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International Telecommunication Union
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Study Group 1 Question 5

# Telecommunications/ICTs for rural and remote areas

Output Report on ITU-D Question 5/1

# Telecommunications/ICTs for rural and remote areas

Study period 2018-2021

**Telecommunications/ICTs for rural and remote: Output Report on ITU-D Question 5/1 for the study period 2018-2021**

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# Acknowledgments

The study groups of the ITU Telecommunication Development Sector (ITU-D) provide a neutral platform where experts from governments, industry, telecommunication organizations and academia from around the world gather to produce practical **tools** and resources to address development issues. To that end, the two ITU-D study groups are responsible for developing reports, guidelines and recommendations based on input received from the membership. Questions for study are decided every four years at the World Telecommunication Development Conference (WTDC). The ITU membership, assembled at WTDC-17 in Buenos Aires in October 2017, agreed that for the period 2018-2021, Study Group 1 would deal with seven Questions within the overall scope of "enabling environment for the development of telecommunications/ information and communication technologies."

This report was prepared in response to **Question 5/1: Telecommunications/ICTs for rural and remote areas** under the overall guidance and coordination of the management team of ITU-D Study Group 1 led by Ms Regina Fleur Assoumou-Bessou (Côte d'Ivoire), as Chairman, supported by the following Vice-Chairmen: Ms Sameera Belal Momen Mohammad (Kuwait); Mr Amah Vinyo Capo (Togo); Mr Ahmed Abdel Aziz Gad (Egypt); Mr Roberto Hirayama (Brazil); Mr Vadim Kaptur (Ukraine); Mr Yasuhiko Kawasumi (Japan); Mr Sangwon Ko (Republic of Korea); Ms Anastasia Sergeyevna Konukhova (Russian Federation); Mr Víctor Martínez (Paraguay); Mr Peter Ngwan Mbengie (Cameroon); Ms Amela Odobašic (Bosnia and Herzegovina); Mr Kristián Stefanics (Hungary) (resigned in 2018) and Mr Almaz Tilenbaev (Kyrgyzstan).

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# Executive summary

This report contains the results of the study of ITU-D Question 5/1 on ICTs for rural and remote areas for the study period 2018-2021.

The report comprises nine chapters, covering an introduction, findings of the previous studies and the scope of the current study; requirements for people in rural and remote areas; solutions for the information and communication technology (ICT) connection of rural and remote areas, as well as small island states; demand, cost and financing mechanisms for the deployment of ICTs; relevant technologies; relevant services and applications; capacity building; policies necessary to connect rural and remote areas; and conclusions and recommendations.

The contents of the chapters are based on written contributions from ITU Telecommunication Development Sector (ITU-D) members who participated in the meetings under the Question and meetings of ITU-D Study Group 1, representing ITU Member States, Sector Members and Academia, as well as the panel discussion hosted under the Question on 25 September 2019.[1],[2] Most of the contributions were of a case-study nature. An overview analysis of the case studies is made in Chapter 2, backed up by more specific analysis in the chapters to which each case study is particularly relevant. An effort was made to draw on every contribution submitted in compiling the report. The report formulates critical findings in Chapter 9 and offers guidelines that can be followed by Member States, Sector Members and telecommunication/ICT service providers.

## Lessons learnt

- There is need for further studies focusing on access to broadband services and how emerging technologies can be used to transform rural and remote areas into digital economies.
- There is no one-size-fits-all model for financing rural connectivity and engaging all stakeholders, but creating public-private partnerships (PPP) provides a workable solution.
- Community networks are an important part of connectivity ecosystems, and they help bridge the digital divide.
- While 4G is the predominant technology for connectivity in the world, a number of countries are turning to 5G for connectivity in rural areas.
- The establishment of community telecentres or information centres is helping to achieve universal service for many countries and is key to attainment of the Sustainable Development Goals (SDGs).
- ICT community information centres are useful in training communities to become ICT literate.
- The principle of universal access has proven to be an essential development tool, and proper use of universal service/access funds offers a good opportunity for economic growth and poverty alleviation in developing countries.

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1 Rapporteur Group for Question 5/1 meeting reports: (1) 1 May 2018 (Geneva): ITU-D SG1 Document 1/REP/5(Rev.2) ; (2) 21 September 2018 (Geneva): ITU-D SG1 Document SG1RGQ1/REP/5; (3) 19 March 2019 (Geneva): ITU-D SG1 Document 1/REP/13(Rev.2) ; (4) 24 September 2019 (Geneva): ITU-D SG1 Document SG1RGQ/REP/12; (5) 18 February 2020 (Geneva): ITU-D SG1 Document 1/REP/21+Annex; (6) 22 and 23 September 2020 (virtual meeting): ITU-D SG1 Document SGRGQ1/REP/19

2 Report on the Question 5/1 workshop held on 25 September 2019 (Geneva): ITU-D SG1 Document 1/308

- Connectivity efforts should take into account persons with disabilities, women, girls and low-income groups.
- The application of ICT in farming can go a long way to enhancing efficiency in agriculture.
- Access to communication services is a prerequisite for the inclusion of rural people in modern society and improving the quality of their lives.
- Current business models need to be appropriately modified for them to be effective in connecting rural and remote areas.
- Mobile communications have allowed impressive progress to be made in rural villages.
- Recommendations ITU-T L.163 (2018), ITU-T L.110 (2017) and ITU- L.1700 (2016) are three of the most popular and useful recommendations in addressing the Question on rural connectivity.[3]
- Neither technology nor spectrum are a barrier for rural connectivity: challenges for rural connectivity are anchored in socio-economic and socio-political issues.
- Many countries are having recourse to conditional rural connectivity obligations when allocating radio-frequency spectrum, especially for low frequency bands.

[3] ITU-T. Recommendations ITU-T L.163 (2018), on criteria for optical cable installation with minimal existing infrastructure; ITU-T L.110 (2017), on optical fibre cables for direct surface application ; and ITU-T L.1700 (2016), on requirements and framework for low-cost sustainable telecommunication infrastructure for rural communications in developing countries.

# Abbreviations and acronyms

*This table contains abbreviations/acronyms relating to international, regional or supranational bodies, instruments or texts, as well as technical and other terms used in this report.*

*Abbreviations/acronyms of national bodies, instruments or texts are explained in the text, and are thus not included in this table.*

| Abbreviation | Term |
|---|---|
| 2G | second-generation mobile technology |
| 3G | third-generation mobile technology |
| 4G | fourth-generation mobile technology |
| 5G | fifth-generation mobile |
| A4AI | Alliance for Affordable Internet |
| ADB | Asian Development Bank |
| ADSL | asymmetric digital subscriber line |
| AFR | ITU Africa region |
| AMS | ITU Americas region |
| ARB | ITU Arab States region |
| ASP | ITU Asia and the Pacific region |
| BaAP | Buenos Aires Action Plan |
| BDT | Telecommunication Development Bureau |
| CAPEX | capital expenditure |
| CATV | cable television |
| CIC | community information centre |
| CIS | ITU Commonwealth of Independent States (CIS) region |
| COVID-19 | coronavirus disease 2019 |
| DOCSIS | Data over Cable Service Interface Specification |
| ECOWAS | Economic Community of West African States |
| ESOA | EMEA Satellite Operators Association |
| EUR | ITU Europe region |
| FDD | frequency-division duplexing |
| FTTB | fibre-to-the-building |

(continued)

| Abbreviation | Term |
|---|---|
| FTTC | fibre-to-the-cabinet |
| FTTH | fibre-to-the-home |
| FTTN | fibre-to-the-node |
| FTTx | fibre-to-the-x<br>(where 'x' indicates the range different possible termination points, e.g. FTTB/C/H/N/P/S) |
| FWA | fixed wireless access |
| G2C | government-to-citizen |
| GNI | gross national income |
| GSMA | Global System for Mobiles Association |
| GSO/GEO | geostationary orbit |
| GSR | ITU Global Symposium for Regulators |
| HAPS | high-altitude platform systems |
| HDTV | high-definition television |
| HEO | highly-elliptical orbit / highly-eccentric orbit |
| ICT | information and communication technology |
| IMT | International Mobile Telecommunications |
| IoT | Internet of Things |
| IPTV | Internet Protocol television |
| ISOC | Internet Society |
| ISP | Internet service provider |
| ITU | International Telecommunication Unon |
| ITU-D | ITU Telecommunication Development Sector |
| ITU-R | ITU Radiocommunication Sector |
| ITU-T | ITU Telecommunication Standardization Sector |
| IXP | Internet exchange point |
| LDC | least developed country |
| LEO | Low earth orbit |
| LLC | landlocked country |
| LLDC | landlocked developing country |
| LTE | Long-Term Evolution |

(continued)

| Abbreviation | Term |
|---|---|
| MAN | metropolitan area network |
| MEO | medium earth orbit |
| MERS | Middle East Respiratory Syndrome |
| MNO | mobile network operator |
| MP2MP | multipoint-to-multipoint |
| MVNO | mobile virtual network operator |
| NGO | non-governmental organization |
| non-GSO/non-GEO | non-geostationary orbit |
| OPGW | optical fibre composite overhead ground wire |
| P2MP | point-to-multipoint |
| P2P | point-to-point |
| POTS | plain old telephone service |
| PPP | public-private partnership |
| PuP | public-public partnership |
| QoS | quality of service |
| RLAN | radio local area network |
| SADC | Southern African Development Community |
| SASEC | South Asia Subregional Economic Cooperation |
| SDGs | United Nations Sustainable Development Goals |
| SGV | smart green village |
| SIDS | small island developing State |
| SMS | short messaging service |
| SOHO | small office/home office |
| STEAM | science, technology, engineering, arts and mathematics |
| TDD | time-division duplexing |
| TSB | Telecommunication Standardization Bureau |
| TSP | telecommunication service provider |
| TVWS | TV white space |
| UAV | unmanned aerial vehicle |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |

(continued)

| Abbreviation | Term |
|---|---|
| VDSL | very high-speed digital subscriber line |
| VHCN | very high-capacity network |
| VoIP | voice over Internet Protocol |
| VSAT | very small aperture terminal |
| WAEMU | West African Economic and Monetary Union |
| WATRA | West Africa Telecommunications Regulatory Assembly |
| WiMAX | worldwide interoperability for microwave access |
| WSIS | World Summit on the Information Society |
| WTDC | World Telecommunication Development Conference |
| xDSL | Generic term for the whole range of digital subscriber line (DSL) technologies (e.g. DSL, ADSL, VDSL, etc.) |

# Chapter 1: Introduction

The Buenos Aires Action Plan (BaAP), which is a major output of the 2017 World Telecommunication Development Conference (WTDC), highlighted the need to continue to contribute to achieving the objectives set by the Geneva Plan of Action of the World Summit on the Information Society (WSIS) and, in particular, to promote attainment of the Sustainable Development Goals (SDGs).[1]

With that in mind, it noted the importance of addressing the challenge of infrastructure development, and the need to install cost-effective and sustainable basic telecommunication infrastructure in rural and remote areas. It also called for further studies in order to enable the vendor community to develop suitable solutions to meet the challenges identified, and maintained ITU-D Question 5/1 to that end.[2]

## 1.1 Overview of findings from the previous study period (2014-2017) and lessons learnt

The Final Report on Question 5/1 for the previous study period (2014-2017)[3] highlighted the importance of studying rural and remote areas, given that more than half of the global population is rural, that development of information and communication technologies (ICTs) in rural and remote areas is slow and requires special policy initiatives and government subsidies, and that a digital divide still exists between rural and urban populations.

The report defined rural areas as sparsely populated areas, characterized by problems of geographical access, inadequate enabling infrastructure such as regular electricity, absence of adequate telecommunication infrastructure, prohibitive access and equipment costs, and low geographic density of the target population (small village communities).

The salient issues that emerged from case studies submitted by various ITU regions, as well as responses to the questionnaire administered to ITU Member States during past studies, were, in summary:

- high cost of installations due to poor enabling infrastructure to support deployment, lack of skilled technical personnel, difficult terrain and ICT illiteracy (Sri Lanka)
- prohibitive licence costs (Guinea) and lack of profitability for operators (Côte d'Ivoire)
- absence of basic infrastructure and poverty (Democratic Republic of the Congo) and serious lack of electricity (Intel Corporation, United States)
- additionally, small market size and regulatory issues, particularly the manner in which spectrum is allocated (responses to the Question 5/1 questionnaire to Member States).

According the 2014-2017 study, the type of technology used by the regions depended on the type of project that each country was deploying or intended to implement, and there was no uniformity. The main technologies used included backhaul, microwave links, satellite links, mobile base stations, wireless technologies such as Wi-Fi and WiMAX, VSAT, copper lines,

1 ITU. Final Report of the World Telecommunication Development Conference (Buenos Aires, 2017) (WTDC-17). Geneva, 2018.
2 ITU. ITU-D Question 5/1.
3 ITU. Final Report on ITU-D Question 5/1 for the study period 2014-2017. Telecommunications/ICTs for rural and remote areas. ITU, 2017.

copper cables and optical fibre. With regard to services, the study noted that there was a need for the provision of content in local languages, services and applications tailored to the needs of persons in rural and remote areas, Internet broadband applications adapted to the areas, telecentres, and e-agriculture applications. With regard to business models, the study also reflected that there was a need to explore public-private partnerships (PPPs) for the funding of ICT projects.

The main conclusions reached in the 2014-2017 study period were, in summary, as follows**:**

- Emerging technologies could expedite extension of ICT services to rural and remote areas in the form of broadband.
- The urban-rural digital divide is still very wide, and forward-looking policy interventions and updated regulation customized to the development of telecommunications/ICTs in rural and remote areas are necessary.
- Case studies provide best practice which bridges the know-how gap in rural communities.
- There is a need to improve the environment and life in rural areas in order to curb rural to urban migration, which constricts rural markets.

The report for the 2014-2017 study period recommended that further studies be carried out on the installation of cost-effective and sustainable basic telecommunication infrastructure and how to adapt network systems which are predominantly designed for urban areas to rural and remote areas.

## 1.2 Gaps requiring attention during the current study (2018-2021)

While previous studies had identified challenges and proposed solutions to address them, as well as ways of improving the development of ICTs for rural and remote areas, there was a real need to update the findings and recommendations of those studies, given the changes that have taken place in both technology and the enabling environment.

## 1.3 Statement of the situation: Scope of the current Question and other issues requiring attention

The present study therefore concentrates on updating the findings of previous studies and filling in any gaps left as identified by the BaAP, in particular to address the challenges of deploying cost-effective sustainable ICT infrastructure in rural and remote areas.

The 2018-2021 study generally also:

- Identifies and updates details of the requisite infrastructure for the deployment of ICTs for rural and remote areas and difficulties in creating or upgrading telecommunication infrastructure in rural and remote areas, as well as the best ways of connecting villages with telecommunications/ICTs and building capacity in ICT usage in rural and remote communities.
- Identifies the difficulties faced for rural deployment of fixed and mobile networks in developing countries and the relevant requirements to be satisfied by such networks, taking into account demand and the need to generate increased usage of ICT services and devices.
- Takes stock of the needs of rural and remote communities, current practices and case studies relating to the deployment of ICTs for rural and remote areas and relevant policies to bridge the digital divide and increase affordable access to ICTs.

- Determines methods and strategies to build human resource ICT skillsets for the deployment of broadband and maintain and encourage the training of technical staff in order to guarantee the reliability of telecommunication infrastructure.
- Identifies best practices and formulates proposed techniques and sustainable solutions in respect of the challenges faced in providing access to ICTs in rural and remote communities, including the deployment of broadband technologies for various e-application services to foster economic and social development.
- Identifies the changes in technology that could be exploited for rural and remote areas, as well as the influence of cultural, social and other factors capable of eliciting creative responses to the demand for multimedia services from rural and remote areas of least developed countries (LDCs), and the required type of community access points and telecentres appropriate for rural and remote areas, in line with WSIS targets.
- Tracks progress made on human resources development as well as opportunities and challenges for access to services in locally relevant languages.

## 1.4 Methodology used by the group

The methodology employed by the group included collecting contributions, analysing them and summarizing the content for inclusion in the appropriate chapters; collecting and analysing case studies; organizing panel discussions and analysing the results.

## 1.5 Deployment of rural connectivity for achieving the United Nations Sustainable Development Goals (SDGs)

This report makes it clear that attainment of the SDGs will depend to a large degree on ensuring that all communities, including those living in rural and remote areas, are connected. Applications discussed in this report are clearly linked to achievement of the SDGs, notably SDG 1 on ending poverty,[4] SDG 2 on ending hunger,[5] SDG 3 on healthy lives and promotion of well-being,[6] SDG 8 on promoting sustainable economic growth,[7] SDG 9 on building resilient infrastructure[8] and SDG 10 on reducing inequality within and among countries.[9] By finding and suggesting solutions for the connection of rural and remote areas, the results of the study track and recommend ways of achieving most of the WSIS action lines that are linked to these SDGs, as a means of achieving the goals. Such connectivity depends on the technologies that are deployed and the services that are available to rural and remote communities, as well as small island developing States (SIDS) and landlocked countries (LLC), especially landlocked developing countries (LLDCs). Small islands can also distribute the existing submarine cable capacity within 5G networks inside the islands for digital equity and economy.

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4 United Nations SDG 1: End poverty in all its forms everywhere.
5 United Nations SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
6 United Nations SDG 3: Ensure healthy lives and promote well-being for all at all ages.
7 United Nations SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
8 United Nations SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
9 United Nations SDG 10: Reduce inequality within and among countries.

# Chapter 2: ICT requirements of people living in rural and remote communities

Many developing countries have taken the development of ICT infrastructure and services up a notch by instituting special policies and related regulation for the "informatization/ICTization" of rural and remote areas. The growth of telecommunication infrastructure has become closely linked with the economic development of a country, especially the development of rural and remote areas. The challenge is to ensure that telecommunication services and their benefits, in terms of economic, social and cultural development, can be extended effectively and efficiently. Most contributions to the current study of ICTs for rural and remote areas indicate that the following have become critical requirements for rural and remote areas:

- Infrastructure that fosters digital transformation, promotes and attracts investment and allows emerging services, such as the Internet of Things (IoT), digital financial services and e-commerce, to blossom.
- Technologies that promote youth employment with the establishment of dynamic enterprises in economic sectors.
- Policies and regulatory initiatives on the deployment of ICT infrastructure to rural and remote areas and policies that help narrow the digital divide through affordable broadband service and access to ICT infrastructure.
- Solutions to challenges relating to building human resources or ICT skills for broadband deployment, maintenance and operation, as well as training of technical staff in order to guarantee the reliability of telecommunication infrastructure.
- Availability of electricity and of access roads for transport, which are prerequisites for the construction of telecommunication/ICT infrastructure for rural and remote areas.

Further scrutiny of the contributions submitted to the meetings under Question 5/1 reveals that cost-effective installation of infrastructure ran like a thread through at least six of the contributions.

## 2.1 Changing social trends and specific needs calling for vendor development of suitable services

The social needs of rural communities have changed and continue to evolve, from just basic telephony and short messaging service (SMS) connectivity, towards broadband. The needs are now more in the realm of broadband services. They henceforth include e-banking, online selling, mobile banking, e-health services, e-news for real-time information, e-agriculture and e-learning, which are all at the core of the SDGs as they help achieve financial inclusion, good health, eradication of hunger and education.

## 2.2 Changing economic environment and economic needs

Empowerment of rural and remote areas is urgent in order to prevent the movement of populations from rural to urban areas in many developing and developed countries, where we are witnessing increased migration of citizens between the age of 15 and 55 years old from rural areas to urban areas or to foreign countries. Some people in rural areas run small

businesses, and they require connectivity for the purposes of sourcing materials for their activity and markets to sell their products. Women are no longer content with staying in the kitchen, and also require a conducive environment for their projects to thrive.

## 2.3 E-services requirements for rural and remote areas

Case studies received for the study highlighted the need to introduce major e-applications to support e-education, e-agriculture, e-health, e-government, e-banking and e-commerce. These are services that are vital to the day-to-day lives of rural and remote communities, including rural businesses.

E-government services are critical. Once communities have access to connectivity and broadband services, government services that continue to operate manually and require the physical attendance of people to access them literally derail gains made by connecting them.

The requirements of rural and remote areas in terms of services are covered in greater detail in Chapter 6, which discusses services and applications for rural and remote areas.

## 2.4 Demand for multimedia services

Once broadband connectivity is extended to rural and remote areas, demand for multimedia services on the part of rural populations is likely to rise, as they seek to receive relevant information in various forms, including pictures, photography, text, voice and other digital media. The desire to exchange information in the community or between communities and with their relatives or friends in foreign countries also makes the need for multimedia access very real. Entrepreneurs need to exchange information efficiently with the outside world. Multimedia services such as basic service, data service, video service and IoT sensors provide enhanced access to ICTs for people in rural and remote areas.

## 2.5 Opportunities and challenges related to access to ICTs in relevant local languages

There are thousands of languages and dialects spoken throughout the world. The challenge is to create sufficient relevant content in local languages. Those that speak the languages often do not have the skills to do so. Opportunities therefore abound under these circumstances. These include inventing pictographs and illustrations. For blind people, it means producing braille keyboards, SMS or a community bulletin board service. Special measures should be taken for the visually impaired. Text translation and text reading may be made available online where the community is connected via Internet.

## 2.6 Analysis of case studies, with emphasis on cases relating to indigenous communities, isolated and poorly served areas, LDCs, SIDS and LLDCs

An analysis of 94 case studies collected in the period 2018-2020 reveals the following:

- A high number of case studies were received from the Africa and Asia-Pacific regions, followed by the Americas, Europe and the CIS region, including from small island developing states, Sector Members and other organizations.

- No case studies were received from the Middle East, and it is recommended that in future studies strategies be put in place to elicit contributions from this region in order to make sure that the study results are based on comprehensive information from all regions.
- These case studies can be of help to ITU members, not only with information on what is happening in other countries, but with ideas on how they can further develop their own ICTs for rural and remote areas in order to overcome the prevailing challenges in those areas.
- The case studies cover many aspects of the issue, which include: challenges faced by many administrations as they develop ICTs for rural and remote areas; technologies suitable for connection of the rural areas; funding models being used to connect rural and remote areas, including SIDS; access points commonly used by developing countries to achieve universal access; universal access policies; universal service fund management; capacity building; stakeholder engagement to include indigenous peoples and tribal leaders; and applications currently under development for rural and remote areas, as well as the impact of and solutions relating to access to broadband during the COVID-19 pandemic.

**Annex 1** to this report lists and references the case studies submitted by countries from the different ITU regions and **Annex 2** presents a brief summary of the content of the case studies and other input documents, as well as hyperlinks to the full case studies.

The main overall findings from analysis of the case studies are as follows:

- The cost of constructing, installing and upgrading ICT infrastructure is dependent on the availability of power and access road networks, and these have to be developed as a prerequisite for creating robust and reliable ICT infrastructure.
- There are no one-size-fits-all financing models for infrastructure development and ICT access programmes. Countries need to explore various options, which include funding from financial institutions, support from a universal service fund, government subsidies and PPPs. It is therefore important for Member States to go through the various case studies presented in this report and find a mix of financing models that works for them.
- Cooperation among neighbouring countries is key to enabling LLCs/LLDCs and SIDS to access submarine cables for the development of their ICT networks and to create robust communication systems.
- Rural people need digital equity for learning, health and agriculture, and this can be provided by high-speed and high-quality intelligent broadband networks.
- ICT access points such as village networks and ICT community information centres provide an effective facility-sharing mechanism for universal access and bridging the rural-urban digital divide. Universal access programmes such as community information centres are a cost-effective public tool which offer a genuine opportunity for stimulating economic growth and alleviating poverty in developing countries.
- The use of universal service funds has evolved to include funding of Internet connectivity projects as well as ICT-assisted educational and agricultural programmes.
- Community networks can provide connectivity relief to remote communities.
- Developing countries can start working on IoT bit by bit within their limited resources.
- The COVID-19 situation has thrown a spotlight on the importance of transition to high-speed broadband networks, both fixed and wireless, including satellite.
- Communal access points are of limited use during pandemics and can only be of major benefit where there are huge spaces that allow social distancing.
- Community Wi-Fi has become one of the ways for rural areas to benefit from affordable broadband.[10]

[10] ITU-D SG1 Document SG1RGQ/318+Annexes from the EMEA Satellite Operators Association (ESOA/GSC)

# Chapter 3: Available, affordable, accessible and sustainable solutions to connect rural and remote areas

From the contributions received from various Member States and entities under Question 5/1, it was clear that issues of concern included the requisite infrastructure to support the deployment of ICTs; environmental and social challenges; and challenges associated with establishing, upgrading, maintaining and operating infrastructure. These issues are examined in this chapter, under relevant subheadings.

## 3.1 Requisite infrastructure for the deployment of ICTs for rural and remote areas

The paramount requisite infrastructure that features in many contributions is power or energy infrastructure. It was reported that, in most rural and remote areas, the power supply is unreliable or conventional power non-existent.

Contributions also highlighted the need for reliable road transport networks to facilitate ICT deployment. In many cases, access roads have to be constructed by the telecommunication operators to reach mountain tops and other isolated areas. According to a contribution from **Zimbabwe**, the distance between optimum site location and the nearest power line is usually large, which translates into a higher power-line construction cost. Collaboration between telecommunication regulators and energy regulators was therefore recommended in order to resolve the issue of power.[11]

A contribution from **Senegal** also cited power as a problem, and recommended that universal service funds should finance other struggling sectors like the power sector.[12] A further contribution, from **Burundi**, specifically pinpointed lack of electricity among the constraints hindering the deployment of telecommunications/ICTs to rural and remote areas.[13]

With regard to islands off the coast of **India**, transport costs and unavailability of electricity were highlighted as major constraints on the development of ICT infrastructure and ICTs in general. The Andaman, Nicobar and Lakshadweep islands were said to be using diesel generator power, and diesel is not readily available on the islands.[14]

Problems of electricity and transport featured in many other contributions submitted throughout the study period, and it is clear that both are a prerequisite for roll-out of ICTs, including broadband infrastructure, in rural and remote areas. Once access roads are in place and electricity is available, it is necessary to have a national backbone comprising both fibre-optic and tower infrastructure, in addition to the traditional copper-line networks, for telecommunication/ICT

[11] ITU-D SG1 Document 1/201(Rev.1) from Zimbabwe
[12] ITU-D SG1 Document 1/30 from Senegal
[13] ITU-D SG1 Document 1/44 from Burundi
[14] ITU-D SG1 Document 1/57 from India

services, including broadband, to be rolled out. Roll-out will also require last-mile connectivity infrastructure.

## 3.2 Environmental and social challenges impacting on infrastructure deployment for fixed and mobile networks

A number of environmental and social challenges emerged from the contributions to the study. These were highlighted by **the Republic of Korea**, **Zimbabwe**, **Bhutan**, **China**, **Burundi**, **Kyrgyzstan** and **the Russian Federation**, each pointing to one or more of the following:

- Low levels of literacy in rural and remote areas, which stifle demand and therefore impact on costs.
- Members of rural communities are not always aware of what is happening in their own environment. In many instances, they just see things unfold without being informed or even being asked for their input. The aspirations of rural communities, their strengths and weaknesses, need to be leveraged to ensure that each rural community buys into and participates in the successful execution of ICT projects.
- Government policy inadequacies that delay approvals for infrastructure roll-out
- Restrictive legal frameworks
- The physical environment in most rural and remote settings is characterized by some combination of heat, dust and humidity, each of which is a challenge for standard telecommunication hardware.
- Low population densities, which make it uneconomic to invest in rural and remote areas.
- Challenges in terms of operator business models, as the cost of deploying and maintaining cell sites in rural areas is significantly more expensive.
- High installation, operating and maintenance costs, due to lack of coordination of development activities, such as road expansion and laying of electrical cables, resulting in frequent cuts in cables.
- Non-availability of power supply in rural and remote areas is also a hindrance to the deployment of ICT Infrastructure.
- Delays in land-use approvals are also a serious bottleneck.
- Difficult geographic access (distance, terrain, poor roads, etc.).
- Non-availability of government land and buildings for the erection of mobile towers, for which procedures are not covered in existing policies.
- Seasonal bridges which are sometimes subject to flooding.
- Low consumer purchasing power.[15]

## 3.3 Challenges in establishing and upgrading Infrastructure

Difficult geographic terrain and inadequate power supply also featured as hindrances to the establishment and upgrading of infrastructure. High costs arising from some of the challenges highlighted above, coupled with low demand which makes it difficult to recoup investments, were cited in most contributions submitted to the meetings under Question 5/1. The costs of constructing access roads, vehicle maintenance and road maintenance were also cited.[16]

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15 ITU-D SG1 Documents SG1RGQ/REP/12, SG1RGQ/REP/5 and 1/REP/21+Annex from the Co-Rapporteurs for Question 5/1

16 ITU-D SG1 Document 1/REP/5(Rev.2) from the Co-Rapporteurs for Question 5/1

## 3.4 Challenges in operating and maintaining infrastructure

A number of contributions referred to one or more of the following as challenges affecting both the operation and maintenance of infrastructure for the provision of ICT services:

- High costs due to long travelling distances, which increases response time as well as general maintenance costs of vehicles using the bad roads.
- Owing to lack of commercial power supply in most rural areas, operators have to resort to other, expensive sources of power like solar power and diesel generators. These sources come with concomitant challenges of fuel and battery theft. Operators are left with no option but to install expensive security systems, which pushes up deployment and maintenance costs even further.
- The appetite for ICT services is also diminished in communities without an energy supply, since customers find it difficult to power their equipment and devices. Where available, power is usually extremely unreliable, or so unstable that it poses a threat to unprotected electronic equipment. This in turn makes infrastructure investment less attractive in rural and remote areas.
- Annual grass and brush clearance along rural routes to prevent damage by veld fires in areas served by overhead fibre can be very costly. In **Zimbabwe**, for example, operators like Liquid Telecom have to clear these areas at least three times a year. Moreover, staff carrying out maintenance sometimes face danger from wild animals.[17]
- Generally, telecommunication operators have to pay high taxes and levies, which push up operating costs.
- Most rural areas are in remote regions, with difficult terrain that makes them very inaccessible. Road infrastructure is poor, often consisting of dusty, eroded tracks, with mostly seasonal bridges. To be able to attract investment, rural areas have to be served with asphalted roads at least to the major rural centres and then dust roads to the villages. Bad roads prevent regular site visits.
- Long downtimes are common because of the time it takes maintenance personnel to reach remote areas. This is compounded by the scarcity of knowledgeable ICT personnel in rural areas to assist with troubleshooting. Sometimes, a service provider is called to remote areas to attend to a simple power switch that has been turned off.
- There is need to empower local people, particularly traditional leaders, so that villagers can attend to general, non-technical maintenance of sites. This also gives villagers a sense of network ownership and affords security against theft.
- Special security provisions have to be made for remote base stations/base transceiver stations (BTS) to ensure that no one tampers with the batteries or drains the diesel from the generators. This can take the form of surveillance systems, motion and heat sensors or permanent security guards, all of which are expensive.

