International Telecommunication Union

QUESTION 10-1/2

Communications for rural and remote areas

ITU-D STUDY GROUP 2 3rd STUDY PERIOD (2002-2006)

Analysis of case studies on successful practices in telecommunications for rural and remote areas

International Telecommunication Union

THE STUDY GROUPS OF ITU-D

The ITU-D Study Groups were set up in accordance with Resolutions 2 of the World Telecommunication Development Conference (WTDC) held in Buenos Aires, Argentina, in 1994. For the period 2002-2006, Study Group 1 is entrusted with the study of seven Questions in the field of telecommunication development strategies and policies. Study Group 2 is entrusted with the study of eleven Questions in the field of development and management of telecommunication services and networks. For this period, in order to respond as quickly as possible to the concerns of developing countries, instead of being approved during the WTDC, the output of each Question is published as and when it is ready.

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Analysis of case studies on successful practices in telecommunications for rural and remote areas

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1 Foreword by the Director of BDT

It is my great pleasure to know that the report of the analysis of case studies on "Communications for Rural and Remote Areas" by the Rapporteur's Group on Question 10-1/2, ITU-D Study Group 2, has been completed. It is now available and will be of interest to many, including planning executives of administrations of developing countries, experts and practitioners conducting projects in rural and remote areas. It is the result of the joint efforts of the experts of the ITU-D Study Group 2 and the BDT Secretariat who are involved in current projects in developing countries, as well as developed countries. I am also very delighted to know that this Report was made available at a timely juncture, the 20th anniversary of the "Missing Link" report by the Maitland Commission published in 1985. The Missing Link report pointed out for the first time in the world the "Communications Gap" between "have and have-nots" and its remedy for bridging the gap, which is now commonly referred to as the "digital divide" in the era of digital technologies.

Since the Maitland Report, several initiatives have taken place. More recently, the ITU-D Study Group 2 Focus Group on topic No. 7 of the Valletta Action Plan worked towards issuing the "New Technologies for Rural Applications" in 2001. The Rapporteur's Group on Question 10-1/2 on "Communications for Rural and Remote Areas" followed up the studies on the subject of solutions for rural communications development. The Group issued last year the report on the "Analysis of the Global Survey on Rural Communications" based on the responses from 57 countries and territories to the questionnaires jointly designed by the experts of BDT's Secretariat and the Rapporteur's Group. This "Analysis of case studies on successful practices in telecommunications for rural and remote areas" is the third report from the Rapporteur's Group on the subject of rural communications development. I would like to take this opportunity to congratulate the continued efforts of all experts involved in this work for their excellent outputs. Bridging of digital divide is one of the key issues of the WSIS and the WTDC-06 to be tackled in the coming years.

I am confident that the successful practices outlined in this report will serve as useful guidelines for developing countries facing the challenge of rural communications development, as was the case of the two previous reports from ITU-D Study Group 2.

Hamadoun I. Touré
Director of BDT

2 Introduction

According to its work plan for the 2002-2005 period, the Rapporteur's Group on Question 10-1/2 conducted the global survey on rural communications from the end of 2002 to mid-2003 by sending out the questionnaires to the Member States and Sector Members of ITU-D. After the analysis of responses to the questionnaires, the analysis report of the results of the global survey was first submitted to the second meeting of Study Group 2 (September, 2003) and then to its third meeting (September, 2004) for approval by SG2 (ref: Docs. 2/111 and 2/117, 2002-2005). Based on the analysis of the global survey on the rural communications, and to respond to some concerns expressed by the respondents for the remedy of rural communications developments, the Rapporteur's Group 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. The invitation letter with the case study submission format as agreed by the Rapporteur's Group in March 2004 (ref: Doc. RGQ10-1/2/012 Rev2, 1 April 2004) was sent out to the selected 15 candidate countries (three from each region). By the beginning of 2005, 15 case studies plus some additions from interested countries and members were collected as listed in section 3 of this report. All the collected case studies were uploaded to the ITU-D website. The volunteers of Rapporteur's Group for the analysis of case studies worked on the report according to the work distribution as agreed by the Rapporteur's Group meeting in September 2004 (ref: Doc. 2/Rep/023 Rev1, 16 September 2004). The rapporteur and four vice rapporteurs collaborated to submit this report for consideration by the meeting of the group in June 2005, Tokyo, and then to the SG2 meeting in September 2005, Geneva.

3 List of the countries that submitted their case studies

By the end of April, the following 19 case studies submitted on the requested format were collected and can be found on the case library page of the ITU-D SG2 website:

www.itu.int/ITU-D/fg7/case_library/index.html

Table 3-1 – List of case studies

Country	Title	Organizations involved	Project status
Brazil	Public Electronic Service	Ministry of Communications Ministry of Defence Ministry of Education Ministry of Agriculture	operational
Bulgaria	Septemvri Telecentre Project	Ministries of Transport & Communication, ICT Dev. Agency, Association of Telecentres, Telco Operator, Local Community, Medical Centres, ITU/BDT, etc.	operational
Burkina Faso	Tenkodogo and Koudougou Rural telephony Project	Onatel, European Investment Bank	operational
Cambodia	Cracking the Digital Divide (Store-and-forward internet service for rural villages)	American Assistance of Cambodia/ Japan Relief for Cambodia, First Mile Solutions	operational

Country	Title	Organizations involved	Project status
Colombia	Colombian Social Telecommunications Programme	Ministry of Communications, Comm. Fund, FONADE, COMPARTEL, S.A.E.S.P.	operational
Egypt	Evolution of the Telephony Service for Egyptian Rural Areas and Villages	Telecom Egypt	N/A
Estonia	Look@World Internet training project for 100 000 people	Look@World Foundation's PPP Project	completed
Ethiopia	Telemedicine Pilot Project in Ethiopia	ETA, NTCC, ETC, MOH, AAUFOM	planned
India 1	ITC eChoupal: A Profitable Rural Transportation through Web-based Meta-market for Indian Farmers	ITC Ltd., Gov. Agencies, Civil Society, Private Sector	operational
India 2	n-Logue-Building a Sustainable Rural Services Organizations	TeNet, IIT Univ. and Chennai n-Logue Comm Ltd.	operational
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
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
Lesotho	Telecommunications in Lesotho	Lesotho Telecom Co.	operational
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
Nepal	Nepal Telecom VSAT Project concerning Village Development Committees (VDCs)	Nepal Telecom, STM Networks	operational
Peru	Infodes – Information and Communication System for Rural Development	OSIPTEL, FITEL, InfoDev, Intermediate Tech. Dev. Group	operational
Syria	3rd Rural Project	EC, EIB, National organizations, Syrian Telco Establishment	operational
Venezuela	First Telecommunications Universal Services Obligation in Venezuela	CONATEL, Operator, Ministries of Panning, Infrastructure, Industry & Commerce, Local Community	planned
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

4 General review and summary of case studies

A variety of case studies was collected as summarized below. They are national projects, private initiative projects and joint projects, which are all aiming at solving the digital divide. Most of all projects are funded by the national universal fund, international funds or international aid agencies for the start up. However, operation, maintenance and sustainability of the projects are key issues to be taken into consideration for provision of rural communications services in all cases. Applications such as e-healthcare, e-education, e-administration, e-commerce and other e-services are provided or planned over the Internet protocol platform for rural areas in addition to voice services. Challenge by the Indonesian R&D institute to provide voice information services including education, healthcare and commerce was to develop the so-called voice Internet platform for rural dwellers without personal computers.

(Brazil)

Brazil has three programmes related to universal service access. The first is the universal service provided by the Fixed Telephone Service Connection – STFC. This type of universal service is the exclusive responsibility of the four incumbent operators of the STFC, which made it possible to install at least one public telephone in all localities with more than 100 inhabitants. Nearly 30 000 localities have already been taken care of in this programme. Users pay the total cost of its use. It is managed by Anatel. The second programme, called Digital Communications Service, is being developed through the partial use of resources from the Globalization Fund by means of a telecommunication service created by Anatel, the telecommunications regulating agency in Brazil. Though still in the implementation stage, it will have to primarily take care of state schools and health and community centres in rural areas. The users pay for part of its use. Joint management is provided by Anatel and the Ministry of Communications. The third programme is the GSAC and is intended to take care of communities in rural areas. All implementation, operation and maintenance resources are subsidized by government budgetary resources. It is totally free of charge to the user and managed by the Ministry of Communications.

(Bulgaria)

The strategic objective of this pilot project is to develop packet-based wireless access infrastructure in one definite rural area, the one of Septemvri, and to test its application not only for telecommunications and information services but for telemedicine care with a special emphasis on tele-cardiology as well. This project will be the first in the country and later can be replicated at other sites in Bulgaria and other countries with similar conditions.

(Burkina Faso)

The project allowed the setting up of telecommunication infrastructures in the zones of Koudougou and Tenkodogo. This infrastructure supported the accessibility of 160 000 inhabitants in 25 villages and places to a minimum of telecommunications services, which contribute to the improvement of their standard of living through, a growth noticed in the agropastoral, artisanal and small trade activities. This telephone service project appeared as a powerful tool to fight against poverty.

(Cambodia)

More than 260 primary schools were built in Cambodia, of which more than 50 are now linked to satellite communications or can send or receive e-mails via wireless access boxes placed on the back of moving motorcycles. This project has reduced the digital divide by opening up remote, rural villages to e-commerce, telemedicine, participatory democracy, e-mail exchanges among children in-country and overseas, e-learning

and opening the path to poverty reduction and economic development. It can eventually provide employment opportunities in the rural areas, such as data entry, so that rural populations do not have to move to the inner cities and potentially make a better living than those who have moved to inner cities.

(Colombia)

In relation to telephony, community solutions are being offered in 9 745 rural localities having more than 100 inhabitants and no service, benefitting around 5 million people. To offer the access to the internet, 1 440 telecentres were installed in the main cities of the local communities and greater inhabited centres; and the possibility of telephone connection to internet, at local fees, in 40 cities having more than 30 000 inhabitants, covering around 5.2 million of Colombians. The internet programme includes training in the use of the computers, applications, e-mail, and navigation; the generation and access to new contents are promoted. These tools contribute to improve productivity levels since time is used efficiently and there is less time wasted travelling to find telecommunication services.

(Egypt)

The greatest challenges for serving rural areas and villages are to overcome their different topologies. From an economical point of view, the operator has to choose the most suitable communication system for the areas to be served. Efficient deployment of appropriate communication systems according to the topography and topology, enhances the services, provides higher rate, and increases revenues. The systems that may be used in providing telephony services to rural areas and villages are: outdoor optical fibre unit system, wireless system, and point-to-point wireless system. The wired line access method, utilizing copper wire cables, is the conventional system. It is normally used for local networks at a maximum range of 5 km. Ordinary topology, using optical fibre cable as one of the network access method is considered a great privilege. The fibre cable is connected to a remote unit; this remote optical unit provides service to the subscribers through copper wires. This system is used when communities are located apart from each other and far from the host exchange. Another network access is the fixed wireless access (FWA) method. The application of FWA for telephone service is generally called “Wireless Local Loop (WLL)”, which applies radio systems in the distribution zone instead of wire lines. This system is used when low to medium subscriber density areas are located apart from each other, and the deployment of primary or secondary local networks is difficult. The case study which is presented describes the wireless access network based on CDMA technology.

(Estonia)

The project is part of the concept of building the information society in Estonia. Its first aim was to help people to get over the fears related to the use of ICTs and the second aim was to educate people to use ICTs in daily routines. The training network was created for these purposes, which involved training centres, trainers and training programmes. To provide training in rural areas the school classrooms and school teachers were used as part-time teachers for the project. This way, a very good geographical coverage was achieved.

(Ethiopia)

The aims of the pilot project are (1) to reach the underserved by efficiently utilizing the clinical specialist, biomedical scientists and public health professionals who are concentrated in the larger cities using the telemedicine system, (2) to allow the underserved regions to get access to medical and health information over the national telemedicine network from the central medical database and other international medical websites through the internet to grant consensus building and awareness rising, and (3) to help/allow the underserved regions get medical consultancy services from the centre and other sites where medical specialists and consultants are appropriately available or concentrated. The main project applications using telemedicine as an information and communication tool are (1) to assist health professionals get a simple

form of distance medical education over the national telemedicine network from the centre to wherever they are located, (2) to enable the medical/health professionals to use the telemedicine system installed at those sites in the underserved regions, and (3) to enable the Ethiopian Telecommunication Corporation technical staff to get acquainted with the telemedicine system configuration.

(India 1)

ITC eChoupal, enabled by internet technologies, charts a focused corporate agenda to create a global demand-led competitive value chain and to open rural markets as future growth drivers. It enmeshes simultaneously a social agenda to bring global resources, knowledge and practices to villages so as to enable farmers to gain control over higher income opportunities while fostering fair and transparent processes with respect for people and local communities. ITC eChoupal goes beyond basic information provisioning and orchestrates knowledge extension services (farm management, risk management), availability of farm inputs and consumption goods (screened for quality, price, local pick-up), and choice of output channel (market access assurance, convenience, lower transaction costs) at farmers' doorsteps through an interlocking partnerships of specialized agencies. In four years, 4 300 ITC eChoupals created across 6 states (MP, UP, Karnataka, AP, Maharastra, Rajasthan) are reaching out to over 2 500 000 farmers engaged in 8 agricommodities in 25 000 villages, with the farmers' output price realizations up by 20%, while delivering extraordinary shareholder value, as market share is up from 8% to 12% and transaction costs are down to 2% from 8%. With the digital infrastructure and associated human and organization capacities, ITC eChoupal has become rural India's largest internet-based intervention and is surging towards the vision of servicing 100 000 villages by 2010, reaching out to 10 million farming households, enhancing rural quality of life and making rural India a competitive source of and destination for products and services in the global economy.

(India 2)

India has over 700 million people living in over 600 000 villages with an average per capita income of around USD 200 per annum. The key issue that needed to be addressed is whether technology can bring about a difference in the lives of people who can earn less than a dollar a day. Can health and education be made available to them? Can they afford the internet? And ultimately, can it significantly enhance their livelihoods and income. TeNet's group's primary objective is to create a rural services organization which would work towards delivering relevant and cost-effective technologies to the rural areas, which can be used to improve the living standards of Indian villages. TeNet believed that any solution which is confined to either a few hundreds or a few thousands of villages and which could not scale up to meet the needs of most of the 600 000 villages in India, would remain an experiment and would not be instrumental in enhancing the lives of people. With the objective of building a scalable, sustainable model to provide commercial ICT services to rural India, n-Logue's charter is dedicated to providing services only to the rural areas and the organization is barred from servicing the urban population. Through n-Logue, TeNet intends to deliver ICT applications for essential services like education, healthcare and e-governance, through setting up a network of village internet centres called Village Kiosks. The dream, however, is to significantly impact rural livelihood and income.

