Background Paper for Identifying the Best Practices in Expanding ICT Access in Asia and the Pacific

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“Strengthening ICT policies and applications to achieve MDG and WSIS goals in Asia and the Pacific”

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1. Introduction

During the past decade, Asia and the Pacific region has experienced continuous Information and Communication Technology (ICT) infrastructure developments. ICT penetration in major cities in most of the countries has been fulfilled; however, in rural areas it is far below satisfactory levels and many people in those regions still do not have access to ICT. The digital divide still is a serious problem in Asia and the Pacific, since the region has extremely diverse income, population size, and geographical features, ranging from land-locked regions in the area of Himalayas and Central Asia to isolated islands in the Pacific. According to the latest ESCAP figures, over 50 out of 100 populations in the ESCAP region have mobile connection access, on average. However, when the figure is disaggregated, stark sub-regional and sub-national disparities become obvious.

Fiber optic cables have become indispensable backbone connections among the countries, while emerging wireless and space technology present good approaches to broaden coverage where the broadband cannot reach. Therefore, technology is ready to penetrate any area around the world. The key issue to bridging digital divide is how to reach “Last Mile” by using combinations of latest technologies and overcome various socio-economic barriers which prohibit wider ICT access.

2. Objective

Access to ICT was a central theme in the World Summit of Information Society (WSIS) Plan of Action adopted in Geneva in 2003. The goal was to ensure more than half the people in the world have access to ICT by 2015, among other goals. Although it has been 6 years since the WSIS Plan of Action was adopted, the goal may not be reached the way things stand. Therefore, more strategic and well targeted initiatives are required in order to meet the goal of WSIS.

The purpose of the paper is to illustrate the status of ICT initiatives and implementations which aim to bridge the digital divide. More precisely, this paper aims to help assess how many people, what kind of groups of people and which regions have been left out from accessing ICT, and to identify the main problems of further expanding ICT access which is the foundation of an inclusive information society. Without such foundation, meaningful utilization of ICT for development would not be feasible.

First, this paper introduces the current situation of the digital divide in Asia and the Pacific. Using and comparing the latest statistical data, it provides a bigger picture of ICT access through examining ICT penetration rate and nature of the digital divide in this region. Second, the paper discusses some latest technologies, such as broadband, wireless, and space technology, which could bridge the digital divide as significant access methodologies: This helps to determine which methodology is suitable to bridge the digital divide in certain locality and under certain condition. Finally, the paper identifies major and strategic ICT projects, mainly at the regional, sub-regional and national levels, which have been undertaken in Asia and the Pacific with a view to expanding ICT access. Those projects are also analyzed and assessed based upon their experiences and recommendations.

3. Methodology

This paper is a desk study and literature review of ICT projects in Asia and the Pacific based on the project reports, annual reports, research papers, and case studies which are all published and accessible on the Internet. Some statistical data are calculated based on ESCAP standard definitions.

4. Definitions and Scope

4.1 Scope of the research

The information is focused on the materials issued in 2004 and onwards (up to July, 2009), covering topics related to ICT access and connectivity and ICT projects in Asia and the Pacific. There are many aspects of ICT for development; however, this paper mainly focuses on ICT connectivity as a foundation of an inclusive information society.

The project and initiatives are selected and assessed in the paper based on the following criteria:

1) Large scale projects such at regional, sub-regional, and national levels.
2) Implementation methods are considered adequate, promising, and useful for the expansion of ICT.
3) Mainly the projects are funded and/or implemented by international organizations, financial institutions, research institutions, and governmental agencies.
4) Focus countries include least developing countries (LDC), landlocked developing countries (LLDC), and/or small island developing states (SIDS).

4.2 Definition of member states in Asia and the Pacific

This background paper focuses on regional and national ICT implementation in Asia and the Pacific, the area including East Asia, Central Asia, South Asia, Southeast Asia, Oceania, and islands in the Pacific. There are 58 ESCAP member States, and 9 associate members; within the member States, 14 are considered as LDC, 12 are LLDC, and 17 are SIDS[i].

4.3 Definition of ICT access

The definition of ICT is varied and has many connotations; hence this paper only aims at ICT access in a limited sense which excludes radio and TV. ICT access in this paper represents how many citizens of the member states, especially in un-connected and under-serviced areas, have access to ICT for development.

