterland areas;
    - Functional Skills
        - High Experience in Mobile Network implementation.
        - Expert in Network Quality Assurance (QA)
        - Proven skill in managing vendors and project budget

- Civil Work Management
    - Role Definition
        - Management of construction activities for passive network infrastructure and other civil works projects as required.
        - Provision of input to site design and architectural specification according to business requirements.
        - Liaison with architects and civil contractors in definition of work, site design and construction execution.
        - Health&Safety management on construction sites according to legal requirements.
        - Quality management and acceptance for all civil works activities.
        - Execution of major maintenance and alteration projects if associated with civil engineering and construction.
        - Maintenance of civil works related documentation (construction drawings, as-build drawings, and other documentation as required).
    - Knowledge
        - Proficient knowledge on construction design
        - Basic knowledge on basic network elements at site including the infrastructure inside.
    - Functional Skills
        - Proven skill in telecom site/tower construction as Base Station Tower, Switching Center etc.
        - Experience in project management control process to deal with vendors.

- Property Management
    - Role Definition
        - Management of real estate related tasks associated with erection and operation of network elements and company property.
        - Application of legal permits for site construction activities (new builds, alterations, decommissioning as required).
        - Liaison with external service providers for property-related tasks, such as site acquisition, procurement, leasing and disposal of property and building.
        - Conclusion and execution of lease- and procurement contracts for property and building space as well as installation space for telco equipment (site sharing) as applicable). Ensure lease rates are favorable and are in line with business objectives.
        - Maintenance of site records and documentation according to specifications.

- Knowledge
  - Expert knowledge on leasing contract and property management
- Functional Skills
  - High experienced in rental rate structural
  - High experience in negotiation and making leased contract.
  - Proven skill on site survey
- Soft Skills
  - Stakeholder management especially to owners of public buildings (e.g. police, Toshaos)

- Network Operation Manager
  - Role Definition
    - Department manager for the Network Operations Section, assumes functional and administrative leadership responsibilities to department staff. Assumption of ownership for all network elements after acceptance from Network Implementation (owner of live network).
    - Implementation and operation of all functions related to network operations, in particular: Fault-, Configuration-, Performance- and Security Management.
    - Single point of contact for problems and tasks related to live network.
    - Escalation instance for network related problems.
    - Management and maintenance of records and documentation related to network, especially network configuration records and network asset register.
    - To manage the Network Operations Department and all of the Network elements and its interconnection. Act as the prime point of contact and the focal point for all operational related activities. Managing suppliers, department operational budgets and sub-contractors. Liaise and coordinate repair/restoration activities with other 3rd parties as and when necessary. Act as the central point of contact for all network fault management.
  - Knowledge
    - Expert knowledge on Mobile Network. Able to transfer knowledge to NOC team.
    - Expert knowledge in SLA management and network KPI
  - Functional Skills
    - High experience in (Mobile) Network Operation (different technologies)
    - High experience on Fault Management.
    - Proven skill in Network Management System for system monitoring in term of KPI and SQM. Apply his knowledge and experience to improve network service quality, KPI/KQI.

- NOC Manager
  - Role Definition
    - Department manager for the Network Operations Centre assumes functional and administrative leadership responsibilities to department staff. Assumption of ownership for all network elements after acceptance from Network Implementation (owner of live network).
    - Central operations entity of all network components, divided into the operations functions of: fault management, configuration management, performance management and security management.
    - Implementation and operation of 24x7 network surveillance.
    - Assumption of responsibility for service assurance.
    - Central contact- and escalation point for customer-facing units (such as Customer Care Centre, Sales, Marketing) for questions and complaints related to live service.
    -
  - Knowledge
    - Expert knowledge on Mobile Network. Able to transfer knowledge to NOC team.
    - Expert knowledge in SLA management and network KPIs
    - Expert knowledge in eTOM

- Functional Skills
  - High experience in Fault Management
  - High Experience in Network Management System for system monitoring and generate report.

- Fault Management Team Leader
  - Role Definition
    - Team manager for Fault Management Team within the NOC department. Assumes functional and administrative leadership responsibilities to team staff. Responsibility for monitoring of operation condition for all network elements.
    - Organization of 24x7 network and service surveillance by means of shifts. Scheduling of shift roster and shift team composition to ensure required expertise and capacity at any time.
    - First escalation instance for all kinds of network and service problems as appropriate and defined in related process.
    - Leading the identification of network and service degradation or outages and initiation of appropriate mitigation measures.
    - Further escalation of activities to second level support and management as appropriate.
    - Ensure the correct maintenance of documentation related to network monitoring (e.g. trouble ticketing, event recording, emergency change management, failure statistics) and handling of communication related to network events (external and internal).
    - Preparation of statistics and history records for faults and other relevant network events.
    -
  - Knowledge
    - Expert knowledge on Mobile Network. Able to transfer knowledge to NOC team.
    - Expert knowledge in SLA management and network KPI
    - Expert knowledge in e-Services platforms and technologies
  - Functional Skills
    - High experience in Fault Management
    - High experience in Network Management System for system monitoring and generate report.
    - High experience in service management and monitoring systems

- Fault Management Operator
  - Role Definition
    - Daily operation of Fault Management functions within the network monitoring/NOC and e-services operation/monitoring.
    - 24x7 shift operation for monitoring of services and network elements.
    - Identification of network and service degradation or outages and immediate reaction by means of initiation of mitigation measures.
    - First line diagnosis of failures and service degradation.
    - Escalation of activities to second level support and management as appropriate.
    - Assumption of responsibility for the execution fault mitigation activities until final resolution.
    - Maintenance of documentation related to network monitoring (e.g. trouble ticketing, event recording, emergency change management, failure statistics) and handling of communication related to network events (external and internal).
  - Knowledge
    - Basic knowledge on Mobile Network.
    - Proficient knowledge of the process to handle fault / tickets from internal training.
    - Knowledge in e-Services platforms and technologies
  - Functional Skills
    - Experience in Fault Management

        - Experience in Network Management System for system monitoring and generate report.
        - Experience in service management and monitoring systems

- Configuration and Support Team Leader
    - Role Definition
        - Team manager for Configuration Management Team within the NOC department. Assumes functional and administrative leadership responsibilities to team staff. Responsibility for configuration activities on all network elements.
        - Single point of contact and single entity within the company to change network configuration on elements in live service.
        - Assume responsibility for correct configuration of all instances of network and all elements, according to planning data.
        - Immediate update of related documentation and records in order to ensure correct reflection of network status at any time.
        - Assume responsibility for second line expert support for network technology.
        - Execute initial configuration (new elements) and reconfiguration of live elements and network parameters according to planning data or as emergency mitigation action in case of problems.
        - Identification of shortcomings and upgrade requirements, e.g. firmware and software upgrades, and triggering of respective planning- and procurement process as appropriate.
        - Provide expert opinion and input to other departments related to network technology. Contributes to general technology- and project planning related to network technology.
        -
    - Knowledge
        - Advance knowledge on Mobile Network Elements and its interfaces.
            - Circuit Switch Network
            - Packet Switch Network
            - IN/VAS
            - RAN/RNC
        - Expert Knowledge on network integration and operation.
        - Expert Knowledge on Fault Handling process from internal training
        - Knowledge on team builder or has a leadership training course.
    - Functional Skills
        - Expert skill on network element's configuration and modification.
        - Expert in network operation on each network element :
            - Circuit Switch Network
            - Packet Switch Network
            - IN/VAS
            - RF
        - Expert skill in critical fault handling when get the escalation from the lower level.
        - Apply his knowledge to advise management and marketing team to create new products.

Program Management

- Network Project Manager
    - Role Definition
        - Planning, scheduling and execution of implementation projects for active and passive network elements and -components. Project management to ensure project stays within designated timeframe, budget, resources and quality.
        - Project planning, such as budget- and resource allocation.
        - Project execution control and management of related vendors and service providers (external and internal).

        - Cross-functional coordination of projects and related interfaces to ensure acceptance and seamless integration of network elements.
        - Provision of reports related to project progress, budget- and resource utilization and other project related parameters as required.
        - Management of project related documentation.
    - Knowledge
        - Expert knowledge level on Radio Network Access (RAN) and Transmission Network.
        - Expert knowledge in project management skills (PRINCE2)
    - Functional Skills
        - High experience in network rollout and quality Assurance
        - High experience in project management, managing vendors and project budget to delivery on time and within budget
        - High experience in acceptance test procedure

- IT Project Manager
    - Role Definition
        - Manage the delivery of all IT & Billing related projects, in accordance with requirements, budget and schedule. Management of project related documentation.
    - Knowledge
        - Advance knowledge in Project Management (Ideally certified in PMI, PRINCE or similar)
        - Proficient knowledge in IT and Billing system, data warehouse as well as other OSS/BSS.
        - Proficient knowledge in ITIL processes in IT service management.
        - Proficient knowledge of MS Project and MSOffice suite
    - Functional Skills
        - Highly experienced in project management, managing vendors and project budget to delivery on time and within budget
        - Ability to plan, organize and direct the work of a technical staff Soft Skill

Strategic Planning

- IT Architect
    - Role Definition
        - Develop, build and maintain an IT architecture of the IT landscape ensuring that it is efficient, effective and fit for purpose in meeting the immediate and future business requirements of eGovernment Agency.
        -
    - Knowledge
        - Expert knowledge in systems design and development
        - Expert knowledge of information technology, services, standards, procedures and guidelines
        - Advanced knowledge of applicable data privacy practices and laws
        - Proficient knowledge of database architecture and operating principles.
        -
    - Functional Skills
        - Experienced in information processing principles and practices
        - Advanced skills in system operations and procedures
        - Advanced analytical (analysis, evaluation) and problem solving (troubleshooting) skills
        - Advanced technical architecture and technical support documentation skills
        - TOGAF skills for Architecture Management

Enterprise solutions

- E-Services Project Manager
  - Role Definition
    - Planning, scheduling and execution of implementation projects e-services. Project management to ensure project stays within designated timeframe, budget, resources and quality.
    - Project planning, such as budget- and resource allocation.
    - Project execution control and management of related vendors and service providers (external and internal).
    - Cross-functional coordination of projects and related interfaces to ensure acceptance and seamless integration of network elements.
    - Provision of reports related to project progress, budget- and resource utilization and other project related parameters as required.
    - Management of project related documentation.
  - Knowledge
    - Expert knowledge level on service and platform technologies (e.g. Java, C++, Linux)
    - Expert knowledge in project management skills (PRINCE2)
  - Functional Skills
    - High experience in service implementation and quality Assurance
    - High experience in project management, managing vendors and project budget to delivery on time and within budget
    - High experience in acceptance test procedure

Note: Fault management for –e-services as described above also applies to this domain.

It has been shown that a comprehensive initiative such as government e-Services implementation hinges on a few success factors, which need to be overserved and implemented as far as possible. Below lists address the four major domains of organization of the eGovernment Agency, the processes and respected organization as well as the people and IT perspectives.

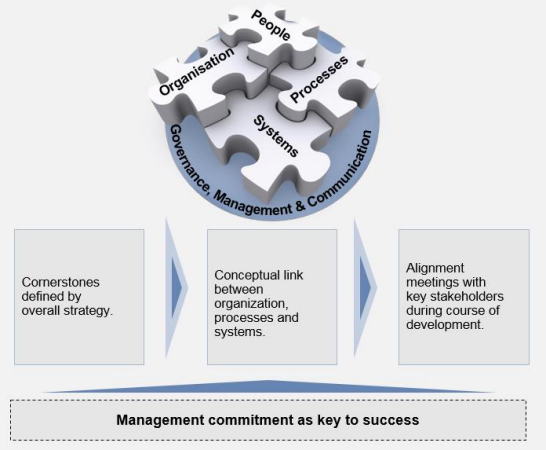


Figure 366 - Key success factors for comprehensive ICT management

6.6.2 Organizational Success Factors

- Get buy-in from higher levels of the organization and support from the responsible minister and other key decision makers at the respective government agency or ministry and hold regular review meetings
- Based on the eGovernment mandate, define the right roles and responsibilities. – Within the Agency and towards the other ministries. From the targets of operational excellence and efficiency, a ratio of 80 to 20 of internal value creation at the eGovernment Agency should be achieved. This means that 80% of the software

and infrastructure needs of the ministries and agencies shall be provided by eGovernment and only 20% are special solutions where the selection and deployment process should be under the responsibility of the respective organization.

- Ensure a powerful project management office is in place. The methodology should follow established project management standards like PRINCE2. Projects managers are needed with clear responsibilities and empowerment as well as a dedicated working team consisting of
    - Key business process owners
    - IT department staff
- Set up a clear project organization with a well-defined, practical escalation procedure
- Set up an IT management framework based on established standards like TOGAF and COBIT[204].
- Drive the deregulation of the telecommunication market while closely monitoring and preventing the creation of new monopolies. This will help to bring costs for telecommunications to a reasonable level while increasing the quality of services provided

Case Study eGovernment Framework in Swiss Government

In the year 2007, the Swiss Government approved the eGovernment strategy to be implemented within the next years. Based on this eGovernment strategy the federal IT steering Unit (FITSU) developed an ICT strategy and an implementation roadmap until the year 2015. Due to the federal structure of the Swiss Confederation, nearly all Swiss cantons developed their own e-Gov strategies and respective implementation roadmaps in parallel at the same time. The overcome this parallel approach and to save resources and increase efficiency, the federal government, representatives of cantons and ICT suppliers joined forces within the eCH association (the eGovernment body) in order to develop the needed eGovernment standards.

Business Challenge

- Lack of coordination within the governmental organization (three organizational layers: federal – canton – municipality)
- Development of eGov standards in a highly complex environment with involvement of different stakeholders (following deviating political agendas)
- Individual ICT architecture strategies and different maturity degrees of ICT landscapes in the different units and agencies
- Limited availability of resources (financial and personnel)
- Challenging timeframes for a planned realization

Project Approach following the TOGAF framework and their Architecture Development Method (ADM)

Step 1: Analysis

- Analysis of eGov strategy and definition of organizational and IT initiatives
- Development of common terminology and procedures
- Identification of action areas and pilot projects
- Definition of architecture principles

Step 2: **TARGET ARCHITECTURE DEVELOPMENT**

[204] COBIT® 5 provides structures for risk optimization and optimization of resource utilization while driving enterprise benefit realization. Furthermore COBIT® 5 is supporting IT alignment by bridging the understanding gap between eGovernment strategy requirements and IT capability definitions.

- Development of detailed IT and technological architectures for the support of eGov strategy
- Identification of common (federated) and individual architecture elements

Step 3- **SOLUTION DESIGN & MIGRATION PLANNING**

- Evaluation of different implementation scenarios
- Development of a migration strategy with single local implementation steps

Step 4 **IMPLEMENTATION & CONTROLLING**

- Establishment of required governance structures in order to control the eGovernment services implementation
- Implementation of an ongoing planning improvement process

6.6.3 Design and Mapping of Processes and Services

- Implement a demand management process. Having this process in place is essential as it balances the customers' requirements with the capabilities of the supply chain hence eGovernment Agency. With the right process in place, management can match supply with demand proactively and execute the plan with minimal disruptions and with an effective usage of available resources. The process is not limited to forecasting. It includes synchronizing supply and demand, increasing flexibility, and reducing variability.
- Having the right e-Service support processes in place is more important than just implementing a software – and it is much more complex. It is essential to considered this in every planning activity for new e-Services.
- Create a clear description of scope and desired outcomes in line with the project methodology being used.
- Include the end user perspective in designing processes and services by conducting end user interviews or surveys.
- Implement pilot services for gaining experience and achieving first results for your stakeholders
- Include outsiders in the process mapping exercise to ensure objective issue analysis, but develop the redesign in the working team, i.e., with key business process owners
- Think big and do not let possible obstacles limit your thinking about service redesign, considering the feedback from users and stakeholders.

6.6.4 IT and Implementation

- Think about a possible Request For Proposal (RFP) already when detailing the process redesign and e-service IT requirements
- Gather sufficient funding from all stakeholders or development partners early in the process
- Execute a stringent vendor management w.r.t. contractually scheduled results/responsibilities
- Ensure regular monitoring and reporting and compare to the set plan of the initiative
- Define project risks and mitigation efforts periodically
- Accept and be ready to fail early – this helps to keep invests to a minimum and give the chance for a successful second attempt.
- High reliable IT infrastructure needs to be provided to secure 24/7 availability of the services. This includes the design of the data center. The following aspects need to be considered:
    - **Architecture:** Low-Key vs. High Profile. The current data center is clearly identifiable from the outside as an eGovernment container. This provides risks in regards to sabotage.
    - **Energy Efficiency:** Design the Data center as a "green" Data center, following LEED[205]- standards and defined energy efficiency rules. "A green Data Center is a high-performance facility for the storage, management, and dissemination of data in which the mechanical, lighting, electrical and computer systems are designed for maximum energy efficiency and minimum environmental impact. The

[205] Leadership in Energy and Environmental Design (LEED) program

construction and operation of a green data center includes advanced technologies and strategies." The Data Center design can force you to make a choice between LEED certification and reliability/availability.

- **Security Systems – Monitoring + Access Control:** Deploy CCTV, Biometrics access controls, Leakage detection techniques as well as man traps.
- **Control Center:** Operating, Network Monitoring, Security Systems, Building Management Systems (BMS), Monitoring vs. Management
- **Continuous Operation:** Optional Shutdown of dedicated IT-systems / Racks upon alarms of technical or security systems
- **Operational Continuity:** Deploy redundancy offsite in a secondary location, securing zero outage handover.
- **Energy Supply:** Secure 2nd source of power

Open Source versus Closed Source (Proprietary)

Open Source and Closed Source are two approaches to the implementation and distribution of software. Open Source Software often comes with a usage license that permits free of charge use. Many public and private organizations have experimented with the deployment of open source software in their environments, with the focus on eventually reducing the Total Costs of Ownership (TCOs). The result gives a mixed picture and leads to the recommendation that Open Source might not be suited for the Guyanese context in general (i.e. replacing standard office products), but might be useful in the back office (e.g. server farms) and for niche solutions. Some points to consider specifically when looking at user-facing software:

1. Multiple professional programs, especially in the public sector, do not run on Linux systems, resulting in the need of having PCs with Windows.
2. Libre Office as a standard open source office product is not as powerful las MS Office. Data formats are not fully compatible and the different UI/UX lead to high training efforts for the users.
3. There is a need for many skilled software engineers to tweak, integrate and maintain an open source based solution.
4. Integration of open source using laptops in existing Windows based environments have been challenging, e.g., resulting in integration problems like not able to print properly.
5. External partners often rely on standard office formats - this has been problematic as the different file formats are incompatible.
6. Open source software in their basic forms are mostly not barrier free for handicapped people to use.
7. Only limited process support, as the acceptance by the users is mostly not given.

6.6.5 IT and Process Management Frameworks

Focus should lie on the implementation of established standards in the management and operation of an IT Department:

- PRINCE2 or other established framework for Project Management
- COBIT5 as an established framework for IT governance
- At a later stage TOGAF to establish an enterprise architecture framework
- ITIL as a set of practices for IT service management

Besides the IT centric standards, the usage of the eTOM framework as a Business Process Framework for the telecommunication industry is recommended as with the increased role of eGovernment Agency in the country the Agency needs to deploy and operate many processes as a telecommunication operator.

6.7 Next Steps towards a successful e-Service enablement

The detailed eServices enablement plan for eGovernment needs to focus on three dimensions:
I. Capacity Building – all aspects of developing the right skillsets being able to develop, operate and use e-Services by the different stakeholders
II. Framework readiness – organizational, operational, legal steps needed to successfully deploy and operate e-Services
III. e-Services rollout – understanding dependencies between needed enabling services and services targeting users like citizens and governmental stakeholders.

In each of these dimensions, there are a number of activities that need to be planned. The following checklists will guide the planning phase.

Capacity Building

- ❑ Initiate and drive capacity building at e-Government Agency
  - Step 1 – Implement a standardized Project Management Framework (PRINCE2 or PMI)
  - Step 2 – Identify and implement relevant aspects of eTOM framework needed for existing and future domains of activities of eGovernment Agency
  - Step 3 – Transform operation and management according to ITIL and CoBIT
  - Step 4 – Implement Enterprise Architecture Capabilities based on TOGAF
- ❑ Setup National Training Center in Georgetown (Location, Trainers, Funding)
- ❑ Elaborate skill profile and job descriptions for IT specialists in all ministries
- ❑ Elaborate skill profile and job descriptions for master trainers
- ❑ Prepare curriculum and develop detailed content of the trainings modules
- ❑ Develop and implement an information campaign about risks of using the internet and ICT services and how to stay safe. Develop dedicated information material to ensure children stay safe when using e-Services and the internet.
- ❑ Elaborate and implement reporting measures in case users observe harmful conduct when using the internet (fraud, sexual harassment, etc.). Create and empower organizations to report to and publish the contact details to the users.

Framework readiness

- ❑ Obtain mandate for e-Government Services to be deployed and operated by eGovernment Agency, considering the proposed 80:20 approach in regards to operational ownership of e-services.
- ❑ Implement demand management process at eGovernment agency.
- ❑ Expand organization of eGovernment Agency and create additional positions required (e.g. account managers, vendor management team) and staff positions within the eGovernment Agency and

Ministries. The new hires need to be skilled and experienced enough to lead infrastructure implementation and software training efforts. Collaboration with external vendors also needs to be steered.
- ❑ Secure carrier grade operation for e-Government Services
- ❑ Setup a dedicated program management office (PMO) to drive and oversee the implementation
- ❑ Address legal activities needed to facilitate digital cooperation between different governmental entities.
- ❑ Extend legal frameworks (e.g. for health e-Services) in line and anticipating the planned e-Services rollout
- ❑ Initiate needed changes in other governmental entities to be ready for the planned e-Services (e.g. police for security services)

e-Services rollout

- ❑ Create a single "e-Services board" which comprises all relevant government stakeholders. This will drive the initiative and make sure sharing of platforms will be realized.
- ❑ Assign the leadership structure for the initiative and schedule regular meetings. This will give authority to the work stream leaders and enable periodic reviews.
- ❑ Develop roadmap for e-Services rollout, considering dependencies between enabling services and user services, existing skills and financial resources.
- ❑ Start tendering phase: Launch RfI (optional), develop detailed technical and procedural requirements and write the RfP, launch tender, evaluate of responses, negotiate with short-listed vendors, close contract
- ❑ Select locations and start pilot of e-Services
- ❑ Drive full-scale rollout of e-Services platforms in hinterland, poor and remote communities

7. Developing skills and capacities (WP3)

7.1 Introduction

A sustainable deployment and usage of e-Services is a key success factor for developing the society in the country further. One driver for this success is the development of needed skills and capacities within the different user groups for e-Services. This report describes what skills are needed to deploy, operate and use e-Services for the different stakeholders (training plans) as well as recommendations how the needed training activities can be performed in the whole country (training schemes), permitting especially people in the hinterland and remote areas to profit from these training activities.

The results from this chapter might update findings from the previous chapters.

7.2 Documented Stakeholders and their Needs in regards to ICT Capacity Building

Several stakeholders are involved in the realization and usage of e-Services in Guyana. All of them must have a certain set of skills and capacities to fulfill their future roles in the e-Services ecosystem. In order to equip all stakeholders with the capacities required to accomplish their tasks and responsibilities a training plan is being developed, considering the different stakeholder groups and their characteristics.

Stakeholders from governmental institutions will benefit from the usage of e-Services, but will also be responsible for the design of content and functionalities of the services.

Teachers and health professionals are less involved in the operation of the e-Services, but are important target groups for the usage. Furthermore they will serve a multipliers as they promote the adoption of the services to citizens: In regards to health related issues doctors, nurses and health workers shall leverage e-Services for e.g. blood glucose monitoring or maternal health care and explain the usage of these services to their patients. In regards to education, teachers and head teachers shall leverage e-Services such as remote classroom and student learning and explain the usage of these services to their students.

Depending on the role the stakeholders will have in the e-Services ecosystem, different skills are required.

7.2.1 Stakeholders from Governmental Institutions

Stakeholder	Roles and Responsibilities	Skills needed
e-Service Experts at eGov/central project office	• Securing the provisioning of basic online services (Email, web browsing, document download, …) • Enabling the use of e-Services • Define service requirements and improve existing services; alignment with stakeholders to derive their e-Service related needs • Understand process needs of e-Services and their respective use-cases, i.e. the flow of information beyond the e-services (e.g. information from Tell Us application) • Understand enabling services: Identification management; payment services	• Advanced knowledge on PC usage, and internet usage • Advanced knowledge in office software & data management • Use of e-Services • Design & Editing of e-Services
IT Experts at all Ministries	• Design, operate and maintain e-Services • Create and publish content for e-Services • Operation and management of devices (remote)	• Advanced knowledge on PC usage, and internet usage • Advanced knowledge in office software & data management • Use of e-Services • Design & Editing of e-Services • Creation and Publishing of content for e-Services • Basic knowledge of Network operation, data models • Basic knowledge of remote device management (laptops, Android, iPhone)
Officials at Ministry of Home Affairs	• Birth Certificate Provisioning • Process passport applications • Process marriage and death related information • Enabling services: Identification; Banking services	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services • Design & Editing of e-Services

Officials at Ministry of Public Health & Ministry of Health, **PAHO**	• Basic Online Service (Email, web browsing, document download, …) • Warehouse management for medical supplies: Entering & monitoring receipt of drugs and other supplies; Entering & monitoring forecast data of needed supplies • Tele-Surveillance and Disease Forecast: Record public health indicators and enter in system in digital format; Retrieve analysis of epidemiologists panel from IT system; Raise appropriate alerts with health experts and community	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services • Design & Editing of e-Services
Officials at Ministry of education/NCERD	• Basic Online Service (Email, web browsing, document download, …) • Teacher classroom support: Receive and send emails with attachments; Access websites and download material (static documents); Operate the equipment in the classroom, e.g. PC, projector, whiteboard; Interact with other teachers remotely for curriculum exchange • School management application: Access attendance records and school inventory remotely; Prepare classes schedule with software; Upload new student roster	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services • Design & Editing of e-Services
Officials at all Ministries	• Basic Online Service (Email, web browsing, document download, …) • Process Information from Tell Us Application • Usage of enabling services: Identification; Banking services	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services

Table 66 – Stakeholders from governmental institutions and their roles and responsibilities

7.2.2 Stakeholder from the Educational Sector

Stakeholder	Roles and Responsibilities	Skills needed
Head teachers, Teachers	• Teacher classroom support: Receive and send emails with attachments; Access websites and download material (static documents); Operate the equipment in the classroom, e.g. PC, projector, whiteboard; Interact with other teachers remotely for curriculum exchange • Individual student learning: Basics of PC operation (on/off, Windows, file system, etc.); Operate the specialized software (Kahn Academy, SuccessMaker, …); Interact with game play in educational software (e.g., Play2Learn) • School management application: Access attendance records and school inventory remotely; Prepare classes schedule with software; Upload new student roster • Remote classroom: Operate the videoconferencing system; Operate the PC to connect to remote classroom; Download instruction material; Interact with the Q&A section for ad-hoc clarification	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services
School secretaries	• Receive and send emails with attachments • Basics tasks with PC operation (Windows, file system, etc.) • Access attendance records and school inventory remotely • Writing of documents and reports using word processing program	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services
Students	• Individual student learning: Basics of PC operation (on/off, Windows, file system, etc.); Operate the specialized software deployed (e.g. Kahn Academy, SuccessMaker, …); Interact with game play in educational software (e.g., Play2Learn) • Remote classroom: Operate the videoconferencing system; Operate the PC to connect to remote classroom; Download instruction material; Interact with the Q&A section for ad-hoc clarification	• Using Computer and Managing Files • Information & Communication via internet & via email • Use of e-Services

Table 67 – Stakeholders from educational sector and their roles and responsibilities

7.2.3 Stakeholders from the Health Sector

Stakeholder	Roles and Responsibilities	Skills needed
Doctors, Nurses, Community Health Workers	• Basic digital services: Send/receive Email on a stationary PC; Access websites with downloadable forms to be printed out; Access blogs and bulletin boards for information exchange; Document repository (document management system) • Create & manage electronic health records: Take clinical notes; Enter administrative data; Upload laboratory results; Track pharmacy dispersal • Warehouse management for medical supplies: Entering receipt of drugs and other supplies & forecast data of needed supplies • Tele-Consultation: Operating the application, incl. Video conference, audio, etc.; Uploading photos into the application; Answering questionnaires, filling forms, etc. • Tele-Diagnosis: Capture vital statistics & upload to IT system, e.g., x-ray, ECG, ultrasound; Operate IT system for diagnosis • Tele-Surveillance and Disease Forecast: Record public health indicators and enter in system in digital format; Retrieve analysis of epidemiologists panel from IT system; Raise appropriate alerts with health experts and community	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services
Clerks, Assistants / Secretaries in hospitals	• Basic digital services: Send/receive Email on a stationary PC; Access websites with downloadable forms to be printed out; Access blogs and bulletin boards for information exchange; Document repository (document management system) for health-related services • Create & manage Electronic Health Record: Take clinical notes; Enter administrative data; Upload laboratory results	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services
Lab technicians / X-ray technicians	• Uploading laboratory results • Tele-Diagnosis: Capture vital statistics and upload to IT system, e.g., x-ray, ECG, ultrasound; Operate specialized IT system for diagnosis	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services
Pharmacists / Druggists	• Warehouse management for medical supplies: Entering receipt of drugs and other supplies; Entering forecast data of needed supplies; Track pharmacy dispersal	• Using Computer and Managing Files • Information & Communication via internet & via email • Organize data • Use of e-Services
Patients	• Access websites with downloadable forms to be printed out • Tele-Consultation: Operating the application, incl. Video conference, audio, etc.; Uploading photos into the application; Answering questionnaires, filling forms, etc.	• Information & Communication via internet & via email • Use of e-Services

Table 68 – Stakeholders from health sector and their roles and responsibilities

7.3 Training Plan

7.3.1 Training Content

People interviewed during the baseline data collection recognize the benefits of using computers, tablets, and laptops. Respondents can see benefits in the use of computers at schools for education and for the information of children and young people. Education professionals mentioned some activities in which they could use these devices, e.g. to complete complex tasks or to add new training features to their classes. Teachers acknowledge that young people need to be in contact with new technologies in order to stay in the same pace as people with access to better telecommunication infrastructure. However, the teachers themselves do not feel comfortable when using some devices, such as computers and laptops. Therefore, in order to implement programs to improve computer literacy in school, teachers would probably need to obtain extra qualifications.

Furthermore the use of computers requires, according to the view of respondents, greater specialization than the use of smartphones. So they see themselves depend on courses and learning, particularly aimed at older audiences, which have more difficulties in operating these types of equipment.

The capacity building must follow a step-wise approach, starting with the development of basic skills among all stakeholders, continuing to an advanced level up to very specialized capacities for the usage and provision of specific e-Services.

The content of the training will be organized in various modules that build on one another. Depending on the future role of the trainees different modules are mandatory, recommended and optional. This way the minimum capacities and skills for the usage of ICT-devices, e-Services and the navigation in the internet will be built up at all stakeholder groups. More complex operations like data analyses and presentation design are being elaborated in the more advanced modules that are only mandatory for selected stakeholder groups.

Module	e-Service Experts at eGov/central project office	IT Experts at all Ministries	Officials at all Ministries	Officials at M. of Home Affairs	Officials at M. of Public Health & Health/PAHO	Officials at M. of Education/NCERD	Head teachers / Teachers	School secretaries	Students	Doctors/Nurses/Community Health workers	Clerks / Assistants / Secretaries in hospitals	Lab technicians / X-ray technicians	Pharmacists / Druggists	Patients
Introduction to IT: Introduces candidates to the basics for maintenance & care of devices, basic commands regarding the use of a smartphone/tablet/PC/laptop and its peripherals as well as the networking and basics of data security and privacy. [2 d]	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Information & Communication Using internet Explorer and Microsoft Outlook: Teaches candidates how to locate relevant information on the internet and ways of using email and e.g. Microsoft Outlook. [3-4 d]	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Using Computer and Managing Files (Windows): Introduces candidates to operational functions of Microsoft Windows and its related applications such as managing files and folders, using Windows' applications and operating printers. [2-3 d]	M	M	M	M	M	M	M	M	M	M	M	M	M	R
Use of e-Services Applications: introduces candidates to the usage of specific e-Services via the respective website/ application/ special IT systems, the usage of specific devices required, and particular needs for data security, data protection and privacy. [2-3 d]	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Word Processing Using Microsoft Word: Teaches candidates how to create, save, format, and print-out documents such as letters, memos, and simple reports and using features such as figures and tables. [3-4 d]	M	M	M	M	M	M	M	R	O	M	M	M	R	O
Spreadsheets Using Microsoft Excel: Teaches candidates basic skills essential to creating and managing tables effectively and efficiently, taking into consideration displaying data clearly and concisely. [3-4 d]	M	M	M	M	M	M	R	R	O	R	R	R	M	O
Presentations Using Microsoft PowerPoint: Equips candidates with the skills needed to create, edit, format, and present data displays, and teaches candidates how to combine texts, format pictures and tables, use special effects, and create simple slides using templates and related tools. [2-3 d]	M	M	M	M	M	M	R	R	O	O	O	O	O	O
Databases Using e.g. Microsoft Access: provides candidates with the skills essential to managing databases successfully. Candidates learn how to create, edit, and format simple databases including creating tables, queries, forms, and reports. [3-4 d]	M	M	O	O	O	O	O	O	O	O	O	O	O	O
Design & Editing of e-Services Applications: introduces candidates to the design of e-Services and the editing of the content and functions via the respective website/ application/ special IT systems. [3-4 d]	M	M	O	M	M	M	O	O	O	O	O	O	O	O

M = mandatory, R = recommended, O = not required - optional, [x d] = recommended duration of module in days

Table 69 – Recommended training modules per stakeholder group

General information on how to use the internet and e-Services shall be part of the first modules (Introduction to IT) and shall also be available for everybody via the internet. Currently the eGovernment Agency does already use online channels, such as facebook, to raise awareness for potential risks of using the internet.

Figure 367 - e-Government Agency's Cyber Security Tips for the Week

To complement this communication a holistic guidebook giving support for the most common use cases should be developed and promoted. The advantages as well as the risks of the usage of e-Services shall be pointed out and concrete rules of conduct shall be provided to mitigate the risks and enable people to stay safe online. Special attention should be paid to children, addressing their behavior and providing advice for the parents on how to prepare their children for safe internet usage and raise awareness for potential risks. The UK council for child safety has developed a guideline to keep children safe, when using the internet. The document covers the risks and recommended rules for safe behavior on the topics of chatting, sharing, gaming, content providing, networking, shopping and commerce. This guide is recommended to be used as input for the development of the training content.[206] The full content is presented in the appendix (chapter 9.5.2).