(India 3)

The project titled "Application of the Telemedicine Technology" to provide health care during "Mela/Festival and Disaster" was sanctioned on 2 January 2001 and was implemented on 6 January 2001 during the *Mahakumbhmela* (big festival) held at Allahabad in the month of January – February 2001. The duration of the project at *Mahakumbhmela* was between 6 January and 26 February 2001. An enterprise based telemedicine network was set up connecting Mela site hospital with Moti Lal Nehru Medical College, Allahabad, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, *Mela* Monitoring Cell, U.P. Secretariat and Public Health Cell, Director General of Health Services, Lucknow. All five nodes were

connected with 128 kbit/s bandwidth ISDN telephone lines, along with medical equipment accessories and videoconferencing system. Tele-consultation were provided by different departments of SGPGI. Daily exchange of events and water report followed by discussion over videoconference were carried out between public health officials at festival site and state HQ at Lucknow. Necessary corrective measures were carried out in water treatment as per advice obtained.

(Indonesia)

This project is part of information and communication technology (ICT) and we develop a new concept of our digital divide. This project has been developed by the DESA MAJU services. It is a system that provides information based on voice and related to economic, education, health, etc., activities on rural communities. With the evolution of Desa Maju, we have introduced VOICE INTERNET, an alternative solution to access the internet and e-mail without utilizing personal computers for rural telecommunication in Indonesia.

(Lesotho)

The government's politic decision to privatize an incumbent operator was rushed by the need to stabilize the operations of the corporation and make it profitable as well as to inject the much needed capital that was critical for the expansion of the services to be provided by the company. The proposed improvements in the delivery of services were secured among others through a capital expansion programme agreed between Telecom Lesotho and the government, as well as the access targets to which the corporation is committed to in its license obligations. The overall commitment considered necessary to achieve the said objectives of government was agreed at the time of privatization and was to be drawn down within a period of five years from the time of the privatization. The state of the roads in rural areas hinders both mobility and accessibility. Due to the lack of transport facilities, the rural populations have to walk long distances to clinics, schools and other social facilities. The wireless local loop was therefore considered to be a better and cheaper solution compared to VSAT.

(Malaysia)

Langkawi is nestled on the Thailand-Malaysian sea border and is the main island in a cluster of 100 islands. With a population of 54 000 inhabitants on a land area of 32 000 hectares, its economy is driven mainly by the tourism industry. Other economic activities include an agro-based economy of rice, rubber as well as fisheries. The ARCADIAN "Fixed Wireless Multiservice Platform" system was installed on Langkawi and two smaller adjacent islands, Pulau Tuba and Pulau Dayang Bunting, and has been operating since May 2004. The system was installed by Cape Range Wireless ("Cape Range"), the manufacturer of the equipment, and local engineering companies, which provided field installation services. The ARCADIAN system uses a proprietary form of direct sequence spread spectrum RF technology and presents both IP-based interfaces and traditionally switched interfaces such as POTs and E1 (although internally they are routed through a built in soft switch). The connectivity to the national network and test for conformance to national PSTN standards was provided by Telkom Malaysia. Frequency licensing and licences to operate the system were provided with the assistance of the Ministry of Energy, Water and Communications, Malaysia, and the Malaysian Communications and Multimedia Commission (MCMC).

(Nepal)

The project covers 1 000 village development committees (VDC) of Nepal in mountainous regions where other modes of telecommunications are not possible. The project will link high mountainous areas to the national telephone network. It will improve the socio-economic status of the people in the remote high mountainous areas of the Kingdom of Nepal. This will uplift the people's socio-economic status by

providing telecom services in the remote mountainous areas of Nepal. The project covers 1 000 VDCs of Nepal, each VDC connected to the network with 2 telephone lines via VSAT DAMA technology. 100 of these VDCs shall have 8 lines each. Application is voice only. But 2400 bit/s data for e-mail /internet is available in voice-band using 8 kbit/s encoding. The project will be implemented in three phases. The project started in 2002 and will be completed by 2007. Currently, 155 terminals have been installed. The project is being implemented with Nepal Telecom's own funds. But His Majesty's Government of Nepal will have to refund the expenditures to Nepal Telecom from the Rural Telecom Development Fund. The equipment cost of the project is over USD 8 Million.

(Peru)

This project, called INFODES consists of the implementation of rural information centres (Infocentros), in six towns of the Cajamarca province. These centres are part of a rural information system designed specially on the base of the necessities of the populations having satellite links. The access allows the interactive communication with the coordination centre located in the city of Cajamarca through internet. Each infocentro counts with a public telephone and a radio transmitter, thus offering services that contribute to the sustainability. The pilot project was developed by ITDG with support of the World Bank. Another complementary project was developed with the participation of the Telecommunication Investment Fund (FITEL) which adds the component of telecommunications and the development of the qualification programs and methodologies of management, required for the sustainability of the infocentros. The INFODES telecentre is a non-profit institution, which promotes, offers and facilitates the access to a large variety of informations through internet, which can be obtained with search engines about subjects, published authors, titles or any information in general. Nowadays, the Infocentros are the base of a new regional project denominated urban-rural information system.

(Syria)

According to the general policy of the Syrian Government, S.T.E. is responsible as the incumbent for telecommunication services in Syria to provide telecommunication services everywhere in Syria. In general, the aim of the 3rd rural project is to provide POTS (plain old telephone service) and data telecommunication services at the remaining non-served telecommunication areas of Syria. With the 3rd rural project, Syria expects to improve the economic and social situation of the inhabitants of such areas. According to the project design, around 430 000 lines for 4 300 villages will end up at 370 existing exchange centres of S.T.E. in 13 out of the 14 provinces of Syria. Short-term (until 2005 and long-term until 2015) demand calculation has been taken into consideration for the network design and network infrastructure planning. Due to the project studies, various types of modern state-of-the-art technologies shall be used to execute the project: optical access network, wireless local loop, digital microwave, optical fiber cable, copper access network and UHF/VHF fixed wireless access.

(Venezuela)

The first obligation derived from the universal service in Venezuela consists of the planning, installation, administration, operation and maintenance of the telecommunications platform which is necessary to offer connectivity to the *Puntos de Acceso*, and the second phase corresponds to the installation, administration, operation and maintenance of the *Puntos de Acceso*, to which the connectivity will take place by means of the development of the first project. The *Puntos de Acceso* are telecommunication centres which are designed to provide the benefits of telecommunication and information services, as well as for the qualification of people in the intensive use of Information and Communication Technologies (ICT's) in order to harness, improve and complement their educative, cultural, economic and productive activities and to allow information exchange, with the purpose of stimulating the community integral development and improving the quality of life of its members. Through these centres, the necessities of the communities and the population development activities can be supported, in order to contribute to their individual and

collective development, from an economic, social and cultural perspective. In this sense, the *Puntos de Acceso* must be conceived as learning, communication and information centres for workers, students, professionals, craftsmen, industrialists, communitarian members of non-governmental organizations, leaders and other members of the community, including handicapped persons or people with special social needs.

(Viet Nam)

In this project, broadband the wireless LAN system, "CFO-SS", was used to provide a 10 Mbit/s broadband link between the General Hospital and the Medical College in the Hatinh province, Viet Nam. Over this link, we evaluated the applications such as "X-Ray image transmission", "video transmission" and "VoIP telephony", and confirmed that these applications work properly and are applicable to medical activities. The CFO-SS system brought a new concept to the people in the Hatinh province on tele-medicine and tele-education. The success of this project proved that we can construct a medical videoconference network within a range of CFO-SS (around 20 km) and doctors can hold a consultation or just send images of patients to other hospitals. As CFO-SS is a good technology to expand the covering of broadband service into rural and remote areas, it can respond to the needs of women, youth, handicapped persons and other marginalized or socially disadvantaged groups living in rural and remote areas.

5 Overview of the project objectives

5.1 General

The main objective is to promote ICT services to improve the quality of life for the dwellers in rural and remote areas as shown in Table 5-1 below. Some of them are national projects under the national telecommunication policy for the provision of universal service in rural and remote areas. There are other projects promoted by private initiatives, such as the Cambodian and Indian cases, or joint initiatives. Most of the projects are operational even if some are still experimental or even in the planning process. There are projects targeting to test and experiment ICT technologies and systems such as the wireless local loop (Wireless LAN) coupled with VSAT and terrestrial wireless trunk lines and optic fiber lines. The majority of the cases consider ICTs as an important factor for the development of rural and backward zones. Their objectives are not limited to providing basic telephony. They usually include several informatics services as a means to promote education, healthcare, commerce and agriculture, as well as a useful tool in case of natural disasters. This shows the importance given to ICTs as a catalyst for development.

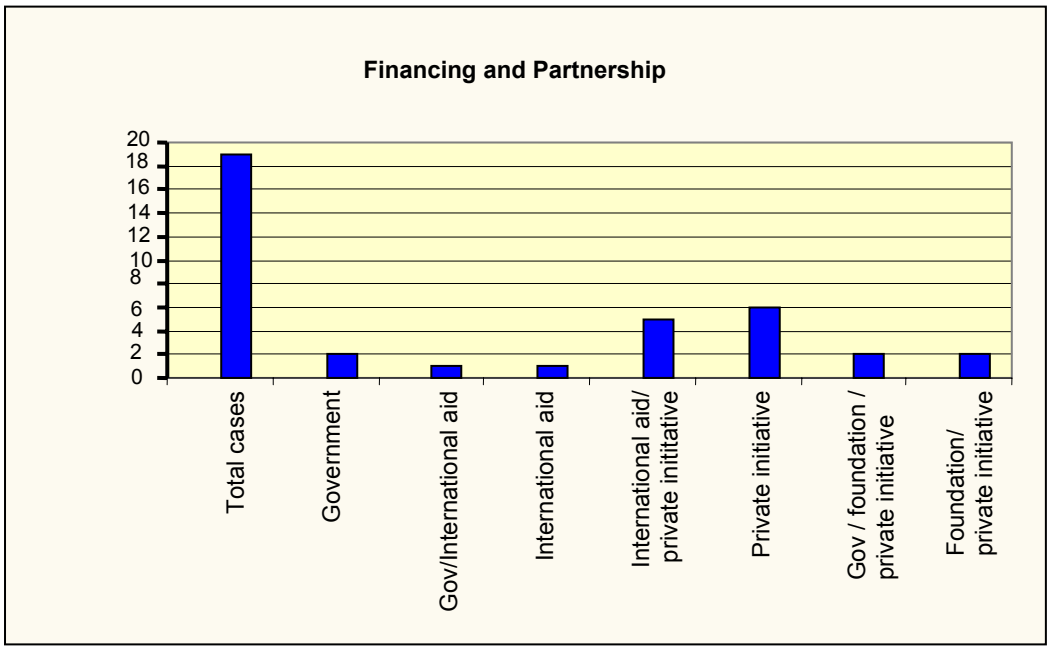
Table 5.1 – Project objectives, financing and partnership

Country	Objectives	Financing and partnership
Brazil	To promote the creation of a horizontal network of mutual cooperation allowing a greater exchange of information, opportunities for the improvement of the quality of life, generation of cultural development and businesses.	Ministry of Communications, Ministry of Defence, Ministry of Education, Ministry of Food Security
Bulgaria	The project has twin objectives: to test and evaluate the effectiveness of new technologies in rural and remote areas as well as to provide a platform for the wide introduction of multimedia services, such as telemedicine, teleeducation, etc.	Bulgarian Ministry of Transport and Communications, ICT Development Agency, Bulgarian Association of Telecentres, Bulgarian Telecommunication Company, Septemvri Community, Community Medical Centres, Telemedicine Group, Solar-Terrestrial Influences, BDT/ITU

Country	Objectives	Financing and partnership
Burkina Faso	The project objective is to build a telecommunication infrastructure in the zones of Koudougou and Tenkodogo. This infrastructure will provide telephone services for 160 000 inhabitants in 25 villages.	European Investment Bank (EIB), Onatel (local operator)
Cambodia	To provide internet access to primary schools in Cambodia. The project provides store-and-forward exchanges of e-mails by using mobile Wi-Fi access points on motorcycles, and fixed Wi-Fi access points located at rural schools and the hub internet access point located at town.	The World Bank, private donors, Japanese assistance to Cambodia, American assistance to Cambodia
Colombia	The Compartel programme's aim is to generalize the access to telecommunications services – rural community telephony and social internet – covering all the country with these services.	Ministerio de Comunicaciones, Fondo de Comunicaciones, Fondo Financiero de Proyectos de Desarrollo – FONADE, Gerencia del Programa Compartel, Telefónica Data Colombia y Gilat Colombia S.A. E.S.P.
Egypt	To provide basic telephone services, to the rural areas and villages, community development, internet services and small business support services. Access lines have been implemented using WLL technology.	Telecom Egypt
Estonia	To create a training network, free of charge basic computer and internet training and to use the network and the experience obtained for advanced IT training.	Look@World Foundation composed by: 2 banks, 2 telecom operators, 1 CATV operator and 4 IT companies
Ethiopia	To reach the underserved by efficiently utilizing clinical specialists, biomedical scientists and public health professionals who are concentrated in the larger cities, using the Telemedicine system.	infoDev (World Bank), ITU, UNECA
India 1	The project leverages ICT to set up a meta-market in favour of India's small and poor farmers. It enables online price discovery and virtually cluster the farmer community using internet technologies. It aggregates the farm products at the village by the sanchalak (the farmer himself), and brings the products directly to the processing plants, eliminating intermediate supply chain costs.	ITC Limited, an Indian agribusiness Company, orchestrating the project with multiple partners form the civil society, the private sector and government agencies
India 2	The primary objective is to create a rural services organization that improves the living standards of Indian villages. The organization delivers ICT applications for essential services like education, healthcare and e-governance, through setting up a network of village internet centres called Village Kiosks.	TeNeT, Indian Institute of Technology, Chennai, and n-Logue Communications Private Ltd
India 3	The objectives of the project was to test the utilities of telemedicine application in a unique Indian festival, to render tele-health care at the festival site in the form of specialty consultation by the doctors working at the make shift local hospital, tele-monitoring public health such as the quality of the water supply, local hygiene conditions, public health education and daily monitoring of infectious diseases so as to take appropriate steps at the right time to contain them in order to prevent public health disaster like epidemic outbreaks. It was a unique experiment carried out in India.	Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS), Department of Information Technology, Online Telemedicine Research Institute, Government of Uttar Pradesh, M.L.N. Medical College