Given these problems, there is need to design simple, high error margin techniques with low-maintenance regimes, so as to reduce operating expenses.

## 3.5 Sustainable solutions

One of the solutions adopted in many countries has been government measures to reduce or subsidize the costs of creating, deploying and maintaining infrastructure. Universal service policies and licensing conditions that place universal service obligations on telecommunication operators have also been employed as solutions to the problem, as deduced from the many case studies received by the rapporteur group during the current study period. In many cases, governments have dipped into the universal service funds to grant subsidies and at times

[17] ITU-D SG1 Document SG1RGQ/73 from Zimbabwe

implement projects for sustainable solutions. Examples include **Zimbabwe**'s Community Information Centre and Connect a School projects, the efforts of the **United States** Federal Communication Commission (FCC) to reduce investment barriers, **Côte d'Ivoire**'s community cybercentre, **Japan**'s Shiojiri biomass power plant, the **Central African Republic**'s fibre-optic connection project, **India**'s submarine cable project to connect islands off its coast and **Kyrgyzstan**'s optical fibre project. **China**'s Sichuan infrastructure programme and **Bhutan**'s Village Network of Community Centres project should also be cited in this narrative. Details of these interventions can be found in the case studies contained in this report.[18]

## 3.6 Available and accessible solutions and systems that address connectivity challenges in rural and remote areas

In order to address connectivity challenges in rural and remote areas, the focus should be on cost and sustainability of the solution applied. The solution should be low cost, and easily deployable. Mobile-network operators in **Benin** and **Ghana** are already using low-cost rural coverage solutions. Others in **Nigeria**, **South Africa**, the **Democratic Republic of the Congo**, **Tanzania**, **Rwanda**, **Liberia**, **Cameroon**, **Afghanistan** and elsewhere are exploring such solutions. Some of the options include using renewable energy to reduce costs, upgrading existing 2G network sites to 3G/4G, extending or densifying networks, deploying fixed wireless access using satellite-powered broadband solutions like direct satellite broadband connectivity, mobile backhaul or community Wi-Fi solutions. Long-range Wi-Fi, virtual network operations and community networks which feed from the nearest point of presence of the national backbone and/or of large networks are also considered: fixed wireless access through key hotspots in the villages, schools or hospitals can be connected to the network to serve locations 20-50 km away from the point of presence networks.[19] Solar power, windmill power, biomass and lead-acid batteries may provide sustainable solutions in the long run, one example being Shiojiri's case study demonstrating biomass power generation which supplies ICTs and 25 000 households, and the use of lead-acid batteries in **Japan**.[20]

It is clear that there are many solutions that are sustainable for use in rural and remote areas. Technical details of these solutions in relation to technologies, capacity building and policy/regulation are provided in Chapters 5, 7 and 8, respectively. In particular, use of these solutions requires enabling policies which will be discussed later in this report.

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18 ITU-D SG1 Documents 1/382 from Zimbabwe, SG1RGQ/30 from Côte d'Ivoire, SG1RGQ/36+Annex from Japan, 1/29 from the Central African Republic, 1/57 from India, SG1RGQ/176 from Kyrgyzstan 1/375 from China and 1/33 from Bhutan

19 Report on the Question 5/1 Workshop held on 25 September 2019: ITU-D SG1 Document 1/308 from the Co-Rapporteurs for Question 5/1

20 ITU-D SG1 Document SG1RGQ/361 from the ITU Association of Japan (ITUAJ), Japan, and Document SG1RGQ/36+Annex from Japan

# Chapter 4: Demand, cost and financing mechanisms for connecting rural and remote areas

## 4.1 Demand for services in relation to capital expenditure for infrastructure

Demand for telecommunication services is low in rural and remote areas for a number of reasons. One or more of these reasons featured in a several contributions submitted to the rapporteur group meetings for Question 5/1, namely:

- Non-availability of power to run devices, which hampers take-up and usage of ICTs by rural populations.
- Lack of awareness of the benefits of ICTs.
- Culture which impedes access to ICTs for women and girls.
- Lack of affordability of both devices and Internet subscriptions.
- Low incomes of the majority of people in rural areas, who rely on either subsistence farming or other very basic industries or trades.

Some of these challenges, which were already observed during the 2014-2017 study period, still prevailed in the current period, although the effects may have changed. In one contribution, information was provided to the effect that, according a report by the Alliance for Affordable Internet (A4AI), affordability remains one of the most significant obstacles to Internet access around the world.[21] The report states that access policies, national broadband strategy, infrastructure sharing and reasonable tax regimes have been used to try and alleviate the problem of slow or low adoption.

A contribution from the **GSM Association** (GSMA), with data from 2018, pointed out that 3.2 billion people that live in areas covered by mobile-broadband networks are not yet using mobile Internet services. This is 80 per cent of the total number of people that remain offline, the remaining 20 per cent (800 million people) not being covered by mobile broadband yet. A large-scale annual consumer survey conducted by GSMA likewise revealed that, for people who were aware of the existence of mobile Internet, affordability was the greatest barrier to using mobile Internet services, followed by lack of digital skills. Affordability is the most significant barrier to the ownership of Internet-enabled devices.[22]

All this suggests that coverage alone cannot address the problem of digital inclusion. One of the targets for 2025 set by the Broadband Commission for Sustainable Development relates to affordability, and is worded as follows: "By 2025, entry-level broadband services should be

[21] Alliance fir Affordable Internet (A4AI). 2018 Affordability Report. Accessed 6 September 2019.
[22] ITU-D SG1 Document 1/389 from the GSM Association (GSMA). The analysis is based on findings from quantitative face-to-face surveys with women and men in 23 low- and middle-income countries across Asia, Africa and Latin America. Source: The Mobile Gender Gap Report 2018. GSMA, London, 2019.

made affordable in developing countries, at less than 2 per cent of monthly gross national income (GNI) per capita".[23]

This development is likely to stimulate debate on the issue and generate efforts to address demand for ICTs.

While demand for Internet services for education, networking, sports, economic and marketing-related applications and health and related applications exists in rural and remote areas, it remains too low to obtain a good return on investment. It is therefore important to come up with a mix of strategies to reduce the cost of Internet access for rural and remote areas which goes beyond what has already been tried, so as to stimulate demand and encourage investment. Some of the methods that can be used include the following:

- ***Demand creation*** through awareness-raising or consumer education that makes people conscious of what ICTs can do for them, their projects and businesses, as well as their social life.
- ***Demand programmes*** that identify traditionally offline or non-electronic services and then bring them online to the Internet, as these will then stimulate demand. Demand programmes can be implemented in many domains, such as banking, health, education, entertainment and employment. Promoting social media applications which connect users to a network or a community and facilitate social interaction also helps to drive demand. Other mechanisms to boost demand include the exchange of user-generated content and compelling local content, as well as programmes with a focus on education through virtual classrooms or other e-learning tools.

  Examples of demand programmes are **Costa Rica**'s Connected Homes programme, which benefits vulnerable socio-economic groups; **Colombia**'s subsidy programme to increase Internet access for low-income households; **Senegal**'s programme of subsidized personal computers and broadband connections for students to enable virtual learning; the **Republic of Korea**'s Information Network Village (INVIL) project; **India**'s efforts to stimulate demand for relevant online content; **Kenya**'s Digital Learning programme to drive primary education; and **Zimbabwe**'s Connect a School programme.[24]
- ***Bridging the gender digital divide*** through policies and activities that combat cultural exclusion of women and children from access to ICTs and business activity can also help stimulate demand.

In this regard, the **United States** Women's Global Development and Prosperity (W-GDP) and Connected Women (supported by the United States Agency for International Development (USAID)) initiatives are two good examples of empowering women in rural areas to bridge the digital gender divide and improve women's participation in everyday life, by meaningfully changing the ways women access and use technology.[25]

- W-GDP aims to reach 50 million women in the developing world by 2025 through United States government activities, PPPs and an innovation fund.
- USAID's partnership with the Australian Agency for International Development (AusAID), GSMA and Visa, under the GSMA Connected Women programme, enabled 15 million underserved women to own and effectively use mobile phones, in order to increase their access to vital information, networks and services and thereby improve their families' quality of life. The GSMA Connected Women programme had awarded 11 innovation grants to mobile network operators (MNOs) and non-governmental organizations (NGOs).

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23 ITU and UNESCO. Broadband Commission for Sustainable Development. 2025 Targets: "Connecting the Other Half"

24 ITU and UNESCO. Broadband Commission for Sustainable Development. Enabling the use of ICTs and broadband: Understanding what works to stimulate ICT adoption. November, 2016.

25 ITU-D SG1 Document SG1RGQ/187 from the United States

The grants provide seed funding for the design and launch of economically sustainable products and services that increase women's access to and use of mobile phones and value-added services. The UK Foreign Commonwealth Development Office and the Swedish International Development Cooperation Agency are now funding the Connected Women Programme initiative, which has impacted over 39 million women.

Other tools which help address low demand include policies that encourage competition and ensure technology neutrality.

It is clear from many contributions submitted to the study on ICTs for rural and remote areas that, whereas considerable attention has been devoted to supply-side issues, case studies suggest that stimulating demand is a vital driver of increased Internet access in many countries.

## 4.2 Investment and cost priorities based on economic and social indicators

The priority for ICT operators is usually return on investment, while governments are focused on universal access and improving the quality of life of their countries' rural and remote populations. From many of the contributions that were submitted under Question 5/1, these two priorities are not necessarily at odds with one another. Although operators focus more on urban areas, once urban demand is substantially satisfied revenues can only be grown by extending services to rural and remote areas. For continents like Africa, where urban people also have a rural home, to effectively serve the urban population the rural population must also be served, as there is a lot of interconnectedness between the two sets of communities. Attention should therefore be given to investment in the following order of priority:

- Backbone infrastructure
- Last-mile connectivity
- Basic data and voice services
- Internet access
- Applications and content that are relevant to communities in rural and remote areas to enable financial inclusion and the use of ICTs in various economic projects in which the communities are involved.

## 4.3 Financing mechanisms (subsidies, etc.) for connecting rural and remote areas

Financing mechanisms for ICT development have evolved over time. Whereas, prior to 2002, the required outlays in terms of investment in infrastructure were much smaller, and voice technology was still largely the main focus, the situation is now much more complex.

The template has shifted from delivery of services in public facilities to last-mile connectivity to the home. Whereas, in the past, services were provided by large monopolistic corporations, today even small entrepreneurs and medium-sized businesses play a significant role. The age-old problems of low incomes and computer illiteracy still limit the number of people who have Internet access in homes. Limited supply of electricity and unreliable road infrastructure in rural areas of some developing countries still cause bottlenecks hampering the development of ICTs.

In order to fund projects designed to achieve increased rural access to ICTs, different financing models have therefore to be used.

There is no single financing structure or model that can be applied to all projects. Generally, telecommunication/ICT/broadband financing mechanisms include recourse to public-utility finance, PPPs, central government funding through grants, low interest rate loans sourced from a development bank or a universal service fund, and operator funding from the capital budget, sometimes complemented by borrowing from lender and policy interventions. Reverse auctions also constitute a method of raising funding, and have been implemented effectively in broadband infrastructure projects in the United States.

### 4.3.1 Public-utility financing model

This is more common for urban and suburban roll-outs, where the municipality or government department acts as an investor for an open-access network, securing initial funding at low rates for construction. An example is **Japan**'s Shiojiri municipality project for IoT implementation through environmental information sensor networks in order to improve the lives of local people. The municipality established an optical fibre network to connect public facilities in the city, as well as an eco-friendly biomass power plant to supply its ICT networks and 20 000 households.[26]

### 4.3.2 Operator funding

This occurs where an operator uses its own budget or borrowed funds to fund infrastructure projects and run the network. It is the most common form of funding. However, with this kind of capital, investment tends to be concentrated in urban areas.

A proposal in one of the contributions received, from **Ericsson**, expressing the view that network operators and communication service providers can serve the cause of rural connectivity through selective investment in mature mobile-broadband technologies, and can sustainably expand network coverage by upgrading existing 2G (GSM) sites, as well as by targeting uncovered areas with new 4G (LTE) and 5G deployments, could provide part of the solution for reducing costs.[27]

### 4.3.3 Universal service fund financing model

In rural settings, cost-sharing models, including infrastructure sharing between competitors, are probably the best option for investment. However, competitors are usually reluctant to apply such models, and this is where public funding comes in.

- In the **United States**, the Universal Service Fund (USF) provides support through four programmes established and directed by the United States Federal Communications Commission (FCC): the High-Cost programme (also known as the Connect America Fund, or CAF); the Lifeline programme; the Schools and Libraries (or E-rate) programme; and the Rural Healthcare programme. The USF receives revenue from contributions levied on telecommunication service providers, based on an assessment on their inter-state and international end-user revenues. The USF programmes have helped 128 147 schools and libraries, 9 050 rural healthcare facilities, 8.1 million lifeline-eligible households and 1.2 million high-cost area households. Administration of the fund is entrusted to an FCC-designated competition-neutral, independent, not-for-profit entity, the Universal Service Administrative Company (USAC), which collects and disburses almost USD 10 billion available annually to the companies and institutions that make universal service possible in the United States. A rigorous process ensures that carriers remain accountable to

[26] ITU-D SG1 Document SG1RGQ/36+Annex from Japan
[27] ITU-D SG1 Document SG1RGQ/382 from Ericsson

consumers, taxpayers and FCC for USF funds and are delivering the network performance they have committed to providing.[28]

- In **India**, the Universal Service Obligation Fund (USOF), instituted by an Act of parliament, is responsible for collecting revenue and using it to support infrastructure and other ICT projects.[29] The fund collects around USD 1 billion annually, and over USD 7 billion have been allocated and disbursed to support various projects. With funding from USOF, the public service provider and private telecommunication service providers create infrastructure in villages.

  "BharatNet" is the largest rural connectivity project of its kind in the world and is the first pillar of the Digital India programme. BharatNet is being implemented to digitally connect a number of rural areas in the country. Under the project, network infrastructure is being laid for broadband highways accessible on a non-discriminatory basis, in order to provide affordable broadband services to citizens and institutions in rural areas, in partnership with states and the private sector.[30]
- In **China**, a universal service pilot project is founded on the general concept of "central fund guidance, local coordination and support, and enterprise-oriented promotion", forming a scheme of central, local and enterprise joint efforts to support the development of rural broadband construction. In accordance with the targets for 2020 set under the "Broadband China" strategy, the pilot project is expected to achieve the target broadband network coverage for committees, schools, clinics and other major public institutions.[31]

Other examples of universal service funding of ICT projects include:

- Funding of connectivity projects and multipurpose community telecentres in rural and low-income areas to bring access to ICTs to rural communities under the **Burundi** Universal Service Fund[32]
- Deployment of broadband Internet connectivity to rural schools in **Rwanda**[33]
- The project for 5 000 cybercentres in **Côte d'Ivoire**[34]
- In **India**, the USOF Sanchar Shakti scheme for mobile value-added services for rural women[35]
- A connectivity project connecting 3 000 villages and 500 public schools and several referral and regional hospitals in **Tanzania**[36]
- Deployment in the **Russian Federation** of more than 50 000 km of fibre-optic cable in sparsely populated localities and submarine communication cables in some regions, to provide universal services to the territory of the Magadan region and the Kamchatka territory[37]
- Telecommunication tower and community information centre projects in **Zimbabwe**[38]
- The telecentre project in **Cameroon**, designed to bridge the digital divide between rural and urban areas[39]
- Deployment of ICT infrastructure in **Sudan**.[40]

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28 ITU-D SG1 Document 1/327(Rev.1) from the United States
29 Department of Telecommunications, Ministry of Communications, Government of India. Universal Service Obligation Fund.
30 ITU-D SG1 Document SG1RGQ/229 from India
31 ITU-D SG1 Document SG1RGQ/217 from China
32 ITU-D SG1 Document SG1RGQ/166 from Burundi
33 ITU-D SG1 Document SG1RGQ/11 from Rwanda
34 ITU-D SG1 Document SG1RGQ/30 from Côte d'Ivoire
35 ITU-D SG1 Document SG1RGQ/32+Annex from India
36 ITU-D SG1 Document SG1RGQ/77 from Tanzania
37 ITU-D SG1 Document SG1RGQ/82 from the Russian Federation
38 ITU-D SG1 Document SG1RGQ/85 from Zimbabwe
39 ITU-D SG1 Document 1/125(Rev.1) from Cameroon
40 ITU-D SG1 Documents 1/157(Rev.1) and 1/279 from Sudan

It is clear that universal service funds play a major role in funding telecommunication/ICT infrastructure and operational projects.

### 4.3.4 Government funding

This type of funding has been used in **Bhutan**, where the government has funded a project to use Wi-Fi hotspots for public service delivery in government offices.[41] The optical fibre project in **Burundi** is another good example, whereby the government received funding from the World Bank to launch a project to deploy a national optical fibre network connecting Burundi to the submarine telecommunication cables of neighbouring countries. The aim of the resulting national backbone, which currently extends over 1 400 km, was to reduce the costs of carrying international and national telecommunications and facilitate universal access. At present, the optical fibre network is operational in all of the country's 18 provinces and connected with international submarine cables at landing points on the coast at Dar-es-Salaam (Tanzania) and Mombasa (Kenya).[42] The Bhutan Royal Government has also established the Village Network of Community Centres Information Highway project in **Bhutan**, with funding by the Asian Development Bank (ADB).[43]

## 4.4 Partnerships to enable connectivity for rural and remote areas

Partnerships become very useful when it comes to funding projects designed to achieve increased rural access to ICTs. The need for partnerships has been invoked and explored often, in many contributions submitted under Question 5/1 and other Questions during the current study period, as a solution to the rural connectivity problem. The value of such partnerships in various aspects of ICTs for rural and remote areas cannot be ignored. It is important to note that such partnerships are not only financial in nature, but take many forms that can lighten the burden on government and even the private sector in implementing rural connectivity. The different types of partnership include public-public partnerships, public-private partnerships, intergovernmental partnerships and partnerships between international organizations and specific countries. The operational models of the partnerships can include public contracts under which the private partner provides management and technical skills such that the public facilities are operated by a private partner's staff. In some cases, the private partner's skills and finance are used to exploit the commercial potential of the public entity's or government's assets. Some involve build-and-operate schemes.

- **Public partnerships**

  A public-public partnership (PuP), i.e. a partnership between a government body or public authority and another government body and/or public authority to promote the provision of, or indeed provide, services and/or facilities, is a concept which is now being used in ICT development, just as in other fields. Sometimes the goal is to share or transfer technical skills and expertise. Sometimes it is to share the financial burden for costly projects in uneconomic areas. Partners can include other local, regional or state provincial bodies, school boards, parks boards, NGOs, unions, pension funds, professional organizations and community groups in developing countries. This concept was historically used by governments to contract corporations to design, build, finance, maintain and operate public projects like schools, hospitals and bridges. An example is the Connect a School project in **Zimbabwe**, where the universal service fund has partnered with the Ministry of

41 ITU-D SG1 Document 1/251 from Bhutan
42 ITU-D SG1 Document SG1RGQ/166 from Burundi
43 ITU-D SG1 Document 1/33 from Bhutan

Education, and another public entity, the Zimbabwe Academic and Research Network (ZARNet), to provide connectivity to schools and tertiary institutions in Zimbabwe. The bulk of the schools and institutions are situated in rural areas.[44]

- **Public-private partnerships**

  Public-private partnerships (PPPs) are the most common type of partnerships, and have been referred to in most contributions under Question 5/1. They have been employed in various sectors of the economy. **Germany**, **Austria** and a host of developing countries, for instance, have used them in most of their economic sectors, and the ICT sector has had its share. This type of partnership is ideal for huge infrastructure projects at the national and international level. For example, ICT content providers such as Microsoft, Amazon and Google are increasingly investing in undersea cables and other ICT projects in various countries, either on their own or in partnership with public corporations and private ICT operators. **Annexes 3 and 4** to this report reflect the extent of the submarine cable network worldwide. Microsoft's Unlimited Potential (UP) programme now funds more than 500 technology training and other projects in 95 countries, to aid the progress and development of the global workforce. Microsoft's Partners in Learning programme works with educators from 101 countries, serving more than 10.2 million students. Satellite operators have been known to partner with public corporations to provide critical services, such as for example Project iMlango in Kenya that brings access to education to 200 000 children in 245 schools.[45] Currently, PPPs have also been used in ICTs for education under the Infrastructure, leasing and financial service project in **India**, **Samoa**'s School Net programme, **Pakistan**'s virtual university, the Gearing up Internet literacy and access for students programme in the **Philippines** and the Intel-Teach programme in **Indonesia**.[46]

- **Private partnerships**

  Private partnerships, which are initiated by for-profit partners, without funding from public coffers, have been used extensively in the ICT sector, usually between ICT operators and financial institutions and insurance service providers. They are, however, not generally aimed at providing universal access to broadband, although financial inclusion has grown significantly thanks to partnerships between banks and ICT service providers.

- **Intergovernmental partnerships**

  Partnerships among governments, businesses and international organizations are vital. Usually, these partnerships are integrated in regional organizations and deal more with policy formulation and guidelines on implementation. In **southern Africa**, the Southern African Development Community (SADC) has implemented this kind of arrangement, resulting in customization of ICT model laws to the region, a good example being cybercrime laws. Intergovernmental partnerships of this kind have also been used in other regional groupings in **northern and eastern Africa**.[47] The South Asia Subregional Economic Cooperation (SASEC) set up the Village Network of Community Centres Information Highway project in **Bhutan**, funded by ADB and the Royal Government of Bhutan.[48] Korea Telecom (Republic of Korea) has worked in partnership with the Ministry of Post and Telecommunications of Cambodia and Telecom Cambodia to provide public Wi-Fi and distance learning for schools in rural and remote areas of **Cambodia**.[49]

- **Partnerships with international and non-governmental organizations**

  At the global level, through its Telecommunication Development Bureau (BDT), ITU has provided both funding and technical expertise for projects in telemedicine and the installation of emergency response teams, as well as IXPs, in various countries.

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44 ITU-D SG1 Document 1/382 from Zimbabwe
45 ITU-D SG1 Document SG1RGQ/318+Annexes from ESOA
46 Reported in ITU-D SG1 Document 1/382 from Zimbabwe
47 Ibid.
48 ITU-D SG1 Document 1/33 from Bhutan
49 ITU-D SG1 Document 1/169 from the Republic of Korea

Other cases include:

- The IT Supporters capacity-building programme implemented by KT Corporation in the **Republic of Korea**, which has seen 3.3 million Koreans and 16 000 institutions benefit. The programme is carried out in conjunction with various government agencies, regional governments and NGOs.[50]
- Submarine cable projects in **Micronesia**, comprising the HANTRU cable system funded through a loan from the United States Rural Utility Service (RUS); the Yap Spur cable system funded by a World Bank grant to Micronesia; the Chuuk to Pohnpei cable system funded by a World Bank grant to Micronesia; the East Micronesia cable system funded by a combination of World Bank grants (to Micronesia and Kiribati) and ADB loans (to Nauru) (planned for 2021). Micronesia is made up of small Islands located in the western Pacific, namely Yap, Chuuk, Pohnpei and Kosrae, and has a population of 118 000. Prior to 2010, the only international connectivity to Micronesia was via satellite. Cable system capacities greatly exceed the requirements of small island communities, even future requirements.[51]

There is no doubt that, in order to increase access to ICTs, there is need to reduce the financing burden governments face in providing infrastructure, providing access, developing content and applications, and providing capacity building.

When implementing partnerships, it is necessary to compare various features of these financing mechanisms and analyse their implications, based on macroeconomic indicators of the economy concerned. Consideration should be given to the suitability of the financing mechanism in regard to the macroeconomic factors. PPPs are more suitable and useful for projects that require huge capital outlays. In-country PuPs can be advantageous for smaller ICT projects.

[50] ITU-D SG1 Document 1/384 from the Republic of Korea
[51] ITU-D SG1 Document SG1RGQ/239+Annexes from FSM Telecommunications Corporation (Micronesia)

# Chapter 5: Technologies to connect rural and remote areas

## 5.1 Availability of telecommunications/ICTs providing enhanced connectivity

Networks are normally configured in two parts: the backhaul and access segments. Sometimes, they are divided into three parts: core, backhaul and access, where the backhaul segment routes traffic from cell sites (or points of presence) into the core network.

The sections that follow give an overview of fibre cable, terrestrial wireless and satellite solutions.

Both wireless and wired technologies can be used in the backhaul and access segments. These two technologies have long been competing, and sometimes complementary. Since the invention of optical cable, its use for backhaul has become the standard design pattern for national networks. On the other hand, for the access segment the dispersed nature of the area involved makes wireless equally as effective as wired. This is specifically the case for rural and remote areas, where pulling the cable is a difficult task.[52]

### 5.1.1 Network configuration patterns

Table 1 shows the technologies used for the access and backhaul segments of the network. The classification and corresponding technical description below are valid for transmission methods suitable for broadband connection. Some historical technologies are mentioned for comparison purposes.

[52] ITU-D SG1 Document SG1RGQ/107 from the BDT Focal Point for Question 5/1 and ITU-D study on Broadband situations in rural and remote areas.

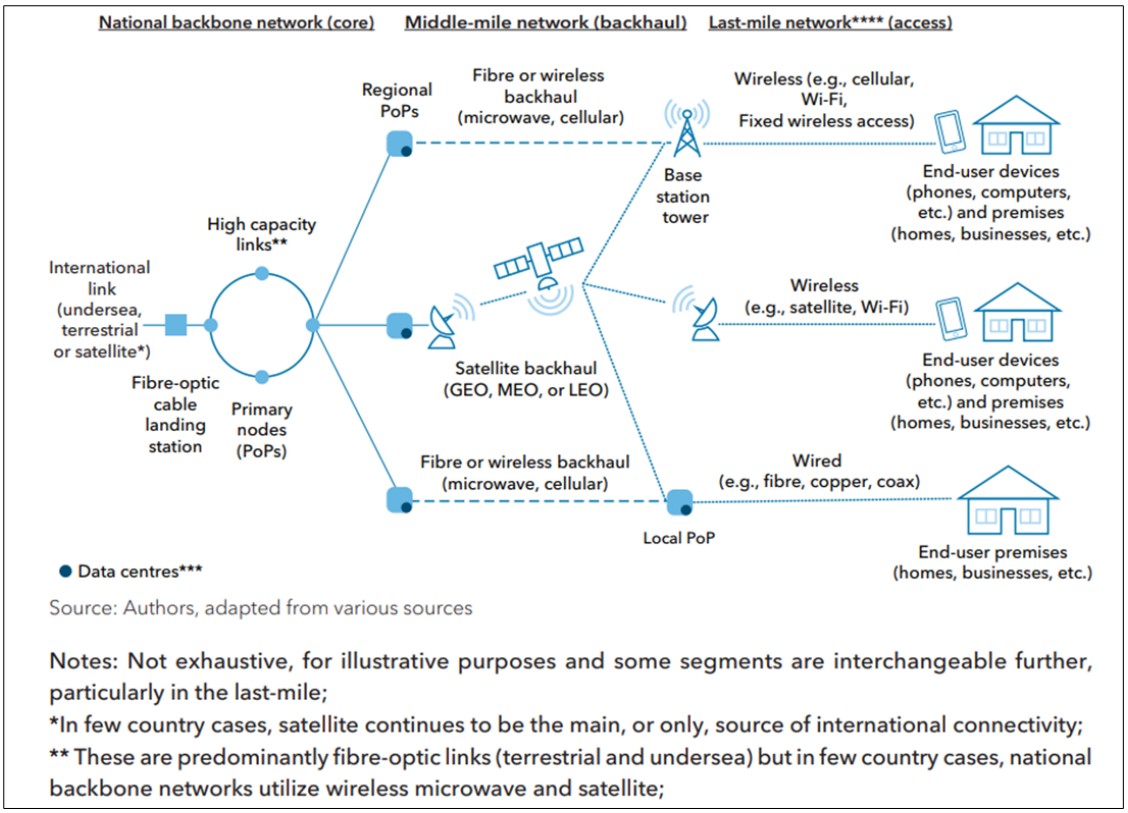
## Table 1: Technologies used for broadband connections

| Technologies | | Terminal mobility | Access | Backhaul |
|---|---|---|---|---|
| Wired | Optical cable | – | Fibre-to-the-home | Optical fibre including optical fibre composite overhead ground wire (OPGW) |
| | Copper cable | – | Copper cable, cable pair to the home | Coaxial cable, including submarine cable |
| Wireless | Terrestrial | Mobile | Mobile network such as Wi-Fi, WiMAX, 2G, 3G, 4G, 5G | Optical fibre, terrestrial microwave, satellite |
| | | Fixed | Fixed wireless access | Optical fibre, terrestrial microwave, satellite |
| | Via satellite | Mobile | Satellite network | – |
| | | Fixed | Satellite link/VSAT | Satellite link/VSAT |

*Source*: Analysis by Q 5/1 vice-rapporteur group

In **China**, the government exploits the characteristics of the wireless network structure to reap the benefits of shared constructions and cost savings in order to meet the country's need for rural ICT development. It leverages the legacy network to create a hierarchical wireless broadband network structure in rural areas. A network structure diagram is shown in Figure 1.

