# Broadband Situations in Rural and Remote Areas

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**Summary:**

This study is on the current status of broadband communications in remote and rural areas. The study will first analyze the cases submitted to the Case Study Library of ITU-D Study Groups to extract and examine the issues and their practical solutions found to telecommunications in rural and remote areas. Next, analysis will be conducted on national broadband plans and policies adopted by ITU Member States to see the goals on broadband coverage of each state. Finally, the report will summarize the technologies available for broadband access communications suited for rural and remote areas. Through these analyses, this report will describe the characteristics and issues of rural and remote areas with a view to connect them with a broad and secure connection and provide some conclusions and recommendations for the "Broadband" infrastructure development in planning and measuring for such areas.

## Chapter 1 Introduction

According to the statistics of United Nation's Population Division (2014) [1], it is estimated that almost half of the global population is in the rural areas. Moreover, in 2005, the majority of global population shifted from rural to urban area. Thus, development efforts made in the remote and rural areas are efforts to improve the lives of the majority of the people, and affordable broadband access should be one of key elements which create an enabling environment in such areas.

Having this global trend in mind, ITU, in close coordination with all UN agencies, coordinated the WSIS+10 High Level Event which took place in Geneva, 2014. The event endorsed two Outcome Documents, the WSIS+10 Statement on Implementation of WSIS Outcomes and the WSIS+10 Vision for WSIS Beyond 2015, which notes the progress made on the implementation of the WSIS Action Lines and at the same time recognized several challenges identified during the implementation..

ITU, the sole facilitator of the WSIS Action Line C2: Information and Communications Infrastructure and the leading International Organization in the field of ICT/telecommunications, has been studying broadband infrastructure from many perspectives. Since 1994, ITU-D Study Groups have been studying on the Questions on telecommunications for rural and remote areas, and have collected many practical and valuable case studies on the development of broadband communication.

Not only ITU, but many countries have studied the challenges and current status of the broadband access in their countries, and reflected them into their National Broadband Policies/Plans for the development of broadband networks. These plans reflect the challenges and current status of the

[1] United Nation, Population Division "World Urbanization Prospects, the 2014 revision", available at: http://esa.un.org/Unpd/Wup/CD-ROM/Default.aspx

broadband access of each country. Many of the policies/plans define the broadband speed as one of important measures of service quality.

This report analyzes the case studies of ITU-D Study Groups, and collects and analyzes the broadband speeds defined or targeted in National Broadband Plans, and technologies available for rural and remote access ICT/Telecommunications infrastructure development.

## Chapter 2 Background

### 2.1 Rural Population

The demographic statistics indicates a relative deterioration of the welfare of rural and remote areas compared to urban areas. It is estimated that almost half of the global population is in the rural areas, according to the statistics of United Nation's Population Division (2014)[2] as shown in Figures 2.1 - 2.3, and in 2005, the majority of global population shifted from rural to urban area.

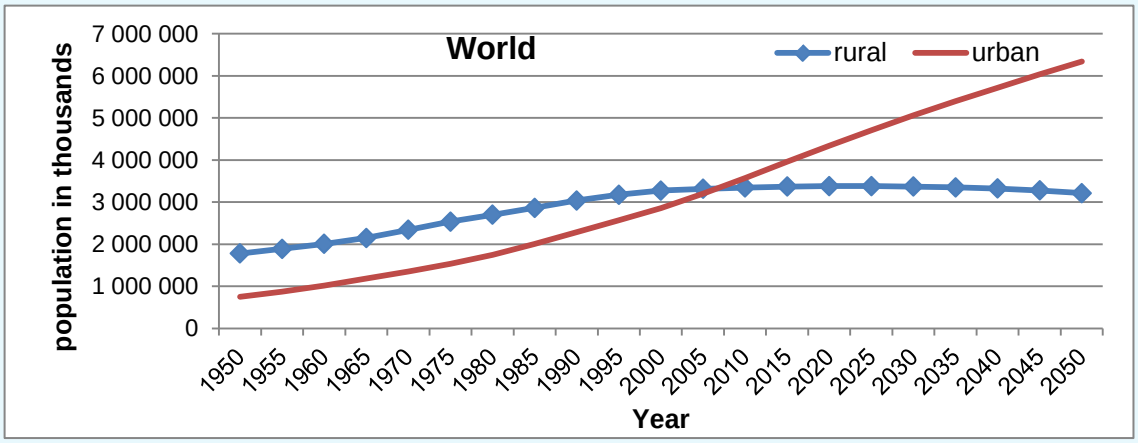
Looking into the regions, in Africa, were Internet penetration is as low as 19.0%[3], this shift is ongoing, and by 2040, rural population is forecasted to surpass the urban population. Also in Asia, were Internet penetration is second lowest as 32.4%, this shift would be in the future in 2016, while its rural population has already peaked out in 2000.

As these figures indicate, rural and remote areas remain largely unconnected to the Internet as they face challenges of attracting investment, and affordable Broadband access to the rural people should be one of key elements which prevent such strong demographic movement.

[2] United Nation, Population Division "World Urbanization Prospects, the 2014 revision", available at: http://esa.un.org/Unpd/Wup/CD-ROM/Default.aspx

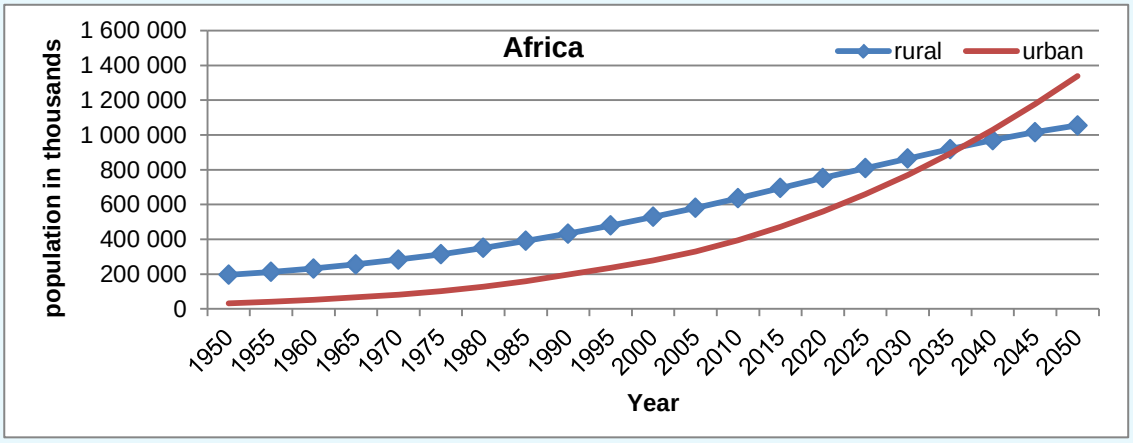
[3] ITU Statistics, estimate for 2014, available at "http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx"

**Figure 2.1: World population trends, rural vs. urban**



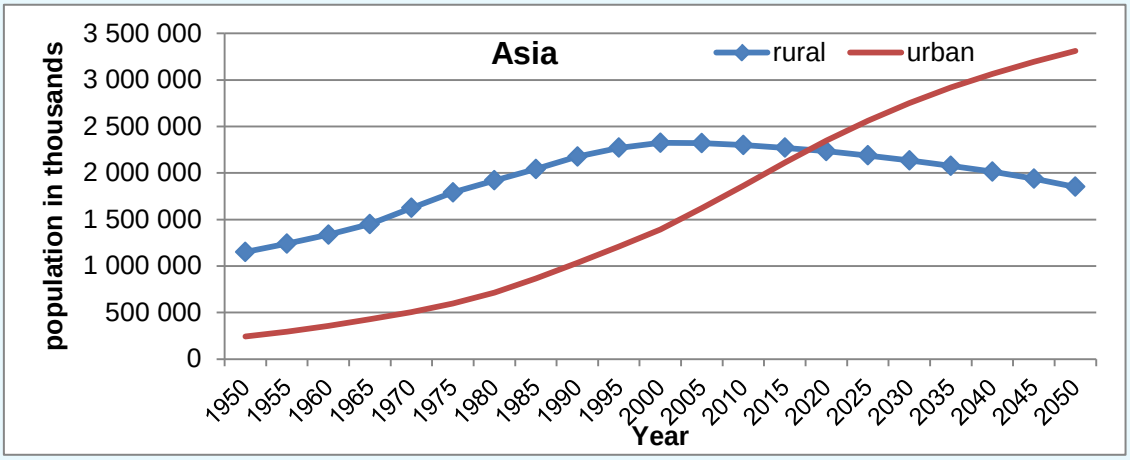

*Source: UN, 2014*

**Figure 2.2: Africa population trends, rural vs. urban**




Source: UN, 2014

**Figure 2.3: Asia population trends, rural vs. urban**




*Source: UN, 2014.*

## 2.2 WSIS

ITU has been the sole facilitator of the WSIS Action Line C2: Information and Communications Infrastructure, and has reviewed[4] the 10 years of accomplishments since the first WSIS in 2003.

Through this review, it has been identified that Broadband connection to the Internet has become an essential part of the long-term economic development. Basic access to telecommunications has increased tremendously thanks to the rapid take-up of wireless technology. Competitive markets, lower cost of deployment compared to wireline networks, falling device prices and no contract subscription has driven mobile penetration to almost 100 at the end of 2013, up dramatically from 22 in 2003.

However, there remain a significant number of unconnected people with over four billion persons around the world still not using the Internet at the end of 2013. The Internet's worldwide penetration is still 40%, and only 32% in developing countries. Rural and remote areas remain largely unconnected to the Internet as they face challenges of attracting private sector investment. The absence of regional connectivity between states with access to submarine cables and landlocked countries, and the scarcity of cross-border backbone links is causing gap in access to the World-Wide Web.

The importance of Broadband is also supported by the fact that the theme of the annual WSIS Action Line C2 Facilitation Meeting, where the theme is decided through the multistakeholder open consultation process, has been on Broadband since 2013.

## 2.3 Broadband Commission

The Broadband Commission for Digital Development was launched in May 2010 by the International Telecommunication Union (ITU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The commission comprises government leaders from around the world, and the highest-level representatives of relevant industries, international agencies, and organizations concerned with development. Its first report was entitled "A 2010 Leadership Imperative: Towards a Future Built on Broadband"[5].

The Commission states that it aims to boost the importance of broadband on the international policy agenda and that expanding broadband access in every country is the key to accelerating progress towards the Millennium Development Goals (MDGs) by the target date of 2015.

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[4] WSIS+10: Overall Review of the Implementation of the WSIS Outcomes, available at <http://www.itu.int/wsis/review/reports/>

[5] Broadband Commission, "A 2010 Leadership Imperative: Towards a Future Built on Broadband" 2010, available at: http://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.01-2010-PDF-E.pdf

In its report of 2010, the Broadband Commission did not explicitly define the term ‘broadband’ in terms of specific minimum transmission speeds, however, in its report of 2013, "Universalizing Broadband"[6], a list of National Broadband Plans for selected economies was published.

This report will use the list of National Broadband Plans of the Commission to investigate the target or goal speeds of broadband connections in each National Broadband Plan.

### 2.4 ITU-D Study Group

As described in the introduction above, ITU-D Study groups have been working on the questions on telecommunications for rural and remote areas. The question of these studies goes back to WTDC–94 (Buenos Aires, Argentina) in 1994 when it was agreed in the Buenos Action Plan (BAP–94) to study these themes as Study Group 2, Question 4/2, “Communications for rural and remote areas”. The title was slightly modified, since then, with the addition of "ICTs". In this study period of 2014 - 2018, it continues as Study Group1 Question 5/1, Telecommunications/ICTs for rural and remote areas[7].

The broadband accesses became one of important issues at the Study Group which study the infrastructure for rural and remote areas, with the following background:

- The voice connection has been generally available with the expansion of GSM and other mobile phone services in rural and remote areas.
- In developed countries, always-on Internet connections are easily available with wired xDSL, optic fiber and wireless 3G/4G systems.
- In the period 2008 - 2011, many countries draw the National Broadband Plan to address the issues and policies for providing the broadband Internet connection to their citizens.

Recent discussion in the last several years has been active about the way to provide the benefit of Broadband for all.

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[6] Broadband Commission, "The state of Broadband 2013: Universalizing Broadband", available at: http://www.broadbandcommission.org/Documents/bb-annualreport2013.pdf

[7] Rapporteur's Group Question details: Question 5/1 "Telecommunications/ICTs for rural and remote areas", available at: http://www.itu.int/net4/ITU-D/CDS/sg/doc/rgq/2014/D14-SG01-RGQ05.1-en.pdf

## Chapter 3 The case studies of ITU-D Study Groups

Since 1994, ITU-D Study Groups have continued studying on the Questions on telecommunications for rural and remote areas and since the study period 2002-2006, the Question have collected many practical and valuable case studies on the development of broadband communication. The case studies are submitted by ITU members and reviewed at the meetings held.

### 3.1 Three study periods

Responding to the mandate, many case studies have been collected during 12 years comprising three study periods:

**Study period 2002-2006 (Question 10-1/2)**

The Rapporteur's Group on Question 10-1/2 decided to collect the case studies from its five regions of the world (i.e. Africa, Asia-Pacific, Arab States, Americas, and East-Europe and CIS countries) at its meeting in March, 2004 and to develop guidelines for successful practices for the countries to address rural communications development. 19 case studies[8] were collected which are listed in Appendix A-1 of this report.

**Study period 2006-2010 (Question 10-2/2)**

Rapporteur's Group on Q10-2/2[9] collected 20 case studies[10] for the study period 2006-2010, which are posted on the ITU-D Case Library. Appendix A-2 lists the 17 case studies after combining some of case studies.

**Study period 2010-2014 (Question 10-3/2)**

Rapporteur's Group on Question 10–3/2[11] collected case studies from the contributions received during this study period. The list of contributions which contain the case study materials is put in the Appendix

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[8] ITU-D Question 10-1/2: "Analysis of case studies on successful practices in telecommunications for rural and remote areas" 2006, available at: http://www.itu.int/pub/d-stg-sg02.10.1-2006/en

[9] Question 10-2/2 - Telecommunications for rural and remote areas, Final Report, available at: http://www.itu.int/pub/D-STG-SG02.10.2-2010

[10] Revised Analysis Report of Case Studies, "Analysis of case studies on successful practices in telecommunications for rural and remote areas (II)", available at: http://www.itu.int/md/D06-SG02-C-0250

[11] Final Report QUESTION 10-3/2: Telecommunications/ICTs for rural and remote areas, available at: http://www.itu.int/pub/D-STG-SG02.10.3-2014

A-3 of this report.

This report will give some additional analysis in the subsequent sections to the case studies submitted for the most recent period, 2010-2014. For the old case studies for the study period 2002-2006 and for 2006-2010, they have been analyzed in the ITU-D Study Group reports for each study period.

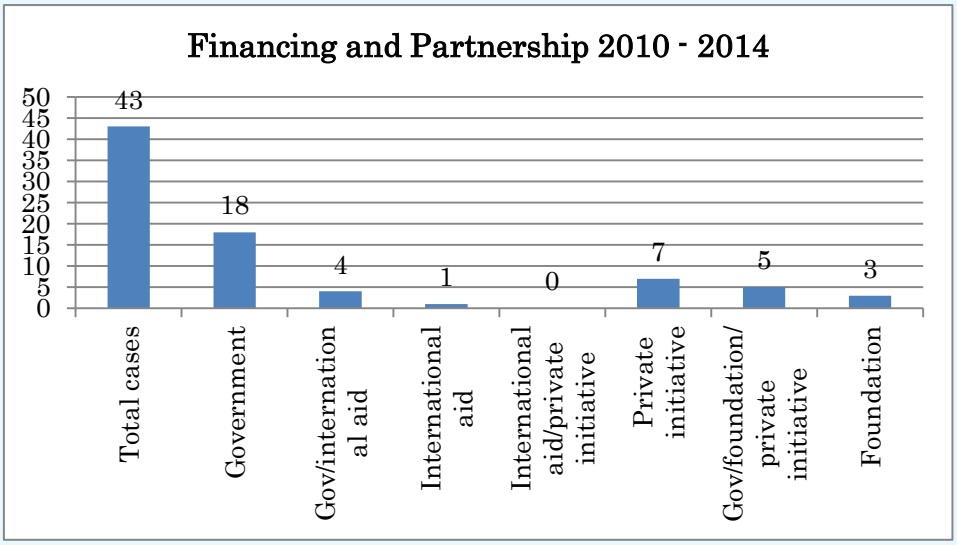
### 3.2 General review and summary of case studies for the period 2010-2014

Analysis was conducted to the 43 contributions which were submitted to the Rapporteur's Group on Question 10-3/2. The contributions report their case studies related to the telecommunications for rural and remote areas. The contributions are listed in Appendix A-3, A-4, and A-5 which contains the characteristics of the contributions – organizations involved, financing and partnership, their applications areas, technologies used and their challenges. The distributions of these characteristics are experimented in the following sections.

#### 3.2.1 Financing and Partnership

Among the 43 cases, 18 (40%) are projects funded by Governments, and private initiatives were placed in second with 7 cases. When we consider the projects which are partially funded by the government (Government/international aid and Government/foundation/private), the total goes up to 29 cases (67%), which shows that the ICT development in rural and remote areas are still driven by the governmental support.

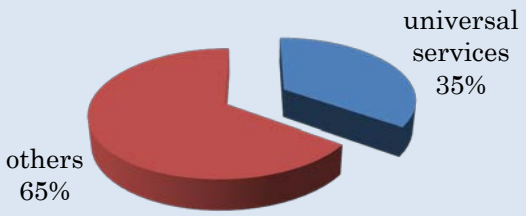
**Figure 3.5 Financing and partnership**




*Source: ITU-D Study Group 2*

Considering the above, the development of telecommunications systems in rural and remote areas seems to be closely connected with the concept of Universal Services. 15 cases, almost 40 % of the total cases are based on Universal Services or related to it.