Country	Objectives	Financing and partnership
Indonesia	To bring internet to the often impoverished and scattered rural population, by combining existing technologies to create an interactive device that offers internet features – e-mail retrieval system based on voice. The system converts text from the internet into digitized speech, which will then be transmitted to users through a terminal similar to a regular payphone.	R&D Centre, PT Telekomunikasi Indonesia, Tbk, International Development Research Centre – Canada
Lesotho	The objective is to satisfy the target number of access lines which was committed when Telecom Lesotho obtained the licenses, by employing wireless local loop technology in the rural areas.	Telecom Lesotho
Malaysia	To provide communication means to residents in rural and remote areas on Langkawi island and its 2 adjacent islands in Malaysia by a propriety radio system developed by Cape Range Wireless. The system was connected to the public telephone network of Telkom Malaysia.	Cape Range Wireless Malaysia Sdn. Bhd., financed by Telkom Malaysia, the Ministry of Energy, Water and Communications and the Malaysian Communication and Multimedia Commission (MCMC)
Nepal	The project covers 1 000 village development committees (VDCs) in Nepal. Each VDC is connected with 2 telephone lines via VSAT DAMA technology. 100 among these VDCs will have 8 lines each. Voice is the main application, but 2 400 bit/s data communications for e-mail /Internet is available in voice-band using 8 kbit/s encoding.	Nepal Telecom, Rural Telecom. Development Fund of Government of Nepal
Peru	The project objective is to contribute to the sub-regional development of Cajamarca, increasing the production capacity of the small rural producers and improving the level of management of the local governments by facilitating the access to telecommunications and the provision of information.	Intermediate Technology Dev. Group, World Bank – InfoDev, OSIPTEL – FITEL
Syria	The aim of the 3rd rural project is to provide POTS (plain old telephone services) & data telecommunication services at the still non-served telecommunications areas of Syria after the first and second projects.	European Commission, European Investment Bank, Syrian Telecommunication Establishment
Venezuela	To accomplish the first Universal Service obligation in Venezuela, which consists of the planning, installation and operation of the telecommunication network to provide connectivity to the *Puntos de Acceso*. The *Puntos de Acceso* are telecommunication centres which are designed to amass the benefit of telecommunications and information services.	National Telecommunication Commission, telecommunication operators notified, Ministry of Infrastructure, Ministry of Planning and Development, Ministry of Production and Commerce, communities involved
Viet Nam (KDDI)	To examine the performance of Wireless LAN and applications of VoIP and Videoconference based on IP technology in the medical field. This project was carried out to acquire experience and competence in telemedicine services using IP technologies. It was also expected through this project, to improve the treatment of patients by using tele-medicine consultation and to obtain better access to medical expertise and knowledge.	Asia Pacific Telecommunity, Japanese Ministry of Public Management, Home Affairs, Posts and Telecommunication, KDDI Corporation, KDDI R&D labs, Waseda University, Hatinh Post and Telecommunications, Hatinh General Hospital/Medical college/ Department of Health

Figure 5-1 – Financing and partnership



5.2 Brief description of the country/region: geography, topography, climate, demography, socio-economic situation

The projects implemented correspond to very different situations: Projects for the whole country, projects for a few villages, for hundreds of people or for hundreds of millions, tropical or cold climate, small islands or large continental areas, but the common point is the belief that ICTs are very valuable for the elimination of poverty and the improvement of the quality of life in these areas. See Table 5-2.

Table 5-2 – Projects applications

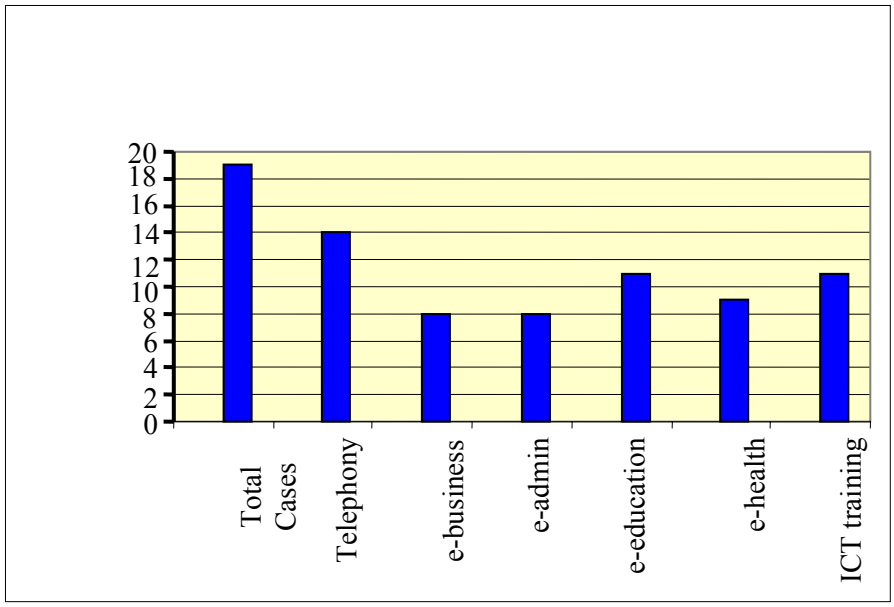
Country	Status		Population involved	Area covered and conditions	Projects applications					
	operational	complete			telephony	e-business	e-admin.	e-education	e-health	ICT training
Brazil	X		$6{,}4 \times 10^6$	The whole country; tropical zone	X	X	X	X	X	X
Bulgaria	X		30 017	Community; continental, semi-mountainous, severe climate	X	X	X	X	X	X
Burkina Faso	X		160 000	25 villages; tropical sub-Saharan climate	X					
Cambodia	X		100 000, 50 primary schools	The whole country; village areas		X	X	X	X	X

Country	Status		Population involved	Area covered and conditions	Projects applications					
	operational	complete			telephony	e-business	e-admin.	e-education	e-health	ICT training
Colombia	X		$5{,}2 \times 10^6$	The whole country, 11 152 locations and 1 440 tele-centres for internet; tropical climate and mountains	X			X		X
Egypt		X	Present 100×10^3 Target 500×10^3	20 governorates 92 locations	X					
Estonia		X	Total $1{,}4 \times 10^6$ 530 000 in rural areas	The whole country specially rural areas; continental area, cold climate	X		X			X
Ethiopia	Planned		NA	10 rural sites connected to a central referral hospital					X	X
India 1	X		$2{,}5 \times 10^6$ 25 000 villages	Covering 6 states; agricultural tropical areas	X	X	X	X	X	X
India 2	X		600×10^6 2 000 villages at present	Villages in 30 districts at present, potential for all Indian rural areas; tropical climate	X		X	X	X	X
India 3		X	10 million people in 6 weeks	District around the city of Allahabad, Uttar Pradesh State					X	
Indonesia	X pilot project		100 000	A district; island in tropical area	Browse the internet and receive e-mail converted to voice accessible via pay phone					
Lesotho	X		97 terminals in operation from a capacity of 1 000	Service provided in 2 rural areas	X					
Malaysia	X		54 000, 3 000 covered	Langkawi island and its 2 adjacent islands	X	X		X		
Nepal	X		1 000 villages	Mountain area of the country	X					
Peru	X		$6 \times 3\,000$ total 18 000	Department of Cajamarca, 6 locations	X	X		X		X
Syria	X		$2{,}2 \times 10^6$	4 300 villages in 13 provinces; Mediterranean climate	X	X	X	X		X
Venezuela	Planned			4 States	X	X	X	X	X	X
Viet Nam (KDDI)	X		120 000	Hatinh town; tropical climate				X	X	

5.3 Objectives and details of the project applications (basic telephony, e-business, e-administration, e-learning, e-health, ICT training)

Most of the cases include several types of services, only in two cases, in areas of very low telecommunication facilities basic telephony is the only service considered. In general, ICT training and e-education are the two types of services most frequently associated with telephony. It looks reasonable that to teach how to use this new tool is the most important at the beginning in order to allow its use for other applications, like e-business, e-administration, e-healthcare, etc. Figure 5-2 shows the number of cases where all applications are implemented.

Figure 5-2 – Number of cases where all applications are implemented



5.4 Financing and partnership aspects of the projects

Ministries of Communication, national telecommunication operators, private organizations for development promotion, communities involved, banks and international organizations are the participants in the financing and execution of the projects. Universal service obligations, initiatives from governments, national organizations for development or international aid funds are the motives for these projects. The origins are diverse but all these projects aim at using ICTs as a development catalyzer in rural, poor and isolated areas. (See Table 5-1.)

6 Infrastructure and regulatory environment

6.1 Infrastructure components: Pre-existing telecommunication facilities, road transportation, electricity supply, distance to the nearest local exchange centre and/or IP network, human resources, security

Table 6-1 shows extracts from the case studies relating to the infrastructure components such as availability of electric power supply, transport access roads, pre-existing telecommunications facilities, etc.

Table 6-1 – Infrastructure components

Country	Infrastructure		
	Electric power	**Transport**	**Telecommunications**
Brazil	Public power supply	NA	Non-existent.
Bulgaria	Public power supply	Not developed	The existing telecommunication infrastructures are analogic and less developed.
Burkina Faso	Public power supply and solar power	NA	The two towns around which the project has been set up have OCB283 telephone exchanges.
Cambodia	Solar power	Not developed	Non-existent.
Colombia	Solar power	Not developed	Non-existent.
Egypt	Public power supply	NA	The transmission network used is microwave and fiber-optic cable.
Estonia	NA	NA	NA
Ethiopia	NA	NA	NA
India 1	Public power supply and solar power backup	NA	Relatively undeveloped.
India 2	Public power supply and solar power backup	NA	Relatively undeveloped: The existing telecommunication infrastructures involve only telephone.
India 3	Public power supply	NA	A temporary telephone exchange was established at the festival site through which the ISDN and PSTN lines were installed at the field hospital where the field telemedicine platform was created.
Indonesia	Public power supply company	Limited	The project sites have telephone switches.
Lesotho	Solar power	Not developed	The project sites are connected to the national network.
Malaysia	Portable diesel generators and solar power	Not developed	Unreliable telecommunication means.
Nepal	Solar power	NA	Non-existent.
Peru	Solar power	Not developed	Non-existent.
Syria	NA	NA	The project takes advantage of the telecommunication infrastructures, which are PDH and/or SDH microwave and fiber optic.
Venezuela	Public power supply	Developed	Proximity of telecommunication infrastructure is one of the criteria for the choice of the project site.
Viet Nam (KDDI)	Public power supply	Not developed	The existing telecommunication infrastructures on the project site are developed and fixed telephony remains the single most widespread means of communication.

6.2 Regulatory components: Universal service obligations, licensing conditions, frequency availability (for radio-based projects), other regulatory issues, etc.

In about half the cases mentioned, there is a universal service obligation policy and a universal service fund in these countries (see Table 6-2), as was also described in the global survey report of RGQ10-1/2 (Doc. 111/2 and 117/2). The frequency spectrum of 2.4 GHz used for wireless local loop or wireless LAN (Wi-Fi) is an internationally agreed ISM band (so-called unlicensed band). This frequency band is used in some cases for the local loop in rural areas, e.g. in Bulgaria and Viet Nam, etc. When a USO/USF system is established, governments can start the promotion and development of rural communications in their countries.

Table 6-2 – Regulatory environment and other factors

Country	Regulatory environments		Other factors influencing the operational environment
	Universal services	Licensing	
Brazil	The GSAC project is one of the three Brazilian universal services programme and is intended to take care of communities in rural areas. It is totally free of charge to the user and managed by the Ministry of Communications.	Required.	The Ministry of Communication has signed a contract with a company, following a call for bids, for the installation and maintenance of the project's systems.
Bulgaria	In accordance with the legislation of the entities involved in the project, only the Bulgarian telecommunication operator (BTC) is obliged to contribute to universal service.	The 2.4 GHz frequencies used in the project are free and require no license.	The political and regulatory framework required for the implementation of the project is in place.
Burkina Faso	The case study simply mentions the existence of a decree establishing arrangements for providing access to universal service, without specific detail.	NA	NA
Cambodia	NA	NA	NA
Colombia	The Government has established a universal access policy and a communication fund has been set up for the purpose. Private or public operators contribute directly by providing tele-communication services in rural areas and areas with underprivileged populations.	Required. However, the Ministry's Decree 1972/2003 provides for social projects to be dealt with in a specific manner.	The operators selected to provide the telecommunication services in rural areas and areas with underprivileged populations are required to apply and respect both legislation and technical standards.
Egypt	Telecom Egypt has the obligation to contribute to the universal service and to respect the standard quality of service. The obligation is set at 1% for fixed networks and wireless local loops.	Required.	NA
Estonia	NA	NA	NA

Country	Regulatory environments		Other factors influencing the operational environment
	Universal services	Licensing	
Ethiopia	NA	NA	NA
India 1	The service in rural areas is financed by a universal service obligation fund (USOF) established by the national telecom policy of 94 and 99.	NA	NA
India 2	The service in rural areas is financed by a universal service obligation fund (USOF) established by the national telecom policy of 94 and 99.	NA	NA
India 3	NA	NA	The developer of the software and the network followed international standard for videoconference in its embedded system.
Indonesia	The government carried out a universal service obligation bidding, financed by the national telecommunication operators.	Required.	The DG has signed a contract with a company, following a call for bids, for the installation, operation and maintenance of the project's systems
Lesotho	NA	Required.	NA
Malaysia	A universal service provision (USP) exists but was not used to fund this project. (The USP is based on fees added to phone bills and the Government uses the money to subsidize projects.)	Required.	NA
Nepal	NA	NA	NA
Peru	The telecom infrastructure was developed with resources from the investment fund for rural telecommunications (FITEL).	Required (the operator).	NA
Syria	NA	Required.	NA
Venezuela	The operators have a universal access obligation established by the statutory telecommunications act. The Puntos de Acceso project is the first and second project for universal service obligations in Venezuela.	Required.	NA
Viet Nam (KDDI)	NA	Use of the frequency band involved, 2.4 GHz, does not require a license.	Developed by KDDI R&D Labs, CFO-SS technology has not been standardized, unlike IEEE 802.11 series devices.