## Figure 1: Mobile and fixed network architecture for rural and remote areas




Source: Authors, adapted from various sources

Notes: Not exhaustive, for illustrative purposes and some segments are interchangeable further, particularly in the last-mile;
*In few country cases, satellite continues to be the main, or only, source of international connectivity;
** These are predominantly fibre-optic links (terrestrial and undersea) but in few country cases, national backbone networks utilize wireless microwave and satellite;

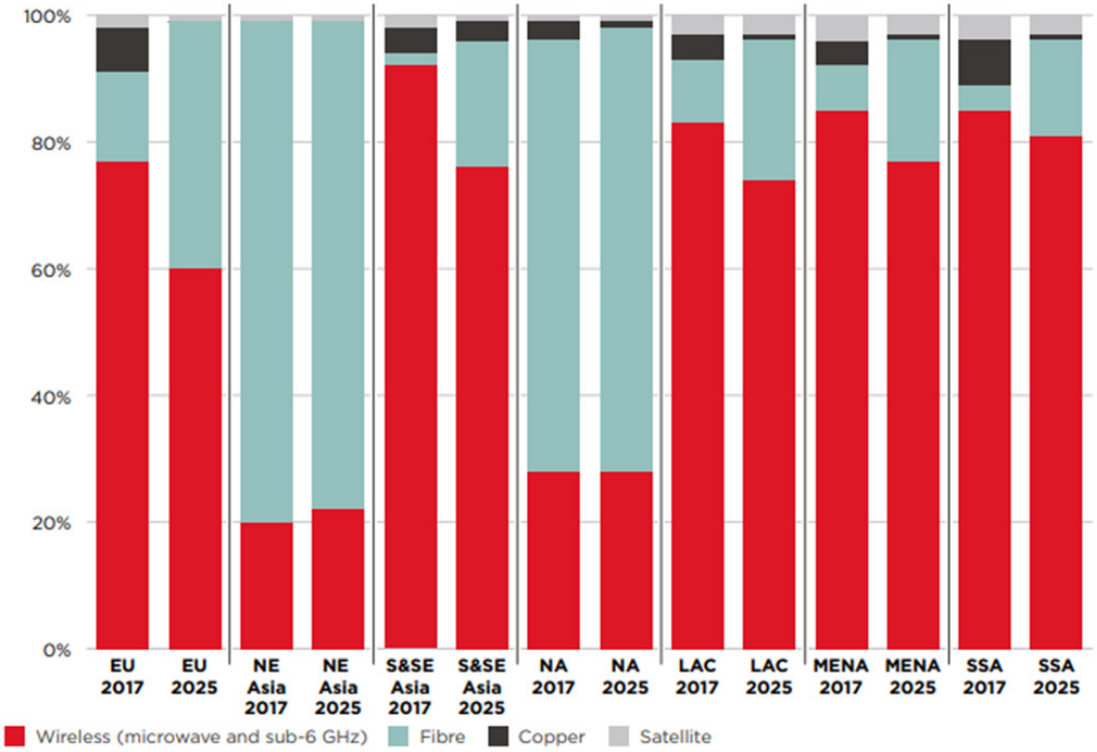
*Source*: ITU (2020)[53]

## 5.2 Backhaul technologies

A single or a combination of backhaul technologies are used that are mainly wireless, terrestrial microwave, optical fibre, submarine cable, copper and satellite.[54] Figure 2 below shows the overall global backhaul landscape per region by technology.

[53] ITU (2020). The Last-mile Internet Connectivity Solutions Guide – Sustainable connectivity options for unconnected sites. Geneva, 2020.
[54] GSMA (2020). Role of wireless backhaul in enabling 5G in MENA. London, September 2020.

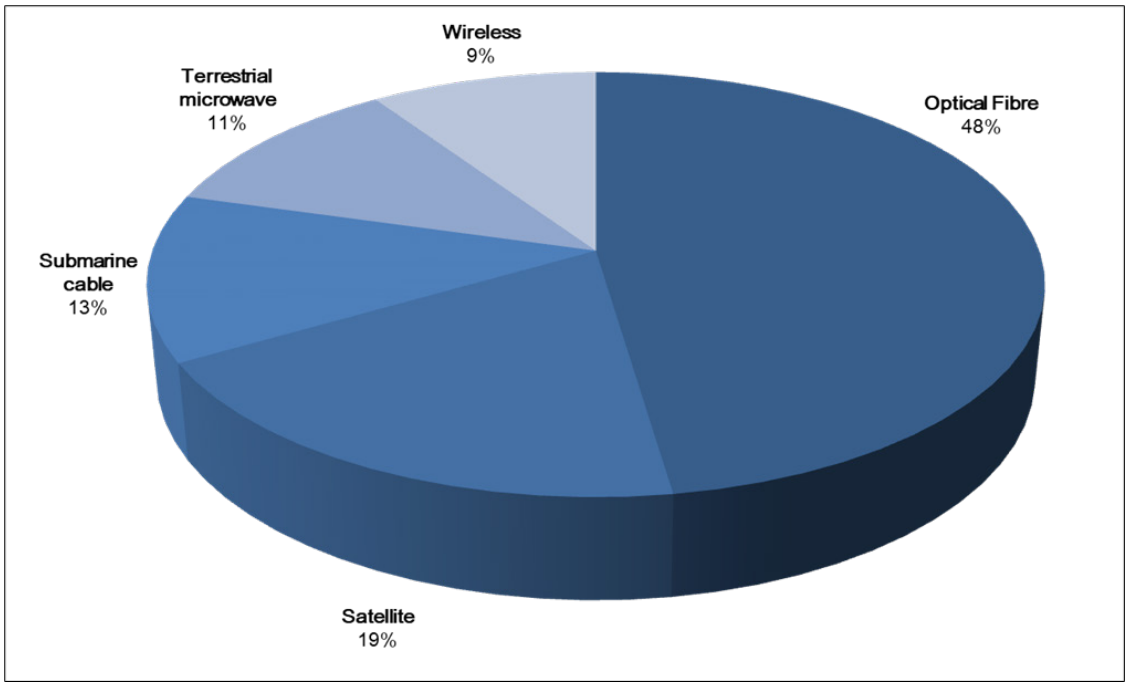
## Figure 2: Global backhaul landscape




*Source*: GSMA (2020)

Based on contributions submitted under Question 5/1 for consideration by the rapporteur group, a breakdown of the main backhaul technologies used for connecting rural and remote areas is given in Figure 3.

## Figure 3: Backhaul technologies used for connecting rural and remote areas




*Source*: Analysis of contributions from the 2018-2021 study period by Q 5/1 Vice-Rapporteur

### 5.2.1 Optical fibre networks

Optical fibre remains in most cases the ideal medium for backhauling between the periphery and the network core. Owing to the marked growth in volumes of data exchanges between users, backhaul has to cope with an ever increasing demand for higher data speeds and volumes for services such as triple play, video on demand (VoD), high-definition television (HDTV), Internet Protocol television (IPTV), videoconferencing, interactive video and video games, cloud computing and data transfer.

To connect islands to the continent, or to the main island in an archipelago, submarine cables are used. They have also been the primary medium used for international telecommunication links. Optical submarine cables are fitted with special armoured cable covers.

Examples reported in various contributions to the study include the Central African Backbone (CAB) fibre-optic project in the **Central African Republic**;[55] submarine cable connectivity to the small island regions (Andaman, Nicobar and Lakshadweep islands) in **India**;[56] **Guinea**'s national fibre-optic cable;[57] the **Russian Federation**'s plan to deploy fibre-optic, including submarine, cables to its 34 small and remote areas that are difficult to connect;[58] the backbone system in **Burundi** using fibre-optic cables and its connection to multipurpose community telecentres;[59] optical fibre communication lines in **Kyrgyzstan**;[60] **Burkina Faso**'s extension plan for the national fibre-optic backbone in Zone 3 (rural zone);[61] **Brazil**'s national programme for broadband, which uses fibre optics to cover more municipalities;[62] and connectivity in **Micronesia** using submarine cables to connect the Yap, Chuuk and Pohnpei island regions.[63] **Waseda University** (Japan) has used a lightweight optical fibre cable covered by a stainless-steel tube and polyethylene jacket which conforms to the standards prescribed by Recommendation ITU-T L.1700 (2016) as well as Recommendations L.110 (2017) and L.163 (2018). The cable is considered affordable and reliable for backhaul solutions when deploying infrastructure in rural and remote areas.[64]

### 5.2.2 Terrestrial microwave links

A number of network topologies can be used to connect the point of presence to the core network, and these include point-to-point (P2P) topology, which has been used traditionally with narrow pencil-like beams connecting two end points; point-to-multipoint (P2MP), using a broader beam at one end to cover a relatively wide area within which there could be several other endpoints; and multipoint-to-multipoint (MP2MP) or mesh, where multiple end points potentially communicate to other multipoints with traffic routed between them.

Wireless backhaul can operate in frequency-division duplex (FDD) mode, with a pair of frequencies, one for each direction; or in time-division duplex (TDD) mode, sharing capacity between uplink/downlink directions. The Digital Island project carried out by Korea Telecom

[55] ITU-D SG1 Document 1/29 from the Central African Republic
[56] ITU-D SG1 Document 1/57 from India
[57] ITU-D SG1 Document SG1RGQ/40 from Guinea
[58] ITU-D SG1 Document SG1RGQ/82 from the Russian Federation
[59] ITU-D SG1 Documents SG1RGQ/166 and SG1RGQ/177 from Burundi
[60] ITU-D SG1 Document SG1RGQ/176 from Kyrgyzstan
[61] ITU-D SG1 Document SG1RGQ/178 from Burkina Faso
[62] ITU-D SG1 Document SG1RGQ/195 from Brazil
[63] ITU-D SG1 Document SG1RGQ/239+Annexes from FSM Telecommunications Corporation (Micronesia)
[64] ITU-D SG1 Document 1/225 from Waseda University (Japan)

in Moheshkhali island in **Bangladesh** used a terrestrial microwave link to connect the island to mainland.[65]

### 5.2.3 Satellite links

Where terrestrial infrastructure has been concentrated in urban centres, with limited coverage for rural and remote areas, satellite backhaul connects remote users to the Internet backbone.[66] Advancements in satellite networks, ground equipment and applications have turned satellite technologies into a cost-effective solution and a critical component of telecommunication and broadband access strategies to ensure coverage in remote and rural areas.

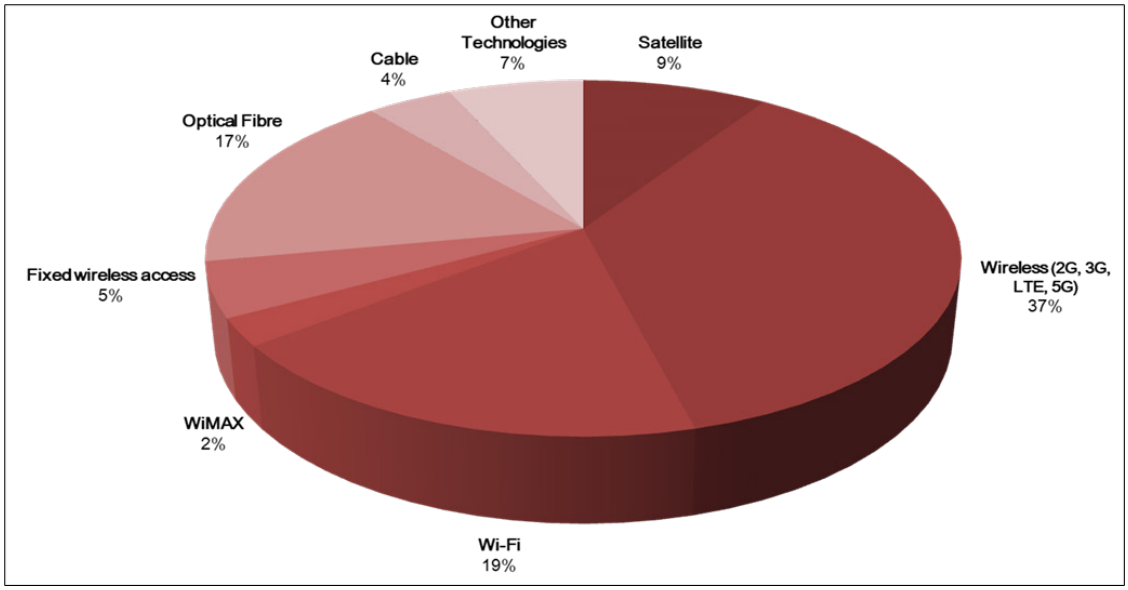
### 5.2.4 Mobile backhaul network

The increasing data volumes brought about by the surge in mobile terminal usage have transformed mobile backhaul networks, by prompting a reduction in cell radius and, in turn, in the cost and physical size of base stations and associated backhaul equipment. Mobile technology has become a viable alternative to deploying fibre optics, especially in rural and remote areas, and equally in high-density urban areas where it would not be physically or economically feasible to deploy optical fibre.[67]

## 5.3 Access technologies

Observations from the contributions submitted in the course of the study for consideration by the rapporteur group indicate that the main access technologies used for connecting rural and remote areas are as shown in Figure 4.

### Figure 4: Access technologies used for connecting rural and remote areas




*Source*: Analysis of contributions from the 2018-2021 study period by Q 5/1 Vice-Rapporteur

[65] ITU-D SG1 Document 1/66 from the Korea Telecom (KT) corporation (Republic of Korea)
[66] ITU-D SG1 Document SG1RGQ/318 from ESOA
[67] ITU-R. Report ITU-R F.2323-1 (11/2017), on fixed service use and future trends.

### 5.3.1 Fibre to premises

Optical fibre is capable of delivering high bandwidth, which carries an integrated voice, data and video signal in the access network. It can cover distances of more than 20 km without repeaters.

There are several configurations of fibre-optic wireline network, depending on the terminating point of the fibre: fibre-to-the-home (FTTH), fibre-to-the-building (FTTB), fibre-to-the-curb (FTTC) and fibre-to-the-node (FTTN). In each case, the optical network is terminated at an optical network unit (ONU). The versions of FTTx are differentiated by the location of the ONU. For FTTH, the ONU is located on the subscriber's premises and serves as the demarcation between the operator's and customer's facilities. Examples are **Rwanda**'s fibre-optic connection to rural and remote schools located less than 200 metres from the national fibre-optic backbone,[68] the KT Corporation digital island project in Moheshkhali island in **Bangladesh**,[69] and the use of fibre-optic technology in **China** to connect administrative villages as means of implementing telecommunication universal service pilots.[70]

### 5.3.2 xDSL (twisted pair cable to premises)

The abbreviation xDSL refers to the range of different digital subscriber line (DSL) technologies. Line-length limitations on DSL signal transmission from the telephone exchanges have led to the existence of many types of DSLs:

- ADSL (asymmetric digital subscriber line) is a technology that enables access to interactive broadband services and VoD through copper wire used in the existing local telephone loop. It has evolved to ADSL2 and ADSL2+, whereby it supports one-way transmission at bit rates up to 24 Mbit/s within a maximum efficiency range of 0.3 km.
- VDSL (very high bit-rate digital subscriber line) provides faster data transmission than ADSL, with downstream and upstream rates of up to 52 Mbit/s and 16 Mbit/s, respectively. VDSL2 provides data rates of 200 Mbit/s (down) and 100 Mbit/s (up) with maximum range of within 0.3 km to provide HDTV, voice over IP (VoIP) and general Internet access. **Mali** has used ADSL for its *centres multimedia scolaires connectés* (CSMC) (connected school multimedia centres).[71]

### 5.3.3 Cable television (CATV) (cable to premises)

In some countries, cable television (CATV) networks are commonly used to satisfy demand for video services. The Data over Cable Service Interface Specification (DOCSIS) was published in 1997. It is a standard that defines the addition of high-speed data communications to an existing CATV system. Using DOCSIS, CATV operators offer competing data communications on their video network, with the development of VoIP offering plain old telephone service (POTS)-like service. The latest version of the standard, DOCSIS 3.0, bonds up to eight channels from the network to the terminal, to deliver up to 343 Mbit/s to the optical node. CATV operators offer subscriber access speeds as high as 100 Mbit/s using this technology.

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68 ITU-D SG1 Document SG1RGQ/11 from Rwanda
69 ITU-D SG1 Document 1/66 from KT Corporation (Republic of Korea)
70 ITU-D SG1 Document SG1RGQ/217 from China
71 ITU-D SG1 Document SG1RGQ/42(Rev.1) from Mali [in French]

### 5.3.4 Mobile network (3G/4G/5G)

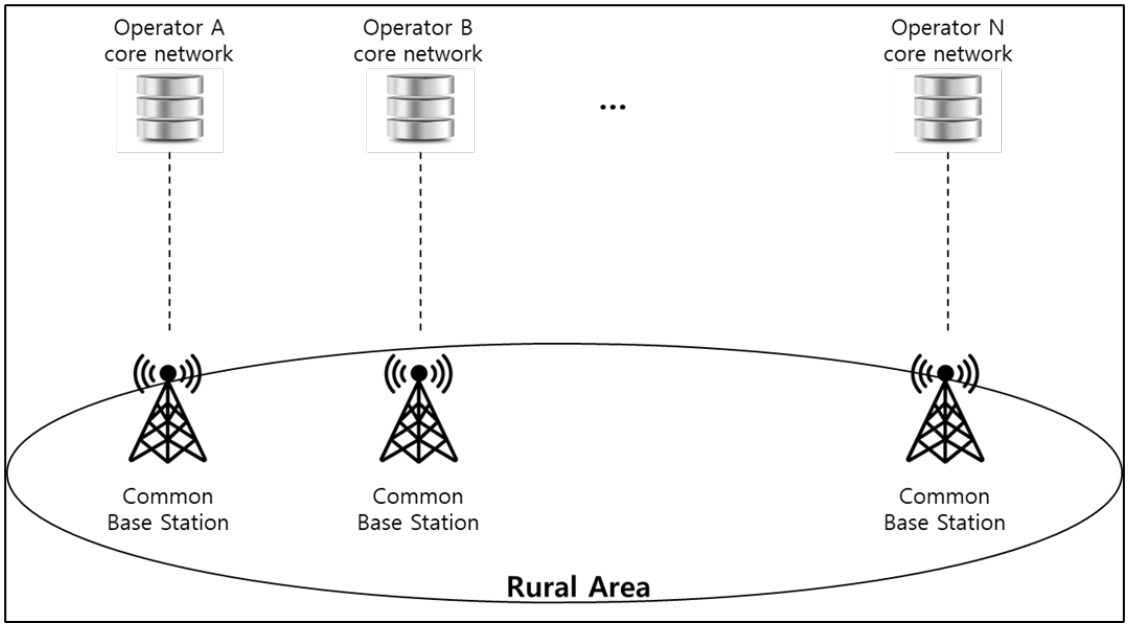
Wireless communications have a wide coverage area. Distinctions are drawn from many perspectives, i.e. fixed vs. nomadic/mobile, licensed vs. unlicensed, as well as point-to-point vs. point-to-multipoint.

To meet the requirements of the different usage, spectrum-regulation and technical network patterns, ITU has drawn up Recommendation ITU-R M.1801, which contains radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz.[72]

These standards support a wide range of applications in urban, suburban and rural areas for both generic broadband Internet data and real-time data, including applications such as voice and videoconferencing. ITU has also adopted Recommendation ITU-R M.2012, which contains detailed specifications of the terrestrial radio interfaces of IMT-Advanced: LTE-Advanced radio interface technology, and Wireless MAN-Advanced radio interface technology.[73] These ITU-R Recommendations and the 3GPP family of standards provide wide choices for modern wireless mobile networks.

Mobile communication technology has entered the 5G era, and in **China** rural areas are also in full swing in terms of the construction of 5G/4G networks. For reasons of cost/benefit, the majority of communication operators in rural areas adopt a "thin coverage" strategy, meaning only areas with significant population and major rural roads are covered. Figure 5 illustrates the typical wireless network structure found at present in rural areas. Each operator has deployed a network of its own, using the typical 5G/4G network structure.

**Figure 5: Schematic diagram of existing wireless network structure in rural areas**




[72] ITU-R. Recommendation ITU-R M.1801-2 (02/2013), on radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz.

[73] ITU-R. Recommendation ITU-R M.2012-4 (11/2019), on detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced).

There are a number of problems with the current wireless networks in rural areas that restrict the development of rural ICTs. First, they are concentrated more in populated areas, which is not necessarily where the farmers work. Secondly, as rural areas are vast in territory and sparse in population, the rural wireless network is generally low speed, and incapable of meeting the demands of hotspot data transmission. Thirdly, each of the multiple operators has deployed its own wireless network, thus pushing up the cost of rural ICT development.

Examples of note are **Rwanda**, where rural and remote schools far away from the national fibre-optic backbone are connected to the backbone by a 4G LTE network;[74] the use of 3G mobile communications to connect rural areas in **Cameroon**;[75] the use of mobile broadband to expand coverage of villages and rural areas in **Brazil**;[76] the use of 5G for rural and remote areas during the 2018 Winter Olympics in the **Republic of Korea**;[77] the use of 4G in **China** to connect administrative villages as means of implementing telecommunication universal service pilots;[78] and mobile connectivity to subregions of **Kenya**.[79] In its latest reports on the global status of 5G, the Global Mobile Suppliers Association (GSA)[80] identifies 769 operators running LTE networks and providing mobile and/or fixed wireless broadband services in 225 countries worldwide in 2019.[81] In 2020, operators in 126 countries had announced that they were investing in 5G by July 2020, while 83 operators were identified as investing in 5G FWA, with 401 devices having been announced as available.[82]

### 5.3.5 Wi-Fi network

Broadband radio local area networks (RLANs), commonly called Wi-Fi, such as those based on the IEEE 802.11 standard, support high-speed access to the Internet over short distances. RLANs, coupled with mesh network architecture, provide extended coverage from hotspots. This Wi-Fi plus mesh arrangement is a convenient way to provide local access networks without licences.

Typical applications are public and private wireless access offered in homes, small offices/home offices (SOHOs), schools, hospitals, hotels, conference centres, airports, shopping centres, etc. Today, broadband RLANs are widely employed for semi-fixed (transportable) and portable computer equipment such as laptops and smartphones that can be used for a variety of broadband applications. The key feature is portability. Wi-Fi provides high data rates and system throughput, but the geographic coverage is limited to about 100 m.

Wi-Fi 6 technology (IEEE 802.11ax) greatly increased throughput, spectrum efficiency and device battery life, compared to earlier versions of the technology, and Wi-Fi technology is now used for a wider range of applications. Availability of licence-exempt radio spectrum in the 6 GHz band promotes the use of Wi-Fi for deployment of broadband to underserved households, thereby helping to bridge the digital divide. **Mali** used Wi-Fi to connect its CMSCs;[83] **Zimbabwe** has recommended the use of Wi-Fi to overcome connection infrastructure challenges faced in

74 ITU-D SG1 Document SG1RGQ/11 from Rwanda
75 ITU-D SG1 Document 1/125(Rev.1) from Cameroon
76 ITU-D SG1 Document SG1RGQ/195 from Brazil
77 ITU-D SG1 Document SG1RGQ/212 from the Republic of Korea
78 ITU-D SG1 Document SG1RGQ/217 from China
79 ITU-D SG1 Document SG1RGQ/256 from Kenya
80 Global Mobile Suppliers Association (GSA): https://gsacom.com/
81 ITU-D SG1 Document SG1RGQ/236 from Intel Corporation (United States)
82 ITU-D SG1 Document SG1RGQ/375(Rev.1) from Intel Corporation (United States)
83 ITU-D SG1 Document SG1RGQ/42(Rev.1) from Mali [in French]

rural and remote areas,[84] as well as the establishment of Internet Wi-Fi gardens;[85] **Sudan** has deployed efforts to use Wi-Fi hotspots in unserved rural and remote areas;[86] the Republic of Korea is working on connectivity to rural areas in **Cambodia** using Wi-Fi technology;[87] **Intel** has submitted detailed information on Wi-Fi 6 technology for consideration in rural areas;[88] **Bhutan** has carried out a pilot project using Wi-Fi technology to enhance the delivery of public services.[89]

### 5.3.6 High-altitude platform systems (HAPS) and unmanned aerial vehicles (UAVs)

Projects and trials are ongoing on UAVs, such as drones, which can serve as mobile base stations to provide connectivity. Airbus's Zephyr, for example, uses a series of lightweight solar-powered UAVs. KT Corporation's Skyship can be used to provide communications, surveillance and monitoring in case of disaster situations.[90]

### 5.3.7 Satellite broadband access

Given their regional and global coverage capabilities, satellites are able to deliver immediate Internet and broadband connectivity, especially to remote and rural areas, using existing satellite resources. Satellite connectivity is utilized for a range of different deployment scenarios in support of last-mile connectivity, such as in providing mobile backhaul in remote and rural areas, community Wi-Fi and direct broadband satellite-to-the-premises.

Very small aperture terminals (VSAT) for end-user premises are now available at a lower cost; and much of the high CAPEX investment for building and launching satellites has already been made by private satellite operators. This means countries can expand last-mile access without having to shoulder the risk of investing in and operating a satellite.

Connecting users with satellite broadband is ideal for lower-density and isolated areas, but it is also important for suburban and other areas where terrestrial solutions alone are not economically viable. Ultimately, a multi-technology approach involving all technologies is key to enabling broadband connectivity everywhere. Satellite technologies have been used to expand and upgrade terrestrial mobile networks in remote and rural areas from 2G to 3G and 4G, often in combination with terrestrial fixed links, and are expected to help backhaul 5G networks in remote and rural areas.[91]

Frequency bands used in satellite communications determine the size of the dish required and their capabilities:

**Satellite frequency band**

- L-band (1.5/1.6 GHz) is used by non-geostationary earth orbit (non-GEO, or non-GSO) and geostationary earth orbit (GEO, or GSO) systems. For GSO systems, large antennas

84 ITU-D SG1 Document SG1RGQ/73 from Zimbabwe
85 ITU-D SG1 Document SG1RGQ/85 from Zimbabwe
86 ITU-D SG1 Document 1/157(Rev.1) from Sudan
87 ITU-D SG1 Document 1/169 from the Republic of Korea
88 ITU-D SG1 Document 1/230 from Intel Corporation (United States)
89 ITU-D SG1 Document 1/251 from Bhutan
90 Ja Heung Koo. Vice-Rapporteur for ITU-D Question 5/1. Broadband technologies in rural and remote areas and key trends in broadband access technologies. Presentation to the *Question 5/1 Workshop on broadband development in rural areas*, 25 September 2019
91 ITU-D SG1 Document SG1RGQ/319 from ESOA

(e.g. 10-20 m diameter) are used on the satellite platform to provide a large number of small spot beams on the Earth's surface. Owing to the limited spectrum available in this range, data rates are limited (currently around 500 kbit/s). L-band frequencies are virtually unaffected by propagation impairments.

- C-band (4/6 GHz) transmissions require larger dishes compared with Ku-band and Ka-band described below. Transmissions in C-band are less affected by rain fade and other weather conditions compared with higher frequencies.
- Ku-band (11-12/14 GHz) has a shorter wavelength, allowing the use of smaller dishes than C-band. However, the higher frequencies make Ku-band more susceptible to atmospheric conditions such as rain fade. Applications include VSAT, rural telephony and broadband, satellite news gathering, backhaul links, videoconferencing and multimedia.
- Ka-band (20/30 GHz) has even shorter wavelengths than Ku-band, allowing even smaller dish sizes. However, transmissions are also even more susceptible to poor weather conditions. High-bandwidth interactive services are possible in this band, including high-speed Internet, videoconferencing and multimedia applications.

**Satellite types by orbit**

- Geostationary (GSO) satellite: Satellites in geostationary orbit are situated at an altitude of 35 800 km and above. They can cover Earth with fewer satellites, and are used for high-capacity broadband Internet, broadcasting and communication purposes.
- Non-geostationary orbiting (non-GSO) satellite: Non-GSO satellites do not stand still with respect to Earth. Different classes of non-GSO satellites are listed below:

  - Highly-elliptical (or highly-eccentric) orbiting (HEO) satellite: Range of operational altitudes between 7 000 km and more than 45 000 km. The inclination angle is selected so as to compensate, completely or partially, the relative motion of Earth with respect to the orbital plane, allowing the satellite to cover successively different parts of Northern land masses (e.g. Western Europe, North America and Northern Asia).
  - Medium-Earth orbiting (MEO) satellite: Satellites in medium Earth orbit are situated at altitudes of 8 000 to 20 000 km and handle high-speed telephone signals and broadband Internet.
  - Low-Earth orbiting (LEO) satellite: Satellites in low Earth orbit are the closest devices to Earth, at altitudes of only 500 to 2 000 km above the Earth's surface. This makes them potentially ideal for future low-latency broadband compared to other satellite technologies. LEO satellites will work in constellations to provide coverage.[92]

### 5.3.8 IMT and land mobile service systems

ITU-R Working Party 5D proposes the use of terrestrial IMT for remote, sparsely populated areas to provide high data rate coverage. The proposed solution could achieve extended coverage as well as high capacity in remote areas through simultaneous use of dual frequency, a lower band for the uplink and a higher band for the downlink, in aggregated configurations.

Relevant ITU-R texts in this regard include Recommendation ITU-R M.819, on IMT-2000 for developing countries[93] and Report ITU-R M.1155, on adaptation of mobile radio communication technology to the needs of developing countries.[94]

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92 See ITU-D SG1 Document 1/326 from Algeria

93 ITU-R. Recommendation ITU-R M.819-2 (02-97), on International Mobile Telecommunications-2000 (IMT-2000) for developing countries.

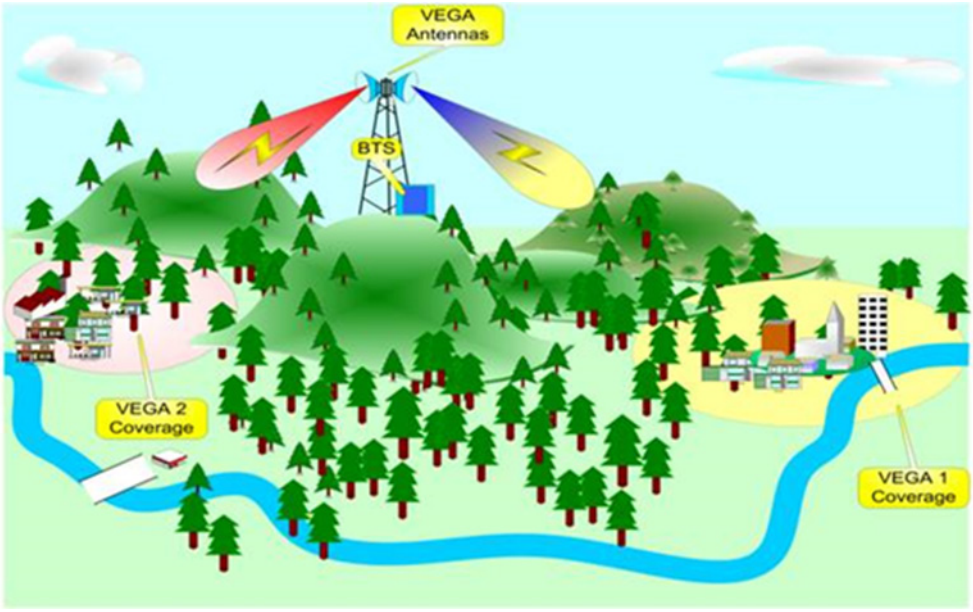
94 ITU-R. Report ITU-R M.1155-0 (1990), on adaptation of mobile radio communication technology to the needs of developing countries.

ITU-R Working Party 5A has issued a guide to the use of ITU-R texts relating to the land mobile service, including wireless access in the fixed service,[95] which is kept up to date on the WP 5A webpage.[96] The guide covers aspects such as the land mobile service, spectrum sharing, different technologies, radiocommunication services related to public protection and disaster relief, intelligent transport systems (ITS), wireless access, trunked systems, cellular systems, cordless telecommunication systems, personal radio and other systems which may be useful in relation to Question 5/1.

**High-gain, narrow-beam antennas on a high-ground strategically placed tower**[97]

With the increased requirements for better wireless broadband applications over rural countryside areas which lack a power source and a backhaul link, Comarcom offers cost-effective tools to achieve this goal. The proposed solution is to use a few high-gain, narrow-beam x-pole antennas on a high-ground strategically placed tower, where power and backhaul exist. Each of the VEGA antennas can cover 15 to 35 km depending on frequency, antenna height, ground surface and vegetation. This way, the expense is split over several service targets.