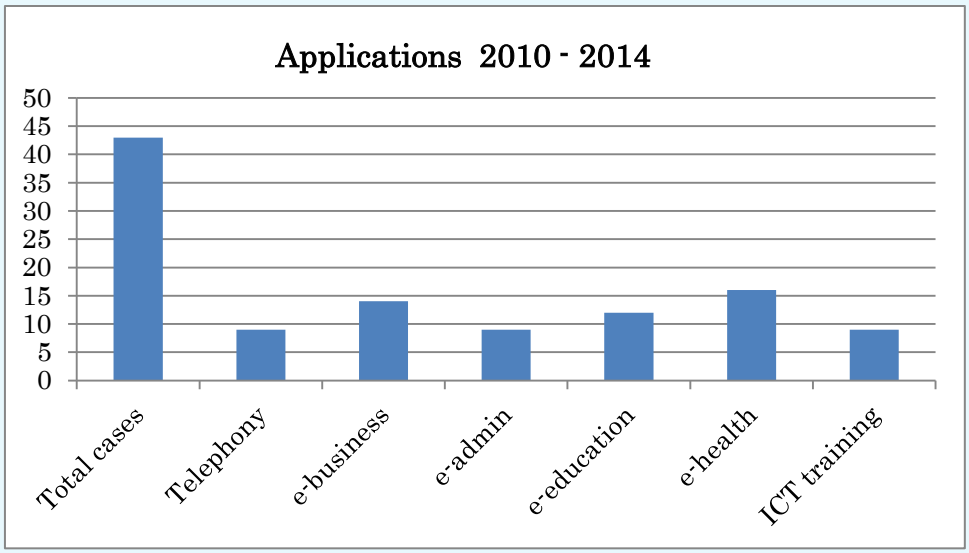
**Figure 3.4 Cases Related to Universal Services 2010 -2014**




### 3.2.2 Project applications

Figure 3.6 shows the distribution of project applications categorized into telephony, e-business, e-admin, e-education, e-health and ICT training. These categories are in line with the categories used in the case study report of the period 2002 -2006, and comparison between the three study periods will be made in the following chapters. Projects on e-health is most major, however, they seem to be rather evenly distributed.

**Figure 3.6 Project applications**

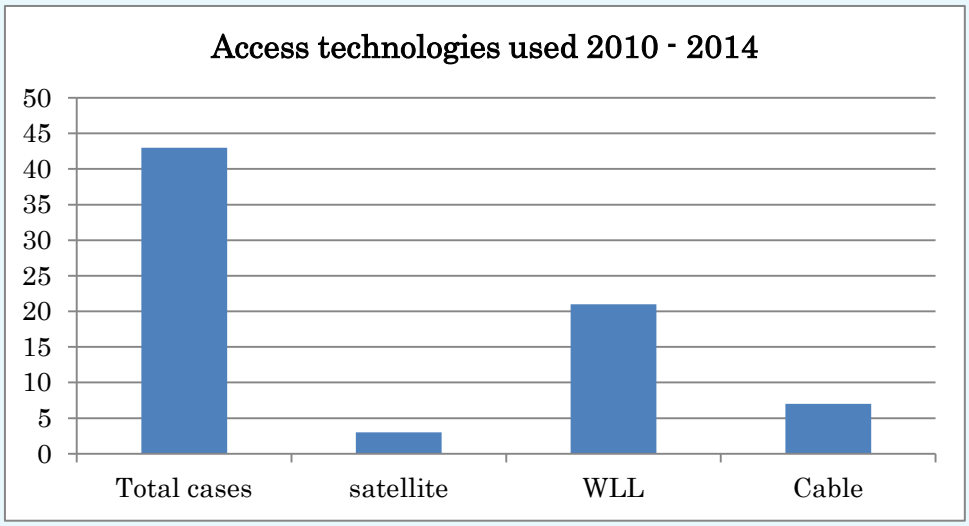



*Source: ITU-D Study Group 2*

### 3.2.3 Architecture and technical characteristics

Following the case study report of the period 2010 -2014, access technologies used are put in the Figure 3.7. Wireless technologies were the most common access method in the projects for rural and remote area.

**Figure 3.7 Technologies used**




*Source: ITU-D Study Group 2*

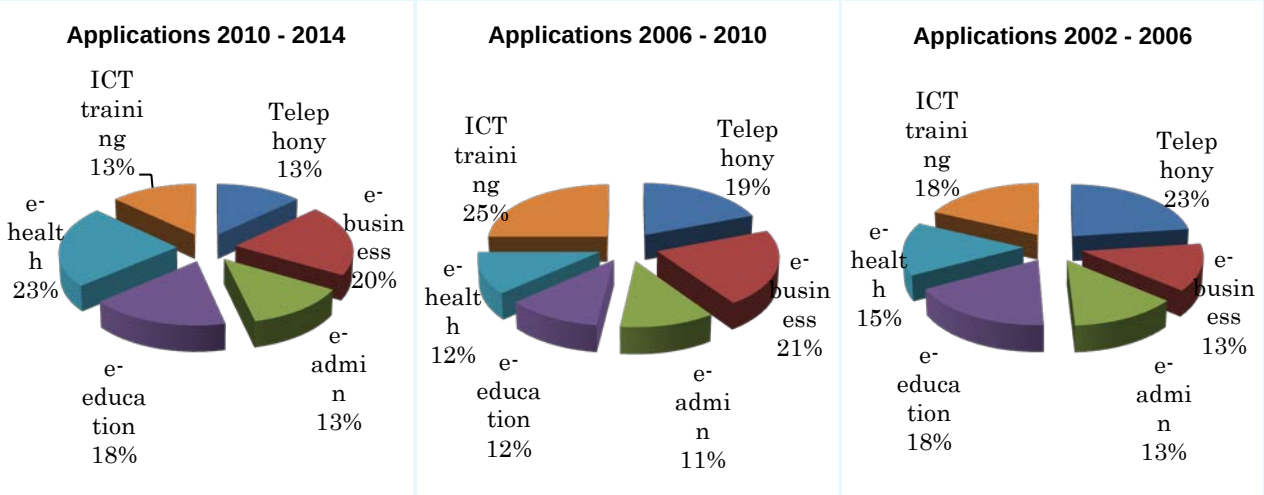
### 3.3 Three study periods compared

This question, "telecommunications for rural and remote areas" has been studied at the ITU-D Study Group for 12 years, starting from 2002, expanding over three 4-year study periods. By observing these 12 years through themes and subjects of the case studies, we could see the issues and questions in historical perspective: what has been changed and what remained the same. In this way, we could gain the lessons learned from the real projects and efforts in rural and remote areas: what have been the main concerns and objectives in remote and rural areas in developing countries.

#### 3.3.1 Project applications

The first historical examination is about the applications dealt with the projects in rural and remote areas. Figure 3.8 contains three charts showing the distribution of applications to be implemented in the projects. Looking the charts give us, the first, not the change but the consistent relative importance of applications to each other. The specific technology emphasized has been changed from ISDN to ADSL and to Broadband Mobile Access in 12 years, still it is apparent that the importance of each applications for the improvement of life in rural and remote areas remained the same.

**Figure 3.8 Project applications**



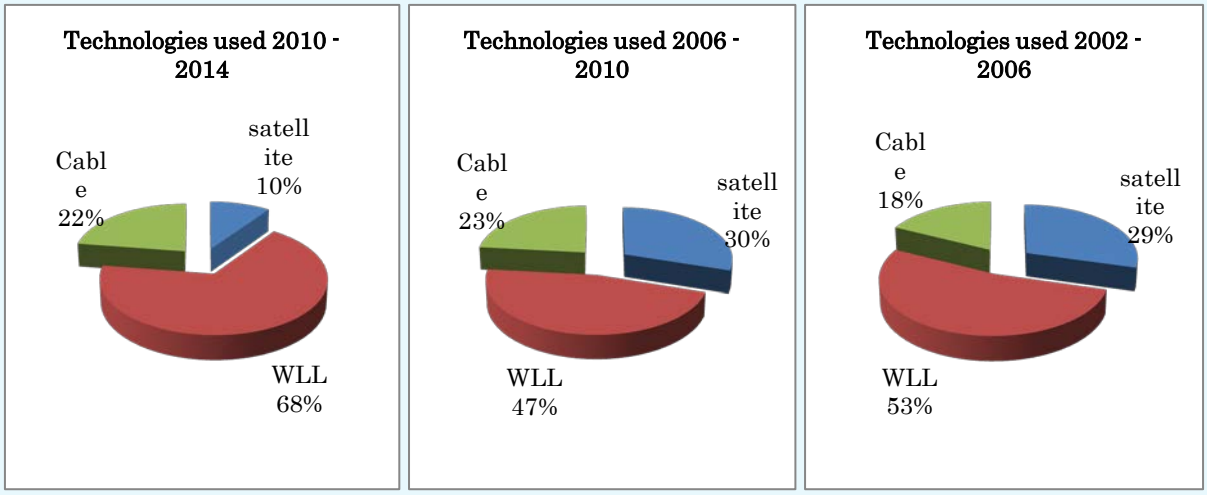

*Source: ITU-D Study Group 2*

With detailed examination of the charts, we notice a slight increase in e-health and decrease in telephony, however, the comparison shows the consistency of the percentage of cases dealing with each category.

### 3.3.2. Technologies used

The second comparison in Figure 3.9 is the technologies used with the projects in rural and remote areas. We can observe that the place occupied by satellite was taken over by the wireless media, specifically evident in the period 2010 -2014.

**Figure 3.9 Technologies used**

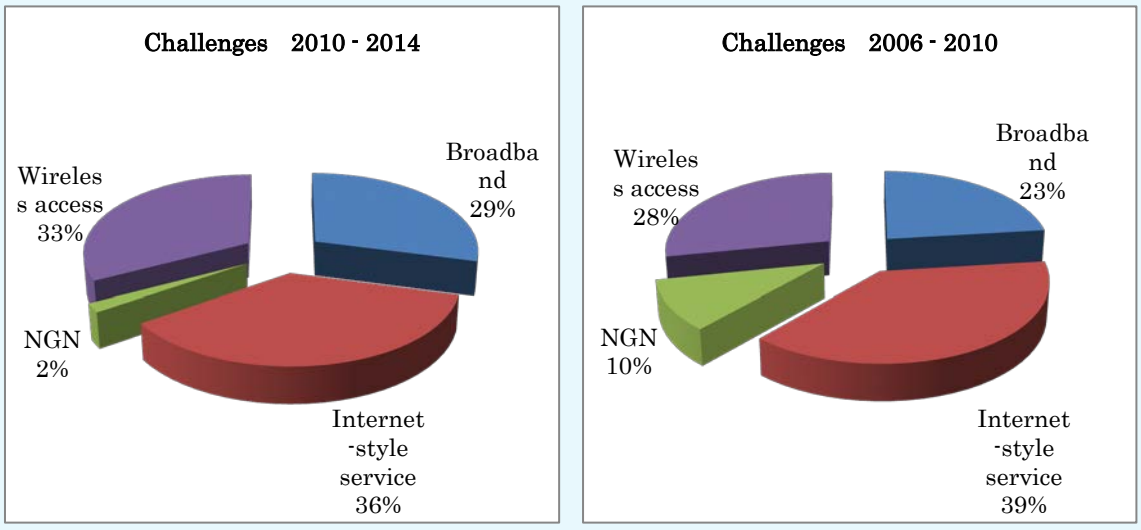



*Source: ITU-D Study Group 2*

### 3.3.3 Challenges

As the third temporal comparison, the occurrence of the key words were collected and summarized for the periods, 2006-2010 and 2010-2014. These words are closely related to the Broadband Internet Access. Their frequencies appeared in the contributions are supposed to reflect the interest and efforts of the ITU-D members at the time. Here again, relative weights of the importance have not drifted much, although the absolute numbers of samples are different for the two periods.

**Figure 3.10 Challenges**




*Source: ITU-D Study Group 2*

The study found from the 12-year long comparisons of project applications, and technologies used, that that importance of applications have not changed much to the people in rural and remote areas even though the technology or access method has been changed. This implies that when planning rural and remote area Broadband development, a long term view is essential even though popular words and individual products may change in several years. The development and maintenance of high speed telecommunications networks in rural and remote areas is the long-term consistent effort to help development in the rural and remote areas.

## Chapter 4 Analysis of "Broadband" definitions in national plans and policies

As analyzed in the previous chapter, broadband access seems to be the uprising and important issue for ICT development in rural and remote areas. However, though frequently used, the term “broadband”, especially its minimum speed, seems not to be clearly defined. In this chapter, we will analyze the National Broadband Policies and Plans of several countries, trying to grasp the targets of each country.

### 4.1 National Broadband Plan

#### Plan objectives

In recent years, many countries have formulated national broadband plans; these plans outline both coverage, target values of service and policies for implementing the plan. Some of them have the purpose of achieving universal broadband service. From the list of national broadband plans of the Broadband commission, plan or policy of 92 economies were investigated in making this report. Among the 92 samples, 50 economies were found to have numerical targets for Broadband connections. These countries and targets values were listed in Table 4.2 below.

The plans investigated covers developed and developing countries, making the description of the plans diverse. However, common structure is more apparent than diverse way of presentations, and the idea of recognizing Broadband as one of the universal services is clear in recently announced plans, for example, that of the United States(National Broadband Plan 2010) and the EU (Digital Agenda for Europe 2010). In Finland, Broadband is now more of the right of citizen than of service available.[12]

The policies for National Broadband Plans could be grouped into the following four broad areas after identifying their general framework:

- **Assignment of county resources to provide a universal service (supply side)**

The primary focus in this policy area is spectrum allocation. Wireless broadband is the primary platform for reaching underserved rural areas in developed countries. It is, on the other hand, the technology to be used for giving ample coverage in developing countries. Therefore, national spectrum plans is a focused area on broadband policies. Major discussions in the plans tend to deal with the reassignment of frequency bands which became available for such purposes from the digitalization of TV broadcasting.

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[12] **"**1 Mbit/s broadband for everyone", available at: https://www.viestintavirasto.fi/en/internettelephone/righttoatelephoneandbroadbandsubscription/rightto1Mbpsbroadband.html

- **Implementation of adoption programs (demand side)**

These programs are, among others, universal service policies; improvement of digital literacy; set-up of public Broadband access centers; broadband penetrations in schools, hospitals and public libraries; adoptions in government institutions. Economic subsidies for certain social groups are also considered.

- **Competition policy (supply side)**

Some plan is based on the policy to introduce competition among telecommunication operations for national broadband plans. There are several patterns for the competition; competition between vertically-integrated operators; service provider competition sharing the telecommunication network of the incumbent operator; If competition does not exist, performance requirements, like coverage and service quality,are established for the dominant operator to follow.

- **Coordination policy (supply side)**

Related to the above policy, under the competitive environment the plan include the coordination policy among the competitors. For example, sharing infrastructure (such as duct, mast, and tower) and rearranging the legal frame of right of way are common strategies to be employed. Some of the plans have stated that government should invest to deploy national backbones to cover backbone network costs for broadband wireless operators.

**Capacity Targets**

Plans are usually divided into the type of areas for defining the target values of coverage, penetration and service speeds of broadband connections. These target values are set up further according to the planned year to achieve them. The table below shows this classification of areas and quality targets.

| Area | Subarea | Network Coverage | Penetration | Connection Speed(in Mbps) |
|---|---|---|---|---|
| **Residential** | | % of households | % of households | Download speed |
| **Social** | primary schools, public libraries, cultural centers | % of institutions | % of institutions | Download and upload speed |
| | universities, hospitals, research centers | % of institutions | % of institutions | Download and upload speed |
| **Company** | large companies, small companies | % of companies | % of companies | Download and upload speed |
| | micro-companies | % of companies | % of companies | Download speed |
| **Public Administration** | | % of institutions | % of institutions | Download and upload speed |

Table 4.1 Common Structures of National Broadband Plans

### 4.2 Residential targets of National Broadband Plan

#### 4.2.1 List of National Plans

Many national plans recognize the need to provide universal (or near-full) coverage of broadband service, which implies the recognition of broadband as a public good for the citizen. Developing countries that are at a lower rate of broadband penetration than developed countries tend to define lower coverage targets.