6.3 Other factors which influenced the operating environment (manufacturers, standards, etc.)

Severe climatic or other natural environmental conditions (high temperature, lightening, wet, rainy and windy conditions, etc.) require protection devices or equipment for the systems installed outdoors, which entails additional costs. Some of the equipments and transmission systems for rural use are reported to be in compliance with standards, but most of the times there is no description provided (see Table 6-2). The rural network is provided interconnected with the conventional PSTN networks or the internet at the gateway exchange or urban centres. In the case of digital technologies, the problem of compliance with standards is less acute.

7 Technical description of the projects

7.1 Architecture, main technical characteristics, frequencies (for radio-based projects), power consumption, performances (capacity, reliability, quality of service), network management, etc.

Three transmission technologies – satellite, wireless and cable are used in the case studies. Among the three, the wireless method is the most widely used: there are 9 cases reported (see Figure 7-1). Point to multipoint WLLs are used in 5 cases. Network architecture using Wi-Fi is constructed in Bulgaria, Cambodia and India 2. For satellite-based systems, 3 out of 5 cases depend on VSAT technology. The choice of technologies depends on the countries size, topographic conditions and availability of the backbone in the target areas or regions. In large countries, such as Brazil and India, mountainous countries such as Nepal or uneven countries, such as Colombia and Peru, VSAT is deployed in addition to satellite systems, though costs for terminals and transponders may be higher compared with a terrestrial wireless system. A conventional network besides the cable system is used in Estonia and Indonesia for ICT services extended to rural areas.

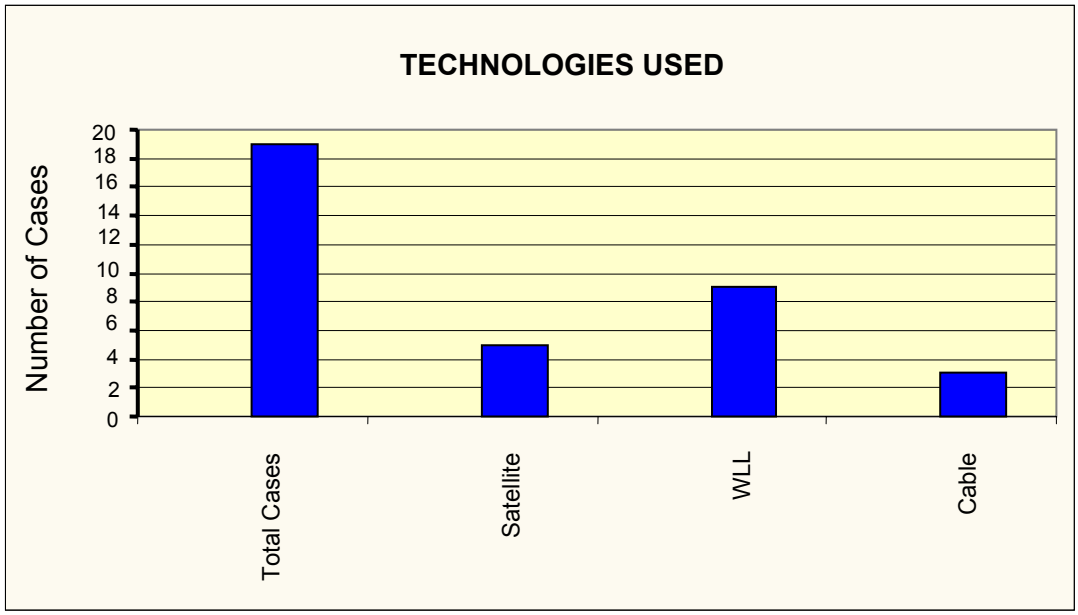
Table 7-1 – Architecture and technical characteristics

Country	Transmission media			Main technical characteristics, installation and interconnection
	Sat.	WLL	Cable	
Brazil	X			Connection by national satellite, star network with one hub, the telephone service is not connected to the national network, IP services interconnected with the internet.
Bulgaria		X		Mesh wireless network to communicate in 9 towns at distances between 2 and 12 km, based on 802.1x and 802.11b standards at 2.4 GHz, transmission power 1 to 100 mW, data rates 2, 5 and 11 Mbit/s, operated in hot stand-by providing redundancy, configuration with a network management system, provides interconnection with telemedicine equipments, IP services and VoIP.
Burkina Faso		X		Wireless point to multipoint 2.5 GHz that links two main centres with 25 villages, provides telephone service at 32 kbit/s, GOS 1% for a 0,05 Erl traffic per subs, interconnection with the national network is made in the two main centres line per line by analogue 2 wire links. Remote units use solar panels when needed.
Cambodia		X		Village fixed access points at schools are connected to the hub internet access point via motorcycle-mounted mobile access points. All of these access points are IEE 802.11b/g compatible and have a built-in PC running Linux. E-mails and web pages are collected and distributed by motorcycles. During about 2 minutes when a motorcycle comes within the range of the village access point, 40 Mbit/s of data can be exchanged between them.

Country	Transmission media			Main technical characteristics, installation and interconnection
	Sat.	WLL	Cable	
Colombia	X			The telephone service is provided by 3 different types of networks, two VSAT (80%) using the Ku band and one hub each in star network, cellular TDMA (18%) and WLL (2%). Interconnection to the national network is made in the hubs in case of VSAT. For social internet, two VSAT platforms and copper cable ISDN, ADSL or frame relay are used depending on the geography and the existing infrastructure.
Egypt		X		Upgrade of the cellular network TDMA, installing 3G RBS, Base station controller, packet control function, packet data serving node, authentication accounting authorization, etc., to provide data services using CDMA2000-1X technology. Interconnection with the internet is provided.
Estonia			X	Project dedicated to the teaching of ICTs not to provide a new network; it uses existing installations in schools, dedicated classrooms, public access points, etc. The main technology used for the connectivity is wired local loops.
Ethiopia	Not defined			10 pilot project sites will be connected to a central referral hospital through a network for telemedicine applications, (teleradiology and teledermatology).
India 1	X			VSAT star network in the Ku band with one hub, internet connection with a leased line in the hub, interconnection with PSTN not allowed.
India 2		X		WLL network with low cost autochthonous equipment CorDECT providing simultaneous telephony and internet access (35/70 kbit/s), equipment suitable for tropical climate without air conditioning, special software for local languages was developed for office tasks, videoconference and other applications. Power requirement for a 1 000 line equipment is 1KW.
India 3			X	The field hospital and 4 institutions were connected with 128 kbit/s bandwidth ISDN telephone lines. A telemedicine system along with medical equipment accessories such as a microscope, X-ray scanner, ECG and real time video-conferencing was installed at the field hospital. Telemedicine systems with data exchange functions and real time videoconference were also installed at the 4 other places.
Indonesia			X	Requires only the installation of a “voice internet server” with a specially developed software that allows the translation of e-mails or of the results of internet navigation into voice messages. This server is connected to the internet network and accessed by the public telephone network via payphones. Does not require the deployment of a dedicated telecom network.
Lesotho		X		WLL point to multipoint system using CDMA modulation at 3.4 to 3.6 GHz, 6 radio channels at 100 MHz spacing, allows telephone channels with 32/64/144 kbit/s, fully connected to the national network on the base of V5.2 protocol, solar power used when necessary. User equipments use an external vertical polarized antenna and 12 V c.c. backup.
Malaysia		X		Propriety point-to-multipoint 2.3 GHz fixed wireless system connecting a base station handling 240 simultaneous calls with 1% blocking rate. Each remote station supports 64 subscribers connected to the remote station via copper wires. The system supports carrier class voice technical standards. The base station is connected to the Malaysian national network.
Nepal	X			Star VSAT network in C-Band with standard B hub, DAMA technology, access technology is MF-TDMA, interconnection with PSTN network using area code 019.

Country	Transmission media			Main technical characteristics, installation and interconnection
	Sat.	WLL	Cable	
Peru	X			Installation of telecentres in 6 locations linked by satellite in order to provide information services mainly dedicated to agricultural promotion. Satellite network in the Ku band.
Syria		X		WLL access networks using 2 technologies PMP and CDMA; BTS stations located in local exchange centres and interconnected by protocol V 5.2, repeaters and terminal stations used as needed, full interconnection with the national network, project implementation in 3 years.
Venezuela	Not defined			Technology neutral bid, so it must be proposed by the operator, frequencies in the following bands are available for the project, 2 300-2 400 MHz, 5 725-5 850 MHz, 10.27-10.30 GHz and 10.62-10.65 GHz, the network must integrate voice, video and data services, deployment in less than 18 months and be fully interconnected with the fixed, mobile and internet networks.
Viet Nam (KDDI)		X		Wireless LAN system at 2.4 GHz, modulation CFO-SS, max distance 20 km, requires LOS, Data Speed 10 Mbit/s, output power 0.08 mW/MHz, power consumption 80 W, support IP Telephony, videoconferences and others IP services. Not implemented interconnection with the national telephone service in this project.

Figure 7-1 Technologies used



7.2 Installation and deployment: network planning, subscriber management, etc.

Planning was discussed for large projects based on the extension of national networks, development of universal service plan and rural development plan. Planning descriptions can be found in the case studies of Burkina Faso, Colombia, Lesotho, Nepal, Syria, etc. In most of the cases, network management is in some way or another required, however this may be performed remotely. In the case of the network for the Langkawi Islands, network monitoring is performed in the centre of Kuala Lumpur and, in case of failure of the island station, locally contracted technicians may be sent to change the parts. Monitoring of each faulty

subscriber line is performed similarly. For the installation and deployment of equipment, a partnership between local operators and local practitioners will facilitate the project implementation as well as operation and maintenance afterwards.

7.3 Interconnection to national networks/backbones

Depending on the size of the project and area covered, interconnection to national network was made. The sizes have impact on technology used. P-MP wireless system is commonly used as an extension of national network, and connected to the national network. VSAT is for a fairly large population, wide coverage area and topographical conditions, and connected to national backbones, except the case of India-2. Wi-Fi was used for small size coverage and interconnected to reach out. Interconnection to national network/backbone is preferable in all cases, however, there are some cases of independent network.

7.4 Cost of the equipment, cost per line and cost of operation of the system

Costs of total system could be divided into: construction costs for core network and for access line cost, and operation costs for core and access line. The level of description of these costs varies depending on the case studies. Not enough information was compiled; Table 7-2 below gives a few figures on the costs. Brief comparison can be made, however: costs of access lines are, in descending order, VSAT, P-MP WLL and Wi-Fi. In the case of satellite deploying VSAT total costs for equipment and per line cost and cost of operation may be higher depending on the availability of specially subsidized low cost transponder. However the use of satellite is inevitable depending on the circumstances.

Table 7-2 – Costs of Network

Country	Transmission media			Costs of the network		
	SAT	WLL	Cable	Cost of the equipment	Per line	Cost of operation
Brazil	X			Cost per Telecentre: USD 18 000	N/A	Total annual cost of operation: USD 3 000 000
Bulgaria		X		Total cost of Telecom equipments: USD 80 000	Cost per wireless line: USD 2 400, Cost per Ethernet line: USD 1 000	Cost of the operation of the system: USD 1 000 monthly
Burkina Faso		X		Total cost: USD 2 800 000	Cost per line: USD 4 166	N/A
Cambodia		X		Cost of mobile access point on motorcycle: USD 600	N/A	N/A
Colombia	X			N/A	Telephony phase 1: USD 4 026, Telephony phase 2: USD 5 341, Internet small centres: USD 8 720, Internet big centres: USD 96 050	The service is provided by several operators, the Government (Compartel) provides partials funds for each project depending of sustainability

Country	Transmission media			Costs of the network		
	SAT	WLL	Cable	Cost of the equipment	Per line	Cost of operation
Egypt		X		Claimed to have a cost lower than wired solutions but figures are not provided	Line cost is USD 180	N/A
Estonia			X	N/A	N/A	N/A
Ethiopia	Not Defined			N/A	N/A	N/A
India 1	X			N/A	Cost per terminal equipment: USD 1 600	Cost of operation per annun per terminal: USD 350
India 2		X		Start-up cost: USD 20 000	Cost per terminal equipment: USD 250	N/A
India 3			X	USD 130 000 for telemedicine equipment	N/A	USD 50 000
Indonesia			X	USD 16 000 for server and installation cost	N/A	Using existing network
Lesotho		X		N/A	N/A	N/A
Malaysia		X		N/A	N/A	N/A
Nepal	X			N/A	Cost per terminal including solar power and batteries: USD 8 000	USD 255 000/year (space segment)
Peru	X			USD 10 000 per locality	USD 7 500	N/A
Syria		X		Total cost of the Project: 205 million Euros	cost per line: 674 Euros	Total cost of operation: 2,3 million Euros
Venezuela	Not Defined			N/A	N/A	N/A
Viet Nam (KDDI)		X		One pair of terminals USD 9 000	Installing 40 telephones per terminal, it cost USD 112.50 per line	N/A

8 Technical description of the services provided

8.1 For each service delivered (POTS, “IP telephony”, etc.): mode (data type and bit rate) and quality (voice quality and bit error rate)

When the network is interconnected to the national telephone network, level of services should be in compliance to the national/international standards. On the other hand, if the network is independent, service quality is mentioned on satisfactory/non-satisfactory basis. See the following Table 8-1 for the details. Variety of services are provided over the IP networks in most cases. However, in Indonesian case the speech Internet application is developed for rural community use. And in the Cambodian case only internet mail and web browsing service is provided by store-and-forward data delivery system. On the other hand, there are cases such as Burkina Faso, Egypt, and Venezuela which are targeting mainly telephony service to rural communities.