**Figure 6: High-gain, narrow-beam antennas on a high-ground strategically placed tower**




95 ITU-R. Guide to the use of ITU-R texts relating to the land mobile service, including wireless access in the fixed service.
96 ITU-R. Working Party 5A (WP5A). Land mobile service excluding IMT; amateur and amateur-satellite service.
97 See ITU-D SG1 Document RGQ/365 from ATDI.

### 5.3.9 Internet of Things (IoT)

The Internet of Things (IoT) is a system that can transfer data over a network without requiring human-to-human or human-to-computer interaction, for example to connect home devices and appliances for the "smart home". It can be used as a shared infrastructure for remote and less connected areas, as seen in the contribution on Smart Green Villages submitted by **BDT**,[98] and case-study contributions from **Japan** on the deployment of IoT sensors for a sustainable smart society in the city of Shiojiri[99] and for e-agriculture.[100] When making a decision on the technologies to use, it is important to take into account ITU-R Recommendations relating to channel assignments, nomadic wireless, mobile wireless, multiple Gigabit wireless, Wi-Fi area sensors, trunked and cellular systems, etc.[101]

A multi-technology approach exploiting different technologies is key to enabling broadband connectivity throughout a country, as evidenced by the fact that satellite technologies have been used to expand or upgrade terrestrial 2G, 3G and 4G networks, often in combination with terrestrial fixed links. Deployments to provide backhaul in 5G networks are taking place in **Chile**, **Myanmar**, **Democratic Republic of the Congo** and **Papua New Guinea**.[102]

98 ITU-D SG1 Document 1/150 from the BDT Focal Point for Question 5/1
99 ITU-D SG1 Document SG1RGQ/36+Annex from Japan
100 ITU-D SG1 Document SG1RGQ/39+Annex from Daiwa computer Co. (Japan)
101 ITU-D SG1 Document SG1RGQ/329 from ITU-R Working Party 5A
102 ITU-D SG1 Document SG1RGQ/319 from ESOA

# Chapter 6: Services and applications for rural and remote areas

## 6.1 Applications for rural and remote areas

The Report on Question 5/1 for the 2014-2018 study period highlighted the need for applications geared to rural and remote areas that foster the development of social, agriculture, health, financial and government services. It also recommended that content and services be developed that address the needs of rural and remote areas. This chapter draws attention to current developments that fulfil these recommendations in some way, and also gives updated information on applications relevant to rural and remote communities, and on what is happening on the ground in relation to applications that are of relevance and of practical use for rural and remote areas.

Applications, together with content for each application, tailored to the rural areas of each specific region across the world, and of developing countries in particular, are key to development. They may be designed in the light of natural resources available in a particular region, as industry often develops on the basis of such resources.

It is therefore necessary to equip rural communities with ICT applications, together with the necessary knowledge to exploit these resources effectively. Relevant applications include:

- Applications that help rural communities to move from subsistence exploitation of a specific resource to commercial and diversified exploitation.
- E-health applications for both disease control and prevention. This is particularly important in relation to pandemics such as the COVID-19 pandemic, which has made the need for health-related information even more critical.
- Social networking applications at the individual level, which enable sharing of information between friends and social groups. In the COVID-19 crisis, religious services are now being held virtually, and without access to broadband infrastructure and services the rural communities would not be able to take advantage of these developments.
- E-banking and mobile-banking applications that bring easily accessible and inexpensive banking facilities to unbanked rural communities.
- Teleworking-related applications for what has been popularized as working from home. This has also become critical since the advent of COVID-19, as even small businesses and projects have had to be managed from home.
- Virtual-meeting applications for both business and social meetings which can cut travel and conference-room costs.
- E-marketing applications to enable rural people to market their produce and trade wares and gain access to wider markets.
- Various sector-specific applications for different rural areas, together with relevant content, so as to circulate information relating to health, tourism, training, food, mining and small-scale manufacturing and the attendant services.
- E-government applications that enable government to disseminate information and offer services electronically in rural areas. This should facilitate access to various trade licences, identity documents and other government-issued documents that citizens require.

Examples of some these applications are outlined below:

- Having implemented and promoted the establishment of comprehensive rural information service platforms, such as "agricultural faith and communication" and "information field", to mention only two, **China** and has seen the growth rate of e-commerce in rural areas outstrip that recorded in urban areas for three consecutive years. In 2017, total rural retail sales of goods reached well over 1 trillion Yuan (CNY 1 244 880 million), up 39.1 per cent compared to 2016. These platforms have given farmers fast and convenient access to information on agricultural technology, markets and policy.[103]
- With the help of **Korea Telecom**, e-learning solutions were deployed in Moheshkali island in **Bangladesh** to provide distance learning and resolve a teaching staff shortage. The e-learning application solution saw urban teachers being linked to teach rural students on the island, with the Ministry of Education running a teachers' portal for the purpose. Likewise, mobile e-health solutions, together with scanners, basic x-ray and ultrasound systems, were provided to local clinics and the Moheshkali Upazila health complex.[104]
- ICT-enabled agriculture has been implemented in **Rwanda** through the use of a "digital green projector", which aims to increase agricultural productivity through the dissemination of agricultural knowledge and technical information.[105]
- In **Japan**, the Shiojiri environmental data collection platform and IoT sensor network is designed to protect children and the elderly when they walk alone, predict landslides, predict floods, track public transport arrival and departure times, protect farmers from wildlife, protect citizens from radioactive pollution, predict natural disasters, detect deterioration of buildings and monitor the environment. The data collected by all these sensors are regularly analysed so that appropriate action can be taken to remedy any impending danger, disaster or undesirable state of affairs.[106]
- **Daiwa Computer Co. Ltd, Japan**, developed an ICT-enabled farming application for producing muskmelons in greenhouses which has contributed to generating income both for the company and for collaborating farmers. This ICT-enabled farming method has proved to be cost effective, increased productivity and reduced labour costs for farmers. It is intended to replicate it for other agricultural products.[107]
- **Japan** also shared a study on e-education and agricultural consultation through regular use of portable emergency telecommunication systems in the rural areas of the **Republic of Nepal**.[108]
- **BDT** shared information on work related to smart green villages and Internet of Things (SGVs and IoT). The contribution summarizes two initiatives planned by BDT on SGVs and IoT that may be useful for developing countries, particularly rural and remote villages.[109]
- **China** provided information on the construction and deployment of telecommunication infrastructure as well as management-based big-data platforms to promote universal telecommunication services.[110]
- In 2016, the **Republic of Korea** launched a smart quarantine system project for disease control, following the outbreak of MERS, which has helped the country to deal effectively and accurately with the outbreak of COVID-19 in 2020.[111]

The examples shared above give a snapshot of the current status in terms of the development of the types of applications that can help rural and remote areas achieve the SDGs and improve

[103] ITU-D SG1 Document 1/69(Rev.1) from China
[104] ITU-D SG1 Document 1/66 from KT Corporation (Republic of Korea)
[105] ITU-D SG1 Document SG1RGQ/11 from Rwanda
[106] ITU-D SG1 Document SG1RGQ/36+Annex from Japan
[107] ITU-D SG1 Document SG1RGQ/39+Annex from Daiwa computer Co. (Japan)
[108] ITU-D SG1 Document 1/268 from Japan
[109] ITU-D SG1 Document 1/150 from the BDT Focal Point for Question 5/1
[110] ITU-D SG1 Document 1/331 from China
[111] ITU-D SG1 Document SG1RGQ/380 from the Republic of Korea

the lives of their populations on many fronts. Replicating them in all rural areas would ensure that no rural or remote community is left behind or unconnected.

## 6.2 Complementary access and village connectivity networks

Existing network systems are primarily designed for urban areas, where the necessary supporting infrastructures such as adequate power, buildings and road transport, as well as skilled manpower, are readily available.

It is clear that connectivity models for urban environments cannot simply be transplanted to rural areas. Many and new approaches are therefore required to address rural connectivity gaps.

According to an ITU report on digital inclusion, at end 2018 no fewer than 80 per cent of people in developing countries across the world lacked access to the Internet or had insufficient or slow connectivity, compared to only 45.3 per cent in developed countries.[112]

To address these issues, details of community networks and other small networks that can be used to provide connectivity in rural and remote villages were reported in contributions received during the study period. Furthermore, these issues were explored in detail during the Workshop on broadband development in rural and remote areas hosted by the Rapporteur Group for Question 5/1 on 25 September 2019.[113]

- **Small operators, such as ISPs, community operators and virtual network operators**

  These small entities operate under authorization (less stringent than a licence) and mostly operate for free or pay low fees (unlicensed with free spectrum regime). In some cases, they provide both data and voice services; but in many countries they provide only data and are not allowed to provide VoIP using a number, so as to "protect" the large operators who pay fees. The main challenge with such small operators is their small geographical coverage and the fact that they operate largely in urban areas, mostly covering underserved communities within urban areas where there is network infrastructure to ride on. In **Brazil**, however, they have been intensively used in underserved municipalities.[114]

  While the ITU Plenipotentiary Conference and World Telecommunication Development Conference (WTDC) have not come up with a commonly accepted definition of "community networks", these are often very small networks managed by a community itself, i.e. small do-it-yourself networks. The parties involved can be families, individuals, social groups, organizations or institutions that manage and use networked computers and devices as a means of electronic communication and of sharing knowledge and information within the community. The aim is to improve business efficiency and increase access to information, as well as to improve on traditional communication channels.

  As reported in the Question 5/1 workshop on broadband development in rural areas, community networks have been employed in remote areas in the Amazon rainforest, the Himalayan mountains and some fly-in communities in Northern Canada; and in many countries, particularly Brazil, Mexico, Colombia and other Latin American countries. They can be an effective solution for connecting rural, remote and underserved communities.

  One such network was introduced in **Zimbabwe** at Mpandawana growth point. A further example, spearheaded by the Internet Society (ISOC), is the development of small community networks in Tusheti, in cooperation with **Georgia**'s ISP Association, the local community in Tusheti and the Georgian Government. Tusheti is located in northeast Georgia on the northern slopes of the Greater Caucasus mountains. Internet connectivity has

[112] ITU-D. Digital inclusion. Ensuring inclusive, equal access and use of ICTs for all.
[113] Workshop report in ITU SG1 Document 1/308 from the Co-Rapporteur for Question 5/1, and on the ITU-D website: Session on Broadband Development in Rural Areas.
[114] ITU-D SG1 Document SG1RGQ/195 from Brazil

helped support the economic sustainability of this remote region and create opportunities for communities to sell their local products, as well as to access education, healthcare and government services. Horses were used to move equipment up the mountain.[115]

During the COVID-19 pandemic, community networks around the world have played a major role in supporting their constituencies. Many of these initiatives have expanded beyond the provision of affordable access to a variety of content-related services such as production and sharing of essential health information in local languages, countering misinformation and supporting digital financial services.[116]

- **Commercial arrangements between small local operators and large operators**

  Arrangements whereby large operators allow small local networks to connect to the large network, with the small operators providing the local solution or last-mile connectivity and the large operators providing capacity to connect to the Internet, can also support affordable connectivity for rural and remote villages.

  In the Eastern Cape province of **South Africa**, the rural community of Mankosi collaborated with researchers from the University of the Western Cape to set up a telecommunication cooperative called Zenzeleni Networks Mankosi, which provides solar-powered wireless mesh connectivity to its 3 500 residents. As a licensed ISP, Zenzeleni works directly with incumbent regional network operators EastTel and OpenServe, from whom it purchases backhaul Internet connectivity, reflecting a truly complementary relationship.[117]

## 6.3 Types of access and exchange points

Different types of access points have been used by different countries to facilitate access to telecommunications/ICTs for rural and remote communities, as can be seen from the following examples:

- **India** has been using ICT-enabled kiosks as intermediaries for offering e-government services.[118]
- The **Democratic Republic of the Congo** highlighted the use of telecentres as recommended access points obviating the need for each household to own a portable phone and receiver.[119]
- In **Bhutan,** village networks enable community centres to serve as an access point for the rural population to benefit from government and Internet services.[120]
- **Côte d'Ivoire** launched a project comprising 5 000 community cybercentres in rural areas of 500 or more inhabitants countrywide. The underlying purpose of the project is to provide access to ICTs for all the country's inhabitants.[121]
- **Cameroon** put in place its *télécentre communautaire polyvalent* (PCV) (multipurpose community telecentre), comprising premises in a village with Internet connectivity and computer equipment, capable of providing services such as telemedicine, teleworking, e-agriculture, e-tourism, e-governance, e-commerce, e-learning and basic training in ICTs.[122]
- **Zimbabwe** shared a case study involving its ICT Community Information Centre programme, whose main purpose is to promote access to telecommunications/ICTs for all Zimbabweans, be they in urban, rural or remote areas, and to narrow the digital divide

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115 Workshop report in ITU SG1 Document 1/308 from the Co-Rapporteur for Question 5/1, and on the ITU-D website: Session on Broadband Development in Rural Areas.
116 ITU-D SG1 Document SG1RGQ/386 from the Association for Progressive Communications (APC)(South Africa)
117 Zenzeleni.net. *Molweni nonke*! Welcome to Zenzeleni Community Networks.
118 ITU-D SG1 Document 1/137 from India
119 ITU-D SG1 Document 1/338 from the Democratic Republic of the Congo
120 ITU-D SG1 Document 1/33 from Bhutan
121 ITU-D SG1 Document SG1RGQ/30 from Côte d'Ivoire
122 ITU-D SG1 Document 1/125(Rev.1) from Cameroon

between urban and rural communities, between rich and poor, as well as between genders. The programme provides relevant infrastructure, Internet service, equipment and free ICT literacy training. Noteworthy beneficiaries are, *inter alia*, the entrepreneurially-minded, who gain access to economic information related to their industry and other economic projects and markets; and students, who use community information centres as research facilities enabling them to search for university places and possible employment opportunities.[123]

- **Burundi** established multipurpose community telecentres, in order to connect rural areas and enable residents to connect to broadband Internet, thereby bridging the digital divide. The project was being implemented in four of the country's 18 provinces, with plans to extend it to all provinces by 2025.[124]

It has been observed, however, following the onset of COVID-19 and its attendant lockdowns and restrictive measures, that such communal access points are of limited use during pandemics and can only be ancillary to individual and household connectivity.[125]

## 6.4 Strategies to promote small complementary operators

At WTDC-17 in Buenos Aires (Argentina), opinions were divided on the recognition of community networks, which revealed that there is reluctance on the part of some countries and regions to adopt this solution or accept that community networks can play a significant role in connecting rural and remote areas. One cannot rule out possibility of governments suspecting that community networks may be used to promote anti-government activities. Operators often also see such networks as pirates encroaching on their turf.

Strategies exist, however, that can help deal with these issues and promote the establishment of community networks, namely:

- Engaging government on the benefits of community networks and demonstrating that the objective is to connect rural communities, which is a shared goal for both the communities and government. In a short, obtaining government buy-in is critical.
- Convincing operators that community networks are not pirate networks but can complement major operators, as they serve the areas that are away from the point of presence of major operators, and hence that the relationship is between the community-network operators and the mobile network operator or fixed-network operator is akin to the relationship between relay runners on the same team in the race to connect rural, remote and underserved communities.

## 6.5 Strategies to localize content

One of the key strategies for fostering the generation of local content for ICTs in general and applications in particular is capacity building, which is discussed in detail in Chapter 7 of this report. Once rural and remote communities are conversant with the use of ICTs, they are likely to start sharing local knowledge systems and generate content that can assist their communities.

Another key strategy is policy. Administrations can come up with policies that promote the production of local content. Innovation hubs and innovation programmes driven by policy can go a long way in generating locally relevant content.

[123] ITU-D SG1 Document SG1RGQ/85 from Zimbabwe
[124] ITU-D SG1 Document SG1RGQ/166 from Burundi
[125] ITU-D SG1 Document SG1RGQ/326 from Zimbabwe

## 6.6 Quality of service and sustainability

Given the challenges and prohibitive cost of installing infrastructure in rural and remote areas, quality of service is usually compromised in such areas. The BDT Focal Point for Questions 1/1 and 5/1 drew attention to publications elaborating on the outcomes of two twinning projects in **Europe**, one between Poland and Albania, in which technical specifications were developed for a tool to measure QoS, and the other between Albania and Slovenia, which focused on broadband infrastructure mapping.[126]

In **Sri Lanka**, a study was initiated, called Sanniwedanaya Gamata (communication for rural communities), to identify unserved and underserved areas in the country. The study used a mobile monitoring vehicle to manually check signal strength, and identify areas afflicted by weak signal and service provision. By comparing the results of the investigation with coverage information provided by operators, the Telecommunications Regulatory Commission of Sri Lanka (TRCSL) found that that coverage in the investigated regions was below par. Solutions, such as erecting mobile base stations, were expected to improve broadband coverage in all identified unserved and underserved areas.[127]

[126] ITU-D SG1 Document SG1RGQ/46+Annex from the BDT Focal Point for Questions 1/1 and 5/1
[127] ITU-D SG1 Document SG1RGQ/141 from Sri Lanka

# Chapter 7: Knowledge development, capacity building and training for increased access

Significant efforts have been made in many countries to link rural and remote areas to national backbone ICT infrastructure, install last-mile connectivity, create applications for use by rural communities and improve physical access to ICTs. All these efforts could, however, go to waste unless the rural communities acquire the skills to use ICTs and to some extent maintain the equipment used. Capacity building is therefore an indispensable component of the action that must be taken to ensure that rural and remote communities are not left behind as broadband services are developed. Capacity-building activities were highlighted in a number of contributions to the study under Question 5/1.

## 7.1 Skills requirements

Several contributions under Question 5/1 reported capacity-building activities that have been undertaken by some countries and organizations in order to impart necessary skills to rural and remote communities. These are outlined below:

- In **Zimbabwe**, in connection with the establishment of community information centres (CICs) as access points for rural and remote communities, a training programme was launched in the form of a basic computer skills course incorporating an appreciation of computer applications. Training is carried out by community members who have undergone a train-the-trainer course run by the Postal and Telecommunications Regulatory Authority of Zimbabwe. In 2018, no fewer than 9 012 people had been trained countrywide, free of charge. The basic course empowers people by enabling them to access information on government-initiated development projects, farming inputs, weather, farming methods, combating disease, sanitation and many other aspects of their lives. It enables them to communicate with family and friends, as well as with their business contacts. After the basic course, members of the community can take the advanced course, which covers presentation skills, graphic design, file management, database management, cybersecurity, computer programming and web design, among other skills. The advanced training programme commences once the majority of community members have received the basic training. It provides a foundation for those who wish to take up careers in the ICT field.[128]
- In **Rwanda**, under the pilot phase of its ICT-enabled agriculture programme, designed to increase agricultural productivity through the use of ICTs, an initiative was launched to accelerate the dissemination, at national level, of agricultural knowledge and technical information from the central office of the Ministry of Agriculture to rural farmers. This was achieved through what are called "Farmer Field School" (FFS) facilitators and agronomists, using a digital device known as a "digital green projector". A total of 108 villages benefited from the initiative. FFS facilitators in each village and sector agronomists were trained with basic skills to operate and use the digital green projectors so as to be able to prepare, plan and carry out training in their respective villages.[129]

[128] ITU-D SG1 Document SG1RGQ/85 from Zimbabwe
[129] ITU-D SG1 Document SG1RGQ/11 from Rwanda

- In **India**, under Sanchar Shakti, the Indian universal service obligation fund's scheme for mobile value-added services for rural women, training aimed at skills enhancement is carried out as an integral part of the projects.[130]
- The **United States** has implemented a number of initiatives to enable women and girls to use ICTs and to grow the initiatives until a digital divide no longer exists. These are:[131]

  - **Academy for Women Entrepreneurs (AWE)**

    The Academy for Women Entrepreneurs (AWE) equips women in 26 countries in Latin America, the Caribbean and Africa and in Papua New Guinea with the technical skills needed to create sustainable businesses. Women participating in AWE have access to Dream Builder, a massive open online course (MOOC) on women's entrepreneurship, which is localized and provides country-specific data on business results and successes. As of 2018, it was available in over 65 countries, with over 100 000 learners worldwide.

  - **Women and the Web**

    Women and the Web is a PPP involving USAID, NetHope, Intel Corporation, World Pulse, World Vision, UN Women and Women in Technology in Nigeria. Through digital literacy training, policy work and online social networks, this alliance seeks to address the Internet gender gap by bringing more than 600 000 young women online in Nigeria and Kenya by 2021. So far, the programme has brought 120 000 women online.

  - **Fulbright Teacher Exchange**

    Fulbright Teacher Exchange brings approximately 200 international secondary-level teachers from the developing world to United States universities for educational technology and gender-responsive training. As a result, thousands of these teachers' female students have access to higher education and greater employment opportunities.

  - **Gender Digital Divide online course**

    Developed through FHI 360's mSTAR project and Panoply Digital, this online course introduces development practitioners to the barriers to women's access to and adoption of digital tools, and the impact of the digital gender divide. Participants develop an understanding of key gender and ICT considerations to be taken into account when designing and implementing digital projects and programmes.

## 7.2 Human resources development

In terms of human resources development, it is important for there to be a wide base of trained ICT experts available across the world. A number of initiatives to this end were detailed in contributions submitted during the current study period, including the following:

- **United States**[132]

  - **Community College Initiative (CCI) programme**

    The CCI **programme** provides participants from underserved regions and underrepresented groups with a one-year, non-degree academic programme at a community college in the United States, focusing on IT technical skills, leadership

[130] ITU-D SG1 Document SG1RGQ/32+Annex from India
[131] ITU-D SG1 Document SG1RGQ/187 from the United States
[132] ITU-D SG1 Document SG1RGQ/187, SG1RGQ/347 and SG1RGQ/348 from the United States

development and English-language learning. In 2018, the CCI programme welcomed 146 participants from 12 countries to the United States, where they participated in 20 265 volunteer and 17 550 internship hours.

- **International Visitor Leadership (IVLP) programme**

  The IVLP programme, a professional and cultural exchange programme, is a two-day to three-week professional exchange programme for current and emerging foreign leaders. In 2018-2019, seven projects focused on improving women's involvement in the fields of science, technology, engineering, arts and mathematics (STEAM).

- **TechGirls**

  TechGirls offers girls aged 15 to 17 from the Middle East and North Africa the opportunity to engage in an intensive, three-week exchange programme in the United States. Exchange activities include a technology camp with American peers, site visits with technology companies, job shadowing, community-service activities and home hospitality arrangements. Since 2012, TechGirls has trained and mentored 186 teenage girls.

- **TechWomen**

  TechWomen selects female participants from Africa, South and Central Asia and the Middle East, who take part in a peer mentoring experience with American women at leading science and technology companies in Silicon Valley and the San Francisco Bay area. The programme develops talent in the fields of science and technology, increases the trade capacity of the participating countries, and enables women to reach their full potential in the science and tech industry. Since 2011, 518 women from 22 countries have participated in the programme.

- **Broadband and digital inclusion**

  The United States National Telecommunications and Information Administration (NTIA) provides capacity building to state and local communities and industry stakeholders in order to improve broadband infrastructure and digital inclusion.

  NTIA is also promoting stakeholder engagement to improve broadband deployment in hard-to-reach rural areas in the United States through partnership development and funding.

– **Mali** has introduced ICT into the Malian school curriculum, especially in the basic and secondary levels of education, through multimedia school centres. Priority in the diffusion of ICTs was given to schools and universities in order to improve learning and reduce the digital divide in the education system.[133]

– In **Tanzania**, during implementation of the School Connectivity project, the universal service fund noted challenges in terms of ICT literacy among teaching staff. In order to tackle this problem, the fund engaged the University of Dodoma and the Dar-es-Salaam Institute of Technology to train teachers in the proper use of devices as well as simple computer troubleshooting and maintenance. So far, 800 teachers from public schools have been trained in these domains.[134]

– In **Cambodia**, **KT Corporation** (Republic of Korea) has worked in close partnership with the Ministry of Post and Telecommunications (MPTC) and Telecom Cambodia (TC) on a public Wi-Fi and digital schools project providing free Wi-Fi in public places and distance learning to schools in remote areas, under the e-education objective of the Cambodian

[133] ITU-D SG1 Document SG1RGQ/42 (Rev.1) from Mali [in French]
[134] ITU-D SG1 Document SG1RGQ/77 from Tanzania

ICT Master Plan 2020 and Cambodia Vision 2023. KT conducted local training, both theory and practical training, which is essential in sustaining the project.[135]

- **KT Corporation** (Republic of Korea) is carrying out a capacity-building programme in conjunction with various government agencies, regional governments and NGOs, which has benefited 3.3 million Koreans and 16 000 institutions. Trainees receive information technology qualification certificates.[136]
- In **West Africa**, a workshop was organized in Lomé (Togo) from 26 to 28 June 2019 by the West Africa Telecommunications Regulatory Assembly (WATRA), the Association for Progressive Communications (APC) and Togo's telecommunication regulatory authority, at which policy-makers and telecommunication/ICT regulatory authorities discussed the need to consider community networks as a viable form of connectivity.[137]

It is clear from the contributions received that there is still a lot that needs to be done in relation to capacity building, if the deployment of ICTs to rural and remote areas is to yield the desired results and no-one is to be left behind in the broadband roll-out and ICT access race. More countries need to adopt capacity-building programmes and submit contributions on this subject to studies under the ITU-D Question on rural access so that progress in this area can continue to be tracked.

[135] ITU-D SG1 Document 1/169 from the Republic of Korea
[136] ITU-D SG1 Document 1/384 from KT Corporation (Republic of Korea)
[137] ITU-D SG1 Document SG1RGQ/213 from Côte d'Ivoire

# Chapter 8: Policies and regulations for telecommunications/ICT in rural and remote areas

There are a number policies and types of regulations that administrations can use to promote development of telecommunications/ICTs in and for rural and remote areas. These can be policies or regulations to stimulate investment or demand, to achieve universal access, and to bridge the rural-urban or gender digital divides. This chapter looks at universal service policies and other policies that have been employed by a number of countries.

With regard to policies in general, a number of contributions revealed some good examples, which include:

- The **European Union**'s Connectivity for a European Gigabit Society programme, aiming to ensure that all schools, transport hubs and main providers of public services, as well as digitally intensive enterprises, have access to Internet connections with download/upload speeds of 1 Gbit/s by 2025. It also aims to ensure that all European households, rural or urban, have access to networks offering a download speed of at least 100 Mbit/s, while all major roads and railways should enjoy uninterrupted 5G wireless broadband coverage, starting with fully-fledged commercial service in at least one major city in each EU Member State by 2020.[138]
- The 5G FAST Plan of the **United States**, which consists of three central components, namely freeing up more spectrum for the commercial marketplace, promoting wireless infrastructure deployment and modernizing existing regulations to promote more fibre deployment.[139]
- The **United States** NTIA's strategy to stimulate increased private investment in broadband infrastructure and services in order to fill broadband connectivity gaps, premised on the principles that government processes should be transparent, federal assets should provide the greatest possible benefits to the public and the government should be a good steward of taxpayer's funds.[140]
- The **United States** Department of the Interior's newly launched broadband deployment strategy that strives to overcome the unique rural and remote challenges faced by the indigenous tribal nations. Based on the creation of a new community for engagement, federal authorities worked with tribal leaders, academics, civil society and subject-matter experts to devise a broadband strategy to address severe geographic, topographic and cultural-preservation challenges, in the face of high poverty and low employment rates.
- Examples cited in a contribution from Intel (United States),[141] namely: The rules adopted in the **United States** creating the 5G Fund for Rural America; the **African Union** Digital Transformation Plan; the **Republic of Korea** task force to expand 5G coverage into rural areas through roaming network sharing among SK Telecom Co., KT Corp. and LG Uplus Corp., in areas with low population density; and the **United Kingdom** digital infrastructure for 5G programme.

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138 ITU-D SG1 Document SG1RGQ/371(Rev.1) from Intel Corporation (United States); and European Commission. Shaping Europe's digital future. Connectivity.
139 ITU-D SG1 Document SG1RGQ/328(Rev.1) from the United States
140 ITU-D SG1 Document SG1RGQ/347 from the United States
141 ITU-D SG1 Document 1/462+Annexes from Intel (United States)

- Policy recommendations put forward by **ISOC** to accommodate community networks in licence regimes, recognizing that community networks are an innovative way to meet current Internet connectivity challenges and that the logistics and administration of community networks are less expensive because of their scale and local nature. Community networks are sustainable as they frequently make use of renewable energy such as solar power.[142]
- Policies that enable the assignment of 5G-related low-mid-high frequency bands to operators without delay for the timely introduction of commercial 5G services. (**Intel Corporation**)[143]
- Provision of licence-exempt radio-frequency spectrum, shared spectrum and infrastructure sharing as a means of reducing barriers for community networks, non-profit-making operators and other small operators, recommended by **ISOC**.[144]

## 8.1 Universal service policies and regulations

It was clear from over 80 per cent of the contributions received from various administrations that recourse to a universal service fund for roll-out of broadband infrastructure and services is a policy common to many countries. This was reflected in contributions from Mali, United States, China, Zimbabwe, Burkina Faso, Côte d'Ivoire, Burundi, Russian Federation, Tanzania, Sudan, Rwanda, India, Japan, Haiti, Guinea, Senegal, Madagascar, Cameroon, India, Brazil, Kyrgyzstan, Republic of Korea, Democratic Republic of the Congo and Senegal, analysed by the Rapporteur Group for Question 5/1.

Without repeating what is already covered in other chapters, the concept of universal access has expanded beyond access to basic telephony and data services, to include broadband services, and the role of universal service funds has also changed to accommodate this evolution, resulting in more flexible universal access policies worldwide. Administrations of countries such as the United States and the Republic of Korea have even gone cross-border or international, assisting disadvantaged communities in other countries through their universal service policies. This can be seen from United States activities with regard to ICTs in various countries and the Republic of Korea's work in Cambodia.

### 8.1.1 Regulations

A number of contributions reflected that administrations had created universal service funds or furthered their universal service policies through an Act of parliament or some other law. These laws generally cover the structure of the fund, its source of revenue and utilization of its revenues, as well as its objectives.