Example from UK: Advice on internet Safety for Chatting

What is chatting?

There are lots of different ways you can chat to people online - and lots of different places you can do it. Chatting includes every type of service which allows you to have a conversation with somebody else. It can be text based messaging (such as instant messaging or SMS) or via a voice or video link (such as by VoIP internet phone calls or a webcam). It can also be instant, real-time communication (chat rooms or instant messaging) or delayed (such as e-mail or voicemail).

[206] https://www.gov.uk/government/publications/advice-on-child-internet-safety-10-universal-guidelines-for-providers

Chatting like this is a great way to stay in touch - as well as meet new people. But there are a few things you can do to make sure you have a good time and stay safe.

Things to think about

- Know who you're talking to online; if you don't know someone face to face they could be anyone
- Remember – what you do or show on your webcam can be recorded and what they do or show on their webcam at the other end might be a recording
- Avoid having one-sided webcam conversations where the other person's webcam is 'broken' or, 'not working…'; you won't know who they really are, what they are doing or who they are watching with

Things to do

- Keep your personal information private - avoid sharing personal information such as your phone number, home address or photographs with people you don't know in person and trust
- Check whether the service you use allows you to create friend lists. These lists let you manage who sees what. For example, you may only want your closest friends to see some information
- Keep your clothes on when using webcam - images of you could end up in the wrong hands
- Use private messages for people you know in person and trust; be careful of private messaging people you don't know
- Use a strong and unique password for all of your online accounts – a combination of letters, numbers and symbols (and if you've ever shared it in the past, change it)
- Know how to block someone if they make you feel uncomfortable or upset
- Learn how to save chat logs and texts so that if someone does make you uncomfortable/upset, you have the evidence to report them
- Remember to log out of a service properly after use, especially on a shared computer

Additional advice for parents/carers

- Talk to your child about who they're talking to online and encourage them to think before talking to people they don't know in person
- Try to understand and guide your child's online behavior - negotiate and establish boundaries and discuss sensitively the issues around the concept of 'friends'
- Familiarize yourself with the chat program your child uses. Find out more about its built-in safety functions and how they can be contacted within the service
- Ask your child if they know how to block someone who they don't want to talk to anymore. If they don't, help them to learn how to use the blocking feature
- Use parental control software provided by your internet service provider, mobile phone network, online content provider or games console and consider using filtering options, monitoring and setting time limits for access to chat
- If you discover misconduct between your child and someone online stay calm, investigate the facts and seek expert help if needed
- As part of a wider discussion about sex and relationships cover how people may use the internet to explore their sexuality, which may include sexual chatting

For the detailed development of the training modules knowledge and experience of institutions from the private sector can be harnessed. The CIE – Cambridge International Examinations (formerly known as the University of Cambridge International Examinations) provides international qualifications, offers examinations and qualifications to 10,000 schools in more than 160 countries and has a detailed curriculum for Information and Communication

Technology[207]. A cooperation for the development and provision of trainings can be useful to ensure a fast ramp up of the training plan.

Existing training content shall be leveraged as well. The Guyana Learning Channel offers Computer Basics as part of its schedule.[208] This content should also be considered as input for the training modules. Beyond that the whole curriculum of the training plan should be incorporated in the schedule of the Guyana Learning Channel especially an introduction into the use of the particular e-Services targeting consumers (e.g. application for passports, birth- and marriage-certificates, diabetes management, maternal healthcare, ePayment).

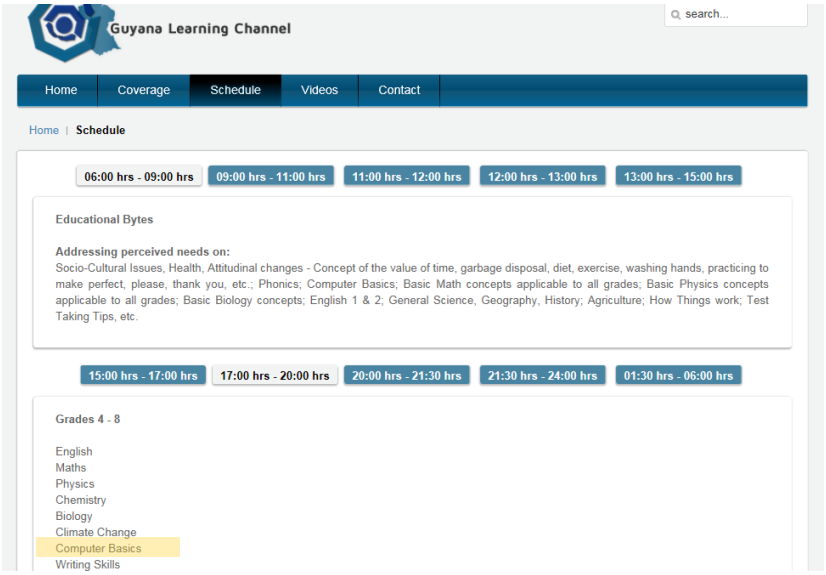


Figure 368 - Computer Basics as module in the Guyana Learning Channel

The University of Guyana does also provide a BSc. Degree in Computing and Information Technology via the Online Degree Program.[209] Graduates of this degree would become confident users and managers of information technologies, administer and manage network or database systems, or develop new software solutions to meet specific market or organizational needs. As this degree goes much more into details and build up specialized knowledge and skills it can benefit from the general trainings on ICT literacy. The general training is likely to arouse more interest in ICT and may also make people feel more comfortable in the use of IT and computers. This can result in higher demand for the BSc. Degree in Computing and Information Technology.

Even though people may already have advanced ICT skills, it still is highly recommended, that they participate in the training modules. This way they will also learn how to explain the use of ICT to their community members. Furthermore a certain level of continuity can only be reached by ensuring that all stakeholders receive the same (basic) trainings and share a common vision of the e-Services of Guyana.

7.3.2 Training Schemes

The existing Guyana Learning Channel can also be leveraged to distribute trainings on ICT literacy in Guyana. The broad technical reach[210] of the Learning Channel is perfectly suitable to broadcast content on computer basics and more advanced computer skills as well as to educate on concrete rules of conduct to mitigate the risks of using the

[207] http://www.cie.org.uk/programmes-and-qualifications/cambridge-igcse-information-and-communication-technology -0417/

[208] http://www.guyanalearningchannel.com/web/schedule

[209] https://turkeyenonline.uog.edu.gy/srms/docs/dist_edu/bsc_comp_it.pdf

[210] http://www.guyanalearningchannel.com/web/coverage

internet and to enable people to stay safe online. These educational bytes must target not only school children, but also older students and adults.

Figure 369 - Guyana Learning Channel, regional coverage

Specialized training modules targeting only few stakeholder groups shall be available on demand, e.g. via the youtube channel.[211]

Still in addition to the broadcasting of training lessons face-to-face trainings are crucial for the sustainable development of ICT skills. The challenge in the development of a training plan for the sustainable introduction of e-Services is that there are plenty stakeholders involved with different skill profiles. Furthermore the stakeholders can be divided into two major groups:

Firstly the officials at the ministries will on one hand use the e-Services and on the other hand will define design requirements and create content for the e-Services. The majority of the officials is based in Georgetown.

Secondly the members from the communities in the hinterland, remote and poor areas will predominantly use the e-Services, especially teachers, health professionals and administrative workers. These stakeholders live in communities geographically scattered over Guyana.

To train stakeholders in the Georgetown area it is recommended to establish a National Training Center in Georgetown and provide trainings on a regular basis.

To reach stakeholders in the hinterland, remote and poor communities a “train-the-trainer” scheme is recommended: Master trainers will be trained and qualified in the National Training Center and then transfer this knowledge and skills to experts from the communities. There should be one master trainer for each administrative region of Guyana.

The master trainer will instruct and train teachers and health professionals from the communities, who in return will transfer this knowledge to their peers in their communities.

[211] https://www.youtube.com/user/LearningChannelGy

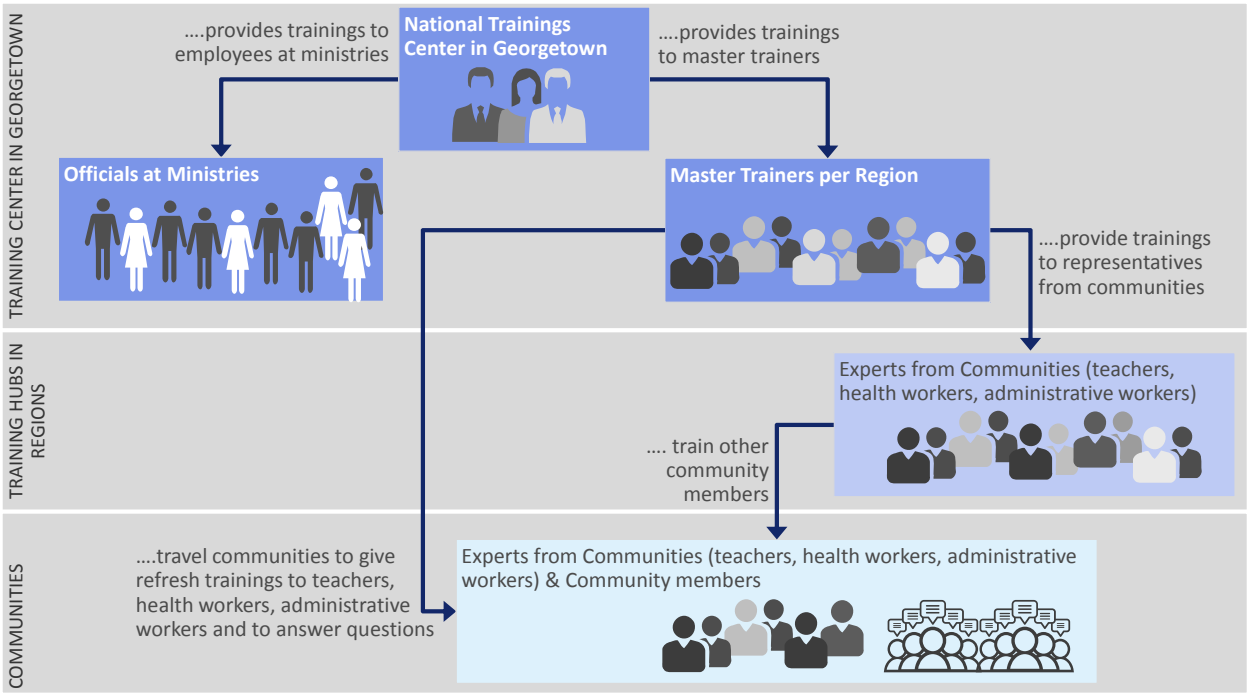


Figure 370 - Master trainer concept for capacity building in the 10 administrative regions of Guyana

National Training Center

- Design, realize and operate e-Services
- Design, realize and operate training plan, receive feedback from master trainers and experts, update and improve training plan on a regular basis
- Liaise with regions and government
- Be single point of contact for all other stakeholders: respond to all questions regarding ICT-services and e-Services
- Develop & update instructors' manual and participants' modules, provide hard copies and digital versions of both
- Provide central knowledge base with all training materials
- Be responsive all times for questions from master trainers and provide a support hotline to assist master trainers via phone and email
- Provide weekly conference calls with master trainers to support ramp up and operation of trainings in regional training hubs
- Be responsible and take care of the further skill development and educational training of master trainers, develop tasks for master trainers and monitor their progress in skill building

Master trainers

- Receive in-depth training on ICT skills and use of e-Services in the National Training Center
- Provide trainings on ICT skills and use of e-Services to experts from communities
- Travel communities to refresh trainings, to answer questions and to assist in the use of e-Services
- Collect questions and feedback from communities and report to the National Training Center for improvement and evolution of training plan
- Access central knowledge base in Georgetown
- Attend weekly conference call with National Training Center to smoothen ramp up and operation of trainings in regional training hubs

- Work on continuous self-improvement and professional development in the field of ICT services
- There should be one master trainer per region. The master trainer should be someone who is endemic to the region and is familiar with people's way of life, culture & traditions. He/she should also have interest in the use of ICT services and be willing to travel on a regular basis.

Experts from communities

- Participate in training in regional learning hubs
- Transfer knowledge and skills generated in training to the peer community members: Present the new e-Services and explain how to use them to community members
- Collect questions from community members and answer if possible, present open questions to master trainer at next encounter and clarify
- Experts from communities should be volunteers and be selected according to their qualification and motivation to accomplish the task. As e.g. head teachers have many tasks in the steering and management it might be more reasonable to send a teacher to attend the trainings. Experts from communities should be assigned for a certain period of time (at least one year) to ensure continuity in the learning process.
- It is recommended that 3 experts per community are assigned to take part in the trainings in the regional training hubs. Ideally there is one each from the health sector, the educational sector, and the administrative sector. Minimum 2 experts must be sent per community.

7.3.2.1 Training in the National Training Center

Staff working at the governmental institutions and being potential users of e-Services shall visit the training center on a regular base. They will be trained and educated in ICT skills, starting with the basics and later they will participate in specialty training classes for dedicated e-Services.

These trainings will be held centrally and on-site at the National Training Center. This center shall be setup in Georgetown under the responsibility of the eGovernment Agency. Online classes will complete the curriculum at a later stage.

The following target groups should participate in these trainings as they will be users of the eGovernment e-Services and infrastructure:

- Officials of all ministries that will use e-Services or related applications
- Master trainers
- Other stakeholders in the Georgetown area (lab-assistants, druggists, etc.)
- Users that need specialized training modules e.g. for x-ray technicians

The generic training modules are the same as described in chapter 7.3.1 and shall be repeated on a regular base. This will permit to train a large number of users and increase the overall knowledge of usage of ICT service in the country significantly and sustainable. In addition, new modules focusing on special e-Services or fields of interest shall be developed and trained to selected stakeholder groups.

7.3.2.2 Training of e-Services in the Training Hubs in the Administrative Regions

To reduce travel efforts for the experts from the communities, especially for those in hinterland and remote areas, there will be trainings hubs in each of the ten administrative regions. Experts from the communities shall travel to the trainings hubs to participate in the high intensity training on the modules. These trainings in the hubs shall last in average about 5 days. The first module will give them the basic skills to use ICT devices and services and is more comprehensive than the subsequent training sessions. Hence, the first training in the regional training hubs would last 9 – 12 days for the experts from the communities.

The following modules are recommended to be trained per term:

- **1st term**
  Introduction to IT [2 days], Information & Communication Using internet Explorer and Microsoft Outlook [3-4 days], Using Computer and Managing Files (Windows) [2-3 days], Use of e-Services Applications [2-3 days]
- **All terms from 2nd term onwards**
  Refresh of previous modules [2 days], Introduction to new e-Services [1 day], Organizing data (MS Word or MS Excel or MS Powerpoint according to participants' demands) [3 days]

The trainings schedule is organized in iterative terms. Each term contains 3 phases and lasts 3-4 months.

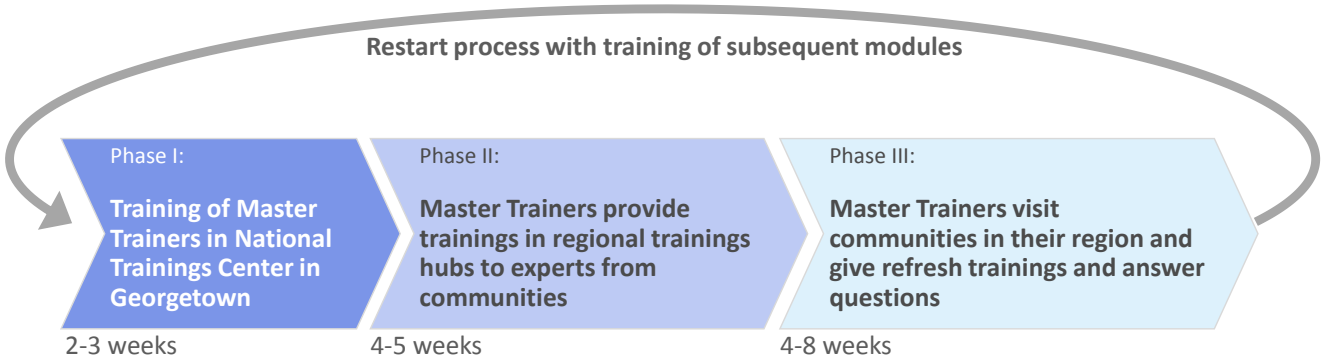


Figure 371 - Structure of iterative trainings terms for master trainers

Each region will have at least one training hub. Depending on the total population and the geographical distribution of the communities in the region, the number of hubs and their locations are defined. The overall goal is to reduce travel efforts for experts from communities and of the master trainers.

In alignment with the roll out plan developed in the Technical Report (work package 2 of this assessment) the following trainings hubs shall be established to cater the communities in the hinterland, poor and remote areas.

Region	Trainings Hub	Communities catered (illustrative)
1	Mabaruma	Arakaka, Aruka River, Baramani River, Hosororo, Kobarina Hill, Barabina Hill, Mabaruma, Kokerital Hill, Morawhanna, Wauna & White Water
1	Moruca (Santa Rosa)	Akwero, Kokerite, Kumaka, Waramuri Mission
1	Port Kaituma	Matthews Ridge, Port Kaituma
2	Anna Regina	Aurora, Lima Sands, Maria Henrietta, Richmond, Spring Garden
2	Charity	Akawini, Wakapau
3	Vreed en Hoop	Fort Nassau, Sans Souci, Vreed en Hoop
4	Georgetown	National Training Center
4	Mahaica	Mahaica
4	Mon Repos	Mon Repos, Friendship (East Bank)
4	Timehri	De Maria Elizabeth, Dora, Hararuni River, Low Wood, Susannah's Rust, Timehri
5	Belladrum	Calcutta, De Hoop
5	Mahaicony	Mahaicony
6	New Amsterdam	New Amsterdam
6	Rose Hall	Rose Hall
6	Skeldon	Skeldon
6	Tacama	Tacama
7	Bartica	Bartica, Ekereku, Issano, Kurupung, Makouria, Penal Settlement, Riversview/ Falmouth, St Mary's, Wineperu
7	Kamarang	Arurau River, Imbaimadai, Kamarang, Paruima, Waramadong
8	Kato	Itabac, Kato, Kopinang, Kurukabaru, Monkey Mountain, Paramakatoi, Taruka
8	Mahdia	Mahdia, Maikwak, Tumatumari
9	Aishalton	Achawib, Aishalton, Karaudarnau, Lumidpau, Shea
9	Annai	Annai, Apoteri, Karanambo, Kwatamang, Massara, Surama, Toka, Yakarinta
9	Lethem	Cracana, Hiawa, Karasabai, Cracrana, Lethem, Manari, Moco Moco, Nappi, Parishara, Sawariwau, Shulinab, Meriwau, St. Ignatius
10	Linden	½ Mile, Amelia's Ward, Christianburg, Cockarata (North Mc Kenzie), Coomaca Lands, Great Falls, Mabura Hill, Mahaicabally, Silver City, Wismar, Wisrock (block 22)
10	Kwakwani	Aurora, Hururu, Ituni, Kwakwani

Table 70 – Proposed training hubs per region and communities catered

Figure 372 - Map of training hubs

7.3.3 Prerequisites

7.3.3.1 Provision and Operation of e-Services

eGovernment Agency needs to provide the technical platforms for the operation of the infrastructure and services as outlined in the technical report (WP2) and the e-Services readiness assessment (WP3). Securing the operational

excellence of the agency beyond the pure management of technologies is essential for delivering a carrier grade availability of services.

The following skills need to be built at eGovernment Agency to achieve operational excellence beyond the pure IT skills.

Organizational need	Rationale	Training/ Capacity	Target group at eGovernment Agency
Secure standardized and efficient project management	Adhering to project management methods and strategies reduces risks, cuts costs and improves success rates in the execution of projects. Following an established project management framework reduces the ramp up time for involved experts and increases the project related interaction with other stakeholders due to commonly known patterns and methods.	**PRINCE2** or **PMI** are established frameworks for a standardized project management approach.	Program managers, project managers and project members
Deploy and operate carrier grade IT services to the customers	Providing carrier grade services, i.e. availability of the service in 99,999% of the overall runtime, require a stable IT that is organized around best practice frameworks and processes - not only in the phases of service development and-launch but especially during the runtime of the service.	**ITIL V3** The "Information Technology Infrastructure Library" is a set of practices for IT service management. It describes processes, procedures and tasks and provides checklists that shall be applied to eGovernment Agency. It allows the agency to establish a baseline from which it can plan, implement, and measure.	Senior manager from project management, IT operation and business strategy
Provide professional IT management and IT governance	The central aim of IT management is to generate value through the use of technology. IT management is the discipline whereby all of the information technology resources of an organization are managed in accordance with the organization's needs and priorities. Information and technology (IT) governance is a subset discipline of corporate governance, focused on information and technology and its performance and risk management.	**CoBIT** is a best-practice framework to address IT management and IT governance. It provides an implementable "set of controls over information technology" and organizes them around a logical framework of IT-related processes and enablers.	Senior manager from project management, IT operation and business strategy
Secure alignment between business strategy and IT operation	Securing a holistic approach in managing the architecture of an organization is essential to align business strategy, business operation and business information with technology. This can be addressed at a later stage of the evolution of the organization, when the maturity	**TOGAF** The "Open Group Architecture Framework" is a framework for enterprise architecture. It is based on four interrelated areas of specialization called architecture domains: Business architecture, Application architecture, Data architecture, and Technical architecture. The Architecture Development Method (ADM) is a core	Enterprise Architecture team, consisting of senior manager from IT management and business strategy

		element of TOGAF and describes a method for developing and managing the lifecycle of an enterprise architecture	
Implement processes and data models from the telco world that are based on established standards	With the increased offering of connectivity services to the hinterland, poor and remote areas and esp. to the consumers in these regions, eGovernment Agency needs to implement business processes and data models similar to those implemented at telecommunication operators, even if they don't compete with them on a commercial level.	**eTOM** the "enhanced Telecom operations Map" provides a process framework for telco operators as well as a respective data model. It is a multipart ITU-T recommendation.	Senior manager from, IT operation and management as well as and business strategy
Create the foundation for data analytics and further intergovernmental cooperation	High quality of available data is a key driver for the evolution of the eGovernment Agency and prerequisite to an improved service offering (e.g. by monitoring the performance of infrastructure and services)	**MDM** "Master Data Management" is key success factor in designing the right data model and to understand the potentials in using and structuring the data available.	Senior manager from IT operation and management responsible for the design of data architectures

CoBIT, ITIL, and TOGAF are frameworks that provide mechanisms for improvement and adjustment of IT centric organizations when facing e.g. the needs to prioritize demands and to mitigate risks. The three differ in scope and audience: TOGAF is an architecture framework covering the above mentioned domains, while ITIL is an IT service framework and subsequently provides more focused guidance in this arena. ITIL could be seen as the way to manage the IT services across their lifecycle, while CoBIT is about how to govern the enterprise IT in order to generate the maximum creation of value by the business. CoBIT describes the principles and enablers that support an enterprise in meeting stakeholder needs, specifically those related to the use of IT assets and resources across the whole enterprise. ITIL describes in more detail those parts of enterprise IT that are the service management enablers (process activities, organizational structures, etc.).

The following diagram illustrates how and where the frameworks overlap, including project management:

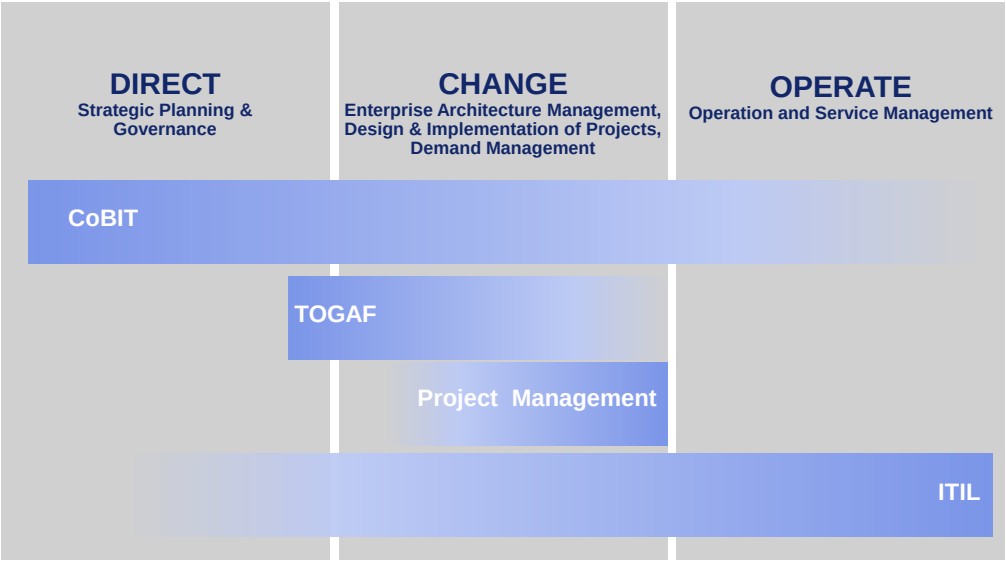


Figure 373 - Areas of overlap of popular IT related frameworks[212]

Despite the areas of overlap, these frameworks are more often used in conjunction with each other for achieving better organizational compliance, security, and overall digital and service resilience. For example, companies often employ COBIT and ITIL together to guide the governance and management of enterprise IT services—with COBIT covering implementation, operation, and improvement and ITIL covering IT service management and business value enablement. TOGAF provides the overall framework from strategy to capability architectures. Project management secures the effective steering of implementation and change projects.

The development of project management skills shall have a top priority (year one) as well as the transformation of the eGovernment organization according to eTOM. CoBIT and ITIL capabilities should be build up subsequently (still year one), followed by the implementation of an enterprise architecture function (using TOGAF) at a later stage (e.g. year three).

7.3.3.2 Provision and Operation of Trainings

Trainings Materials are essential for the success of the training plan. All materials shall be available as hard copy. On top the materials must be accessible via the internet so that master trainers as well as experts from communities can view and reread content online and download documents of single modules. The following training materials shall be provided:

- Instructor's manuals:
  Booklet and presentations / interactive demo versions and show cases of e-Services and software
- Participants Modules:
  Detailed explanations of the different modules and handbooks for the software/e-Services discussed in the single modules. Participants will have a ring book and will receive print outs for each module during training sessions in the training hubs. This way, they create their individual manual according to their needs.

Facilities for the Training Hubs in the administrative regions must be available and maintained. Training hubs must provide classrooms with desks and chairs for the participants, steady internet access and electricity supply. Devices namely computers or laptops, beamers and screens must be provided.

[212] Source: ITpreneurs.com

Human resources namely the instructors and staff at the National Training Center and the master trainers must be hired and qualified. As the training hubs in the different regions will be build up stepwise, master trainers will be hired accordingly:

- Phase 1: 7 master trainers (regions 1, 2, 4, 5, 6, 8, 10)
- Phase 2: additional 3 master trainers (regions 3, 7, 9)

In addition to the salary the travel expenses of master trainers must be covered / reimbursed. Even more expedient would be the provision of personal vehicles to the master trainers to be used for their travels to the National Training Center and to the communities in their region. The vehicles must be suitable for the infrastructure and geographical conditions in the respective region.

Examples for vehicles to be provided are:

- Master trainer in region 1 – boat
- Master trainer in region 7 – motorcycle
- Master trainer in region 8 – ATV (all terrain vehicle) / Quad
- Master trainer in region 7 – motorcycle

7.4 Recommendation for Next Steps in the Field of Capacity Building

7.4.1 Next Steps

- ❑ Setup Training Center in Georgetown (Location, Trainers, Funding)
- ❑ Elaborate skill profile and job descriptions for IT specialists in all ministries
- ❑ Elaborate skill profile and job descriptions for master trainers
- ❑ Prepare curriculum and develop detailed content of the trainings modules
- ❑ Develop and implement an information campaign about risks of using the internet and ICT services and how to stay safe. Develop dedicated information material to ensure children stay safe when using e-Services and the internet.
- ❑ Elaborate and implement reporting measures in case users observe harmful conduct when using the internet (fraud, sexual harassment, etc.). Create and empower organizations to report to and publish the contact details to the users.
- ❑ Buildup of operational skills at eGovernment Agency and initiate the transformation to implement these skills
    - Step 1 – Implement a standardized Project Management Framework (PRINCE2 or PMI)
    - Step 2 – Identify and implement relevant aspects of eTOM framework needed for existing and future domains of activities of eGovernment Agency
    - Step 3 – Transform operation and management according to ITIL and CoBIT
    - Step 4 – Implement Enterprise Architecture Capabilities based on TOGAF

7.4.2 Implementation Plan

The realization of the capacity building concept must be aligned with the roll out of the technical infrastructure, the programs for the provision of devices (e.g. one laptop per teacher project, ICT hub program), and with the availability of e-Services.

The National Training Center is key for the coordination and operation of the trainings and must be established and operational from the very beginning of the realization of ICT services roll out.

- Phase 1 (2017):
  Establish the National Training Center in Georgetown.
  Establish regional training hubs in:
  Port Kaituma (Region 1)

Charity (Region 2)
Mahaica (Region 4)
Belladrum, Mahaicony (Region 5)
New Amsterdam, Rose Hall, Skeldon (Region 6)
Kato, Mahdia (Region 8)
Kwakwani (Region 10)

- Phase 2 (2018):
  Establish regional training hubs in:
  Mabaruma, Moruca (Santa Rosa) (Region 1)
  Anna Regina (Region 2)
  Vreed en Hoop (Region 3)
  Mon Repos, Timehri (Region 4)
  Tacama (Region 6)
  Bartica, Kamarang (Region 7)
  Lethem, Aishalton, Annai (Region 9)
  Linden (Region 10)
- Phase 3 – 5 (2019 - 2021):

Expand local training hubs as more communities will have access to e-Services

8. Risks and Concerns regarding the Introduction of ICT

8.1 Introduction

Why is national broadband-coverage important? - As different studies dealing with the topic of rural development and rural internet access have demonstrated, broadband is the catalyst for economic and social development of a country. Availability of broadband services to the broad population and for affordable prices contributes amongst others to: higher GDP growth rates, a larger and more qualified labor force and more efficient workforce collaboration. The World Bank estimates a 10% increase in broadband penetration in developing countries to bring a 1.3% rise in GDP. When comparing different ICT-related services, the impact of broadband growth on GDP is estimated to be higher than the impact of mobile telephony growth.

There are economic and social effects:

- Network operators and service providers generate profit from provisioning high-speed internet access
- Businesses can benefit from the use of digital technologies to enable new business models or to improve efficiency
- New jobs are created
- Public tax income is increased by additional revenues and profits generated
- Competition among operators results in price decreases and hence increases the purchasing power of businesses and end-users
- Overall positive effects on growth and jobs due to shorter innovation cycles, improvement of productivity by more efficient business processes, supraregional labor markets and employment opportunities through remote work
- Positive effects on consumers through the application of amongst others e-Health, e-Education, e-Government, Smart Grid, home entertainment and home automation, transport and traffic monitoring
- Enabling the Digital society concept

Not all benefits of high-speed broadband can be monetized or captured in numbers. There are three layers of welfare that can be associated to high speed broadband deployment:

1) Socio-economic benefits can be monetized and internalized
   This is the case for efficient for market operators, who follow a profitable business case to deploy high speed broadband. Citizens are willing to pay for high speed broadband an amount that covers the cost of capital of the operator and allows the operator to generate profit. Given the strong economies of density that drive broadband networks, this is typically happening in urban areas.
2) Socio-economic benefits can be monetized, but not internalized
   Here the benefits accrue to a different actor than the network operator. For example high speed broadband networks may enable savings to the national health system through the availability of eHealth services, but these savings would not be reflected in the cash flow of the network operator.
3) Socio-economic benefits cannot be monetized or internalized:
   In addition there are some benefits that cannot be measured through traditional instruments like GDP. Examples are well-being quality of life and the possibility of new applications arising in the future as policy makers empower content creators. The only manner to capture these benefits is to have broadband as a public good.

Still besides all the positive effects of the availability of advanced ICT-Access and –Services there are also some risks that should be considered.

8.2 Risks & Concerns

The use of social media and digital technologies has grown on a vast scale during the last years in almost every region on earth. This includes remote locations and hinterlands that formerly didn't have access to contemporary instruments of communication like ICT connections or mobile devices. While digital technology and the use of social media have their obvious advantages for both the development and conservation of the cultural heritage and social structures, it is important to mention possible drawbacks including cyber bullying, cyber racism and the exchange of sexually explicit content between minors.

The installation of new means of telecommunication might show both in the short and long run important effects on the established communities and change their way of communication and social behavior on a significant scale. While modern civilizations grew slowly into the new forms of communication and had sufficient time to adapt as a whole, this is often not the case for indigenous societies. Due their lifestyle and unique cultures a participation in the technological revolution of 21st Century didn't take place in many cases. It is therefore not possible to simply transfer the problems that occurred in highly developed countries to those that might arise in indigenous societies.

Research initiatives with indigenous cultures, see the threat of a new kind of colonialism, the so called computer-mediated colonialism:

> *"Misguided ICT4D implementation that doesn't take into consideration a wide range of cultural factors and explicitly or implicitly imposes Western processes or structures upon indigenous recipients does constitute a new form of computer-mediated colonialism"*[213]

On the following pages this report elaborates certain problems that might occur during the adoption process of modern telecommunication technologies. The topics described refer to different case studies regarding the topic and shall give a broad overview over the main possible implications that might arise especially in communities that had been more isolated before. While most of those problems regard especially the younger generations, who are more prone to get influenced and affected by the possibilities offered by the internet, other effects might influence societies as a whole and could change the structure of entire communities. Especially the generational gap in knowledge and use of social media between indigenous young people and their parents and elders who are often less familiar with these digital technologies might lead to further problems.

[213] Source: http://www.ethnosproject.org

In the following this report is focusing on 6 main aspects and possible implications that might have a crucial effect on the societies in the hinterland, remote and poor communities of Guyana. The order is irrelevant and doesn't reflect a higher social threat of any aspect.