Table 8-1 – Technical description of the services

Country	Technical description of the services
Brazil	Telephony: at least 1 public telephone in villages with more than 100 inhabitants, 96% provided by a national satellite. 30 000 villages served. Internet: Broadband service mainly by satellite in Telecentres in towns.
Bulgaria	All services included are provided using IP technology provided by wireless links.
Burkina Faso	Only telephone service at present (the project is an extension of the national network to cover rural areas).
Cambodia	Store-and-forward e-mail delivery services are provided to primary schools, using motorcycles circulating the delivery routes. Motorcycle could store 40 Mbit/s of data for each school. This corresponds to 2 000 e-mails or 200 pictures for each visiting session.
Colombia	All services are provided wireless via VSAT, cellular TDMA or WLL, for Telephony voice is compressed at 8 kbit/s, GOS 1%, BER $<10^{-6,}$ availability of links 99.5%, of service 90%. For internet, 4% of the cases use copper connections with ADSL, FR or ISDN and 96% use VSAT. Bandwidth for small centres is 2 kbit/s per PC, for bigger centres (6 PC) 8 kbit/s per PC, BER $<10^{-6}$, availability of service 88.9%.
Egypt	Telephony with a GOS of 1% using a cellular network IS-95, Internet by CDMA2000-1X with a wide band of 153.6 kbit/s, the project is an extension to rural areas and upgrade of the national cellular network.
Estonia	Project dedicated to the teaching of ICT, Phase 1 to check the appropriateness of the training course, Phase II to spread the course to all installations.
Ethiopia	Telemedicine services will be provided to 10 project sites with PC equipped with telemedicine software. Network connects these sites to a central referral hospital, then on to regional and/or university hospitals depending on the cases.
India 1	High speed Internet access to provide agriculture related video streaming, e-mail and Chat, technical parameters not available.
India 2	Village kiosks providing through Internet ICT training, languages courses, e-health, e-governance, VoIP, videoconferences, agricultural consultation and connection for a rural ATM (automatic teller machine). Uses low cost system wireless links with 35~70 kbit/s bandwidth developed in India.
India 3	All the transfer of medical data and videoconference was carried out in 128 kbit/s bandwidth.
Indonesia	Provides Speech Internet, Speech e-mail, Speech Browser, using a Public Telephone. Special software developed in Indonesia is used.
Lesotho	Offer only voice over a WLL system, the system has possibilities for data services but are not used at present, technical parameters of quality N/A.
Malaysia	Offer standard telephone services via a fixed wireless system, which is connected to the national network. Internet dial-up access, payphone and leased lines are also provided.
Nepal	Telephone service via VSAT, voice compressed at 8 kbit/s, possible e-mail/internet at 2 400 bit/s.
Peru	Services oriented to Library Services and Rural Information, provides Internet Access, Public Telephones, VoIP, e-mail, local radio and ICT training.
Syria	Telephony, IP access via modem (56 kbit/s). Quality of service N/A.
Venezuela	Telephony: delay < 150 ms, BER $< 10^{-6} \sim 10^{-7}$, monthly completed calls 95%, GOS 99%. Internet: BER $< 10^{-7} \sim 10^{-8}$, bandwidth 192 kbit/s.
Viet Nam (KDDI)	IP telephony over H.232 protocol with good quality, video conference with MPEG-4 support a VGA (640 × 480) full screen display used for e-health applications.

8.2 Cost of each terminal and cost of the service for the user

Tariffs or prices paid by user for the services are compiled in Table 8-2. Since there are the projects based on universal service policy or the projects are implemented with government subsidy and/or funds, the price paid and cost incurred may not have direct relationship. For the cases of independent network, the prices may be low or free. The cost of terminal and services for the cases shown in the Table 8-2 are very informative for other countries and the other countries may easily compare their own case. In the case of India 1, Estonia and Bulgaria (limited to within the network), it is noteworthy that the service is provided free for users.

Table 8-2 – Cost of terminals and services

Country	Cost of the terminals and services		
	Per terminal	Cost of service	
Brazil	Provided by operator: N/A USD 18 000 per Telecentre	Normal telephone: tariff paid by user. For schools: health points and frontier post cost are jointly paid by Gov and users. For less developed communities, Gov paid all	
Bulgaria	Investment is USD 4 900/town with 3 terminals, Operational cost USD 1 000/month (8 towns)	Voice inside the Network is free. Outside normal tariff, e-mail USD 0.13, Internet Access USD 0.62/hour	
Burkina Faso	USD 4 166 per terminal	Subscription cost USD 42, services at normal cost	
Cambodia	USD 600 per fixed access point	N/A	
Colombia	Telephony phase 1, USD 4 026 Telephony phase 2, USD 5 341 Internet small centres USD 8 720 Internet large centres USD 96 050	Telephone tariff PC with Internet access	Local calls USD 0.14/min Dept calls USD 0.20/min National USD 0.32/min USD 0.83/hour * calculated at 1 USD = 2 341 COP
Egypt	USD 100 per terminal	N/A	
Estonia	N/A	Free courses	
Ethiopia	N/A	N/A	
India 1	Cost per terminal USD 1 600 Operation cost USD 350/ year	Free Service for the users	
India 2	Cost for a Kiosk terminal USD 1 000	N/A	
India 3	N/A	N/A	
Indonesia	Using existing network	USD 0.03 per 3 minute access	
Lesotho	Cost per line USD 2 000	Cost per line USD 10 per month	
Malaysia	N/A	N/A	
Nepal	VSAT terminal including solar power supply, USD 8 000	Cost per minute is RS 6.50 (approximately USD 0.09, plus 30% taxes, calculated at 1 USD = 72 RS)	
Peru	VSAT terminal with solar power, USD 7 500	N/A	
Syria	Installation tariff: 62.5 Euro	Monthly cost 0.625 Euro, 300 min free for local calls, national calls 0.02 Euro/min	

Country	Cost of the terminals and services	
	Per terminal	Cost of service
Venezuela	N/A	To be fixed by Conatel
Viet Nam (KDDI)	Telephone terminal USD 250, Video conference terminal USD 1 500+ PC	Free

9 Effectiveness and sustainability of the project

9.1 Effectiveness and benefits of the project for the targeted user groups

Most of case studies stress various items relating to effectiveness and benefits for the users in the rural communities generated by the implementation of the ICT projects as summarized below:

- Help dwellers of the rural communities to digital exposure
- Provide digital multi- services such as Voice over IP, telemedicine, community information, ICT training
- Help small farmers, artisans and small trading businesses by providing real time information despite distance and customized knowledge despite heterogeneity
- Increased telephone coverage and ICT services resulting in the community development such as equal opportunity for the people, better territorial and social integration, increased economic productivities, faster attention to emergencies for the rural communities
- Help the people in rural community for the ICT training
- Building village kiosks with ICT raises revenue and creates robust business model, and contributes to the socio-economic development of the rural and remote areas
- Stop the trend of the mobility of people from rural to urban areas
- Great contribution to the healthcare services and mortality of the rural communities, and nation wide reduction of healthcare costs.

9.2 Profitability of the project

As regards profitability of the projects there is no case study which clearly state about profitability, however, they encourage the efforts of rural communities, institutes, and operators in charge of Telecentres and associated ICT facilities in the areas to operate and maintain by themselves after the implementation of the funded projects. In some case studies, they expect the improvement of profitability by the increased usage of the services as the growth of awareness of the dwellers and the development of rural communities. The business model of the village kiosks or community centres in Indian, Egyptian, and Nepali case studies expected to develop in the future as the rural economy grows.

9.3 Specific strategies to respond to the needs of women, youth, handicapped and other marginalized or socially disadvantaged groups

Benefits for children, young men and women and elderly people as the result of the HRD and computer literacy improvement policy by the use of ICT, and the healthcare services to be provided for the patients of the rural areas isolated by the geographical conditions are addressed in the several case studies as summarized in the table below. In general, project descriptions were oriented towards communications access methods via voice or Internet. Strategies for services to socially disadvantaged groups were discussed more in relation to the operations of Telecentres, info-centres and Internet kiosk, where specific applications/ services and operators were mentioned.

9.4 Aspects of the project which could be strengthened to enhance its effectiveness or sustainability

There is no clear description about the self-sustainability of the projects for several years after the implementation since all the projects are not in that stage yet and justified whatsoever. Most of the project are guaranteed for the subsidization of the maintenance and operation cost or communication cost in some cases by the government or equivalent funds. Private and government partnership is sought for rural communications development in some cases.

Table 9-1 – Effectiveness and sustainability

Country	Effectiveness and Sustainability			
	Effectiveness	**Profitability**	**Strategies to disadvantaged**	**Aspects to be strengthened**
Brazil	The great benefit of the GSAC programme is the digital exposure of the communities where telecentres are installed.	It is estimated that after five years of operation, the community itself can bear the costs of maintenance and operate the telecentre.	The Ministry of Education is administering courses on human resource development for young men and women at the telecentres.	Cooperation with the private sector is necessary for better planning of its sustainability.
Bulgaria	31.6% of Bulgarian population lives in remote villages. The project will ensure to the people there various services: voice over IP, telemedicine, community information, IT training and so on.	The project is social oriented. Bulgarian Association of Telecentres will be responsible for funding the operation after the project implementation.	Telemedicine project is based on involvement in the testing procedures of both patients and elderly people, apart of normal population.	Usage by the local authorities has to be encouraged. The infrastructure can be used for development of small business in the region. The local governmental, non-governmental and private institutions have to work jointly on the project.
Burkina Faso	The project provided basic telecommunications services to 160 000 inhabitants. It also helped agropastorales, artisanal and small trading activities.	NA	NA	NA
Cambodia	The benefit of the project is to provide email access facility with low cost where telecommunication infrastructure is non-existent.	NA	Children are taught how to use computers by orphans who have mastered computer literacy at a computer centre near Phnom Penh.	NA
Colombia	Compartel Programme increased the telephone coverage from 36% to 82%. It provided the benefits of equal opportunities, better territorial and social integration, increased economic productivities as well as faster attention to emergencies.	An assignment structure for allocating resources to the providers has been designed for the execution of the projects, to make a loss-making business plan at market conditions, feasible.	The programme allows unemployed people to search for employment, giving one hour of free access to Internet in the low traffic hours to consult job offers at the website of the Servicio Nacional de Aprendizaje (SENA).	The telecommunications providers had sent its people to five departments in order to figure out the reasons of the problems that often appear, and the way to solve them and to promote optimum improvement.

Country	Effectiveness and Sustainability			
	Effectiveness	**Profitability**	**Strategies to disadvantaged**	**Aspects to be strengthened**
Egypt	The benefits of the WLL project is to provide the basic telephony services, as well as Internet services to increase community development.	Profitability will improve by various increased usages, for example, for community development, small businesses and emergency support.	NA	To enhance effectiveness and sustainability of the system, start-up parameters of the system must be tuned.
Estonia	According to our knowledge, this project is one of the biggest training projects in the world, which is financed by private sector. The courses were free of charge to participants. Totally 10% of Estonia's adult population was trained.	NA	NA	NA
Ethiopia	NA	NA	NA	NA
India 1	ITC eChoupal brings the power of scale to the small farmer, relevant & real-time information despite distances, and customized knowledge despite heterogeneity.	NA	ITC is partnering with various NGOs for the delivery of those services to respond to socially disadvantaged groups.	The business model effectiveness will increase manifold if the communications services related to voice and video are permitted by regulation and at a nominal license fee.
India 2	N-logue derives its revenue primarily from usage revenues of the kiosk operations. Hence it is highly conscious of the need of the kiosk to survive in order to create a robust business model.	N-logue has built a self-sustaining model at all levels which is driven by profitability and not dependent on grants/charity.	NA	NA
India 3	Over 100 tele-consultations were provided by different departments of SGPGIMS. Daily exchange of Event report and Water reports followed by discussion over videoconference were carried out between public health officials at festival site and state HQ.	The project was envisaged to study feasibility of telemedicine applications in a field environment.	Many of the pilgrims belonged to low socio-economic status and the patients could get access to specialist care at the field location.	As a spin-off effect of the project, two mobile platforms were developed, one in a vehicle for application in similar situation and the other is a portable one in a suitcase for disaster applications.
Indonesia	This service represents the complement for accessing to Internet besides accessing conventional way of using PC.	NA	Telco should join together with various NGOs for the delivery of the services to respond to socially disadvantaged groups.	To enhance sustainability by empowering community.
Lesotho	NA	NA	NA	NA
Malaysia	Villagers have been able to use the system effectively.	NA	NA	NA

Country	Effectiveness and Sustainability			
	Effectiveness	**Profitability**	**Strategies to disadvantaged**	**Aspects to be strengthened**
Nepal	The VSAT phone lines are dominantly used as Public Call Office (PCO) in Village Development Committees and serve very effectively remote rural people.	After the project is implemented, not only project shall be self sustainable, it will generate profit for Nepal Telecom to a certain extent.	The people of high mountains are socially backward poor people. The project will serve to uplift their status.	Addition of low and high speed data will enhance the effectiveness.
Peru	Promotion campaign was conducted to assure that the system was well-known and indeed used. The agreement with other regional institutions was considered as a decisive factor of sustainability to feed the system with excellent information.	A goal should be that after 30 months the system can walk without any assistance. For this, it is required to build a local market for information and communication services and goods.	Unexpected results during implementation was about the leaders in charge of the infocentros: all of them were young people, even though the objective of the project did not consider an approach towards this sector.	NA
Syria	Providing the telecommuni-cation infrastructure within the none-served rural areas will improve the economical and social situation. Therefore the current trend that inhabitants of the rural areas in Syria moving to the urban and sub-urban areas might be stopped.	NA	NA	NA
Venezuela	NA	Participating operators must present an economic study with income and loss estimations. According to these estimates and by using a formula established by CONATEL, the subvention amount can be calculated.	The universal service obligations are a mechanism for the inclusion of traditionally excluded groups in ICT area.	NA
Viet Nam (KDDI)	Almost all the doctors in Hatinh General Hospital commented that this application should be widely used in Hatinh province. It was also very clear that the video transmission application worked successfully.	This project is not aiming at profitability but improvement of quality in medical activities.	As CFO-SS is a good way to expand the cover areas of broadband service into rural and remote areas where socially disadvantaged groups tend to live, it responds to the needs of such people.	NA

10 Social and human development impacts

10.1 General

In today's emerging knowledge society, information is a key resource for decision-making, empowerment, social participation and human development. So increasingly the ability to access and interact with information and communication technologies and networks are increasingly becoming key determinants to one's ability to influence their quality of life. At the international, national and local level there are numerous actions plans, initiatives, task forces and policies which explicitly or implicitly recognize this strong potential and role of information and communication technologies (ICT) in supporting human development. Many of these plans seek to engage ICT as a catalyst for stimulating economic development, supporting health and food security, access to education, greater and more equitable social participation of "marginalized" or "disadvantaged" groups, the protection of the environment and other goals either through their direct or ancillary use. Better, more equitable access to knowledge and information and communication technologies is vital. However, if these limited resources are to be utilized in an optimal manner and the potential of ICT for effective social engineering and transforming actualized, as the following case studies point out, greater attention is needed to the "soft" aspects of technology use in the design, provision and monitoring of the roll-out of ICT projects and services.

10.2 Overview of social and human development needs

The analysis of social and human developments is based primarily on the information provided by the respondents who prepared the individual studies based on their experiences. These projects are located in rural and remote communities of 17 countries in Africa, Asia, South America and Europe. Most of these countries have Human Development Indices[1] which fall into the medium human development category. However, Burkina Faso and Lesotho belong to the low human development category and Estonia to the high human development category. Despite these inter-country differences, all respondents attested to a significant divide in the opportunities available to urban and rural populations.