5. Characteristics of Asia and the Pacific

5.1 Geographical characteristics and challenges in Asia and the Pacific

The ESCAP region covers east and central parts of Eurasian continents and islands in the Pacific, the area stretching from the Far East and islands in the Pacific, to Turkey. There are a variety of landscapes in these regions, ranging from landlocked regions around the Himalayas and Central Asia to remote small islands in the Pacific Ocean. They have unique characteristics as well as common characteristics, such as lack of access to information, goods and services. Mountains and deserts surround typical landlocked regions in Asia and the Pacific, and some areas are located in high altitudes. Small islands are located away from the rest of the region and typically scattered in the middle of the Pacific Ocean.

5.2. LDC, LLDC, and SIDS in Asia and the Pacific

Since accessing goods and services is generally more difficult in the landlocked countries and remote islands than other groups of countries, geography is one of the primary obstacles of, not only expanding ICT access, but also expanding economic and social opportunities. There are 14 member states that are Least Developed Countries (LDC)[ii] in Asia and the Pacific, and four out of 14 are Landlocked Developing countries (LLDC), which are Afghanistan, Bhutan, Nepal, and Lao D.P.R [iii]. Another six states are Small Island Developing States (SIDS), which are Kiribati, Maldives, Samoa, Solomon Island, Tuvalu, and Vanuatu[iv].

6. Current status of digital divide in Asia and the Pacific

The digital divide has become an important criterion to measure the level of a country's readiness to take advantages of ICT for socio-economic development. This chapter aims to illustrate the digital divide with focus on access to ICT in Asia and the Pacific from a regional perspective. Using statistical data generated by ESCAP, the current status of the digital divide in terms of access to ICT is analyzed in the following categories: 1) fixed-telephone, 2) mobile cellular phone (and ratio of mobile subscription out of total share of all subscriptions), 3) Internet and 4) broadband. Data from 2003 and 2008 are used and the compound annual growth rate (CAGR) is applied in each category for the 5-year period.

In the first section, data is compared at the national level to determine changes and trends in each category. In the second section, the average statistical data by geographical sub-region and groups such as LDC, LLDC, and SIDS are compared for further analysis.

6.1. Digital divides at the national level

6.1.1. Fixed-telephone at the national level

Data extracted from E-01(Source: UNESCAP Statistics Division)

Fixed telephone lines per 100 populations			
Country/Name	2003	2008	CAGR(%)
Australia	52.6	44.5	-3.3
Republic of Korea	53.3	44.3	-3.6
Japan	47.3	40.2	-3.2
Nepal	1.4	2.8	14.4
Myanmar	0.8	1.4	13.4
Bangladesh	0.5	0.8	10.9

The number of fixed telephone lines started declining among countries with advanced countries in the region. . Based on the statistics, (data in seven out of 58 member countries, and one out of 14 LDC are not available at the time of compiling this report), it can be summarized that fixed line has grown very slowly compared with other communication means or has decreased in an increasing number of countries. Taking a close look at data in advanced countries, CAGR shows negative figures, in such countries as Australia (-3.3%), Japan (-3.2%), Korea (-3.6%). It is assumed that those countries have been in the transition to wireless, broadband or wireless broadband technology from fixed telephone line. Although 19 member states out of 51 show negative CAGR figures, some countries still depend on fixed telephone, due to unavailability of alternative communication means. High CAGR figures in terms of fixed telephone lines converge in LDC in South and Southeast Asia, such as in Bangladesh (10.9%), Myanmar (13.4%), and Nepal (14.4%)

6.1.2. Mobile cellular subscribers at the national level

Data extracted from E-02(Source: UNESCAP Statistics Division)

Mobile subscribers per 100 populations			
Country/Name	2003	2008	CAGR(%)
Australia	72.1	105.0	7.8
Republic of Korea	71.2	94.7	5.9
Japan	68.1	86.7	5.0
Pakistan	1.5	49.7	101.0
Uzbekistan	1.2	46.5	106.2
Bhutan	0.4	36.5	150.1
Tajikistan	0.7	34.4	115.1
Afghanistan	0.9	29.0	101.3
Nepal	0.3	11.3	105.0
Turkmenistan	0.2	6.9	103.9

Mobile technology is one of the most rapidly expanding technologies in terms of the speed of expansion and reach to un-connected segments of population and its prevalence has been growing rapidly especially in the developing countries for the past several years. Even though data is not reported by six member countries, 2003 and 2008 mobile cellular subscription data shows that CAGR of industrialized countries , including Australia, Japan, and Korea usage has increased at stabilized rates of 7.8%, 5.0% and 5.9% respectively. On the other hand, subscription rates have exploded in developing countries, often reaching or exceeding double digits. In fact, growth exceeds triple digits in countries which are both LLDCs and LCDs, such as Afghanistan, Bhutan, and Nepal, with growth rates of 101.3%, 150.1%, and 105.0% respectively, which indicates the existence of underlying demand for communication means and unavailability of other means, such as fixed telephone lines.