8.2.1 Cultural loss and Cyber Colonialism

Another central question is the impact of the internet on the indigenous cultures. It is argued by some scientists that the internet serves only to reinforce negative stereotypes that have plagued indigenous communities since their first encounters with modern societies. Some argue that in some cases information might be controlled and could be transmitted in a way that suits governments or enterprises. The internet might be used as a modern tool for further colonization of indigenous peoples worldwide, conquering both geography and knowledge systems.[214]

While the familiar and social bonds are highly developed in indigenous societies, they aren't immune to external impacts and might be threaten by changes in values and behavior, triggered from use of the internet:

> *"Ethnicity does not provide the basis for communal heavens in the network society, because it is based on primary bonds that lose significance, when cut from their historical context, as a basis for reconstruction of meaning in a world of flows and networks, of recombination of images, and reassignment of meaning. Ethnic materials are integrated into cultural communities that are more powerful, and more broadly defined than ethnicity, such as religion or nationalism, as statements of cultural autonomy in a world of symbols. Or else, ethnicity becomes the foundation for defensive trenches, then territorialized in local communities defending their turf"*[215]

Because of that it is highly important to work on an intelligent integration of the internet in the local communities and their value systems and behavioral patterns. A knowledge economy, based largely on the indigenous culture, traditions and practices of the local tribes is very difficult to preserve, because the global nature of the internet is such that it precludes this as an option, as the vision of the internet is that everybody can access any information and knowledge. Several observations drive this conclusion. For example, the dominant internet language is and will continue to be English, despite the adoption of the internet by strong second tier languages. English is already so prevalent that the internet serves much like an enforcer that might put local languages and traditions in danger. While marginalized cultures can use the internet to reinforce their community, to build protective barriers and to politicize their marginalization, they have to take in regard that the preservation of their own culture isn't a generic part or aim of the internet and that they need to find a way to integrate it in an appropriate and effective manner. The biggest challenge for their future is therefore the conservation of their culture and not possible short time gains.[216] Therefore, it is highly important to properly assess sectors were the internet can be of use for those communities, such as learning of the traditional language and cultural habits.

The internet in itself is not eroding indigenous culture and reshaping indigenous self-identities as much as reinforcing those tendencies that exist. An important matter is the preservation of local languages like Macushi, Akawaio and Wai-Wai; Arawak and Wapishana. In a country like Guyana, with English as main language, the creation of ICT networks and a closer connection of the people in remote areas with the Georgetown area might put even more pressure on these languages as they will be more and more repressed. Especially younger generations might favor English as their main language of communication and loose the capacity to communicate in their regional tongues. This development lead to the death of various languages in the next generations.

However, what is not disputable is that as the "first" world becomes increasingly connected, those who do not have access to its cyber resources will be increasingly marginalized and might be excluded from future benefits of the cyber resources.

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[214] Source: Hershey; The Impact of Digital Technology on Indigenous Peoples, 2009

[215] Source: Castells, The power of identity

[216] Source: Pannekoek: Cyber Imperialism and the Marginalization of Canada's Indigenous Peoples, 2008

8.2.2 Sex-Texting/Sexting

Sex-Texting, or sexting, is considered to be a form of pornography and a phenomenon that rose in scale in the last decade, especially between children and in younger social groups. Sexting is, as its name suggests, the act of sending sexually implicit or explicit message via mobile devices and social networks. These are usually multimedia texts pictures of the sender in various stages of undress. But they don't necessarily have to be nude images. Sexually implicit text-only messages also qualify. In fact, sexting could be defined as the process of sending any communication that relays sexual desire or intent.

These are usually sent from a mobile device, whether through the phone's stock messaging system, or apps like Snapchat. This makes them easy to take, send, and delete while minimizing "getting caught." Whether they are a natural product of sexual curiosity, an uneducated way to impress feelings, or an active harassment of individuals, depends on case and perspective, but it's hard to dispute the danger a teen (or adult) faces with naked pictures of themselves floating around. If one involves schools into the equation, the situation gets even more delicate and dangerous. However, sexting is hard to monitor and legal enforcement has been inconsistent in many countries.

Especially in the case of indigenous populations with a different and maybe quite restrictive approach to sexuality this is an important matter. It is therefore absolutely necessary to educate parents, teachers and social workers in the dangers and possible effects of sexting to the development of teenagers and apply a strict set of rules for the case that sexting occurs.

Other findings on the relationship between sexting and sexual behavior support the perspective that sexting is a part of young adult's sexual relationships but is not necessarily correlated with riskier or safer behavior. Although some teens report sexting as a substitute for physical contact, this use for sexting may not be common among teenagers and young adults.[217] Furthermore a range of studies show that young adults who are already sexually active are far more likely to sext than those who are not sexually active. Two explanations of this behavior are possible: when sexting is used to flirt with potential partners, it may precede or initiate sexual relationships or sexually active persons will engage in a range of sexual behavior, including sexting.

Especially in the context of indigenous societies it is necessary to observe phenomena's like sexting even more and being cautious of possible implications and effects on younger members of the societies.

8.2.3 Cyber-Bullying, Cyber-Racism and other Conflicts

Cyber-bullying and cyber-racism are ought to be mentioned as other possible disadvantages and threats of ICT implementation in indigenous communities. In many indigenous communities, there is a generational gap in knowledge and use of social media between indigenous young people and their parents and elders who are often less familiar with these digital technologies. Previously typically incorporating gesture, sign, and gaze, communication via written messages reduces the capacity for traditionally socially sanctioned forms of conflict resolution and social control by the older generation. Especially bullying for reasons like gender, race or being part of a different community via social networks or short messages might pose threats to younger people that the older generation isn't aware of. This means that cyber bullying can go on unaddressed and even result in severe outcomes such as suicide if family members are not aware of young people's activities on social media. Educational programs are needed to raise awareness of issues like cyber bullying and cyber racism in order to ensure that parents, adults, community leaders and elders in remote locations have opportunities to learn about social media use and the potential negative effects it can have on individuals, families and communities.[218]

Another negative effect of social media is the increased connectivity between people who live far away from each other, so that conflicts that previously remained local can spread as young people call, text or inform kin in other places about conflicts. These behaviors might include, cyber bullying, cyber racism and posts that are meant to incite

[217] Source: Messer, Baumeister, Grodzinski; Sexting among young Adults, 2011

[218] Source: Rice, Haynes; Social media and digital technology use among Indigenous young people in Australia, 2016

violence between feuding families or villages. Especially in in the hinterland and remote areas of Guyana problems between communities that weren't as connected before the implementation of ICT networks might appear in that process.

To mitigate the risks of cyber-bullying etc. especially the education of both younger and older people about the possible effects and negative implications of cyber-bullying and cyber-racism is important. The awareness of these threats has to be a topic in schools and it might be necessary to offer professional advice for parents and students who feel threatened or harassed in any forms. Policy is another way to tackle cyber racism, but it might be difficult to take down user-generated content that is in violation of personal rights when it relates to overseas hosted websites like Facebook.

Figure 374 - Example for information campaign against cyber-bullying

A tangible approach to address the issues of cyber-bullying, cyber-racism, and to a certain level sexting is to tackle it from an educational and community-based perspective. For example, in Australia the "Be Deadly Online" program has been launched to address cyber safety. It specifically targets indigenous young people through a culturally relevant approach. The program was created in several indigenous communities across Australia and promotes that online business is everyone's business. It cautioned users to be mindful that the use of social media and the internet in general creates an online digital footprint, and it offers positive, practical advice on playing smart online through a series of short animations, posters and educational videos.

8.2.4 Rural Depopulation

Geographic exclusion can occur at different levels. Analysis of the telecommunications infrastructure in many countries reveal significant differences between well-equipped areas with highly developed ICT networks, and the periphery, with ICT services being less developed and far more expensive. ICT and transportation investments have

reduced costs of distance, but also fostered urbanization and rural depopulation.[219] . Therefore communities in remote areas are even more likely to suffer from exclusion from societal shifts to ICT-based information societies.

Especially young people with a certain level of education are prone to migrate from rural areas into metropolitan areas for better job opportunities. The implication of E-Learning might even boost this dynamic. While the better education of young adults is a good thing on the one hand, it might pose a threat to the established communities in the hinterland and remote areas of Guyana. Nevertheless the question is whether this development is actually possible to prevent. On the long term it's not a question of ICT and its implications but of the success of development policies and the positive economic outlook for the regions.

The application of ICT and diverse media in the hinterland, poor and remote areas of Guyana might furthermore lead to an increasing dissatisfaction and unhappiness in isolated communities. While the value system in these communities has significantly been shaped by traditional habitat, the introduction of new media devices and a wider view on national and global news, might create new desires and incite people them to search for new opportunities in the metropolitan centers of the country and search for the lifestyle that is promoted by the media. An increase in the number of (predominantly young) people departing their communities to live in the cities might be the result.

8.2.5 Manipulation of People not experienced with ICT Media

The manipulation of people who aren't experienced with ICT media might be another threat that is posed by the future application of ICT in the hinterland, poor and remote areas without access to adequate education on how to use ICT services. The sudden access to the vast amount of information available via the internet can present an enormous challenge. The ability to filter information and to identify the quality of both the information and the source providing it is essential to navigate the internet and to judge if information are true or false, relevant or irrelevant. People lacking this ability can fast be overstrained and become lost in the information overload. One specific threat is that extreme political views might be transported via social networks and influence people. Social media and the internet in general have become a useful tool for populists that might see a chance for political endeavors in indigenous communities. While the diversity of information is very high and sometimes hard to understand, political parties or other relevant players might take advantage of that and try to cause political turmoil's by feeding anger and fear in communities that are isolated and or less experienced in political opinion-forming via the internet.

While the idea that people with a lower education and lower life standard are easier to manipulate isn't limited to less developed regions, indigenous societies might be especially prone to those factors.

8.2.6 Social Exclusion of (elderly) People

Charities and service providers, backed up by research, are concerned that older people are often excluded from services offered via digital platforms. Digital exclusion refers to those factors beyond a person's direct control to limit their access to and ability to use information and communication technologies. When examining such user profiles, it becomes clear that what makes older people disadvantaged in general also constitutes a disadvantage with respect to the digital environment, especially age, health, income and social isolation. Even though the familiar bonds are closer in indigenous than in other societies and the isolation of elderly people due to their lack of understanding of modern media devices may be less of a problem it might be important to give basic courses in the usage of such devices. Even in the remotest areas the digital revolution will take place and younger generations will depend on electronic devices of different form. The exclusion of elderly people might lead to a further gap in the society and make the loss of culture and knowledge even more realistic.

[219] Source: Griffing, Trevorrow Developments in E-Government (2008)

8.3 Mitigation Measures

Under the impression of the variety of different threats that ICT and internet usage might pose to society, there isn't one simple solution that applies to every single one of them. Therefore it is necessary to develop a set of different instruments and solutions to regard the distinct sorts of problems in an efficient way. Both a strengthening and adaptation of national jurisdictional and executive institutions, as well as proper education of all parts of society in ICT capacities, are necessary for a successful introduction of new technologies. The following aspects should be considered in the process of introducing ICT and e-Services.

1. Training of law enforcement agencies to new offences based on e-Services

Additional knowledge and resources are important and needed to properly address cases of ICT misuse. It is essential to raise the awareness that harassment, sexting and other types of crimes might have shifted from the physical into the cyber space. It is of high importance to sensitize officials to the possible implications and offer specific training courses to raise the awareness of such matters. Furthermore it might be necessary to introduce specific laws that regard ICT abuse. It is important that such laws are communicated and implemented in an efficient way.

2. Education of civil society and officials.

It is necessary to offer knowledge sources about the use of internet and online services to the civil society and social partners like NGO's. This includes specific training of social workers, teachers and government officials as well as members of the communities. The trainings must include basic teaching in use and function of the internet and social networks, and a discussion about the possible negative implications of ICT. The training plan (see Figure 371) provides a comprehensive concept including the stakeholders, training content and training scheme.

Figure 375 - Education on ICT skills in indigenous communities

Furthermore, campaigns to prevent cyber bullying, sexting or online harassment should take place in schools and town halls. Especially the training of teachers and a proper education and sensitization of parents regarding the possible risks of ICT for their children is important. It is the duty of national institutions to inform about the potential threats and how to avoid them in order to prevent a huge knowledge gap between young adults and their parents or teachers.

3. Mandatory IT-education in schools

IT Education on a technical and social level needs to be offered in schools. It is important to properly educate the younger generations in the use of social networks and their possible advantages and disadvantages. The possible negative implications need to be discussed among the students to prevent possible abuse of such media.

4. IT-based solutions for child protection

In particular for families with children specialized software security settings should be promoted. This includes age oriented access control mechanisms or the deactivation of online components in mobile devices.

5. Show the possible positive economic impact of ICT on communities

To prevent rural depopulation it is important to develop models for the useful application of e-Services in the local economy. The better connection between the communities in the hinterland, remote and poor areas and the

metropolitan areas via social networks and the internet might lead to new economic endeavors in a wide range of areas. It is important to show both young and senior members of the communities' possible new perspectives and chances that could come with the offerings of ICT. Specialists could aid in the implementation of ICT devices in small enterprises and show the possible positive effect of IT integration.

9. Appendix

9.1 Appendix Inception Report

9.1.1 Questionnaires for Primary Market Research

The questionnaires in this chapter 9.1.1 have been elaborated by Spiegel Institut Mannheim GmbH & Co. KG, Eastsite VI, Hermsheimer Str. 5, 68163 Mannheim, Germany. Contact person: Jin Jlussi, +49 (621) 72844-142, j.jlussi@spiegel-institut.de

9.1.1.1 Quantitative Survey

ICT Guyana: Quantitative Survey

Respondent-ID: _____

Community _____

Interviewer _____

Date _____

Time _____

What is the rough distribution of your community (map, drawing, measurements)? Please indicate any masts, telecommunication points and landmarks in the map/drawing.

Moderation: Please use your app "network info 2" to check the mobile networks available and GPS data. Then turn on your WiFi and check if there are any WiFi networks available. Additionally take screenshots of the available WiFis and the network info as backup.

Name of community	
GPS coordinates	
Zone	1. Remote 2.Hinterland 3. Poor

Status of interviewee	
Mobile networks available *(INTERVIEWER: TO TEST THE DEVICES*)	1. GSM (2G) 2. GPRS (2.5G) 3. EDGE (2.75G) 4. UMTS/HSPA (3G) 5. LTE (4G) 99. I didn't get to identify
Main ethnical group of community	
Take some panoramic pictures of community or draw a sketch. **Highlight the towers/antennas in sketch.**	

Moderation: The following document is divided into two sections: 1) Quantitative questionnaire; 2) Qualitative interview/ethnography. Quantitative questions can be assessed in any stage of the research, from initial telephone contact/appointment making to qualitative interview. Some questions might even be assesses by yourself (e.g. counting masts/carriers). For demography, respondents (or other relevant contact persons) might need some time to gather this information themselves.

Please make sure, that all information in quantitative questionnaire is assessed by the end of the research phase for a given community. To ensure this, please carry this document with all collected information with you for the whole research process of a given community.

Quantitative questionnaire is also used as a basis for the qualitative interview.

If respondents cannot give a precise answer to quantitative question, encourage them to give an estimation. In this case, please note down, how sure the respondent was about his/ her answer.

Some questions or sub-questions are marked as medium priority or low priority. If you are facing time pressure, you may skip those questions according to their priority. Though, please cover all questions, if possible.

Hello, my name is _____.

I am a researcher working in behalf of the Guyanese government who aim to assess the situation of telecommunication in Guyana to help its people to get the possibilities they need in a targeted way.

Thank you very much for taking the time to participate in this research! We really appreciate your help and it will make a big and meaningful contribution to the efforts of the Guyanese government.

Let's start with some basic information about your community.

A. Demography

1. Medium priority: How many people are permanent residents of your community?

	% of people in community	Number of people in community
a. Permanent residents		
b. Temporary residents (live in another region/abroad for part of the year)		
c. Nomadic residents		

Notes/Moderation: if necessary, note additional/ explanatory information here

2. What languages are spoken in your community?

	language	% of people in community	Number of people in community
a. Main language			
b. Second language			
c. Other language(s)			

Notes/Moderation: if necessary, note additional/ explanatory information here

B. Community facilities and finances

3. Please state the number of the following facilities in your community:

Number of facilities	None	1 – 4	5 – 9	10 – 14	More than 14	n.a.
a. Schools (nursery)						
b. Schools (primary)						
c. Schools (secondary)						
d. medical facilities (health center/hut)						
e. medical facilities (health post)						
f. medical facilities (hospitals)						
g. communal buildings (village offices, please specify below)						
h. places of social gathering (leisure places, sports courts, youth club, please specify below)						
i. Areas of sports activities						
j. Libraries						
k. Religious facilities						
l. Hotel/ hostels/lodge/guest house						

Notes/Moderation: if necessary, note additional/ explanatory information here.

IF NO MEDICAL FACILITIES: What are the specific expectations/wishes for your village?

4. **Is your community threatened by one of the following occurrences?**

	yes	no
a. Destruction of environment/nature		
b. Organized crime (poaching,illegal mining, smuggling, human traffic, etc.)		

Notes/Moderation: if necessary, note additional/ explanatory information here

5. **Did people in your community receive a loan? What is the percentage of people living in your community who have received small business loans/microloans within the last 10 years?**
   What percentage of these people has paid back their loans yet?

	Quantity	0%	Less than 10%	10-29%	30-49%	50-75%	More than 75%	n.a.
	Fill in number	nobody	nearly no one	some	partly	majority	to a great extent	n.a.
a. Received loan								
b. Paid back loan								

Notes/Moderation: if necessary, note additional/ explanatory information here

6. and 7. ONLY if more than 0%

6. **Medium priority: What is the main purpose that people use their loans for?**

Moderation: business development/ establishing new businesses/ repair and maintenance/ refinancing etc.

Notes:

7. **Low priority: Do you think there is enough time to repay these loans? Why/ Why not?**

○ yes○ no ○ n.a.

Moderation: business development/ establishing new businesses/ repair and maintenance/ refinancing etc.

Notes:

C. Power supply

8. Please describe the power supply in your community.

Please enter the estimated quantity and percentage of people using the following options of power supply.

	0%	Less than 10%	10-29%	30-49%	50-75%	More than 75%	n.a.
a. Electric supply network (landline)							
b. Electric generator (local)							
c. Solar electricity							
d. Hydropower							
e. Wind energy							
f. Thermoelectricity							
g. Biothermal energy							
h. No electricity at all							
i. Other, please specify	*Moderator: please note below*						
j. Planned power supply, please specify:	*Moderator: please note below*						

Notes/Moderation: if necessary, note additional/ explanatory information here

9. How many hours a day does your community have electricity?

	When? / What time span?
a. Up to 5 hours	
b. More than 5 to 15 hours	

	When? / What time span?
c. More than 15 to 24 hours	

Notes/Moderation: if necessary, note additional/ explanatory information here

10. **How often are people affected by power breakdowns of the public electric supply network in your community?**

Please enter the times of people affected by power breakdowns in the given time span.

	No. of power breakdowns
a. Within the last week	
b. Within the last month	
c. Within the last year	

Notes/Moderation: Please use one time span only, or make sure to include the small time spans into the large time spans.

a) **Medium priority: How do people cope with this situation?**

b) **Medium priority: Are there accumulations of power breakdowns in certain situations (rainy season, certain times of the year/ week/ day, special events etc.?)?**

Notes/Moderation: if necessary, note additional/ explanatory information here

D. Mobile network infrastructure

11. Do you know which mobile carrier/ provider is available in your community?

- ☐ Digicel
- ☐ GT&T
- ☐ Other, please specify: _____
- ☐ n.a.

12. How many telephone masts/(towers)/antennas for mobile communication are installed in your community?

None	1	2 – 4	5 – 9	10+

☐ n.a.

13. Where are those telephone masts (towers)/antennas for mobile communication installed in your community?

If respondent is aware of carriers, please ask if these carriers are obvious/easy to find.

Notes/Moderation: if necessary, note additional/ explanatory information here

E. Electric devices and ICT usage

14. Please enter the estimated quantity and percentage of people in your community who own the following electric devices.

Please enter the estimated quantity and percentage of people who own the following electric devices.

	Quantity	0 %	Less than 10%	10-29%	30-49%	50-75%	More than 75%	n.a.
a. Private landline telephone								
b. Private cell phone (not web-enabled)								
c. Private smartphone (web-enabled)								
d. Private satellite phone								
e. Desktop Computer (not web-enabled)								
f. Laptop/ Tablet PC (not web-enabled)								
g. Desktop Computer (web-enabled)								
h. Laptop/ Tablet PC (web-enabled)								
i. HF Radio								

Notes/Moderation: if necessary, note additional/ explanatory information here

15. Are the following electric devices available in your community?

	Quantity
a. Public landline telephone	
b. Privately owned landline telephone	
c. Privately owned cell phone (not web-enabled)	
d. Privately owned smartphone (web-enabled)	

e.	Public phone booth	

Notes/Moderation: if necessary, note additional/ explanatory information here

16. Please estimate how frequently people in your community approximately use these devices.

Please enter the frequency of use for the following devices for the people in your community.

	never	Less often than once a week	About once a week	Several times a week	About once a day	Several times a day	n.a.
a. Private landline telephone							
b. Private cell phone (not web-enabled)							
c. Private smartphone (web-enabled)							
d. Private satellite phone							
e. Public landline telephone							
f. Privately owned landline telephone							
g. Privately owned cell phone (not web-enabled)							
h. Privately owned smartphone (web-enabled)							
i. Public phone booth							
j. Privately owned satellite phone							
k. Desktop Computer (not web-enabled)							
l. Laptop/ Tablet PC (not web-enabled)							

	never	Less often than once a week	About once a week	Several times a week	About once a day	Several times a day	n.a.
m. Desktop Computer (web-enabled)							
n. Laptop/ Tablet PC (web-enabled)							
o. HF Radio							
p. Privately owned landline telephone							

Notes/Moderation: if necessary, note additional/ explanatory information here

17. Where do people in your community use the following internet and telephone services/ devices mainly?

Please note down any other places/devices of use. **Please only tick one box per row.**

	eKiosk / internet Café	at work	at place of education	Other public places (please specify)	Shared (family/ friends /neigh-bours)	at home	n.a.
a. Private landline telephone							
b. Private cell phone (not web-enabled)							
c. Private smartphone (web-enabled)							
d. Private satellite phone							
e. Public landline telephone							
f. Privately owned landline telephone							

	eKiosk / internet Café	at work	at place of education	Other public places (please specify)	Shared (family/ friends /neigh-bours)	at home	n.a.
g. Privately owned cell phone (not web-enabled)							
h. Privately owned smartphone (web-enabled)							
i. Public phone booth							
j. Privately owned satellite phone							
k. Desktop Computer (not web-enabled)							
l. Laptop/ Tablet PC (not web-enabled)							
m. Desktop Computer (web-enabled)							
n. Laptop/ Tablet PC (web-enabled)							
o. HF Radio							
p. Privately owned landline telephone							

Other, please specify: _____

Notes/Moderation: if necessary, note additional/ explanatory information here

Why do they go there? Coverage? Network? Price? Availability of services (domestic/national/international call). Divide data utilisation.

18. **Has your community received any support from the government recently (which has enhanced your communities' living standard)?**

Moderation: ***IF IN TIME PRESSURE****, skip this question completely (topic is also covered in Q 30)*

Please note down any info on received subsidies/government programs.

○ yes ○ no ○ n.a.

If yes:

What was the purpose/ application of these support actions?
Where did this aid come from (which part of government/ administration)?

Medium priority: Since when has your community been receiving those aids?

Medium priority: What activities were done in your community because of the aid(s) received?

Medium priority: Has this activities been useful to your community?

Medium priority - Moderation: government subsidies: How has the subsidy been realized? Was it a money transfer solely or programs where infrastructure (streets, energy/water supply,…), healthcare (e.g. vaccinations for humans and animals), health education (birth control,…) have been implemented? Please specify!

Notes:

F. Previous ICT development projects

19. Have there been any previous ICT development projects in your community?

○ yes ○ no ○ n.a.

If yes:

Please briefly describe previous ICT development projects in your community.

How successful were these projects?

If not successful, why did these projects fail?

Notes/Moderation: if necessary, note additional/ explanatory information here

What is your opinion regarding this kind of initiatives?

Notes/Moderation: if necessary, note additional/ explanatory information here

You mentioned/talked about some projects above. In your opinion, would other projects benefit your community or country better than those projects? Which specific projects come to mind?

Moderation: Please probe on environmental initiatives, healthcare, education, infrastructure, etc.

Notes/Moderation: if necessary, note additional/ explanatory information here

20. **Medium priority: We are also interested in the current economic situation in your community or region and how this situation might change in the future.**

    How would you describe the economic situation in your community or region in general? How is the situation of employment and unemployment here?

    Notes/Moderation: if necessary, note additional/ explanatory information here

21. **What is the main source of income or main economic factor in your community or region?**

    Moderation: basically: how do people make a living? For example tourism, farming, handicrafts, natural resources…

    Notes

22. **What are the main challenges/ difficulties for generating revenue/income in your community?**

Moderation: any hindrances according infrastructure/ telecommunication/ accessibility of technology, etc.?

Notes

23. **Medium priority: How did this situation change over the past years? Which developments happened?**

Moderation: developments of certain economical branches (tourism etc.), migration/ in-migration, changes in environment/ climate/ society…

Notes

24. **Medium priority: How do you see the future development regarding economy and sources of income, etc.?**

Is your community planning any projects that will affect the economic situation?

Moderation: also: are plans of government/ private investors etc. known that will affect the situation

Notes

9.1.1.2 Qualitative Survey

Qualitative Interview/ ethnography

Respondent-ID: _____	Interviewer _____
Community: _____	Date _____
Age of resp.: _____	Time _____
Gender O female O male	
Occupation of resp: _____	

***Moderation:* This section is to be conducted *for each of the three* contact persons in a certain preselected community.**

This interview part will take about 30 minutes.

We will now have a more open conversation than in the previous interview part. We are solely and exclusively interested in your subjective opinion, so there are no right or wrong answers. You are the expert and everything you say is very important to us. Please tell us whatever comes into your mind, respond spontaneously without thinking about it for too long.

Moderation: Encourage participant to tell stories about themselves.

The following questions are intended as a guideline of topics, not a strict sequence of questions. Please feel free to probe at your own discretion.

You may at any point use examples to investigate deeper that you have heard of in other interviews or feel would be appropriate.

It is not supposed to be a typical interview situation following a structure of questions and responses, but instead the interviewee is supposed to dominate and lead the conversation.

Photos: Respondent in interview situation

I. **When thinking about communication over long distances: Which distance would you call "a distance I do not travel easily myself" to communicate face-to-face with another person?**

Moderation: Please note down time (time spans) for maximum travel if distance is given.

II. **How frequently do you encounter situations in which you need to communicate over longer distances? What situations would that be?**

Moderation: situations like funeral announcements, sports events, etc.

III. **What means (device) of communication would you typically use for such long distance communication?**
How often would you use which means (device) of communication?
For which occasion would you use which means (device) of communication?

IV. **What means (device) of communication are typically used in your community for long distance communication?**

V. **What is your role regarding (tele)communication systems in your community? What are your points of contact with telecommunication?**

Moderation: e.g. decisions about purchase of telecommunication devices, negotiations with local government, etc.

VI. **Do members (any member, including you) of your community own a: landline telephone/ mobile phone/ computer/ laptop/ tablet/ smart phone?**

*Moderation: Please repeat the following questions **for each of the mentioned means of communication**:*

If no:

i. **Why do you or members of your community not own such a device?**
Is there the wish or need to own or use such a technology?

ii. **Are there any plans to purchase such a device for your community in the future?**

iii. **How are the preconditions for this technology?**

iv. **Are there any plans to develop the telecommunication infrastructure of your community in the future regarding this technology?**

If yes:

v. **For how long has the following device been present in your community?**

vi. **Do you personally feel capable of using or operating a <device>?**

vii. **How would you evaluate the capability of the members of your community to use a <device>? Please explain.**

viii. **Usage: How frequently do you and the members of your community use a <device>?**

Moderation: in case of smartphone/ computer/ laptop:

Low priority: Do you or a member of your community chat over the internet?

If yes: what channels for chatting are used?

Do you or a member of your community use social media?

Moderation: prompt on facebook, whatsapp, Skype, Twitter

ix. **In what occasions do you/ your community use a <device>?**

x. **Are there any special occasions or cases that a <device> is specifically used for? What occasions would these be?**

For all:

xi. **Are there other uses/applications you can image/you have heard of that a <device> is used for? Would this also be an application that you can consider for yourself/ your community?**

VII. **Are there any other means of communication you would generally wish for?**

Use Cases

Now, I would like to present you some scenarios and learn about your typical habits/ routines in such cases.

Moderation: Please adapt use case 1 to the economic infrastructure/ source of income/ trading goods of community (handcrafts, crops, natural resources etc.)

1) **Imagine: you would like to sell your <goods> to a remote area/ different country/ region/ anywhere you cannot reach easily yourself. How would you do this?**
   Now imagine the possibility of a government-run website that enables you to trade your goods on a national (or international) trading platform online.
   How do you feel about this?

2) **Imagine: you would like to send money to a person/ institution who or that you cannot reach easily yourself. How would you do this?**
   Now imagine the possibility of transferring money via cell phone deposit (e.g. M-Pesa, Kenya).
   How do you feel about this?

Moderation: Use case 3 → Please keep short if respondent uses internet regularly or has a high ICT literacy.

3) **Imagine: you would like to inform yourself about current political issues and developments. How would you do that?**
   Now imagine the possibility of receiving this information or contacting governmental or public authorities (e.g. to register a new-born, apply for marriage…) online.
   How do you feel about this?

Moderation: Use case 4 → only for medical professionals/ vets/ farmers

4) **Imagine: you would like to consult a (fellow) physician/ doctor/ medicine man/ vet/ farmer regarding a severe medical condition or diagnosis unknown to you. How would you do that?**

   Now imagine the possibility seeking help easily and at all times or train yourself online.
   How do you feel about this?

Moderation: Use case 5→ only for police chiefs/ responsible person for security issues

5) **Imagine: your community suffers from organized criminality, such as poaching, plundering of nature, illegal gold mining, border incursion, etc.**
There would be the possibility to use surveillance cameras (also including night vision) or flying drones (affordable) that are equipped with surveillance cameras that directly submit a video stream to your computer.
How do you feel about this?

6) **Imagine: you would like to get a degree from a university outside of your county/community/anywhere in the world. How would you do that?**
Now imagine the possibility get a degree from anywhere for yourself online.
How do you feel about this?

Now, some final questions about you and your environment.
If introducing yourself to a person from another country, how would you describe your cultural identity?

Moderation: Try to ask indirectly about sense of belonging to a certain tribe/ ethnicity/ group/ community. Please be careful about peoples' feelings.

Do you see yourself as a "Guyanese"? Why, why not? Which feeling does the current government give you in this regard? What measures need to be taken to strengthen your national identity as a Guyanese?

Do you feel your country is one big unity of people? Why, why not?

Is there something that in your eyes especially Guyanese people have in common?

Moderation: E.g. a common set of values, something to be proud of, something uniquely Guyanese.

What would need to happen to make Guyana a more united country, to give you a feeling of a more unified community?

Would a better communication infrastructure help to achieve this?

Photos: At the end of interview/ during interview (whenever possible or appropriate): Please kindly ask respondent if you are allowed to take the following pictures:

- Home of respondent: different rooms of house (living room/ kitchen…) (as many shots as possible), home from outside, views outside respondent's home (streets…)
- Detail shots: special objects of interest/ hobby equipment/ family photos
- Community: Streets/ houses/ special places of interest, if applicable

9.1.1.3 Checklist

ICT Guyana: Checklist

To be filled in by Detecon interviewer

Respondent-ID _____

Community _____

Zone ○ remote ○ hinterland ○ poor

Date _____

Position of resp in comm..: _____

PLEASE FILL IN YOUR DATA:

Age___

Ethnicity _____

Gender ○ female ○ male

Level of education _____

Dear participant,

Thank you very much for taking the time to participate in this research! We really appreciate your help and it will make a big and meaningful contribution to the efforts of the Guyanese government! Please answer these following questions to the best of your knowledge and let our interviewer know should there be any need for assistance, they will gladly help with any issue. All answers will be analysed anonymously and no response will be traceable to you as a person.

G. Electric devices and ICT usage

25. How many of the following devices do <u>you own</u>?

Please fill in the quantity/number of devices that you own, for each device separately.

		Quantity
j.	Private landline telephone	
k.	Private cell phone (not web-enabled)	
l.	Private smartphone (web-enabled)	
m.	Private satellite phone	
n.	Desktop Computer (not web-enabled)	
o.	Laptop/ Tablet PC (not web-enabled)	
p.	Desktop Computer (web-enabled)	
q.	Laptop/ Tablet PC (web-enabled)	
r.	HF Radio	

26. Are the following electric devices available <u>in your community</u>, please estimate how many of the devices are available?

		Quantity
f.	Public landline telephone	
g.	Privately owned landline telephone	
h.	Privately owned cell phone (not web-enabled)	
i.	Privately owned smartphone (web-enabled)	
j.	Public phone booth	
k.	Privately owned satellite phone	

27. How frequently <u>do you</u> approximately <u>use</u> these devices?

Privately owned devices are e.g. devices in an internet café or kiosk. A public phone booth, for example, can be owned by a network provider.

		never	Less often than once a week	About once a week	Several times a week	About once a day	Several times a day	n.a.
q.	Your own private landline telephone							
r.	Your own private cell phone (not web-enabled)							
s.	Your own private smartphone (web-enabled)							
t.	Your own private satellite phone							
u.	Public landline telephone							
v.	Privately owned landline telephone							
w.	Privately owned cell phone (not web-enabled)							
x.	Privately owned smartphone (web-enabled)							
y.	Public phone booth							
z.	Privately owned satellite phone							
aa.	Desktop Computer (not web-enabled)							

	never	Less often than once a week	About once a week	Several times a week	About once a day	Several times a day	n.a.
bb. Laptop/ Tablet PC (not web-enabled)							
cc. Desktop Computer (web-enabled)							
dd. Laptop/ Tablet PC (web-enabled)							
ee. HF Radio							

28. <u>Where do you use</u> the following internet and telephone services/ devices <u>mainly</u>?