While some of the studies are focused on a project within a single village or sector, others span several villages, states and vastly separated geographical regions with different languages, landscapes, cultures and socio-economic conditions. While the lessons from each case remain valid this however poses some challenge for making social comparisons.

When one broadly compares across the projects one can detect differences in the nature and severity of social challenges both across countries and within a country from one rural community to another. Therefore it is increasingly important if ICT projects are to address social needs that be developed with these caveats in mind or be adapted, to the extent possible, to the needs and peculiarities of the rural communities. Doing so will better allow these services to have maximum impact. The Table 10/1 below shows how various ICT case study projects have attempted to address various human development concerns.

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[1] The human development index (HDI) focuses on three measurable dimensions of human development: living a long and healthy life, being educated and having a decent standard of living. Thus it combines measures of life expectancy, school enrolment, literacy and income to allow a broader view of a country's development than does income alone.

Table 10-1 – Project goals and social challenges as reported by respondents

Projection location and status	Primary population served by the project	Social services supported by project	Primary social challenges faced by communities
Brazil (Ongoing)	6.4 million rural dwellers in almost 30 000 locations some with as few as 100 inhabitants.	Telecentres, small business, health and educational support, ICT training.	Limited access to social services and opportunities, health, education, etc., due to low incomes and remoteness.
Septemvri, Bulgaria (Ongoing)	30 017 inhabitants.	Telecentre, health services, ICT training, access to information (governmental, trade).	Low income region, high unemployment ~33%, poor health/transport communication, etc., services.
Koudougou, Tenkodogo, Burkina Faso (Completed)	160 000 in 25 villages.	Telecentres, small enterprise development (employment creation).	High poverty, high infant mortality, reduced life expectancy, low school attendance.
Cambodia (Ongoing)	50 rural primary schools.	Education, ICT training.	Lack of communications infrastructure, Isolated area and lack of transportation infrastructure.
Colombia (Ongoing)	5.2 million in 9 745 rural areas.	Telecentres, ICT training, emergency relief efforts, rural telephony.	High poverty, social inequity, violence, Inadequate communication infrastructure to support productivity.
Egypt (First phase completed extension Ongoing)	100×10^3 serving 20 Governorates.	Telephony and Internet, foster small business creation.	Inadequate communication infrastructure.
Estonia (Ongoing)	100 000 rural dwellers.	Telecentres, ICT training.	Lack of skills to access and benefit from ICT-based services, work, etc.
Ethiopia (Planned)	NA	Health.	High poverty, social inequity and inadequate communications.
India 1	~2.5 million rural villagers.	Telecentre, education, small business, health, ICT training.	Lack of fair pricing, lending sources, timely market access and information for farmers and others.
India 2 (Ongoing)	2 000 villages in 6 states: Andra Pradesh Gujarat, Karnataka Madhya Pradesh, Maharashtra, Tamil Nadu.	Telecentre, health, agri-services, education, e-governance.	Healthcare, education, participation in governance, adequate wage.
India 3 (Completed)	10 million people in 6 weeks.	Telemedicine at Festival in the city of Allahabad.	Large number of pilgrims in a short period of time in a city where medical facilities are not enough for the festival.

Projection location and status	Primary population served by the project	Social services supported by project	Primary social challenges faced by communities
Tarakan Indonesia (Field trial)	100 000 rural dwellers.	Voice Internet.	Low literacy, limited access to information based services.
Lesotho (Operational)	97 WLL to increase to 1 000.	No information provided.	Difficult road transport and telecom-munication service.
Malaysia	Residents on Langkawi island and its 2 adjacent islands.	Rural telephony, public phone, Internet, emergency communications.	Difficult transport and lack of telecom-munication services.
Nepal	1 000 villages.	Telecentre.	Difficult transport and lack of telecom-munication services.
Peru, Cajamarca (Operational)	6 towns with 3 000 inhabitants, a total of 18 000.	Telecentres, small business development, ICT training, radio broadcast.	Difficult road access, high illiteracy.
Syria (Operational)	2.2 Million in 13 provinces.	Telecentres, small business, health, ICT training, education, emergency/relief.	Lack of telecom facilities retarding development.
Venezuela (Planned)	4 states.	Telecentres, small business, health, ICT training, education.	Lack of telecommunication infrastructures, poor accesses to information services.
Hatinh Viet Nam (Operational)	120 000 rural dwellers.	Telecentre, health, education.	Low income, poor health, education, communication and road access, remote area.

10.3 Role and commitment of the project in addressing these needs

All of the case study respondents at one level or another recognize the impact that improved telecom-munication services have on enhancing various aspects of the quality of life of the citizens in the project area. However, as Table 10-2 indicates, there is considerable variation in the extent to which the various projects have explicitly built strategies into the conception, implementation and operational phases of these technology rollouts to build a bridge between the potential of their projects offers and existing social and developmental needs of the communities they serve. Too often the technology is seen as the driver, in reality, technology is a tool and so we need to equip people, the users of the tool, with the means and knowledge to apply these technologies to the development challenges they face.

Table 10-2 – Strategies employed to address social needs

Projection location and status	Primary population impacted by the project	Evidence of clear plan to address social needs (yes, no, unclear)	Project design elements and practices to ensure project addresses social needs of rural communities
Brazil (Ongoing)	6.4 million rural dwellers in almost 30 000 locations some with as few as 100 inhabitants.	Y	Project trains local people to operate Telecentres including the development of solutions tailored to each locale's needs. Human resource development and training projects for rural youth (men and women) to encourage use of ICT.
Septemvri, Bulgaria (Ongoing)	30 017 inhabitants.	Y	Project is a component of a larger national project for social development. Strong social advocacy and ICT awareness. Project supports delivery of specialized services, skills and training for key rural sectors.
Koudougou, Tenkodogo, Burkina Faso (Completed)	160 000 in 25 villages.	U	Respondents acknowledge that follow-up efforts in the form of finance, civil society mobilization, training, etc., are needed to maximize impact of infrastructural investment made.
Cambodia	50 rural primary schools.	Y	Project supports school children's access to e-mail. It expands to cover e-commerce, telemedicine and e-learning with aim to opening the path to poverty reduction and economic development.
Colombia (Ongoing)	5.2 Million in 9 745 rural areas.	Y	Telecentre supported in creating services and information resources for local needs such as agriculture, eco-tourism, and community development projects, etc. Special software, hardware and support for deaf and blind users were provided. Community and local authorities were involved in decisions related to the telecentre. Special pricing and free use provisions.
Egypt (Ongoing)	100×10^3 serving 20 Governorates.	Y	Project supports the basic telephony with Internet, and fosters small business creation to the rural areas as social development. The financing is carried out completely by Telecom Egypt (incumbent operator).
Estonia (Ongoing)	100 000 rural dwellers.	Y	Private-public partnerships promoted free training programme with an advocacy and awareness raising campaign. Pre-launch pilot studies were made to assess effectiveness of training coupled with follow-up evaluations. Self-study workbooks and introductory lessons.
Ethiopia (Planned)	NA	Y	Project will be done by the National Telemedicine Coordinating committee of Ethiopia with members from government, university and telecom company.

Projection location and status	Primary population impacted by the project	Evidence of clear plan to address social needs (yes, no, unclear)	Project design elements and practices to ensure project addresses social needs of rural communities
India 1	~2.5 million rural villagers.	Y	Project works closely with local NGOs and community groups to tailor services to address social needs/concerns and mobilize awareness on key issues, etc. Support building of networks for capacity, capability and income generation among users. Support use of local language content. Low cost service.
India 2 (Ongoing)	2 000 rural villages in 6 states.	Y	Integrated approach combining appropriate technologies with grassroot scalable organizational structures and business models and services suited to rural life. Low cost service.
India 3 the city of Allahabad (Completed)	10 million pilgrims in 6 weeks.	Y	Two weeks of planning was carried out with technical partners and discussions were held with the district administration and telecom officials looking after the administration of the festival. All the medical and paramedical deployed at the field hospital were explained about the telemedicine network and its purpose.
Tarakan Indonesia (Field trial)	100 000 rural dwellers.	U	Project trained a limited group of people to access, exchange store-and-forward information via telephone.
Lesotho (Operational)	97 WLL to increase to 1 000.	U	
Malaysia	Residents on Langkawi island and its 2 adjacent islands.	U	
Nepal	1 000 villages.	Y	Project is initiated by telecom operator, but it would be refunded by the governmental Rural Telecom Development Fund for the purpose of improvement of socio-economic status of high mountain people.
Peru Cajamarca (Operational)	6 towns of 3 000 a total of 18 000.	Y	Public awareness of the usefulness of the technology coupled with advocacy and training at introduction of the project. Practical projects developed to attract women and other target groups. Special pricing and free use provisions.
Syria (Operational)	2.2 million in 13 provinces.	U	
Venezuela	Rural dwellers in 4 states.	Y	Project is based on the Universal Service Fund to provide basic telecommunication services, with purpose of stimulating the community integral development and improving the quality of life of its members.
Hatinh, Viet Nam (Operational)	120 000 rural dwellers.	Y	Participation of medical staff and patients in the use and application of the technology.

Rural dwellers may be at a marked disadvantage relative to urban dwellers in terms of their familiarity and access to technologies. If they are to accept and incorporate these new tools into their daily lives, it is important that adequate preparation, awareness and information be given to them. as well as involvement be afforded to them regarding the site selection of facilities and other activities to engage community involvement and ownership, to reduce fear, learning curves and other hurdles which may pose other barriers to the successful employment of ICT.

As the Peruvian case study pointed out, new technology often involves a steep learning curve so introducing it to new users in a friendly manner and highlighting practical benefits and uses is important. In the Estonian case study, trainees were provided with material which they could refer to and follow on their own, helping them to practice independently, gain confidence and develop skills. Other efforts such as engaging local champions to raise awareness, using local languages and encouraging persons to visit telecentres help to pass on the message that technology can solve real problems and pass on the skills that allow it to be used.

Commitment to addressing social issues can also be demonstrated through pricing strategies that facilitate access of the communities to ICT services that allow development needs to be met. Examples are free or subsidized training, and free or reduced costs for certain types of services and through the use of prepaid services. Often creative approaches, such as using a portion of revenue from income generating activities or public-private funding can offer solutions.

10.4 Socio-economic benefits for, and impacts on, the community(ies) and/or at a wider level, including support for gender equity and the needs of marginalized and disadvantaged populations

Table 10-3 provides a description of various tangible near and long term benefits that respondents have reported as occurring as a result of the introduction of the telecentres and other services in the case studies. While it is may be possible to obtain some quantitative measures or indicators of the impact of these projects the scope of our present study does not afford us the opportunity to detail this. The tremendous and often dramatic positive life-changing impacts and possibilities that open up to communities when previously small, isolated villages that have been entirely cut off from the rest of their country become connected by telecommunications – new found ability to receive warnings of impending flood, to gain information about new job opportunities, government immunization programmes, to access radio education programmes – paradoxically often go unnoticed, unreported or are taken for granted. Furthermore these telecommunication services, which while initially unprofitable, often have a far-reaching future catalytical role of making possible/feasible other activities for generating social and economic capital which without their presence may not have even been contemplated.

A useful follow up to these case studies would be periodic revisits over time to these areas to obtain quantitative measures of impact. Perhaps even more important though would be to collate and publish the stories of individuals and villages that have been changed by these projects.

Table 10-3 – Socioeconomic benefits reported by case study respondents

Projection location and status	Primary population impacted by the project	Observed /Expected social outcomes and benefits	Other comments
Brazil (Ongoing)	6.4 million rural dwellers in almost 30 000 locations some with as few as 100 inhabitants.	**Short term:** Income-generation opportunities, community participation, cultural expressions.	Free use of telecentres, public telephone installed where more than 100 inhabitants.
Septemvri, Bulgaria (Ongoing)	30 017 inhabitants.	**Short term:** Improved health care, ICT skills. **Long term:** capacity for e-series (education, job creation, business, governance).	Pilot project for replication in areas/countries with similar characteristics.
Koudougou, Tenkodogo Burkina Faso (Completed)	160 000 in 25 villages.	**Short term:** Improved communication access to health, police and other services. **Long term:** poverty reduction.	Improvement in trade (agriculture, artisanal, etc.) seen at project completed.
Cambodia (Ongoing)	50 rural villages.	**Short term:** e-mail exchanges, e-learning, telemedicine. **Long term:** employment opportunities in the rural areas.	
Colombia (Ongoing)	5.2 million in 9 745 rural areas.	**Short term:** greater citizen participation in governance, promotion of ecotourism, skills training, faster emergency response times. Reduction in transportation costs 70-90%. **Long term:** telemedicine, distance education, reduce war/conflict.	Telephone offered where more than 100 inhabitants, Internet where more than 1 700 inhabitants.
Egypt (Ongoing)	100×10^3 serving 20 governorates.	**Longer term:** equitable participation in social life, E-services: government health education.	
Estonia (Ongoing)	100 000 rural dwellers.	**Short term:** overcome fears of technology and apply ICT in everyday life. **Longer term:** create an economically competitive mobile information society.	Private-public venture combining taught and self-paced learning modes – involved 15% of rural adults.
Ethiopia (Planned)	NA	**Short term:** IT and telemedicine training. **Long term:** starting telemedicine practices, improving healthcare.	
India 1	~2.5 million rural villagers.	**Short term:** greater awareness, stronger bargaining position, better incomes. **Long term:** enhanced social services education, health, etc.	Model to enable wealth creation, and its equitable distribution to stakeholders.
India 2 (Ongoing)	2 000 rural villages in 6 states (Tamil Nadu, Gujarat, Maharashtra, Madhya Pradesh, Andra Pradesh and Karnataka).	**Short term:** ICT delivered services (vet education, health,) small businesses, civil society mobilized. **Long term:** economy diversification to non agro-based products, reverse urban migration, more infrastructural services.	Integrated approach for rural areas: appropriate technologies + organizational structures + business model. Support for 8 languages.