Moreover, all the other countries which exceed triple digit growth, except Pakistan, are landlocked countries. These include Tajikistan, Turkmenistan, and Uzbekistan, with 115.1%, 103.9%, and 106.2%. This data could imply that landlocked areas have more advantages of mobile technology implementation and deployment. Although the growth rate is high in these countries, the density of mobiles is still lower than other groups of member countries, such as in Nepal (11.3) and Turkmenistan (6.9), which makes exponential growth possible on statistics. At the same time, there might be continued growth to meet communication demands for the greater number of un-connected people.

Another identified trend is a disparity in growth among developing countries and sub-regions. According to the 2008 data, coverage was relatively high in LLDC, such as Kazakhstan, Azerbaijan, and Armenia, with 96.1, 75.0, and 61.0 per 100 populations respectively, while the growth rates in SIDS are generally lower, with several having only single digit growth. However, these figures need to be assessed in more detail within an overall picture which combines growths and coverage of other means of communication, such as fixed telephone lines, Internet and broadband networks to elicit a conclusion.

6.1.3. Mobile cellular as share of total telephone at the national level

Mobile technology is not only expanding rapidly, but also far outnumbering conventional fixed telephone line communication tools. The average mobile subscribers among the ESCAP countries already exceeded 50 per 100 populations. On the surface, it appears to qualify meeting the WSIS objective of providing access to half of the population at the regional level. However, there still are significant disparities and differential growth rates between more advanced countries and developing countries.

An interesting finding is that there are growth differences among LDCs. For example, countries with high growth rates of mobile share are Bhutan (59.1%), Nepal (34.8%), and Myanmar (17.5%), while a group of LDC countries show slow growth rates. These countries include Cambodia with only 1% and Afghanistan with 3.2% growth. However, it should be noted that the latter countries already had high of mobile share rates in 2003 including Cambodia with 94.1% and Afghanistan with 84.5%. Another observation finds that there are generally high growth rates in north and central landlocked countries: Kyrgyzstan (25.9%), Tajikistan (40.0%), Turkmenistan (78.4%), and Uzbekistan (40.7%). One interpretation could be that mobile technology probably fits the requirements of landlocked countries more so than in SIDS.

6.1.4. Internet users at the national level

(Data extracted from E-04(Source: UNESCAP Statistics Division)

Internet users per 100 populations			
Country/Name	**2003**	**2008**	**CAGR(%)**
Republic of Korea	65.9	77.8	3.4
Japan	48.4	69.2	7.4
Singapore	53.8	67.3	4.6
Malaysia	35.0	62.6	12.3
Cambodia	0.3	0.5	13.0
Bangladesh	0.2	0.3	13.8
Myanmar	0.0	0.1	27.3
Timor-Leste		0.1	

There are huge digital divides in the number of Internet users between developed or advanced countries and developing countries. The data in 2008 indicates that Internet users per 100 populations are 77.83 in Korea, 69.22 in Japan, 67.28 in Singapore and 62.57 in Malaysia. In contrast, in the same year, only 0.3 per 100 populations in Bangladesh, 0.5 in Cambodia, 0.1 in Myanmar and 0.14 in Timor-Leste subscribed to the Internet. This remains a serious problem, although this figure might not include occasional use of the Internet at Internet cafes or other public access points. However, examining the other figures and tables on fixed telephone lines and much less available broadband networks, such usage might not be prevalent in un-connected and under-serviced areas among developing countries.