- For **Rwanda**, a policy of universal service was formulated as part of the nation's Vision 2020 to turn the country into a middle-income economy. The Universal Service and Access Fund (UAF) was established in 2004 in order to support roll-out of communication infrastructure, and has since been expanded by law to cover literacy training, rural school Internet connectivity, ICT-enabled agriculture, subsidizing the cost of Internet in rural and remote areas and supporting access to ICTs for people with disabilities.[145]
- In **Tanzania**, the Universal Communication Service Access Fund was set up by law in order to help bridge the digital divide between rural and urban communities. To date, it has

[142] ITU-D SG1 Document SG1RGQ/338 from the Internet Society (ISOC)
[143] ITU-D SG1 Document SG1RGQ/375(Rev.1) from Intel Corporation (United States)
[144] ITU-D SG1 Document SG1RGQ/338 from ISOC
[145] ITU-D SG1 Document SG1RGQ/11 from Rwanda

funded school connectivity projects, telemedicine projects and training of teachers, as well as rural communities.[146]

- **Côte d'Ivoire** adopted a decree on 19 November 2014 setting out contribution rates for a fund for the allocation of ICT/telecommunication-sector resources to public ICT infrastructure. Each telecommunication service provider pays 5 per cent of its previous year's turnover into the fund. However, up to 50 per cent of this contribution can be offset by the operator by financing public ICT projects. This has led, for example, to financing of the digital library at Alassane Ouattara University to facilitate student research, and the hosting of inter-school technology and telecommunication days.[147]
- In **Senegal**, a number of decrees have been used to implement universal access and support the country's Electronic Communication Code. The country also established a well-structured, participative and transparent governance model for the Universal Service Access Fund and the policies that relate to it.[148]
- Six countries whose universal service missions were studied by **Senegal**, namely **Malaysia**, **Colombia**, **Morocco**, **Ghana**, **Côte d'Ivoire** and **Uganda**, were found to have developed appropriate policies which reflected the political will to operationalize their universal service funds effectively, as can be seen from the following observations made by Senegal in its contribution on the subject:

  - In all cases, there was political will to implement universal service with a diversified source of revenue.
  - Each of the six countries had a regulatory framework that clearly defined "access" and "universal service".
  - All six countries had concrete projects running within the framework of universal access and service and the funds. The type of project depended on the needs of each country.
  - The financial resources of each of the funds were not used for other purposes, only those for which the universal service funds were set up.[149]

- In a contribution analysing the universal service approach in the Economic Community of West African States (ECOWAS) and West African Economic and Monetary Union (WAEMU), **Senegal** recommended sharing experiences and best practices among regional members, prioritizing education, health, agriculture, fishing, the financial industry and other key industries, as well as the requirements of people with disabilities, as integral to any universal access policy.[150]
- Starting with a decree establishing the objectives and guidelines of public telecommunication policies, **Brazil** issued a series of decrees which resulted in a number of initiatives described below:

  - The Broadband in Schools programme (PBLE), which sought to connect all urban public schools to the Internet free of charge
  - The National Broadband programme (PNBL), which offered concessions to operators to expand broadband into rural and remote areas
  - The "Intelligent Brazil" programme, which implemented incentives and financing mechanisms for industry players to expand their broadband networks
  - The Structural Plan for telecommunication networks
  - Frequency spectrum auctions, used to stimulate network expansion in Brazil.[151]

146 ITU-D SG1 Document SG1RGQ/77 from Tanzania
147 ITU-D SG1 Document SG1RGQ/165 from Côte d'Ivoire
148 ITU-D SG1 Documents 1/160 and SG1RGQ/175+Annex from Senegal
149 ITU-D SG1 Document SG1RGQ/43 from Senegal [in French]
150 ITU-D SG1 Document 1/152 from Senegal
151 ITU-D SG1 Document SG1RGQ/195 from Brazil

– The **United States** provided useful information – and what could become best practice – in regard to the management framework of a universal service fund, in order to accelerate broadband connectivity in rural areas. Universal access goals were expanded in the Telecommunication Act of 1966 to include telecommunications and high-speed Internet for consumers at just, reasonable and affordable rates. Other principles were also added, so that the United States' Universal Service Fund (USF) also supports schools, libraries and rural healthcare entities. This is done through the High-Cost programme (also known as the Connect America Fund), the Lifeline programme, the Schools and Libraries programme and the Rural Healthcare programme.

  While FCC has overall management and oversight of the USF, the fund's operations are carried out by the Universal Service Administrative Company (USAC), which is the designated permanent administrator of all four USF support mechanisms. USAC collects contributions, disburses support funds, advises FCC and provides informative data, as well as educating stakeholders on how to participate in the USF programmes.[152]

  This set-up is different from the set-up in most countries, where the universal service fund is run by a government ministry or comes under the regulator, which may in some cases compromise independent decision-making, particularly as the relevant government ministry may be responsible for overseeing state-owned telecommunication companies.

## 8.2 Policy assistance to other countries

Some of the contributions submitted also highlighted examples of policy assistance provided to other countries:

– The **United States** has developed policies designed to assist other countries, with particular focus on developing countries. Through these policy tools, the United States has helped other countries through technical assistance for network expansion and digital inclusion projects, as well as policy assistance and capacity building, as outlined below:[153]

  - **Mawingu network**: USAID worked with the Government of Kenya, Nethope, Microsoft and Mawingu Networks, a local tech start-up, on the use of TV white space (TVWS) technology and solar units to extend Internet access to remote communities in Kenya.[154]
  - **Recover.IT**: **T**hrough a PPP between USAID and the Orange group, USAID worked to improve ICT infrastructure for connectivity in order to fight Ebola in Liberia.[155]
  - **Jamaica Rural Broadband** project: In an effort extend last-mile connectivity to 31 new sites, including schools, community centres, police stations and health clinics, USAID worked with Nethope, Microsoft, Jamaica Universal Services Fund and the Jamaica Ministry of Science and Technology, to expand broadband to rural Jamaica.[156]
  - In **Lebanon**, USAID focused on two rural communities, Ghazza and Sebhel, to get 80 per cent of the population in these rural areas covered.
  - The Dadaab connectivity project in **Kenya** brought connectivity to Somali refugee camps and five local community centres to support education, medical programmes and youth-related projects. These policy tools have also seen USAID support GSMA in developing a platform that provides mobile coverage.[157]

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[152] ITU-D SG1 Document 1/327(Rev.1) from the United States
[153] ITU-D SG1 Document SG1RGQ/193 from the United States
[154] USAID. Case study. Delivering Low-Cost Broadband to Rural Kenya.
[155] Inveneo. Inveneo Launches New Rural Connectivity Project in Liberia with USAID.
[156] Nethope Solutions Center. The Jamaica USF, USAID, NetHope, Microsoft and FLOW deliver TV White Space Pilot to Jamaica. 27 April 2016.
[157] Nethope. High speed Dadaab network connects refugees to family, support and opportunities.

- Beginning in October 2016, **KT Corporation** (Republic of Korea), with assistance from the Bangladesh Government, constructed telecommunication infrastructure in Moheshkhali island in **Bangladesh** which connected three unions, an information technology space (containing IT and business education areas) and 25 government-related organizations that included schools and clinics.[158]
- The work carried out by **KT Corporation** in **Cambodia** to install public Wi-Fi for schools and public places, reported in Chapter 7, is another good example of cross-border assistance.[159]

## 8.3 Other key findings and conclusions from various contributions

- The method used for financing universal service must promote economic efficiency and not distort the economic behaviour of operators or markets.
- The fund must allow competition and stimulate additional investment.
- The contribution scheme must be fair and reasonable.
- No operator, licensee or other supplier should be privileged and no technology should be favoured.
- When drawing up telecommunication/ICT development policies, it is important to focus on the strong link between WSIS action lines and the SDGs of the 2030 Agenda for Sustainable Development.
- Policy should allow diversification of sources of funding for universal service/access.
- Policy-makers are encouraged to adopt policies that support mobile operators' efforts to provide affordable mobile Internet services. This includes:
  - consider reviewing sector-specific taxes which have an impact on the price of telecommunication mobile devices and the costs of providing mobile Internet services;
  - adopt pro-investment policies in areas such as spectrum policy and planning;
  - provide open and non-discriminatory access to state-owned public infrastructures.[160]
- There is need for policy-makers to remove barriers to the deployment of broadband access in their countries.
- Regulators need to avoid prescribing artificial requirements, such as unrealistic speed requirements and latency.[161]
- **China** highlighted telecommunication universal service policy and practices in China, which include measures that promote the construction of rural information infrastructure and mechanisms to achieve deep network coverage in rural and remote areas as well as encouraging residents in poor areas to use broadband.[162]
- The policy pursued by **China** of poverty alleviation through broadband network roll-out, resulting in rural e-commerce, online education and online medical care, has seen an increase in rural Internet users of 33 million since 2018.[163]
- **China Telecom** came up with an innovative policy of ensuring universal service and access for Sichuan Province, which has a poor economy and is characterized by complicated terrain, thereby reducing the digital divide. The approaches used are aimed at ensuring network construction and incentivizing network use in the area, by designing packages and tariffs that are cheaper and tailored to the communities. Smartphones and broadband terminals were offered for free.[164]

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158 ITU-D SG1 Document 1/66 from KT Corporation (Republic of Korea)
159 ITU-D SG1 Document 1/169 from the Republic of Korea
160 ITU-D SG1 Document 1/389 from GSMA
161 ITU-D SG1 Document SG1RGQ/319 from ESOA
162 ITU-D SG1 Document SG1RGQ/217 from China
163 ITU-D SG1 Document SG1RGQ/341 from China
164 ITU-D SG1 Document 1/375 from China

- **India** shared its Universal Service Obligation Fund (USOF) model, including rules and regulations, resources for collecting the universal service levy, and major programme projects. Alongside public service providers, private telecommunication service providers are creating infrastructure in remote and rural villages, and providing telecommunication services, with subsidies from USOF. The BharatNet project is the first pillar of the Digital India programme, and has been hailed as the largest rural connectivity project of its kind in the world.[165]
- In a contribution by **Intel Corporation** (United States) providing updated information on the global status of 5G and its importance for developing countries, it was suggested that the assignment of 5G-related low-mid-high frequency bands to operators was important for the timely introduction of commercial 5G services.[166]
- In the **United States**, FCC used a reverse-auction system to efficiently and effectively allocate limited government funds to broadband providers for last-mile broadband deployment and connectivity in rural and remote areas. FCC plans to use this regulatory tool in its universal service programme going forward. In a reverse auction, broadband providers compete to roll out broadband to a specific number of locations in an unserved area for the smallest government subsidy. FCC's Connect America Fund Phase II Auction (CAF II Auction) successfully used a reverse-auction solution to help bridge the digital divide between urban and rural communities.[167]
- **BDT** has elaborated a toolkit for regulators, governments, service providers and communities to address inadequate communication service delivery in developing countries. It offers last-mile connectivity solutions to connect the unconnected in developing countries.[168]
- The **Global Symposium for Regulators** has developed Best Practice Guidelines which recognize that flexible and innovative policy and regulatory approaches can support and incentivize digital transformation. These best practices allow regulators to respond to the changing landscape and address the continuing need for secure and reliable ICT infrastructure and affordable access to and delivery of digital services, as well as protecting consumers and maintaining trust in ICTs.[169]

The technologies and solutions discussed in this report are generally subject to regulation. It is therefore important to look at the regulatory models used and make recommendations for effective last-mile connectivity for rural and remote areas.

Regulators usually license large mobile-service and satellite providers, with large coverage. These large operators are often reluctant to serve rural and remote areas which they consider as uneconomic. It is therefore important to formulate licensing models that can be used for connecting rural and remote areas. These include the MVNO model, where operators who do not own infrastructure can offer services by riding on the infrastructure of a larger operator; the community network model, where small and medium operators are run by local entrepreneurs, cooperative ventures or groups; and the hybrid model, which combines both large and small operators.

165 ITU-D SG1 Document SG1RGQ/229 from India
166 ITU-D SG1 Document SG1RGQ/375(Rev.1) from Intel Corporation (United States)
167 ITU-D SG1 Document SG1RGQ/209 from the United States
168 ITU-D SG1 Document 1/362+Annexes from BDT
169 ITU-D SG1 Document SG1RGQ/56+Annexes from the BDT Focal Point for Question 6/1. See also: ITU. Global Symposium for Regulators (GSR). Best-practice guidelines on new regulatory frontiers to achieve digital transformation. *GSR-18*, Geneva, 9-12 July 2018.

For this to happen, regulators and existing large network operators need to keep an open mind and remove regulatory barriers in order to encourage investment and lower operational cost. The United States FCC has made efforts to reduce regulatory barriers to investment created by local regulatory fees, one-time application fees, annual recurring fees and discriminatory gross revenue fees in order to tackle access and affordability problems.

# Chapter 9: Conclusions and guidelines

## 9.1 Conclusions

This chapter covers the main conclusions of the current study in relation to a number of aspects, under appropriate sub-headings for each aspect.

### 9.1.1 Challenges

- Challenges arising from difficult geographical access and lack of adequate power and good road infrastructure, including inadequate bridges, highlighted in previous study periods remain very real in the current study.
- Long distances over rough roads and dangers from wildlife affect the maintenance of infrastructure and result in lengthy downtimes.
- Low demand for telecommunications/ICTs due to low consumer incomes and sparse populations, which discourages investment in ICTs in rural and remote areas, remain a challenge to the creation and installation of telecommunication/ICT infrastructure, as well as the provision of services.
- The cost of constructing, installing and upgrading ICT infrastructure is dependent on the availability of power and access road networks, and these have to be developed as a prerequisite for creating robust and reliable ICT infrastructure.
- Power supply for consumer equipment and devices is a critical ingredient or enabler for the deployment of broadband services.
- Current government policies and procedures such as high licence fees and delays in land-use approvals affect the speedy development of ICTs.
- Uncoordinated development activities such as road expansion and laying of electrical cables result in frequent damage to telecommunication cables.
- High taxes and levies continue to push up operating costs for investors and operators.
- Competing service providers are usually reluctant to share infrastructure construction and installation costs.

### 9.1.2 Needs and requirements of rural and remote areas

- The social and economic needs of rural and remote communities are significant in terms of e-education, e-agriculture, financial inclusion (e-banking) and e-health.
- Empowering rural and remote areas with knowledge in the use of ICTs helps prevent unnecessary rural-to-urban migration in the age groups between 15 and 55 years.
- There are no one-size-fits-all solutions in terms of the type of technologies that can be used to connect rural and remote areas.
- There is a need for security for remote base stations, which can be costly, as they are often tampered with and items like diesel for generators or power batteries are prone to theft.

### 9.1.3 Demand

- Demand for multimedia services is a function of broadband roll-out, capacity building in ICTs and the need for communication between individuals, social groups and relatives.
- Lack of relevant local content continues to affect demand for services in rural and remote areas.

- Lack of awareness of the benefits of telecommunications/ICTs and non-affordability of devices results in low demand for broadband services.
- Culture also hampers uptake of ICTs, particularly by women.
- Policy interventions can help bridge the gender digital divide.
- Considerations in the development of telecommunications/ICTs have hitherto concentrated on supply-side issues, with very little focus on the demand side.
- The current focus is on last-mile connectivity.
- There is no single financing structure or model that can be applied to all projects, and some tend to be more successful than others.

### 9.1.4 Financing mechanisms

- Competitors are reluctant to share the cost of investment in infrastructure for rural and remote areas.
- The universal service funds across the world have been shouldering the bulk of the financing for telecommunication/ICT projects, including construction of infrastructure, capacity building and development of applications for rural and remote areas.
- Partnerships have played an important role in reducing the financing burden.
- There are no one-size-fits-all financing models for infrastructure development and ICT access programmes: countries need to explore various options, which include funding from financial institutions, support from a universal service fund, government subsidies, partnerships (public-public, private-public, public-non-governmental) and regional cooperation.
- Partnerships between BDT and various administrations are helping in financing ICT infrastructure and capacity building.
- Universal access programmes such as community information centres are a cost-effective public tool which offer a good opportunity for stimulating economic growth and alleviating poverty in developing countries.
- The use of universal service funds has evolved to include funding of Internet connectivity projects, as well as ICT-assisted educational and agricultural programmes.
- Community networks are one of the options available to meet current Internet connectivity challenges, and the logistics and administration of community networks are less expensive because of their scale and local nature. They can also be sustainable as they frequently make use of renewable energy such as solar power.

### 9.1.5 Access points

- Cooperation among neighbouring countries is key to enabling landlocked countries and small islands to access submarine cables for the development of their ICT networks and to create robust communication systems.
- ICT access points such as village networks and ICT community information centres or telecentres constitute a good facility-sharing mechanism for universal access and bridging the rural-urban digital divide.

### 9.1.6 Technologies

- In addition to technologies highlighted in previous studies, additional and updated technologies have been identified in the current study as having the potential to enhance rural connectivity. However, in a nutshell, these are still either wireline or wireless and utilize optical cable, copper-cable, mobile terrestrial and satellite technologies.
- The construction of submarine cables that link continents and developed and developing countries plays a major role in connecting rural and remote areas.

- Wi-Fi technology in the form of Wi-Fi hotspots is increasingly being used to connect localities in rural and remote areas, homes, schools, hospitals, hotels, conference centres, airports and shopping centres.
- High-altitude platform systems (HAPS) and unmanned aerial vehicles (UAVs) have been used as mobile base stations in some instances.
- 5G networks are being employed for last-mile connectivity in some countries.
- ITU has drawn up Recommendation ITU-R M.1801, containing radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz, which support a wide range of applications in urban, suburban and rural areas, for both generic broadband Internet data and real-time data, including applications such as voice and videoconferencing.
- There are a number of problems with the current wireless networks in rural areas that restrict the development of rural ICTs. The networks are also concentrated more in areas with large populations, regardless of where farmers actually work.
- Given their regional and global coverage capabilities, satellites are able to deliver immediate Internet and broadband connectivity directly to the home, even for remote areas, using existing satellite resources. This technology has become a viable alternative to deploying fibre optics, especially in rural and remote areas, and equally in high-density urban areas where it would not be physically or economically feasible to deploy optical fibre.
- As governments seek to ensure mobile connectivity for all citizens, satellite backhaul will continue to play a role in providing connectivity to rural and remote regions.
- Developing countries can start working on Internet of Things (IoT) bit by bit with their limited resources.
- Wi-Fi and IMT convergence towards 5G spans a range of domains and reflects the potential that both these technologies possess to jointly redefine wireless connectivity, as each carves out its own role within the wireless infrastructure.

### 9.1.7 Applications

- The following applications have become a necessity for rural and remote areas:

  - Applications that help rural communities to move from subsistence exploitation of a specific resource to commercial and diversified exploitation.
  - E-health applications for both disease control and prevention, particularly in relation to pandemics such as the COVID-19 pandemic, which has made the need for health-related information even more acute.
  - Social networking applications at the individual level, which enable sharing of information between friends and social groups, especially in the COVID-19 crisis, where virtual meetings and communication have become the norm.
  - E-banking and mobile-banking applications that bring easily accessible and inexpensive banking facilities to unbanked rural communities.
  - Teleworking-related applications for what has been popularized as "working from home", which have become critical since the advent of COVID-19, as even small businesses and projects have had to be managed from home.
  - Virtual-meeting applications for both business and social meetings that cut travel and conference room costs and enable people to meet even during lockdown periods.
  - E-marketing applications to enable rural people to market their produce and trade wares and gain access to wider markets.

- Various sector-specific applications for different rural areas, together with relevant content, so as to circulate information relating to health, tourism, training, food, mining and small-scale manufacturing, and the attendant services, which form a good foundation for a rural digital economy.
- E-government applications that enable government to disseminate information and offer services electronically in rural areas, which have become a necessity on the road to achieving the SDGs.

### 9.1.8 Capacity building

- Rural communities often lack the skills to use ICTs and to some extent maintain the equipment used. Capacity building is therefore a necessary component of the action that must be taken to ensure that rural and remote communities are not left behind as broadband services are developed.
- A lot of work has been done by ITU and individual countries and institutions to build the required capacity to support access to and use of ICTs by rural and remote communities.

### 9.1.9 Policies

- Many countries have promulgated laws or legal instruments to guide the implementation of universal access programmes, particularly in respect of how the universal access levy should be collected and how the revenues should be allocated for the deployment of telecommunications/ICTs.
- BDT has put together a toolkit for regulators, governments, service providers and communities, to address inadequate communication service delivery in developing countries and provide last-mile connectivity solutions to connect the unconnected in the developing world.
- The Global Symposium for Regulators (GSR) has developed Best Practice Guidelines which recognize that flexible and innovative policy and regulatory approaches can support and incentivize digital transformation.
- Regulatory policies, in the form of high licence fees, levies and taxes and cumbersome land-use approval regimes, can be a barrier to deployment of telecommunications/ICTs for rural and remote areas.

## 9.2 Guidelines for Member States

In order to address the challenges that affect the creation, upgrading and maintenance of infrastructure, the following measures are proposed:

- Telecommunication/ICT regulators are encouraged to make an effort to cooperate with energy and transport regulators, municipalities and local authorities when formulating policies.
- Allocate, where and when absolutely necessary, some of the financing from universal service funds to assist the energy and transport sectors where necessary in order to ensure availability of the necessary power and transport infrastructure required for ICT infrastructure to be rolled out.
- Use renewable energy to power base stations and other network equipment.
- Adopt pro-investment and balanced policies.
- Focus may be in the following order:
  - National backbone infrastructure
  - Last-mile connectivity

  - Basic data and voice services
  - Internet access provision
  - Relevant applications for rural and remote communities
  - Local content generation and content relevant to specific rural populations
- Encourage shared infrastructure investment and sharing.
- Use frequency-spectrum auctions to finance rural ICT infrastructure.
- Attach obligations to connect rural and remote areas when allocating radio-frequency spectrum.
- Regulators and existing large network operators need to keep an open mind and remove barriers in order to encourage investment and lower operational costs.
- It is important to use an optimum mix of licensing models for connecting rural and remote areas. The mix can include the MVNO model, whereby operators who do not own infrastructure can offer services by riding on the infrastructure of a larger operator; the community network model, where small and medium operators are run by local entrepreneurs, cooperative ventures or groups; and the hybrid model, which combines both large and small operators.
- "Dig once" policies may be implemented in relation to the laying of fibre, in order to make the cost of installation affordable, while at the same time keeping service fees low.
- Policy interventions including tax breaks and duty breaks can go a long way to increasing investment.
- Flexible universal fund policies which allow diversification of revenue sources, independent management of financial resources and flexible disbursement of resources are recommended for achieving universal access and the objectives under the WSIS action lines, leading to achievement of the SDGs.
- Governments are encouraged to consider welcoming a wider range of technological solutions, including emerging technologies, in order to encourage innovation and broadband deployment in rural and remote areas.
- Creation of local content is critical in stimulating demand. Production of content services and applications should therefore be a key component of policy.
- Telecommunications/ICTs need to be an integral part of all education curricula in every country, and capacity building a key component of every country's ICT policy.
- Universal access needs to be taken into account when telecommunication development policies are formulated, with particular focus on the strong link between the WSIS action lines and the SDGs.
- Policy-makers are encouraged to adopt policies that will support efforts by operators to provide affordable Internet services, particularly through the removal of sector-specific levies and taxes.
- ICT policy-making needs to take into account the needs of persons with disabilities and incorporate obligations relating to such people when licensing operators.
- Governments can consider making land available for the installation of telecommunication towers, and having clear policies and a precise idea of the role of each government department in the document approval chain for facilitating installations.
- An enabling environment needs to be created where no service provider or technology is favoured.
- Operators and investors are encouraged to consider efficient, cost-effective and fast deployment technologies and business and policy models to improve accessibility.
- Operators are encouraged to consider upgrading 2G network sites to 3G, 4G or 5G.

In other areas, the following measures are considered useful:

- Develop national/regional strategies and targets for the transition to high-speed broadband networks to facilitate 5G.
- Determine national and priority coverage areas for high-speed broadband connectivity.
- Provide a sufficient amount of radio-frequency spectrum for 5G and adopt a technology/service-neutral approach in the licensed 3G/4G frequency bands for the transition to 5G.
- Provide sufficient spectrum for advanced Wi-Fi access technologies.
- Provide sufficient access to spectrum for use by satellites, including by high-capacity satellite services.
- Implement high-speed fixed wireless access (FWA) technologies in both urban and rural areas.
- Promote facilities-based competition. Competition in broadband needs to be encouraged, not only at the user access level, but also across all of the segments of the broadband value chain (access networks, backbone and international connectivity).
- Promote investments in new fibre-optic networks and other high-speed wireless broadband infrastructure.
- Promote cost-effective complementary access solutions to bridge the digital divide, by exempting them from licence and spectrum fees.
- Consider benefiting from the budget/funds available to various ministries and municipalities by developing joint projects in areas such as e-agriculture, e-health, e-learning, smart cities, etc.
- Implement measures to cut infrastructure deployment costs.
- Implement a sound taxation regime in respect of broadband-related devices and services in order to reduce the cost of ownership, thereby making high-speed broadband more affordable.
- Develop a national broadband roadmap.
- Consider including in the terms and conditions of licences obligations to meet specified coverage, deployment, speed or other quality-of-service requirements.
- Implement effective ICT policy and regulation to pave the way for the deployment of very high-capacity networks (VHCNs) such as fibre, DOCSIS cable and 5G mobile.
- Stimulate demand by increasing broadband awareness and digital literacy, emphasizing the promotion of high-touch distribution channels, and accelerating the uptake of high-speed broadband.
- Implement demand-creation programmes.
- Increase the amount of relevant local content and applications, particularly those related to education, government services and economic productivity.
- Engage local stakeholders, encourage public-private partnerships and create, centralize and share information widely. Create cohorts that can work together and learn from each other much faster than they would otherwise, for example: digital inclusion leaders' networks, city-planning cohorts, sovereign tribal leaders with national authorities and subject-matter experts, and a variety of smart-city and community groups.
- Use data to drive policy.

# Annex 1: Case studies presented by Member States/Sector Members/Associates/Academia, and their regions[170]

| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 1 | 1/29 | International Internet connectivity of the Central African Backbone (CAB) fibre-optic project, Central African Republic component | Central African Republic/AFR | *international Internet connectivity; CAB; fibre-optic; Central African Republic component* | 2, 3, 4, 5, 8 |
| 2 | 1/30 | Empirical analysis of factors determining mobile-broadband penetration in sub-Saharan Africa | Higher Multinational School of Telecommunications (Senegal)/AFR | *penetration; broadband; adoption; Africa* | 1, 2, 3, 8 |
| 3 | 1/33 | Village Network in Bhutan – Building the digital divide | Bhutan/ASP | *ICT; rural; network; infrastructure; community; ICT services* | 2, 3, 4, 5, 6, 7 |
| 4 | 1/44 | Current situation, mechanisms and constraints in ensuring widespread availability of telecommunication/ICT services in rural and isolated areas | Burundi/AFR | *Ensuring widespread availability of telecommunication/ICT services in rural and isolated areas* | 1, 2, 3, 4, 8 |
| 5 | 1/57 | Submarine cable connectivity from mainland to other small islands with government funding to provide reliable telecommunications and to increase broadband penetration in rural and remote islands | India/ASP | *Universal Service Obligation fund; ASEAN; SAARC; LDCs; LLDCs; SIDS* | 1, 2, 3, 4, 5, 8 |
| 6 | 1/66 | Study topics for Question 5/1 in the current study period | Korea Telecom Corporation (Rep. of Korea)/ASP | *broadband; ICT solution/application; public-private partnership; job* | 2, 3, 4, 5, 6, 7 |
| 7 | 1/69 (Rev.1) | Expanding the new space for rural information consumption | China/ASP | *rural; information consumption; new space* | 1, 2, 3, 6, 7 |
| 8 | 1/125 (Rev.1) | Broadband connectivity model for rural areas of developing countries | Cameroon/AFR | *broadband connectivity; rural areas of developing countries* | 2, 3 |
| 9 | 1/133 | Survey on the status of ICT access and use in the rural areas of Madagascar | Madagascar /AFR | *Internet; ICTs* | 2, 3, 6 |
| 10 | 1/136 | Uncovered villages: Method to find out number of uncovered villages and government initiatives to provide mobile coverage | India/ASP | *access; villages* | 1, 2, 3, 5, 6 |
| 11 | 1/137 | Identifying determinants of satisfaction of intermediaries working as social entrepreneurs in rural and remote areas of LDCs and developing countries for delivery of e-government services | India/ASP | *common service centres; e-government; service delivery; rural; developing countries; social entrepreneur* | 1, 2, 3, 6, 8 |
| 12 | 1/140 | Telecommunications/ICTs for rural and remote areas | Guinea/AFR | *ICTs; broadband connectivity; development of rural and remote areas* | 2, 3, 4, 6, 8 |
| 13 | 1/152 | Chapter 8: Public and regulatory policies relating to telecommunications/ICTs for rural and remote areas | Senegal/AFR | *public policies; legal framework; universal service/access; rural and peri-urban areas* | 8 |

[170] The six ITU-D regions are: Africa (AFR), the Americas (AMS), the Arab States region (ARB), Asia and the Pacific (ASP), the Commonwealth of Independent States region (CIS), Europe (EUR)

## (continued)

| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 14 | 1/157 (Rev.1) | Technology and strategy deployment to modernize the ICTs in rural and remote areas – Sudan case study | Sudan/AFR | *access telecommunications and information technologies; modern technical solutions; broadband* | 1, 2, 3, 4, 5, 6, 8 |
| 15 | 1/160 | Overview of the study to update the universal service strategy in Senegal (Part 2) | Senegal/AFR | *update; strategy; legal framework; universal service/access; rural and peri-urban areas* | 1 ,2, 3, 4, 6, 8 |
| 16 | 1/169 | ICT improvement initiatives in public and remote areas | Rep. of Korea/ASP | *broadband; ICT solutions; public Wi-Fi; public-private partnership; distance learning; remote areas; Broadband Commission report; capacity building* | 1, 2, 3, 4, 6, 7 |
| 17 | 1/201 | Current practices, best practice, mechanisms and policies for deployment of ICTs in rural and remote areas and building ICT skill sets: Perspective from Zimbabwe | Zimbabwe/AFR | *ICT skill sets; rural and remote areas; case study* | 1, 2, 5, 6, 7, 8 |
| 18 | 1/224 | Transition to high-speed, high-quality mobile broadband networks (5G) | Intel (United States)/ AMS | *5G (IMT-2020); high-speed; high-quality; mobile; broadband; transition* | 5 |
| 19 | 1/225 | Affordable and reliable optical cable backhaul solution standardized at ITU-T for use on the ground's surface to air to water in a DIY manner | Waseda University (Japan)/ASP | *urban-rural digital divide; affordable; reliable; optical cable; backhaul; on the ground's surface* | 5 |
| 20 | 1/230 | Importance and evolution of Wi-Fi | Intel (United States)/ AMS | *Wi-Fi; high-speed; wireless; broadband access; evolution* | 5 |
| 21 | 1/245 | Broadband demand programmes and financing mechanisms, for rural and remote areas | Intel (United States)/ AMS | *broadband; demand; finance* | 3, 4 |
| 22 | 1/251 | Wi-Fi hotspot for public service delivery | Bhutan/ASP | *Wi-Fi hotspots; public service* | 6 |
| 23 | 1/254 | Connecting the unserved – Broadband access networks and trial with TV white space technology | Bhutan/ASP | *TV white spaces (TVWS); broadband access networks* | 3, 5, 6 |
| 24 | 1/268 | Proposal for case studies of e-education in rural areas through ordinary use of emergency telecommunication systems | Japan/ASP | *emergency telecommunication; e-education; e-agriculture; rural communication; disaster drill* | 2,3,5,6 |
| 25 | 1/279 | Mobile broadband in rural areas: The case of Sudan | Sudan/AFR | *rural areas; ICTs; broadband* | 1, 2, 3, 4, 5, 8 |
| 26 | 1/302 (Rev.1) + Annex | Overview of the organization and functioning of the Steering and Monitoring Committee for universal service/access | Senegal/AFR | *electronic communication code; policies and strategies; universal service/ access; rural and peri-urban areas* | 1, 2, 8 |
| 27 | 1/316 | Improving the efficiency of universal services: Experience of the Russian Federation | Russian Federation/CIS | *universal services; broadband access; tariffs for universal services; remote regions* | 1, 2, 8 |