As mentioned above, 92 National Broadband Plans or equivalent Policies/Strategies were investigated in making this report. The following table contains 50 countries for which clear numerical planned speed values (with coverage percentages) were found in their plans/policies. The table lists for each country the target Broadband speeds with target coverage area percentage for residential household. It also contains the names of associated national broadband plans, their adopted years and links to the reference documents.

| Country | Year policy adopted | Download Speed (coverage % of household) | Target Year | Remarks | Plan Name / Link to documents |
|---|---|---|---|---|---|
| **Australia** | 2014 | 25Mbps(100%) | ASAP | | NBN Plan |
| | | | | | http://www.communications.gov.au/broadband/broadband_initiatives |
| **Austria** | 2012 | 25Mbps(100%) | 2013 | | Broadband Strategy 2020 |
| | | 100Mbps(70%) | 2018 | | http://ec.europa.eu/digital-agenda/en/country-information-austria |
| | | 100Mbps(99%) | 2020 | | |
| **Brazil** | 2010 | 1Mbps (70%) | 2014 | | National Broadband Plan |
| | | | | | http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7175.htm |
| **Brunei Darussalam** | 2014 | 2Mbps(95%) | 2015 | | National Broadband Policy |
| | | 20Mbps(75%) | 2017 | | http://www.aiti.gov.bn/news/announcements/Pages/National-Broadband-Policy-of-Brunei-Darussalam.aspx |
| **Bulgaria** | 2009 | 1Mbps(100%) | 2013 | | National Strategy |
| | | 10Mbps(90%) | 2013 | in average cities | http://ec.europa.eu/digital-agenda/en/country-information-republic-bulgaria |
| **Canada** | 2014 | 5Mbps | 2019 | additional 280 thousands households | Economic Action Plan 2014 |
| | | | | | http://www.actionplan.gc.ca/en/initiative/access-broadband |
| **Chile** | 2013 | 2Mbps(80%) | 2020 | penetration | Agenda Digital Imagina Chile 2013-2020 |
| | | | | | https://www.mtt.gob.cl/wp-content/uploads/2014/02/agenda_digital.pdf |
| **China** | 2013 | 4Mbps(x%) | 2015 | | National Broadband Strategy |
| | | 12Mbps(x%) | 2022 | | www.miit.gov.cn |
| **Cost Rica** | 2012 | 2Mbps(15%) | 2014 | symmetric | National Broadband Strategy |
| | | 2Mbps(21%) | 2017 | | http://www.camtic.org/actualidad-tic/gobierno-de-costa-rica-presenta-estrategia-nacional-de-banda-ancha/ |
| **Croatia** | 2011 | 2Mbps(90%) | 2013 | | Strategy for Broadband Development |

| Country | Year policy adopted | Download Speed (coverage % of household) | Target Year | Remarks | Plan Name / Link to documents |
|---|---|---|---|---|---|
| | | 30Mbps(50%) | 2015 | | http://ec.europa.eu/digital-agenda/en/country-information-croatia |
| **Cyprus** | 2012 | 2Mbps(100%) | 2013 | | Digital Strategy for Cyprus |
| | | 30Mbps(100%) | 2020 | | http://ec.europa.eu/digital-agenda/en/country-information-cyprus |
| | | 100Mbps(50%) | 2020 | | |
| **Czech Republic** | 2013 | 2Mbps(100%) | 2013 | | Digital Czech republic v.2.0 |
| | | 30Mbps(100%) | 2020 | | http://ec.europa.eu/digital-agenda/en/country-information-czech-republic |
| | | 100Mbps(50%) | 2020 | | |
| **Denmark** | 2013 | 100Mbps(100%) | 2020 | | National Broadband Plan |
| | | | | | http://danishbusinessauthority.dk/danish-broadband-goals |
| **Ecuador** | 2011 | 2Mbps (75%) | 2017 | | Estrategia Ecuador Digital 2.0 |
| | | | | | http://www.itu.int/ITU-D/tech/events/2012/RDF_AMS_Mexico_April12/Session2/3_AnaValdiviezo.pdf |
| **Egypt** | 2011 | 2Mbps(75%) | 2015 | | National Broadband Plan |
| | | 25Mbps(90%) | 2021 | | http://www.tra.gov.eg/emisr/Summary_En.pdf |
| **EU** | 2010 | basic 0.5-2Mbps(100%) | 2013 | | Digital Agenda for Europe |
| | | 30Mbps(100%) | 2020 | | https://ec.europa.eu/digital-agenda/en |
| | | 100Mbps(50%) | 2020 | | |
| **Finland** | 2008 | 1Mbps(100%) | 2010 | | Kainuu Information Society Strategy 2007-2015 |
| | | 100Mbps(99%) | 2015 | | http://ec.europa.eu/digital-agenda/en/country-information-finland |
| **France** | 2011 | 2-5Mbps(100%) | 2017 | | Plan France tres haut debit |
| | | 100Mbps(100%) | 2022 | | http://ec.europa.eu/digital-agenda/en/country-information-france |
| **Germany** | 2009 | 1Mbps(100%) | 2010 | | Broadband Strategy |
| | | 50Mbps(75%) | 2014 | | http://www.bmwi.de/EN/Service/publication |

| Country | Year policy adopted | Download Speed (coverage % of household) | Target Year | Remarks | Plan Name / Link to documents |
|---|---|---|---|---|---|
| | | | | | s,did=294718.html%20http://www.zukunft-breitband.de |
| **Greece** | 2006 | 2Mbps(100%) | 2013 | | Digital Strategy |
| | | | | | http://www.infosoc.gr/infosoc/en-UK/sthnellada/committee/default1/top.htm |
| **Iceland** | 2012 | 30Mbps(90%) | 2014 | | Electric Communications Plan 2011-2022 |
| | | 30Mbps(100%) | 2022 | | http://www.pfs.is/library/Skrar/English/About-PTA/PTA_Annual_Report_2012_En_HIGHRES.pdf |
| | | 100Mbps(70%) | 2014 | | |
| | | 100Mbps(90%) | 2022 | | |
| **India** | 2012 | 2Mbps(100%) | 2015 | | National Telecom Policy |
| | | 2Mbps(60%) | 2020 | penetration | http://www.dot.gov.in/sites/default/files/NTP-06.06.2012-final.pdf |
| **Indonesia** | 2011 | 20Mbps(8%) | 2014 | penetration | Masterplan for Acceleration and Expansion of Indonesia's Economic Development |
| | | | | | http://www.aseanbriefing.com/userfiles/resources-pdfs/Indonesia/FDI/ASEAN_Indonesia_Master%20Plan%20Acceleration%20and%20Expansion%20of%20Indonesia%20Economic%20Development%202011-2025.pdf |
| **Ireland** | 2012 | 70-100Mbps(50%) | 2015 | | National Broadband Plan |
| | | 30Mbps(100%) | 2015 | | http://www.dcenr.gov.ie/Communications/National+Broadband+Plan/ |
| **Japan** | 2010 | 100Mbps(100%) | 2015 | | New Growth Strategy |
| | | | | | http://japan.kantei.go.jp/kan/topics/sinseichou01_e.pdf |
| **Korea (Republic of )** | 2009 | 100M-1Gbps(100%) | 2015 | | Ultra Broadband Convergence Network |
| | | | | | www.kcc.go.kr |
| **Lithuania** | 2011 | 30Mbps(100%) | 2020 | | Lithuanian Information Society Development Programme |

| Country | Year policy adopted | Download Speed (coverage % of household) | Target Year | Remarks | Plan Name / Link to documents |
|---|---|---|---|---|---|
| | | | | | http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=425996 |
| **Malaysia** | 2007 | 1-2Mbps(50%) | 2010 | | National Broadband Initiative |
| | | | | | http://www.skmm.gov.my/Sectors/Broadband/National-Broadband-Initiative.aspx |
| **Mauritius** | 2012 | 10Mbps(60%) | 2014 | | National Broadband Plan |
| | | 100Mbps(100%) | 2020 | | https://www.icta.mu/documents/nationalbroadbandpolicy2012.pdf |
| **Netherlands** | 2010 | 100Mbps(50%) | 2020 | | DigitalAgenda.nl |
| | | 100Mbps(95%) | 2013 | present penetration | http://ec.europa.eu/digital-agenda/en/country-information-netherlands |
| **New Zealand** | 2010 | 100Mbps(75%) | 2020 | | Ultra-fast Broadband initiative |
| | | | | | http://www.med.govt.nz/sectors-industries/technology-communication/fast-broadband |
| **Norway** | 2012 | 2Mbps(100%) | 2012 | present penetration | Digital Strategy for Norway 2012 |
| | | 25Mbps(80%) | 2012 | present penetration | https://www.regjeringen.no/nb/tema/statlig-forvaltning/ikt-politikk/id1367/ |
| **Paraguay** | 2011 | 512kbps(50%) | 2015 | | National Telecommunications Plan |
| | | | | | http://www.conatel.gov.py/files/MANUAL%20PLAN%20NACIONAL.pdf |
| **Peru** | 2010 | 512kbps(12.7%) | 2016 | | National Plan for Broadband Development |
| | | | | | https://www.mtc.gob.pe/portal/proyecto_banda_ancha/proyecto.html |
| **Philippines** | 2011 | 2Mbps(80%) | 2016 | average speed | Philippine Digital Strategy |
| | | | | | http://www.ncc.gov.ph/files/PDS.pdf |
| **Poland** | 2012 | 30Mbps(100%) | 2020 | | Regulatory Strategy until 2015 |
| | | 100Mbps(50%) | 2020 | | http://www.en.uke.gov.pl/regulatory-strategy-until-2015-11926 |
| **Puerto Rico** | 2012 | 4Mbps(98%) | 2015 | | Broadband Strategic Plan |
| | | 100Mbps(85%) | 2020 | | http://www.connectednation.org/sites/default/files/pr_bb_plan_final.pdf |

| Country | Year policy adopted | Download Speed (coverage % of household) | Target Year | Remarks | Plan Name / Link to documents |
|---|---|---|---|---|---|
| **Qatar** | 2013 | 100Mbps(95%) | 2016 | | National Broadband Plan |
| | | | | | http://www.ictqatar.qa/en/national-programs/ict-infrastructure/national-broadband-network |
| **Romania** | 2009 | basic 0.5-2Mbps(80%) | 2015 | | Broadband Strategy |
| | | 30Mbps(100%) | 2020 | | http://www.ancom.org.ro/en/uploads/links_files/strategie_2007-2010_en.pdf |
| | | 100Mbps(50%) | 2020 | | |
| **Saudi Arabia** | 2006 | 512kbps(100%) | 2013 | | Universal Access and Universal Service Policy |
| | | | | | http://www.citc.gov.sa/English/RulesandSystems/Bylaws/Documents/LA%20007_%20%20E_%20%20The%20Universal%20Access%20and%20Universal%20Service%20Policy.pdf |
| **Singapore** | 2005 | 100Mbps(100%) | 2012 | | Intelligent Nation 2015（iN2015） |
| | | | | | http://www.ida.gov.sg/Infocomm-Landscape/iN2015-Masterplan |
| **Slovakia** | 2014 | 30Mbps(100%) | 2020 | | Strategic Document (2014 - 2020) |
| | | | | | http://informatizacia.sk/strategicky-dokument/16604s |
| **Slovenia** | 2008 | basic 0.5-2Mbps(100%) | 2010 | | Broadband Network Development Strategy |
| | | 20Mbps(90%) | 2015 | | http://www.mgrt.gov.si/nc/si/medijsko_sredisce/novica/article/11987/6272 |
| | | 100Mbps(90%) | 2020 | | |
| **Spain** | 2013 | basic 0.5-2Mbps(100%) | 2013 | | Digital Agenda for Spain |
| | | 30Mbps(100%) | 2020 | | http://www.agendadigital.gob.es/digital-agenda/Documents/digital-agenda-for-spain.pdf |
| | | 100Mbps(50%) | 2020 | | |

| Country | Year policy adopted | Download Speed (coverage % of household) | Target Year | Remarks | Plan Name / Link to documents |
|---|---|---|---|---|---|
| **South Africa** | 2013 | 5Mbps(50%) | 2016 | | South Africa Connect |
| | | 5Mbps(90%) | 2020 | | http://www.researchictafrica.net/countries/south_africa/South_Africa_Broadband_Policy_-_2013.pdf |
| | | 100Mbps(100%) | 2030 | | |
| **Sweden** | 2009 | 1Mbps(98.5%) | 2012 | | Broadband Strategy for Sweden |
| | | 100Mbps(90%) | 2020 | | http://ec.europa.eu/digital-agenda/en/country-information-sweden |
| **Thailand** | 2010 | 2Mbps(80%) | 2015 | | National Broadband Policy |
| | | 2Mbps(95%) | 2020 | | http://www.regeringen.se/sb/d/108/a/134633 |
| **United Kingdom** | 2010 | 2Mbps(100%) | 2015 | | Superfast Broadband Future |
| | | | | | https://www.gov.uk/government/publications/britains-superfast-broadband-future |
| **United States** | 2010 | 4Mbps(100%) | 2012 | | National Broadband Plan |
| | | 50Mbps(85%) | 2015 | 100 million homes | http://www.fcc.gov/national-broadband-plan |
| | | 100Mbps(85%) | 2020 | 100 million homes | |
| **Uruguay** | 2011 | 256kbps-2Mbps(60%) | 2012 | | Agenda Digital Uruguay 2011-2015 |
| | | 256kbps-2Mbps(80%) | 2015 | | http://www.agesic.gub.uy/innovaportal/file/125/3/adu_english_version.pdf |

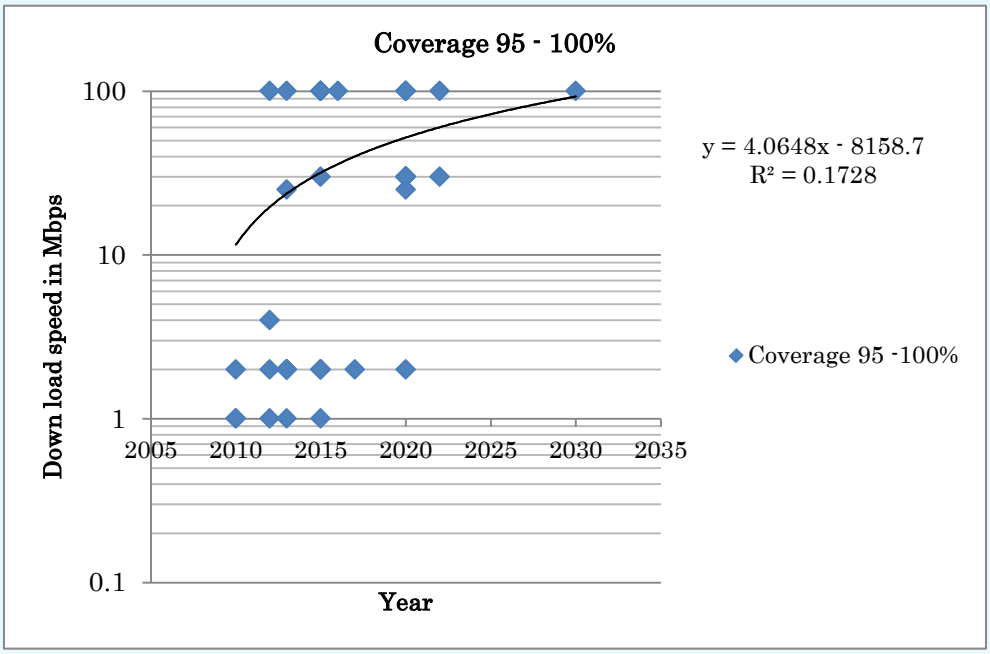
Table 4.2 List of Broadband speeds and coverages

### 4.2.2 Target speeds in broadband plans

#### Distribution of broadband speeds

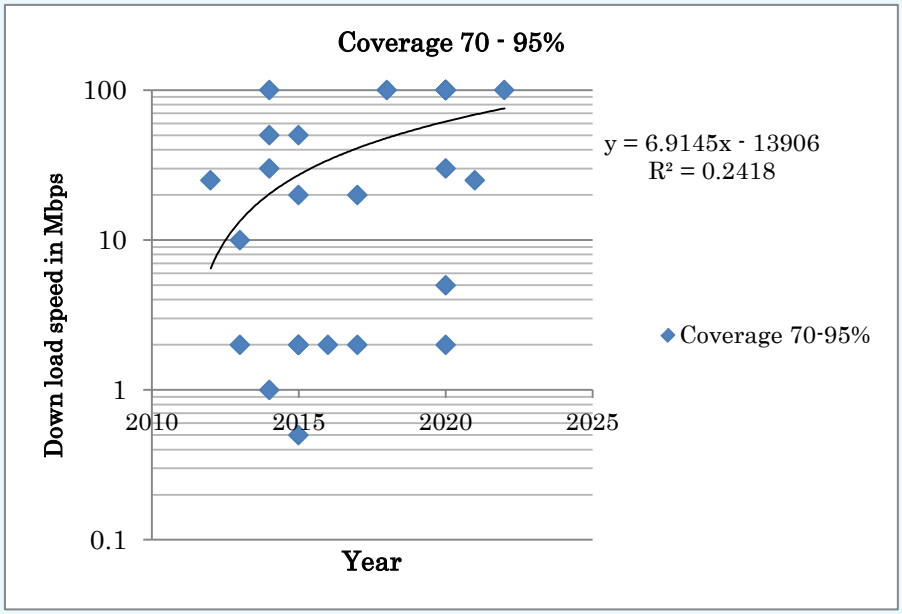
Using the data obtained from these National Broadband Plans or National Broadband Strategies, several graphs were plotted. Figure 4.1 and Figure 4.2 show the distribution of broadband target speeds for the bands of household coverage: Figure 4.1 for 95 - 100% coverage band; Figure 4.2 for 70 - 95% coverage band. The fitting curves indicate that 95-100% coverage plan gives higher speed at the beginning while 70-95% coverage plans increase the average speed quickly along the time. This shows the fact that countries with 100% targets are normally developed countries.

**Figure 4.1 Distribution of broadband target speeds (95% - 100% household coverage)**




*Source: author*

**Figure 4.2 Distribution of broadband target speeds (70 - 95% household coverage)**

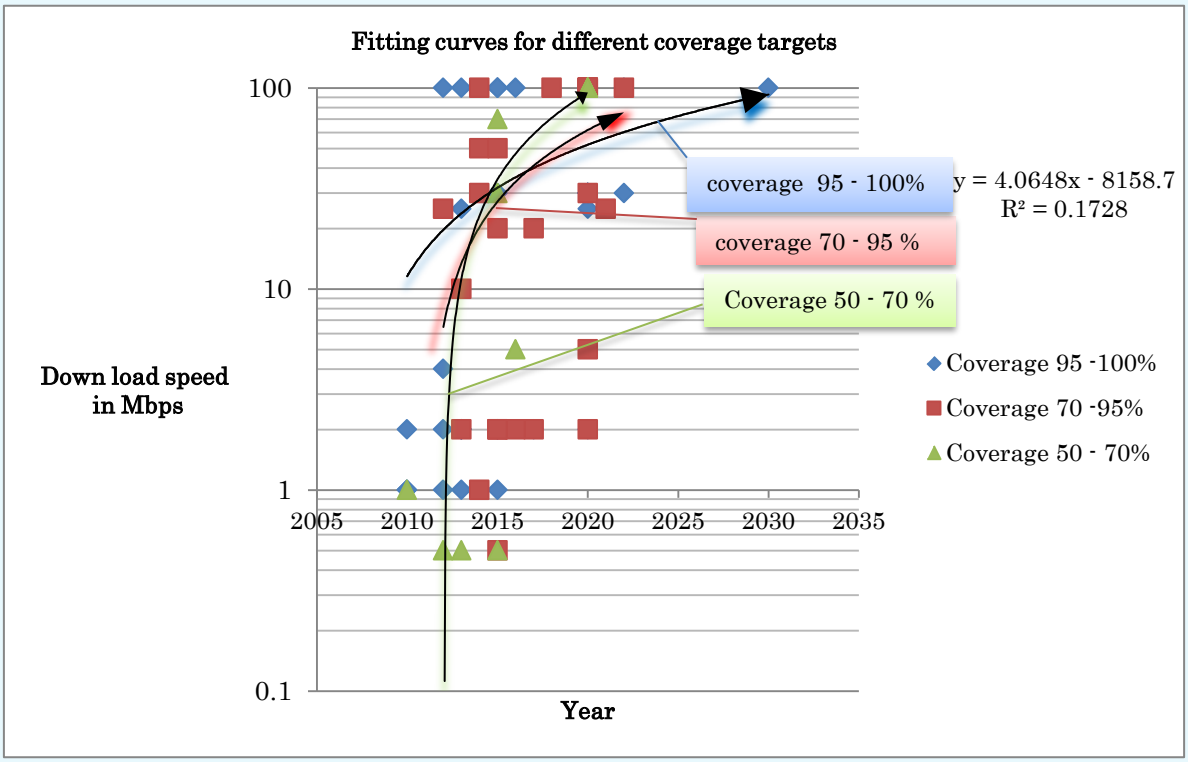



*Source: author*

Next, Figure 4.3 plotted the 3 different coverage bands in one place. Target dates of many plans are

clustered in two time period: one in 2014 - 2015, another in 2020. The latter is the consequence of EU Digital Agenda[13], which has been followed by EU Member countries.

