"Challenge for rural communications development in the past, and way forward"

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1. General

Article I of the Constitution [1] of International Telecommunication Union's purpose states a) "to maintain and extend international cooperation between all members of the Union for the improvement and rational use of telecommunication" and b) " to promote and to offer technical assistance to developing countries in the field of telecommunications, and to promote the mobilization of materials and financial resources needed for implementation". The ITU has been executing the assistance to the developing countries for years by the resources mobilized from the International Aid Institutes including World Bank, UNDP, foundations, etc. and membership. The author has been participating, in particular, in the meetings and field activities of the development of telecommunications for rural and remote areas of developing countries for years through the ITU and Asia-Pacific Telecommunity (APT), and other project funding organizations. According to the recent report of the ITU, "Measuring Digital Development, Facts and Figures 2022" [2]one third of the global populations (2.6 billion as of 2023, updated) remain offline. The ITU is striving to find the solutions to "connect the unconnected". This paper describes the short history of the telecommunications development activities of the ITU and international organizations and the author's experiences and thoughts on the development of telecommunications for rural and remote areas in the developing countries especially focusing pacific small islands developing states (SIDS) and landlocked least developing countries (LLDC) of Asia-pacific region. Urbanization [3] is globally progressing resulting in the fact that the workable male population between 16-55 years old are leaving rural areas to make the situation worse. The communications infrastructure is sometimes destroyed by the regional conflicts and frequent natural disasters. However, we have to continue the efforts for development of telecommunications especially for the rural and remote areas. This paper also discusses the way forward challenges.

2. Short history

Purpose of the ITU is stated in the constitution to extend international cooperation between all members of the ITU. Technical cooperation and assistance have been provided to developing countries for years on this basis since 1960s [4]. Technical cooperation department executed the mission by the resources mobilized from World Bank Group, UNDP and International Aid Institutes, etc. until 1985 when "Missing Link Report" [5] [6] [7] [8] by the Maitland Commission recommended the establishment of Center for Telecommunication Development (CTD) independently from the ITU. CTD established in 1985 aimed to raise the financial resources efficiently and promote telecommunication development projects. CTD continued until 1990 when the BDT (Bureau for Development of Telecommunication) started. Missing Link Report

（also called Maitland report）identified communications gap between industrialized countries and developing countries, i.e. "Haves and have-nots" of telephones, and recommended remedies, and sets a goal to bring telephone services within easy reach of humankind before 21st century. The goal was almost achieved as the access to telephone was reported within walking distance for all at that time. The CTD continued the challenges for five years and succeeded by the BDT. World Telecommunication Development Conference in Valletta, Malta (WTDC-98) discussed Action Plan and decided to study the new technologies for rural and remote applications. The Focus Group was set up under the ITU-D SG2 and worked for one and a half year by collecting case studies via ITU-D website and their analysis. The group which the author chaired submitted the report September, 2000, titled "New technologies for rural applications" [9] **which recommended to bring internet style services within the first decade of the new millennium to respond to millennium development goals (MDGs) and apply new technologies and applications so that the gaps in connectivity to the internet can be reduced. The report profiled the new technologies including satellite-based internet access, IMT-2000 cellular systems and Wireless Local Loop (WLL) for rural applications such as remote education, remote healthcare and electronic commerce, community grid with renewable power source, etc. The study of the telecommunications development for rural and remote areas is succeeded by the ITU-D Study Group rapporteur's group on the related study question; "Telecommunications/ICTs for rural and remote areas", which the author chaired for three study cycles (12 years). The study continues until now by the ITU-D SG1 or 2 depending on the allocation of study question of study cycle. World Summit on Information Society (WSIS) took place in Geneva and Tunis in 2003 and 2005 respectively** [10]**, and the list of action lines (C1～C11) was given in the Tunis Agenda, C7 of the action line as in the following is moderated by the ITU;**

C7. ICT Applications

- **E-government**
- **E-business**
- **E-learning**
- **E-health**
- **E-employment**
- **E-environment**
- **E-agriculture**

The ITU-D rapporteur's group on rural communications development has been working to develop these applications, especially e-government, e-learning and e-health. e-environment and e-agriculture applications are drawing special attention of developing countries.