Please note down any other places/devices of use. **Please only tick one box per row.**

	eKiosk / internet Café	at work	at place of education	Other public places (please specify)	Shared (family/ friends /neigh-bours)	at home	n.a.
a. Your own private landline telephone							
b. Your own private cell phone (not web-enabled)							
c. Your own private smartphone (web-enabled)							
d. Your own private satellite phone							
e. Public landline telephone							
f. Privately owned landline telephone							
g. Privately owned cell phone (not web-enabled)							
h. Privately owned smartphone (web-enabled)							
i. Public phone booth							
j. Privately owned satellite phone							
k. Desktop Computer (not web-enabled)							
l. Laptop/ Tablet PC (not web-enabled)							

	eKiosk / internet Café	at work	at place of education	Other public places (please specify)	Shared (family/ friends /neigh-bours)	at home	n.a.
m. Desktop Computer (web-enabled)							
n. Laptop/ Tablet PC (web-enabled)							
o. HF Radio							

29. Are there any satellite services in place?

○ yes ○ no ○ n.a.

If yes, what service is it (name of service)? How much does it cost? When is it available?

_____

_____

30. How much would you be willing/able to spend on a <u>service per month</u>? Please tell us a price. This is only about your wishes, it does not need to reflect actual prices.

	Price ($)
a. internet access on cell	
b. internet access at home	
c. Texting	
d. Phone calls	
e. Other, please specify: _____	

31. Which of the following devices do you use for the following types of calls?

Multiple answers are possible. Privately owned devices are e.g. devices in an internet café or kiosk. A public phone booth, for example, can be owned by a network provider.

Usecase	Local Call	National Call	International Call
Your own private landline telephone			
Your own private cellphone (without Internet)			
Your own private smartphone (with Internet)			
Your own private satellite phone			
Public landline telephone			
Privately owned landline telephone			
Privately owned cellphone (without Internet)			
Privately owned smartphone (with Internet)			
Public phone booth			
Privately owned satellite phone			
Desktop computer (without Internet)			
Laptop/Tablet PC (without Internet)			
Desktop computer (with Internet)			
Laptop/Tablet PC (with Internet)			
HF Radio			

9. How much do you agree with the following statements about having more access to technology in your village?

	I totally disagree 1	2	3	4	I totally agree 5	n.a.
It could help us to preserve the environment						
It will make us forget things related to our traditional culture						
It would enhance the quality/ level of education						
It could help to boost the economy						
It could help resolve conflicts						
It could help to improve healthcare						
Technology helps the leader of the community to manage the community better						

8. Do you use the internet for the following purposes?

	Yes	No
a. Web browsing		
b. Chatting (WhatsApp, Viber, Skype, LINE...)		
c. Social networks (Facebook, Google+, Twitter, Linkedin...)		
d. Video-sharing websites (YouTube, Netflix, Vimeo, Vine...)		
e. Online gaming (League of Legends, Counter Strike...))		
f. E-commerce (Amazon, ebay, Mercadolibre...)		
g. E-government		
h. E-learning		

9.1.2 Questionnaires for collecting Information on existing ICT Infrastructure

The questionnaires are tailored to the different stakeholder groups of providers of ICT infrastructure:

9.1.2.1 Questionnaire Mobile Operator

Introduction

The ICT Access and E-Services for the Hinterland, Poor and Remote Communities project is a Government of Guyana initiative in partnership with the UNDP and is aimed at enabling access to high quality ICT infrastructure in all parts of Guyana with a focus on enhancing connectivity and enabling the provision of training and e-services for individuals and communities - with particular attention given to vulnerable groups and remote communities who might otherwise be excluded.
The lack of readily available accurate information on the accessibility of ICT Services for the residents of the communities described above hinders any effective interventions intended to increase connectivity. As a result the Government of Guyana through UNDP has recruited the services of Detecon International GmbH - a consultancy firm headquartered in Germany - to undertake a national ICT needs assessment focusing on the hinterland, poor and remote areas.
As part of the process, they will conduct research and analysis with the many stakeholders that will inform the study. We consider your input critical to the success of the study and in this context that we are requesting your cooperation by facilitating access to information and personnel.
If you need any clarification or explanation regarding the ICT Needs Assessment Study, please feel free to contact Ms. Shabnam Malick, Deputy Resident Representative at shabnam.mallick@undp.org or 226-4040.

The objective of this questionnaire is to obtain information about the network architecture, technologies used and available capacity of the existing telecommunications networks in Guyana and to analyze them in terms of the requirements of the project, especially within the hinterland, as well as poor and remote communities throughout the country.

Please provide either comprehensive answer in the column D or provide a short statement and provide a name of the reference document in the column E. Reference documents should be attached to the answered questionnaire if possible. If you are sharing any confidential information please highlight this.

In case of misunderstanding of the requirements or any other issues please contact Mr. Dmitriy Grigorev. Contact details are on the cover page of this questionnaire.

General Information

Company Name	
Name	
Position	
E-Mail	
Mob.	

Technical Questions

Question ID	Question	Reason of the request/Details
M.1	**General**	
M.1.1	Provide a list of services that the operator is currently offering on the market and services planned for rollout for the next three years.	This information is required to get a better understanding of the market, its demands and ideally derive proper requirements for the transport network in hinterland. - Specify the long term voice services development. Are there any plans for migration to VoLTE? - Are there any specific requirements to the packet data caused by use of any kind of applications?
M.1.2	Provide subscriber and traffic figures (current as well as forecast for the next years) for all existing and planned services.	These figures will be used as an indicative input to derive the most appropriate solution for relevant areas in the context of the project.
M.1.3	Provide statistics about mobile service usage on the regional level (number of subscribers, type of the connectivity, services used, etc.).	This information will be helpful to understand required network capacities, again from the context of our project (hinterland, poor and remote areas)
M.1.4	Highlight the company's strategic objectives.	Insights to the operator's strategy are one essential indicator to identification of possible complementing ICT solution for the regions addressed in the project context.
M1.5	Describe any obstacles hindering the implementation and usage of the current access technology.	Described obstacles will be reviewed and considered during the project steps.
M.1.6	List which initiatives are deemed unfeasible? Explain the reasons in details.	Answer to this question will provide insights for the team to understand better the situation and restrictions, which are already faced by the operator, if any.
M.1.7	Provide regulatory requirements and description of the existing emergency backup solution in case of terrestrial network disruption.	These details will provide additional input to the project.
M.2	**Technology**	
M.2.1	List existing RAN equipment suppliers/vendors.	Details about the existing network and agreements with network equipment vendors will help to understand the network flexibility, opportunities and allow to recommend most appropriate strategies of for ICT in the hinterland, poor and remote areas. Please describe in your answer the following details: - Are there any managed services, implementation services provided by the vendor? What are these services? - How performed operation & maintenance services? Own Operator's team or vendor? - What services are done by the operators themselves, which are outsourced?
M.2.2	Provide documents related to company's technology strategy and description of the currently used technologies.	Insights of the operator's technology strategy are essential for the identification of suitable ICT solutions for the hinterland, remote and poor areas.
M.2.3	Provide a feature list implemented on RAN.	This information will be helpful for the estimation of the required network capacities and services if extended to the project regions.
M.2.4	Outline the technical roadmap (new type of features or functionalities to be introduced)!	Possible impact of the new features introduction will be assessed and taken into

		account to derive technical recommendations for the hinterland, remote and poor areas.
M.2.5	Describe the current level of the RA network utilization? Which areas are congested, which ones are underutilized.	Provision of these figures will give the understanding of the market demands and required bandwidths in different areas.
M.2.6	List the frequency ranges is radio access network licensed? What are the regulatory constrains regarding the spectrum used and plans for new bands launch coverage obligations for mobile Telcos.	Understanding of the situation in current frequency band allocation and strategy is basic step for the ICT strategy development. What is the current status of the 700MHz band? Is it allocated between operators? Please provide details. Please provide comprehensive information regarding the following bands: - 800 MHz - 900 MHz - 1800 MHz - 1900 MHz PCS - 2100 MHz or AWS band - 2600 MHz (or they might use PCS and AWS as names) Please provide the details about spectrum usage of the 450-470MHz band and 300-450MHz band. Are these band already used by other companies and/or government? What are the strategy to free up these bands? What are the current license expiration dates of the used bands? What are the conditions of use? Is support of the regulatory authority / government possible?
M.2.7	Provide the plan of the existing network, including geographical map with all existing base stations with specification of technologies used and backhaul type/capacities should be provided.	Availability of required data for the map plotting is necessary to reveal the areas which are not covered and areas where the new infrastructure should be pulled to, especially in the hinterland, remote and poor areas. Please provide a structured database of the base stations, which contain base station ID, region, city, coordinates, number of sectors/cells, band used, traffic volumes per month and backhaul specification.
M.2.8	Please provide the existing coverage map focusing on technology and their specific abilities in relation to the environment.	The required coverage map should be provided for each technology used, representing indoor and outdoor coverage. RAN planning assumptions and link budget should be provided. Please specify the assumptions and general approach used for planning of different clutter types (dense urban, urban, sub-urban, rural) as well as Hinterland and remote areas. Do you consider any specific assumptions for planning the hinterland and remote areas?
M.3	**Backhaul Network**	
M.3.1	Outline the general approach of the site backhaul for urban and rural areas (microwave links, fiber access etc.) What kind of the equipment used for the backhaul realization?	Provided details will be used as a baseline for a potential transmission network strategy development in the hinterland, poor and remote areas.
M.3.2	List current the transmission suppliers/vendors.	Details about the existing network and agreements with network equipment vendors will help to reveal the network flexibility, opportunities and allow to recommend appropriate strategies in the project context.
M.3.3	Describe the technical roadmap (new type of components or functionality to be introduced).	Possible impact of the new features introduction will be assessed and taken into

		account to derive most technically feasible solutions.
M.3.4	Describe what frequency ranges is MW transmission network are licensed?	Understanding of the situation in used frequencies is essential for the ICT strategy development in the project's context.
M.3.5	Describe the architecture of the transmission and IP network.	Availability of required data for the map plotting is necessary to reveal the areas which are not covered and areas where the new infrastructure should be pulled to. The following information should be provided: - All network nodes which are leased or shared with other operators should be marked - network topology diagram geographical map with coordinates of each point of the transport networks - detailed information with available capacities. Which components are deployed at which site?
M.3.6	Describe the general conditions for the backhaul sharing/leasing (including average price).	This information will be necessary for deriving high level cost modelling considering the local conditions and focusing on the hinterland, poor and remote areas.
M.3.7	Provide statistics regarding the current utilization of the backhaul links.	This information will help to understand and predict lack of bandwidth in project focus regions after a potential network expansion.
M.3.8	Provide information if any expansion projects are planned for the backhaul.	This information will help to understand the operator's activities in the backhaul development from a country wide perspective.
M.3.9	Describe the redundancy and resilience concept of the backhaul network applied in general? Please explain in details.	Existing redundancy concept will be taken as a basis for a possible solution concept for the hinterland, poor and remote areas.
M.4	**Core network**	
M.4.1	Describe the existing solution deployed (vendor, equipment, version, features enabled).	Details about the existing network and agreements with network equipment vendors will help to reveal the network flexibility, opportunities and allow to recommend the most appropriate strategy of the ICT sector development.
M.4.2	Provide existing network architecture in details and geographical map with coordinates of all the core network edge components (MSC, gateways, optional BSC).	Availability of required data for the map plotting is necessary to reveal the areas which are not covered and areas where the new infrastructure should be pulled to.
M.4.3	Outline the technical roadmap (new type of components or functionality to be introduced). What are the future developments planned in the core network (IMS, EPC)?	Possible impact of the new features introduction will be assessed and taken into account to derive the most technically feasible solution.
M.5	**User Equipment (CPEs)**	
M.5.1	Describe the ratio of the 2G/3G/4G capable devices and which frequencies are supported. Please provide forecast for the next 5 years.	Provided forecast will be used for the assessment of the market maturity for the different options of an ICT infrastructure development.
M.5.2	Specify the user equipment strategy. For which services and subscribers are used, feature phones, smartphones, tablets, data dongles / Routers and modems – standalone or embedded e.g. laptops. Do you have specific strategies for customers in the hinterland, poor and remote areas?	Insights of the operator's technology strategy are essential for the identification suitable ICT solutions for the hinterland, poor and remote areas.
M.5.3	Highlight, which Technology Characteristics you see as required in future user equipment (CPEs).	Please explain the strategy which covers capability of the user equipment to support - multi frequencies and multi standards (e.g. 900/1800 MHz, 2,1 GHz, 2,6 GHz), GSM/UMTS/LTE TDD-FDD in different

		frequencies) - support of different technology features (e.g. HSPA+ 84 Mbps MC, LTE A)
M.6	**Towers and metal constructions**	
M.6.1	Provide details about existing and planned towers within the country (e.g. tower map).	Please provide the answer with following details: - Detailed information regarding types of the used towers, heights and utilization of the towers - Are the towers shared between operators, and if applicable provide information about how and to what extend the towers are shared with other operators
M.6.2	Provide the average cost and time required for the deployment of the new tower construction with respect to the tower height (e.g. 10m, 20m, 30m etc.) and location (city and remote rural areas).	This information will be necessary for the high level cost modelling considering the local conditions
M.7	**Power supply**	
M.7.1	Describe, how in general realized power supply of the sites in different regions is handled, esp. with respect to the area type (Dense urban, suburban, urban, and rural). Any specifics in remote and hinterland areas?	Provided information will help to identify the difficulties which should be taken into account in the strategy development. What are the typical problem operator faces especially in the rural area (e.g. fraud, stealing of the oil, vandalism) and how are these problems solved at the moment?
M.7.2	Describe, what role energy efficiency level play for the optimization and the planning of new sites rollout. Do you follow any green IT guidelines?	Provided information will help to identify the difficulties which should be taken into account in the strategy development for the hinterland, poor and remote areas.
M.7.3	Describe the high level roadmap of power supply systems and the general strategy for the deployment of new sites in regards to power supply?	Provided information will help to identify the difficulties which should be taken into account in the strategy development for the hinterland, poor and remote areas.
M.8	**Pricing models**	
M.8.1	Explain the current service pricing strategy towards B2C and B2B customers. Is there a difference in pricing approach for different areas?	This information will help to estimate revenues from the infrastructure deployment in hinterland, poor and remote areas. Provide answer with the following details: - Service uptake and distribution - service bundling (mobile voice/data, fixed, etc.) - geographical price differentiation
M.8.2	Please specify the market prices for the B2B and B2C customers, separating between basic services (basic connectivity) and on-top services.	This information helps to understand the willingness to pay available in the market for the respective services attached. Provide details for tariff structures for prepaid, postpaid and business service offerings.
M.8.3	Please specify the ARPU for different areas within the country	This information will be necessary for deriving high level cost modelling considering the local conditions and focusing on the hinterland, poor and remote areas. Provide answer with the following details: - ARPU calculation methodology - ARPU metrics - geographical and market segment distribution

9.1.2.2 Questionnaire Fixed Line Operator

Introduction

The ICT Access and E-Services for the Hinterland, Poor and Remote Communities project is a Government of Guyana initiative in partnership with the UNDP and is aimed at enabling access to high quality ICT infrastructure in all parts of Guyana with a focus on enhancing connectivity and enabling the provision of training and e-services for individuals and communities - with particular attention given to vulnerable groups and remote communities who might otherwise be excluded.
The lack of readily available accurate information on the accessibility of ICT Services for the residents of the communities described above hinders any effective interventions intended to increase connectivity. As a result the Government of Guyana through UNDP has recruited the services of Detecon International GmbH - a consultancy firm headquartered in Germany - to undertake a national ICT needs assessment focusing on the hinterland, poor and remote areas.
As part of the process, they will conduct research and analysis with the many stakeholders that will inform the study. We consider your input critical to the success of the study and in this context that we are requesting your cooperation by facilitating access to information and personnel.
If you need any clarification or explanation regarding the ICT Needs Assessment Study, please feel free to contact Ms. Shabnam Malick, Deputy Resident Representative at shabnam.mallick@undp.org or 226-4040.

The objective of this questionnaire is to obtain information about the network architecture, technologies used and available capacity of the existing telecommunications networks in Guyana and to analyze them in terms of the requirements of the project, especially within the hinterland, as well as poor and remote communities throughout the country.

Please provide either comprehensive answer in the column D or provide a short statement and provide a name of the reference document in the column E. Reference documents should be attached to the answered questionnaire if possible. If you are sharing any confidential information please highlight this.

In case of misunderstanding of the requirements or any other issues please contact Mr. Dmitriy Grigorev. Contact details are on the cover page of this questionnaire.

General Information

Company Name	
Name	
Position	
E-Mail	
Mob.	

Technical Questions

Question ID	Question	Reason of the request/Details
F.1	**General**	
F1.1	Describe the current situation on the local broadband market.	This information is required to get a better understanding of the market, its demands and ideally derive proper requirements for the transport network in the project context of hinterland, remote and poor areas.
F1.2	Provide a list of services that the operator is currently offering on the market.	This information is required to get a better understanding of the market, its demands and ideally derive proper requirements for the

		transport network in the project context of hinterland, remote and poor areas.
F1.3	Provide subscriber numbers (current as well as forecast) for all existing and planned services.	These figures will be used as an indicative input to derive additional and appropriate solution for relevant areas in the context of the project.
F1.4	Describe the reliability models implemented on the network in case of emergency situations.	Existing redundancy concept will be taken as a basis for a possible solution concept for the hinterland, poor and remote areas.
F.2	**Architecture**	
F2.1	Describe the architecture of the existing transmission network.	Insights of the operator's network architecture is essential for the identification of suitable ICT solutions for the hinterland, remote and poor areas. Please provide a network topology diagram for each of the transport networks.
F2.2	Provide the geographical map with coordinates of all network nodes (OLT/ONT, PE/P, Fiber connectivity DWDM/SDH etc.) deployed within the country with specification of the current/available capacities and type of the equipment.	Availability of required data for the map plotting is necessary to reveal the areas which has no existing infrastructure and areas where the new infrastructure should be pulled to, especially in the hinterland, remote and poor areas. Please provide a structured database of network nodes, which contain node ID, capacity, type of the equipment installed, traffic volumes per month and backbone specification.
F2.3	Describe the current cooperation status with mobile operators.	This information will be necessary for deriving high level cost modelling considering the local conditions and focusing on the hinterland, poor and remote areas. Please provide the following information: - typical SLAs with other mobile and/or fixed providers - price estimation for the backhaul leasing
F.3	**Technology**	
F3.1	Provide description of the installed equipment (vendors, models, specifications etc.).	Details about the existing network and agreements with network equipment vendors will help to understand the network flexibility, opportunities and allow to recommend most appropriate strategies of for ICT in the hinterland, poor and remote areas. Please describe in your answer the following details: - Are there any managed services, implementation services provided by the vendor? What are these services? - How performed operation & maintenance services? Own Operator's team or vendor? - What services are done by the operators themselves, which are outsourced?
F3.2	Describe technologies that are currently being used on the physical level to implement the different parts of the transport networks.	Provided details will be used as a baseline for a potential transmission network strategy development in the hinterland, poor and remote areas. The following information should be provided: - current condition of the access network - modernization plans for each of the network segment if available - general lifecycle description for each type of the deployment considering local conditions - details about the existing physical lines fiber or copper, method of the cable laying in ducts, aerial installation for each of the regions

		(special focus on hinterland, remote and poor areas)
F.4	**Capacity**	
F4.1	Provide statistic about fixed internet access service usage on the regional level (number of subscribers, type of the connectivity, services used, etc.).	This information will be helpful to understand required network capacities, again from the context of our project (hinterland, poor and remote areas)
F4.2	Specify the utilization of the existing backbone and traffic details.	This information will help to understand and predict lack of bandwidth in project focus regions after a potential network extensions. Details regarding the utilization of the backbone should be specified for each segment of the network separately.
F4.3	Provide information if any capacity or network extensions is planned.	This information will help to understand the operator's activities in the backbone development from a country wide perspective.
F.5	**Roadmap**	
F5.1	Provide a 3 year roadmap for services that the operator is planning to offer on the market and the user groups you're targeting.	This information is required for better understanding of the market demands and prepare proper requirements for the transport network in hinterland.
F5.2	What is the technical roadmap (new type of components, technologies or functionality to be introduced).	Possible impact of the new features introduction will be assessed and taken into account to derive most technically feasible solutions.
F5.3	Explain in details currently used access technologies lifecycle with the roadmap (market entry, earn and refine, phase out).	Detailed lifecycle information will help to trace the estimated end of life and swap of the existing systems.
F.6	**Deployment**	
F6.1	Describe the obstacles that appear at the time of deployment new fiber lines and/or access points with respect to the area type (rural/urban/hinterland/remote).	Please describe in details E2E process of the new backhaul capacities deployment in Guyana with average time required and typical challenges faced by the operators.
F6.2	List specific regulatory rules regarding the deployment of the backbone in different regions. What are the regulatory constraints and coverage obligations?	Specific requirements will be considered during development of recommendation for the infrastructure development in hinterland, poor and remote areas.
F.7	**Pricing models**	
F7.1	Explain the current service pricing strategy for customers (B2B and B2C). Is there a difference in pricing approach for different areas?	This information will help to estimate revenues from the infrastructure deployment in hinterland, poor and remote areas. Provide answer with the following details: - Service uptake and distribution - service bundling (mobile voice/data, fixed, etc.) - geographical price differentiation
F7.2	Please specify the market prices for the B2B and B2C customers, separating between basic services (basic connectivity) and on-top services.	This information helps to understand the willingness to pay available in the market for the respective services attached. Provide details for tariff structures for different service offerings.
F.7.3	Please specify the ARPU for different areas within the country.	This information will be necessary for deriving high level cost modelling considering the local conditions and focusing on the hinterland, poor and remote areas. Provide answer with the following details: - ARPU calculation methodology - ARPU metrics

		- geographical and market segment distribution

9.1.2.3 Questionnaire Satellite Operator

Introduction

The ICT Access and E-Services for the Hinterland, Poor and Remote Communities project is a Government of Guyana initiative in partnership with the UNDP and is aimed at enabling access to high quality ICT infrastructure in all parts of Guyana with a focus on enhancing connectivity and enabling the provision of training and e-services for individuals and communities - with particular attention given to vulnerable groups and remote communities who might otherwise be excluded.
The lack of readily available accurate information on the accessibility of ICT Services for the residents of the communities described above hinders any effective interventions intended to increase connectivity. As a result the Government of Guyana through UNDP has recruited the services of Detecon International GmbH - a consultancy firm headquartered in Germany - to undertake a national ICT needs assessment focusing on the hinterland, poor and remote areas.
As part of the process, they will conduct research and analysis with the many stakeholders that will inform the study. We consider your input critical to the success of the study and in this context that we are requesting your cooperation by facilitating access to information and personnel.
If you need any clarification or explanation regarding the ICT Needs Assessment Study, please feel free to contact Ms. Shabnam Malick, Deputy Resident Representative at shabnam.mallick@undp.org or 226-4040.

The objective of this questionnaire is to obtain information about the network architecture, technologies used and available capacity of the existing telecommunications networks in Guyana and to analyze them in terms of the requirements of the project, especially within the hinterland, as well as poor and remote communities throughout the country.

Please provide either comprehensive answer in the column D or provide a short statement and provide a name of the reference document in the column E. Reference documents should be attached to the answered questionnaire if possible. If you are sharing any confidential information please highlight this.

In case of misunderstanding of the requirements or any other issues please contact Mr. Dmitriy Grigorev. Contact details are on the cover page of this questionnaire.

General Information

Company Name	
Name	
Position	
E-Mail	
Mob.	

Technical Questions

Question ID	Question	Reason of the request/Details
S.1	**General**	

S1.1	Provide description of the existing service providers' organizational structure, key users and services provided via the satellite infrastructure.	This information is required to get a better understanding of the market, its demands and ideally derive proper requirements for the transport network and services provided in the hinterland and remote areas.
S1.2	Provide information about the regulatory requirements regarding deployment of the hubs, communication centers, and data centers abroad.	Specific requirements will be considered during development of recommendation for the infrastructure development in hinterland, poor and remote areas
S1.3	Provide information about regulatory requirements regarding licensing of the satellite communication frequencies.	Understanding of the situation in current frequency band allocation and strategy is basic step to derive technical recommendations for the hinterland, remote and poor areas.
2	**Architecture**	
S2.1	Provide the structure of the existing networks including location of the ground stations and hubs within the country.	Availability of required data for the map plotting is necessary to reveal the areas which have some infrastructure and areas where the new infrastructure should be pulled to, especially in the hinterland, remote and poor areas. Please provide a structured database of the ground stations, which contain station ID, region, city, coordinates, and number of transponders used and available, traffic volumes per month and backbone specification for hubs.
S2.2	Describe the technical solution of ground-, space- and terminal segment and technical roadmap for the next 3 years.	Possible impact of the new features introduction will be assessed and taken into account to derive technical recommendations for the hinterland, remote and poor areas.
S2.3	Provide detailed information about the installed equipment of the ground stations (vendor, model, capacity, etc.).	Details about the existing network and agreements with network equipment vendors will help to understand the network flexibility, opportunities and allow to recommend most appropriate strategies of for ICT in the hinterland, poor and remote areas. Describe in your answer the following details: - Are there any managed services, implementation services provided by the vendor? What are these services? - How performed operation & maintenance services? Own Operator's team or vendor? - What services are done by the operators themselves, which are outsourced?
S2.4	Explain the key features enabled in the existing satellite network.	This information will be helpful for the understanding of the existing satellite network capabilities and services if extended to the project regions.
S2.5	Provide the typical service quality KPIs (latency, jitter, etc.), variety of services and protocols supported.	Details about the KPI will help to reveal the network flexibility, service opportunities and allow to recommend appropriate strategies in the project context.
3	**Capacity & pricing**	
S3.1	Specify the existing utilization level of the satellite access and provide the details about capabilities available e.g. number of transponders of a satellite and frequency bands used, throughput.	This information will help to understand and predict lack of bandwidth in project focus regions after a potential network expansion. Details regarding the utilization of the satellite access should be specified for each segment of the network separately.
S3.2	Explain the current service pricing strategy for customers. Is there a difference in pricing approach for different areas?	This information will help to estimate revenues from the infrastructure deployment in hinterland, poor and remote areas. Provide answer with the following details:

		- Service uptake and distribution - service bundling (mobile voice/data, fixed, etc.) - geographical price differentiation
S3.3	Specify the average cost per month for traffic and services for business customers (B2B) and end users (B2C).	This information helps to understand the willingness to pay available in the market for the respective services attached. Provide details for tariff structures for different service offerings.
S3.4	Please specify the ARPU for different areas within the country.	This information will be necessary for deriving high level cost modelling considering the local conditions and focusing on the hinterland, poor and remote areas. Provide answer with the following details: - ARPU calculation methodology - ARPU metrics - geographical and market segment distribution

9.1.3 Terms of Reference

National ICT Needs Assessment Consultancy

1. Background

1.1. The Government of Guyana has developed a Project Concept Note (PCN) to guide its preparatory activities to design the ICT Access and E-services for Hinterland, Poor and Remote Communities project. The project is expected to be funded through the Guyana REDO + Investment Fund (GRIF) which is a multi-contributor trust fund for the financing of activities undertaken as part of the Government's Low Carbon Development Strategy. The funds currently in the GRIF have been earned by the Government of Guyana (GoG) for the provision of its forest climate services and the limiting of emissions from deforestation and forest degradation under its partnership with Norway.

1.2. The ICT Access and E-services for Hinterland, Poor and Remote Communities project is a Government of Guyana initiative in partnership with the UNDP and is aimed at enabling access to high quality ICT infrastructure in all parts of Guyana with a specific focus on enhancing connectivity and enabling the provision of training and e-services for individuals and communities - with particular attention given to vulnerable groups and remote communities who might otherwise be excluded.

1.3. It is recognized that for a truly advanced and inclusive digital society, the facilitation and provision of e-services and ICT are crucial and integral to improving the quality of life for citizens. Therefore the introduction of ICT infrastructure and networks will provide greater convenience, availability and accessibility to support social, economic and environmental development.

1.4. Currently Guyana does not have a universal service fund (USF) in place. internet and broadband infrastructure is concentrated on the coastal region with sparse and expensive connectivity options in the hinterland, poor and remote communities. Private telecommunications companies have shied away from providing internet services and telecommunications to hinterland, poor and remote communities because of the difficult and varying terrain,

economic status of the majority of the residents, and the low return on investments. This means that the onus is on Government to provide the enabling environment for hinterland, poor and remote communities to access ICT, inclusive of access to e-Services.

1.5. In the absence of a National ICT Authority, the Ministry of the Presidency, E-Government Unit

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NOTE: (9. This document serves as a guide to Requestor on how to write the TOR for the RFP, by suggesting contents. This document is not to be shared with Proposers in this current state and form. The TOR actually written by the Requestor shall be the TOR that will be attached to this port of the RFP.)

has the responsibility for the development of the ICT sector with the goal of developing a digital knowledge-based society. As part of this initiative, the E-Government Unit is working to improve ICT services delivered to citizens and businesses. In the short and medium term, the Unit has set as its target providing broadband access to hinterland, poor and remote communities to enable the residents of these communities to be informed and empowered to more actively participate in society's decision making processes.

1.6. The end is visualized as significant enhancement in the quality of life of Citizens, national efficiency and competitiveness, inclusive and sustainable growth and development, and the realization of a knowledge-based society. With this in mind the provision of ICT access to hinterland, poor and remote communities is a priority of the E-Government program.

1.7. The lack of readily available accurate information on the access to ICT services by the residents living in hinterland, poor and remote communities has hindered the design of an effective ICT service to meet the needs of these residents.

1.8. The Ministry of Presidency, is therefore soliciting the services of a Consulting Firm (hereinafter referred to as "the Firm") to conduct a current state and ICT needs assessment that would contribute to the socio-economic development of hinterland, poor and remote communities of Guyana.

2. Objectives

2.1 The outputs of this consultancy are intended to inform the preparation of a full project document for approval by the GRIF Steering Committee and the subsequent implementation, monitoring and evaluation of the actual project: “ICT Access and e-Services for Hinterland, Poor and Remote Communities”.

2.2 To achieve this objective the GOG with support from the UNDP is seeking to recruit a Firm to conduct the current state and ICT needs assessment study.

3. Scope of Work

3.1. The Firm will be contracted to compile the necessary baseline data and information, as well as establish indicators against which the project and its impacts will be measured. The Firm will also be responsible for conducting a needs assessment study that is intended to identify the scope, costing, best technical solutions and revenue structures in providing, operating and maintaining ICT access and e-services for hinterland, poor and remote communities, as well as assess the overall viability of the project. The Consultancy will, inter alia, be expected to:

Task 1: Baseline Data Collection and Analysis

i. Identify and collect data based on the current environment, analyze data and provide recommendation in line with the project objectives, and to facilitate achievable target setting for the project. Information on key indicators will assist in the evaluation of the achievement of project progress, objectives, outcomes, and impacts. For example: number of hinterland, as well as poor and remote communities or households that have internet and telephony access; number of children ages x-y in the hinterland, as well as poor and remote communities accessing online

education, or separately enrolled in primary, secondary and tertiary education; poverty levels of all identified hinterland, poor and remote communities; number of ICT literate persons within all identified hinterland, as well as poor and remote communities; number of desktop computers and laptops within all identified communities; number of schools, medical facilities, and communal buildings in each hinterland, poor and remote community identified.

ii. Identify the existing ICT networks and infrastructure in Guyana, especially within the hinterland, as well as poor and remote communities throughout the country.

a. Both public and private networks and infrastructure should be covered, including any planned expansion of the networks through other initiatives;

b. Identified networks and infrastructure in relation to communities should be plotted on a map of Guyana;

iii. Identify the existing national ICT infrastructural needs;

Task 2: Technical Report

i. Conduct a detailed assessment of current technologies available for the provision of internet access and telephony services to hinterland, poor and remote communities.

a. The assessment of technologies should consider, inter alia, the advantages and disadvantages of each, both generally and with specific reference to Guyana's context, including the potential target communities; important risks (and mitigation measures) associated with each technology and the implementation of these technologies; indicative costs; capacity; reach; reliability; security; important requirements for installation; ease of maintenance and upgrade; and any environmental concerns.

ii. Identify the necessary stakeholders, as well as institutions and institutional requirements for the successful implementation and operation of the identified technologies, for example: Guyana Telephone and Telegraph Company (GT&T), Digicel, National Frequency Management Unit NFMU), E-Government Unit- Ministry of the Presidency, Ministry of Indigenous Peoples' Affairs, National Toshaos Council, Ministry of Communities, Ministry of Public Infrastructure;

Note: Records of all stakeholder meetings shall be summarized and presented in a report.

iii. Determine the requirements, impacts, opportunities and risks associated with existing and impending legislation, such as the draft Telecommunications Bill and the draft Public Utilities Commission Bill;

iv. Examine the potential for strategic partnerships and utilization of existing and near-term public and private networks and infrastructure;

v. Identify the best ICT solution or solutions in providing internet and telephony access to all identified hinterland, poor and remote communities (or clusters of communities) considering all previously identified activities. Clearly identify:

a. All infrastructure, equipment, hardware, and software necessary to provide internet and telephony access to end users;

b. All infrastructure, equipment, hardware, and software necessary for end users to utilize the internet and telephony access;

c. Renewable energy solutions (inter alia, solar, wind, and micro-hydro) to power the necessary systems, including infrastructure, networks, and equipment. The analysis should identify any weather data collection equipment required to be installed synergistically with the identified infrastructure, so as to support location-based selection of the best generation technology by establishing a system to collect process and manage alternative energy data, and connect it in a standardized format to a central storage;

d. Proposed locations for infrastructure and networks;

e. All legal, institutional, infrastructural, social, environmental and other requirements and considerations;

f. All associated costs for implementation giving a clear breakdown, including indicative costs for maintenance over a five year period, and training of personnel and community members in installation, use and maintenance;

Note: The technology or technologies identified should consider and incorporate anticipatory flexibility in terms of allowing possible modifications and upgrades in the future - Open Source.

Depending on the ICT solution(s) identified, due consideration should be given to the effective distance between end point infrastructure and essential facilities such as schools, medical facilities, and communal buildings to determine the feasibility for the use of point to multi-point equipment or other means of facilitating internet access directly in these critical facilities instead of just at a centrally located hub.

vi. Identify the best business model or models for implementation within the identified hinterland, poor and remote communities to provide internet and telephony access. The business model should provide realistic cost and revenue projections required for operation and maintenance of the ICT solution(s), including infrastructure, equipment, networks, and service. Establish criteria for the application of each developed model to specific hinterland, poor and remote communities in Guyana.