## (continued)

| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 28 | 1/326 | Satellite components for the 5G system | Algeria Telecom SPA (Algeria)/AFR | *satellite; 5G; non-terrestrial networks (NTN); 3GPP* | 2, 3, 5 |
| 29 | 1/327 (Rev.1) | Managing and distributing universal service funds in the United States | United States/AMS | *broadband; universal service funds; USF; rural development* | 1, 2, 4, 8 |
| 30 | 1/338 | Telecommunications/ICTs for rural and remote areas in the developing countries | Dem. Rep. of the Congo/AFR | *access; telecentre; teleservices; communities* | 1, 2, 8 |
| 31 | 1/354 | South African broadband policy and strategy | South Africa/AFR | *broadband expansion; connectivity; network* | 1, 2, 8 |
| 32 | 1/361 | Promoting the use of 5G in regional environments, including rural and remote areas | Japan/ASP | *5G; field trial; local 5G* | 2, 3, 5, 8 |
| 33 | 1/375 | Innovative approaches for universal service | China Telecom (China)/ASP | *network; low tariff; e-commerce; platform* | 2, 4, 6 |
| 34 | 1/378 | Updated information on the global status of 5G | Intel Corporation (United States)/AMS | *5G (IMT-2020); high-speed; high-quality; mobile; broadband; digital economy* | 2, 5 |
| 35 | 1/379 | Updated information on Wi-Fi 6 (IEEE 802.11ax) | Intel Corporation (United States)/AMS | *Wi-Fi; high-speed; high-quality; wireless; broadband; evolution; digital economy* | 2, 5 |
| 36 | 1/382 | Useful partnerships in ICT projects and programmes that enhance access to ICTs by rural and remote communities | Zimbabwe/AFR | *partnership* | 2, 4 |
| 37 | 1/384 | ICT capacity-building support programme "IT Supporters" to bridge the information gap in Korea's rural and remote areas | Korea Telecom Corporation (Rep. of Korea)/ASP | *capacity building; rural and remote areas; underprivileged population; underserved population; disabled population; digital divide* | 2, 7 |
| 38 | 1/386 | Affordable and reliable optical cable backhaul solution and its implementation by following newly standardized ITU-T Recommendations | Waseda University (Japan)/ASP | *urban-rural digital divide; affordable; reliable; optical cable; backhaul; on the ground's surface* | 2, 3, 5 |
| 39 | 1/389 | Addressing barriers to mobile network coverage | GSMA | *mobile broadband; taxation; policy; mobile networks; rural coverage* | 2, 4 |
| 40 | RGQ/11 | Universal access and service fund as a pivotal for rural development | Rwanda/AFR | *UAF; broadband; rural and remote areas* | 2, 4, 6, 7, 8 |
| 41 | RGQ/30 | Community cybercentres in Côte d'Ivoire | Côte d'Ivoire/AFR | *cybercentre; community* | 2, 4, 6, 8 |
| 42 | RGQ/32 | The case of Sanchar Shakti, the Indian universal service obligation fund's scheme for mobile value-added services for rural women, an example of flexible, bottom-up, collaborative business models | India/ASP | *gender; women; ICTs; universal service; ICTs for rural areas* | 2, 4, 6, 7, 8 |

## (continued)

| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 43 | RGQ/36 | Proposal for the sustainable smart society | Japan/ASP | *IoT sensors; visualization of information and data; smart city and society; renewable and eco-friendly; biomass power generation; clean energy; big-data analysis* | 2, 3, 5, 6, 8 |
| 44 | RGQ/37 | Accès numérique aux populations des zones reculées | Haiti/AMS | *accès; intégration* | 2, 3, 4, 6, 7, 8 |
| 45 | RGQ/39 | ICT-applied farming method for producing muskmelon by an IT company | Daiwa Computer Co., Ltd. (Japan)/ASP | *ICT control; IoT sensors for e-agriculture; hydroponic production for muskmelon* | 2, 4, 5, 6 |
| 46 | RGQ/40 | Télécommunications/TIC pour les zones rurales et isolées – les initiatives de la Guinée | Guinea/AFR | *TIC ; connectivité haut débit ; développement des zones rurales et isolées* | 2, 4, 6, 8 |
| 47 | RGQ/42 | La problématique de l'introduction des nouvelles technologies de l'information et de la communication (TIC) dans l'enseignement au Mali | Mali/AFR | *TIC; connectivité; ordres d'enseignements (éducation de base, secondaire et supérieure); nouvelles technologies; 'TIC, la problématique'* | 2, 4, 6, 7, 8 |
| 48 | RGQ/43 | Aperçu de l'étude pour l'actualisation de la stratégie de service universel (SU) au Sénégal | Senegal/AFR | *actualisation; service/accès universel; zones rurales et périurbaines* | 2, 4, 5, 8 |
| 49 | RGQ/44 + Annexes | Aperçu des politiques et stratégies des communautés économiques régionales (CER) – UEMOA et CEDEAO pour le service/accès universel de télécommunications | Senegal/AFR | *service/accès universel; zones rurales et périurbaines; directives; actes additionnels; transposition* | 2, 4, 8 |
| 50 | RGQ/46 | Information on two publications based on twinning projects in Europe in 2017 (Poland, Albania, Slovenia) | BDT Focal Point for Questions 1/1 and 5/1 | *twinning projects; Poland; Albania; Slovenia; QoS measurement tool; broadband infrastructure mapping* | 1, 2, 3, 5, 6 |
| 51 | RGQ/72 | The needs of consumers: A perspective from Zimbabwe's telecommunication operators and consumer watchdogs | Zimbabwe/AFR | *consumer needs* | 1, 2, 3, 6 |
| 52 | RGQ/73 | Enabling infrastructure, challenges in maintaining and upgrading infrastructure, ICT infrastructure for rural and remote areas and policies: Perspective from Zimbabwe's telecommunication operators | Zimbabwe/AFR | *infrastructure challenges and solutions* | 1, 2, 3, 4, 5, 8 |
| 53 | RGQ/77 | The role of universal communications service access fund in connecting the unserved and underserved in Tanzania | Tanzania/AFR | *unserved and underserved* | 2, 3, 4, 5, 8 |
| 54 | RGQ/82 | Universal services for rural and remote areas of the Russian Federation | Russian Federation/CIS | *universal service fund; tariffs for universal services; broadband; rural and remote areas* | 2, 3, 4, 8 |
| 55 | RGQ/85 | Empowering disadvantaged communities through telecommunications/ICTs: The case of Zimbabwe's universal service fund driven information communication technology centres | Zimbabwe/AFR | *ICT community information centres* | 2, 3, 4, 6, 7, 8 |

## (continued)

| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 56 | RGQ/141 | Communication for rural communities project initiatives in Sri Lanka | Sri Lanka/ASP | *universal access to unserved areas; social and economic development; USF* | 1, 2, 5 |
| 57 | RGQ/165 | Contribution of ICT/telecommunication providers and operators to research, standardization, training, awareness raising and studies | Côte d'Ivoire/AFR | *access; telecommunications/ICTs; financing* | 1, 2, 4, 8 |
| 58 | RGQ/166 | Establishment of multipurpose community telecentres in rural areas to bridge the digital divide in Burundi | Burundi/AFR | *connectivity in rural areas; national optical fibre backbone; broadband Internet; multipurpose community telecentres* | 1, 2, 3, 6 |
| 59 | RGQ/175 + Annex | The place of universal service/access policy in the new Electronic Communication Code: Overview of the code's provisions and implementing decrees | Senegal/AFR | *updating electronic Communication Code; development strategy; legal framework; universal service/access; rural and peri-urban areas* | 1, 2, 8 |
| 60 | RGQ/176 | Expansion of telecommunication service coverage in remote and hard-to-reach communities of the Kyrgyz Republic | Kyrgyzstan/CIS | *remote and rural area; telecommunications* | 1, 2, 3, 8 |
| 61 | RGQ/177 | Rural broadband deployment and its benefits in Burundi | Burundi/AFR | *rural connectivity; rural broadband deployment; ICTs rural services* | 2, 8 |
| 62 | RGQ/178 | Adoption of the Digital Planning Roadmap in Burkina Faso | Burkina Faso/AFR | *planning; digital divide; high-speed broadband; very high-speed broadband* | 8 |
| 63 | RGQ/187 | Women, ICTs and development | United States/AMS | *women; girls; ICTs and development* | 7 |
| 64 | RGQ/193 | Rural connectivity | United States/AMS | *broadband; ICTs; rural development* | 2, 7, 8 |
| 65 | RGQ/195 | Expansion of Brazilian broadband network (Structural Plan for Telecommunication Networks – PERT) | Brazil/AMS | *broadband expansion; network; PERT; community networks* | 2, 4, 8 |
| 66 | RGQ/200 | Access to banking services in remote, hard-to-reach and sparsely populated areas | Russian Federation/CIS | *remote areas; banking services; connectivity; identification* | 2, 3, 6 |
| 67 | RGQ/209 | Promoting last-mile connectivity using reverse auctions | United States/AMS | *broadband; reverse auctions; rural development* | 4, 8 |
| 68 | RGQ/212 | Using 5G in rural and remote areas: Lessons learned and implications from 5G trial service in PyeongChang and other remote areas | Rep. of Korea/ASP | *5G; 2018 PyeongChang Winter Olympics; 5G fixed wireless access; FWA; Edge cloud centre; UN Broadband Commission report; 5G village* | 2, 5 |
| 69 | RGQ/217 | Strengthening the construction of rural information infrastructure | China/ASP | *rural; information infrastructure; rural revitalization* | 2, 3, 6, 7 |
| 70 | RGQ/229 | India's USOF model | India/ASP | *universal service; USOF* | 2, 4, 8 |
| 71 | RGQ/239 + Annexes | FSM Connectivity Project – FSMTCC status report and presentation | FSM Telecommunications Corporation (Micronesia)/ASP | *implementation; submarine-cable projects* | 2, 4, 5 |

## (continued)

| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 72 | RGQ/241 | Broadband deployment as a means of meeting consumer needs in rural and remote areas | Zimbabwe/AFR | *broadband deployment; consumer needs* | 3, 8 |
| 73 | RGQ/243 | Socio-economic benefits of 5G services provided in mm wave-bands | Intel Corporation (United States)/AMS | *5G; socio-economic, benefits of mm wave* | 5 |
| 74 | RGQ/256 | Universal service fund – The case of Kenya | Kenya/AFR | *USF; access gaps* | 1, 4, 8 |
| 75 | SG1RGQ/289 | Update of recycling method of lead acid battery since 2016 | Japan/ASP | *ICT waste; carbon dioxide; recycling centre* | 1, 2, 3 |
| 76 | SG1RGQ/370 (Rev.1) | Affordable and reliable optical cable backhaul solution for quickly and reliably closing the digital divide and stopping pandemics | Waseda University (Japan)/ASP | *urban-rural digital divide; pandemics; affordable; reliable; optical cable; ITU-standardized optical backhaul; on the ground's surface* | 3, 5 |
| 77 | SG1RGQ/341 | Exploration and practice of network poverty alleviation in China | China/Asia Pacific | *rural; network poverty alleviation; Internet application* | 8 |
| 78 | SG1RGQ/380 | Smart quarantine system: Using ICT and telecommunications to assist with COVID-19 | Rep. of Korea/ASP | *COVID-19; big data; ICT solution/application; public-private partnership; SMS* | 3, 6, 8 |
| 79 | SG1RGQ/328 | Overview of the United States 5G FAST Plan roll-out | United States/AMS | *broadband; 5G; rural development* | 5, 8 |
| 80 | SG1RGQ/338 | Creating an enabling regulatory environment for community networks | Internet Society (United States)/AMS | *sustainable; affordable; complementary approach; community networks; rural connectivity; self-management; common goods; capacity building; underserved and unserved* | 4, 6, 8 |
| 81 | SG1RGQ/347 | Broadband deployment and digital equity capacity building for state and local stakeholders | United States/AMS | *capacity building; stakeholders; broadband infrastructure; digital inclusion; rural broadband access* | 7, 8 |
| 82 | SG1RGQ/348 | Lessons from U.S. rural broadband network planning and capacity-building workshops – NTIA's perspectives | United States/AMS | *Rural; broadband; capacity building; network planning; funding; stakeholder engagement* | 4, 7, 8 |
| 83 | SG1RGQ/371 | Best-Practice Guidelines for the transition to high-speed and high-quality broadband networks | Intel Corporation (United States)/AMS | *transition; high-speed; high-quality; broadband* | 2, 4, 5, 6, 8 |
| 84 | SG1RGQ/375 | Updated information on the global status of 5G | Intel Corporation (United States)/AMS | *5G (IMT-2020); high-speed; high-quality; mobile; broadband; digital economy* | 5, 8 |
| 85 | SG1RGQ/300 | Coverage and quality of service of telecommunication networks for social and economic development in Burundi | Burundi/AFR | *coverage; quality of service; rural connectivity; infrastructure; mobile financial services* | 5, 6 |
| 86 | SG1RGQ/326 | COVID-19 impact – Rethinking the approach on access to ICTs by people in rural and remote areas | Zimbabwe/AFR | *rural connectivity* | 5, 6 |

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| No. | Doc. | Title | Country/region | Keyword(s) | Related chapter(s) |
|---|---|---|---|---|---|
| 87 | SG1RGQ/327 | COVID-19 and ICTs in remote and rural areas | Haiti/AMS | *pandemic; ICTs; remote and rural areas* | 5, 6 |
| 88 | SG1RGQ/386 | Role of community networks as a response to the COVID-19 pandemic | Association for Progressive Communications – APC (South Africa)/AFR | *COVID-19; community networks* | 5, 6 |
| 89 | SG1RGQ/357 | "Gamata Sannivedanaya" (Connect Sri Lanka) project initiatives in Sri Lanka | Sri Lanka/ASP | *universal access* | 8 |
| 90 | SG1RGQ/364 | Satellite TV enables access to meaningful content for COVID response and educational channels in Africa | SES World Skies | *e-learning; educational channel broadcasting; COVID-19; satellite broadcasting* | 5, 6 |
| 91 | SG1RGQ/318 | Case studies – Satellite connecting rural areas | EMEA Satellite Operators Association (ESOA/GSC) | *rural connectivity; satellite solutions; last mile; backhaul* | 5, 6 |
| 92 | SG1RGQ/319 | Satellite connecting rural and remote areas with multiple solutions | EMEA Satellite Operators Association (ESOA/GSC) | *satellite connectivity; last-mile connectivity; backhaul; rural coverage* | 5, 6 |
| 93 | SG1RGQ/382 | Addressing rural connectivity | Ericsson | *rural connectivity; mobile infrastructure; spectrum* | 5, 6 |
| 94 | 1/443 | Proposed observations and suggestions for output report | EMEA Satellite Operators Association (ESOA/GSC) | *rural connectivity, satellite solutions, last mile, backhaul* | 2, 3, 4, 5, 7, 9 |
| 95 | 1/446 | Proposed revision of the Question 5/1 Draft Output Report | Zimbabwe/AFR | *delete the word " Recommendation "* | 9 |
| 96 | 1/433 | Proposal to update the content of "Annex preliminary terms of reference of ITU-D Questions" about SG1 Q5/1 which is drafted in "Liaison statement from the Chairmen of ITU-D SG1 and SG2 to TDAG-WG-RDTP on discussions related to WTDC Resolution 1, future study group Questions, streamlining of WTDC Resolutions and WTDC Declaration" | China | *future work, future of Questions* | Annex |
| 97 | 1/435 (Rev.2) | Question 5/1 future studies | Zimbabwe/AFR | *Question 5/1 future studies* | 1 |
| 98 | 1/462 + Annexes | Importance of terrestrial high-speed and high-quality broadband for digital equity and proposed revision of the Question 5/1 Draft Output Report | Intel Corporation (United States)/AMS | *terrestrial, high-speed, high-quality, broadband, digital equity, rural, SDGs* | 1, 2, 8 |
| 99 | 1/463 | A roadmap for governmental and private-sector efforts in rural and remote areas: The U.S. National Tribal Broadband Strategy | United States | The U.S. National Tribal Broadband Strategy | 2, 8 |

# Annex 2: Summary of the contents of case studies and input documents submitted during the study period

**May 2018**

The Rapporteur Group for Question 5/1 held its first meeting for the 2018-2021 study period in Geneva on 1 May 2018. The meeting report may be found in ITU-D SG1 Document 1/REP/5(Rev.2), and the input documents, including case studies, are summarized below:

Document 1/29 (**Central African Republic**) (case study) describes the current state of affairs with regard to the deployment of fibre-optic access in the Central African Republic. It was presented to the Q1/1 meeting in detail. The aspects related to strategies and policies for the deployment of broadband in developing countries and ICTs for rural and remote areas were highlighted. Some participants suggested that the rapporteur group should collaborate with ITU-T Study Group 3.

Document 1/30 (**ESMT, Senegal**) (case study): The presentation of this document was postponed to the next meeting as the representative of the ESMT was absent.

Document 1/33 (**Bhutan**) (case study) presents a village network of community centres established under the South Asia Subregional Economic Cooperation (SASEC) Information Highway Project funded by the Asian Development Bank (ADB). The village network enables community centres to serve as an access point for the rural population to be able to use government-to-citizen (G2C) services and Internet services made available by the Royal Government of Bhutan. Lessons learnt and best practices are also shared. Participants requested clear definitions of 'rural area' and 'remote areas'. It was noted that a definition of 'rural areas' can be found in the Q5/1 report from the previous period.

Document 1/44 (**Burundi**) (case study) highlights the overall situation and possible means of ensuring the major additional investments that are needed to enable both public and private authorities to make telecommunication/ICT services widely available in rural and isolated areas in Burundi. Charges are high compared to neighbouring countries in East Africa.

Document 1/57 (**India**) (case study) shares information about the Indian Government's initiative to connect its rural and remote islands to its mainland in order to provide reliable and affordable telecommunication services to these islands' people so that they can also reap the benefits of high-speed broadband and e-governance initiatives. In view of the non-viable commercial conditions, the Indian Government is acting as a facilitator in proving the submarine link, and will distribute bandwidth among TSPs/ISPs on a non-discriminatory basis. India would like to share its experience gained through this project for providing connectivity solutions to SIDS/LDCs/LLDCs, and seeks to collaborate with other Member States to share expertise and build capacity.

Document 1/66 (**KT Corporation, Republic of Korea**) (case study) reflects the need to install cost-effective and sustainable basic telecommunication infrastructures in rural and remote areas. One of the key elements is specific outcomes that need to be in place for the vendor community to develop suitable solutions to meet the challenges in rural and remote areas. Current systems need to be better adapted to specific rural requirements in order to be widely deployed. One other important aspect raised is the need to study public policies and regulatory measures, as well as business models related to telecommunications/ICTs in rural and remote areas. The

meeting was invited to consider the suggestions made in this document when discussing Q5/1 study topics.

Document 1/69(Rev.1) (**China**) (case study) briefly introduces the latest situation in terms of information consumption of rural groups, network infrastructure and application services in China, and noted that there are still many shortcomings to be overcome in improving rural information consumption. It puts forward some suggestions for the promotion, further expansion and upgrading of rural information consumption from the perspective of user skills, network terminals and applications.

Document 1/84 (**BDT**) shares a list of lessons learned extracted from the contributions received for the ITU-D Study Group 1 meeting.

**September 2018**

The Rapporteur Group for Question 5/1 held its second meeting for the 2018-2021 study period in Geneva on 21 September 2018. The meeting report may be found in ITU-D SG1 Document SG1RGQ1/REP/5, and the input documents, including case studies, are summarized below.

Document SG1RGQ/11 (**Rwanda**) (case study) highlighted different initiatives taken by Rwanda to foster optimal use of ICTs for empowering rural communities through a universal access and service fund as a financing mechanism. It also highlights Rwanda's rural schools Internet connectivity project implemented through the Smart Rwanda master plan, ICT-enabled agricultural development in Rwanda and the ICT support provided to people living with disabilities. The contribution was discussed at length and suggestions were made to the effect that appropriate software for people with disabilities also be included in the support.

Document SG1RGQ/30 (**Côte d'Ivoire**) (case study) describes the launch of a project comprising 5 000 community cybercentres in Côte d'Ivoire for localities of 500 or more inhabitants. The project was launched for the purposes of providing access to ICTs for all the country's inhabitants. The pilot phase started with 12 sites, of which 11 are in post offices and one is in a town hall.

Document SG1RGQ/32 + Annex (**India**) (case study) outlines the case of Sanchar Shakti, the Indian Universal Service Obligation Fund's scheme for mobile value-added services for rural women, an example of a flexible, bottom-up and collaborative business model. The project was started as a way of recognizing the special ICT needs of rural women.

Document SG1RGQ/36 + Annex (**Japan**) gives an account of the work of Shiojiri municipality, which is implementing IoT environmental information sensor networks in order to improve the life of local people. The city introduced an optical-fibre network connecting public facilities in the city, and established an information and incubation plaza for the purpose of nurturing an IT-literate population. Shiojiri municipality has almost completed eco-friendly and biomass power plant to supply its ICT networks and 20 000 households autonomously in preparation for emergencies. Participants commended Japan for the project and agreed that it would be included in the Q5/1 report.

Document SG1RGQ/37 (**Haiti**) (case study) highlights the establishment of ICT access zones in Haiti's rural and remote areas.

Document SG1RGQ/39 (**Daiwa Computer Co., Japan**) (SME pilot participant IT company – Daiwa Computer Co. Ltd – case study) introduces ICT-enabled farming for producing

muskmelons in greenhouses, which has contributed to income generation for both the company and collaborating farmers. It was developed in collaboration with other IT companies and academia. ICT-enabled farming for the greenhouse production of muskmelons has proved to be cost effective, increased productivity and reduced farmers' labour. This e-agriculture method is going to be replicated for other agricultural products. The contribution was well received by participants. After discussion, it was agreed to include the content in the case study section of the Q5/1 report.

Document SG1RGQ/40 (**Guinea**) (case study) provides an overview of the deployment of a fibre-optic backbone by the Government of Guinea which has assisted in providing access to ICTs for rural communities.

Document SG1RGQ/42(Rev.1) (**Mali**) (case study) provides an insight into the introduction of ICT into the Mali school curriculum, especially in the basic and secondary levels of education, through multimedia school centres, with proposed funding of the connected multimedia school centres (CMSC) by the regulatory authority. Priority in the diffusion of ICTs is given to schools and universities in order to improve learning and reduce the digital divide in the education system. It was noted that there was a need for ICT education to be introduced at much lower levels than secondary school. Participants welcomed the contribution and recommended that ICT education be introduced earlier than secondary level education.

Document SG1RGQ/43 (**Senegal**) (case study) provides an insight into Senegal's commitment to making access to telecommunication services a priority for all populations in rural and peri-urban areas. It highlights the maturity of Senegal's pilot phase for the operation of a telecommunication network by a universal service consortium in the Matam region of northern Senegal, in order to cover the various localities of the region. It also highlights current efforts to update the universal service strategy in Senegal, adopted in 2018. Participants noted that most African countries were using universal service funding, and that it was important to find out if other sources of funding could also be used.

Document SG1RGQ/44 + Annexes (**Senegal**) (case study) shares some elements of the experience of West African regional economic communities with regard to policies and strategies for the development of the universal telecommunication service, particularly the Economic Community of West African States (ECOWAS), which comprises 15 member countries located in West Africa (Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo). These countries have both cultural and geopolitical ties, and share a common economic interest. It also shares the experience of the West African Economic and Monetary Union (WAEMU), which is made up of eight member states (Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo).

Document SG1RGQ/61 (**Zimbabwe**) (case study) proposes text for the introductory chapter of the draft report on Q5/1. The text analyses the previous study reports, particularly the Report for the 2014-2017 study period, and highlights the key findings, including challenges and proposed solutions to them. It also highlights the areas on which the current study should concentrate, based on the previous reports, the Buenos Aires Action Plan of the 2017 World Telecommunication Development Conference (WTDC-17) and the Geneva Action Plan of the World Summit on the Information Society (WSIS), as they relate to the ITU-D Question on ICTs for rural and remote areas. Participants agreed to incorporate the text into the report, subject to any modifications that may be necessary during the course of the study.

Document SG1RGQ/72 (**Zimbabwe**) (case study) highlights telecommunication consumer needs from the perspective of Zimbabwe's mobile telecommunication service providers and consumer watchdogs. The contribution cites access, social and economic needs of telecommunication consumers in Zimbabwe. E-education, e-agriculture, mobile banking and e-health featured repeatedly in the feedback on consumer needs obtained by Zimbabwe's telecommunication regulatory authority in response to a circular sent to the service providers. It was recommended that the content of the contribution be incorporated in Chapter 1 of the report.

Document SG1RGQ/73 (**Zimbabwe**) (case study) highlights challenges that persist in Zimbabwe's remote areas, emphasizing inadequate power infrastructure and supply and transportation networks as the main challenges faced. Additional challenges include cost of equipment and devices, unavailability of finance, environmental issues, cultural resistance to ICT installations and lack of skills. These affect both the installation and maintenance of ICT infrastructure. The contribution made recommendations on solutions to the challenges.

Document SG1RGQ/77 (**Tanzania**) (case study) provides details of the role played by the Tanzania's universal communications service access fund of in bridging the digital divide/ICT access gap between urban and rural populations. It also lists some of the challenges faced in implementing projects under the fund.

Document SG1RGQ/82 (**Russian Federation**) (case study) provides an overview of the activities undertaken by the Russian Federation to provide universal services in rural and remote areas of the country in order to bridge the digital divide. The contribution highlights best practices adopted by the Russian Federation in providing universal services in sparsely populated territories, the activities of the universal service operator, universal service tariff policy and the current situation regarding the universal services, to be considered for inclusion in the Q5/1 report.

Document SG1RGQ/85 (**Zimbabwe**) (case study) shares a case study relating to the ICT Community Information Centre programme being run by Zimbabwe's universal services fund. The programme's main objective is to promote access to telecommunications/ICTs for all Zimbabweans, be they in urban, rural or remote areas. Furthermore, it is expected to narrow the digital divide between urban and rural communities, between rich and poor, as well as between genders. To achieve this, the programme provides relevant infrastructure, Internet service, equipment and free ICT literacy training. Noteworthy beneficiaries are, *inter alia*, the entrepreneurially-minded, who gain access to economic information related to their agricultural and other economic projects and markets; and students, who use community information centres as research facilities enabling them to search for university places and possible employment opportunities.

Document SG1RGQ/46 + Annex (**BDT Focal Point for Europe**) refers to two past publications elaborated as outcomes of two twinning projects which are relevant to the ITU-D Study Group 1 Questions. These projects offer approaches that can be replicated by other Member States. In a twinning project between Poland and Albania, technical specifications for a tool to measure quality of service were developed. A twinning project between Albania and Slovenia focused on broadband infrastructure mapping.

Document SG1RGQ/56 + Annex (**BDT Focal Point for Question 6/1**) shares an overview of the Best Practice Guidelines adopted by the Global Symposium for Regulators (GSR-18) which recognize that flexible and innovative policy and regulatory approaches can support

and incentivize digital transformation. These best practices allow regulators to respond to the changing landscape and address the continuing need for secure and reliable ICT infrastructure, affordable access to and delivery of digital services, as well as protecting consumers and maintaining trust in ICTs.

Document SG1RGQ/66 + Annex (**BDT Focal Point for Europe**) further highlights the outcomes of the workshop on "The future of cable TV", which was held in January 2018 in Geneva, jointly organized by the ITU Telecommunication Development (BDT) and Telecommunication Standardization (TSB) Bureaux. The workshop was conducted within the context of the European regional initiative approved by WTDC-17 on "Broadband infrastructure, broadcasting and spectrum management", under which assistance is provided to countries in need for assessing the dynamics, challenges and opportunities of diverse broadband technologies across Europe, including cable TV.

***Liaison statements:***

Document SG1RGQ/ADM/2 sets out the list of incoming liaison statements and their allocation to ITU-D Study Group 1 rapporteur group meetings.

***Mapping of ITU-T and ITU-D work:***

Document SG1RGQ/1 contained the liaison statement from the Chairmen of ITU-D SG1 and SG2 that was sent to ITU-T study groups following the annual ITU-D SG1 and SG2 meeting which took place from 30 April to 11 May 2018. The ITU-D SG1 and SG2 rapporteurs were invited to review the mapping and make any updates as deemed necessary. Three tables matching ITU-D SG1 and SG2 Questions of interest to the different ITU-T study groups were shared. Document SG1RGQ/10 (ITU-T Study Group 2) gave ITU-T Study Group 2's updated input for the mapping. Document SG1RGQ/22 + Annex (ITU-T Study Group 11) contained the response of ITU-T SG11 in relation to the mapping. The mapping document and related tables were considered, and participants undertook to take a further look at the mapping and propose any necessary improvements.

***Mapping of ITU-R and ITU-D work:***

Document SG1RGQ/84 (**ATDI, France**) was a first attempt to provide a mapping of ITU-D SG1 and SG2 Questions onto the work of the ITU-R working parties. The group noted the mapping and added a reference from Q5/1 to ITU-R WP1A.

**March 2019**

The Rapporteur Group for Question 5/1 held its third meeting for the 2018-2021 study period in Geneva on 19 March 2019. The meeting report may be found in ITU-D SG1 Document 1/REP/13(Rev.2), and the input documents, including case studies, are summarized below:

Document 1/125(Rev.1) (**Cameroon**) (case study) presents a case study of the telecentre project undertaken by Cameroon in order to bridge the digital divide between rural and urban areas. It proposes broadband connectivity models and connectivity solutions suited to rural areas in developing countries. A remote participant from **Nigeria** informed the meeting that the Internet Society (ISOC) had done a lot of work in this area and could be encouraged to provide contributions under Q5/1.

Document 1/132 (**Haiti**) contains proposed draft text on capacity building for Chapter 7 of the Q5/1 final report. The document highlights the necessity of training technical staff and details strategies to promote small non-profit community operators.

Document 1/133 (**Madagascar**) (case study) provides a survey on the status of ICT access and use in the rural areas of Madagascar. The survey was carried out in 2018 in order to quantify ICT access and use by households and individuals and identify areas for improvement, particularly in rural/remote areas. In response to a question from **Côte d'Ivoire** on whether or not people with disabilities had been included in the survey, Madagascar advised that where any household included a person with disabilities, the results included data pertaining to the person. **Vice-Rapporteur** Mr Babou Sarr from Senegal highlighted the need to ensure that, in any survey, the sample selection process and size are adequate for accurate results.