3. Definition of rural and remote areas

The report of ITU-D SG2 rapporteur's group (2006-2010) [11] **defined the general features of rural and remote areas as follows;**

1) Lack of basic infrastructure (telecommunications infrastructure, electricity, access road, water supply, sewer system, etc. difficult living conditions)

2) Low geographical population density (small village populations, in sparsely populated communities that are geographically separated from one another)

3) Low economic activities

4) High degrees of illiteracy

5) Lack of information and social administrative services

6) Marginalized group (women, children and elderly people, disables) are left in the areas.

7) Difficult geographical and environmental conditions (mountainous, isolated by water, harsh climate etc.)

８） Among others

These difficult living conditions for the residents of rural and remote areas are accelerating the rapid migration of population to urban areas according to the recent UN report (See Fig 1). However, about half of world population is still living in the rural and remote areas of developing countries, least developed countries (LDC), least landlocked developing countries (LLDC), and small island developing states (SIDS). As the result of migration of workable populations to urban areas, children and young people under 16 years old, elderly people over 55 years old, women, and marginalized group of people are left in the rural and remote areas. However, the urbanization will be the potential cause of social problem of poverty in the major cities of the developing countries.

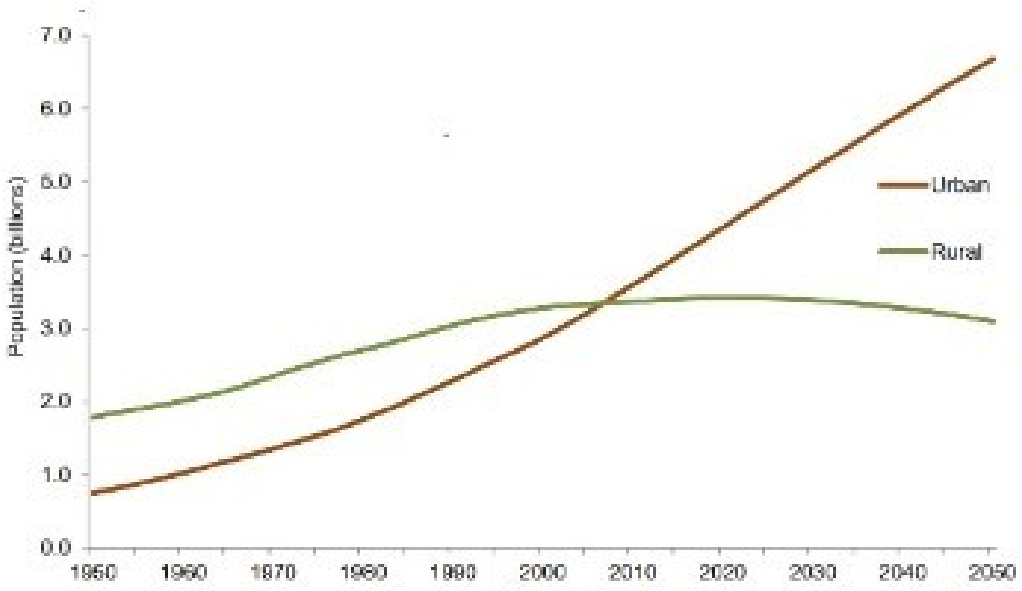


Figure 1: Urban and rural population of the world 1950-2050

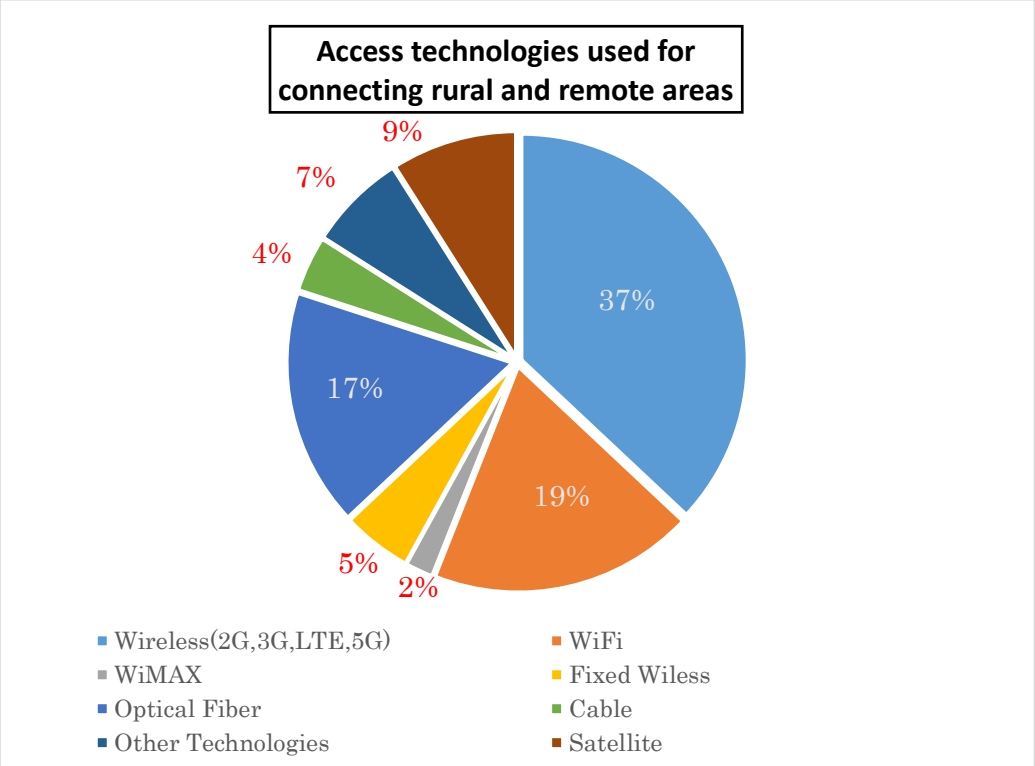
Data source; United Nations, Department of Economic and Social Affairs, Population Division (2018)

4. Research activities

The rapporteur's group of ITU-D Study Group on telecommunication /ICT for rural and remote areas issued and published the reports each four-year study cycle to provide information, best practices and guidelines for developing countries which are available from the ITU website. Rapporteur's group conducted the global survey during 2002-2006 [12] **study cycle by sending questionnaires to membership and received 56 responses for analysis. It says male workable populations (between 16 and 55, inclusive respectively) are leaving to urban areas or outside the countries to get the income to support the family left in the rural and remote areas. Telecommunications/ICTs will be expected to contribute to remedy the situation for improving the quality of life in rural and remote areas. It revealed the situations of rural and remote areas for improvements. Global survey was also conducted during 2014-2017** [13] **study cycle by the group. The following findings are derived from the survey;**

1) **Lack of or inadequate basic enabling infrastructure such as regular electricity supply**
2) **Absence of telecommunications infrastructure**