The technical, financial, and institutional sustainability of models identified should be clearly formulated. Examples of models include but are not limited to:

a. Solely Government Owned

b. Public-Private Partnership

c. Community Supported

Note: Sustainability measures should, inter alia, consider maintenance, recurrent costs, and training. For example, recurrent costs such as internet charges can be covered in the project cost for 6 years after which the GoG, or a public private partnership arrangement can absorb the cost. In the future, cost recovery measures can include communities paying for their internet services once they are generating sufficient income. It is foreseen that as the internet allows for regional, national and international integration of communities, as communities Opt-in, pursue economic ventures such as ecotourism etc., these can provide much needed income, some of which can offset internet charges.

Training is necessary to operate the community system, to support maintenance, and provide permanent initial on site capacity to guide users who are new to the internet. It is also critical for the diffusion of the services necessary for the community to improve its functions.

vii. Identify the best possible sequence or prioritization of possible hinterland, poor and remote communities (including clusters) to commence project implementation of identified ICT solution(s) based on a selected list of factors such as location, topography, proximity to existing infrastructure and networks, ease of access and cost of logistics, economic activities, size of communities, population dispersion within communities, critical mass, types of linkages between cluster communities, poverty level, existing infrastructure, cost/benefit analysis.

viii. Assist in the development of all necessary information and documentation needed for the procurement of identified ICT technologies/solutions including, but not limited to: engineering designs, technical specifications, bills of quantities, qualifications and experience of firms/suppliers;

Task 3: e-Services Readiness Assessment and Action Plan

i. Prepare a National e-Government Readiness Assessment and Action Plan, identifying:

a. The current types, levels, quantity, quality and reach of e-Government services in Guyana;

b. The current state of legal, institutional, managerial, technological, infrastructural and other requirements, structures, and mechanisms necessary for e-Government services (in Guyana) currently in place outside of and inside all Government agencies across all relevant sectors, including but not limited to: education, health, agriculture, business, housing, public security, social protection, social cohesion, and tourism;

c. A gap analysis and the next steps to bridge the gap needed to establish the additional legal, institutional, managerial, technological, infrastructural and other requirements, structures, and mechanisms necessary to provide additional and improved e-Government services, especially to hinterland, poor and remote communities. Carefully consider, inter alia, all ICT solutions required, including infrastructure; equipment; hardware and software; organizational changes; human resource requirements; processes; policies; list of potential e-services; tailoring of e-services to the social, cultural, economic, and environmental scenarios of the hinterland, poor and remote communities; content preparation;

d. Map the roles and responsibilities of all relevant stakeholders in providing e-Government services;

e. Assist in the development of all necessary documents and information such as engineering designs, technical specifications, bills of quantities, qualifications and experience of individual consultants, firms/suppliers needed to effect the additional requirements identified to provide e-Government services;

f. Estimate all necessary costs to implement the next steps and activities identified.

ii. With specific focus on e-learning and its application to hinterland, poor and remote communities:

a. Identify the necessary steps, requirements, stakeholders, and inputs in developing and delivering tailored accredited e-learning programs at the primary, secondary, tertiary, and technical/vocational levels.

b. Provide costs for all steps and inputs.

iii. Examine the potential for collaboration and partnerships with the private sector in providing the supporting capacity to create linkages to generate inter-sectoral benefits in the areas identified, but not limited to those, above in "ii (a)";

iv. Examine the potential for synergies with:

a. Government Learning Channel

b. Amerindian Development Fund and Amerindian Land Titling Projects

c. One Laptop per Family Project

d. Telecommunication Liberalization

v. Based on the identified ICT literacy rate of the hinterland, poor and remote communities (established from the baseline study) determine the scope of training required for members of these communities to utilize the technologies and e-services to be provided, including teachers and health professionals within the communities;

9.1.4 Routes

9.1.4.1 Region 1 - Barima-Waini

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Airplane	1	**Mabaruma**	Overnight	1
Departs 7:45			Region 1		
Base	Airplane	1	Ogle/Georgetown	Overnight	2
			Region 4		
Georgetown	Airplane	1	**Port Kaituma**	Overnight	3
			Region 1		
	Airplane	1	Ogle/Georgetown	0	4
Georgetown			Region 4		
				Total days	**5**

Table 71 - Detail trip plan Region 1 - Barima-Waini

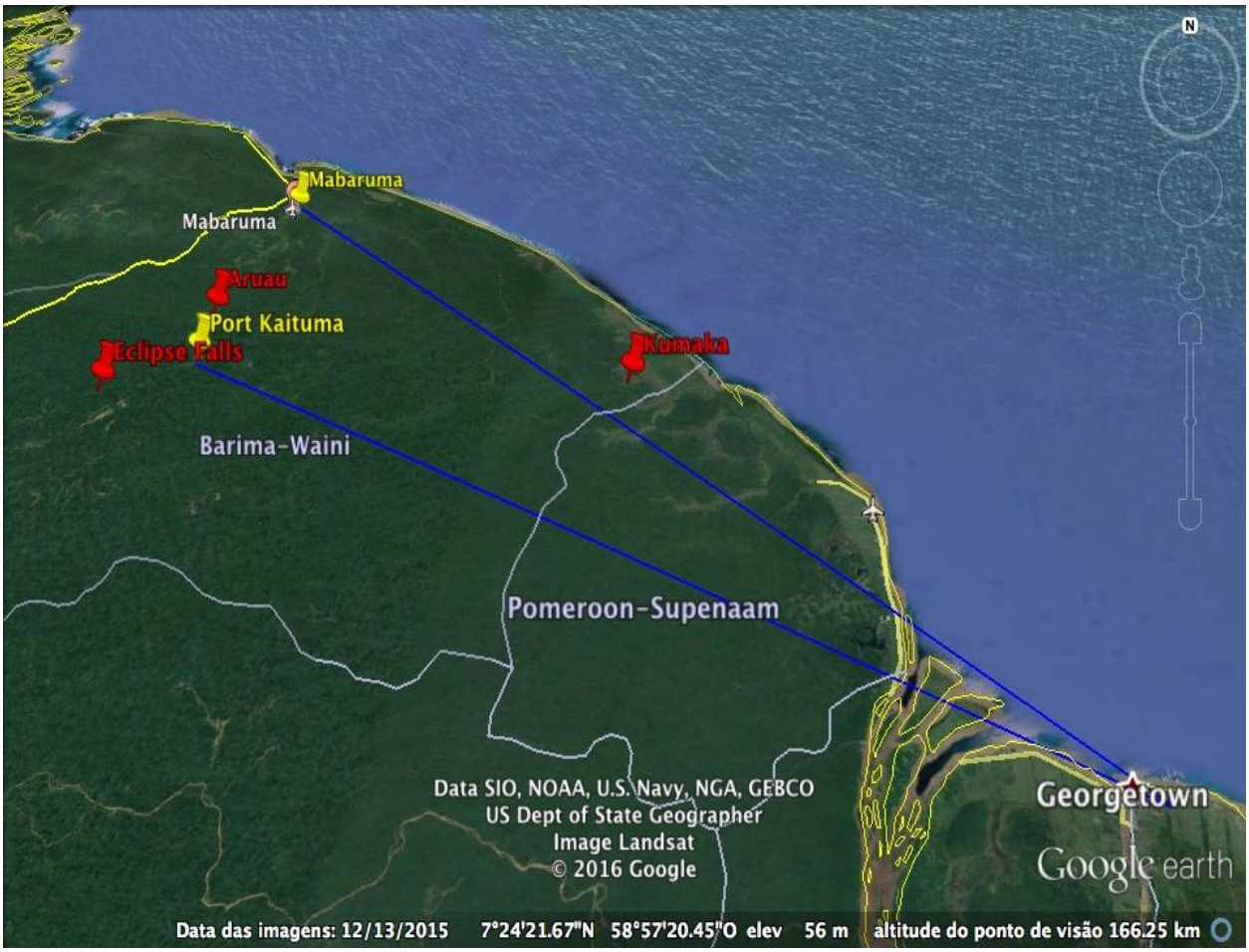

Figure 376 - Travel map plan Region 1 - Barima-Waini

9.1.4.2 Region 2 – Pomeroon-Supenaam

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	1	Parika	1	1
Departs 6:00	Minibus	40km	Region 3		
	Boat	45min	Supenaam	15min	1
	Speedboat		Region 3		
	Road	1	**Mainstay/Whayaka**	Overnight	1
	Taxi	44km	Region 2		
	Road	1	**Charity**	Overnight	2
	Taxi	23km	Region 2		
	Boat	1	**Santa Monica**	8	3
		34km	Region 2		
	Boat	1	Charity	Overnight	3
		34km	Region 2		
	Road	1	Supenaam	1	4
	Taxi	50km	Region 3		
	Boat	45min	Parika	15min	4
	Speedboat		Region 3		
	Road	1	Georgetown	0	4
Georgetown	Minibus	40km	Region 4		
				Total days	**5**

Table 72 - Detail trip plan Region 2 – Pomeroon-Supenaam

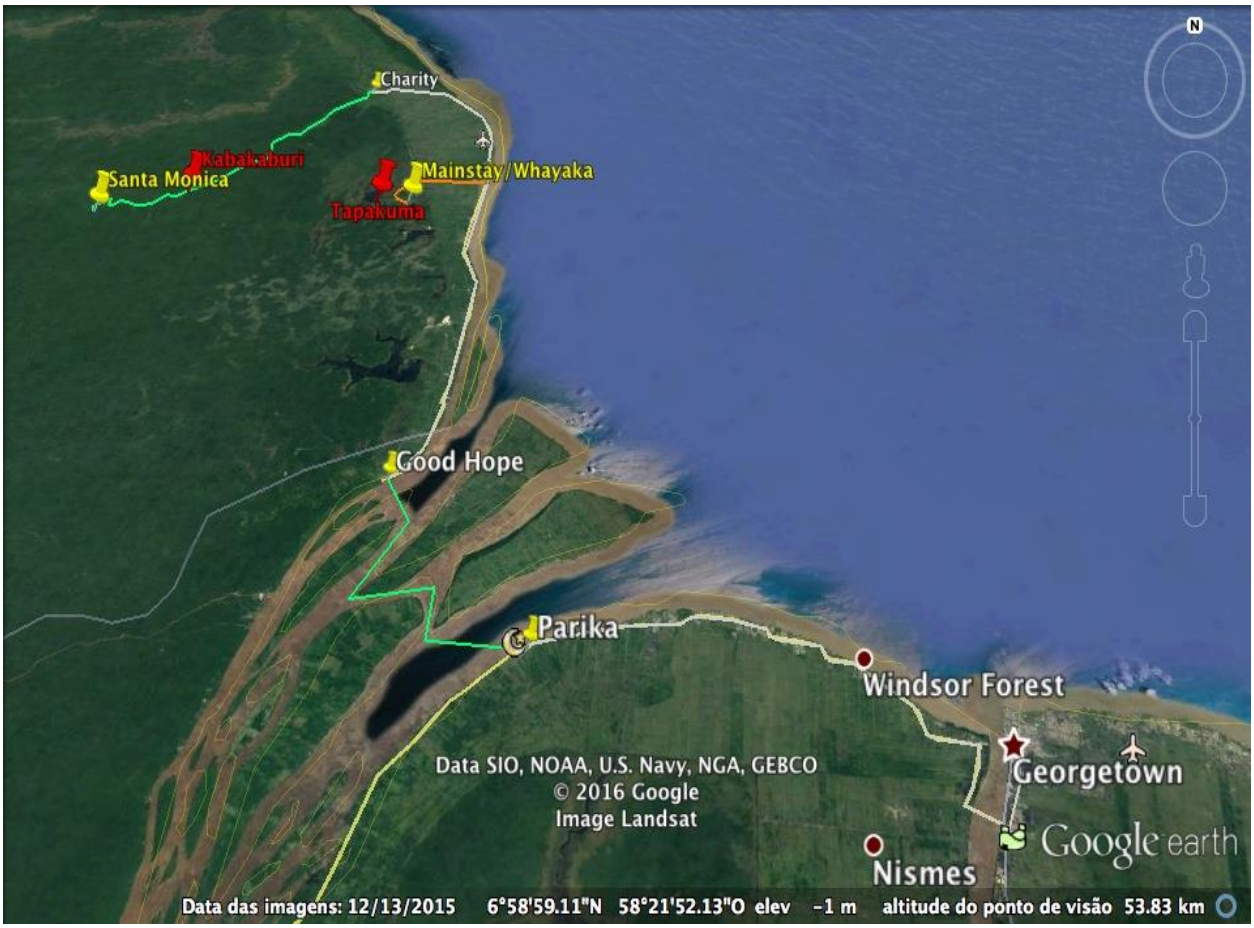

Figure 377 - Travel map Region 2 – Pomeroon-Supenaam

9.1.4.3 Region 3 – Essequibo Islands – West Demerara

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	1	Parika	15min	1
Departs 6:00	Minibus	40km	Region 3		
	Boat	1	**Saxacally**	8	1
		35km	Region 3		
	Boat	1	Parika	15min	1
		35km	Region 3		
Base	Road	1	Georgetown	15min	1
	Minibus	40km	Region 4		
Georgetown	Road	20min	**Wales**	8	2
	Taxi	15km	Region 3		
Base	Road	20min	Georgetown	0	2
	Taxi	15km	Region 4		
Georgetown	Road	1	Parika	15min	3
	Minibus	40km	Region 3		
	Boat	20min	**Hog Island**	8	3
		8km	Region 3		
	Boat	20min	Parika	15min	3
		8km	Region 3		
	Road	1	Georgetown	0	3
Georgetown	Minibus	40km	Region 4		
				Total days	**4**

Table 73 - Detail trip plan Region 3 – Essequibo Islands – West Demerara

Figure 378 - Travel map Region 3 – Essequibo Islands – West Demerara

9.1.4.4 Region 4 – Demerara - Mahaica

This region will be used to validate the questionnaire and to train the trainers due to its proximity to Georgetown.

Team members= 1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	10min	**Albouystown**	8	1
	Taxi	3km	Region 4		
Base	Road	10min	Georgetown	0	1
	Taxi	3km	Region 4		
Georgetown	Road	30min	**Buxton**	8	2
	Taxi	19km	Region 4		
Base	Road	30min	Georgetown	0	2
	Taxi	19km	Region 4		
Georgetown	Road	1h30	**Laluni**	8	3
	Taxi	43km	Region 4		
Base	Road	1h30	Georgetown	0	3
	Taxi	43km	Region 4		
Georgetown	Road	3	**St. Cuthberts**	8	4
	Taxi	80km	Region 4		
	Road	3	Georgetown	0	4
Georgetown	Taxi	80km	Region 4		
				Total days	**5**

Table 74 - Detail trip plan Region 4 – Demerara - Mahaica

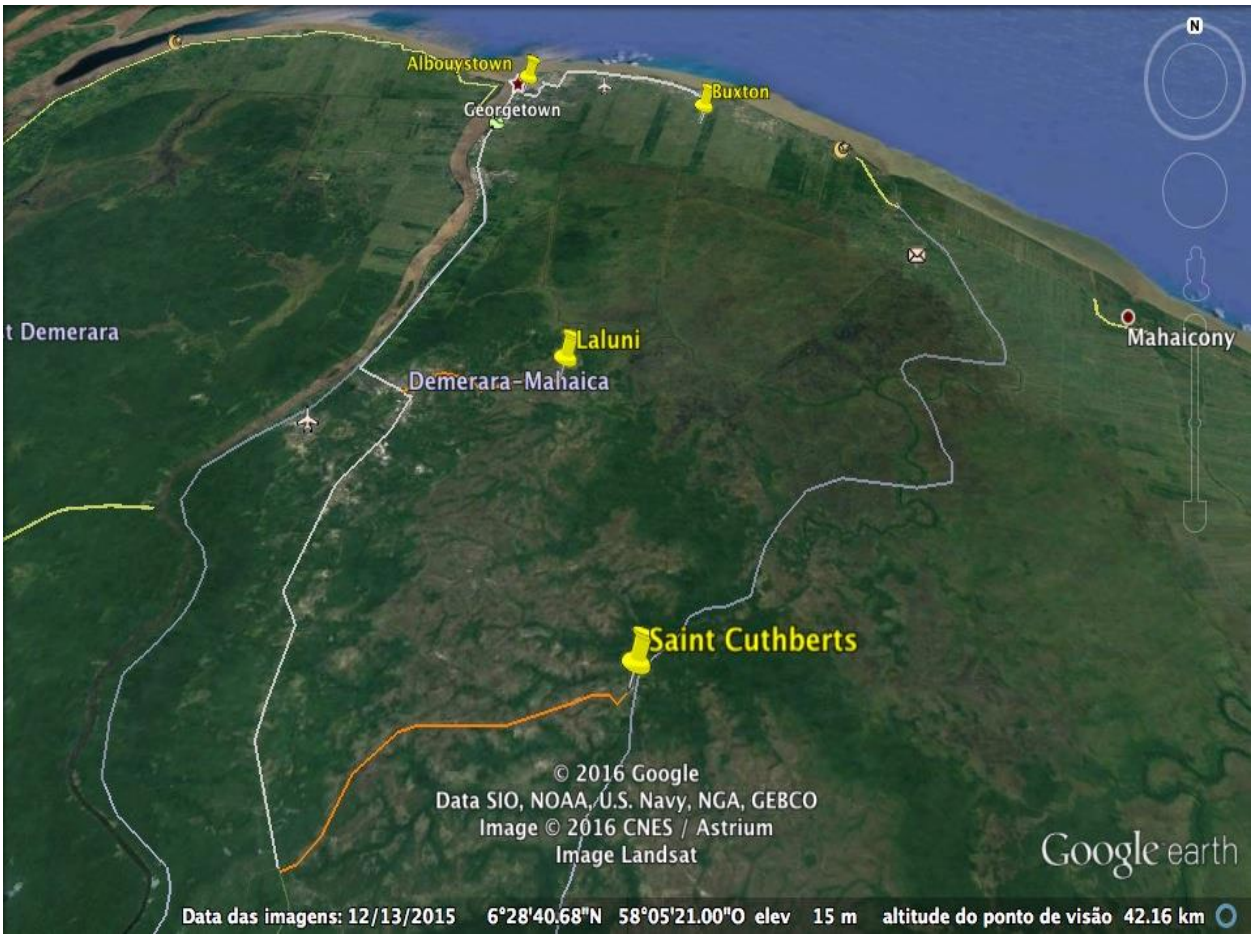

Figure 379 - Travel map Region 4 – Demerara - Mahaica

9.1.4.5 Region 5 – Mahaica-Berbice

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	1h30	**Perth**	8	1
	Minibus	50km	Region 5		
Base	Road	1h30	Georgetown	0	1
	Minibus	50km	Region 4		
Georgetown	Road	2	**Number 3**	8	2
	Minibus	75km	Region 5		
Base	Road	2	Georgetown	0	2
	Minibus	75km	Region 4		
Georgetown	Road	2h30	**Ithaca**	8	3
	Minibus	100km	Region 5		
	Road	2h30	Georgetown	0	3
Georgetown	Minibus	100km	Region 4		
				Total days	**4**

Table 75 - Detail trip plan Region 5 – Mahaica-Berbice

Figure 380 - Travel map Region 5 – Mahaica-Berbice

9.1.4.6 Region 6 – East Berbice-Corentyne

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	2h45	**Plegt Ankor/Lighttown**	8	1
	Minibus	130km	Region 6		
	Road	35min	New Amsterdam	Overnight	1
	Minibus	25km	Region 6		
	Road	10min	**West Canjie**	8	2

	Taxi	5km	Region 6		
	Road	1h40	Corriverton	Overnight	2
	Taxi/Minibus	75km	Region 6		
	Boat	1h30	**Orealla**	Overnight	3
		75km	Region 6		
	Boat	1h30	Corriverton	15min	3
		75km	Region 6		
	Road	3h30	Georgetown	0	4
Georgetown	Minibus	200km	Region 4		
				Total days	**5**

Table 76 - Detail trip plan Region 6 – East Berbice-Corentyne

Figure 381 - Travel map Region 6 – East Berbice-Corentyne

9.1.4.7 Region 7 – Cuyuni-Mazaruni

Team members= 1

Region 7 (plus Dog Point from Region 3)

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	1	Parika	15min	1
	Minibus	40km	Region 3		
	Boat	1	**Bartica**	8	1
		55km	Region 7		
	Boat	1	Parika	15min	1
		55km	Region 3		
Base	Road	1	Georgetown	0	1
	Minibus	40km	Region 4		
Georgetown	Airplane	1	Kamarang	15min	2
			Region 7		
	Boat	40min	**Kako**	2 Overnight	2
		25km	Region 7		
	Boat	4	**Phillipai**	2 Overnight	4
		75km	Region 7		
	Boat	5	Kamarang	15min	6
		100km	Region 7		
	Airplane	1	Georgetown	0	6
Georgetown			Region 4		
				Total days	**7**

Table 77 - Detail trip plan Region 7 – Cuyuni-Mazaruni

Figure 382 - Travel map Region 7 – Cuyuni-Mazaruni

9.1.4.8 Region 8 – Potaro-Siparuni

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Airplane	1	**Mahdia**	2 Overnight	1
			Region 8		
ö	Road	1	**Tumatumari**	8	3
	4x4	10km	Region 8		
	Road	1	Mahdia	Overnight	3
	4x4	10km	Region 8		
Base	Airplane	1	Ogle/Georgetown	0	4
			Region 4		
Georgetown	Airplane	1	**Kato**	2 Overnight	5
			Region 8		
	Airplane	1	Georgetown	0	7
Georgetown			Region 4		
				Total days	**8**

Table 78 - Detail trip plan Region 8 – Potaro-Siparuni

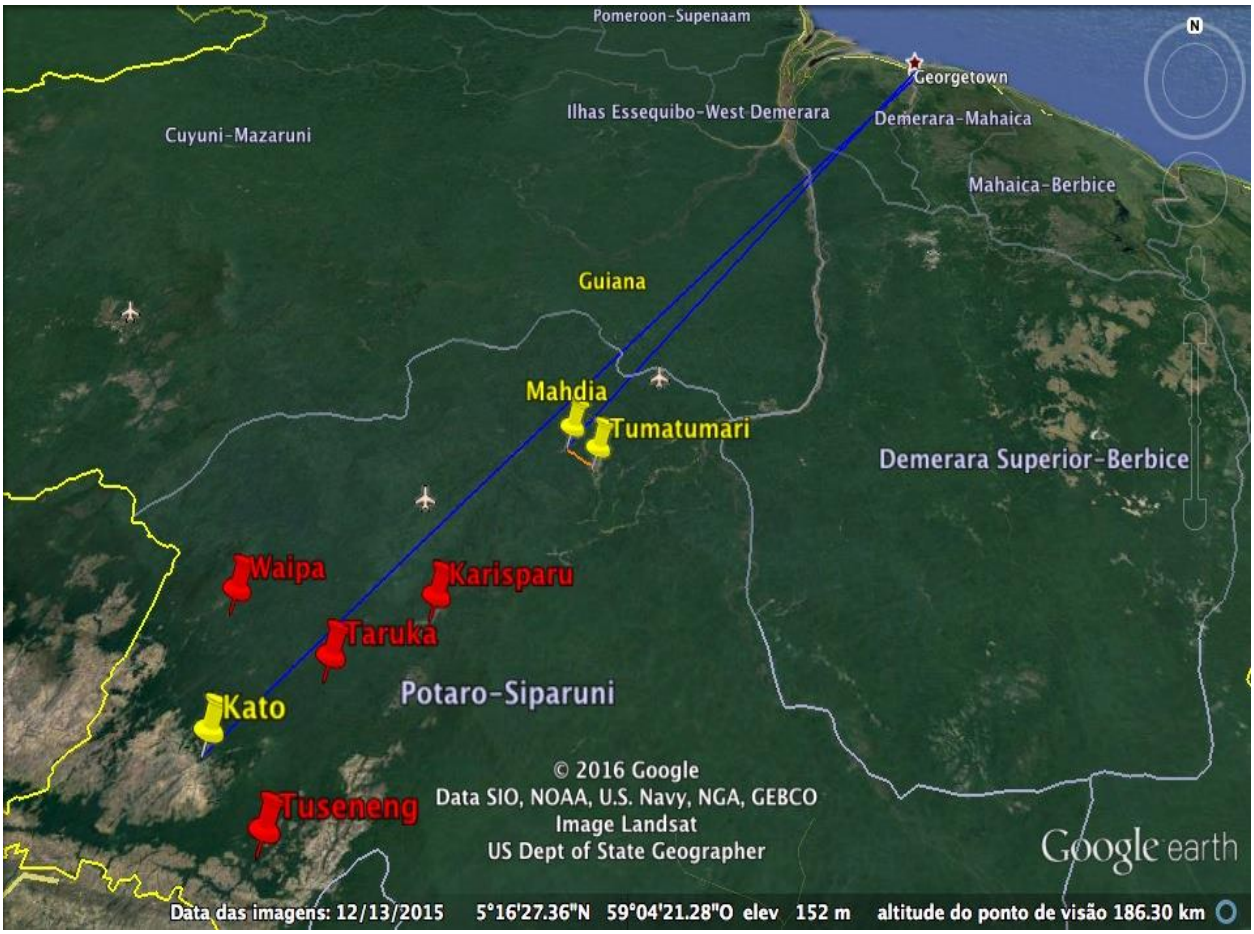

Figure 383 - Travel map Region 8 – Potaro-Siparuni

9.1.4.9 Region 9 – Upper Takutu-Upper Essequibo

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Airplane	1	**Lethem**	Overnight	1
			Region 9		
	Road	3	**Karasabai**	Overnight	2
	4x4	100km	Region 9		
	Road	3	Lethem	0	3
	4x4	100km	Region 9		

	Road	6	**Aishalton**	2 Overnight	3
	4x4	140km	Region 9		
	Road	6	Lethem	Overnight	5
	4x4	140km	Region 9		
	Airplane	1	Georgetown	0	6
Georgetown			Region 4		
				Total days	**7**

Table 79 - Detail trip plan Region 9 – Upper Takutu-Upper Essequibo

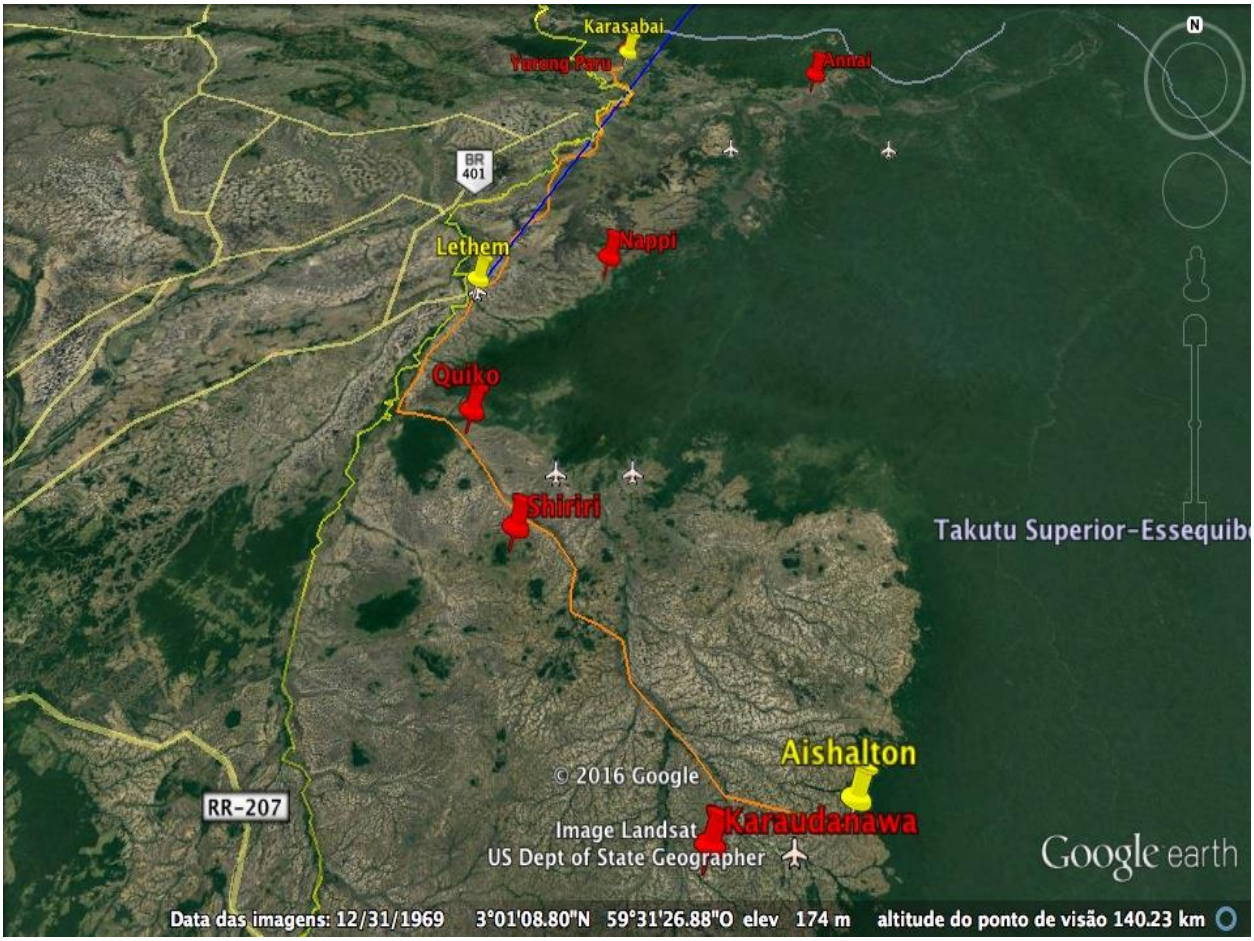

Figure 384 – Travel map Region 9 – Upper Takutu-Upper Essequibo

9.1.4.10 Region 10 – Upper Demerara – Upper Berbice

Team members=1

Base	Transport	Trip Hours	Site	Stay (hs)	Day
Georgetown	Road	2	Linden	15min	1
	Bus	110km	Region 10		
	Road	15min	**Wismar**	8	1
	Taxi	4km	Region 10		
	Road	15min	Linden	Overnight	1
	Taxi	4km	Region 10		
	Road	1	**Coomaca**	8	2
	Bus	35km	Region 10		
	Road	1	Linden	Overnight	2
	Bus	35km	Region 10		
	Road	3h30	**Kwakwani**	2 Overnight	3
	Bus	100km	Region 10		
	Road	5	Georgetown	0	5
Georgetown	Bus	215km	Region 4		
				Total days	**5**

Table 80 - Detail trip plan Region 10 – Upper Demerara – Upper Berbice

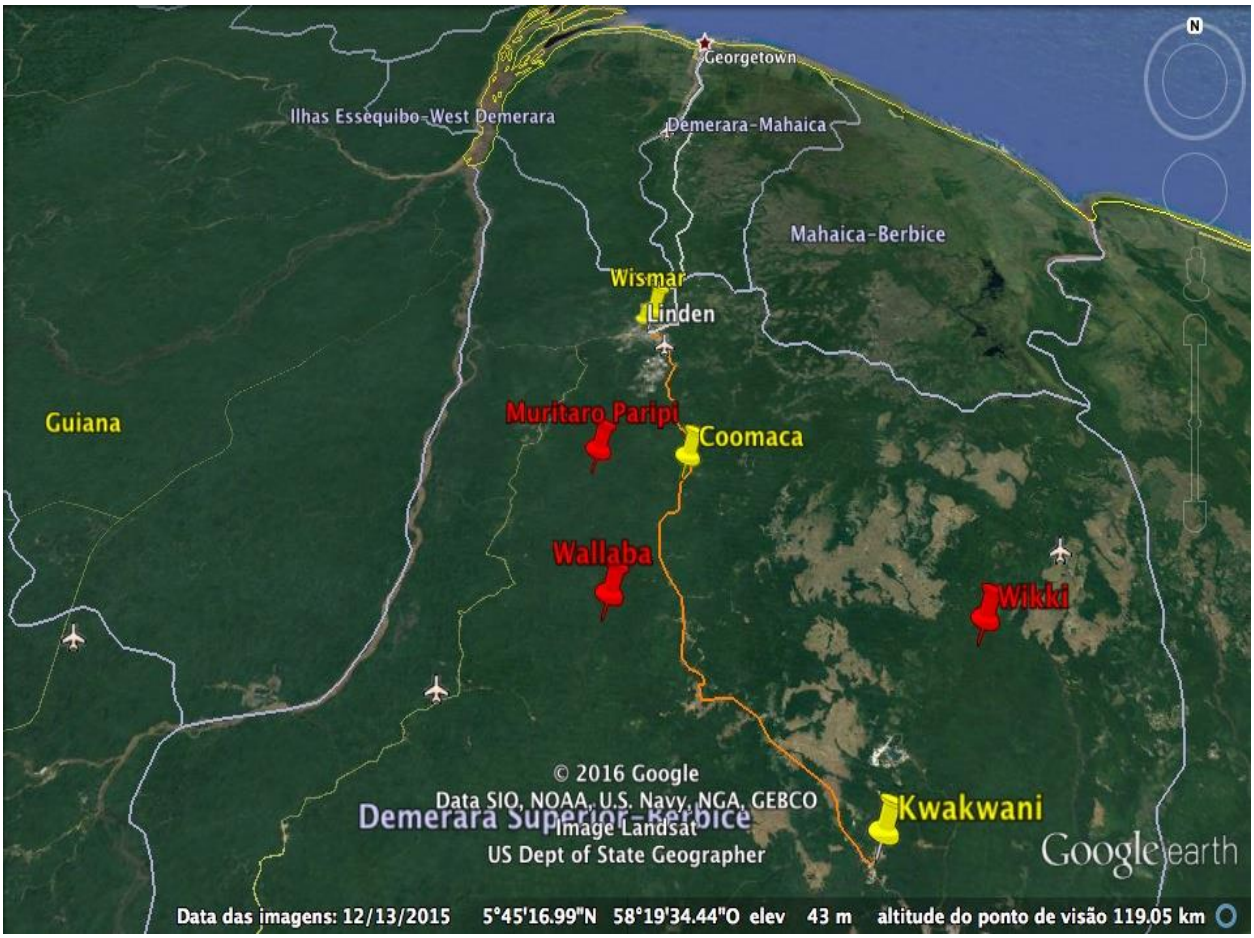

Figure 385 - Travel map Region 10 – Upper Demerara – Upper Berbice

9.1.5 Detailed timeline of field work

Current state of planning as of July 26th and subject to change.