**Figure 4.3 Distribution of broadband target speeds with target household coverage.**



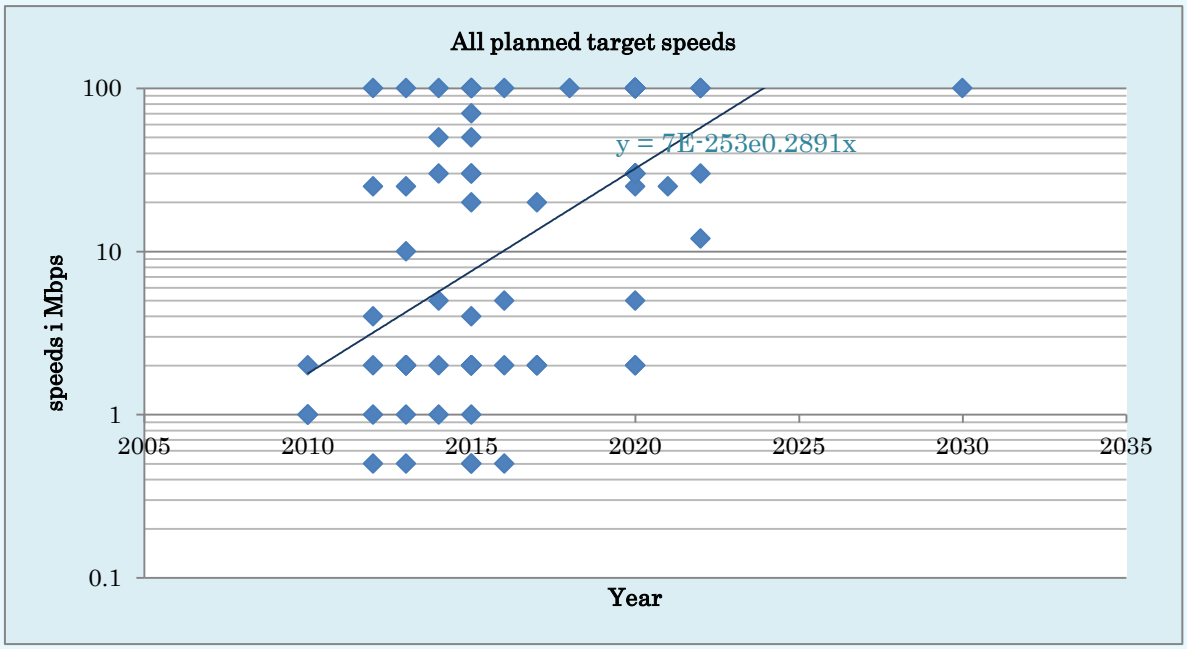

*Source: author*

Taking into the fact that countries or economies with clear numerical targets and timeframe are usually developed countries or the ones with clear vision of the road to follow, these targets and associated fitting curves are thought to be the maximum values attainable by about half of the countries with their ICT plans or Broadband Plan.

Finally, we plotted the graph in Figure 4.4, assuming the progress of Broadband speeds follows the growth of exponential type. Results show that Broadband speed will be 20 times higher in 10 years. This is equal to the annual growth rate of 35% or 2.5 times higher in 3 years. We could compare this with the famous Moore's law suggesting the complexity of semiconductor chips will increase in an exponential curve.

[13] https://ec.europa.eu/digital-agenda/en

**Figure 4.4 Distribution of broadband target speeds with assumed exponential growth**




*Source: author*

## Chapter 5 Broadband technologies for use

### 5.1 Telecommunications for rural and remote areas

Network normally configured in two parts: backhaul and access parts. Sometimes it is divided into three parts: core, backhaul and access, where the backhaul is routing traffic from cells sites (or points of presence) into the core network. Since these classification is sometimes not clear due to the complexity of modern telecommunications configuration, in order to make arguments simple, core or backhaul section is called simply "backhaul" in this study.

Backhaul has higher speed to transfer large information sent from various terminal equipments. Backhaul parts as well as access parts can be made via wired or wireless solutions. The following sections include overviews of solutions via fiber cable, terrestrial wireless, and satellite.

Both wireless and wired technologies are used in backhaul and access parts. These two technologies have been competitive and sometimes complementary each other for longtime. After the invention of optical cable, its use for backhaul has become the standard design pattern for national network. On the other hand, dispersed area of access network makes wireless equally effective as wired. This is specifically the case for rural and remote areas, where pulling the cable is a difficult task.

### 5.2 Network configurations patterns

Table 5.2 shows the technologies used for the access part and the backhaul part of the network. Classification and corresponding technical description below are for those transmission methods suitable for wide band connection. Some historical technologies are mentioned for comparison purpose, although many of them are still in use.

| Technologies | | Terminal Mobility | Access | Backhaul |
|---|---|---|---|---|
| Wireline | Optical cable | -- | fiber to the home | optical rings |
| | Copper cable | -- | pair cable to home | coaxial cables |
| Wireless | terrestrial | mobile | mobile network | -- |
| | | fixed | wireless fixed link | micro wave link |
| | via satellite | mobile | satellite mobile network | -- |
| | | fixed | satellite link | satellite link |

Table 5.1 Technologies used for broadband connections.

## 5.3 Access technologies[14][15]

### 5.3.1 Fiber to premises

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

A fibre optic wireline network can have several configurations, depending on the terminating point of the fiber: 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. For FTTB and FTTC, the ONU serves as a common interface for several subscribers (e.g., the basement of an apartment building or a telephone pole), with the service delivered over the customers' existing TWP(twisted pair) drop cables. xDSL over TWP (will be discussed in the next section) is often used to provide service from the ONU in FTTB and FTTC configurations. For FTTN, the ONU is located in an active network node serving dozens to hundreds of subscribers from which service is delivered by existing TWP local loops.

There are two common architectures for FTTx: "point-to-point" (PtP) and the Passive optical network (PON). In a PtP configuration, a dedicated optical fibre (one or two fibres) connects the ONU directly with the telephone exchange. In a PON network, several ONU – typically up to 32 – share a single fibre connection to the network. Signal is split for each ONU at a passive network node. Table 5.3 lists the ITU recommendations for FTTx configurations.

| ITU-T G.982 | Optical access networks to support services up to the ISDN primary rate or equivalent bit rates |
|---|---|
| ITU-T G.983.x | Broadband optical access systems based on Passive optical networks (PON) |
| ITU-T G.984.x | Gigabit-capable passive optical networks (GPON) |
| ITU-T G.985 | 100 Mbit/s point-to-point Ethernet-based optical access system |
| ITU-T G.986 | 1 Gbit/s point-to-point Ethernet-based optical access system |

[14] Land Mobile (including Wireless Access) - Volume 5: "Deployment of Broadband Wireless Access Systems", 2011 ITU Publications, available at: http://www.itu.int/pub/R-HDB-57

[15] Final Report, ITU-D SG Question 25/2: Access technology for broadband telecommunications including IMT, for developing countries, 2014, available at: http://www.itu.int/pub/D-STG-SG02.25-2014

| | |
|---|---|
| ITU-T G.987.x | 10-Gigabit-capable passive optical network (XG-PON) systems |
| ITU-T G.988 | ONU management and control interface specification (OMCI) |

Table 5.2: Summary of ITU-T FTTx wireline broadband standards

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

Integrated Services Digital Network (ISDN) was the first attempt at a completely digital telephone/telecommunications network (as opposed to using modems over switched analogue circuits). ISDN provides one or two 64 kb/s digital service channels and a 16 kb/s digital signal channel to each subscriber. It was designed to carry voice, data, images, video, in digital format, with a standard network and device interface over the legacy PSTN, using TWP local loop cable. it did not establish itself as a popular broadband access technology. However, the speed of 128kbps, namely two times 64kbps was recognized as the speed of digital "broadband" connections when it was introduced.

ISDN was not adopted widely as digital services and replaced by Digital Subscriber Line (DSL – originally “Digital Subscriber Loop”) as a broadband wireline technology.

DSL carries digital signals on the PSTN using higher frequencies than those used for voice traffic. Thus, customer can use the telephone and computer at the same time, so that computer internet connection is "always on". There are several varieties of DSL: Asymmetric DSL (ADSL), with higher speed of upload than download, Symmetric DSL(SDSL) with the same upload and download speeds, Symmetric-High Speed(SHDSL) and Very high speed DSL( VDSL).

The performance differences are accomplished by changing the power levels and spectrum characteristics, modulation techniques, channel bonding and noise management. Advanced versions of ADSL and VDSL such as ADSL2, VDSL2 and ADSL2+ are also available.

DSL is easy to deploy because it uses the legacy PSTN physical plant. However, the existing local loop physical characteristics define a certain limitation on the transmission quality. Transmission speed reduces as the distance from the network operator’s DSL modem (DSLAM, DSL Access Multiplexer) to the subscriber’s DSL modem increases.

### 5.3.3 CATV (cable to premises)

In some countries CATV network is common to satisfy the demand for video services. Since CATV typically employs coaxial cables with capability of sending video signal, CATV access network is fit to the broadband services to compete with the exiting telecom carriers. The Data Over Cable Service Interface Specification (DOCSIS) was published in 1997. It defines the addition of high-speed data

communications to an existing CATV system. Using DOCSIS, CATV operators offered competing data communications on their video network, and with the development of Voice Over Internet Protocol (VoIP) offered POTS-like service. The latest version of the standard, DOCSIS 3.0, bonds up to 8 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.

ITU-T standards describing this application are in the ITU-T J-series of Recommendations.

### 5.3.4 mobile network (3G)

As table 5.2 shows the usage area covered by wireless communications is wide. Distinction is made from many perspective: by fixed vs. nomadic/mobile, but licensed vs. unlicensed as well as point-to-point vs. point-to-multi-point.

Responding to these requirements of user usage pattern, spectrum regulation and technical network pattern, the ITU has made a large 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”.

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. The following standards are included in Recommendation ITU-R M.1801:

- (Annex 1) ARIB HiSWANa
- (Annex 1) ETSI BRAN HiperLAN 2
- (Annex 1) IEEE 802.11-2012 Subclause 17 (Formerly 802.11a)
- (Annex 1) IEEE 802.11-2012 Subclause 18 (Formerly 802.11b)
- (Annex 1) IEEE 802.11-2012 Subclause 19 (Formerly 802.11g)
- (Annex 1) IEEE 802.11-2012 As amended by IEEE 802.11n (Subclause 20)
- (Annex 2) IMT-2000 CDMA Direct Spread
- (Annex 2) IMT-2000 CDMA Multi-Carrier
- (Annex 2) IMT-2000 CDMA TDD
- (Annex 2) IMT-2000 FDMA/TDMA
- (Annex 2) IMT-2000 OFDMA TDD WMAN
- (Annex 2) IMT-2000 TDMA Single-Carrier
- (Annex 3) LTE-Advanced
- (Annex 4) IEEE 802.16 WirelessMAN/ETSI HiperMAN
- (Annex 5) ATIS-0700004.2005 high capacity-spatial division multiple access (HC-SDMA)
- (Annex 6) eXtended Global Platform : XGP
- (Annex 7) IEEE 802.20

– (Annex 8) YD/T 1956-2009 Air interface of SCDMA broadband wireless access system standard.

Recommendation ITU-R M.1457 contains overviews and detailed specifications of each of the IMT-2000(International Mobile Telecommunications) radio interfaces:

– (Section 5.1) IMT-2000 CDMA Direct Spread
– (Section 5.2) IMT-2000 CDMA Multi-Carrier
– (Section 5.3) IMT-2000 CDMA TDD
– (Section 5.4) IMT-2000 TDMA Single-Carrier
– (Section 5.5) IMT-2000 FDMA/TDMA
– (Section 5.6) IMT-2000 OFDMA TDD WMAN

Recommendation ITU-R M.2012 contains detailed specifications of the terrestrial radio interfaces of IMT-Advanced(International Mobile Telecommunications Advanced). It includes the two IMT-Advanced radio interfaces:

– (Annex 1) Specification of the LTE-Advanced radio interface technology
– (Annex 2) Specification of the WirelessMAN-Advanced radio interface technology

In parallel with these ITU-R recommendations, the 3GPP family of standards provides wide choices of modern wireless mobile networks.

| Version | Name | Max uplink speed | Max downlink speed | Released |
|---|---|---|---|---|
| Release 99 | WCDMA | 384 kbit/s | 384 kbit/s | 2000 Q1 |
| Release 4 | WCDMA | 384 kbit/s | 384 kbit/s | 2001 Q2 |
| Release 5 | HSDPA | 384 kbit/s | 14 Mbit/s | 2002 Q1 |
| Release 6 | HSPA | 5.8 Mbit/s | 14 Mbit/s | 2004 Q4 |
| Release 7 | HSPA+ | 11.5 Mbit/s | 42 Mbit/s | 2007 Q2 |
| Release 8 | LTE | 80 Mbit/s | 300 Mbit/s | 2008 Q3 |

Table 5.3 Evolution of 3GPP specifications

### 5.3.5 WiFi

Broadband RLANs , commonly called WiFi such as those based on the IEEE 802.11 standard, allow for high-speed access to the Internet at short distances. RLANs, coupled with mesh network architecture provide the extended coverage from hot spots. This WiFi plus mesh is a convenient way to provide local access network without licenses.

Recommendation ITU-R M.1450 contains “Characteristics of broadband radio local area networks” and includes technical parameters, and information on RLAN standards and operational characteristics. The Recommendation contains each broadband RLAN standard and information in the annexes can be used for general information on RLANs, including characteristics. Information is also provided on how to obtain complete standards described in the Recommendation:

- IEEE Std 802.11-2012 Clause 17, commonly known as 802.11b
- IEEE Std 802.11-2012 Clause 18, commonly known as 802.11a
- IEEE Std 802.11-2012 Clause 19, commonly known as 802.11i
- IEEE Std 802.11-2012 Clause 20, commonly known as 802.11n
- IEEE 802.11ac
- IEEE Std 802.11ad-2012
- ESTI BRAN HIPERLAN2
- ARIB HiSWANa

Typical applications are public and private wireless access offered in homes, SOHOs, schools, hospitals, hotels, conference centers, airports, shopping centres, etc. Today, broadband RLANs are widely used 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. WiFi provides high data rates and system throughput but the geographic coverage is limited to about 100 m.

### 5.3.6 Satellite mobile access

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

- L-band (1.5/1.6 GHz) is used by non-geostationary earth orbits (NGEO) and geostationary earth orbit (GEO) systems. For GEO systems large antennas (e.g. 10-20 m diameter) are used on the satellite platform to provide large number of small spot beams on the Earth surface. Due 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 the C-band are less affected by rain fade and other weather conditions compared with higher frequencies because of the highly favorable propagation characteristics of this spectrum..
- Ku-band (11-12/14 GHz) has a shorter wavelength allowing for smaller dishes than C-band. However, the higher frequencies make Ku-band more susceptible to atmospheric conditions like rain fade. Applications include VSAT, rural telephony and broadband, satellite news gathering, backhaul links, videoconferencing and multi-media.

– Ka-band (20/30 GHz) has even shorter wavelengths than Ku-band, allowing for even smaller dish size; however transmissions are also even more susceptible to poor weather conditions. High-bandwidth interactive services are possible including high-speed Internet, videoconferencing, and multi-media applications.

Given their unique regional and global coverage capabilities, satellites are able to deliver immediate internet and broadband connectivity even to remote areas using existing satellite resources.

A geostationary earth orbit (GEO) satellite communication system can provide broadband services to fixed or mobile user terminals. With the use of large satellite antenna(s), broadband services can be provided to small user terminals taking advantage of the large satellite antenna gain. A GEO satellite system with multi-beam antennas has a larger capacity than a system with a single global beam over the same service area.

Satellite systems that use non-geostationary eartn orbits (NGEO) usually have a lower orbital altitude than geostationary earth orbit satellites (GEO), which operate at approximately 36,000 km altitude. One type of NGEO satellite system uses a Medium-Earth Orbit (“MEO”), which follows circular orbits around the Equator. Other NGEO satellite system operate in low-Earth orbits (LEOs), sometimes in circular but inclined orbits that provide better coverage to higher latitudes, such as the Scandinavian countries. While still other MEO systems employ highly elliptical orbits that are closer to the earth at one point in their orbit and farther at the opposite point. MEO satellite system has various advantages over GEO: affordable cost, high throughput, shorter delay..

Countries throughout the developing world are experiencing tremendous growth in VSAT deployments, as e-governance initiatives, corporate networks, rural demand for broadband, video conference, mobile phone and mobile broadband services increase.

### 5.4 Backhaul technologies

#### 5.4.1 Optical networks

For terrestrial optical fiber cable, see Section 5.3.1 above.

To connect islands to the continent or to the main island, submarine cables are used. They have been used mainly as international telecommunication links. Optical submarine cable is a cable with special armored cable covers. Some island countries have laid non-repeater optical fiber submarine cables to connect outer islands with distance of several hundred Kilo meters.