3) **The relative high cost of telecommunication infrastructure**
4) **Geographic access problems due to distance, terrain, poor quality of road/transport network and remoteness of some rural communities**
5) **Cost of physical access and equipment installation due to any combination of the above geographically related issues**
6) **Low income, lack of disposable income and relative poverty of rural population**
7) **Low geographic density of target population (i.e. small village populations, in sparsely populated communities that are geographically separated from one another)**
8) **High degrees of illiteracy in some rural areas**
9) **Low levels of awareness (if any) of the benefits of modern telecommunications leading to low current demand in some areas**
10) **Vandalism/theft of infrastructure elements such as cables and solar panels in rural areas**
11) **Unproven feasibility of telecommunication services in rural areas**
12) **Overall lack of funding (both public and private, subsidies)**
13) **Commercial viability of telecommunication services resulting in the least interest of service providers.**

The group continued the study and issued the reports on the rural communications development as the new technologies advance in the following study cycles. According to the report of 2017, the analysis of the case studies submitted by the membership of the group shows the following variety of access technologies used for connecting rural and remote areas.



Whereas backhaul technologies used for connecting rural and remote areas are;

- **Optical fiber (48%)**
- **Satellite (19%)**
- **Submarine cable (13%)**
- **Terrestrial microwave (11%)**
- **Wireless (9%)**

With technological advancement the connectivity to rural and remote areas is remarkably improved year by year. The report of "Measuring the Information Society Report 2015" [14] **by the ITU indicates 3.2 billion people are now online, representing 43.4% of the global population, and the report of "Measuring digital development, facts and figures, 2022" says 2.7 billion in 2022, and more recently updated as 2.6 in 2023 are offline. The Amelioration of policy and regulatory environment for improving connectivity for rural and remote areas is also recognized as the result of the rapporteur group's periodical reports providing guidelines and recommendations for challenges. The following findings are given in the most recent report of 2021** [15] **as the result of analysis of almost 100 inputs;**

- **Over 80 per cent of the contribution papers received from various administrations that recourse to a universal service fund for roll-out of broadband infrastructure and services which deems a policy common to many countries**
- **Administrations had created universal service funds or furthered their universal service policies through an Act of parliament or some other law. These laws generally cover the**

structure of the fund, its source of revenue and utilization of its revenues, as well as its objectives.