	July														August														
Day	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Team 1	Arrival	Briefing/ Training		4 - Buxton	4 - Laluni		7- Bartica	3- Sawacally							8- Mahdia	8- Mahdia	8- Tumatumari	Travel	8- Kato	8- Kato	Travel						
Team 2	Arrival	Briefing/ Training		4 - Aboustown		Travel	1- Mabaruma	Travel	1- Port Kaituma	Travel	3- Wales	3- Hog Island			7- Kako	7- Kako	7- Phillipai	7- Phillipai	Travel								
Team 3	Arrival	Briefing/ Training		4 - Buxton	4 - Laluni		5- Perth	5- No. 3	5- Ithaca		6- West Canje				9- Lethem	9- Karasabai	Travel	9- Aishalton	Travel	Travel							
Team 4		Briefing/ Training		4 - Aboustown			10- Wismar	10- Coomaca				4- St. Cuthberts			2- Mainstay	2- Charity	2- Sta. Monica	Travel	6- Orealla	6- Orealla	6- Pkgt. Arikor			10- Kwakwani	10- Kwakwani	Travel	
				Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Region 9	Region 10														

Table 81 - Plan of visits to communities

9.2 Appendix Baseline Report (WP1)

9.2.1 Work Package 1.1 – Market Research

Willingness to Pay ranges - By Service per month

Willingness to Pay: Mobile Internet (in GYD)	Minimum	Maximum
Poor, Remote and Hinterland	0	45.000
Poor	200	8.000
Hinterland	40	3.800
Hinterland and Poor	1.000	3.500
Remote and Poor	50	44.000

Figure 386 - Willingness to pay ranges for Mobile internet in different communities

Willingness to Pay: Fixed line Internet (in GYD)	Minimum	Maximum
Poor, Remote and Hinterland	0	25.000
Poor	0	10.000
Hinterland	0	10.000
Hinterland and Poor	5.000	7.000
Remote and Poor	0	44.000

Figure 387 - Willingness to pay ranges for Fixed Line internet in different communities

Willingness to Pay: Texting (in GYD)	Minimum	Maximum
Poor, Remote and Hinterland	0	10.000
Poor	0	12.000
Hinterland	10	5.000
Hinterland and Poor	20	5.000
Remote and Poor	0	4.000

Figure 388 - Willingness to pay ranges for Texting in different communities

Willingness to Pay: Willingness to Pay: Phone Calls (in GYD)	Minimum	Maximum
Total	0	50.000
Poor, Remote and Hinterland	0	50.000
Poor	5	10.000
Hinterland	30	5.000
Hinterland and Poor	20	5.000
Remote and Poor	0	25.000

Figure 389 - Willingness to pay ranges for Phone Calls in different communities

Willingness to Pay ranges - By age groups per month

Willingness to Pay: Mobile Internet (in GYD)	Minimum	Maximum
Less than 24 years old	0	45.000
25-54 years old	100	44.000
More than 54 years old	0	5.000

Figure 390 - Willingness to pay ranges for Mobile internet per age groups

Willingness to Pay: Fixed line Internet (in GYD)	Minimum	Maximum
Less than 24 years old	0	10.000
25-54 years old	0	44.000
More than 54 years old	0	20.000

Figure 391 - Willingness to pay ranges for Fixed line internet per age groups

Willingness to Pay: Texting (in GYD)	Minimum	Maximum
Less than 24 years old	0	10.000
25-54 years old	0	12.000
More than 54 years old	0	5.000

Figure 392 - Willingness to pay ranges for Texting per age groups

Willingness to Pay: Willingness to Pay: Phone Calls (in GYD)	Minimum	Maximum
Less than 24 years old	0	50.000
25-54 years old	0	25.000
More than 54 years old	5	20.000

Figure 393 - Willingness to pay ranges for Phone Calls per age groups

Willingness to Pay ranges - By Gender per month

Willingness to Pay: Mobile Internet (in GYD)	Minimum	Maximum
Male	1.000	45.000
Female	0	28.000

Figure 394 - Willingness to pay ranges for Mobile internet per gender

Willingness to Pay: Fixed line Internet (in GYD)	Minimum	Maximum
Male	0	44.000
Female	0	28.000

Figure 395 - Willingness to pay ranges for Fixed Line internet per gender

Willingness to Pay: Texting (in GYD)	Minimum	Maximum
Male	0	10.000
Female	0	12.000

Figure 396 - Willingness to pay ranges for Texting per gender

Willingness to Pay: Willingness to Pay: Phone Calls (in GYD)	Minimum	Maximum
Male	7	50.000
Female	0	5.000

Figure 397 - Willingness to pay ranges for Phone Calls per gender

9.2.2 Work Package 1.2 - Technology research

Price List fixed Line GT&T (as of September 1st, 2016)

	EXCHANGE	Georgetown	New Hope	Timehri	Linden	Ituni	Kwakwani	B V Central	Cove & John	Mahaica	Mahaicony	Rosignol	New Amsterdam	Whim	Benab	Skeldon	Vreed -en - Hoop	Wales	Leonora	Tuschen	Suddie	Anna Regina	Bartica	Matthew's Ridge	Maha	
Peak	Georgetown	0.60	3.00	4.00	7.00	7.00	7.00	3.00	3.00	4.00	4.00	7.00	7.00	7.00	7.00	7.00	3.00	3.00	3.00	3.00	5.00	5.00	5.00	7.00	7.00	7
OffPeak	Georgetown	0.30	2.00	3.00	5.00	5.00	5.00	2.00	2.00	3.00	3.00	5.00	5.00	5.00	5.00	5.00	2.00	2.00	2.00	2.00	4.00	4.00	4.00	5.00	5.00	5
Peak	New Hope	3.00	0.60	3.00	5.00	7.00	7.00	3.00	4.00	4.00	4.00	7.00	7.00	7.00	7.00	7.00	3.00	3.00	4.00	4.00	5.00	5.00	5.00	7.00	7.00	7
OffPeak	New Hope	2.00	0.30	2.00	4.00	5.00	5.00	2.00	3.00	3.00	3.00	5.00	5.00	5.00	5.00	5.00	2.00	2.00	3.00	3.00	4.00	4.00	4.00	5.00	5.00	5
Peak	Timehri	4.00	3.00	0.60	4.00	7.00	7.00	4.00	5.00	5.00	5.00	7.00	7.00	7.00	7.00	7.00	4.00	3.00	4.00	3.00	7.00	7.00	4.00	7.00	7.00	7
OffPeak	Timehri	3.00	2.00	0.30	3.00	5.00	5.00	3.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	3.00	2.00	3.00	3.00	5.00	5.00	3.00	5.00	5.00	5
Peak	Linden	7.00	5.00	4.00	0.60	4.00	5.00	5.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	5.00	7.00	7.00	7.00	7.00	5.00	7.00	7.00	7
OffPeak	Linden	5.00	4.00	3.00	0.30	3.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5
Peak	Ituni	7.00	7.00	7.00	4.00	0.60	4.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Ituni	5.00	5.00	5.00	3.00	0.30	3.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Kwakwani	7.00	7.00	7.00	5.00	4.00	0.60	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Kwakwani	5.00	5.00	5.00	4.00	3.00	0.30	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5
Peak	B V Central	3.00	3.00	4.00	5.00	7.00	7.00	0.60	3.00	3.00	4.00	5.00	5.00	7.00	7.00	7.00	3.00	3.00	3.00	4.00	5.00	5.00	5.00	7.00	7.00	7
OffPeak	B V Central	2.00	2.00	3.00	4.00	5.00	5.00	0.30	2.00	2.00	3.00	4.00	4.00	5.00	5.00	5.00	2.00	2.00	2.00	3.00	4.00	4.00	4.00	5.00	5.00	5
Peak	Cove & John	3.00	4.00	5.00	7.00	7.00	7.00	3.00	0.60	3.00	3.00	4.00	5.00	7.00	7.00	7.00	3.00	4.00	4.00	4.00	5.00	7.00	7.00	7.00	7.00	7
OffPeak	Cove & John	2.00	3.00	4.00	5.00	5.00	5.00	2.00	0.30	2.00	2.00	3.00	4.00	5.00	5.00	5.00	2.00	3.00	3.00	3.00	4.00	5.00	5.00	5.00	5.00	5
Peak	Mahaica	4.00	4.00	5.00	7.00	7.00	7.00	3.00	3.00	0.60	3.00	4.00	5.00	5.00	7.00	7.00	4.00	5.00	5.00	5.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Mahaica	3.00	3.00	4.00	5.00	5.00	5.00	2.00	2.00	0.30	2.00	3.00	4.00	4.00	5.00	5.00	3.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Mahaicony	4.00	4.00	5.00	7.00	7.00	7.00	4.00	3.00	3.00	0.60	3.00	4.00	5.00	7.00	7.00	4.00	5.00	5.00	5.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Mahaicony	3.00	3.00	4.00	5.00	5.00	5.00	3.00	2.00	2.00	0.30	2.00	3.00	4.00	5.00	5.00	3.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Rosignol	7.00	7.00	7.00	7.00	7.00	7.00	5.00	4.00	4.00	3.00	0.60	3.00	3.00	4.00	4.00	5.00	5.00	5.00	5.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Rosignol	5.00	5.00	5.00	5.00	5.00	5.00	4.00	3.00	3.00	2.00	0.30	2.00	2.00	3.00	3.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5
Peak	New Amsterdam	7.00	7.00	7.00	7.00	7.00	7.00	5.00	5.00	5.00	4.00	3.00	0.60	3.00	4.00	4.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	New Amsterdam	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	3.00	2.00	0.30	2.00	3.00	3.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Whim	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	5.00	5.00	3.00	3.00	0.60	4.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Whim	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	2.00	2.00	0.30	3.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Benab	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	4.00	4.00	4.00	0.60	3.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Benab	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	3.00	3.00	0.30	2.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Skeldon	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	4.00	4.00	4.00	3.00	0.60	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7
OffPeak	Skeldon	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	3.00	3.00	2.00	0.30	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5
Peak	Vreed -en - Hoop	3.00	3.00	4.00	7.00	7.00	7.00	3.00	3.00	4.00	4.00	5.00	7.00	7.00	7.00	7.00	0.60	3.00	3.00	3.00	4.00	5.00	5.00	7.00	7.00	7
OffPeak	Vreed -en - Hoop	2.00	2.00	3.00	5.00	5.00	5.00	2.00	2.00	3.00	3.00	4.00	5.00	5.00	5.00	5.00	0.30	2.00	2.00	2.00	3.00	4.00	4.00	5.00	5.00	5
Peak	Wales	3.00	3.00	3.00	5.00	7.00	7.00	3.00	4.00	4.00	5.00	5.00	7.00	7.00	7.00	7.00	3.00	0.60	3.00	4.00	5.00	5.00	5.00	7.00	7.00	7
OffPeak	Wales	2.00	2.00	2.00	4.00	5.00	5.00	2.00	3.00	3.00	4.00	4.00	5.00	5.00	5.00	5.00	2.00	0.30	2.00	3.00	4.00	4.00	4.00	5.00	5.00	5
Peak	Leonora	3.00	3.00	4.00	7.00	7.00	7.00	3.00	4.00	4.00	5.00	5.00	7.00	7.00	7.00	7.00	3.00	3.00	0.60	3.00	4.00	4.00	5.00	7.00	7.00	7
OffPeak	Leonora	2.00	2.00	3.00	5.00	5.00	5.00	2.00	3.00	3.00	4.00	4.00	5.00	5.00	5.00	5.00	2.00	2.00	0.30	2.00	3.00	3.00	4.00	5.00	5.00	5
Peak	Tuschen	3.00	3.00	4.00	7.00	7.00	7.00	4.00	4.00	5.00	5.00	5.00	7.00	7.00	7.00	7.00	3.00	3.00	3.00	0.60	4.00	4.00	5.00	7.00	7.00	7
OffPeak	Tuschen	2.00	2.00	3.00	5.00	5.00	5.00	3.00	3.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	2.00	2.00	2.00	0.30	3.00	3.00	4.00	5.00	5.00	5
Peak	Suddie	5.00	5.00	7.00	7.00	7.00	7.00	5.00	5.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	4.00	5.00	4.00	4.00	0.60	3.00	4.00	7.00	7.00	7

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file:///C:/Users/PFF/Downloads/nao_e_brincadeira_nenhuma_o_estado_das_latrinas_no_mundo_2015.pdf

9.3 Appendix Technical Report (WP2)

9.3.1 Coastal area LTE450 MHz Cost Estimation

To increase the area of e-service availability esp. to poor communities, the target of phase 0 of the deployment plan was set to provide connectivity along the coastal area by upgrading existing eGovernment agency LTE base stations. As specified in the description this Phase, optimal coverage can be achieved by deploying the 450 MHz LTE frequency layer on 18 LTE base stations. As these base stations are already operating with LTE services, upgrade should include only the installation of the new radio units and antennas, cabling and purchase of the licenses. Respective price assumptions based on Detecon database for the upgrade of the infrastructure are specified in the following table.

Unit description	CAPEX		OPEX	
	Price Detecon	Description	Price Detecon	Description
Upgrade of 3 Sector LTE2300 to LTE 2300/450	$25,000	Price per base station including all active, passive equipment, software, installation and commissioning	$5200	Yearly service fee including license fees, spare parts and maintenance of the base station
Microwave link capacity extension	$2,000	Price includes license upgrade of the MW link	$0	

User Access devices	$150	Price per LTE Wi-Fi or Wi-Fi Mesh Access Point	$30	Reparation fee, spare parts and maintenance

Table 82 - LTE equipment and facilities unit price list (in USD)

For the expansion of the EPC and deployment of the User Access devices cost will be based on the price information specified in chapter 3.3.2 Cost components and assumptions.

The next table shows the estimation of the numbers of equipment planned to be needed for the deployment in coastal areas for the next five years.

New Deployment	2017	2018	2019	2020	2021
Upgrade of 3 Sector LTE2300 to LTE 2300/450	18	0	0	0	0
MW Link capacity extension	18	0	0	0	0
Core deployment Mbps	210	200	130	0	0
User Access devices	650	750	400	0	0

Table 83 - Itemized deployment plan for coastal area

Based on the deployment plan and unit price information the following capital and operational expenses are expected to occur during the 5 years.

CAPEX Components	2017	2018	2019	2020	2021	Sum
Active equipment	$906,000	$400,000	$260,000	$0	$0	$1,566,000
Towers and facilities	$0	$0	$0	$0	$0	$0
User access	$97,500	$112,500	$60,000	$0	$0	$270,000
					Sub-total	**$1,836,000**
OPEX Components						
Active equipment	$150,600	$170,600	$183,600	$183,600	$183,600	$872,000
Towers and facilities	$0	$0	$0	$0	$0	$0
User access	$19,500	$42,000	$54,000	$54,000	$54,000	$223,500
					Sub-total	**$1,095,500**
					TOTAL	**$2,931,500**

Table 84 - Overall cost expectations in USD for the coastal area

9.3.2 Rolloutplan

9.3.2.1 Rollout Details for Solution 4 "combined" including Coastal Area

New Deployment	2017	2018	2019	2020	2021
LTE BS 3 Sector Outdoor 24 hours battery backup	0	7	0	3	0
Upgrade of 3 Sector LTE2300 to LTE 2300/450	18	0	0	0	0
Microwave backhaul link 7GHz	0	2	0	5	0
MW Link capacity extension	18	0	0	0	0
Evolved Packet Core upgrade	210	410	130	90	0
UA devices	706	1251	470	49	18
WiBACK Link	0	20	0	11	0
Diesel generator approx. 17 KW for LTE, Microwave and/or satellite equipment	0	3	0	3	0
Tower 60 m	0	4	0	5	0
Tower 30 m	0	18	0	8	0
Satellite link user Low requirements	7	0	0	0	0
Satellite link user Med requirements	0	16	14	6	0
Satellite link user High requirements	0	0	0	3	9

Table 85 - Required infrastructure per year

9.3.2.2 Phase 1 (2017)

Broadband rollout via VSAT: 7 communities with a population of more than 1,000 people each are connected, which represent 13.6% of the population in hinterland and remote areas.

Name	Population
Mahdia	2564
Kwakwani	2503
Wakapau Village	1807
Matthews Ridge - Kaituma Railway	1433
Paramakatoi	1423
Wauna & Whitewater	1220
Port Kaituma	1152

Figure 398 - Phase 1, Additional VSAT Communities

9.3.2.3 Phase 2 (2018)

Broadband rollout using VSAT technology: 16 communities with a population of more than 400 people are connected, which represent 11.3% or HPR population

Name	Population
Kobarina Hill, Barrabina Hill	935
Lima Sands	853
Anabisi River	797
Akawini Village	729
Hosororo	723
Monkey Mountain	711
Kurukabaru	686
Ituni	676
Kopinang	669
Mabaruma, Kokorital Hill	569
Waramadan	492
Hururu	484
Kokerite	448
Aruau River	446
Kato	424
Matthews Ridge	409

Figure 399 - Phase 2, Additional VSAT Communities

14 communities are connected by WiBACK representing 7593 people, which represent 8.5% of the population in the hinterland and remote areas.

Name	Population
Aishalton	1069
Karasabai, Cracrana	1024
Karaudanau, Lumidpau	909
Shulinab,Meriwau,	764
Nappi	677
Achiwib	586
Yupukari	493
Sawariwau	444
Yakarinta	438
Parishara	421
Hiawa	363
Toka	241
Kwaimatta	145
Karanambo	19

Figure 400 - Phase 2, Additional WiBACK Communities

95 communities in 81 locations are connected using LTE450 technology: 53877 people will be in reach of the network, representing 60.6% of population in the hinterland and remote areas.

Name	Population

Bartica	8004
Amelia s Ward	6407
Timehri	4433
Wismar	4137
Hope	4131
Wisroc (Block 22)	3931
Danjou Park	2675
The Bell	2472
Lethem	1702
Christianburg	1457
St. Ignatius	1276
Akwero	1174
Half Mile	1004
Kumaka	982
Cockatara (North Mc Kenzie)	932
Agatash	740
Silver City	734
Waramuri Mission	717
Riverview, New Foundout	676
Coomacka Lands	611
Vreed En Hoop	481
Annai	481
Moco Moco	440
Sans Souci	431
Good Hope	339
Vreed En Rust	325
Fort Nassau	263
Vryheid	236
Blenheim	228
Three Friends	164
Saint Mary s	147
Friendship	146
Durban	145
Wineperu	137
Hauraruni River	136
De Maria Elizabeth	89
Uitkomst	86
Hittia Settlement	84
Kumaru	71
Mon Repos	69
Prosperite	66
Hermanstyne	62
Warida	61

De Endragt	59
Low Wood	56
Berlin	48
Makouria	42
Penal Settlement	37
Old England	37
Dora	37
Maria	34
Catherina	33
Tacama	30
Stena	29
Peter s Hoff	28
Susannah s Rust	28
Wolga	27
Manari	27
Berenstein	25
Spring Garden	25
Princess Carolina	25
Aurora	24
Hofwerk	22
Aurora	22
Charters	22
Maria Henrietta	21
Rustenburg	21
De Velde	21
De Hoop	21
Hope	21
T Fortune	20
Rusthoff	19
Zeelandia	18
De Vryheid	16
Lucky Spot	16
Richmond	16
Meyer Beck	14
Helvetia	14
Elizabeth	14
Endeavour	14
Mahaicabally	12

Figure 401 - Phase 2, Additional LTE450 Communities

9.3.2.4 Phase 3 (2019)

Broadband rollout using VSAT technology: 14 communities with a population of more than 200 people each , representing around 4% of the population in the hinterland and remote areas.

Name	Population
Massara	388
Shea	372
Kamarang	347
Ayanganna Mountain	308
Baramanni River	280
Surama	274
Apoteri	271
Imbaimadai	246
Ekereku River	244
Issano	220
Itabac	216
Mabura Hill	208
Paruima	207
Morawhanna	203

Figure 402 –Phase 3, Additional VSAT Communities

9.3.2.5 Phase 4 (2020)

Broadband rollout using VSAT technology: 8 communities that are larger than 75 people each will have broadband access, representing 1% of the population in the hinterland and remote areas.

Name	Population
Arakaka	196
Aruka River	142
Kurupung	128
Great Falls	122
Kaboyari Creek	103
Maikwak River	98
Pot Falls	88
Tumatumari	86

Figure 403 - Phase 4, Additional VSAT Communities

Six communities will be upgraded from VSAT to WiBACK technology in the mountainous areas providing higher bandwidth to 4433 people, representing 5% of the population in the hinterland and remote areas.

Name	Population
Paramakatoi	1423
Karasabai, Cracrana	1024
Monkey Mountain	711
Kurukabaru	686
Kato	424
Taruka	165

Figure 404 - Phase 4, Additional WiBACK Communities

2 locations will be upgraded from VSAT to LTE450 technology in the tall forest areas providing higher bandwidth to 5067 people, representing 5.7% of the population in the hinterland ans remote areas.

Name	Population
Mahdia	2564
Kwakwani	2503

Figure 405 - Phase 4, Additional LTE450 Communities

9.3.2.6 Phase 5 (2021)

Broadband rollout using VSAT technology: reaching out to 9 communities larger than 10 people each with 300 people in total, representing 0.3% of population in the hinterland and remote areas.

Name	Population
Great Fall	74
Puruni River	52
Butakari	52
Konawaruk	49
Kumaka	22
Chi Chi	15
Saka	13
Surprise Hill	12
Eping River	11

Figure 406 - Phase 5, Additional VSAT Communities

9.3.3 Willingness to pay by Community Segment

The willingness to pay as split over community segments is displayed in the following figures. Data are based on the findings from the baseline analysis.

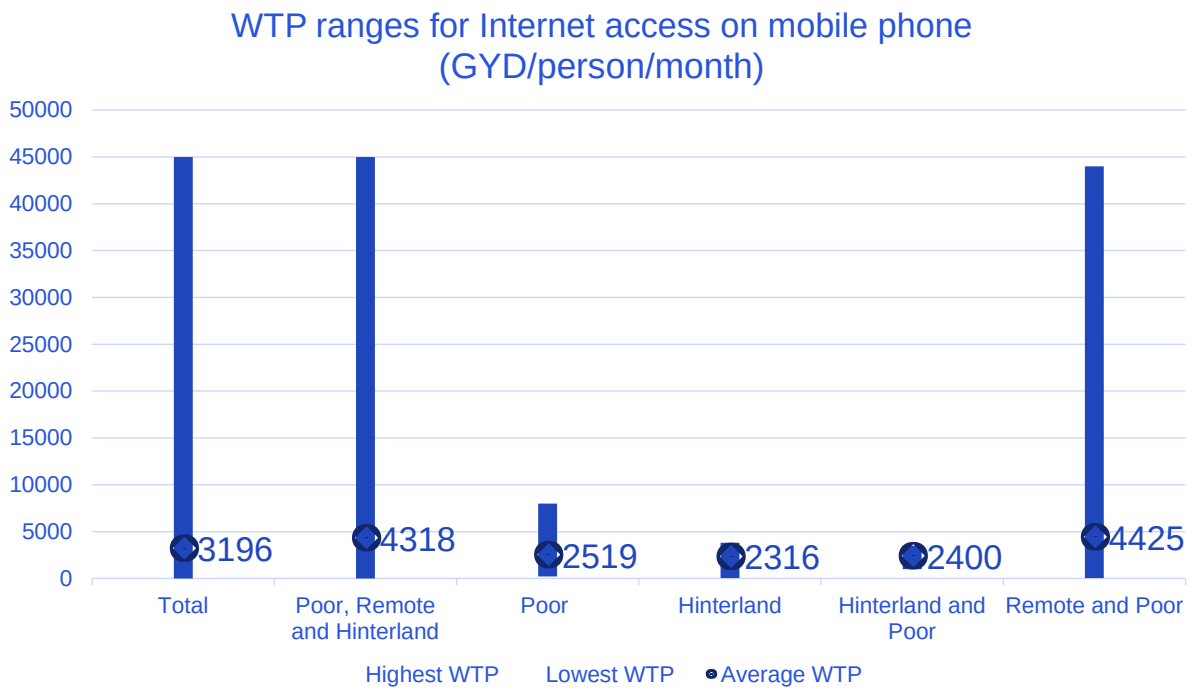


Figure 407 - Willingness to pay ranges for internet access via the mobile phone by community segment

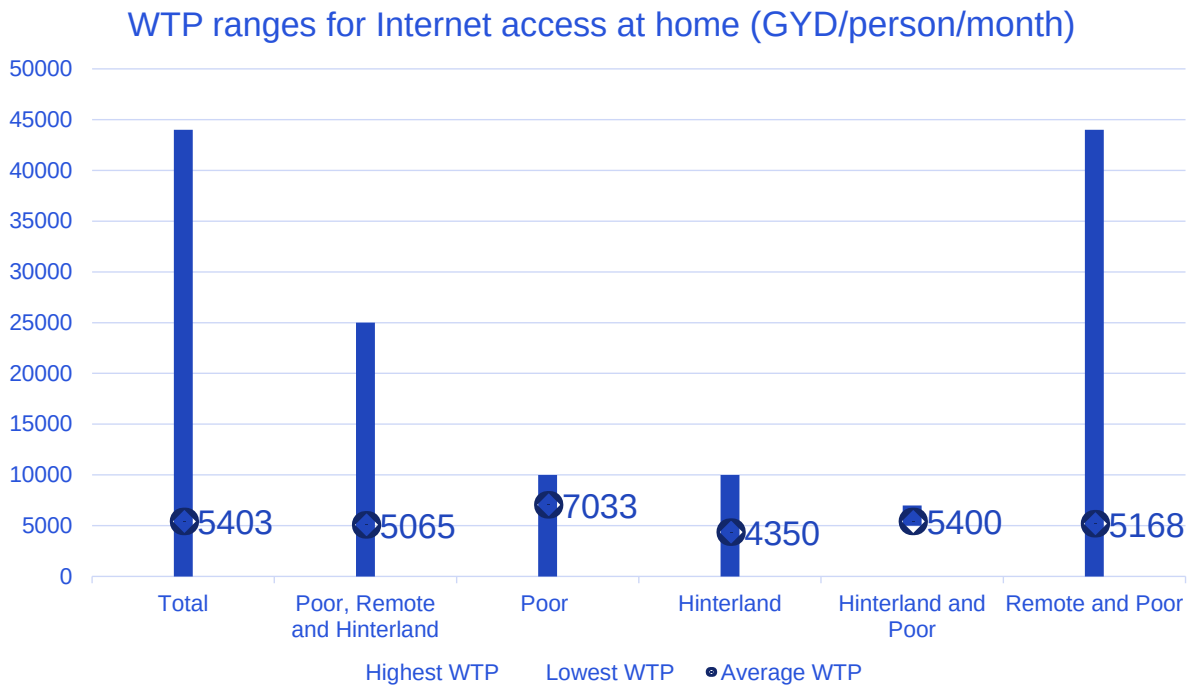


Figure 408 - Willingness to pay ranges for internet access at home by community segment

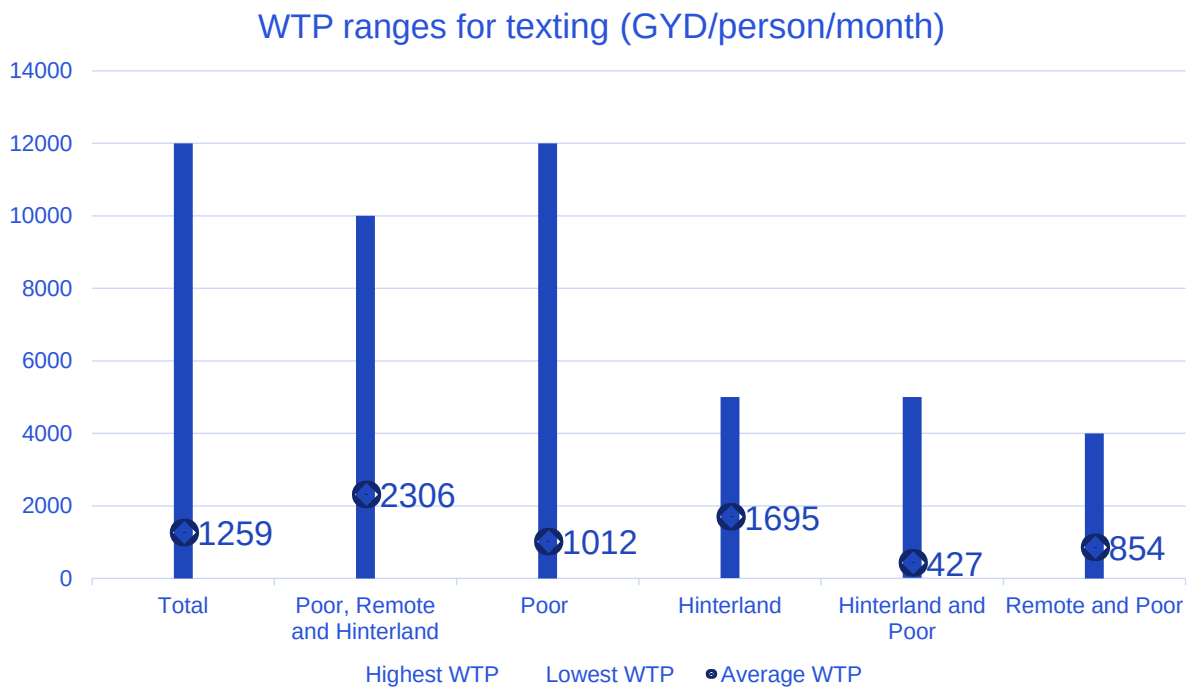


Figure 409 - Willingness to pay ranges for texting by community segment

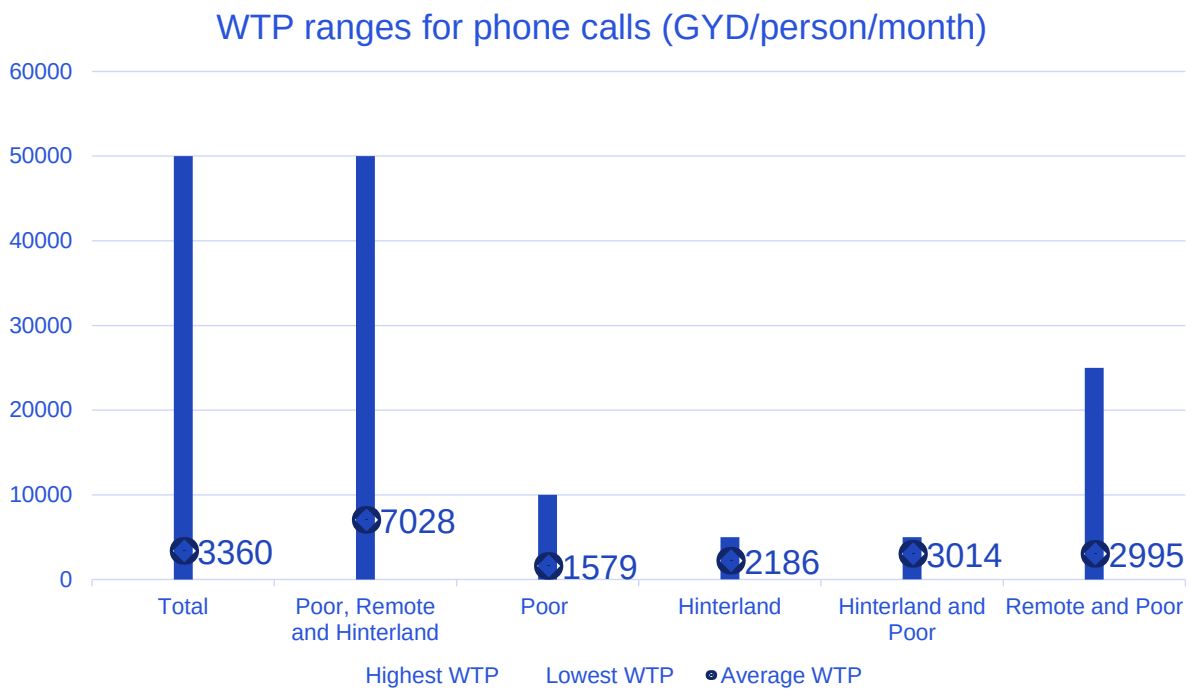


Figure 410 - Willingness to pay ranges for phone calls by community segment

9.3.4 Proposed Tendering Approach for Network Infrastructure

9.3.4.1 Example approach

The following images show a proposed tendering approach:

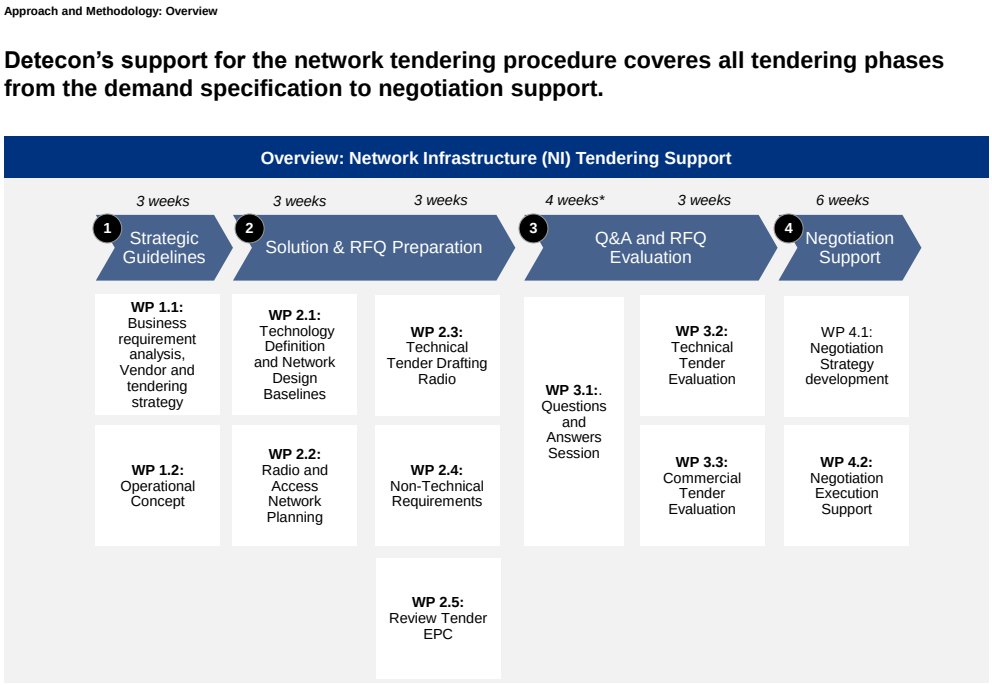


Figure 411 - Overview Approach Tendering Support

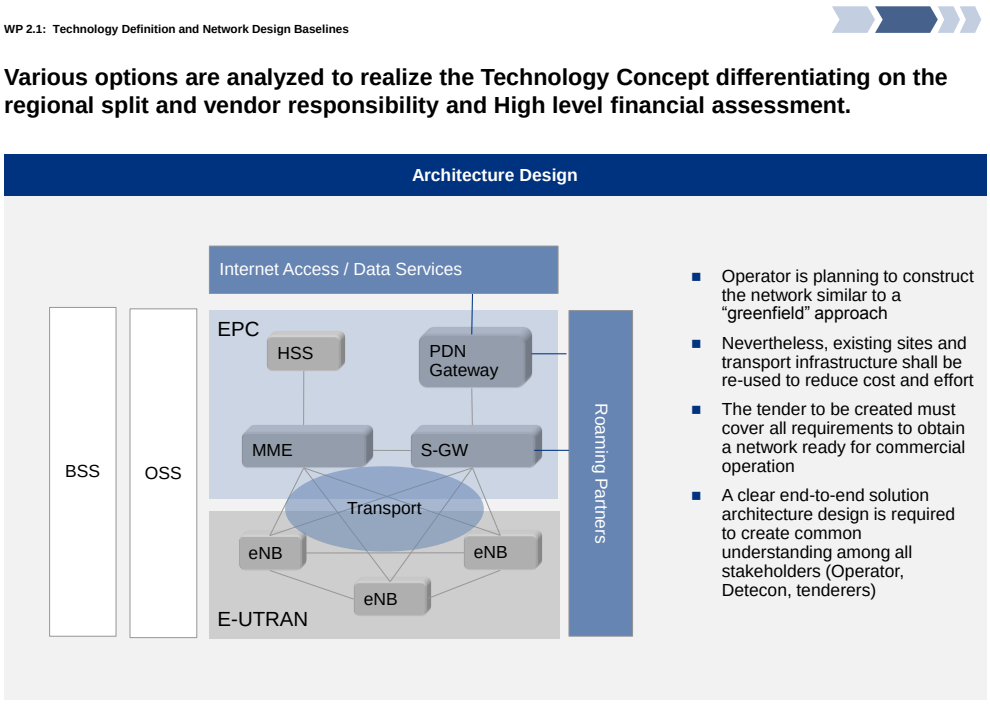


Figure 412 - Tendering Support (Architecture Design)

WP 2.1: Technology Definition and Network Design Baselines

The solution design will consider operator's business requirements and existing facilities. It provides the basis for an understanding of technical requirements.