Document 1/136 (**India**) (case study) reflects a new method adopted by the Department of Telecommunications in India to identify the number of villages that are unconnected, based on user feedback, by obtaining actual coverage data from these villages through the mobile network. Previously there had been gaps in data regarding the number of villages connected to the mobile network, as the data had been based on telecommunication service providers' coverage approximation. The new method helps the government ascertain the actual number of uncovered villages. The data collected are used to plan projects to extend coverage to all villages. In response to comments from **Brazil**, **Mauritania** and **Côte d'Ivoire**, India confirmed that the surveys they had carried out involved collecting data through all operators across all rural areas in the country. India also informed the meeting that the country had not faced any serious challenges in utilizing universal service funds to get the villages connected.

Document 1/137 (**India**) (case study) draws attention to research on the effective provision of e-government services by the Indian Government to rural areas. It highlights that provision of services can be greatly improved by increasing the satisfaction levels of social entrepreneurs (or outlets run by intermediaries) who are responsible for providing ICT infrastructure and support for e-government services.

Document 1/140 (**Guinea**) (case study) provides information on initiatives undertaken in the country to build an information society that is people-oriented, inclusive and secure, and that catalyses in a cross-cutting manner the development of other aspects of people's social and economic lives. This vision is embodied in the National Programme for Social and Economic Development and the National Policy and Strategy Document for the Development of ICTs and the Digital Economy.

Document 1/152 (**Senegal**) (case study) shares experiences of countries, and regional and international organizations, with regard to public policies and other measures relating to the legal framework for telecommunications/ICTs in rural and remote areas. It sets out recommendations to promote the development of universal service/access, particularly in developing countries.

Document 1/157(Rev.1) (**Sudan**) (case study) shares information on the latest situation in Sudan in relation to ICTs and strategies in rural and remote areas, and provides an overview of the methods and strategies used in deploying ICTs. In response to a question from **Tanzania** on whether Sudan had experienced any ownership problems with regard to the infrastructure built through universal service funds, Sudan informed the meeting that they had not and that the funds were mostly used for rural and remote areas.

Document 1/160 (**Senegal**) (case study) provides an overview of Senegal's commitment to making access to telecommunication services a priority for all populations in rural and peri-urban areas. The document highlights the legal aspects of the universal telecommunication service strategy in Senegal, particularly with reference to a new Electronic Communications Code for the country.

Document 1/169 (**Republic of Korea**) (case study) highlights how Korea Telecom has worked in partnership with the Ministry of Post and Telecommunications of Cambodia (MPTC) and Telecom Cambodia to provide public Wi-Fi and distance learning for schools in rural and remote areas of Cambodia.

Document 1/201 (**Zimbabwe**) (case study) provides input from telecommunication operators in Zimbabwe on the deployment of broadband in rural and remote areas, regulatory initiatives to narrow the digital divide and capacity building. The **United States** commended the innovative approach employed by Zimbabwe of eliciting input from operators who are the normal providers of infrastructure and services in the rural areas, and suggested that other administrations could use this approach.

Document 1/224 (**Intel Corporation, United States**) provides information on the transition to high-speed, high-quality 5G mobile-broadband networks, including the importance of Sub-1 GHz and fixed wireless access (FWA) for rural areas.

Document 1/225 (**Waseda University, Japan**) introduces the use of a lightweight optical fibre cable covered by stainless-steel tube and polyethylene jacket which conforms to the standards prescribed by Recommendation ITU-T L.1700 (2016) as well as Recommendations ITU-T L.110 (2017) and L.163 (2018). The cable is considered affordable and reliable for backhaul solutions when deploying infrastructure in rural and remote areas.

Document 1/230 (**Intel Corporation, United States**) shares an overview of the importance and evolution of Wi-Fi for high-speed wireless broadband access (including the complementary role of Wi-Fi in 5G and the importance of Wi-Fi for rural areas).

Document 1/245 (**Intel Corporation, United States**) provides information on broadband demand programmes and financing mechanisms for rural and remote areas, with a focus on Chapter 4 of the Q5/1 final report.

Document 1/251 (**Bhutan**) (case study) highlights the use of Wi-Fi hotspots for public service delivery in 20 Dzongs, four Gewogs and two Thromde offices over the country. The Royal Government of Bhutan funds the pilot project.

Document 1/254 (**Bhutan**) (case study) reports on how Bhutan's Ministry of Information and Communications reached out to operators in the country to gather case studies that could be of interest to the ITU-D study groups. The document contains two such case studies, one on a trial with TV white space technology and one on broadband access networks.

Document 1/150 (**BDT Focal Point for Question 5/1**) shares information on work related to smart green villages and Internet of Things (SGVs and IoT). The contribution summarizes two initiatives planned by BDT on SGVs and IoT that may be useful for developing countries.

Document 1/168 + Annexes (**BDT Focal Point for Question 4/1**) contains 2018 data and charts on infrastructure development and sharing from the annual ITU Tariff Policies Survey. The

overview it provides of the trends in this area across the ITU membership may be of interest to Q5/1.

Document 1/178 + Annexes (**BDT Focal Point for Question 1/1**) highlights 2018 data from the annual ITU World Telecommunication/ICT Regulatory and Tariff Policies Surveys, on regulatory practices related to universal service (definition, funding and financing, obligations, activities funded, etc.), broadband and ICT policies and plans, IXPs and municipal networks. It provides an overview of the trends in this area across ITU the membership.

**September 2019**

The Rapporteur Group for Question 5/1 held its fourth meeting for the 2018-2021 study period in Geneva on 24 September 2019. The meeting report may be found in ITU-D SG1 Document SG1RGQ/REP/12, and the input documents, including case studies, are summarized below:

Document SG1RGQ/141 (**Sri Lanka**) (case study) gives information about a study initiated in Sri Lanka, Gamata Sanniwedanaya, to identify unserved and underserved areas in the country. Three such districts were identified. Field investigations were then undertaken in the districts, to check fixed and mobile voice service and broadband service availability. The study was carried out using a mobile monitoring vehicle to manually check signal strength and identify areas afflicted by weak signal and service provision. By comparing the investigation results with coverage information provided by operators, the Telecommunications Regulatory Commission of Sri Lanka (TRCSL) found that that coverage in the region was below par. Solutions, such as erecting mobile base stations, are expected to improve broadband coverage to all identified unserved and underserved areas.

Document SG1RGQ/165 (**Côte d'Ivoire**) (case study) (also for Q1/1) provides a practical example, which could be implemented in other countries, of financing projects for public benefit. The case study shows how Côte d'Ivoire has developed multiple sources of financing for telecommunication/ICT projects for public benefit. The mechanism involves ICT/telecommunication providers' and operators' contributing to research, standardization, training, awareness-raising and studies, pursuant to a decree issued by the country's government in November 2014. The decree sets the contribution rates for the allocation of ICT/telecommunication sector resources to public structures and the terms of payment. The document was well received and allocated to Chapter 4 of the Q5/1 final report.

Document SG1RGQ/166 (**Burundi**) (case study) highlights how Burundi has established multipurpose community telecentres in order to connect rural areas and enable residents to connect to broadband Internet, thereby bridging the digital divide. The project is being implemented in four of the country's 18 provinces, with plans to extend it to all provinces by 2025. It was made possible by the existence of a national optical fibre network connecting Burundi to the submarine telecommunication cables of neighbouring countries. This network was deployed by the Burundi Government with financing from the World Bank. The optical fibre management company which manages the fibre network, the Burundi Backbone System (BBS), was established in 2013 and is jointly owned by the government and network operators.

Document SG1RGQ/175 + Annex (**Senegal**) (case study) shares information on Senegal's Digital 2025 strategy. The strategy proposes that the legal framework of the telecommunication/ICT sector and its governance be updated. The contribution highlights the Senegalese Government's determination to implement universal access through decrees, in application of the country's

Electronic Communications Code. The purpose of the first decree is to set the implementing arrangements for universal service/access and the organizational and operational rules for the country's Universal Telecommunication Service Development Fund (FDSUT).

Document SG1RGQ/176 (**Kyrgyzstan**) (case study) (also for Q1/1) explains how the unique natural setting and geographical terrain of the country, which led to the formation of cities in the valleys and villages in remote areas and mountain gorges, has impacted on the level of development and penetration of telecommunication services, as well as the technologies used. The result was that mostly wireless technology was used to connect 31 cities and about 2 000 villages. The contribution also provides information on how various measures adopted by the government, including the installation of optical fibre for both backbone and national distribution networks, have helped to ensure access to modern communication services, not only in cities, but also in remote rural areas. Land-use reforms have also been implemented to expedite the implementation of telecommunication/ICT installations.

Document SG1RGQ/177 (**Burundi**) (case study) outlines the latest developments in rural broadband and the digitalization of 10 of the 18 rural provincial offices in Burundi. It describes new initiatives related to broadband Internet services for rural and remote areas undertaken by the Government of Burundi to further promote universal rural telecommunication/ICT services and facilitate coordinated urban and rural development. It highlights how the government, with financing from the World Bank, has constructed 8 000 km of optical fibre around the country, covering the entire national territory, in order to provide Bujumbura and all provinces with access to reliable broadband, while reducing costs. High maintenance costs have however been problematic.

Document SG1RGQ/178 (**Burkina Faso**) (case study) (also for Q1/1 and Q6/1) provides information on the Digital Planning Roadmap adopted by the Government of Burkina Faso. The contribution further explains how this roadmap is going help reduce the country's digital divide in terms of access to high-speed and very high-speed broadband by 2030.

Document SG1RGQ/187 (**United States**) (case study) (also for Q1/1) provides a list of current and recent United States exchange programmes focused on bridging the digital gender divide. Some of the programmes directly build capacity or enhance skills in ICT, while others encourage general empowerment of women and girls by providing the tools they need to create a more stable, democratic and prosperous world. The contribution attracted a lot of debate, and the United States was commended for bringing gender-gap issues to bear in the study. The meeting agreed that the gender issue be incorporated into the final report on Q5/1. It was suggested that the issue could be explored as an annual deliverable under the Question (maybe along with other Questions).

Document SG1RGQ/193 (**United States**) (case study) provides a list of current and recent United States programmes with a focus on enabling rural connectivity in developing countries. Some of these programmes directly target technical support to developing countries to enable rural connectivity, while others support countries with policies and national strategies for connectivity.

Document SG1RGQ/195 (**Brazil**) (case study) (also for Q1/1) provides an overview of the Brazilian broadband network and explains its expansion. According to the contribution, in Brazil there are currently 4 482 municipalities covered with 4G technology, 5 454 municipalities with 3G, and 570 municipalities with 2G, with over 228 million mobile-phone service subscriptions.

Document SG1RGQ/200 (**Russian Federation**) (case study) examines best practices in providing accessible banking services to people living in remote, hard-to-reach and sparsely populated areas. Working with the Post Bank, Russia has introduced digital technologies and solutions to accelerate financial inclusion for the entire population, including hard-to-reach and sparsely populated areas, thereby ensuring universal access to banking services.

Document SG1RGQ/209 (**United States**) (case study) (also for Q1/1) provides an overview of how the United States Federal Communications Commission (FCC) is promoting last-mile connectivity by using "reverse auctions" for rural broadband. The contribution also suggests a broad list of best practices for using reverse auctions, and an annex provides an example of how bidding in such an auction works. The contribution generated a lot of interest and debate. The Chairman of ITU-D Study Group 1 proposed that a workshop on reverse auctions could be held to explore the concept, together with other financing mechanisms.

Document SG1RGQ/212 (**Republic of Korea**) details how the Republic of Korea utilized 5G for connectivity during the Seoul Olympics and extended the project to provide connectivity in some rural and remote villages. The document gives insights into utilizing 5G to connect remote areas, as evidenced by the Republic of Korea's village network solutions.

Document SG1RGQ/213 (**Côte d'Ivoire**) reports on the Lomé (Togo) workshop organized by the West African Regulators Association from 26 to 28 June 2019, where policy-makers and telecommunication/ICT regulatory authorities discussed community networks as a viable form of connectivity. The participants at this workshop called for reflection at the international level through ITU for a more global response to this concept. The vocabulary committee could also be seized.

Document SG1RGQ/217 (**China**) (case study) highlights telecommunication universal service policy and practices in China. It also outlines measures to promote the construction of rural information infrastructure and mechanisms to achieve deep network coverage in rural and remote areas, as well as how to develop rural Internet applications and guide and encourage residents in poor areas to use broadband.

Document SG1RGQ/229 (**India**) (case study) shares its Universal Service Obligation Fund (USOF) model, including rules and regulations, resources for collecting the universal service levy, and major programme projects. The contribution explains how, besides public service providers, with funding from USOF, private telecommunication service providers are creating infrastructure in remote and rural villages, and providing telecommunication services. India's infrastructure project called the BharatNet project is the first pillar of the Digital India programme, and has been hailed as the largest rural connectivity project of its kind in the world.

Document SG1RGQ/232 + Annex (**BDT Focal Point for Europe**) is a summary of the activities carried out by the ITU Regional Office for Europe for 2019, which included workshops and projects. It provides key outcomes, where possible, for actions taken and events already held, as well as relevant weblinks to outcome reports and event webpages. It also summarizes upcoming actions and lists the 2019 training courses under the ITU network of centres of excellence for Europe.

Document SG1RGQ/236 (**Intel Corporation, United States**), presented by Vice-Rapporteur Mr Muluk, provides updated information on the global status of 5G, based on information

from the Global Mobile Suppliers Association (GSA).[171] The GSA reports identify 769 operators running LTE networks and providing mobile and/or fixed wireless broadband services in 225 countries worldwide.

Document SG1RGQ/239 + Annexes (**FSM Telecom Corporation, Micronesia**) (case study) shares information on the implementation of current and future submarine cable projects in Micronesia. The optical submarine cable system links four states (Yap, Chuuk, Pohnpei, Kosrae), thereby connecting thousands of inhabited small islands. Challenges faced included right-of-way, lack of expertise, marine maintenance costs and training. The contribution was well received, as it was the first contribution received under Q5/1 from a small island developing state. The contribution was detailed and informative.

Document SG1RGQ/241 (**Zimbabwe**) (case study) (also for Q6/1) highlights the link between satisfaction of consumer needs and access to broadband. It concludes that investment, solutions to the digital divide, research and innovation are key elements for broadband roll-out and affordability of broadband access. The contribution recommends addressing the problems related to these key elements in order to improve broadband coverage, broadband adoption and consumer satisfaction. Participants proposed that the document also be shared with Q1/1, as it contained useful information for that Question. The need to avoid duplication when writing reports for Questions which receive common contributions was stressed.

Document SG1RGQ/243 (**Intel Corporation, United States**) (case study) highlights the socio-economic benefits of 5G services provided in millimetre (mm) wavebands. According to the results of a study contained in the document, by 2034 mm-wave spectrum will result in an increase of USD 565 billion in global GDP and USD 152 billion in tax revenue, producing 25 per cent of the value created by 5G.

Document SG1RGQ/254 (**Association for Progressive Communications (APC), South Africa**) highlights how connectivity models for urban environments cannot simply be transplanted to rural areas and why many approaches to addressing rural connectivity fail. It recommends bottom-up approaches that involve local communities and have real potential to address digital exclusion and incentivize economic growth.

Document SG1RGQ/256 (**Kenya**) (case study) highlights universal service fund projects in Kenya which include e-resource centres, research and development on universal access, computerization of health centres, digitization of the education curriculum, programmes for people with disabilities, community telecentres and school-based ICT centres. The fund has also embarked on a project to construct new telecommunication infrastructure to provide mobile services to cover 80 per cent of the geographical area in identified sub-locations. Two operators, Safaricom and Telkom Kenya Ltd, have been awarded the contracts to construct the infrastructure.

Document SG1RGQ/259 highlights key lessons learned from the various contributions and provides a quick reference for use by administrations and by the Q5/1 team in preparing its report. The lessons include the realization that rural areas are still largely unconnected and that there is need to use a variety of measures, such as linking developing countries with submarine cables and constructing telecentres, in order to connect rural areas.

[171] Global Mobile Suppliers Association (GSA). About GSA – Global mobile Suppliers Association.

Document SG1RGQ/258 shares, for information, ideas for collaboration with the WSIS platform. The link with Q5/1 was noted, and it was agreed to explore ways of taking advantage of the WSIS activities, particularly in relation to Action Lines C1, C2, C3, C4 and C7.

Document SG1RGQ/ADM/25 contains a list of all documents submitted under Q5/1 for the meeting.

Document 1/ADM/20 contains all the liaison statements that were submitted in respect of SG1 Questions, including Q5/1, for the September 2019 meetings.

***Liaison statements:***

Document SG1RGQ/132 + Annexes (**ITU-T Study Group 5**) (mapping), on ITU inter-Sector coordination, was reviewed and the proposed changes to add linkages between ITU-D SG1 Q5/1 and ITU-T SG5 Q4/5, Q6/5, Q7/5 and Q9/5 to the existing mapping was noted.

Document SG1RGQ/134 + Annexes (**ITU-T Study Group 20**) (mapping), on ITU inter-Sector coordination, did not include any updates and was noted.

Document SG1RGQ/150 (**ITU-R Working Party 4B**) (also for Q1/1, Q1/2, Q5/2), on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15), was acknowledged, and the information on integration of satellite technologies with other technologies to connect rural areas was found relevant for Chapter 5 of the final report. The meeting agreed to send a response to ITU-R WP4B.

Document SG1RGQ/154 (**ITU-R Working Party 4A**) (also for Q1/1, Q1/2, Q5/2), also on interrelated activities of ITU-R and ITU-D in response to Resolution ITU-R 69 (RA-15), was reviewed. The meeting noted the draft revision of Recommendation in ITU-R S.1782-0, on possibilities for global broadband Internet access by fixed satellite, and agreed that it would be useful to receive any future updates on the subject. It was therefore agreed to send an appropriate response to ITU-R WP4A.

Document SG1RGQ/157 (**ITU-T Study Group 15**) (also for Q1/1), on contributions from developing countries, was noted. The liaison statement draws the attention of the Q5/1 team to contributions submitted to ITU-T SG15 for its July 2019 meeting, notably contributions from the Democratic Republic of the Congo, the Central African Republic, Palestine and Guinea. The information was found useful for Chapter 5 of the Q5/1final report. The meeting agreed to send an appropriate response to ITU-T SG15.

Document SG1RGQ/159 + Annex (**ITU-T Study Group 15**), on inter-Sector coordination, was reviewed. The meeting noted the mapping of Q5/1 to ITU-T SG15 Q1/15 and Q16/15, on coordination of access and home network transport standards and optimal physical structure, and agreed to request relevant information as necessary.

Document SG1RGQ/216 (**ITU Coordination Committee for Terminology – ITU CCT**) (also for Q1/1) advises that, at its 17 June 2019 meeting, ITU CCT had not come up with a general definition of the terms "broadband", "broadband access" and variants such as "low-speed, medium-speed and high-speed broadband" that would suit the context of the work of all the parties involved.

**February 2020**

The Rapporteur Group for Question 5/1 held its fifth meeting for the 2018-2021 study period in Geneva on 18 February 2020. The meeting report may be found in ITU-D SG1 Document 1/REP/21 + Annex, and the input documents, including case studies, are summarized below:

Document 1/268 (**Japan**) (case study) highlights a study on e-education and agricultural consultation through regular use of portable emergency telecommunication systems in the rural areas of the Republic of Nepal.

Document 1/279 (**Sudan**) (case study) provides an insight into challenges faced by Sudan in rolling out broadband in rural and remote areas. A key challenge is network infrastructure limitations (optical fibre).

Document 1/302(Rev.1) + Annex (**Senegal**) (case study) updates previous contributions by Senegal on universal service access. The document highlights the establishment of a well-structured, participative and transparent governance model for the universal service/access fund and the policies that relate to it.

Document 1/308 contains the abridged report of a workshop held by the Q5/1 rapporteur group at ITU headquarters in Geneva on 25 September 2019, on the topic of broadband development in rural and remote areas.

Document 1/316 (**Russian Federation**) (case study) provides updated information on work being done by the Russian Federation to provide universal services in rural and remote areas of the country, with the objective of eliminating the digital divide, and in particular on key aspects of a new legislative bill amending the Federal Communications Act.

Document 1/326 (**Algérie Télécom SPA, Algeria**) (case study) introduces aspects of integrating satellite and non-terrestrial networks (NTN) in 5G in accordance with the work of 3GPP, as there is increasing interest for an integrated satellite and terrestrial network infrastructure in the context of 5G. The **United States** pointed out that the document highlights early inputs to external standardization processes and that it might be premature to include much of this information in the report on Q5/1 until those processes have concluded. It was agreed that a liaison statement between Q5/1 and the relevant ITU-R study groups would be sent to seek further information before including the information in the final report.

Document 1/327(Rev.1) (**United States**) (case study) provides details of how the universal service funds in the United States are managed and how effective the management framework is in promoting the acceleration of broadband connectivity in rural and remote areas. The contribution provides useful information for the part of the draft final report related to financing models.

Document 1/331 (**China**) provides information on the construction and deployment of management-based big-data platforms to promote universal telecommunication services.

Document 1/338 (**Democratic Republic of the Congo**) (case study) notes that one inexpensive way of democratizing access to new ICTs is to provide each community in a socially underprivileged geographical area with teleservices (telephone, fax, Internet, telex, radio). Telecentres are deemed community-serving, because they bring together all available telecommunication facilities and other computer-assisted services for the benefit of the entire community, obviating the need for each household to own a portable phone and receiver.

At the request of the submitter, consideration of Document 1/354 (**South Africa**) (case study) was deferred to the next meeting.

Document 1/361 (**Japan**) (case study) presents Japan's efforts to develop an environment for using 5G in regional or rural areas, focusing on comprehensive 5G demonstration tests and the concept of 'local 5G'. As part of the demonstration tests, field trials have been carried out to study how 5G can address regional needs, including those in rural areas. Local 5G provides local communities with access to frequencies for deploying 5G networks locally to address regional needs.

Document 1/375 (**China Telecom, China**) details the innovative approach adopted by China Telecom in coming up with ways of ensuring universal service and access for Sichuan Province, which has a poor economy and is characterized by complicated terrain, thereby reducing the digital divide. The approaches used are aimed at ensuring network construction and incentivizing network use in the area, by designing packages and tariffs that are cheaper and tailored to the communities. Smartphones and broadband terminals are offered for free to encourage use.

Document 1/378 (**Intel Corporation, United States**) provides updated information on the global status of 5G and its importance for developing countries. It underlines that the prompt assignment of 5G-related low-mid-high frequency bands to operators is important for the timely introduction of commercial 5G services.

Document 1/379 (**Intel Corporation, United States**) provides updated information on the progress of Wi-Fi 6 (IEEE 802.11ax) technology. It highlights that Wi-Fi 6 technology is ready to utilize the 6 GHz spectrum for next-generation applications.

Document 1/382 (**Zimbabwe**) highlights different types of partnerships, together with details that reflect their indirect impact on the financial burden of connecting rural areas. These partnerships include public-public partnerships, public-private partnerships, intergovernmental partnerships and partnerships between international organizations and specific countries.

Document 1/384 (**KT Corporation, Republic of Korea**) (case study) provides details of Korea Telecom's capacity-building programme, which has seen 3.3 million Koreans and 16 000 institutions benefit. Trainees receive information technology qualification certificates. The programme is carried out in conjunction with various government agencies, regional governments and NGOs.

Document 1/386 (**Waseda University, Japan**) (case study) shares information on two practical examples of the implementation of an optical-fibre rural-connectivity solution. The solution conforms to new Recommendations ITU-T L.1700, L.110 and L.163, which identify the requirements of the solution for affordably and quickly narrowing the urban-rural digital divide.

Document 1/389 (**GSMA**) provides information on the barriers to mobile-network coverage. It also includes information for policy-makers to adopt policies that will support mobile operators' efforts to provide affordable mobile Internet services.

Document 1/362 + Annexes (**BDT**), introduced by the BDT Focal Point for Question 5/1, contains a toolkit for regulators, governments, service providers and communities to address inadequate communication service delivery in developing countries. It offers last-mile connectivity solutions to connect the unconnected in developing countries. Participants were invited to submit their

comments to BDT within two weeks. There was also mention of a forthcoming report on power supply.

Document 1/ADM/32 contains a list of all documents submitted under Question 5/1 for the current study period to date. Document 1/398 contains a list of the lessons learnt from the various documents submitted under Q5/1 for the current meeting.

***Liaison statements:***

Document 1/295 (**ITU-R Study Group 5**) shares revised Question ITU-R 238-3/5, on mobile broadband wireless access systems.

Document 1/294 (**ITU-R Study Group 5**) shares for consideration revised Question ITU-R 77-8/5, on consideration of the needs of developing countries in the development and implementation of IMT.

**September 2020**

The Rapporteur Group for Question 5/1 held its fifth meeting for the 2018-2021 study period (virtual meeting) on 22 and 23 September 2020. The meeting report may be found in ITU-D SG1 Document SGRGQ1/REP/19, and the input documents, including case studies, are summarized below:

Document SG1RGQ/288 (**ITU Association of Japan, Japan**) updated Chapter 2 of the draft output report with 11 case studies.

Document SG1RGQ/289 (**ITU Association of Japan, Japan**) provided an overview and analysis of the case studies submitted under Q5/1 in 2018 and 2020.

Document SG1RGQ/361 (**ITU Association of Japan, Japan**) is a follow-up to a previous contribution, Document 2/336 (2016), describing a method for recovering used lead-acid batteries and how the technology can contribute to reducing the cost of telecommunications/ICTs in rural and remote areas, as well as e-waste. It is expected that the technology will be widely employed in rural and remote areas of developing countries, thereby helping to cut down on e-waste for the benefit of the environment.

Document SG1RGQ/370 (**Waseda University, Japan**) describes a lightweight optical cable backhaul solution developed with the aim of helping to bridge the urban-rural digital divide (and halt pandemics). The solution is affordable, reliable, green, scalable and quickly implementable, and meets the standards in Recommendations ITU-T L.1700, L.110 and L.163. It has been used in rural areas in the Republic of Nepal and Mongolia for short- and long-range purposes.

Document SG1RGQ/341 (**China**) reflects China's efforts in the exploration and practice of exploiting the telecommunication network for poverty alleviation in China. It summarizes the latest broadband network development in rural areas, and introduces the remarkable progress made by rural e-commerce, online education and Internet medical care in poverty alleviation. The document provides a relevant reference for promoting poverty alleviation in other countries, especially developing countries.

Document SG1RGQ/380 (**Republic of Korea**) describes the smart quarantine system project led by the Ministry of Science and ICT (MSIT) as a pilot project in collaboration with the Korea Centres for Disease Control and Prevention (KCDC) and Korea Telecom (KT), using KT's roaming

data and KCDC's entry quarantine data, which has enabled the government to respond more effectively and accurately to the outbreak of COVID-19 in 2020.

Document SG1RGQ/328 (**United States**) presents an overview of roll-out of the United States 5G FAST Plan. It explains the importance of 5G to a nation's economy, security and quality of life. The United States is pursuing a comprehensive strategy to encourage innovation and investment in 5G mobile networks. To realize the potential of 5G, FCC has developed and is executing what is called the 5G FAST Plan, which consists of three central components, namely: freeing up more spectrum for the commercial marketplace, promoting wireless infrastructure deployment, and modernizing existing regulations to promote more fibre deployment.

Document SG1RGQ/338 (**Internet Society**) provides information on creating an enabling regulatory environment for community networks. It highlights three main barriers that community networks face in endeavouring to provide sustainable, affordable connectivity to rural, remote and underserved areas, namely: lack of access to funding mechanisms, to appropriate licensing/authorization frameworks, and to necessary electromagnetic spectrum and infrastructure. The contribution outlines approaches adopted by governments and regulators with a view to overcoming these three barriers in order to create an enabling environment for community networks to flourish and to expand the Internet infrastructure, with the underlying principle of permissionless innovation, openness and diversity. The document also highlights the following case studies:

- **Georgia:** The Tusheti region of Georgia is extremely remote and isolated, with a sparse population. Thanks to inexpensive wireless technology, local champions and an enabling regulator, the region is now connected to a community network that provides an unprecedented level of connectivity to the region. ISOC's 2018 report *Connecting Tusheti* details how an enabling regulatory environment has been key to the community network's success. The Tusheti project benefits from a liberal communications environment and variety of State support mechanisms. It does not need a licence to use wireless spectrum and does not need any permission to set up a community Wi-Fi network or to operate as an ISP. A simple online General Authorization is all that is required. The special tax regime of 0 per cent value-added tax for small and medium-sized enterprises (SMEs) applies to community Wi-Fi networks. Settlements in high mountainous regions also receive other special tax relief, such as being exempt from income tax. As it is a protected area, legislation also provides for some benefits for residents of Tusheti. Finally, the Georgian Government has allocated up to USD 4 million to support households in rural areas in installing broadband access and acquiring knowledge in digital literacy as part of its GENIE project.[172]
- **Mexico**: Mexico's telecommunication regulator, the *Instituto Federal de Telecomunicaciones* (IFT), has modelled how to create a regulatory framework that supports community networks. In 2015, IFT allocated a portion of the 800 MHz band for social use. The "social use" licence is reserved for networks that will serve communities with 2 500 people or less, or communities located in an indigenous region or priority zone. This new regulation has allowed the non-profit association *Telecomunicaciones Indígenas Comunitarias* (TIC AC) to use the social-purpose licence to support a community network in indigenous regions around Oaxaca, Mexico.[173,174,175]
- **Zimbabwe**: Murambinda Works is a community network in Zimbabwe's rural Buhera district. The connectivity project works closely with local schools and the country's Ministry of Education to provide e-learning services to schools. The publicly owned TelOne

[172] ISOC (2018). Connecting Tusheti: The impact of community networking in Europe's highest settlements.
[173] See ISOC (2018). Community networks in Latin America: Challenges, Regulations and Solutions, p. xxi.
[174] See ISOC (2018). Unleashing community networks: Innovative licensing approaches, p. 9.
[175] *Telecommunicaciones indigenas comunitarias*: https://www.tic-ac.org/[in Spanish]

Zimbabwe ISP has partnered with Murambinda Works to provide Internet connection, and the telecommunication regulator has granted preliminary approval for the pilot to go ahead. The initiative is pursuing discussions with the regulator for approval of a licence.[176]

- **United Kingdom**: The telecommunication regulator in the United Kingdom, Ofcom, has set good examples of how spectrum sharing can enable innovative connectivity solutions.[177]
- **Brazil:** Since 2008, the Brazilian regulatory framework provided for a prerogative allowing sharing of Internet access to third parties. Some progress was made in this regard in 2013, and in 2017 the resolution on Private Limited Service (SLP) (Resolution 617/2013) was re-issued. The SLP resolution allows non-profit entities to provide Internet connectivity and creates a licensing exemption, allowing Internet providers, the famous "Via Gato" providers, to operate.[178] In January 2020, the National Telecommunications Agency (Anatel), in response to international recommendations, notably Recommendation ITU-D 19,[179] and the representations made by civil society, created a page on its website that discusses community network initiatives as viable complementary Internet access solutions for reducing the digital divide in the country.[180]

Document SG1RGQ/347 (**United States**) gives an overview of how the United States National Telecommunications and Information Administration (NTIA) is providing capacity building to state and local communities and industry stakeholders in order to improve broadband infrastructure and digital inclusion. The contribution explains NTIA's efforts to educate and assist stakeholders with their broadband goals, while working across the United States government to improve federal policies and broadband data through the Broadband USA programme. The document also showcases practices that are replicable with a low investment.