- **The financial resources of each of the funds were not used for other purposes, only those for which the universal service funds were set up.**
- **When drawing up telecommunication/ICT development policies, it is important to focus on the strong link between WSIS action lines and the SDGs of the 2030 Agenda for Sustainable Development.**

5. Field activities

The author participated in the field activities for implementing projects and feasibility studies in the rural and remote areas of Asia and Pacific region funded by the ITU and APT.

1) Providing Internet connectivity to Bhutanese village [16]

In collaboration with Bhutan InfoComm and Media Authority (BICMA), the project was supported by APT to provide internet connectivity to Rukubuji village in Bhutan in 2005. 66 recycled laptop computers were donated by the Telecom Company of Japan and transported to the village. The village has the community power grid to supply the ICT facilities including satellite antenna and equipment. Villagers also enjoy the TV viewing via satellite. Technical training was given to the villagers for operation and maintenance of facilities by the BICMA (See photos). Later, additional project was provided by the financial support of APT in 2011 to expand the Internet connection to tele-centers of the other villages.

Internet kiosk in rural area of Bhutan

Rukubuji villagers and the parabolic antenna

2) **Feasibility Study mission to Nepali Himalayan villages, and connectivity provided to villages** [17]

The author participated in the ITU mission team to assist Nepal Wireless Networking Project operated and maintained by Mr. Mahabir Pun. ITU Bangkok donated WiFi equipment and associated devices. The mission team trekked ten villages in Myagdi district staying in the guest houses for ten days. There is no motor road in the district. Villages are connected via WiFi and wireless local loop (WLL) connected at the school based multi-purpose tele-centers. Later the wireless network was upgraded by the WiMAX and broadband WLL using TV white space spectrum funded by APT and other sources of international institutes. Mr. Pun is the famous practitioner who received the Ramon Magsaysay award for his community leadership, and innovative wireless and computer technology in Nepal. The technical team volunteered by the Japanese Telecom companies and NGOs supported by the ITU and APT funds assisted the operation of Mahabir's tele-centers, health posts and community computer center in schools connected to Nepal Wireless Networks.

ITU Mission Team in Nangi village, and One Laptop per Child (OLPC) computers in a remote school donated by the European Aid agency

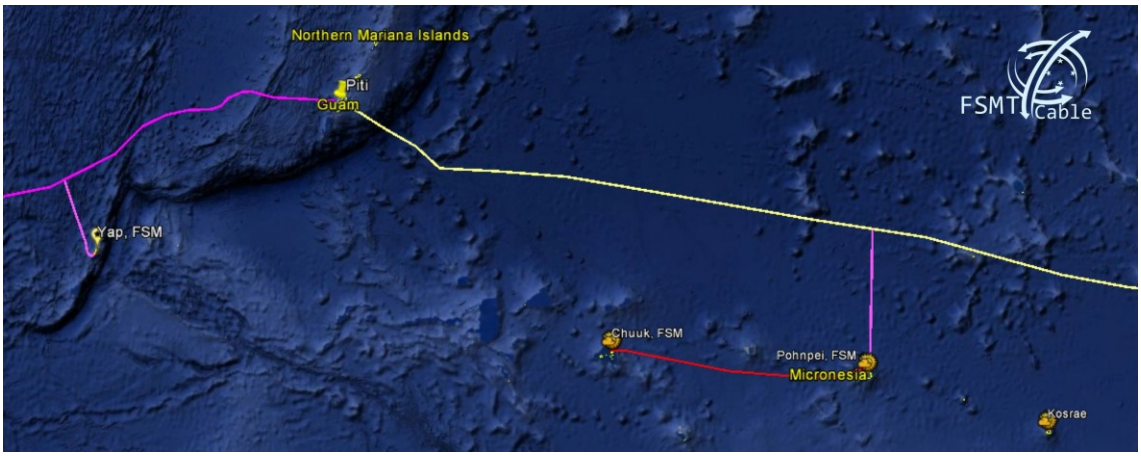
Mr. Mahabir Pun setting up antenna at the relay station, and at the computer room of Nangi village

Wireless antenna fixed on the tree, and an old woman carrying heavy drinking water from water drawing place on her head in a Himalayan village

In 2017, APT funded the additional project to expand Nepal Wireless Networks to 16 mountain villages by WLL deploying VHF TV white space spectrum, Trekker Tracking System (TTS) deploying wireless tags, the transfer of lead-acid battery regeneration technology and extension of network to Mustang region by WLL.