Objectives	Methodology

■ Identify key features, capabilities and constraints for operator's network solution design
■ Analyze existing infrastructure and facilities to be included in the solution design (sites, backhaul, transmission)
■ Identify and assess technological options
■ Draft the most suitable solution design including major functional requirements for
  ■ RAN
  ■ Transmission (RAN Backhaul)
  ■ OSS/BSS
	■ Capitalize on learnings from prior network rollouts
	■ Analysis of business requirements and formulation of derived technical requirements
	■ Identify minimal requirements for commercial operation for retail, wholesale, roaming, prepaid, postpaid
	■ Capture existing network and infrastructure resources and capabilities from interviews and document review
	■ Survey of technology options and identification of candidates best able to fulfill the technical requirements
	■ Workshop to recommend, discuss and validate the network solution design with the operator

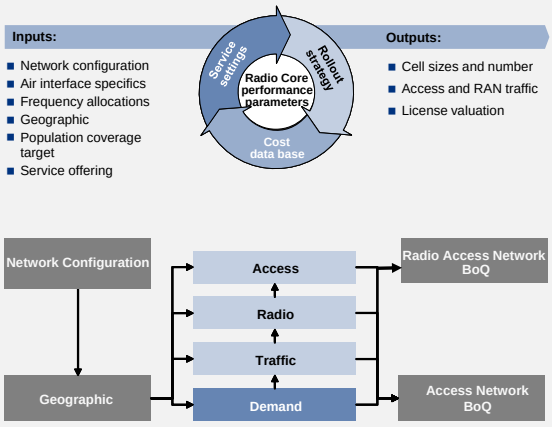
Prerequisites	Client Benefits / Deliverables
■ Availability of topology, design and capacity documentation of existing infrastructure (e.g. radio sites, backhaul, transport) ■ Availability of technical experts as well as the management for interviews, requirement reviews and validation of options ■ Input from WP 1.1	■ Agreed understanding of technical requirements resulting from the business requirements ■ Documented high level network solution design and major functional requirements

Figure 413 - Tendering Support - Detailed solution design

WP 2.2: Radio and Access Network Planning

Comprehensive analysis of all regional conditions with provisioning of the Network Planning model reflecting all operator's requirements

Planning Process Baselines



- Planning Target Definition (Coverage Requirements, Traffic Model, Quality Demands)
- Network Nominal Planning (Pre-Planning, Site Survey and Site Selection)
- The dimensioning results conduct nominal planning.
- Nominal planning will verify, visualize and optimize dimensioning.
- Site Acquisition
- Detailed Network Planning

Figure 414 - Tendering Support - Example Baseline Definition

WP 2.2: Radio and Access Network Planning

Radio Network Planning process including capacity and coverage planning to achieve targeted performance KPI

Objectives

- Assess the technology requirements with regards to geographical coverage, urbanity and population covered
- Planning of the radio network with a full service package, including network dimensioning (pre-planning or nominal planning), at the initial stage of network deployment.
- Estimate required number of Radio Access Networks sites and backhaul Transmission (BoM)
- Verification of investment needs within Business Plan based on PxQ calculation for RAN and backhaul transmission

Methodology

- Coverage Analysis (Define Radio propagation model and Link Budget calculation)
- Capacity Analysis (Service model, Subscribers distribution, Traffic layer statistic)
- Deriving key license parameters (duration, frequency band, spectrum, service obligations, minimum coverage in certain time, etc.) which are relevant for the technical model
- **Note:** Model will be done on high level basis, using analyst reports and commercial and technology benchmarks; Greenfield approach will be taken as a basis for the model
- Investment calculations based on operator's prices; if not available price assumptions will be used

Prerequisites

- Client provides information on clutter types for the relevant coverage areas, if not available, clutter types are estimated
- Sufficient details on geography and coverage
- Local census data broken down to required levels of granularity and corresponding areas of cities and/or regions to be covered
- Availability of operator's pricelists

Client Benefits / Deliverables

- Consolidated information on the estimated quantity and location of network elements for ensuring the achievement of the targeted quality and performance thresholds
- Technical parameter as basis for the engineering modelling

Figure 415 - Tendering Support - Detailed Network Planning

WP 2.3: Technical Tender Drafting

The RFP development phase is critical. Systematic preparation, top-down derivation of requirements and adherence to best-practice methodology are essential ingredients.

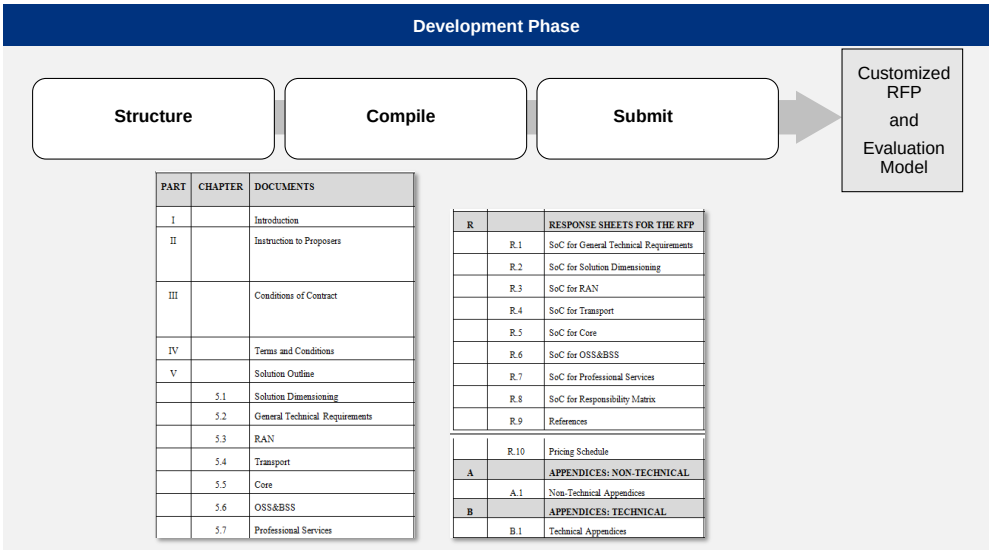


Figure 416 - Tendering Support - Tender Drafting

WP 2.3: Technical Tender Drafting

The tender documents will be prepared based on Detecon's tender methodology to ensure solution suitability, ease a transparent and fast proposal comparison.

Objectives	Methodology

■ Generate comprehensive and clearly structured technical tender documents:
  ■ Clear description of the required solution
  ■ Detailed and precise technical requirements and conditions.
■ The technical tender will include:
  ■ RAN, RAN Transmission, Antenna Systems, Tools & OSS
  ■ Operational requirements for network and IT
  ■ Integration with existing transmission and backhaul facilities; additional backhaul capacity as required
■ Create an evaluation matrix for the RfP evaluation phase
	■ Top-down derivation of technical specification from the prepared business and high-level functional requirements
	■ Considerations of recent versions of relevant standards
	■ Continuous interaction with operator's experts as well regular management briefing to meet client expectations
	■ Concurrent development of the evaluation and weighting model
	■ Scoping of tender lots in line with the defined tendering strategy
	■ Application of Detecon's proven tender methodology will ensure high quality documents and reproducible approach

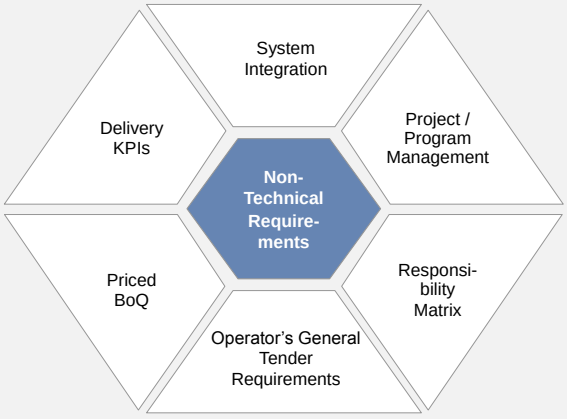
Prerequisites	**Client Benefits / Deliverables**
■ Access to operator's experts and senior management ■ Specified and agreed tendering strategy, agreed business requirements, solution design and operational model / framework from previous WPs ■ Operator's internal approvals to be supported by Detecon must be completed before end of the work package	■ Comprehensive RfP documents supporting precise proposal generation ■ Evaluation model for efficient evaluation ■ Knowledge transfer ■ Presentation of evaluation model, tender structure and key requirements to tender committee

Figure 417 - Tendering Support - Tender Drafting Details

WP 2.4: Non-Technical Requirements

Detecon recommends to re-use operator's standard commercial terms and non-network specific general requirements. Comprehensive Professional Services must be specified.

Cooperation for Non-Technical Requirements



- Operator is expected to contribute "standard" requirements that are not specific to the network tender, e.g.
  - Commercial and legal requirements
  - Instructions for tendering
  - Corporate rules and procedures to be obeyed by suppliers
  - General safety, security, electrical, mechanical, warranty specifications
- Detecon offers support for
  - Advice on "standard" requirements if adaptation is needed
  - Setting up the pricing structure to be followed by tenderers
  - Definition of Professional Service requirements

Figure 418 - Tendering Support - Non-Technical Requirements

WP 2.4: Non-Technical Requirements

Requirements for LTE network rollout management, system implementation and integration including corresponding SLAs must be defined.

Objectives	Methodology
■ Define all Professional Service requirements for the LTE rollout ■ Compile the relevant SLAs ■ Ensure price comparability of bids on an element level as well as full transparency through suitable pricing structure ■ Prepare pricing evaluation ■ ***Note:*** *The commercial tender requirements and non-LTE specific general requirements must be contributed by operator; advice on enhancement can be provided.*	■ Specify requirements for system implementation and rollout management ■ Depending on tendering strategy, identify and specify system integration requirements, tenderer's responsibilities and SLAs ■ In coordination with Detecon technical experts, define a suitable priced BoQ structure that allows for meaningful financial bid comparison ■ Review operator's standard commercial and general requirements and propose adjustments / amendments as required
Prerequisites	**Client Benefits / Deliverables**
■ Access to operator's experts and senior management ■ Availability of operator's standard tender documents including commercial requirements, templates, SLAs, draft contracts, general requirements ■ Close cooperation with Procurement and clarification of existing requirements	■ Priced Bill of Quantities (Excel) ■ Professional Service and System Integration requirements ■ Advice on existing operator's general requirements

Figure 419 - Tendering Support - Non-Technical Requirements Details

WP 2.5: Review Technical Tender EPC

Existing technical tender documents regarding will be reviewed wrt application of standards, best practices and alignment with technology strategy.

Objectives	Methodology

■ Review existing technical tender documents regarding:
  ■ Clear description of the required solution
  ■ Detailed and precise technical requirements and conditions
  ■ Application of standards and best-practices
  ■ Ensure RFP is comprehensive and modular
  ■ Review evaluation criteria for RFP submissions
  ■ Evaluation matrix for the RfP evaluation phase
■ Provide recommendations on areas where to improve the tender documentation (and NOT to rewrite the tender document)
	■ Detecon experts will focus on reviewing the technical parts of the Tender based Detecon's RFP Methodology
	■ Comparison with relevant standards and industry practices
	■ Review of alignment with operator's business strategy, network technology solution and existing tenders
	■ Continuous interaction with operator's experts as well regular management briefing to meet client expectations
	■ Concurrent alignment of the evaluation and weighting model

Prerequisites	**Client Benefits / Deliverables**
■ Operator's technical tender document ■ Access to operator's experts and senior management ■ Specified and agreed tendering strategy, agreed business requirements, solution design and operational model / framework from previous WPs ■ Operator's internal approvals to be supported by Detecon must be completed before end of the work package	■ Recommendations where to improve the tender documentation ■ Comprehensive RfP documents supporting precise proposal generation ■ Application of industry best-practices ■ Evaluation model for efficient evaluation ■ Knowledge transfer

Figure 420- Tendering Support – Review supporting tenders

WP 3.1: Questions and Answers Session

Providing timely and qualified answers to bidder's questions on specific tender aspects – technical or commercial – significantly increases the quality of the tender responses.

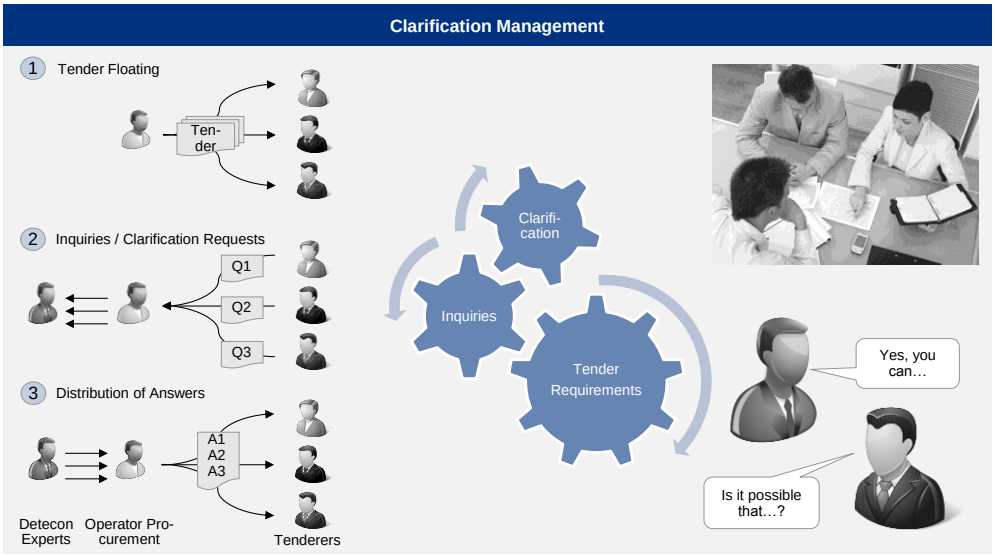


Figure 421- Tendering Support - Overview Clarification Management

WP 3.1: Questions and Answers Session

During the tender execution / bid preparation phase, Detecon will support operator in answering tenderer inquiries and providing instructions on the bidding procedure.

Objectives	Methodology
■ Answer tenderer inquiries and clarifications for the technical as well as the commercial part of the RfP. ■ Support clarification of potential ambiguities or misunderstandings regarding the tendering procedure ■ Ensure that prerequisites for delivery of qualified and comparable proposals are available to all tenderers	■ Detecon support is planned to be provided off site ■ Operator's procurement forwards tenderer's inquiries, instruction and clarification requests to a single point of contact (SPoC) named by Detecon; e.g. Detecon PM ■ Operator's procurement may decide to answer clarifications regarding tendering procedure directly or seek consultation from Detecon ■ Detecon experts (technical and commercial team representatives) will prepare structured and clear answer. SPoC will forward to Operator's procurement ■ Any clarification shall be made available to all tenderers to ensure a fair procedure
Prerequisites	**Client Benefits / Deliverables**
■ Agreement with operator's procurement on approach and deadlines ■ For potential clarification of operator's internal aspects, operator shall nominate technical and commercial counterparts responsible to answer Detecon's requests within the agreed deadlines	■ Meet prerequisites for enhanced quality and transparency of the bids ■ List of clarifications with the respective answers ready to be sent back to the tenderers

Figure 422 - Tendering Support - Clarification Management Details

Detecon follows a proven evaluation methodology including transparent management briefings and providing a solid basis for the negotiation with the qualified tenderers.

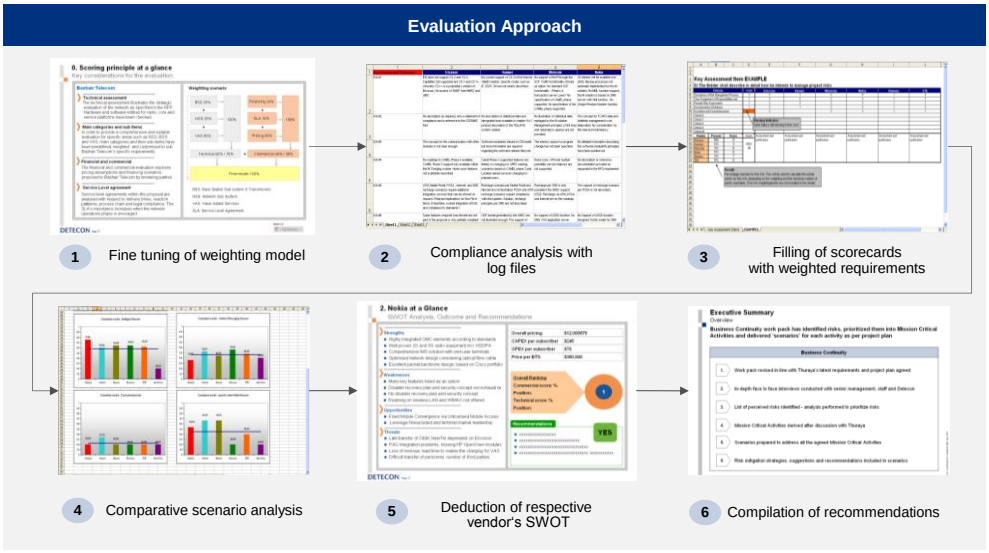
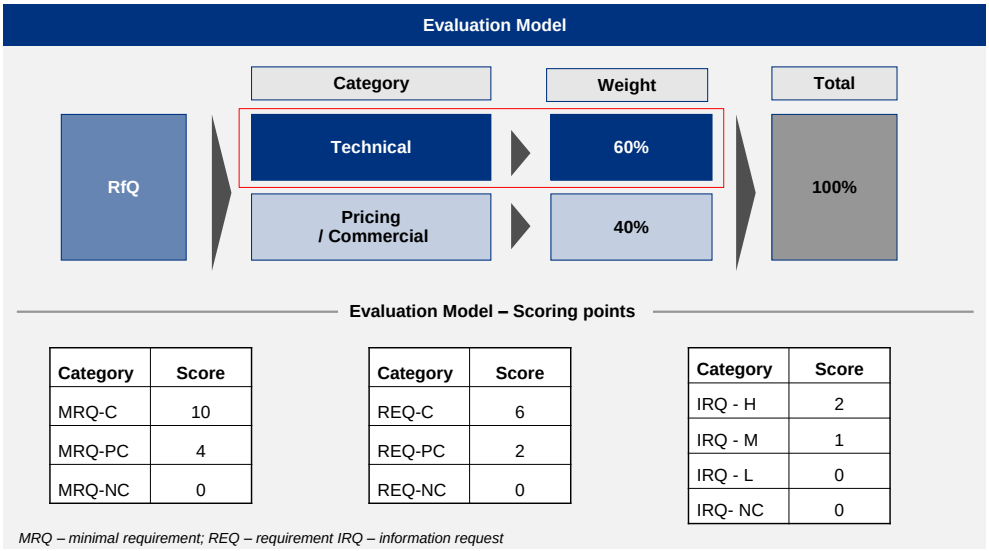


Figure 423- Tendering Support - Evaluation Approach

The general structure of the evaluation model and its constituent broken down as shown below. (technical part).



Evaluation Model – Scoring points

Category	Score
MRQ-C	10
MRQ-PC	4
MRQ-NC	0

Category	Score
REQ-C	6
REQ-PC	2
REQ-NC	0

Category	Score
IRQ - H	2
IRQ - M	1
IRQ - L	0
IRQ- NC	0

MRQ – minimal requirement; REQ – requirement IRQ – information request

Figure 424- Tendering Support - Evaluation Model

The RFP evaluation result will be based on a sophisticated weighting matrix reflecting all major evaluation items .

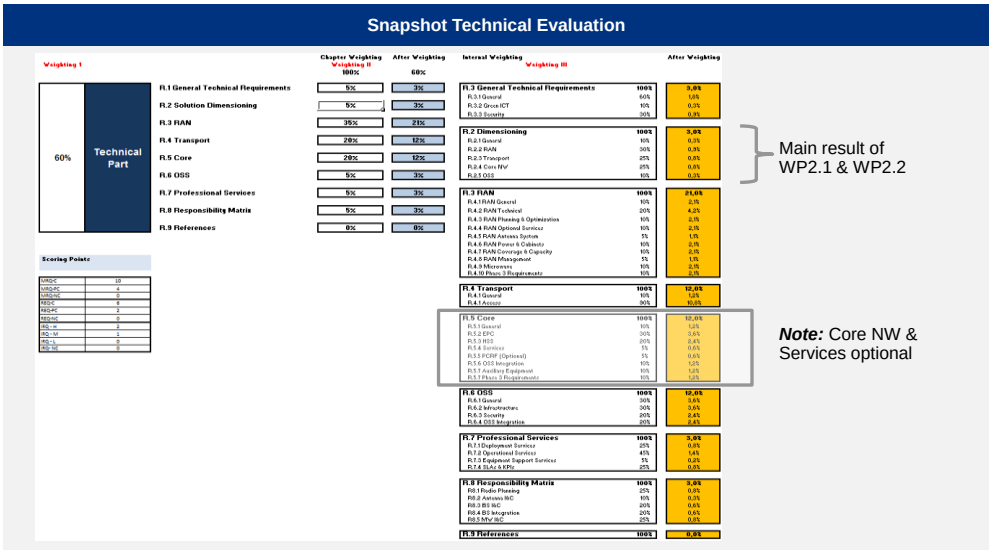


Figure 425- Tendering Support - Snapshot Technical Evaluation

The technical tender will be evaluated by the technical team of Detecon following the pre-defined evaluation matrix and weighted criteria.

Objectives	Methodology
■ Reliable evaluation and meaningful ranking of tenderer proposals ■ Transparent comparison of proposals ■ Clarification of open issues and unclear RfP responses with the suppliers ■ Assessment of tenderers' strengths and weaknesses; qualitative and strategic vendor evaluation ■ ***Note:*** *Evaluation of responses of* ***max. 5 tenderers***	■ Evaluation of tenderer's compliance statements; cross-check against documentary evidence provided by tenderers ■ Clarification requests are communicated in writing; clarification meetings with tenderers can be called as required ■ Coordination with operator's procurement department ■ The results are summarized in an evaluation matrix. ■ Qualitative assessment of tenderer's proposed solution, overall impression of the tender response and Detecon's expert advice are summarized in recommendations and strength / weakness analysis of each proposal
Prerequisites	**Client Benefits / Deliverables**
■ Commercial tender is assumed to be evaluated by operator ■ Access to operator's experts and senior management	■ Evaluation report including • Technical scoring and ranking matrix • Compliance assessment log files • Supplier strengths/weaknesses and recommendations ■ Knowledge transfer and transparent procedure

Figure 426- Tendering Support - Technical Evaluation Details

WP 3.3 Commercial Tender Evaluation

The Detecon evaluation methodology is based on a fact-driven approach and proven concept in order to evaluate and rank all bids objectively.

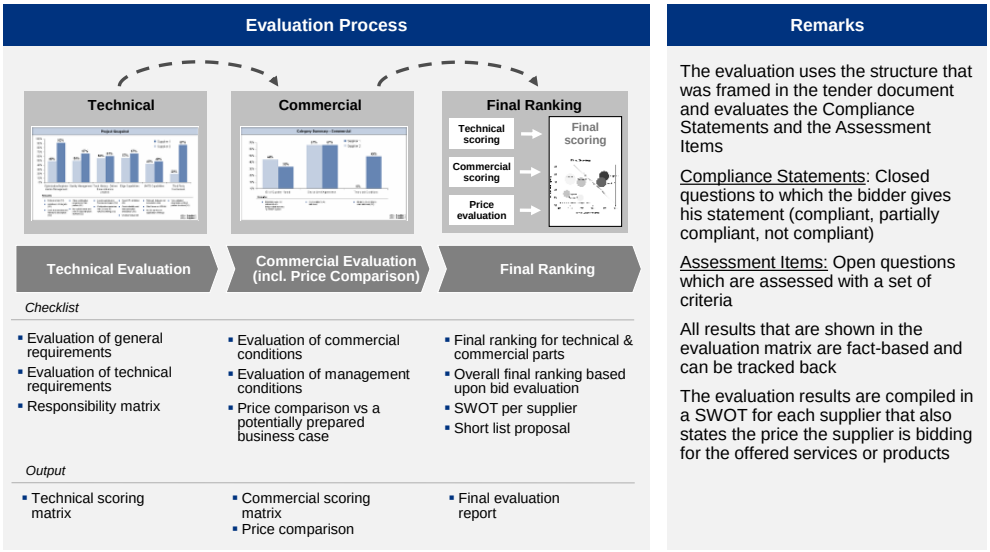


Figure 427- Tendering Support - Commercial Evaluation Approach

WP 3.3 Commercial Tender Evaluation (optional)

Evaluation based on per equipment and e2e solution comparison plus provision of pricing transparency based on TCO methodology.

Example

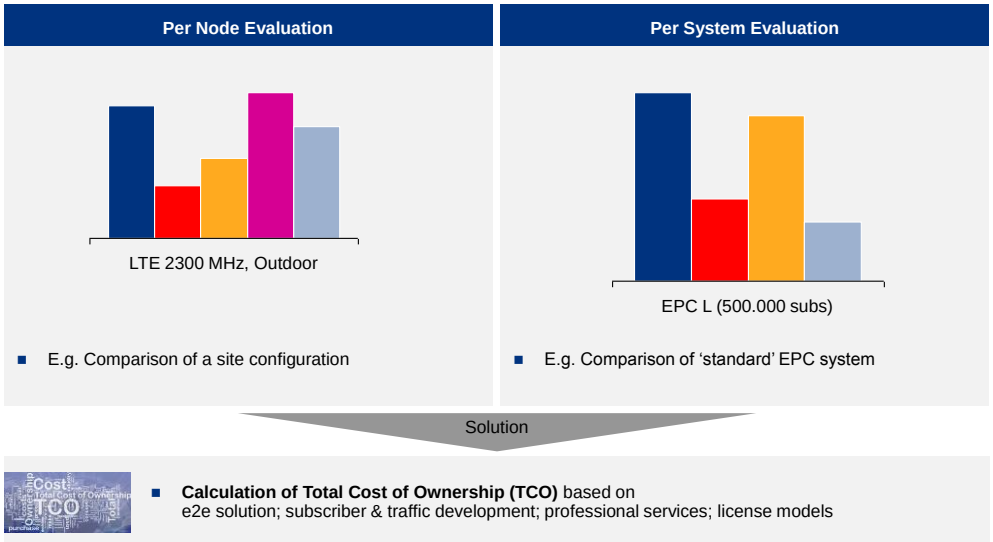


Figure 428- Tendering Support - Commercial Evaluation Examples

WP 3.3 Commercial Tender Evaluation (optional)

The technical tender will be evaluated by the technical team of Detecon following the pre-defined evaluation matrix and weighted criteria.

Objectives	Methodology
■ Reliable evaluation and meaningful ranking of tenderer commercial proposals ■ Evaluation based on per equipment but also end-to-end solution comparison ■ Transparent comparison of proposals ■ Clarification of open issues and unclear RfP responses with the suppliers ■ Assessment of tenderers' strengths and weaknesses; qualitative and strategic vendor evaluation ■ ***Note:** Evaluation of responses of **max. 5 tenderers***	■ Application of TCO methodology ■ Alignment of commercial and technical conditions ■ Clarification requests are communicated in writing; clarification meetings with tenderers can be called as required ■ Coordination with operator's procurement department ■ The results are summarized in an evaluation matrix. ■ Quantitative and qualitative assessment of tenderer's proposed commercial solution, overall impression of the tender response and Detecon's expert advice are summarized in recommendations and strength / weakness analysis of each proposal

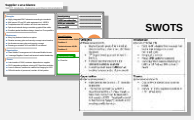
Prerequisites	Client Benefits / Deliverables
■ Coordination with operator's procurement department ■ Access to operator's experts and senior management	■ Evaluation report including • Commercial scoring and ranking matrix • Compliance assessment log files • Supplier strengths/weaknesses and recommendations ■ Knowledge transfer and transparent procedure

Figure 429- Tendering Support - Commercial Evaluation Details

WP 4.1: Negotiation Strategy Development

The negotiation rounds must be well prepared taking into account the findings during the evaluation. Agreement of the strategy between operator & Detecon team is essential.

Negotiation Objectives

Team Preparation	Negotiation Strategy	Negotiation Material
Management directives Commercial team Technical team		Supplier Scorecards  SWOTS

Prepare Negotiation Team	Develop Negotiation Strategy	Prepare Negotiation Material
Checklist ▪ Outline the objectives of the negotiation ▪ Assign negotiation team including potential legal support ▪ Anticipate positioning & interests of other parties	▪ Review supplier performance history ▪ Assess alternatives ▪ Define Most Desired Outcome (MDO) ▪ Define Least Acceptable Agreement (LAA)	▪ Prepare list of items to be negotiated ▪ Determine "bargaining chips" ▪ Define roles and responsibilities of negotiation team ▪ Set up negotiation tactics and schedule
Output ▪ Prepared negotiation team	▪ Negotiation strategy set-up	▪ Prepared negotiation material and negotiation teams

- The negotiation strategy development serves to obtain a common understanding between operator and Detecon on key negotiation objectives
- Prior experience with the short-listed suppliers, operator management directives as well as the evaluation results must be considered
- Emphasis of the negotiation should be on obtaining a fair and realistic agreement that facilitates a partnership with trustful cooperation and common goals
- Before starting any negotiation, the negotiation bandwidth from the Most Desired Outcome (MDO) to the Least Acceptable Agreement (LAA) must be clear

Figure 430- Tendering Support - Approach Negotiation Strategy

WP 4.1: Negotiation Strategy Development

The development of a negotiation strategy is essential in order to assess the own position and interest and prepare relevant material before starting with the negotiations.

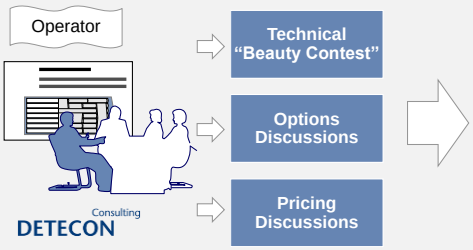
Objectives	Methodology
■ Comprehensive alignment on negotiation objectives between operator and Detecon ■ Clear definition of the least and most desired outcome ■ Prepare financial and technical items subject to negotiation, own and potential supplier positions ■ Set-up of negotiation team and negotiation timeline	■ Prepare overview of negotiation items for the short-listed tenderers from evaluation results ■ Workshops and discussions with operator's management and experts to: • Define Most Desired Outcome (MDO) • Define Least Acceptable Agreement (LAA) • Assess alternatives ■ Define schedule for negotiation phase and communication management ■ Define negotiation team members
Prerequisites	**Client Benefits / Deliverables**
■ Technical and Financial Evaluation completed and management directive obtained to start negotiations ■ Close cooperation with operator's experts and management; decision taking on negotiation strategy ■ Assignment of operator's negotiation team	■ Agreed negotiation timeline, communication management and negotiation team members ■ Leads for decision taking during negotiations ■ Clear negotiation strategy based on technical and financial facts

Figure 431- Tendering Support - Negotiation Strategy Details

WP 4.2: Negotiation Execution Support

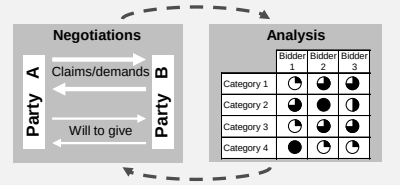
During the contractual negotiations potentially critical issues should be addressed and jointly resolved, allowing all parties to prove their commitment to the project.