#### 5.4.2 Microwave link

A number of network topologies can be used to connect the point of presence to the core network,:

– Point to point (PtP): this is what traditionally has been used, with narrow pencil like beams connecting two end points
– Point to multi-point (PtMP): in this approach at one end a broader beam is used so that it covers a relatively wide area within which there could be several other endpoints
– Multi-point to multi-point or mesh: here multiple end points communicate to potentially other multi points 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 time division duplex (TDD) mode, sharing capacity between uplink / downlink directions.

### 5.4.3 Satellite link

Satellite-based GSM/3G backhaul has played an increasingly important role in extending the reach and coverage of mobile telephony and mobile broadband networks, particularly in developing countries. As governments seek to ensure mobile connectivity for all citizens, satellite backhaul will continue to play a role in providing connectivity to regions where terrestrial-based technologies alone are not an economically viable solution nor geographically reachable.

The use of satellite backhaul also provides redundancy of connectivity. Damage to the fiber backbone network could lead to terrestrial base stations being cut off from core networks, while the extra diversity that satellite backhaul provides will ensure that connectivity remains un-interrupted, even if there is serious damage to terrestrial infrastructure.

## 5.5 Selection of technologies

Wireless and wired technologies for broadband networks were described in the previous section. Although many technologies for telecommunications are available, we could list some basic selection criteria which guide to a right mix of technologies. Wireless and wired technologies have advanced in competition or in collaboration with each other, consequently the relative construction cost and bandwidth have been fairly stable in qualitative terms. Therefore, such a relative design rule would continue to be applicable in the foreseeable future.

- wired technologies offer greater bandwidth but requires high construction cost.
- low frequency wireless technologies provides less expensive but lower capacity network than the one with high frequency wireless technologies.

Mobile broadband is a fast approach to address broadband demand in rural and remote area. On the

other hand wired (or fixed) technologies respond better for the demand of high density urban areas.

Based on the criteria as above, the following table summarizes an optimized mix of the wired and wireless technologies for use in urban and remote areas. Please note that particular name of standards were mentioned as examples to show a current mix of wired and wireless systems. Unlicensed WiFi supplements and extends the access connection in urban and rural areas, as well as extreme rural regions.

| Access Technologies | urban - suburban | rural - remote | extreme rural |
|---|---|---|---|
| **Wired** | **FTTx, xDSL, GPON, etc** | **xDSL** | **--** |
| **Wireless** | **HSPA, LTE, EVDO WIMAX** | **cellular at low frequency, e.g. HSPA, LTE, EVDO** | **Satellite** |

Table 5.4 Selection of wired and wireless technologies

## Chapter 6 Current Situations of Broadband in remote and rural areas

Broadband penetration in developing countries is by far worst in the rural and remote areas. Connectivity for individual villagers and households is attained by 2G/2.5G mobile services for basic voice and short messages, etc. in rural and remote areas of developing countries including LDC and LLDC. Real situation of the rural and remote areas in developing countries including LDCs and LLDCs is by far different from that of developed or average developing countries.

### 6.1 Definition of rural and remote areas

Definition of rural and remote areas is given by the report of ITU-D for the Question 10-3/2 (21010-14) on "Telecommunications/ICTs for rural and remote areas" as follows;
Rural and remote areas are away from large cities or towns and mostly not heavily populated in comparison with urban and suburban areas. In some countries, such areas are defined as areas which have population less than 2500. Rural areas are depending on a lot of agricultural activity and may be characterized by the followings:

1) Geographic access problems due to distance, terrain, poor quality of road/transport network and remoteness of some rural communities;
2) Lack of or inadequate basic enabling infrastructure such as regular electricity supply;
3) Absence of adequate telecommunications infrastructure;
4) High Cost of physical access and equipment installation due to any combination of the above geographically related issues;
5) Low geographic density of target population (i.e. small village populations, in sparsely populated communities that are geographically separated from one another);
6) Low income, lack of disposable income and relative poverty of rural population;
7) High degrees of illiteracy in some rural areas;
8) Low levels of awareness (if any) of the benefits of modern telecommunications leading to low current demand in some areas;
9) Overall lack of funding (both public and private);
10) Others.

The following specific rural and remote areas in the developing countries are underserved and left behind from modern broadband telecommunication/ICT services.

**(Landlocked areas)**
Landlocked developing areas are enclosed or nearly enclosed by the land and suffer from lack of territorial access to the sea, remoteness and isolation from the market. The high transit costs impose serious constraints on the socio economic development. These harsh terrains have significant impact on building of telecommunications infrastructure providing broadband telecommunication/ICT services to

those areas.

**(Mountainous villages)**

There are mountainous villages where villagers are dwelling sparsely on the slopes of mountains, ridges and hills in cluster scattered over from one valley to another. There are Himalayan mountain villages in South Asia and others in Latin America or elsewhere. Building telecommunications infrastructure and its maintenance in these areas impose high costs and revenue on investment tends to be limited making service provision less lucrative for the telecommunication/ICTs service providers.

**(Isolated remote islands in SIDS)**

Small Islands Developing States (SIDS) were recognized as a distinct group of developing countries facing specific social, economic and environmental vulnerabilities at the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, held in Rio de Janeiro, Brazil (3-14 June 1992). The United Nations recognizes the 38 UN Member States belonging to the Alliance of Small Island States (AOSIS), an ad hoc negotiating body established by SIDS at the United Nations. Three geographical regions have been identified for the location of SIDS, namely, the Caribbean, the Pacific and the Atlantic, Indian Ocean, Mediterranean and South China Sea (AIMS). SIDS tend to confront similar constraints in their sustainable development efforts, such as a narrow resource base depriving them of the benefits of economies of scale; small domestic markets and heavy dependence on a few external and remote markets; high costs for energy, infrastructure, transportation, communication and servicing. Connectivity to remote islands may be provided by satellite links or optic fiber submarine cables rather than by terrestrial transmission medium.

**(Isolated villages in vast countries with desert, forest, etc. where no social infrastructure)**

There are isolated villages scattered over the desert and forest in the vast countries of ITU regions of the world. These villages are geographically separated by far distance in remote areas and difficult to access terrestrially. There may not be access road to these villages nor terrestrial access network infrastructure to be constructed except via satellite link. To provide connectivity cost effectively to these areas is the challenge by choosing appropriate technologies but the needs for the Telecommunications/ICTs are high for the quality of their lives of the dwellers.

### 6.2 Rural and urban divide widening

Half of the global population lives in the rural and remote areas as of 2014 according to the statistics given by UN Economic and Social Affairs, Population Division. Migration of population from rural to urban areas is predicted to progress year by year. This may be because of the difficult life, environmental and economic conditions in the rural communities. Rural communities have been mainly relying on the agriculture which was the self-supporting economy but gradually affected by the globalization of the economy. The villagers have to purchase the imported seeds, fertilizer, foods and other commodity goods, etc., which make their lives gradually difficult. Migration to urban areas is thus progressing in

developing countries. Those people migrated to urban areas are not always easy to spend urban lives. Urban city life is not easy to find jobs and houses to live, which result in the poverty in most of the cases. Development of telecommunications/ICTs services in rural and remote areas of developing countries in the meantime is slow unless special policy, initiatives and government subsidy are implemented in those countries. Provision of telecommunications/ICTs services such as basic voice, short message, video-conference and internet services is not lucrative in general in sparsely populated rural areas of developing countries.

As a result, according to the report by the BDT director “Measuring the Information Society (2014)”[16], it is said urban-rural digital divide prevails in many developing countries. There is the strong gap observed in the levels of Individuals/Households ICT access, ICT skills and fixed/mobile telecommunication infrastructure in urban and rural communities.

Although mobile cellular coverage for rural population has reached almost 90% of the world’s rural inhabitants by 2013, they are most covered by the 2G/2.5G mobile services including SMS. 3G mobile service coverage which enables the use of smartphone or tablet terminal sets is comparatively low for rural population. There is the need to address the urban/rural digital divide that prevails in many developing countries of the world in particular in LDC, LLDC, and SIDs. People living in rural areas of developing countries are disadvantaged compared with their counterparts in urban areas because of lower service coverage. They also often lack the economic allowance to pay for the broadband internet services, or high speed mobile services such as 3G or higher grade mobile services as well as to make effective use of ICTs. On the other hand they are population group that could potentially benefit from the ICT access.

### 6.3 E-applications needed for rural and remote areas

Three major killer applications for the rural and remote areas are said to be e-education, e-health care, and e-administration services. In addition e-banking or money transfer service is popular service required for the workers in the foreign countries to remit the earnings back to their homes and families. E-agriculture is the important application for rural community in some countries where applicable to increase productivity of per square meter or mile to attain the self-food supply as much as possible. E-bulletin board is useful means for the rural villagers where no newspapers or TV or other broadcasting services is not available.

**(E-education)**

[16] Measuring the Information Society Report (2014), available at: http://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2014/MIS2014_without_Annex_4.pdf

Every developing country is stressing the importance on children's education for most important policy to build the good nation in future. They have the schools in most of the rural villages which have the population of 400-800 even in mountainous areas and remote isolated islands. The common problems are teaching staff and teaching materials. Tele–teaching method by the quality teacher from the urban city schools and the digitized teaching materials are shared by the rural schools and by the school children by the inexpensive tablet terminals or 100-200 USD computers over the internet or intranet.

Figure 6.1 School Children learning from the digitized school text by the 100 USD OLPC in rural areas of Nepal

**(E-health care)**

E-health care is also most demanded application by the developing countries. Medical doctors are shared by the health posts in the rural communities. It will contribute to the improvement of mortality in the developing countries. It is useful to provide information about the contagious disease to rural communities and to let them know how to protect their health in the rural areas. Teleconsultation by the doctor in the urban hospital over the internet is also useful application for the rural areas of developing countries.

Figure 6.2 Health post of the remote Island of Mejit of the Republic of Marshall Islands in the Pacific Ocean

**(E-Administration)**

The administrative office of the rural community is required to be connected by telecommunications and internet for the administrative services for the rural communities of the region or dissemination of administrative information from the central government for the social welfare of the rural population. Emergency information may also be disseminated as quickly as possible by the internet.

### 6.4 Broadband required for rural and remote areas

The broadband commission did not provide the definition of broadband in its report (2012) because the requirement of data rate for the broadband changes rapidly depending on the emerging services. However the minimum requirement data rate for the above mentioned e-applications over the internet for the rural communities may be 256Kbps/128Kbps for down/up-streams considering the current potentiality of infrastructure by the wireless and wired last mile access lines in rural and remote areas. There are administrations targeting 512Kbps/256Kbps or 2Mbps in the near future for the services of rural and remote areas in their regulations.

### 6.5 Universal service policy for broadband in rural and remote areas

According to the analysis report on the results of survey by the questionnaires on the universal service policies of the ITU member states, there are administrations which have the regulation to prescribing Universal Service Obligation and Fund. Sharing of infrastructure, base transceiver stations (BTS) and antenna towers etc. in the rural and remote areas is mentioned in their regulation among the competitive telecommunication operator(s), mobile service operator(s), and internet service providers etc.

## Chapter 7 Conclusions and recommendations

### 7.1 Broadband as universal service

The concept of universal services has been associated with the communications in rural and remote areas. Universal services, like water or electricity, should be available to all the citizens in the country. Since costs to provide telecommunications services are higher in rural and remote areas due to sparse population and wider regions for the services to cover, some forms of government intervention are necessary to share the costs under public framework.

Universal Service Fund has been in use for this purpose in developed as well as developing countries. This public fund is supported by Government and/or telecom operators. At the start, the fund is used primarily for telephone services in rural and remote areas.

With the proliferation of the Internet and contents it offers to the society, the objective of Universal Service Fund seems to have moved to provide high speed accesses to the Internet. One reason of this shift comes from the fact that large areas in developing and developed countries have been quickly covered by GSM. As the contents and information provided by the Internet become an important knowledge base for all of the citizen, governments realized that Broadband access could replace the role played by the old telephone services.

One of the recent examples is the ITU 19th Plenipotentiary Conference, held in Busan in Republic of Korea in October 2014. It approved Resolution 200 "Connect 2020 Agenda for Global Telecommunication/ICT Development"[17]. The annex to the Resolution lists four goals and 17 targets. Among these targets, the followings are directly related to the coverage of broadband accesses.

**Target 1.1**: Worldwide, 55% of households should have access to the Internet by 2020
**Target 2.1.A**: In the developing world, 50% of households should have access to the Internet by 2020
**Target 2.1.B**: In the least developed countries (LDCs), 15% of households should have access to the Internet by 2020
**Target 2.4**: Worldwide, 90% of the rural population should be covered by broadband services by 2020

### 7.2 Variations of broadband speeds

When comparing these targets of "Connect 2020" with the national broadband plans listed in Chapter 4 of this report, the lack of description of Broadband speed in the targets is apparent.

The definition of Broadband speed for the Internet finds several difficulties. First, as the applications of

[17] Available at: http://www.itu.int/en/connect2020/Pages/default.aspx

Internet normally contain video, voice, and message of characters, the bandwidth for them is about 100 times broader than pure voice (plain old telephone) communications. This makes the construction of such networks in rural and remote areas quite demanding. Second, the property of best-effort packet communications used for Internet leads to the changing speed during the communication session. There could be the minimum speed, the average speed and maximum speed, all depending on the measurement period employed and how congested in various parts of the networks during the measurement period.

Also the rapid technological development makes some specific definitions of speed quickly obsolete. The advance of urban networks with ultra-high speed of order of 50Mbps has introduced many applications requiring even higher speed. If we consider specific areas like e-medicine, real-time remote diagnosis may demand more than 50Mbps. That means "Broadband" technologies and services contain concepts or frameworks, which are 1000 times different each other: from 128kbps ISDN to 30Mbps ADSL to 100Mbps optical FTTHs. Perception of users or providers may differ widely depending on what they imagine or define as wideband services, e-mail, file download, video download or video upload.

### 7.3 Recommended target values

Broadband speed target values are proposed, with some consideration as follows:

- **Broadband access to the Internet as universal service.**

  If we take the recent trend of regarding Broadband access to the Internet as the next step of universal services, the Broadband target value of service quality should be a unique value for the country. There should not be two broadband speeds, one for cities and another for rural and remote areas.

- **Broadband access to the Internet for residential users**

  Since the target value is for all the citizen, the target should the ones living in residential areas in cities or in villages. The residential user should be able to use the fixed access line to his/her premise or his/her wireless terminal/smartphone in his residence.

- **Target values should be easy to understand**

  As described above, the real speed of Broadband is less than the nominal or subscribed speed. The latter speed is also referred to as the peak speed which is the fastest theoretical transmission of data over the connection. Some of the recent measurement of the EU found that the average speed

(24hours) is 74% of the advertised (namely, nominal) Broadband speed[18]. Since it is not practical for a citizen to measure real speed of his access line, the target value should be defined in terms of the value of subscribed speed.[19]

- **Attainable value with technology advancement and with the strategy of a country.**

  From Figure 4.4, the average target speed of the investigated 50 countries is about 6 Mbps in the year of 2014. This value should be considered as a maximum/ceiling value for the minimum Broadband speed, since many developing countries tend not to specify target speeds for Internet connection. If those countries expressed their targets, the average over the 92 economies would have been lower than 6 Mbps.

- **Target speed should be fit to Internet contents at present.**

  Contents of the Internet demand higher and higher throughput, like video stream and large files to download. A study[20] shows the range of peak speed of 500kbps - 1Mbps is a basic value for today's Internet : Voice over IP, E-mail, basic web browsing, music streaming and low quality video. The study gives the next range of 1Mbps - 5Mbps, which further provides e-mail with large attachments, remote surveillance, medium quality IPTV and high quality music streaming.

Considering the points mentioned above, it should be possible to suggest that:

**the nominal down-stream speed of some “Mbps” (i.e. 2Mbps) or above should be defined to be the minimum Broadband speed for rural and remote areas.**

This definition covers many National Broadband Plans in place at the moment (Table 4.2). Although real average speed experienced by the user may often be less than the nominal value. It sometime goes lower than 60% of the nominal value, due to the efficiency in access portion itself, or to the congestion in traffic peak hours encountered in the network beyond, it still is able to carry the many typical contents of the Internet.

In technical terms, the report recommends the nominal or designed peak speed of Broadband access, which ensures real average download speed of order of 1Mbps or above.

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[18] "Quality of Broadband Services in the EU March 2012", available at: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=2319

[19] Ibid., at 11.