Projection location and status	Primary population impacted by the project	Observed /Expected social outcomes and benefits	Other comments
India 3 the city of Allahabad (Completed)	10 million pilgrims in 6 weeks.	**Short term:** tele-consultation, monitoring of water supply and of local hygienic conditions. **Long term:** subsequent development of two mobile platforms, one in a vehicle in similar situation and the other is a portable one in a suitcase for disaster applications.	Equipment used in the project was transferred later to a peripheral Medical College. Tele-educational sessions were carried out between this college and SGPGIMS using ISDN media. So the equipments have been utilized to its fullest extent during and continued to be used even after the project.
Tarakan Indonesia (Field trial)	100 000 rural dwellers.	**Short term:** cost and literacy barriers to ICT removed.	Process of converting text to voice offers opportunities for deaf and illiterates.
Lesotho (Operational)	97 WLL to increase to 1 000.	**Short term:** Improved telecom-munication services.	
Malaysia	Residents on Langkawi island and its 2 adjacent islands.	**Short term:** reliable telecom services in case of emergency, Internet for schools and homes.	
Nepal	1 000 villages.	**Short term:** Improved voice services., **Long term:** data/Internet services.	
Peru, Cajamarca (Operational)	6 towns of 3 000, a total of 18 000.	**Short term:** information needs (local government, producers, etc.), sustainable telecom models; youth and women mobilized. **Long term:** participation in decision making, economic development.	Training, awareness raising, advocacy, usefulness of technology are essential to ensuring rural technology uptake.
Syria (Operational)	2.2 Million in 13 provinces.	**Short term:** put infrastructure in non-served areas; improved access to socio-economic development, **Long term:** e-services (education, health, business administration), reversal of urban drift.	
Venezuela (Planned)	Rural dwellers in 4 states.	**Short term:** Improved telecom-munication services through the Puntos de Acceso. **Long term:** e-services centres for the members of the community.	
Hatinh, Viet Nam (Operational)	120 000 rural dwellers.	**Short term:** tele-diagnosis, video conference, healthcare and training of health staff.	Positive feedback from health staff and patients.

10.5 Means foreseen to enhance future contributions to human and social development

Table 10-4 below provides a summary of the projects and their anticipated human development impacts. It must be noted that in order for the projects to remain relevant and responsive to the needs and priorities of the communities, continual learning and reshaping are needed. These changes may take a variety of forms

and be in response both to external changes such as new ICT policies and technological development or from within the communities/beneficiaries as they become more sophisticated, empowered and their needs evolve.

Table 10-4 – Anticipated/planned follow-up activities

Projection location and status	Follow-up activities foreseen (yes, no, unclear)	Type of follow-up and expected impacts
Brazil (Ongoing)	Y	
Septemvri, Bulgaria (Ongoing)	Y	Awareness-raising campaign coupled with training in specific skills to support productivity, effectiveness and competitiveness of farming and small enterprises.
Koudougou, Tenkodogo Burkina Faso (Completed)	Y	Establishment of a development fund, management structure to ensure that at least minimum telecommunication services are provided to un-served areas.
Cambodia (Ongoing)	U	Expansion of network usage by various rural groups, ICT training at primary schools.
Colombia (Ongoing)	Y	Project foresees continuing review of project to ensure effective service delivery and support, anticipates new development needs of the community.
Egypt (Ongoing)	Y	Broad recognition, acknowledgement for the important role of ongoing public, private sector and civil society collaboration in addressing human development needs.
Estonia (Ongoing)	Y	Further expansion of training programmes and public private sector partnerships to deliver skills to citizens that facilitate greater citizen participation in government, ICT literacy and economic development.
Ethiopia (Planned)	Y	Official launching of telemedicine project. Development of a telemedicine software adapted to local needs. Training of telemedicine expert in each pilot area.
India 1	Y	Supporting training, capacity building, creation of networks for sharing of information and complementarily to scale-up delivery of services and the project's reach.
India 2 (Ongoing)	Y	Expansion of network supporting job-creation and entrepreneurial activities contributing to more equitable wealth distribution and reducing rural-urban migration.
India 3 (Complete)	Y	The telecommunication solution for such kind of project can be made by IP-VPN through terrestrial broadband if nodes are located in far off locations and by Wi-Fi/WiMAX if nodes are located at short distances.
Tarakan, Indonesia (Field trial)	Y	Software application improvement to increase service reliability, Development of Dumb and Deaf Telecommunication System in order to support disable community activity.
Lesotho (Operational)	U	
Malaysia (Operational)	U	

Projection location and status	Follow-up activities foreseen (yes, no, unclear)	Type of follow-up and expected impacts
Nepal	Y	Addition of data, low and high speeds, will enhance socio-economic benefit of the project.
Peru, Cajamarca (Operational)	Y	Lessons learnt in pilot project can be applied in other regions to enhance effectiveness of telecom based development projects in rural regions.
Syria (Operational)	U	Broad recognition, acknowledgement for the important role of ongoing public, private sector and civil society collaboration in addressing national human development needs.
Venezuela (Planned)	U	
Hatinh, Viet Nam (Operational)	Y	Expansion of telecommunication network, training of additional personnel thus increasing number of persons served by health services.

11 Other observations (additional remarks)

11.1 Unexpected results and lessons learned

There is no clear-cut description about the sustainability or profitability after the implementation of the projects given in the cases but also no report about the unsustainable projects after the implementation so far. In privately financed projects such as India 1 & 2 and Cambodia, the administrator of the projects is challenging to maintain the system or enhancing and expanding the projects to create business model for Village Kiosk in the Indian Case and the increase of the number of schools or communities to receive the benefit of Internet services in Cambodian Case. Uninterrupted efforts by the administrator of projects are difficult but may be essential.

11.2 Anticipated near/long-term project challenges and reorientation

As mentioned above the projects should be updated to adapt to the development of technologies, enhanced and expanded to be benefited by services under the scale of merit of ICT networks. If the benefit of services is recognized by dwellers of the rural communities little by little and the rural economy grows as the results of penetration of ICT services, profitability and sustainability will be gradually improved. The financial subsidization, however, may be required by the government and local administration in any event in the near/long term projection to maintain and operate the service and system in the rural and remote area.

11.3 Additional information considered useful

Wireless network

When building network in rural areas from nothing, wireless technology is very effective and roll out time is short. Building, operation and maintenance of wireless network are compared to “islands” rather than “lines” in the case of wired network. Consideration for propagation range and capacity of the wireless system is important for designing the appropriate system to meet the requirements. Long range system does not require many repeaters, which contributes to the reduction of costs for construction, operation and maintenance of the system but less capacity. On the other hand, for short distance system, system capacity may be increased which also contribute to the reduction of cost per channel. When choosing the wireless system, the cost for terminals will also contribute to the per channel cost.

Combination of the network elements

When building networks, especially in the case of large size networks, the networks will deploy the combination of different technologies judging from the case studies. Choice of appropriate technologies and system integration should be done by the experienced engineers at the planning stage to meet the requirements and conditions of the target rural areas. Egyptian case study gives us the good example in this respect.

Flexibility of IP network

The networks over the IP platform can provide the many useful functions such as easy interconnection with other IP networks, scalability and multi-service capability for VoIP, Video conference, data services, and various e-applications services.

Mobile network

The penetration of mobile telephone services in the rural areas is very fast. It is well known that the number of subscribers for mobile telephone exceeded that of fixed telephone in many countries. The penetration of mobile telephone to the rural areas started recently in many developing countries; however the penetration to the low population areas and the low income areas is still difficult to happen. Mobile telephone terminal has no significant problems as regards the power supply and terminal costs compared with other technologies but the main service is voice in the rural areas.

12 Conclusion on successful practices

There are 19 case studies collected by the Rapporteurs Group on Q10-1/2 in accordance with the case study submission format as agreed upon. The collected case studies, as uploaded to the ITU-D website, are ranging from small to large area coverage, and from the small to large size countries including areas of mountainous, forestry, severe climatic and harsh terrain. The state of the art technologies are deployed by most of case studies which are made viable to the environment and conditions of the project site. Accordingly, this report may provide the guidelines for project planning, implementation and its operation and maintenance in the rural and remote areas of various developing countries.

It is clear that the main objectives of the projects addressed in the case studies are to promote ICT services for the improvement of quality of life for the dwellers in the rural and remote areas. The majority of the cases consider the ICT as an important factor for the development of the rural and backward zones. Their objectives are not only to provide basic telephony but also to provide several informatics services as a means to promote education, healthcare, commerce, agriculture as well as a useful tool in case of natural disasters. The majority of the projects face sustainability problem as impact of miscorrelation between the project and social-economic community improvement. This shows the importance given to the ICT as a catalyzer for development. The challenge for the rural socio-economic development by the various informatics services related to agriculture, village kiosks, computer education, school qualification drill provided over the ICT networks and the efforts for raising awareness of these services as is observed in both of Indian Case Studies will be successful practices because of it scale merit of the projects. Once the economic development is stimulated by the provision of informatics services it will generate the traffic and subsequent revenue.

Projects are funded in most cases by the government, international aid funds, and universal service obligation fund or the combination of different funds. The partnership among government, international agencies and private entities is observed in many cases for launching the projects and succeeded by the operators, local administrations, rural communities, and rural or local service operator in some cases. In order to encourage the funding to the ICT projects in rural and remote areas, it is observed that the prioritization of ICT projects by the government initiative will help to accelerate the development of communications in rural community. Under the circumstances of privatization of telecommunication services in many developing countries, private initiative are often seen but funded by the aid sources for the start-up cost. M&A may be succeeded by the private entrepreneur in rural areas or local service operators.

Choice of technologies suited for the rural connectivity depends on the projects. There are Wireless technologies such as VSAT and terrestrial wireless (FWA, WLL and Wi-Fi) for trunk line and local loop are deployed in many cases because of faster role-out time, cost effectiveness and scalability and advantage for maintenance and operation. To provide informatics services the multi-service platforms are provided by introducing TCT/IP over the networks in almost all cases. The copper wires are still valid for local loops in the small villages clustered within the several kilometre radius. The low bit rate speech codecs are deployed for voice and data services over the local loop and integrated at the hub stations. Store-and-forward internet service combined with the motor cycle courier of upward and downward electronic data is very unique. It is reported that the project generated job opportunities for motor men and school teachers for computer skill and village people have the exposure to the urban society and channelled to appeal to local administrations or outside world.

Training for computer skills for all generations from children to elderly people is stressed in many cases, which will help the rural people to launch the kiosks, electronic shopping mall or small enterprises particularly for the women and young people, which will consequently stop the mobility of population from rural to urban. The tables in sections 3 to 10 are summarizing the features of cases and will be useful to provide guidelines for the successful practices for the planners of rural projects in the developing countries. The needs of guide book for energy supply in rural areas are pointed out in the final report of Focus Group 7 in one of its recommendations in 2001. Many case studies indicated the importance of solutions for energy supply in rural areas. Winrock International is just ready for publishing the guide book on the solutions for energy for small scale ICT facilities in rural areas. Rebecca Mayer of Winrock International who is one of the authors of FG7 Final Report contributed to this analysis report the extracts of guide book as annexed hereto.

13 Acknowledgement

The Rapporteur for Q10-1/2 appreciates the Administrations and organizations who submitted the case studies of their countries and territories concerned on the valuable projects for rural communications developments. The information contained in the case studies is very precious and useful for the planners and practitioners of other countries who have the common problems on the subject of rural communications. The Rapporteur also thanks to the cooperation and contribution of volunteers in the list who have worked for the analysis of the case studies according to the work distribution plan as agreed during the RGQ10-1/2 meeting in September 2004. The vice rapporteurs including ex-vice rapporteur John Rose also kindly participated in the work of analysis and the design of case study submission format. The analysis works are performed by exchanging the electronic documents over the Internet and ITU-D website. In this respect, the Rapporteur thanks the members of Rapporteur's Group and Study Group 2 for their valuable suggestions and comments,

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14 Acronyms and abbreviations

AC Alternating Current

ADPCM Adaptive Differential Pulse Code Modulation

ADSL Asymmetric Digital Subscriber Line

ASIC Application Specific Integrated Circuit

ATM Automatic Teller Machine

BER Bit Error Rate

BOS Balance Of System Components

CDMA Code Division Multiple Access

CFO-SS Carrier Frequency Offset – Spread Spectrum

CPU Central Processing Unit

CS Cell Station

DAMA Demand Assignment Multiple Access

DC Direct Current

DCTS Digital Cordless Telephone System

DECT Digital Enhanced Cordless Telecommunications

EEPROM Electrically Erasable Programmable Read Only Memory

ETSI European Telecommunications Standards Institute

FG7 Focus Group 7

FR Frame Relay

FT Fixed Terminal

FWA Fixed Wireless Access

GOS Grade of Service

HRD Human Resource Development

HTTP Hyper Text Transfer Protocol

ICT Information and Communication Technologies

IMT-2000 International Mobile Telecommunications-2000

IP Internet Protocol

ISDN Integrated Services Digital Network

ISP Internet Service Provider

IT Information Technology

IVR Interactive Voice Response

kW	Kilowatt
LAN	Local Area Network
LOS	Line of Sight
MCT	Multipurpose Community Telecentre
NGO	Non-Governmental Organization
OS	Operating System
PAD	Packet Assembly and Disassembly
PC	Personal Computer
PCO	Public Call Office
PHS	Personal Handyphone System
PMP	Point to Multipoint
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
PTP	Point To Point
RAM	Random Access Memory
ROM	Read Only Memory
RU	Repeater Unit
SLIP	Serial Line Internet Protocol
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SSL	Secure Socket Layer
TCP/IP	Transmission Control Protocol/Internet Protocol
TDAG	Telecommunication Development Advisory Group
TDMA	Time Division Multiple Access
UNESCO	United Nations Educational, Scientific and Cultural Organization
VAP	Valetta Action Plan
VDC	Village Development Committees
VMU	Visual Memory Unit
VOIP	Voice Over Internet Protocol
VSAT	Very Small Aperture Terminal (used with satellite systems)
WAN	Wide Area Network
WAP	Wireless Access Protocol
WARC	World Administrative Radio Conference
Wi-Fi	Wireless Fidelity. Wireless Local Area Networking standard
WLL	Wireless Local Loop
WSIS	World Summit on the Information Society
WTDC	World Telecommunication Development Conference
WWW	World Wide Web

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ANNEX

Reducing Off-Grid Energy Costs for Small-Scale Rural ICT Projects

The cost of providing electricity for small-scale ICT projects in off-grid and poorly electrified areas can consume as much as 80% of initial project funds if energy demand is not managed properly from the outset. When on-site energy generation and storage systems are used, the selection of low-power ICT equipment such as notebook computers, low-power desktop computers, LCDs screens, and ink jet printers (**Figure A-1**) can result in significant net savings in initial project costs by reducing the need for energy. Simply using energy efficient notebook computers instead of desktop systems can reduce the upfront investment in an off-grid, solar-powered telecenter by over USD 30 000. One of the primary goals of this discussion is to raise awareness of the relationship between ICTs and energy, and the financial benefits of considering energy needs early in the process when planning ICT programs in unelectrified rural areas.