Document SG1RGQ/348 (**United States**) presents an overview of how NTIA in the United States is promoting network planning, community capacity building and stakeholder engagement to improve broadband deployment in hard-to-reach rural areas in the United States. While this process was developed specifically to improve partnerships and build capacity for wireline and fixed wireless deployments, the process could be applied equally well to other technical challenges that require stakeholder engagement, partnership development and funding.

Document SG1RGQ/371 (**Intel Corporation, United States**) provides information on best-practice guidelines for the transition to high-speed and high-quality broadband networks. It explains the importance of high-speed and high-quality broadband networks for the developing countries during COVID-19.

Document SG1RGQ/375(Rev.1) (**Intel Corporation, United States**) provides updated information on the global status of 5G and its importance for the developing countries, including: 5G market snapshot, 5G FWA, 5G devices and 5G spectrum snapshot. It also underlines that the prompt assignment of 5G-related low-mid-high frequency bands to operators is important for the timely introduction of commercial 5G services.

Document SG1RGQ/300 (**Burundi**) (case study) highlights how the coverage of the country and high-quality service have led to economic growth, accessibility and digital inclusion.

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176 Association for Progressive Communications (APC). Murambinda Works.
177 Ofcom United Kingdom. (2019). Enabling wireless innovation through local licensing: Shared access to spectrum supporting mobile technology. 25 July 2019.
178 *Agência Nacional de Telecomunicações* (Anatel), Brazil. Resolution 617 of 19 June 2013 approving the regulation of private limited service.
179 ITU-D. Recommendation ITU-D 19, on telecommunication for rural areas.
180 For more information, see IBEBrazil (2020). Brazil's regulatory framework for CNs.

Document SG1RGQ/326 (**Zimbabwe**) highlights the need to focus on household connectivity, as opposed to communal connectivity which is of limited use during times of emergency and pandemics, and proposes policy solutions for such connectivity.

Document SG1RGQ/327 (**Haiti)** (case study) describes the usefulness of ICTs for remote and rural areas in Haiti, following the difficulties faced by rural and remote communities during the COVID-19 pandemic.

Document SG1RGQ/386 (**APC, South Africa**) highlights the important role that community networks around the world play in the provision of affordable access and in sharing essential health information in local languages, addressing misinformation and supporting digital financial services.

Document SG1RGQ/357 (**Sri Lanka**) presents a project initiated by Sri Lanka to identify unserved areas in the country and improve coverage countrywide in order to achieve universal access.

Document SG1RGQ/364 (**SES World Skies**) highlights how the COVID-19 pandemic has resulted in drastic changes in education, with a huge growth in e-learning solutions. It proposes satellite connectivity as an ideal medium to support essential educational channels and access to information through free-to-air (FTA), free-to-view (FTV) or pay-TV platforms for vulnerable communities

Document SG1RGQ/318 + Annexes (**EMEA Satellite Operators Association – ESOA**) contains a collection of 11 contributions submitted by ESOA on the use of satellites to connect the last mile in rural and remote areas, including:

- Viasat is connecting unconnected communities in **Mexico** using satellite as a primary technology, mainly via VSAT and Wi-Fi. The Viasat financing model charges users a low price, making it commercially viable, and does not involve government subsidies or draw on universal service funds.
- Hughes provides low-cost satellite and Wi-Fi services in **Mexico** through affordable data packages (USD 0.5 for 100 MB or one hour) in areas where terrestrial infrastructure is not available.
- iMlango is using Avanti's satellites to connect schools in **Kenya** with 100 per cent coverage as well as providing the schools with a learning platform and solutions (180 000 children have benefited).
- SES has provided a satellite network using MEO and GSO satellites to Tigo in **Chad**, Gilat Telecom in the **Democratic Republic of the Congo**, ENTEL in **Peru** and Orange in the **Central African Republic** so as to enable the telecom operators to provide 3G and 4G services in rural and remote areas. SES has also worked with Lux Dev (funding) and government (funding and ownership) to provide end-to-end connectivity and solutions using MEO satellites to create a reliable communications network in **Burkina Faso**.
- SES is also assisting the Ministry of Communication and Information Technology of **Indonesia** and its universal service obligation (USO) agency *Badan Aksesibilitas Telekomunikasi dan Informasi* (BAKTI) in providing satellite connectivity in order to bring broadband and mobile to rural areas (Sumatra, Maluku-Papua, among others).
- Intelsat is providing community Wi-Fi to a refugee camp in **Ghana**, and has launched a pilot project to roll out Internet to rural areas in **South Africa** ("South African Internet for all"), through a multistakeholder approach in partnership with the Department of Telecommunications and Postal Services (DTPS) and the World Economic Forum (WEF), involving a trial of five Wi-Fi hotspot pilot sites.

Document SG1RGQ/319 (**EMEA Satellite Operators Association – ESOA**) highlights the benefits of satellite technology, both when used as a direct connectivity solution and when employed in

conjunction with terrestrial or Wi-Fi networks. Developments in **Chile**, **Myanmar**, the **Democratic Republic of the Congo** and **Papua New Guinea** were cited as examples.

Document SG1RGQ/382 (**Ericsson**) describes how network can help achieve rural connectivity, through three network-deployment scenarios for providing rural coverage, namely: upgrade existing 2G network sites to 3G/4G or 5G NR (new radio); extend or densify networks in remote rural areas through low-cost solutions; deploy fixed wireless access.

Document SG1RGQ/365 (**ATDI, France**) recommends high-gain antennas as a cost-effective solution for achieving better mobile broadband applications over rural countryside.

Document SG1RGQ/344(Rev.1) containing proposals for the future of Q5/1 was presented by Mr Kawasumi, Vice-Rapporteur. It proposes that socio-economic and technological trends associated with the current digital transformation be taken into account in the formulation of the future scope for studies under Q5/1.

Document SG1RGQ/366 (**ATDI France**) provides inputs for §5.3.4 of the draft final report, in relation to Recommendation ITU-R M.1801, which contains radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz.

Document SG1RGQ/388 (**Brazil**) shares current experience with regard to connectivity in rural areas in Brazil, as an enhancement for §5.3.4 of the final report on Q5/1.

Document SG1RGQ/313 (**Vice-Chairman of ITU-D Study Group 1**) compiles preliminary views on the future of ITU-D study group Questions, consolidating inputs from Questions 1/1, 2/1, 3/1, 4/1, 5/1, 6/1 and 7/1, and identifying issues of relevance to the next study period. A summary of this report was shared in Annex 8 to the report by the Chairman of SG1 to the virtual meetings of the Telecommunication Development Advisory Group (TDAG) held from 2 to 5 June.

Document SG1RGQ/317 (**Co-Rapporteurs and Vice-Rapporteurs for Question 5/1**) contains a proposal for future studies related to ICTs for rural and remote areas. It proposes a new or revised topic that takes into account the need to transform rural economies into digital economies through access to broadband services.

Document SG1RGQ/344(Rev.1) (Japan) sets out a proposed wording for the future of Q5/1 based on the discussion among the interested experts in the rapporteur group.

Document SG1RGQ/345 (**Japan**) puts forward a new ITU-D Recommendation, formulated in the appropriate template, reflecting the content of Chapter 9 of the draft final report for Question 5/1 proposed for consideration by the rapporteur group.

Document SG1RGQ/275 (**ITU-T Study Group 5**) contains an incoming liaison statement on the preparations for the World Telecommunication Standardization Assembly (WTSA).

Document SG1RGQ/277 (**ITU-T Study Group 15**) contained an incoming liaison statement from ITU-T SG15, transmitting information on the contributions received from developing countries during the ITU-T SG15 meeting in Geneva on 27 January – 7 February 2020 dealing with their country-specific investments and projects for the deployment of optical fibre infrastructure in order to foster national and regional economic development.

Document SG1RGQ/290 (**ITU-R Working Party 5D**) contains a liaison statement highlighting proposed solutions that support remote, sparsely populated areas by providing high data-rate coverage, which will be incorporated in Chapter 5 of the final report. It was noted with appreciation.

Document SG1RGQ/329 (**ITU-R Working Party 5A**) is a liaison statement from ITU-R Working Party 5A in response to Q5/1's liaison statement in Document 5A/11. The response draws the attention of Q5/1 to useful information on telecommunications/ICTs for rural and remote areas contained in the WP5A Guide to the use of ITU-R texts relating to the land mobile service, including wireless access in the fixed service, which is kept up to date on the WP5A webpage. The information would be referred to and used in Chapters 3, 5 and 6 of the final report on Q5/1.

Document SG1RGQ/REP/19 contains the Report of the Rapporteur Group meeting on Question 5/1 held on Tuesday, 22 September 2020, 14:30-16:00 hours and Wednesday, 23 September 2020, 13:00-16:00 hours.

Document 1/433 (**China**) proposes paying more attention to the development of Internet applications in rural and remote areas.

Document 1/418(Rev.4) (**Co-Rapporteurs for Question 5/1**) contained the near final draft report following the September 2020 meeting of the Rapporteur Group on Question 5/1: Telecommunications/ICTs for rural and remote areas.

Document 1/435(Rev.2) (**Co-Rapporteur for Question 5/1**) contains the proposal for future studies on telecommunications/ICTs for rural and remote areas, highlighting topics for study. It is a re-publication, with refinements of Document 1/345 originally submitted by Japan for review purposes only.

Document 1/409 (**ITU-R WP 5D**) contains a liaison statement from ITU-R Working Party 5D to ITU-D SG1 Q1/1 in reply to a liaison statement from ITU-D SG1 Q1/1 (copy to ITU-D SG1 Q5/1 for information).

Document SG1RGQ/ADM/39 (**BDT**) contains a list of all documents submitted to Question 5/1 up to 3 February 2021.

Document SG1RGQ/389 (**BDT**) contains a compilation of lessons learned from contributions received.

Document SG1RGQ/ADM/34 (**BDT**) contains a list of incoming liaison statements

Document 1/443 (**ESOA**) submits suggestions and modifications for Chapters 2, 3, 4, 5, 7 and 9, which were duly attended to.

Document 1/446 (**Co-Rapporteurs for Question 5/1**) contains a proposal to modify the title of section 9.2 of the draft final report.

Document 1/463-E (**United States**) highlights the United States Department of Interior's recently announced Indian Affairs National Tribal Broadband Strategy (as of January 2021) designed to help indigenous people in regard to broadband connectivity. Tribal communities have faced higher construction and operating costs associated with broadband deployment due to often lower population and higher poverty and unemployment rates compared to non-tribal rural areas. The strategy serves as a roadmap for the U.S. Federal Government and the private

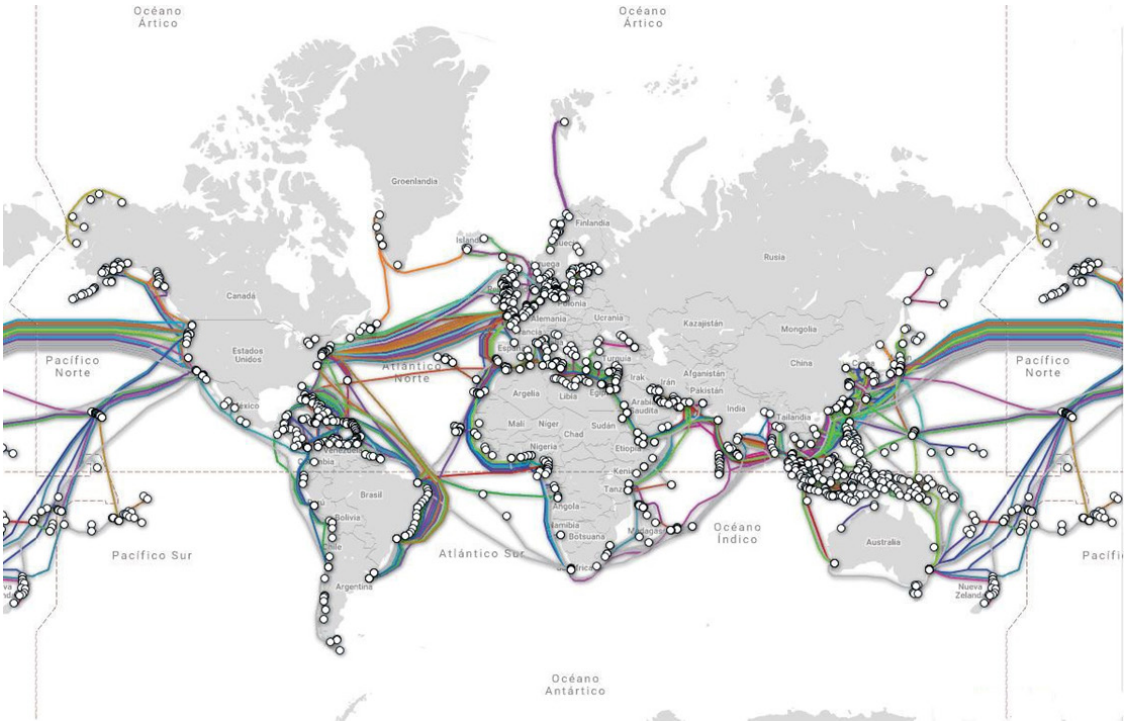
sector, highlighting the strategic components of broadband deployment and expansion, and the necessary actions to spur investment within American Indian and Alaska Native (AI/AN) communities, lessons that could be applied to other global communities and indigenous peoples constrained by geography.

Document 1/462 (**Intel, United States**) provides information on the importance of terrestrial high-speed and high-quality broadband for digital equity and examples from different countries/regions. It includes broadband, 5G and fibre strategy examples for rural and remote areas to provide high-speed and high-quality broadband in countries/regions such as the United States, the Republic of Korea, the United Kingdom, China, India, Switzerland, the African continent and the European Union. The document proposed changes to the draft output report to take into account the need for "high-speed broadband for rural and remote areas".

Document 1/427 (**Co-Rapporteurs for Question 5/1**) provided a brief report on the progress made by the Rapporteur Group working on Question 5/1 in achieving its mandate and objective as handed down by WTDC-17. The document covers details of the number of meetings held under Question 5/1, an analysis of the contributions received and considered at the meetings and the chapters of the final report to which the contributions have been allocated, as well as an update on the preparation of the final report, and proposals for the future of the Question. It highlighted that, during the current study period, **165** contributions were submitted for consideration and all of them had been utilized in compiling the Final Report.

Document 1/REP/29(Rev.1) (**Co-Rapporteurs for Question 5/1**) contains the report of the informal and formal meeting for Question 5/1 held on 3 and 24 March 2021, respectively.

# Annex 3: Map of the global submarine cable network




Disclaimer: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of ITU and of its secretariat concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

*Source*: Submarine cable map by Tele Geography (accessed 12 December 2019)

## Annex 4: List of submarine cables (A-Y)

| | | | |
|---|---|---|---|
| ACS Alaska-Oregon Network (AKORN) | Aden-Djibouti | Adria-1 | AEConnect-1 |
| Africa Coast to Europe (ACE) | Alaska United East | Alaska United Southeast | Alaska United Turnagain Arm (AUTA) |
| Alaska United West | ALBA-1 | Aletar | Alonso de Ojeda |
| ALPAL-2 | America Movil Submarine Cable System-1 (AMX-1) | America Movil-Telxius West Coast Cable | American Samoa-Hawaii (ASH) |
| Americas-I North | Americas-II | Amerigo Vespucci | Antillas 1 |
| APCN-2 | Aphrodite 2 | Apollo | Aqualink |
| ARBR | ARCOS | ARSAT Submarine Fibre Optic Cable | Asia Africa Europe-1 (AAE-1) |
| Asia Pacific Gateway (APG) | Asia Submarine-cable Express (ASE)/Cahaya Malaysia | Asia-America Gateway (AAG) Cable System | Atisa |
| Atlantic Crossing-1 (AC-1) | Atlantis-2 | Atlas Offshore | AU-Aleutian |
| AURORA Cable System | Australia-Japan Cable (AJC) | Australia-Papua New Guinea-2 (APNG-2) | Australia-Singapore Cable (ASC) |
| Avassa | Azores Fibre Optic System (AFOS) | Bahamas 2 | Bahamas Domestic Submarine Network (BDSNi) |
| Bahamas Internet Cable System (BICS) | Balalink | BALOK | Baltic Sea Submarine Cable |
| Baltica | Bass Strait-1 | Bass Strait-2 | Basslink |
| Batam Dumai Melaka (BDM) Cable System | Batam Sarawak Internet Cable System (BaSICS) | Batam Singapore Cable System (BSCS) | Batam-Rengit Cable System (BRCS) |
| Bay of Bengal Gateway (BBG) | Bay to Bay Express (BtoBE) Cable System | BCS East | BCS East-West Interlink |
| BCS North – Phase 1 | BCS North – Phase 2 | BERYTAR | Bharat Lanka Cable System |
| Bicentenario | BlueMed | Bodo-Rost Cable | Boracay-Palawan Submarine Cable System |
| Boriken Submarine Cable System (BSCS) | Botnia | Brazilian Festoon | BRUSA |

## (continued)

| | | | |
|---|---|---|---|
| BT Highlands and Islands Submarine Cable System | BT-MT-1 | BUGIO | C-Lion1 |
| Cabo Verde Telecom Domestic Submarine Cable Phase 1 | Cabo Verde Telecom Domestic Submarine Cable Phase 2 | Cabo Verde Telecom Domestic Submarine Cable Phase 3 | CADMOS |
| CAM Ring | Canalink | CANDALTA | CANTAT-3 |
| Caribbean Regional Communications Infrastructure Programme (CARCIP) | Caribbean-Bermuda U.S. (CBUS) | Caucasus Cable System | Cayman-Jamaica Fibre System |
| Ceiba-1 | Ceiba-2 | Celtic | Celtic Norse |
| CeltixConnect-1 (CC-1) | CeltixConnect-2 (CC-2) | Challenger Bermuda-1 (CB-1) | Channel Islands-9 Liberty Submarine Cable |
| Chennai-Andaman & Nicobar Islands Cable | Chuuk-Pohnpei Cable | Circe North | Circe South |
| COBRAcable | Colombia-Florida Subsea Fibre (CFX-1) | Columbus-II b | Columbus-III |
| Comoros Domestic Cable System | Concerto | Converge ICT Domestic Submarine Cable | Coral Sea Cable System (CSCS) |
| Corse-Continent 4 (CC4) | Corse-Continent 5 (CC5) | Cross Straits Cable Network | Crosslake Fibre |
| Curie | DAMAI Cable System | Danica North | DANICE |
| Denmark-Norway 5 | Denmark-Norway 6 | Denmark-Poland 2 | Denmark-Sweden 15 |
| Denmark-Sweden 16 | Denmark-Sweden 17 | Denmark-Sweden 18 | Dhiraagu Cable Network |
| Dhiraagu-SLT Submarine Cable Network | Diamond Link Global | Didon | Djibouti Africa Regional Express 1 (DARE1) |
| Dumai-Melaka Cable System | Dunant | E-LLAN | EAC-C2C |
| East-West | East-West Submarine Cable System | Eastern Africa Submarine System (EASSy) | Eastern Caribbean Fibre System (ECFS) |
| Eastern Light | ECLink | Elektra-GlobalConnect 1 (GC1) | EllaLink |
| Emerald Bridge Fibres | Energinet Laeso-Varberg | Energinet Lyngsa-Laeso | England Cable |

## (continued)

| | | | |
|---|---|---|---|
| Equiano | ESAT-1 | ESAT-2 | Estepona-Tetouan |
| Europe India Gateway (EIG) | FALCON | Far East Submarine Cable System | FARICE-1 |
| Farland North | FASTER | Fehmarn Bält | Fibre Optic Gulf (FOG) |
| Fibra Optica Austral | Fibralink | Finland Estonia Connection (FEC) | Finland-Estonia 2 (EESF-2) |
| Finland-Estonia 3 (EESF-3) | FLAG Atlantic-1 (FA-1) | FLAG Europe-Asia (FEA) | FLAG North Asia Loop/REACH North Asia Loop |
| Flores-Corvo Cable System | FLY-LION3 | FOS Quellon-Chacabuco | Gemini Bermuda |
| Geo-Eirgrid | Georgia-Russia | Germany-Denmark 2 | Germany-Denmark 3 |
| Glo-1 | Glo-2 | Global Caribbean Network (GCN) | GlobalConnect 2 (GC2) |
| GlobalConnect 3 (GC3) | GlobalConnect-KPN | GlobeNet | GO-1 Mediterranean Cable System |
| Gondwana-1 | Greenland Connect | Greenland Connect North | GTMO-1 |
| GTMO-PR | GTT Atlantic | GTT Express | Guadeloupe Cable des Iles du Sud (GCIS) |
| Guam Okinawa Kyushu Incheon (GOKI) | Guernsey-Jersey-4 | Gulf Bridge International Cable System (GBICS)/ Middle East North Africa (MENA) Cable System | Gulf of California Cable |
| Gulf2Africa (G2A) | H2 Cable | Hainan-Hong Kong Submarine Cable System | HANNIBAL System |
| HANTRU1 Cable System | Havfrue/AEC-2 | Hawaiki | Hawk |
| HICS (Hawaii Inter-Island Cable System) | HIFN (Hawaii Island Fibre Network) | High-capacity Undersea Guernsey Optical-fibre (HUGO) | Hokkaido-Sakhalin Cable System (HSCS) |
| Hong Kong-Americas (HKA) | Hong Kong-Guam (HK-G) | Honotua | i2i Cable Network (i2icn) |
| IMEWE | INDIGO-Central | INDIGO-West | Indonesia Global Gateway (IGG) System |

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| | | | |
|---|---|---|---|
| INGRID | Interchange Cable Network 1 (ICN1) | Interchange Cable Network 2 (ICN2) | International Gateway (IGW) |
| IOX Cable System | IP-Only Denmark-Sweden | Ireland-France Cable-1 (IFC-1) | Isles of Scilly Cable |
| Italy-Albania | Italy-Croatia | Italy-Greece 1 | Italy-Libya |
| Italy-Malta | Italy-Monaco | JaKa2LaDeMa | JAKABARE |
| Jakarta Surabaya Cable System (JAYABAYA) | Jakarta-Bangka-Bintan-Batam-Singapore (B3JS) | Jambi-Batam Cable System (JIBA) | Janna |
| Japan Information Highway (JIH) | Japan-Guam-Australia North (JGA-N) | Japan-Guam-Australia South (JGA-S) | Japan-U.S. Cable Network (JUS) |
| JASUKA | Java Bali Cable System (JBCS) | Jerry Newton | Jonah |
| Junior | JUPITER | Kanawa | Kattegat 1 |
| Kattegat 2 | Kerch Strait Cable | KetchCan1 Submarine Fibre Cable System | Kodiak Kenai Fibre Link (KKFL) |
| Korea-Japan Cable Network (KJCN) | Kumul Domestic Submarine Cable System | Kuwait-Iran | La Gomera-El Hierro |
| Labuan-Brunei Submarine Cable | Lanis-1 | Lanis-2 | Lanis-3 |
| Latvia-Sweden 1 (LV-SE 1) | Lazaro Cardenas-Manzanillo Santiago Submarine Cable System (LCMSSCS) | Lev Submarine System | LFON (Libyan Fibre Optic Network) |
| Libreville-Port Gentil Cable | Link 1 Phase-1 | Link 1 Phase-2 | Link 2 Phase-1 |
| Link 2 Phase-2 | Link 3 Phase-1 | Link 3 Phase-2 | Link 4 Phase-2 |
| Link 5 Phase-2 | Lower Indian Ocean Network (LION) | Lower Indian Ocean Network 2 (LION2) | Luwuk Tutuyan Cable System (LTCS) |
| Lynn Canal Fibre | MainOne | Malaysia-Cambodia-Thailand (MCT) Cable | Malbec |
| Malta-Gozo Cable | Malta-Italy Interconnector | Manatua | Mandji Fibre Optic Cable |
| Maple Leaf Fibre | MAREA | Mariana-Guam Cable | Mataram Kupang Cable System (MKCS) |

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| | | | |
|---|---|---|---|
| Matrix Cable System | Mauritius and Rodrigues Submarine Cable System (MARS) | Maya-1 | Med Cable Network |
| MedNautilus Submarine System | Melita 1 | Meltingpot Indianoceanic Submarine System (METISS) | Mid-Atlantic Crossing (MAC) |
| Middle East North Africa (MENA) Cable System/Gulf Bridge International | Miyazaki-Okinawa Cable (MOC) | Monet | Moratelindo International Cable System-1 (MIC-1) |
| N0R5KE Viking | National Digital Transmission Network (NDTN) | Nationwide Submarine Cable Ooredoo Maldives (NaSCOM) | NATITUA |
| Nelson-Levin | New Cross Pacific (NCP) Cable System | Nigeria Cameroon Submarine Cable System (NCSCS) | NordBalt |
| North Sea Connect (NSC) | North West Cable System | Northern Lights | NorthStar |
| Nunavut Undersea Fibre Optic Network System | NYNJ-1 | Okinawa Cellular Cable | Oman Australia Cable (OAC) |
| OMRAN/EPEG Cable System | Oran-Valencia (ORVAL) | Orient Express | OTEGLOBE Kokkini-Bari |
| Pacific Caribbean Cable System (PCCS) | Pacific Crossing-1 (PC-1) | Pacific Light Cable Network (PLCN) | Palapa Ring East |
| Palapa Ring Middle | Palapa Ring West | Palawa-Iloilo Cable System | Pan American (PAN-AM) |
| Pan European Crossing (UK-Belgium) | Pan European Crossing (UK-Ireland) | Pan-American Crossing (PAC) | Paniolo Cable Network |
| PASULI | PEACE Cable | PENBAL-5 | Pencan-8 |
| Pencan-9 | Persona | PGASCOM | Picot-1 |
| PIPE Pacific Cable-1 (PPC-1) | Pishgaman Oman Iran (POI) Network | PLDT Domestic Fibre Optic Network (DFON) | PNG LNG |
| Polar Circle Cable | POSEIDON | Prat | Qatar-U.A.E. Submarine Cable System |
| Quintillion Subsea Cable Network | Redellhabela-1 | Rockabill | Russia-Japan Cable Network (RJCN) |

## (continued)

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|---|---|---|---|
| Rønne-Rødvig | S-U-B Cable System | Saba, Statia Cable System (SSCS) | SABR |
| SAFE | Saint Maarten Puerto Rico Network One (SMPR-1) | Sakhalin-Kuril Islands Cable | Samoa-American Samoa (SAS) |
| San Andres Isla Tolu Submarine Cable (SAIT) | SAT-3/WASC | Saudi Arabia-Sudan-1 (SAS-1) | Saudi Arabia-Sudan-2 (SAS-2) |
| Scandinavian Ring North | Scandinavian Ring South | Scotland-Northern Ireland 1 | Scotland-Northern Ireland 2 |
| SEA-US | sea2shore | Seabras-1 | SEACOM/Tata TGN-Eurasia |
| SeaMeWe-3 | SeaMeWe-4 | SeaMeWe-5 | SEAX-1 |
| Segunda FOS Canal de Chacao | Seychelles to East Africa System (SEAS) | SHEFA-2 | Silphium |
| Singapore-Myanmar (SIGMAR) | Sirius North | Sirius South | Sistem Kabel Rakyat 1Malaysia (SKR1M) |
| SJJK | Skagenfibre East | Skagenfibre West | Skagerrak 4 |
| SMPCS Packet-1 | SMPCS Packet-2 | Solas | Sorsogon-Samar Submarine Fibre Optical Interconnection Project (SSSFOIP) |
| South America-1 (SAm-1) | South American Crossing (SAC) | South Asia Express (SAEx2) | South Atlantic Cable System (SACS) |
| South Atlantic Express (SAEx1) | South Atlantic Inter Link (SAIL) | Southeast Asia Japan Cable (SJC) | Southeast Asia-Japan Cable 2 (SJC2) |
| Southern Caribbean Fibre | Southern Cross Cable Network (SCCN) | Southern Cross NEXT | St. Pierre and Miquelon Cable |
| St. Thomas-St. Croix System | Strategic Evolution Underwater Link (SEUL) | Subcan Link 1 | Subcan Link 2 |
| Sumatera Bangka Cable System (SBCS) | Suriname-Guyana Submarine Cable System (SG-SCS) | Svalbard Undersea Cable System | Swansea-Brean |
| Sweden-Estonia (EE-S 1) | Sweden-Finland 4 (SFS-4) | Sweden-Finland Link (SFL) | Sweden-Latvia |
| SxS | Taba-Aqaba | Taino-Carib | Taiwan Strait Express-1 (TSE-1) |

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| Tamares North | Tampnet Offshore FOC Network | Tangerine | Tanjun Pandan-Sungai Kakap Cable System |
| Tannat | Tarakan Selor Cable System (TSCS) | Tasman Global Access (TGA) Cable | TAT-14 |
| Tata TGN-Atlantic | Tata TGN-Gulf | Tata TGN-Intra Asia (TGN-IA) | Tata TGN-Pacific |
| Tata TGN-Tata Indicom | Tata TGN-Western Europe | TE North/TGN-Eurasia/SEACOM/Alexandros/Medex | Telstra Endeavour |
| Tenerife-Gran Canaria | Tenerife-La Gomera-La Palma | Tenerife-La Palma | TERRA SW |
| Thailand-Indonesia-Singapore (TIS) | The East African Marine System (TEAMS) | Tobrok-Emasaed Cable System | Tonga Cable |
| Tonga Domestic Cable Extension (TDCE) | Trans-Pacific Express (TPE) Cable System | TRANSCAN-2 | TRANSCAN-3 |
| Transworld (TW1) | Trapani-Kelibia | TT-1 | Tui-Samoa |
| Turcyos-1 | Turcyos-2 | Tverrlinken | UAE-Iran |
| UGARIT | UK-Channel Islands-7 | UK-Channel Islands-8 | UK-Netherlands 14 |
| Ultramar GE | Ulysses 2 | Unisur | Unity/EAC-Pacific |
| Venezuela Festoon | Vodafone Malta-Sicily Cable System (VMSCS) | WALL-LI | WARF Submarine Cable |
| West African Cable System (WACS) | Yellow | | |

*Source:* PriMetrica, Inc. (last updated on 5 December 2019)

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