[20] Commerce Commission New Zealand (2012): High-Speed Broadband Services Demand-side Study, available at: http://www.comcom.govt.nz/dmsdocument/8917

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**Acronym**

| | |
|---|---|
| ADSL | Asymmetric DSL |
| AIMS | Atlantic, Indian Ocean, Mediterranean and South China Sea |
| AOSIS | Alliance of Small Island States |
| BDT | Bureau de développement des télécommunications |
| CATV | cable television |
| CIS | Commonwealth of Independent States |
| CPE | Customer-premises equipment |
| DOCSIS | Data Over Cable Service Interface Specification |
| DSL | Digital Subscriber Line/ Digital Subscriber Loop |
| DSLAM | DSL Access Multiplexer |
| EPON | Ethernet Passive Optical Network |
| EU | European Union |
| EVDO | Evolution Data Only |
| FDD | frequency division duplex |
| FTTB | Fibre-to-the-Building |
| FTTC | Fibre-to-the-Curb |
| FTTH | Fibre-to-the-Home |
| FTTN | Fibre-to-the-Node |
| FTTV | Fiber to the Village |
| GEO | Geostationary Earth orbit |
| GPON | Gigabit-capable passive optical network |
| GSM | Global System for Mobile Communications |
| HEO | Highly elliptical earth orbit |
| HF | High Frequency |
| HSPA | High Speed Packet Access |
| HTML | HyperText Markup Language |
| ICT | Information and communications technology |
| IEEE | Institute of Electrical and Electronics Engineers |
| IP | Internet Protocol |
| ISDN | Integrated Services for Digital Network |
| IT | Information Technology |
| ITU | International Telecommunication Union |
| LDC | least developed country |
| LLDC | landlocked developing country |
| LTE | Long-Term Evolution |
| MEO | Medium Earth orbit |
| MSAN | Multi-Service Access Node |

| | |
|---|---|
| NGEO | non-geostationary earth orbit |
| OLPC | One Laptop per Child |
| OMCI | ONU management and control interface |
| ONU | Optical Network Unit |
| PC | Personal Computer |
| PON | Passive Optical Network |
| PSTN | Public Switched Telephone Network |
| RLAN | radio local area network |
| SDSL | Symmetric DSL |
| SHDSL | Symmetric-High Speed DSL |
| SIDS | Small Island Developing States |
| TDD | time division duplex |
| TWP | Twisted Wire Pair |
| UN | United Nations |
| UNCED | United Nations Conference on Environment and Development |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| VAS | value-added service |
| VDSL | Very high speed DSL |
| VSAT | very small aperture terminal |
| WIMAX | Worldwide Interoperability for Microwave Access |
| WLAN | Wireless Local Area Network |
| WSIS | World Summit on the Information Society |

## Appendix A

### Appendix A-1 List of ITU-D Study Group case studies for 2002-2006

| | Country | Title | Organizations involved | Project status |
|---|---|---|---|---|
| 1 | **Brazil** | Public Electronic Service | Ministry of Communications<br>Ministry of Defence<br>Ministry of Education<br>Ministry of Agriculture | operational |
| **2** | **Bulgaria** | Septemvri Telecentre Project | Ministries of Transport & Communication,<br>ICT Dev. Agency,<br>Association of Telecentres,<br>Telco Operator, Local Community,<br>Medical Centres, ITU/BDT, etc. | operational |
| **3** | **Burkina Faso** | Tenkodogo and Koudougou Rural telephony Project | Onatel,<br>European Investment Bank | operational |
| **4** | **Cambodia** | Cracking the Digital Divide (Store-and-forward internet service for rural villages) | American Assistance of Cambodia/ Japan Relief for Cambodia,<br>First Mile Solutions | operational |
| **5** | **Colombia** | Colombian Social Telecommunications Programme | Ministry of Communications,<br>Comm. Fund, FONADE,<br>COMPARTEL, S.A.E.S.P. | operational |
| **6** | **Egypt** | Evolution of the Telephony Service for Egyptian Rural Areas and Villages | Telecom Egypt | N/A |
| **7** | **Estonia** | Look@World Internet training project for 100 000 people | Look@World Foundation's<br>PPP Project | completed |
| **8** | **Ethiopia** | Telemedicine Pilot Project in Ethiopia | ETA, NTCC, ETC, MOH, AAUFOM | planned |
| **9** | **India 1** | ITC eChoupal: A Profitable Rural Transportation through Web-based Meta-market for | ITC Ltd., Gov. Agencies,<br>Civil Society, Private Sector | operational |

| | Country | Title | Organizations involved | Project status |
|---|---|---|---|---|
| | | Indian Farmers | | |
| **10** | **India 2** | n-Logue-Building a Sustainable Rural Services Organizations | TeNet, IIT Univ. and Chennai n-Logue Comm Ltd. | operational |
| **11** | **India 3** | Application of the Telemedicine Technology to provide Tele-health care during Mela/Festival and Disaster | Sanjay Gandhi Postgraduate Institute of Medical Sciences, Department of Information Technology, Online Telemedicine Research Institute, Government of Uttar Pradesh, M.L.N. Medical College | completed |
| 12 | **Indonesia** | Voice internet, Access to the internet and E-mail without personal computer as complementary solution for Rural Telecommunications in Indonesia | PT Telekomunikasi Indonesia Tbk. International Development Research Centre – Canada | operational pilot project |
| 13 | **Lesotho** | Telecommunications in Lesotho | Lesotho Telecom Co. | operational |
| 14 | **Malaysia** | ARCADIAN Fixed Wireless Multi-service Platform on Langkawi Islands | Cape Range Wireless. Telkom Malaysia, Ministry of Energy, Water & Communications, Malaysian Communication and Multimedia Commission (MCMC) | operational |
| 15 | **Nepal** | Nepal Telecom VSAT Project concerning Village Development Committees (VDCs) | Nepal Telecom, STM Networks | operational |
| 16 | **Peru** | Infodes – Information and Communication System for Rural Development | OSIPTEL, FITEL, InfoDev, Intermediate Tech. Dev. Group | operational |
| 17 | **Syria** | 3rd Rural Project | EC, EIB, National organizations, | operational |

| | Country | Title | Organizations involved | Project status |
|---|---|---|---|---|
| | | | Syrian Telco Establishment | |
| 18 | **Venezuela** | First Telecommunications Universal Services Obligation in Venezuela | CONATEL, Operator, Ministries of Panning, Infrastructure, Industry & Commerce, Local Community | planned |
| 19 | **Viet Nam (KDDI)** | Solution for Rural Areas Telecommunication using CFO-SS | KDDI, Waseda University, Hatinh Dept of Health, Hatinh General Hospital, Hatinh Medical College, Hatinh P&T | operational |

**Appendix A-2 List of ITU-D Study Group case studies for 2006-2010**

| No | Country | Title | Organizations involved | Project status |
|---|---|---|---|---|
| **1** | **Bhutan** | Rukubji ICT and media centre | ITU, BICMA, MOIC, Bhutan Broadcasting Service Corp. Bhutan Telecom Japan TELECOM | Operational Completed |
| **2** | **Bolivia** | Connectivity in the Community | IICD Netherland ACLO, Locust World | Operational Completed |
| **3** | **Cameroon** | Multipurpose community Telecentre project | MPT, International Bodies, Companies Local administration | In progress |
| **4** | **Canada I** | Government program to provide broadband services to underserved areas | Government, Communications Research Center Canada | Operational |
| **5** | **Canada II** | Broadband access to Alberta remote areas | Special Area Board Alberta SuperNet Netago Wireless Nortel | Operational Completed |
| **6** | **Cuba I** | Deployment of PLC and WiMAX technologies in a Rural Establishment | EMPRESA DE TELECOMUNICACIONES DE CUBA S.A. (ETECSA) | Completed |
| **7** | **Cuba II** | Low cost wireless network For agricultural concerns | Institute of Animal Science, Jose Antonio Echeverria Higher Institute | Operational |
| **8** | **India** | Connecting rural India with broadband wireless | IIT (Madras), RTBI(Rural Technology and Business Incubator) | Operational |
| **9** | **Indonesia (I)** | NGN solutions for serving The rural areas in Sumatera | Local Government, PT Trans Komunikasi Datanet (TKD), PT Industri Telekomunikasi (INTI), PT Telekomunikasi Indonesia RD I | Operational Completed |
| **10** | **Indonesia (II)** | Providing Internet & Voice Access to Way Kanan | QUALCOMM, PT Sampoerna | Operational |

| No | Country | Title | Organizations involved | Project status |
|---|---|---|---|---|
| | | &Pacitan | Telekomunikasi Indonesia (STI), MIC, Min for Development of Underdeveloped Regions Ministry of Education, Microsoft, IndoNet, Axesstel | |
| **11** | **Lithuania (I)** | "Rural Internet Access Points" Project | Central Project Management Agency, Information Society Development Committee Sonex kompiuteriai, Labochema, Lithuanian Radio & TV center, AHT Group AG, PRO Management GMBH, Kaunas Univ. of Technology, UAB Noratus, Vilinius Univ. UAB S4ID | Completed |
| **12** | **Lithuania (II)** | Rural Area Information Technology Broadband Network (RAIN) | Institute of Mathematics and Informatics Ministry of Transport and Communications of the Republic of Lithuania Ministry of Education and Science of the Republic of Lithuania Public Institution "Placiajuostis internetas" | Operational |
| **13** | **Nepal** | Installation of a Fill in FM At Humla | Radio Nepal, MIC, District Development Committee, Humla | Completed |
| **14** | **Papua New Guinea** | Telehausline: Wireless IP Broadband for e-services | APT, PANGTEL, Telicom PNG Ltd., Japan Radio Corporation Tokyo Electric Power Co. | Operational Completed |
| **15** | **Peru** | CEPES Huaral project | OSIPTEL CEPES (Peruvian Centre for Social Studies) | Operational Completed |

| No | Country | Title | Organizations involved | Project status |
|---|---|---|---|---|
| **16** | **Philippines (KDDI)** | E-learning through Wireless LAN in Bantayan, Cebu | APT, KDDI, Waseda Univ.,<br>CICT Office of the President of Philippines, Univ. of Philippines Cebu, Local Government Unit | Operational<br>Completed |
| **17** | **Rep. Of Korea** | Information access centres<br>For rural and remote Areas | MIC,<br>MoMAF,<br>MoGAHA<br>MAF<br>Local Government | Operational |
| **18** | **Rwanda** | An integrated communications Infrastructure for Rwanda | Government of Rwanda<br>TERRACOM Power Line Co.<br>New Artel, BushNet/BIGDISH<br>ELECTONICA (Italy) | On going |
| **19** | **Tanzania** | Sengerema multimedia Community centre | IDRC, ITU, UNESCO, DANIDA Fund,<br>Tanzania Comm. Regulatory Authorit (TCRA),<br>Tanzania Telecom Company Ltd.<br>Tanzania National Commission for UNESCO<br>Tanzania Commission for Science & Technology (COSTECH) | Operational |
| **20** | **Uganda** | The universal access project | MTN Uganda<br>Uganda Communications Commission | Operational |

## Appendix A-3 List of ITU-D Study Group case studies for 2010-2014

| No | Country (reporting Member) | Title | Organizations involved | Link to Documents |
|---|---|---|---|---|
| 1 | Micronesia (Japan) | Pilot installation of Tele–Center for remote Education and Health–Care in Rural Area and Isolated Islands in Micronesia | Federated States of Micronesia (FSM), APT, KDDI | 2/40 |
| 2 | Nepal I | Policy and Regulatory Intervention for Telecom Growth in Rural Nepal | Nepal Telecommunications Authority | RGQ10-3/2/3 |
| 3 | Nepal II | Rural Challenges: Telecommunications/ICT Development Perspectives | Nepal Telecommunications Authority | RGQ10-3/2/4 |
| 4 | Burundi | Connectivity project broadband wireless | Burundi Ministry of Telecoms, Information, Communication and Relations with Parliament, Foundation Craig & Suzan McCAW, ITU | RGQ10-3/2/5 |
| 5 | Uganda | Universalizing Access to ICTs for Social and Economic Development: Lessons and Experiences learnt from Uganda | Uganda Communications Commission | RGQ10-3/2/6 |
| 6 | Chad | The development of telecommunications/ICTs for rural and remote areas in Chad | Chad | RGQ10-3/2/7 |
| 7 | Rwanda | Rwanda National Broadband within ICT Plans and Objectives for Success | Rwanda Utilities Regulatory Agency | 2/101 |

| No | Country (reporting Member) | Title | Organizations involved | Link to Documents |
|---|---|---|---|---|
| 8 | China (People's Republic of) | EPON in the Rural Areas of China | People's Republic of China | 2/102 |
| 9 | Malawi | Regulatory Challenges for Rural Telecommunications in Malawi | Malawi Communications Regulatory Authority | RGQ10-3/2/16 |
| 10 | Philippines (Japan) | Case studies of rural telecommunications / ICT projects | Commission on Information and Communications Technology (CICT), Ateneo de Manila University, COMSTE, PLDT, SMART, TTC, NTT West, NARO-Japan, Tokyo University, JRC | RGQ10-3/2/25 |
| 11 | Madagascar I | Rural and remote areas | Madagascar | 2/162<br>RGQ10-3/2/INF/5 |
| 12 | Madagascar II | Widening access to mobile telephone services in Madagascar through the Cloud Phone system | Airtel Madagascar, Movirtu Ltd | 2/167 |
| 13 | Togo | Provision of basic services in rural telephony | ART&P, Togo | 2/188 |
| 14 | Japan | Application of sensor network for agriculture | Fujitsu Limited, Japan | 2/190 |
| 15 | Tanzania | Status of e-Health in the United Republic of Tanzania | Tanzania | 2/228 |
| 16 | Rwanda | Access to telecommunication/ICT services by persons with disabilities and with special needs | Rwanda | RGQ10-3/2/28 |

| No | Country (reporting Member) | Title | Organizations involved | Link to Documents |
|---|---|---|---|---|
| 17 | Japan | Contribution to Case Study Library: Mobile WiMAX in Japan | KDDI, Intel Capital Corporation, East Japan Railway Company, KYOCERA Corporation, Daiwa Securities Group Inc., The Bank of Tokyo-Mitsubishi UFJ, Ltd. | RGQ10-3/2/35 |
| 18 | Marshall Islands | Livelihood Opportunities and Culture Preservation through a Sustainable and Eco–Friendly ICT Telecentre | Ministry of Transportation and Communications(MOTC), Marshall Islands National Telecommunications Authority, KDDI Foundation, Mejit Local Government | RGQ10-3/2/362/INF/25 |
| 19 | Luxembourg (Netherlands) | Emergency.lu Rapid Response Communications Solution | SES TechCom, Hitec, Luxembourg Air Rescue, Ministry of Foreign Affairs of Luxembourg | RGQ10-3/2/38 |
| 20 | South Africa (United States) | Contribution to Case Study Library: Mobile Health Information System: Providing access to information for health care workers | Qualcomm Wireless Reach, Eastern Cape Department of Health, FHI 360, MTN South Africa, Nelson Mandela Metropolitan University, South Africa Partners | RGQ10-3/2/44 |
| 21 | Indonesia (United States) | Contribution to Case Study Library: Mobile Microfranchising & AppLab Project in Indonesia | Grameen Foundation, Qualcomm Incorporated, Ruma | RGQ10-3/2/45 |
| 22 | China (People's Republic of) | WLAN Coverage solutions in rural China | China (People's Republic of) | 2/322 |

| No | Country (reporting Member) | Title | Organizations involved | Link to Documents |
|---|---|---|---|---|
| 23 | Brazil (United States) | Contribution to case study library: Fishing with 3G Nets (Environment and Entrepreneurships Project) | Qualcomm Wireless Reach, Telefonica Vivo Foundation, he United States Agency for International Development, Editacuja Publishing, the Institute Ambiental Brasil Sustentavel (IABS) | 2/339 |
| 24 | China (Unites States) | Contribution to case study library: Let's Get Ready! Mobile Safety Project | Qualcomm Wireless Reach, Sesame Workshop, China Telecom Corporation Limited, China Youth Development Foundation | 2/340 |
| 25 | Korea | The INV (Information Network Village) Project | the Ministry of Government Administration and Home Affairs | 2/INF/3 |
| 26 | Turkey | Turkey's rural transformation project | TURK TELEKOMUNIKASYON A.S. | 2/INF/4 |
| 27 | Korea | Korean Case Study of Inducing Middle–aged People to Use Internet | Korean government | 2/INF/7 |
| 28 | Cameroun | The new legislative and regulatory environment for electronic communications | Cameroun | 2/INF/21 |
| 29 | Korea | Broadband Internet in Rural and Remote Areas of Korea | Korea Communications Commission (KCC) | 2/INF/26 |
| 30 | Bangladesh | Statistics and Strategic Action Plan of Telecommunication/ICT Development in Bangladesh: Rural and Remote Areas | Bangladesh Telecommunication Regulatory Commission | 2/INF/36 |

| No | Country (reporting Member) | Title | Organizations involved | Link to Documents |
|---|---|---|---|---|
| 31 | Pakistan | Telecom/ICTs for Rural and Remote Areas – Universal Service Experience of Pakistan | Ministry of Information Technology | 2/INF/38 |
| 32 | Uganda | Uganda's Approach to Implementing Broadband Connectivity in Underserved Areas | Uganda | 2/INF/41 |
| 33 | Japan | Overview of Fixed and Mobile Broadband environment in Japan | NTT DoCoMo | 2/INF/55 |
| 34 | Turkey | Fiber Effect | Türk Telekom Group | 2/INF/76 |
| 35 | Italy | ICTP's Fifteen Years Experience in ICT Training and Dissemination | The Abdus Salam International Centre for Theoretical Physics | RGQ10-3/2/INF/4 |
| 36 | Lao (Japan) | Country case study: Pilot project for the improved health & medical environment with ICT for rural areas in Lao P.D.R. | Laos Government, JTEC, Fujitsu Limited | 2/INF/82 |
| 37 | Bhutan | Case Study: WiMAX and FiberWiFi Broadband in Rural Areas of Bhutan | Department of Information Technology and Telecom (DITT), Ministry of Information and Communications, KDDI Foundation, Tashi InfoComm Limited | 2/INF/83 |
| 38 | India | Innovative technological solution for broadband use in rural areas – Data Rural Application Exchange (D–Rax from C–(DoT | Centre for Development of Telematics (C-DOT) | 2/INF/84 |
| 39 | Africa (India) | A concept paper on setting up of Tele–education Network in developing countries | Telecom Consultants of India Limited | 2/INF/85 |

| No | Country (reporting Member) | Title | Organizations involved | Link to Documents |
|---|---|---|---|---|
| 40 | India | Successful e–initiative for rural people in remote North Eastern part of India - Active community participation for sustainability | Indian government | 2/INF/86 |
| 41 | Japan | Country Case Study: Telecommunications/ICT development by ad–hoc communications network for rural Shiojiri City in Nagano prefecture (Japan) | Shiojiri City, Japan | 2/INF/88<br>RGQ10-3/2/48 |
| 42 | Côte d'Ivoire | Evolution of the regulatory and institutional framework in the field of Telecommunications / ICT in Côte d'Ivoire | Côte d'Ivoire | 2/INF/92 |
| 43 | Burkina Faso (Netherlands) | Case Study submitted to the Case Study Library: Satellite broadband supporting elections in Burkina Faso | SES World Skies | 2/INF/93 |

**Appendix A-4 List of Characteristics of ITU-D Study Group case studies for 2010-2014**

Note 1: The Case study numbering is the same as Table A-3 above.