3) **Pilot project of school based tele-centers for Federated States of Micronesia (FSM)** [18]

Three school based tele-centers in Pohnpei, Chuuk, and Kosrae states were established by the APT funded pilot project in 2009. Recycled computers were donated by the KDDI with the collaboration of TC&I and DoE of Micronesian government. FSM Telecom supported to connect three schools in three states via satellite link and WLL. Workshop and training for local school teachers were provided by the Japanese expert at three locations. The state of Yap was provided the tele-center at next phase of APT pilot project.



(From FSMT Cable Home Page)

Above is the optic submarine cable network to connect three states of FSM (Yap, Chuk and

Pohnpei) via Guam and outer world. Extension to Kosrae, Nauru and Kiribati is projected in the very near future.

4) **Extension of mobile phone connectivity via satellite to Mejit Island of Republic of Mashall Island (RMI)** [19]

RMI is Small Island Developing State consisting of 29 atolls and 5 islands. Mejit island is one of 5 islands isolated by about 400 km from its capital of Majuro on the main atoll. Population is 420 individuals and 85 families. Inhabitants rely on riches of the surrounding ocean and a few fruit bearing trees on the island. At that time only telecommunication system was short wave radio via an operator to the capital for commercial and personal communication. The project was funded by the APT to introduce satellite connectivity deploying VSAT and low power and compact femto-cell base station. With the C-band geostationary (GEO) satellite connection via Marshall Island National Authority (MINTA) and femto-cell base station, islanders may benefit for use of cellular phone and other telecommunication services such as e-health consultation with the hospital of Majuro at the health post of the island, and e-learning at the school and e-government service through the tele-center. Electricity is supplied only by solar power and windmill power together with lead-acid battery. After completion of the system in October, 2011, the system was transferred to national telecom authority (MINTA). The ITU Association of Japan, KDDI and KDDI foundation provided expertise and consultation. Optic fiber fusion splicing machine and its technical training workshop was provided at the later phase by the APT funded project.

Mejit islanders using Inmarsat BGan satellite terminal. Mejit women islanders.

Air Marshall flies once a week between Mejit and Majuro. Cargo ship comes once a one or two

months to bring commodity goods to Mejit.

Additionally, the author visited rural areas of Pakistan, Malaysia, Indonesia, Thailand and PNG, among others for study mission and participating in the rural telecommunications development forums.

6. Way Forword

New emerging technologies suitable for rural and remote areas application will soon be available. Low earth orbit (LEO) satellite constellations which may globally provide services covering pacific islands and landlocked areas, and High-Altitude Platform Station (HAPS) will be expected to "connect the unconnected areas" of Asia and Pacific countries in the near future. There will be problems to be tackled by the stakeholders such as coordination among constellations, frequency spectrum issues, clearing space debris after the life time of LEO, affordability of usage charge for rural population, availability of technical experts for rural areas, development of appropriate e-applications, and raising awareness of the benefit of ICT services by the rural population, among others. The ITU and APT may take important role in this respect.

7. Conclusion

In order to solve the problem of "connect the unconnected" of one third of global population, it is vital to provide the connectivity to small islands in the south pacific and mountain villages of landlocked counties of Asia. There are more than 25 thousand of inhabited small islands in the south pacific, so in the case of mountain villages. Investment should be more encouraged in such unprofitable rural and remote areas. Government subsidies through the regulatory scheme of universal service obligation and universal service fund raised by setting aside a portion of communication charge, service licensing fee, frequency spectrum fee, etc. The global tax frame work is the future agenda for the domestic infrastructure development resources. Bringing up the domestic telecommunication installation companies and NGOs for O&M of rural community networks, etc. in the developing countries will help to promote and sustain infrastructure development of local loop in the rural and remote areas. Electrification by renewable energy sources for rural and remote community is another challenge.

8. Acknowledgment

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