Figure A-1 – Energy-Saving ICT Options for Off-Grid Projects

Even when grid power is available, low ICT power consumption may be beneficial if the grid is unreliable and subject to frequent power outages. When the grid has frequent outages, a back-up electricity generator and/or a battery system may be needed to ensure continuous availability of electricity. As with distributed energy generation systems, the cost of a back-up battery system typically increases with the capacity of the battery bank. In general, the less energy the ICTs are consuming, the less expensive it will be to supply any shortfalls that may arise during the lifetime of the project.

A variety of field tested, commercialized standalone power systems are available to provide electricity for small-scale rural ICT applications. Energy management is particularly important with the use of photovoltaic (PV) and small wind systems. An assessment of the availability, quality and reliability of access to electricity at the site of proposed information and communications facilities can be a valuable cost-saving tool when matched with an understanding of distributed energy options and the impact that ICT power requirements have on energy system size and cost.

S*mall-scale* energy needs are defined in this paper as the consumption of no more than 10 or 12 kilowatt-hours (kWh) of electricity per day. These needs can typically be met by power systems with rated capacities ranging from tens of Watts up to 2 to 3 kilowatts (kW) of peak power. In practical terms, power systems within this size range are capable of supporting applications such as battery charging for cell phones; a satellite dish, television and videocassette player for distance education; or a rural telecenter with eight to ten energy-efficient computers. Once the demand for electricity starts to exceed the range defined above, greater economies of scale in the purchase of energy system equipment begin to tip the balance of cost-benefit analyses toward different solutions and approaches.

Rural Energy Options

There are a number of ways to power small-scale ICT installations in locations that are not served by the electricity grid. Typically, the easiest and least expensive solution from the end user's perspective is to arrange for the extension of the electricity grid to the project site. The cost of grid extension increases with the distance from the grid at a rate of several thousand U.S. dollars per kilometre (Table A-1). Therefore grid extension often starts to become economically prohibitive farther than three to five km from the grid.

When grid extension is not an option, a *stand-alone* or *distributed* power system can be installed to generate electricity at a location close to the site where the electricity is needed. Examples of small-scale, standalone power systems include generator sets powered by diesel, photovoltaic systems, small wind systems, and micro-hydro systems. Power systems based on renewable energy resources such as sunlight, wind and running water typically incur most of their costs up front with the initial purchase and installation of the system. On the other hand, power options based on fossil fuels tend to have lower initial investment costs and much higher running costs over time (Table A-1).

Table A-1 – Costs of Energy Options for Off-Grid ICT Installations

	Grid extension	Solar PV	Small wind	Micro-hydro	Diesel/gas generator
Capital costs[2]	USD 4 000 to USD 10 000[3] per km	USD 12 000 to USD 20 000 per kW	USD 2 000 to USD 8 000 per kW	USD 1 000 to USD 4 000 per kW	USD 1 000 per kW
Operating costs[4]	USD 80 to USD 120 per 1 000 kWh	USD 5 per 1 000 kWh	USD 10 per 1 000 kWh	USD 20 per 1 000 kWh	USD 250 per 1 000 kWh

2 Capital costs include energy system components, installation, vendor markups, taxes and duties.

3 NRECA, February 2000.

4 Source: U.S. Office of Technology Assessment, 1992. Grid operating costs are based on retail electricity rates of USD 0.08 to USD 0.12 per kWh. Generator operating costs include fuel at a price of USD 0.50/liter.

Powering Small Loads: Energy for Public Telephones

Figure A-2 – PV-powered Payphone in Guzman, Dominican Republic

Photo source: Soluz, Inc.

Power systems incorporating renewable energy technologies can be very appropriate for powering small loads, such as telephones for public use. Soluz, Inc., a developer of rural energy delivery companies, has implemented several commercial approaches to powering cellular telephones with renewable energy, balancing technical and financial needs. As part of its work to support microenterprise and expand productive applications of PV, Soluz installed a pilot PV-powered cellular payphone in a rural store in 2001. The store, already renting a PV system for lighting, radio, and television from Soluz's local subsidiary, received a separate, dedicated system for the telephone, with a 50 W PV module, battery, and controller.

The system operated smoothly for the three years it was piloted, but was not financially self-sustaining. Though at times well used, the payphone did not generate enough revenue to cover the cost of the dedicated power system. The system was oversized, able to produce much more energy than the phone needed, and as such was more expensive than necessary.

Low-power loads such as the cellular payphone can benefit from an alternate approach to energy supply. As additions to larger power systems like the store's, such loads can use existing batteries and controllers, requiring at most a small upgrade in power-system capacity. The incremental cost of adding a 10 W PV module, for example, is minor compared to the cost of a standalone 10 W PV system.

In small loads, as with larger ICT systems, efficiency can be important. The payphone piloted by Soluz consumed 50-100 Watt-hours per day, but could be designed to consume half that by turning it on for outgoing calls only. Many Soluz customers power standard portable cell phones for their own use with negligible energy from their household or business PV systems. Such phones can also be operated as businesses in underserved areas.

Because computers consist of a wide variety of power-consuming components, power consumption varies substantially from one computer to another. To determine the size of an energy system for off-grid computing facilities, the key parameter that needs to be established is the average power consumption of the computer while running the types of software applications that will be used at the rural location. As a practical rule of thumb, Winrock has found that adding 20% to the rate of power consumption of a PC when it is in a booted, but idle, state provides a comfortable margin above the actual power consumption of that PC while running typical office applications.

In Table A-2, Winrock's provides its own benchmarks regarding desktop power consumption, against which program managers may wish to compare the models available to them in their new and used computer markets. These benchmarks are based on power consumption while the computer is in use or idling at full power mode.

Powering Computers

Table A-2 – Benchmarks for Power Consumption of New and Used Desktop Computers*, 2004

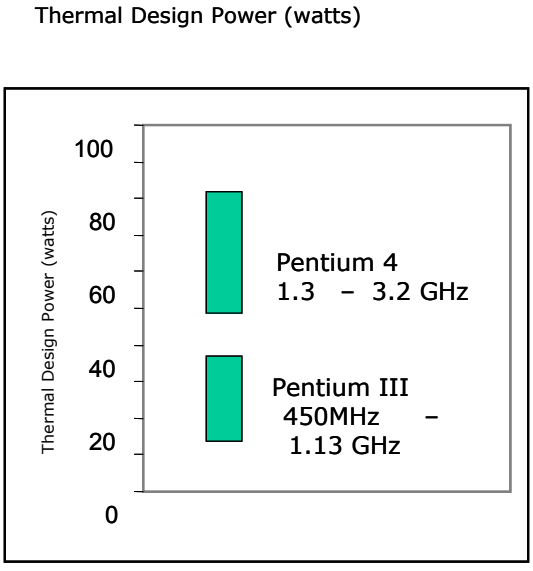
Average rate of Power Consumption	Caractérisation
< 20 – 40 W	Low
40 – 60 W	Average
60 – 80 W	Average/high
80 – 150 W	High

Source: Winrock International.

* *Not including monitor.*

Computer processing units (CPUs), also known as processors or computer chips, are responsible for a significant percentage of a computer's power consumption. As the power of processors has increased with each new generation of chips, maximum CPU power has risen as well. For example, the Intel P4 desktop processor, which is available at clock speeds ranging from 1.3 to 3.2 GHz, consumes significantly more power than the previous generation of desktop chips (see Figure A-3). Within a given family of processors, CPU power consumption generally increases along with clock speed. Processors designed to be used in notebook computers typically consume much less power than those designed for desktop computers.

Figure A-3 – Desktop CPU Thermal Design Power

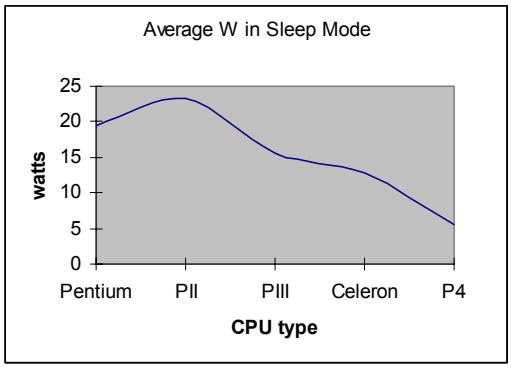


Source: Intel thermal specification datasheets.

Energy system designers often use a desktop computer's power rating[5] to represent the electrical load when sizing renewable energy systems. Information on the rating power is almost always available as it is printed on the computer's power supply for safety reasons. However, a variety of studies have shown that computers typically consume less than the maximum power rating. In some cases computers have been found to consume as little as 5% to 50% of the rated power level[6]. As a result of this discrepancy between rated and actual power consumption, it is possible to reduce the size and cost of the required energy system by using actual power consumption when calculating the energy demand and determining energy system size rather than using the power rating.

Computers reduce power consumption by shutting down system components when they are not in use. Power management enables a computer to enter reduced power states such as standby and sleep mode. Perhaps the most recognized power management guidelines are those set by the U.S. Environmental Protection Agency (EPA) Energy Star program. Desktop computers that meet EPA Energy Star guidelines power down to no more than 15 percent of maximum power use while in sleep mode. Computer models registered with EPA Energy Star typically consume between 5 and 25 W in sleep mode (Figure A-4). For the purpose of selecting off-grid ICT products, it is important to be aware that current Energy Star markings do not provide very useful information.

Figure A-4 – Sleep Mode Power Consumption of Energy Star-Qualifying Computers



Source: U.S. Energy Star, March 21, 2003.

Telecenter Power Consumption and PV System Costs

In order to illustrate the impact of ICT power consumption on the cost of PV-powered telecenters, Winrock selected a range of computers with varying rates of power consumption and used their specifications to calculate the upfront investment required in both PV and ICT equipment. Figure A-5 indicates the types of computers selected, their rates of power consumption and their estimated market prices when purchased new.

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5 See Section 1.2 for an explanation of the term "power rating".

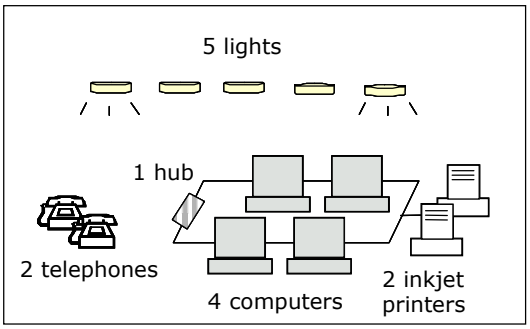
6 Roth, et al. Dec 2001. Energy Consumption by Commercial Office and Telecommunications Equipment, report by Arthur D. Little for the US Department of Energy.

Figure A-5 – Computer Options Used in Telecenter Cost Analysis[7]

Notebook	Low-Power Desktop	Business PC + LCD Monitor	Entertainment PC + CRT Monitor
			
Power Consumption Active: 15.8W Sleep: 0.8W Price: $1800	Power Consumption Active: 55W Sleep: 5W Price: $950	Power Consumption Active: 89W Sleep: 9.5W Price: $1078	Power Consumption Active: 208W Sleep: 15W Price: $1050

Figure A-6 illustrates the daily energy demand of a hypothetical rural telecenter using each of the four computer options indicated above. When configured with energy efficient notebook computers consuming electricity at a rate of 15.8 W, the telecenter consumed an average of 0.64 kilowatt-hours (kWh) per day. By contrast, the daily energy demand of the telecenter when configured with CRT monitors and desktops suitable for gaming was 5.6 kWh – almost a nine-fold increase in load.

Figure A-6 – Configuration and Energy Demand of Medium-Sized Rural Telecenter



If the computer option is ...	Telecenter energy demand* is around ...
Notebook	0.64 kWh/day
Low-power desktop	1.7 kWh/day
Business PC + LCD monitor	2.5 kWh/day
Entertainment PC + CRT monitor	5.6 kWh/day

***Usage Assumptions: Telecenter open 11 hrs/day, 6 days/wk. PCs 65% active, 35% sleep mode. Printers active 1.4 hrs/day. Telephones 1.5 hrs/day offhook. Lights on 4 hrs/day.**

7 Pictures shown are for illustrative purposes and do not represent "actual" models used.

The cost implications of this difference in energy demand are significant. As indicated in Table A-3, the total investment in the telecenter with notebook computers comes to USD 11 050, whereas the telecenter with the highest-power computers costs USD 28 265.

Table A-3 – Investment costs in ICT and PV Energy Systems: Medium-Sized Rural Telecenter

Computer option	Energy demand (daily, Wh)	PV system size (Wp)	PV system cost (USD)	ICT equipment cost (USD)	Total (ICT + energy cost) (USD)
Notebook (16 W)	638	200	3 465	7 585	11 050
Low-power desktop (55 W)	1 654	540	7 892	4 185	12 077
Business PC + LCD monitor (89 W)	2 547	850	11 233	4 696	15 928
Entertainment PC + CRT monitor (208 W)	5 580	1 700	23 680	4 585	28 265

Most of the PV systems costed in Winrock's analysis fell between USD 12/Wp and USD 19/Wp, inclusive of all system components such as the inverter and BOS, taxes (import and value-added), vendor markups and installation costs. These prices correlate fairly well with reports Winrock has received from individuals and installations in the field, as well as its own projects. Recent prices for complete PV systems include USD 11/Watt to USD 17/Watt (Ghana[8]); USD 16.69/Watt to USD 20.25/Watt (Honduras[9]); USD 14.02/Watt to USD 15.71/Watt (Rwanda[10]). Pricing at the lower end of the range is more likely for large-scale procurements and/or in countries where there are government subsidies, low import duties, significant domestic manufacturing of PV systems or components, or highly competitive PV distribution markets.

In conclusion, the selection of low-power information and communications equipment for projects in off-grid rural areas can make a significant difference in the net combined cost of off-grid energy and ICT systems. Policymakers, NGOs and entrepreneurs can ensure more robust and sustainable ICT activities in rural areas by taking these issues into account during the design stage of rural ICT projects.

This annex is based on the Guide to Energy Options for Small-Scale ICT Projects *by Winrock International, which is available free of charge in electronic format by sending a request to rmayer@winrock.org.*

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8 Source: Email communications between Wisdom Ahiataku-Togobo of the Ministry of Energy in Ghana and Dr Abeeku Brew-Hammond, September 2003.

9 Sources: Robert Foster, NMSU; Guillermo Mazariegos, COHCIT, 8/12/2003.

10 Source: dot-ORG Rwanda, 2003.

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