Note 2: The value 1 in a cell indicates "related to the characteristics of the column header".

| No | Country (reporting Member) | Financing and Partnership | Related to Universal Services | Access | | | Application | | | | | | Challenge | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Satellite | Wireless | Cable | telephony | e-business | e-admin | e-education | e-health | ICT-training | Broadband | Internet-style service | NGN | Wireless access |
| 1 | Micronesia (Japan) | Foundation | | | 1 | | | | | 1 | 1 | 1 | | | | |
| 2 | Nepal I | NA | yes | | | | | | | | | | | | | |
| 3 | Nepal II | NA | yes | | | | | | 1 | | | | | | | |
| 4 | Burundi | Foundation | | | 1 | | | | | 1 | 1 | | 1 | 1 | | 1 |
| 5 | Uganda | Government | yes | | | | 1 | | | 1 | 1 | 1 | | | | |
| 6 | Chad | Government | | | | | | | | | | | | | | |
| 7 | Rwanda | Government | yes | | | | | | 1 | 1 | 1 | | | | | |
| 8 | China (People's Republic of) | Government | | | | 1 | | | | | | | 1 | 1 | | |
| 9 | Malawi | Gov/ international aid | yes | | | | | | | 1 | | | | | | |
| 10 | Philippines (Japan) | Foundation | | | 1 | | | 1 | | | | 1 | | 1 | | 1 |
| 11 | Madagascar I | Government | yes | | 1 | | | | | | | | 1 | 1 | | 1 |
| 12 | Madagascar II | Private initiative | | | 1 | | 1 | 1 | | | | | | | | |
| 13 | Togo | NA | yes | | 1 | | 1 | | | | | | | | | |
| 14 | Japan | Private initiative | | | 1 | | | 1 | | | | | | | | 1 |
| 15 | Tanzania | Government | | | | | | | | | 1 | | | | | |

| No | Country (reporting Member) | Financing and Partnership | Related to Universal Services | Access | | | Application | | | | | | Challenge | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Satellite | Wireless | Cable | telephony | e-business | e-admin | e-education | e-health | ICT-training | Broadband | Internet-style service | NGN | Wireless access |
| 16 | Rwanda | NA | yes | | | | | | | | 1 | | | | | |
| 17 | Japan | Private initiative | | | 1 | | | | | | | | 1 | 1 | | 1 |
| 18 | Marshall Islands | Gov/ international aid | | | 1 | | 1 | | | 1 | 1 | 1 | | 1 | | 1 |
| 19 | Luxembourg (Netherlands ) | Government | | 1 | | | | 1 | | | 1 | | | | | |
| 20 | South Africa (United States) | Private initiative | | | 1 | | | | | | 1 | 1 | 1 | 1 | | 1 |
| 21 | Indonesia (United States) | Gov/foundation/ private initiative | | | 1 | | 1 | 1 | | | | | | | | |
| 22 | China (People's Republic of) | Government | | | 1 | | | | | | | | | | | 1 |
| 23 | Brazil (United States) | Gov/foundation/ private initiative | | | 1 | | | 1 | | | | 1 | 1 | 1 | | 1 |
| 24 | China (Unites States) | Private initiative | | | 1 | | | | | 1 | | | 1 | 1 | | 1 |
| 25 | Korea | Government | | | | 1 | | 1 | 1 | | | | 1 | 1 | | |
| 26 | Turkey | Government | | | | 1 | 1 | | | | | | 1 | | 1 | |
| 27 | Korea | Gov/foundation/ private initiative | | | 1 | | | 1 | | | | 1 | | 1 | | 1 |
| 28 | Cameroun | Government | yes | | | | 1 | | | | | | | 1 | | |
| 29 | Korea | Gov/foundation/ private initiative | yes | 1 | 1 | 1 | | | | | | | 1 | 1 | | |

| No | Country (reporting Member) | Financing and Partnership | Related to Universal Services | Access | | | Application | | | | | | Challenge | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Satellite | Wireless | Cable | telephony | e-business | e-admin | e-education | e-health | ICT-training | Broadband | Internet-style service | NGN | Wireless access |
| 30 | Bangladesh | Government | yes | | | | | | | | | | 1 | | | 1 |
| 31 | Pakistan | Gov/foundation/ private initiative | yes | | | | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | |
| 32 | Uganda | Government | yes | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | | | |
| 33 | Japan | Private initiative | | | 1 | | | | | | | | 1 | 1 | | 1 |
| 34 | Turkey | Private initiative | | | | 1 | | | | | | | 1 | | | |
| 35 | Italy | Gov/ international aid | | | | | | 1 | | | 1 | 1 | | | | |
| 36 | Lao (Japan) | Gov/ international aid | | | 1 | | | | | | 1 | | | | | 1 |
| 37 | Bhutan | International aid | | | 1 | 1 | | | | | | | 1 | | | 1 |
| 38 | India | Government | | | | | | 1 | 1 | 1 | 1 | | | 1 | | |
| 39 | Africa (India) | Government | | | | | | | | 1 | 1 | | | 1 | | |
| 40 | India | Government | yes | | | | | 1 | 1 | 1 | 1 | 1 | | | | |
| 41 | Japan | Government | | | 1 | | | 1 | 1 | | | | | 1 | | 1 |
| 42 | Côte d'Ivoire | NA | yes | | | | | | | | | | | 1 | | 1 |
| 43 | Burkina Faso (Netherlands) | Government | | 1 | | | | | 1 | | | | | 1 | | 1 |

## Appendix A-5 Project or case study objectives, financing and partnership (2010-2014)

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 1 | Micronesia (Japan) | For e-education and e-health, the project is developed for rural area and isolated islands in Micronesia. Several tele-centers have been installed as a pilot project. | APT (Document 2/40) |
| 2 | Nepal | Practical policy and regulatory interventions for telecom growth in rural Nepal have been made. Evaluation is made for such government and regulatory initiatives from the perspectives of transparency, professionalism, efficiency and independence of such initiatives. Experiences highlight some of the major initiatives made by the government and the regulator, and the objectives achieved. | (Document RGQ10-3/2/3) |
| 3 | Nepal | To achieve the targets set in the WSIS Action Plan and the related action lines, Nepal faces many challenges. Considerations were made on these challenges for each major stakeholders in the entire value chain and ecosystem for the development of telecommunications/ICTs in the rural and remote areas of developing countries: the government, the regulator, the telecom service providers, the CPE manufacturers, the infrastructure manufacturer (vendors), the VAS providers, the content developers, the bilateral and multilateral donor agencies, the civil society organizations, the consumers etc. | (Document RGQ10-3/2/4) |
| 4 | Burundi | The project is funded by Craig & Suzan McCAW Foundation and consists of:<br>- Deployment of a broadband infrastructure to areas identified in Burundi, by agreement with the ITU<br>- The development of ICT applications<br>- Training of local experts to operate the installed network<br>- The development of a national plan to deploy a broadband ICT network providing free or inexpensive services for underserved populations in rural and remote areas. | Craig & Suzan McCAW Foundation (RGQ10-3/2/5) |
| 5 | Uganda | Report and analysis are made on Uganda's experiences with regard to its universal access policy and objectives. | Government (Document RGQ10-3/2/6) |
| 6 | Chad | The government of Chad started the construction of 640km fiber optic network from 2010 to improve the communication situation which has been based on the unstable VSAT with low capacity. The government committed to implement the fiber optic project to improve the communications for all the Chadian population. | Government (Document RGQ10-3/2/7) |
| 7 | Rwanda | Report is made for the current status of project in Rwanda which provides broadband communications. It mainly focuses on the fiber optic deployment and lightly on other broadband technologies. National Backbone Fiber Optic Coverage (FOC) is now 4732 km. This backbone network is in its completion phase and will be available in each of the 30 districts of Rwanda | Government (Document 2/101) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 8 | China (People's Republic of) | The Chinese government will establish subsidy mechanism for the "broadband to the countryside" program, and enhance the percentage of administrative villages with broadband from the current 80% to 95% at the end of the twelfth 5-year plan period (2015). EPON(Ethernet Passive Optical Network ) has begun to be deployed in rural China. Descriptions are made for the main characteristics of EPON and its typical application in building rural broadband networks in China. Additionally, the study compares the project costs of FTTH and FTTV which are the two main ways to deploy EPON in rural China. | Government (Document 2/102) |
| 9 | Malawi | Study was made about the constraints facing Malawi's rural telecommunication growth and the regulatory challenges to universal access in the country. Malawi is very well positioned with respect to the national backbone networks whereby there is availability of two separate optical fibre network links provided by MTL and ESCOM. However, the main challenge is last mile connectivity where telecom operators find it easy to offer last mile solution to the cities and towns close to the main backbone, leaving the rural and remote areas disadvantaged. | Government (Document RGQ10-3/2/16) |
| 10 | Philippines (Japan) | To establish ICT Access Points for proper information provision to the public (especially health and medical information) by expanding the existing e-Government Network: (1)Deployment of the ICT facilities available for the remote consultation between Central Hospital (Mitttaphab Hospital) and Provincial Hospital; (2) e-Education for doctors, nurses, and other medical staff. | APT (Document RGQ10-3/2/25) |
| 11 | Madagascar | Presentation was made for some ideas concerning ICTs, economic and technological solutions for rural communities, the regulatory environment required and, globally, the manner in which ICTs can help to improve quality of life in rural and remote areas. | Government (Document 2/162 & Document RGQ10-3/2/INF/5) |
| 12 | Madagascar | The GSM mobile operator Airtel Madagascar, with technical assistance from Movirtu Ltd, is widening access to communication services in rural areas of Madagascar, using a technology (called Cloud Phone) that allows users to lend their portable phones to others while keeping their phone numbers and accounts. The partnership between Airtel and Movirtu takes advantage of the mobile operator's network to extend coverage to more customers in rural areas while providing local micro-entrepreneurs with a supplementary source of revenue. | Airtel Madagascar, Movirtu Ltd (Document 2/167) |
| 13 | Togo | Togo has implemented several ICT development programs responding to the Millennium Development Goals which aims to improve connectivity and access to ICT for all by 2015. Experiences are presented about Togo's Universal Service. Since 2008, the definition of a new strategy of universal service has covered several localities in rural areas in order to make available basic telecommunications services to the people of these communities. | (Document 2/188) |
| 14 | Japan | To respond to the increasing demand for ICT application for agriculture in Japan and in other countries. Sensor network trials was conducted for collecting field data such as temperature and humidity from the vineyards and sweet-corn fields, and analyzed harvesting time or used for controlling air ventilation. | Fujitsu Limited (Document 2/190) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 15 | Tanzania | Having completed the implementation of national fiber optic backbone that connect all regions, during year 2011 and 2012, the Minister of Communications, Science and Technologies of Tanzania convened several meetings with stakeholders to deliberate e-health issues. The Government also formed a National Committee to oversee the implementation of e-health services which will start to ensure five hospitals are connected before the end of 2012.Two major pilot projects have been planned in this connection. | Government (Document 2/228) |
| 16 | Rwanda | To promote social inclusion of people/consumers with special needs in Rwanda, study was presented on some policy and regulatory remedies in order to improve access to services by those people and gives also current status of projects which gives access to telecommunication/ICT services for persons with disabilities and with special needs. | (Document RGQ10-3/2/28) |
| 17 | Japan | To make any kind of high speed applications available to people in Japan, an WiMAX service started in Japan. Any kind of (data) applications including VoIP (voice) are supported by the mobile WiMAX service. It is provided as commercial service. WiMAX by UQ provides real wireless mobile broadband services all over the country of Japan. | KDDI, Intel Capital Corporation, East Japan Railway Company, KYOCERA Corporation (Document RGQ10-3/2/35) |
| 18 | Marshall Islands | To promote actions that will lead to economic growth and help reduce the poor quality of life in Mejit by researching on multimedia services over the broadband IP platform that can be deployed such as local e-commerce, money remittance services, credit card transaction services, e-governance, mobile phone services, and internet services available to the remote island of Mejit. To educate the Mejit inhabitants that there is a more efficient way of communicating, for the purpose of business or personal, other than the HF radio and that is broadband solutions in order to attract tourists as well as social welfare of island dwellers, thus promoting tourism, associated investment, empowering the local economy and enriching the life of inhabitants. To research on what broadband technology will be applicable to Mejit that will be sustainable and tap into prospected sponsors to kick-start the phase two of the project, which is deployment. To encourage the inhabitants that they can utilize technology to preserve the culture of leaf-weaving and rope making and to enrich the next generation population on the isolated island through higher quality basic education of urban standard. To study the technology options, applicable services, maintenance and operation, sustainability, economic viability, possibility of public private partnership for the plan of Mejit Network Project for implementation and its replication to other atolls. | Government, APT (Document RGQ10-3/2/36 & Document 2/INF/25) |
| 19 | Luxembourg (Netherlands) | In the event of a natural disaster or humanitarian emergency, there is an immediate challenge to coordinate the relief effort, at a time when connectivity is often interrupted or damaged or where responses are needed across wide spread physical areas and often challenging operating environments. emergency.lu was formed as a public-private partnership to fill the need for a rapid response communication and coordination system with global capacity. The public-private partnership provides multi-layer support for the first hours and days following a large-scale disaster, and integrates into existing communications infrastructures used in humanitarian operations. | SES TechCom, Hitec, Luxembourg Air Rescue, Ministry of Foreign Affairs of Luxembourg (Document RGQ10-3/2/38) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 20 | South Africa (United States) | The goal of the project is to improve access to the latest health information at the point of care, so nurses and doctors can better diagnose and treat patients among the Eastern Cape Province populace. The Mobile Health Information System (MHIS) taps into the power of mobile technology to overcome barriers to Internet access and information poverty. Designed to support the delivery of comprehensive patient care, the mobile library includes digitized medical guidelines, protocols, diagnostic tools and drug formularies to improve patient care. The MHIS was designed to improve the ability of health care workers in urban and rural settings to care for their patients by providing them with locally relevant, reliable and accurate clinical information accessible using a commercially available mobile device. Each device provides access to a pre-loaded library of clinical and educational resources developed by FHI 360 as well as dynamic Internet content accessed through wireless broadband connectivity provided by MTN-South Africa. | Qualcomm Wireless Reach, Eastern Cape Department of Health, FHI 360, MTN South Africa, Nelson Mandela Metropolitan University, South Africa Partners (Document RGQ10-3/2/44) |
| 21 | Indonesia (United States) | Implementing partner Grameen Foundation, through its Application Laboratory (AppLab) initiative, is working to establish a multi-tier suite of data services that can be accessed via two distribution channels: (1) via Ruma Entrepreneurs, a human network of mostly women who own and operate mobile microfranchise businesses, and (2) through commercially available phones and the mass market. The core concept of the program is simple, effective and sustainable: a local small-business entrepreneur uses a microfinance loan to purchase a pre-packaged kit that includes a mobile phone and then re-sells the “airtime minutes” to neighbors. The mobile phone then serves as a platform for providing additional applications and services to further increase their revenues and profits. New applications and services are also being launched through a mass-market channel, which directly supports the poorest entrepreneurs. | Grameen Foundation, Qualcomm Incorporated, Ruma (Document RGQ10-3/2/45) |
| 22 | China (People’s Republic of) | Rural China has a particular type of broadband user distribution. This distribution is dense at micro level while scattered from the macro perspective, and the wired network resource in remote villages is extreme inadequate. In contrast to the fixed broadband access network, WLAN with limited mobility, high bandwidth and low building cost, can be flexibly deployed and utilized, which means WLAN tends to better satisfy the broadband data access demand in rural areas. Comparison is made for 3 types of WLAN solutions in Rural China and their transportation technologies for rural WLANs. | Government (Document 2/322) |
| 23 | Brazil (United States) | Originally launched in 2010, the purpose of Fishing with 3G Nets is to promote the economic and social development of Santa Cruz Cabrália, in southern Bahia, through the digital and social inclusion of fishermen and mariculturists (oyster cultivators who are mostly women). The goal is to use 3G connected smart phones and tablets with a customized application to support mobile education and the development of new economic activities for fishermen, mariculturists) and youth. The current phase will demonstrate how communities can scale the power of 24/7 mobile connectivity to transform learning and create new business opportunities. | Qualcomm Wireless Reach, Telefonica Vivo Foundation, he United States Agency for International Development, Editacuja Publishing, the Institute Ambiental Brasil Sustentavel (IABS) (Document 2/339) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 24 | China (Unites States) | Sesame Workshop, Qualcomm Wireless Reach, China Telecom Corporation Limited, Guizhou Branch, and China Youth Development Foundation are collaborating to design, implement and scale compelling 3G-enabled interactive content that helps children and their families learn in engaging ways how to better-prepare for possible emergency situations. The goal is to improve safety awareness in rural areas of China, particularly in those that are underdeveloped. In March 2013, a four-week pilot study was implemented in Guizhou Province to evaluate the project's effectiveness. During the pilot phase, 31 families with children ages 3-6 each received a 3G Snapdragon? enabled smartphone pre-loaded with the mobile tools, wireless connectivity, a data plan and an approximately hour long, individual orientation to the technology. An HTML 5 website optimized for mobile platforms and accessible to all 3G-enabled smartphones was developed to provide interactive games and activities. After the conclusion of the pilot, in June 2013, the mobile website and the Android application were made available nationally throughout China. | Qualcomm Wireless Reach, Sesame Workshop, China Telecom Corporation Limited, China Youth Development Foundation (Document 2/340) |
| 25 | Korea | There were several major objectives for the INV project. First, it aimed at building broadband internet infrastructure in agricultural/fishing villages, remote areas and other sites alienated from the information revolution in order to address an information gap between urban and rural areas. It was also hoped to cement the foundation for E-government and electronic democracy. Second, the project aimed to create information content including online marketplace for local products to generate practical benefits and rejuvenate local economies for balanced national development. Third, it was designed to enable local residents to have easier access to information on education, medicine, culture and agricultural skills via the internet in daily life. Before the INV project was launched, cases for electronic villages in Europe and the U.S. (Tele-cottage, Tele-village) were analyzed. The finding was that given the Korean situation, it was imperative for the central government to provide administrative, financial, and technical support. | Government (Document 2/INF/3) |
| 26 | Turkey | To construct a reliable and measurable broadband network infrastructure over different geographical areas , with an aim to eliminate the digital divide by lowering the infrastructure discrepancies between rural and urban areas and providing valuable services to the rural areas with the same quality and cost advantages. In building the new infrastructure, existing 10,270 rural exchanges embracing 4 million lines were removed and substituted by the Multi-Service Access Nodes (MSAN). Secondly, number of toll, tandem and local switches was reduced from 11,000 to 1000, which are located between the gateways and MSANs. Finally, these toll/tandem/local switches were connected to 12 gateways at the upper end so that they gave the opportunity to manage the system as a whole. | Government (Document 2/INF/4) |
| 27 | Korea | To induce the old group to join the internet population and thereby bridging digital divide between generations. The Korean government task force group studied the profile and requirement of the lagging group and found killer application for them, along with learning opportunities on PC operation. The private sector developed service applications needed for the project. | Government (Document 2/INF/7) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 28 | Cameroun | The reform of the telecommunications sector and ICT in Cameroon launched since 1995. Liberalization in the telecommunications and ICT brought added value to the national economy. To respond further to the changing environment, the Government of the Republic of Cameroon undertook the redesign of the legal and regulatory framework: in 2010, Law No. 2010/013 for electronic communications in Cameroon and Law No. 2010/012 on cybercrime and cybersecurity. These two laws are aimed firstly to adapt the sector legal framework for the development of technologies and services, to transpose EU directives CEMAC in our legislation and also to secure communications networks and information systems. | Government (Document 2/INF/21) |
| 29 | Korea | To provide broadband services in the "far" remote areas in Korea. Rural broadband has been completed in Korea through the cooperation of private telecoms operator (KT, former state-owned operator) and the Government (central and local) by 2008 and currently Next Generation Network is under construction in the rural areas. However, broadband construction in the far remote areas such as the village of less than 50 households could be a financial burden for KT and therefore, the Korean Government has decided to provide financial subsidies for the construction of broadband networks for deep remote areas. The financial subsidy has amounted to 50% of the total construction cost and it was shared by central and local Government by half and half. This policy has enabled households in far rural areas to subscribe broadband internet at the same price with same quality as urban households. | Government (Document 2/INF/26) |
| 30 | Bangladesh | Presentation was made on Bangladesh's status with respect to access to technology for broadband telecommunications including IMT. It also covers relevant information regarding telecommunication and ICTs for rural and remote areas of Bangladesh, such as tariff structure, national backbone infrastructure, Social Obligation Fund, and the National Frequency Allocation Plan. | Government (Document 2/INF/36) |
| 31 | Pakistan | To complete the successful roll out of telecommunications/ICT services in rural and remote areas of Pakistan, the Universal Service Policy framework and corporate structure (Public - Private Partnership) have been employed. The projects contain Rural Telecom Services, Optical Fiber to Every Tehsil, Broadband for Un-served Urban Areas and Community Tele-centers | Government (Document 2/INF/38) |
| 32 | Uganda | To develop Internet services in rural and remote areas, Uganda's Universal Access Policy (2010) is developed within the premise of the global development agenda, the Millennium Development Goals (MDGs). This policy is also developed building on the previous universal access policy (2001) and within the framework of Uganda's ICT and telecommunications policy. Therefore the new policy objective is expected improve broadband uptake in selected underserved areas as a pilot case. | Government (Document 2/INF/41) |
| 33 | Japan | Presentation was made about the situation of Fixed and Mobile Broadband services, especially LTE services delivered by NTT DoCoMo thought out Japan. | NTT DoCoMo (Document 2/INF/55) |
| 34 | Turkey | Presentation provides an overview of the correlation between fiber, broadband penetration and incomes and how fiber can accelerate the growth of the broadband incomes. | Türk Telekom Group (Document 2/INF/76) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 35 | Italy | To disseminate knowledge, focusing on training of young scientists that could diffuse the acquired knowledge further in their native regions, CTP has been playing a leading role in the field of training in ICT for developing countries. In the last fifteen years, more than 40 training activities on wireless networking have been organized both in house as in-situ. Several projects have been developed starting from training activities, and the knowledge acquired has been widely disseminated | The Abdus Salam International Centre for Theoretical Physics (Document RGQ10-3/2/INF/4) |
| 36 | Lao (Japan) | To improve health and medical environment in Lao, web video conference system for e-health between Central hospital and Provincial hospital was constructed. It aims to realize more smooth communication between the doctors in isolated areas . In Lao P.D.R., major medical resources, such as special doctors and medical equipment, are located in Vientiane. Transportation of doctors and patients between Vientiane and provincial areas are difficult due to the road conditions in the land locked area. | Laos Government, JTEC, Fujitsu Limited (Document 2/INF/82) |
| 37 | Bhutan | To provide internet broadband connections in rural areas of Bhutan, pilot projects started using WiMAX or fiber optic cables. Pilot project clients in all fours geogs (villages) prior to the pilot project were using 3G data card or subscribed to mobile internet to access Internet. People in these geogs had to travel more than half a day to access Internet. Given the lack of IT literacy and technical know-how in the geogs, The connectivity up to the customer premises is managed by Tashi InfoComm Limited (TICL). To ensure project sustainability, TICL will manage the business aspect of project without any intervention from department. Broadband through WiMAX provided easier and faster deployment in the geogs, than fiber optic cable | Department of Information Technology and Telecom (DITT), Ministry of Information and Communications, KDDI Foundation, Tashi InfoComm Limited (Document 2/INF/83) |
| 38 | India | To overcome the lack of ICT skills in rural and remote areas, a product from CDoT1 is developed, which was exclusively developed to take care of limitation of ICT skill sets in rural people in India. The product is significant, as it deals with one of the fundamental issues i.e. lack of ICT skill sets and literacy rampant for large masses to benefit from the broadband services to exploit the opportunities for their socio economic development. | Government (Centre for Development of Telematics, C-DOT) (Document 2/INF/84) |
| 39 | Africa (India) | To provide e-education environment to developing countries, TCIL has implemented and is operating Tele-education and Tele-medicine network projects of pan African e-Network Project. In the projects, 5 reputed Indian universities and 12 Indian super specialty hospitals are connected to 48 of the 54 member countries of African union for providing Tele-education and Tele-medicine. TCIL is implementing agency on turnkey basis covering design, development, supply, installation, commissioning and operations of the network. | Government(Telecom Consultants of India Limited) (Document 2/INF/85) |