Conduct Negotiations



- During the negotiations the suppliers are updated with the specific project scenario that may have changed during the tendering phase (e.g. reaction on supplier feedback)
- The negotiation should focus on main divergences discovered between the specified requirements and the bid
- For items that cannot be committed by the supplier as requested, an alternative agreement must be found

Iterative Procedure



- Introduce the teams, clarification of roles
- Specification of issues to be discussed
- Prepare opening state-ments, Clarification of positions
- Structured negotiation process
- Joint review of negotiation protocol and approval of results

- Consolidate results from different sessions
- Find the key pressure points
- Understand severity of issues that appeared
- Understand the other parties' specific interests
- Update supplier scorecard
- Decide on action to be taken (new round / terminate / select)

Figure 432- Tendering Support - Negotiation Execution Approach

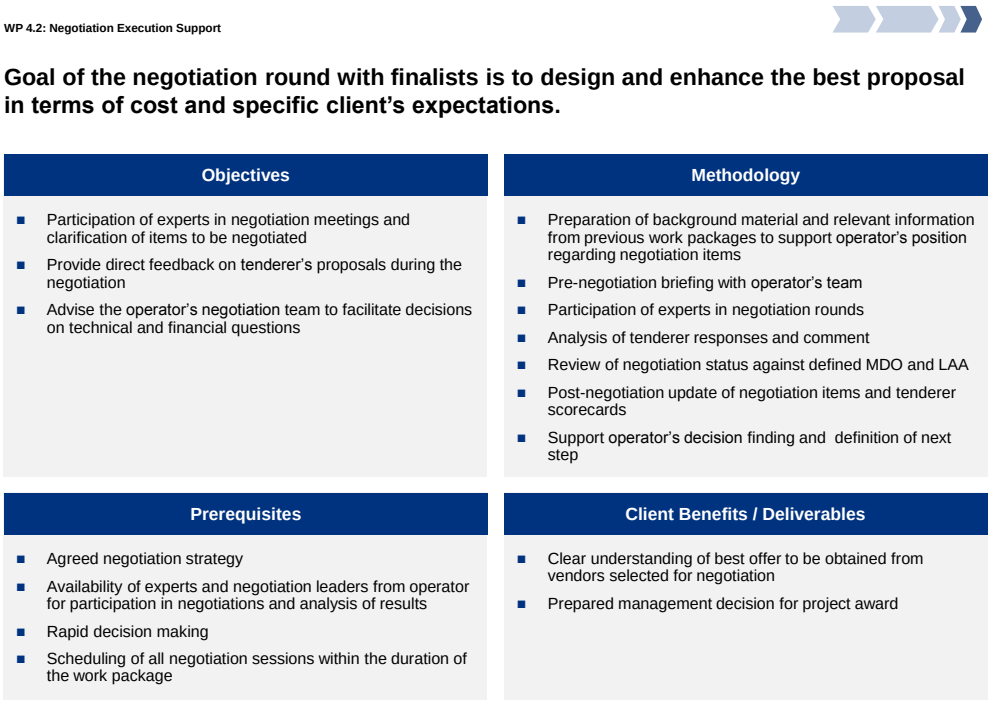


Figure 433- Tendering Support - Negotiation Execution Details

9.3.4.2 Table of Content (Example)

The following list shows a non-exhaustive list of the different chapters/topics that a RFP document for telecommunication network infrastructure needs to address:

- **RAN General**
  - General
  - High-level Requirement of RAN
  - Architecture
  - SW support
  - Performance
  - QoS
  - Hand-over
  - Synchronization
  - External Interference
  - Hardware Requirements
  - Auxiliary Infrastructure
  - Documentation
  - Future readiness
- RAN Technical
  - Capacity
  - 3GPP Release Roadmap and Software
  - Interoperability
  - Bandwidth
  - Common Channel Configuration
  - Random Access

  - Power Control
  - Scheduling and Link Adaptation
  - Coverage Enhancements
  - Uu Security Management
  - Radio Resource Control (RRC)
  - Admission and Congestion Control
  - Inter-cell Interference Coordination
  - Cell Combination
  - Load Balancing
  - Terminal Power Consumption Saving
  - QoS
  - Multi-antenna Function
  - S1 /X2 interface
  - Measurements and Counters
  - KPI´s
  - Network Element General Requirements
  - BBU Hardware requirements
  - BBU Power Supply Requirements
  - BBU Reliability Requirements
  - BBU Operation and Maintenance
  - BBU Environmental Requirements
  - BBU CPRI Requirements
  - RRU Frequency and Bandwidth
  - RRU Hardware
  - RRU RF Requirements
  - RRU Power Supply Requirements
  - RRU Reliability
  - RRU Operation and Maintenance
  - RRU Environmental Requirements
  - RRU CPRI Interface
  - Power Consumption
  - Auxiliary Infrastructure System Requirements
  - Upgrade Scenarios
- Antenna system
  - Passive Antenna System 2X2 MIMO
  - Active Antenna System (OPTIONAL)
  - General Antenna System Requirements
  - Remotely Controllable Electrical Downtilt
  - Feeder & Jumper Cable
  - Option: Passive Antenna System for 4X4 MIMO
- Cabinets and power
  - Power Supply for Radio Base Station (eNodeB)
  - Outdoor cabinets for eNodeB´s
  - Door
  - Door locking system
  - Ventilation method
  - Temperature Limit
  - Power Compartment
  - Cabinet Painting (optional)
  - Earthing
  - AC Components
  - Signal Distribution
  - Others

  - Rectifier
  - Batteries
- Management
  - General
  - Software Management
  - Fault Management
  - Provisioning
  - Configuration
  - Performance Management
  - Inventory
- Microwave
  - Microwave Radio requirements
  - Interface requirements
  - Service requirements
  - Protection requirements
  - DCN requirements
  - Standards and regulatory requirements
  - Environmental requirements
  - Infrastructure requirements
  - Product quality requirements
  - Security
  - Documentation
  - References

9.3.5 Price Breakdown Cost Estimation

Note: All the price used for estimation of the network costs were derived based on the Detecon worldwide experience and should be considered as indicative only.. Prices shown below always reflect the expected network size and contract volume. Prices shown are vendor independent and used as indicative prices in the Technology Assessment Report. Due to a variety of possible contract conditions the ratio between Hardware, Software and License prices can be different and additional price components can appear.

LTE 3 Sector Base Station		
Hardware	**Quantity**	**Price**
Baseband Unit	1	$4.400
Remote Radio Heads/Remote Radio Unit	3	$2.900
Battery 1 hour backup	8	$200
Cabinet incl rectifier	1	$3.000
Antenna	3	$750
Mounting kits	3	$250
Other accessories	1	$1.500
Licenses	**Quantity**	**Price**
Software	1	$1.000
Throughput license	30	$30
Output power license	3	$300
Installation	**Quantity**	**Price**
Installation including cabling	1	$10.000
Total		**$35.000**

Figure 434 - Price breakdown single LTE station

Microwave Link		
Hardware	**Quantity**	**Price**
Chassis+boards	2	$700
Outdoor Unit 7G 256QAM	4	$800
Cables and accessories set	2	$250
Antenna + mounting pole	2	$400
Licenses	**Quantity**	**Price**
Basic Software Package	2	$250
Capacity License(100M)	2	$100
Installation	**Quantity**	**Price**
Installation including cabling	2	$700
Total		**$8.000**

Figure 435 - Price breakdown single Microwave link

WiBACK Link		
Hardware	**Quantity**	**Price**
WiBACK Node	2	$900
Antenna + mounting kit + cables	2	$200
Solar Panel	2	$650
Backup battery	2	$500
Licenses	**Quantity**	**Price**
Node License	2	$400
Installation	**Quantity**	**Price**
Installation including cabling	2	$350
Total		**$6.000**

Figure 436 - Price breakdown single WiBACK link

9.4 Appendix e-Service Readiness Assessment and Roadmap (WP3)

9.4.1 References

Ghirardini, B., “E-learning methodologies - A guide for designing and developing e-learning courses”, FAO (Food and Agriculture Organization of the United Nations, 2011

Olson J., Codde J., et al., “An Analysis of e-Learning Impacts & Best Practices in Developing Countries”, ICT4D, Michigan State University, 2011

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9.4.2 List of current Projects in the eGovernment Agency (as of Sept. 2016)

#	Project Name	Main Objective	Lead
1	Application Store Project - Web Portal	Create a web portal to improve the delivery and accessibility of governmental electronic resources.	n/
2	Appointment Scheduling Solution	Implement an appointment scheduling solution for the public to reserve a specific date and time for government services.	n/a
3	Biz Continuity in the Banking Sector	The project seeks to provide secure off site back up business continuity service to the Bank of Guyana.	n/a
4	Captive Portal Project	Creation of Captive Portal for Public internet Access	n/a
5	Center of Excellence in IT Project	Design and Implement a Center of Excellence in Information Technology (CEIT) together with the Government of India	n/a
6	Community ICT Hub	To create ICT hubs that provide eGovernment services to residents in 24 poor, rural or hinterland communities across Guyana.	n/a
7	Corporate Email Project	Implementation of Enterprise Email Solution	Guoyan Rampersaud
8	Correspondence Mgmt	Source and implement an appropriate application with the basic features that can enhance correspondence management.	Guoyan Rampersaud
9	CPCE Project	To provide network connectivity to eight Cyril Potter College institutions that fall within range of the eGov network infrastructure.	Lloyd Marks
10	eGov Critical Services	Deployment of IaaS, PaaS and SaaS solutions for Cloud-based Email, web portal, captive portal, appointment scheduling, …	Clarence Garraway
11	eGov NDMA Project	To secure legal mandate and establish the institutional framework for the eGovernment Unit. National Data Management Authority Act	Nichelle Layne
12	eGov Net	Enable a sustainable EA model to align business processes, technology, and information to deliver G2C, G2G and G2B solutions.	Ganesh Sharma
13	Enterprise IT Infrastructure	To procure, install, configure & test a complete enterprise IT infrastructure, network monitoring and helpdesk solution (Solarwinds)	Clarence Garraway
14	Fin Mgmt Sy - LTE Info Processing Sys	Computerized and comprehensive financial management software that will manage the Inventory and Accounting activities.	Joycelyn Forde Garnett
15	Frequency Convert	To convert 60Hz cycle GPL power supply to 50Hz cycle to feed the Data Centre.	Alec Persaud
16	Gov.Net Host	Create a portal that provides for a unified, effective web presence, complete with visual designs and information architecture.	Clarence Garraway
17	Gov Official Calendaring Solutions	Implementing Bitrix 24 content management systems to support the calendaring and scheduling solution for eGov.	Guoyan Rampersaud
18	GPL Project	Provide a fiber optic infrastructure link from GPL's network to eGov's LTE sites from Parika to Skeldon by end Q3/2016.	Alec Persaud
19	GT FO Restore	Restore functional capacity to the Georgetown fiber ring, providing network connectivity to 20 ministries/agencies by 03/2016.	Avinash Ramraj

20	GT Linden FO Project	Establish a communication infrastructure that connects Linden as part of the wider eGov infrastructure.	Rosco Greene
21	LTEPS Project	Development and implementation of the SIM and Mobile Device Tracking Manager software.	n/a
22	MARAD project	To extend and modernize the IT architecture at the MARAD.	Rosco Greene
23	Ministry Of Business Project	Providing connectivity and additional services (internet access, backup services etc.) between the MoB and other gov agencies.	Ish Singh
24	Min of the Presidency project	Facilitating ease of access, collaboration and dissemination of information within the MOTP and with external agents.	Steveon Thomas
25	National eID Project	To transform the existing ID system into a single unique identification system for citizens and residents.	Dr. Samantha Scotland
26	NOC Project	Establishment of the eGovernment Unit Network Operations Center (NOC)	Kevon Smith
27	PIAPS Project	Bridge the digital divide by providing public internet access points, by which citizens can access ICT and eGovernment services.	Phillip Walcott
28	Policy Frame Project	Development of a Policy Framework for the eGovernment Unit, Ministry of the Presidency.	Nichelle Layne
29	PoI Rep Project	MIS Department of the eGovernment Unit to identify a software solution to function as a repository for the projects.	Asena Marques
30	GWI Project	Integrate GWI's network (LAN segments and connected via WAN) with CPE links provided by eGovernment to the LTE network.	Sherwin Felicien
31	Pub Agency Project	Enable connectivity across government ministries, departments and agencies to promote effective transformational change.	Sherwin Felicien
32	Pub Srvc Staff Coll	Establishing a very high level public service institution for the purpose of addressing the training needs of public servants	Mfon Akpan
33	Sec Schools Project	To provide access to ICT and its related services to fifty educational institutions of Guyana.	Ish Singh
34	SEIP Proejct	Provide connectivity to the main administrative departments of the MoE at the national and regional levels and Secondary Schools	Ish Singh
35	Tell-US	Create a multi-platform system whereby members of the public can report on issues affecting them.	Nkasi Nedd
36	Teaching Improvement Aid Project	Design and implement a training program that addresses at least 85% of the identified training needs for the eGovernment Unit	Abiola Smith
37	Train & Cap	Develop and Implement a Training and Capacity Building Program for the eGovernment Unit 2016	Abiola Smith
38	TWGs Project	Establishment of 3 technical working groups with a minimum of 12 suitably qualified members.	Dr. Samantha Scotland
39	UG Tele	Installation of Huawei Telepresence and Videoconference at The University of Guyana, connecting Turkeyen and Tain Campuses	Robin Ally

9.5 Appendix Developing Skills and Capacities (WP3)

9.5.1 List of proposed Training Hubs

Region	Hub	Communities	Phase
1	Port Kaituma	Matthews Ridge	1
1	Port Kaituma	Port Kaituma	1
2	Charity	Wakapau	1
4	Georgetown	Georgetown	1
4	Mahaica	Mahaica	1
5	Mahaicony	Mahaicony	1
5	Belladrum	Calcutta	1
5	Belladrum	De Hoop	1
5	Belladrum	Mahaicony	1
6	Skeldon	Skeldon and surroundings	1
6	New Amsterdam	New Amsterdam and surroundings	1
6	Rose Hall	Rose Hall	1
8	Mahdia	Mahdia	1
8	Kato	Paramakatoi	1
10	Kwakwani	Kwakwani	1
1	Moruca (Santa Rosa)	Akwero	2
1	Mabaruma	Aruka River	2
1	Mabaruma	Hosororo	2
1	Mabaruma	Kobarina Hill, Barabina Hill	2
1	Moruca (Santa Rosa)	Kokerite	2
1	Moruca (Santa Rosa)	Kumaka	2
1	Mabaruma	Mabaruma, Kokerital Hill	2
1	Moruca (Santa Rosa)	Waramuri Mission	2
1	Mabaruma	Wauna & White Water	2
2	Charity	Akawini	2
2	Anna Regina	Aurora	2
2	Anna Regina	Lima Sands	2
2	Anna Regina	Maria Henrietta	2
2	Anna Regina	Richmond	2
2	Anna Regina	Spring Garden	2
3	Vreed en Hoop	Fort Nassau	2
3	Vreed en Hoop	Sans Souci	2
3	Vreed en Hoop	Vreed en Hoop	2
4	Timehri	De Maria Elizabeth	2
4	Timehri	Dora	2
4	Mon Repos	Friendship (East Bank)	2
4	Timehri	Hararuni River	2
4	Timehri	Low Wood	2
4	Mon Repos	Mon Repos	2
4	Timehri	Susannah's Rust	2
4	Timehri	Timehri	2
6	Tacama	Tacama	2
7	Kamarang	Arurau River	2
7	Bartica	Bartica	2
7	Bartica	Makouria	2
7	Bartica	Penal Settlement	2
7	Bartica	Riversview/ Falmouth	2
7	Bartica	St Mary's	2
7	Kamarang	Waramadong	2
7	Bartica	Wineperu	2
8	Kato	Kato	2

8	Kato	Kopinang	2
8	Kato	Kurukabaru	2
8	Kato	Monkey Mountain	2
9	Aishalton	Achawib	2
9	Aishalton	Aishalton	2
9	Annai	Annai	2
9	Lethem	Hiawa	2
9	Annai	Karanambo	2
9	Lethem	Karasabai, Cracrana	2
9	Aishalton	Karaudarnau, Lumidpau	2
9	Annai	Kwatamang, Massara	2
9	Lethem	Lethem	2
9	Lethem	Manari	2
9	Lethem	Moco Moco	2
9	Lethem	Nappi	2
9	Lethem	Parishara	2
9	Lethem	Sawariwau	2
9	Lethem	Shulinab, Meriwau	2
9	Lethem	St. Ignatius	2
9	Annai	Toka	2
9	Annai	Yakarinta	2
10	Linden	½ Mile	2
10	Linden	Amelia's Ward	2
10	Kwakwani	Aurora	2
10	Linden	Christianburg	2
10	Linden	Cockarata (North Mc Kenzie)	2
10	Linden	Coomaca Lands	2
10	Kwakwani	Hururu	2
10	Kwakwani	Ituni	2
10	Linden	Mahaicabally	2
10	Linden	Silver City	2
10	Linden	Wismar	2
10	Linden	Wisrock (block 22)	2
1	Mabaruma	Baramani River	3
1	Mabaruma	Morawhanna	3
7	Bartica	Ekereku	3
7	Kamarang	Imbaimadai	3
7	Bartica	Issano	3
7	Kamarang	Kamarang	3
7	Kamarang	Paruima	3
8	Kato	Itabac	3
9	Annai	Apoteri	3
9	Aishalton	Shea	3
9	Annai	Surama	3
10	Linden	Mabura Hill	3
1	Mabaruma	Arakaka	4
7	Bartica	Kurupung	4
8	Mahdia	Maikwak	4
8	Kato	Taruka	4
8	Mahdia	Tumatumari	4
9	Lethem	Cracana	4
10	Linden	Great Falls	4

Table 86 – Extended list of training hubs and communities catered

9.5.2 Advice on Child Internet Safety

The following text is an extract from the Advice on child internet safety 1.0 Report – compiled by members of the UK Council for Child internet Safety (UKCCIS) – it draws together the most effective messages for keeping children safe online. The text is written to address children and their parents directly and is supposed to be published on a respective website or to be printed in a hand out brochure.[220] The reporting measures, organization and contact details refer to the UKCCIS organization and must be adjusted for the specific situation of Guyana

9.5.2.1 Chatting

What is chatting?

There are lots of different ways you can chat to people online - and lots of different places you can do it. Chatting includes every type of service which allows you to have a conversation with somebody else. It can be text based messaging (such as instant messaging or SMS) or via a voice or video link (such as by VoIP internet phone calls or a webcam). It can also be instant, real-time communication (chat rooms or instant messaging) or delayed (such as e-mail or voicemail). Chatting like this is a great way to stay in touch - as well as meet new people. But there are a few things you can do to make sure you have a good time and stay safe.

Things to think about

- Know who you're talking to online; if you don't know someone face to face they could be anyone
- Remember – what you do or show on your webcam can be recorded and what they do or show on their webcam at the other end might be a recording
- Avoid having one-sided webcam conversations where the other person's webcam is 'broken' or, 'not working…'; you won't know who they really are, what they are doing or who they are watching with

Things to do

- Keep your personal information private - avoid sharing personal information such as your phone number, home address or photographs with people you don't know in person and trust
- Check whether the service you use allows you to create friend lists. These lists let you manage who sees what. For example, you may only want your closest friends to see some information
- Keep your clothes on when using webcam - images of you could end up in the wrong hands
- Use private messages for people you know in person and trust; be careful of private messaging people you don't know
- Use a strong and unique password for all of your online accounts – a combination of letters, numbers and symbols (and if you've ever shared it in the past, change it)
- Know how to block someone if they make you feel uncomfortable or upset
- Learn how to save chat logs and texts so that if someone does make you uncomfortable/upset, you have the evidence to report them
- Remember to log out of a service properly after use, especially on a shared computer

Additional advice for parents/carers

- Talk to your child about who they're talking to online and encourage them to think before talking to people they don't know in person
- Try to understand and guide your child's online behavior - negotiate and establish boundaries and discuss sensitively the issues around the concept of 'friends'
- Familiarize yourself with the chat program your child uses. Find out more about its built-in safety functions and how they can be contacted within the service
- Ask your child if they know how to block someone who they don't want to talk to anymore. If they don't, help them to learn how to use the blocking feature

[220] https://www.gov.uk/government/publications/advice-on-child-internet-safety-10-universal-guidelines-for-providers

- Use parental control software provided by your internet service provider, mobile phone network, online content provider or games console and consider using filtering options, monitoring and setting time limits for access to chat
- If you discover misconduct between your child and someone online stay calm, investigate the facts and seek expert help if needed
- As part of a wider discussion about sex and relationships cover how people may use the internet to explore their sexuality, which may include sexual chatting

Reporting

- If someone makes you feel uncomfortable, talk to an adult you trust, such as a relative or teacher. If you would prefer to talk to someone in confidence you can contact Childline (0800 1111). If someone has acted inappropriately online towards you, or someone you know, you can report directly to the Child Exploitation and Online Protection Centre (CEOP). It could be sexual chat, being asked to do something that makes you feel uncomfortable or someone asking to meet up.
- If someone is bullying you, there is help and support available from CyberMentors
- If the problem concerns issues of privacy, or a breach of terms of service, report the issue to us [direct users on how to do this]

9.5.2.2 Sharing

What is sharing?

If you have something you're proud of then it can feel good to share it with others. Maybe it's a photo you've taken or a video you've made. Maybe you have opinions and thoughts you want to share on a forum or in your own blog, or you want to share your interests with people who like the same things as you. One of the great things about sharing on the internet is that it's so quick and easy - you just click a button on your computer, smartphone or digital camera and it's there online. But that can also be the problem. If you post something in haste you may regret it later and by that time it may be too late to get it back. Here are some things you should think about before you ever share anything online.

Things to think about

- Once you've shared something online you've lost control and ownership of it [point out ways to stay in control on your service here]
- Remember that people may still be able to see things you share online months or even years into the future
- If you're unsure about what you should and shouldn't share online, ask yourself this: 'Would I show this to my parents/carers/teacher?' If you wouldn't, then don't share it online
- Some people could use information or things you've shared in ways you don't like or couldn't have imagined
- Some people could share things about you which are upsetting - without your knowledge

Things to do

- Find out how to use the privacy settings on the service you use. These settings will help you take control of your information so that you can decide what information you will share, and who you will share it with
- Keep your personal information private – this includes photos of you and your friends, your school's name, email, phone number, date of birth, address and location; only share them with people you know and trust
- Only upload pictures of yourself which you would be happy for your parents/carers or teachers to see
- Only share details of your location with people you know in person and trust

Additional advice for parents/carers

- Set up a family email address you can all use to fill in online forms
- Set clear guidelines for your children about what is ok to share about themselves and about your family – lead by example and explain what you have shared and why; be aware that comments posted by your children could impact on you and your family's reputation

- Talk to your children about how easy it is for people to assume another identity online
- There are a number of ways that you can set your own lists of sites you want to block access to; activating your internet service provider's parental controls, or those of another provider, can make this easy for you
- Install reputable internet security software on your computers and mobile devices; keep this and operating systems up to date
- Be aware that children can access the internet through publicly available wifi for example in shops, coffee bars and bus termini; check whether your children's devices have built in wifi connectivity and see if there are any tools to help manage access to inappropriate content
- As part of a wider discussion about sex and relationships cover how people may use the internet to explore their sexuality which may include sharing sexual images
- Be aware that smartphones often contain location technology. This technology finds the mobile's position and provides services related to where you are. Talk to your child about who they share this information with

Reporting

- Know/learn what to do if you have shared something you shouldn't have – [point out how users can report to you on your service here]
- If someone has shared information about you which upsets you, or if someone is making you feel uncomfortable, talk to an adult you trust, such as a relative or teacher. If you would prefer to talk to someone in confidence you can contact Childline (0800 1111). If someone has acted inappropriately online towards you, or someone you know, you can report directly to the Child Exploitation and Online Protection Centre (CEOP). It could be sexual chat, being asked to do something that makes you feel uncomfortable or someone asking to meet up.
- If someone is bullying you using your information, there is help and support available from CyberMentors and BeatBullying
- Know what to do if something online has upset you: talk to Childline or the Samaritans if you are feeling desperate or sad, B-eat for eating disorder advice and go to Report-it to report incidents of race hate. You can also report to us if our terms of service have been broken [point out ways users can do this on your service here]

9.5.2.3 Gaming

What is gaming?

Playing games online against other people can be really enjoyable and great fun. You can do it via a mobile phone, a computer or a games console and online games come in every shape and form. There are the ones where you each take a turn - like chess on a mobile phone app - and others where you compete to get your scores as high as you can on a leaderboard. Then there are the 3D virtual worlds where hundreds or thousands of people are simultaneously playing against each other. Online gaming has something for everyone and millions of children and young people across the UK regularly take part. Below are some tips to ensure you get the most out of your online gaming experience.

Things to think about

- When you're gaming as part of a network this often involves live online chat and you're playing with real people
- You should be respectful to others in the game and understand the rules and boundaries of the website or community

Things to do

- Keep gaming friends 'in the game' – avoid sharing personal information with people you've met in games and avoid giving them your social networking profile details or email address. Also, choose a user name that does not reveal any personal information about you

- Use a strong and unique password for all of your online accounts – a combination of letters, numbers and symbols (and if you've ever shared your password in the past, change it)
- Learn how to block people you don't want to be in contact with any more. If you experience any bullying, hacking and racism, save the evidence and report it
- Remember to always log out of a service properly after use, especially on a shared computer
- Experts recommend you take regular 5 minute breaks every 45 minutes to an hour to help your concentration

Additional advice for parents/careers

- Young people can also go online through some gaming devices and online gaming often involves playing against real people
- Use the PEGI games ratings to guide you when buying games for your child or making judgements about the games they are playing. The PEGI system rates video games at various age levels (3, 7, 12, 16 and 18) and is designed to protect children and young teenagers from inappropriate content
- Make sure your children are using games from reputable and legal online providers
- Online gaming can be compulsive for some; be aware of the amount of time spent online and set boundaries around your child's use
- Games should be played as part of a healthy and balanced lifestyle; regular 5 minute breaks should therefore be taken every 45 minutes to an hour
- Use parental controls on games consoles to disable or restrict access to facilities such as voice chat. They can also be used to disable online credit payments or applications that you feel are inappropriate
- You can use online parental controls to restrict or block access to online gaming websites and other content altogether
- Familiarize yourself with the chat program your child uses. Find out more about its built-in safety functions and how they can be contacted within the service
- Install reputable internet security software on your computers and mobile devices; keep this and operating systems up to date

Reporting

- Know where to get help if someone is bullying you in a game – us as service provider or talk to CyberMentors and BeatBullying who can provide help and support
- If someone is upsetting you or making you feel uncomfortable, talk to an adult you trust, such as a relative or teacher. If you would prefer to talk to someone in confidence you can contact Childline (0800 1111). If someone has acted inappropriately online towards you, or someone you know, you can report directly to the Child Exploitation and Online Protection Centre (CEOP). It could be sexual chat, being asked to do something that makes you feel uncomfortable or someone asking to meet up.

9.5.2.4 Content providing (including downloading)

What is content providing?

There is so much information available on the internet that it's like having the world's biggest library at your fingertips. But not everything you read and see online will be true, and not everyone will be who they say they are. It is also illegal to download some files, while others could be infected with viruses which steal your personal details and pass them on to thieves. Below are a few things you need to consider when browsing the web - and few steps you can take to keep yourself safe.

Things to think about

- Not everything you read or see online is true - it is easy for people to make things up or alter photos on the internet
- There are things online you might find upsetting and distressing – you will know what these things are

- Downloading may harm your computer or mobile device and could be illegal - just because you can download something, it doesn't mean that you are allowed to or should do, as copyright law applies online. This is especially true of illegal file-sharing sites
- If you make music, film or TV available to others on a file-sharing network, download from an illegal site or sell copies without the permission of those who own the copyright then you are breaking the law; use legal sites that reward the creators for their work
- Copying someone else's ideas and passing them off as your own is called plagiarism – your school will have rules about this. Ask them to explain them to you

Things to do

- Learn how to block pop ups
- Check whether information is true by looking on at least two other sites; ignore sites you don't recognize and consider carefully what you are reading
- Use reputable sources of information such as organizations or brands you know and trust
- Only download files from websites you are sure are safe to use; sites might contain malicious software (such as viruses) which could damage your computer or steal your personal information.
- Only open attachments or click on links in emails you are expecting; if you get a suspicious-looking email, even from a friend, it might not be genuine if their computer has been infected by a virus and you should not open it
- Think – if an offer seems too good to be true, it probably is
- Additional advice for parents/carers
- Set safe search filters and lock this on for a particular desktop computer, laptop or mobile
- Use parental controls to manage access; mobile operators use network filters which block over 18 content; these are free of charge and are mostly set as 'on' by default for all contract and prepay customers
- Use software filters on computers, laptops and mobiles; most fixed internet service providers offer these free to customers
- Around one in every 100/200 emails can contain malware (a piece of malicious software which takes over a person's computer) or phishing attacks (attempts to access your personal details, such as usernames and passwords): install reputable antivirus or firewall software on your computer or mobile and make sure you keep this and operating systems up to date
- As part of a wider discussion about sex and relationships, cover how people may use the internet to explore their sexuality, which may include viewing pornography
- Ask your child's school to share their plagiarism rules with you

Reporting

- If you come across something which upsets you, tell us as service provider. Talk to an adult you trust, such as a relative or teacher. If you would prefer to talk to someone in confidence you can contact Childline (0800 1111). You can talk to Childline or the Samaritans if you feel sad or desperate, B-eat for eating disorder support and Report-it to report incidents of race hate. You can also report to us if our terms of service have been broken
- Illegal child sex abuse images online can be reported to the internet Watch Foundation (IWF) or your local police
- You can report fraud or online scams or viruses to Action Fraud – the UK's national fraud reporting center
- Get Safe Online provides advice on how people can use the internet confidently, safely and securely

9.5.2.5 Networking (closely relates to 'sharing')

What is networking?

Online communities - such as social networking sites - are some of the most popular sites on the web. Millions of people log onto these sites every day to hang out with their friends and talk about their lives. When you sign up you get the chance to create and customize your own profile and you can upload your favorite photos and videos. There

are even networks within networks where you can join others who share the same interests, or who live in the same area or go to your school. Most people will have a great time being a member of these sites - but it's important you take care, particularly when giving out information about yourself. Here are some tips on how to network safely.

Things to think about

- Adding someone as a 'friend' means they (and sometimes their friends) may be able to see the things you share, share things with you and even share things about you; can you trust them with your information?
- It's easy to lie online, not everyone is who they say they are

Things to do

- Learn about privacy settings to take control of your information and decide what information you will share, and who you will share it with - use lists/groups to share different information with different 'friends'
- Avoid friending people you don't know in person and sharing personal information with them such as your phone number, home address or photographs
- Learn how to block 'friends' in case you feel you need to, and keep the evidence
- Use a strong and unique password for all of your online accounts – a combination of letters, numbers and symbols (and if you've ever shared it in the past, change it)
- Think very carefully about meeting someone face to face who you only know online; if you do decide to do this, never go without taking a trusted adult with you
- Only upload or share pictures of yourself which you would be happy for your parents/carers or teachers to see
- Remember to properly log out of a site after use, especially on a shared computer

Additional advice for parents and carers

- Keep an open dialogue with your child about who they're talking to online and why they should think before talking to people they don't know in person; try to understand and guide their online behavior just as you would for their offline activity; negotiate and establish boundaries and discuss sensitively the issues around the concept of 'friends' (and 'friends of friends')
- Use parental controls to restrict or block access to social networking sites; device-level parental controls mean you can set up unique settings per user so that you can restrict access to particular networks based on the user
- Explain why it's important to be honest about your age online, for example in signing up to social networking sites – advertising and other content will be aimed at the age the user says they are
- As part of a wider discussion about sex and relationships cover how people may use the internet to explore their sexuality

Reporting

- If someone is making you feel uncomfortable, talk to an adult you trust, such as a relative or teacher. If you would prefer to talk to someone in confidence you can contact Childline (0800 1111). If someone has acted inappropriately online towards you, or someone you know you can report directly to the Child Exploitation and Online Protection Centre (CEOP). It could be sexual chat, being asked to do something that makes you feel uncomfortable or someone asking to meet up.
- If someone is bullying you using your information, there is help and support available from CyberMentors and BeatBullying
- Know what to do if something online has upset you: talk to Childline or the Samaritans if you are feeling desperate or sad, B-eat for eating disorder advice and Report-it to report incidents of race hate. You can also report to us if our terms of service have been broken [point out ways in which users can do this here]

9.5.2.6 Shopping and Commerce

What is commerce?

Online shopping brings the High Street to your fingertips, wherever you are. The internet offers great choice and shopping online can be really convenient - there are no closing times, or queues, and you can compare deals from dozens of online stores to get the best deals. There are also other forms of shopping that are unique to the internet. For example, you can pay for virtual goods and services such as virtual currency to spend in games on social networking sites. But while online shopping can bring many benefits, there are also some risks. Below are a few things you need to look out for when shopping online - and a few steps you can take to ensure you're not left out of pocket.

Things to think about

- Remember – if an offer seems too good to be true, it probably is
- It's also a good idea to look for unbiased reviews of online retailers. Cross-check information on the internet and see if anyone else has had problems
- Beware of online scams, which can be very convincing; check that online stores have a physical address and telephone contact details

Things to do

- Buy from reputable retailers online – brands and services you know well in person, or which you have researched thoroughly
- When paying for goods and services online, make sure the website address in the browser window begins with https:// – the 's' stands for 'secure' and ensures that any personal and financial data cannot be intercepted during transactions
- Look for the padlock symbol on payment pages [similar to the example shown above]. Don't be fooled by a padlock that appears on the web page itself. It's easy to copy the image of a padlock. You need to look for one that is in the window frame of the browser itself
- Always use a strong and unique password for all of your online accounts – a combination of letters, numbers and symbols (and if you've ever shared your password in the past, change it)
- Never follow links to shopping or banking sites – always type the address straight into the address bar
- Tell the truth about your age and do not lie about it to obtain goods or services which are age restricted – if you do you will be breaking the law
- Remember to always log out of a service properly after use, especially on a shared computer

Additional advice for parents/guardians

- Ensure that you and your children check for the padlock symbol in the window frame of the browser [similar to the example shown above]: only 25% of 12-15s do this when visiting new sites according to Ofcom
- Talk to your children about safe online shopping and supervise purchases with younger children – explain that criminals can set up online shops that are only there to steal money, so check out the website carefully, be careful when disclosing any personal/financial/payment information and ensure that the site is using a secure payment method
- Check bank and card transactions regularly for unrecognized transactions
- Install reputable internet security software on your computers and mobile devices; keep this and operating systems up to date – security software provided by your internet service provider or third party can tell you whether a site is secure or not

Reporting

- If the problem concerns issues of privacy or is a breach of terms of service, report the issue to us [point out ways that users may do this on your service]
- You can report fraud or online scams or viruses to Action Fraud –the UK's national fraud reporting center
- Get Safe Online provides advice on how people can use the internet confidently, safely and secure!