| No | Country (reporting Member) | Objectives | Financing and partnership (link to reference documents) |
|---|---|---|---|
| 40 | India | To extend e-literacy and e-governance with an aim to improve livelihood, a number of pilot projects for remote North Eastern villages in India were introduced by different stake holders from time to time. But the sustainability issue is still in its teens. Keeping in mind the number of hindrances in North East India, like accessibility problems for remote areas, partial availability of basic infrastructure (transport, power, communication) and others, there is a basic need that development policies are to be made community need based to make them sustainable. So the participation of local community in planning and implementation phase of ICT projects becomes mandatory. two successful e-initiative of ICT projects were analyzed: Model e-village project in Arunachal Pradesh; e- health project in Tripura Vision Centre. | Government (Document 2/INF/86) |
| 41 | Japan | To protect citizens in City of Shojiri from natural disasters, the sensing and alerting system in combination of ICT was developed using a special frequency band in Japan, whose small transmitting power does not require licensing. | City of Shiojiri, Japan (Document 2/INF/88 & Document RGQ10-3/2/48) |
| 42 | Côte d'Ivoire | Presentation was made on the evolution of regulatory reform and institutional framework of telecommunications / ICT in Côte d'Ivoire. | (Document 2/INF/92) |
| 43 | Burkina Faso (Netherlands ) | To facilitate e-government activities in elections, SES Broadband Services provided satellite broadband services for the parliamentary and municipal elections in Burkina Faso. As part of the agreement with the Independent National Elections Committee (CENI) in Burkina Faso, SES Broadband Services and its partners Newtec, Access Sat and Unicom provided satellite equipment and bandwidth to enable connectivity between the 45 electoral district offices, which serve as the hubs for 14,698 polling stations across the country, and the central election office in the capital, Ouagadougou. The system was used for video conferencing, video surveillance, Internet access, and fast and secure communication of ballots. | Government, SES World Skies (Document 2/INF/93) |

## Appendix B List of Broadband speeds definitions

| Country /Name of Plan | Year policy adopted | Download Speed (coverage % of household) | Upload Speed (coverage % of household), otherwise remarks | Target Year | Download Speed (penetration % of household) | Target Year |
|---|---|---|---|---|---|---|
| **Australia** | 2014 | 25Mbps(100%) | | ASAP | | |
| NBN Plan | | | | | | |
| **Austria** | 2012 | 25Mbps(100%) | | 2013 | | |
| Broadband Strategy 2020 | | 100Mbps(70%) | | 2018 | | |
| | | 100Mbps(99%) | | 2020 | | |
| **Brazil** | 2010 | 1Mbps (70%) | | 2014 | | |
| National Broadband Plan | | | | | | |
| **Brunei Darussalam** | 2014 | 2Mbps(95%) | | 2015 | | |
| National Broadband Policy | | 20Mbps(75%) | | 2017 | | |
| **Bulgaria** | 2009 | 1Mbps(100%) | | 2013 | | |
| National Strategy | | 10Mbps(90%) | households in average cities | 2013 | | |
| **Canada** | 2014 | 5Mbps | additional 280 thousands households | 2019 | | |
| Economic Action Plan 2014 | | | | | | |
| **Chile** | 2013 | | | | 2Mbps(80%) | 2020 |
| Agenda Digital Imagina Chile 2013-2020 | | | | | | |
| **China** | 2013 | 4Mbps(x%) | | 2015 | | |
| National Broadband Strategy | | 12Mbps(x%) | | 2022 | | |
| **Cost Rica** | 2012 | 2Mbps(15%) | symmetric | 2014 | | |
| National Broadband Strategy | | 2Mbps(21%) | | 2017 | | |
| **Croatia** | 2011 | 2Mbps(90%) | | 2013 | | |
| Strategy for | | 30Mbps(50%) | | 2015 | | |

| Country /Name of Plan | Year policy adopted | Download Speed (coverage % of household) | Upload Speed (coverage % of household), otherwise remarks | Target Year | Download Speed (penetration % of household) | Target Year |
|---|---|---|---|---|---|---|
| Broadband Development | | | | | | |
| **Cyprus** | 2012 | 2Mbps(100%) | | 2013 | | |
| Digital Strategy for Cyprus | | 30Mbps(100%) | | 2020 | | |
| | | 100Mbps(50%) | | 2020 | | |
| **Czech Republic** | 2013 | 2Mbps(100%) | | 2013 | | |
| Digital Czech republic v.2.0 | | 30Mbps(100%) | | 2020 | | |
| | | 100Mbps(50%) | | 2020 | | |
| **Denmark** | 2013 | 100Mbps(100%) | 30Mbps(100%) | 2020 | | |
| **Ecuador** | 2011 | 2Mbps (75%) | | 2017 | | |
| Estrategia Ecuador Digital 2.0 | | | | | | |
| **Egypt** | 2011 | 2Mbps(75%) | | 2015 | | |
| National Broadband Plan | | 25Mbps(90%) | | 2021 | | |
| **EU** | 2010 | basic 0.5-2Mbps(100%) | | 2013 | | |
| Digital Agenda for Europe | | 30Mbps(100%) | | 2020 | | |
| | | 100Mbps(50%) | | 2020 | | |
| Finland | 2008 | 1Mbps(100%) | | 2010 | | |
| Kainuu Information Society Strategy 2007-2015 | | 100Mbps(99%) | | 2015 | | |
| **France** | 2011 | 2-5Mbps(100%) | | 2017 | | |
| Plan France tres haut debit | | 100Mbps(100%) | | 2022 | | |
| **Germany** | 2009 | 1Mbps(100%) | | 2010 | | |
| Broadband Strategy | | 50Mbps(75%) | | 2014 | | |
| **Greece** | 2006 | 2Mbps(100%) | | 2013 | | |
| Digital Strategy | | | | | | |
| **Iceland** | 2012 | 30Mbps(90%) | | 2014 | | |

| Country /Name of Plan | Year policy adopted | Download Speed (coverage % of household) | Upload Speed (coverage % of household), otherwise remarks | Target Year | Download Speed (penetration % of household) | Target Year |
|---|---|---|---|---|---|---|
| Electric Communications Plan 2011-2022 | | 30Mbps(100%) | | 2022 | | |
| | | 100Mbps(70%) | | 2014 | | |
| | | 100Mbps(90%) | | 2022 | | |
| **India** | 2012 | 2Mbps(100%) | | 2015 | | |
| National Telecom Policy | | | | | 2Mbps(60%) | 2020 |
| **Indonesia** | 2011 | | | | 20Mbps(8%) | 2014 |
| Masterplan for Acceleration and Expansion of Indonesia's Economic Development | | | | | | |
| **Ireland** | 2012 | 70-100Mbps(50%) | | 2015 | | |
| National Broadband Plan | | 30Mbps(100%) | | 2015 | | |
| **Japan** | 2010 | 100Mbps(100%) | | 2015 | | |
| New Growth Strategy | | | | | | |
| **Korea (Republic of )** | 2009 | 100M-1Gbps(100 %) | | 2015 | | |
| Ultra Broadband Convergence Network | | | | | | |
| **Lithuania** | 2011 | 30Mbps(100%) | | 2020 | | |
| Lithuanian Information Society Development Programme | | | | | | |
| **Malaysia** | 2007 | 1-2Mbps(50%) | | 2010 | | |
| National Broadband Initiative | | | | | | |
| Mauritius | 2012 | 10Mbps(60%) | 5Mbps(60%) | 2014 | | |

| **Country /Name of Plan** | **Year policy adopted** | **Download Speed (coverage % of household)** | **Upload Speed (coverage % of household), otherwise remarks** | **Target Year** | **Download Speed (penetration % of household)** | **Target Year** |
|---|---|---|---|---|---|---|
| National Broadband Plan | | 100Mbps(100%) | | 2020 | | |
| Netherlands | 2010 | 100Mbps(50%) | | 2020 | | |
| DigitalAgenda.nl | | 100Mbps(95%) | 実績 | 2013 | | |
| New Zealand | 2010 | 100Mbps(75%) | | 2020 | | |
| Ultra-fast Broadband initiative | | | | | | |
| **Norway** | 2012 | 2Mbps(100%) | | 2012 | current | |
| Digital Strategy for Norway 2012 | | 25Mbps(80%) | | 2012 | current | |
| **Paraguay** | 2011 | 512kbps(50%) | | 2015 | | |
| National Telecommunications Plan | | | | | | |
| **Peru** | 2010 | 512kbps(12.7%) | | 2016 | | |
| National Plan for Broadband Development | | | | | | |
| **Philippines** | 2011 | 2Mbps(80%) | | 2016 | average speed | |
| Philippine Digital Strategy | | | | | | |
| **Poland** | 2012 | 30Mbps(100%) | | 2020 | | |
| Regulatory Strategy until 2015 | | 100Mbps(50%) | | 2020 | | |
| **Puerto Rico** | 2012 | 4Mbps(98%) | 1Mbps(98%) | 2015 | | |
| Broadband Strategic Plan | | 100Mbps(85%) | 50Mbps(85%) | 2020 | | |
| **Qatar** | 2013 | 100Mbps(95%) | 50Mbps(95%) | 2016 | | |
| National Broadband Plan | | | | | | |
| **Romania** | 2009 | basic 0.5-2Mbps(80%) | | 2015 | | |

| Country /Name of Plan | Year policy adopted | Download Speed (coverage % of household) | Upload Speed (coverage % of household), otherwise remarks | Target Year | Download Speed (penetration % of household) | Target Year |
|---|---|---|---|---|---|---|
| Broadband Strategy | | 30Mbps(100%) | | 2020 | | |
| | | 100Mbps(50%) | | 2020 | | |
| **Saudi Arabia** | 2006 | 512kbps(100%) | | 2013 | | |
| Universal Access and Universal Service Policy | | | | | | |
| **Singapore** | 2005 | 100Mbps(100%) | | 2012 | | |
| Intelligent Nation 2015（iN2015） | | | | | | |
| **Slovakia** | 2014 | 30Mbps(100%) | | 2020 | | |
| Strategic Document (2014 - 2020) | | | | | | |
| **Slovenia** | 2008 | basic 0.5-2Mbps(100%) | | 2010 | | |
| Broadband Network Development Strategy | | 20Mbps(90%) | | 2015 | | |
| | | 100Mbps(90%) | | 2020 | | |
| **Spain** | 2013 | basic 0.5-2Mbps(100%) | | 2013 | | |
| Digital Agenda for Spain | | 30Mbps(100%) | | 2020 | | |
| | | 100Mbps(50%) | | 2020 | | |
| **South Africa** | 2013 | 5Mbps(50%) | | 2016 | | |
| South Africa Connect | | 5Mbps(90%) | | 2020 | | |
| | | 100Mbps(100%) | | 2030 | | |
| **Sweden** | 2009 | 1Mbps(98.5%) | | 2012 | | |
| Broadband Strategy for Sweden | | 100Mbps(90%) | | 2020 | | |
| **Thailand** | 2010 | 2Mbps(80%) | | 2015 | | |
| National Broadband Policy | | 2Mbps(95%) | | 2020 | | |
| **United Kingdom** | 2010 | 2Mbps(100%) | | 2015 | | |
| Superfast Broadband | | | | | | |

| **Country /Name of Plan** | **Year policy adopted** | **Download Speed (coverage % of household)** | **Upload Speed (coverage % of household), otherwise remarks** | **Target Year** | **Download Speed (penetration % of household)** | **Target Year** |
|---|---|---|---|---|---|---|
| Future | | | | | | |
| **United States** | 2010 | 4Mbps(100%) | | 2012 | | |
| National Broadband Plan | | 50Mbps(85%) | 20Mbps | 2015 | | |
| | | 100Mbps(85%) | 50Mbps | 2020 | | |
| **Uruguay** | 2011 | 256kbps-2Mbps(60%) | | 2012 | | |
| Agenda Digital Uruguay 2011-2015 | | 256kbps-2Mbps(80%) | | 2015 | | |

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