6.1.5. Broadband Internet at the national level

Globally, the mode of access to information has been changing from dial up telephone lines to mobile and optic fiber cables, which allow people to access information through the Internet, and to use more bandwidth intensive applications, such as video streaming. Data for nearly half the countries (28 countries out of 58) has not been provided, but CAGR on the fixed telephone lines in many developed or advanced countries have shown slowdown: Singapore (16.7%), Japan (15.1%) and Korea (6.3%). It seems that fixed telephone lines have passed their peak in those countries. On the other hand, 11 of 13 LDC do not share the updated data of fixed broadband Internet subscriptions, but deployment of broadband Internet seem to have increased rapidly between 2003 and 2008 in developing countries. Two LDC, namely Cambodia and Maldives, show CAGR of 80.9% and 96.5%. Other non-LDC countries indicate similar growth rates for the same period. For example, CAGR is 169.7% in Azerbaijan, 252.7% in Kazakhstan, 103.5% in India, 232.2% in Iran, and 165.7% in Viet Nam. However, it should be noted that the baseline figures of 2003 are very small to compare with.

Data extracted from E-05(Source: UNESCAP Statistics Division)

Broadband Internet per 100 populations			
Country/Name	**2003**	**2008**	**CAGR(%)**
Republic of Korea	23.701	32.1	6.3
Japan	11.722	23.7	15.1
Singapore	10.041	21.7	16.7
Malaysia	0.447	4.8	60.9
Kazakhstan	0.007	3.6	252.7
Viet Nam	0.011	1.5	165.7
Azerbaijan	0.005	0.7	169.7
India	0.013	0.5	103.5
Iran (Islamic Rep.)	0.001	0.4	232.2
Cambodia	0.003	0.1	80.9

6.2. Data comparison by regions and groups

6.2.1. Fixed telephone lines: regional and group average

As mentioned above, the growth of fixed telephone lines has decreased in general, especially in developed countries, but the rates have still been growing in some of the LDC. The average growth rate of telephone lines in ESCAP member countries is 4.2%, while there is one region which has a higher growth rate than other regions, namely South-East Asia with 19.6%. Within the region, three countries have high growth rates that pull the average up; Viet Nam, Indonesia and Myanmar with 43.6%, 28.8% and 13.4% respectively. Another observation finds that though average CAGR between 2003 and 2008 has been decreasing (-3.1%) in the Pacific (including Australia and New Zealand), there is almost no growth among SIDS. Finally, the LDC group as a whole has a high average CAGR rate of 11.7%. The analysis finds that Afghanistan (18.2%), Nepal (14.4%), and Myanmar (13.4%) are LDC with non-SIDS with a higher average CAGR.

6.2.2. Mobile cellular subscription: regional and group average

Even though the average CAGR of mobile cellular subscriptions in ESCAP member countries is 26.4%, the average CAGR of LDC is very high (88.5%). The detail shows that 10 out of 14 LDC exceed the ESCAP average. These include Afghanistan (101.3%), Bhutan (150.1%), and Nepal (105%). The growth rates of LLDC, and South and South-West Asia are also high at 68.1% and 51.6%, since Afghanistan, Bhutan, and Nepal are also included in both categories.

Another observation is the number of mobile subscription per 100 populations in 2008. Statistically, about half of the population of ESCAP member countries in Asia and the Pacific (50.6) now subscribe to mobile phone services. Moreover, data in North and Central Asia reported 106.2 subscribers per 100 populations in 2008. On the other hand, the 2008 data among SIDS showed lower numbers (16.8) of mobile owners. This data may confirm that overall difficulty of establishing mobile towers to cover thousands of islands spreading out in the Pacific.

6.2.3. Mobile cellular as share of total telephone: regional and group average

The relevant statistics data show that substitution of fixed telephones with mobile phones is very popular in some developing countries. The average 2008 mobile share among the total telephone lines are higher in LDC (95.1%), LLDC (84.9%) and SIDS (76.9%) than industrialized countries; these are all above the average of ESCAP (75.4%). The five-year growth rate among LLDC (19.8%) was the highest, growing from 34.4% to 84.9%.

Considering the geographical characteristics of landlocked regions, the mobile option seems to have communication advantages over fixed lines, based on the above observations. Other 2008 data shows the high mobile share in South and South-West Asia (87.1%) and North and Central Asia (81.3%). These areas cover many landlocked countries and mobile technology may have overcome many disadvantages of landlocked geographical conditions.

Another finding is that the 2008 data in East and North-East Asia (64.4%) is the lowest in the region, even though this area covers Japan and Korea, with advanced ICT infrastructure. Although they are advanced in ICT, statistics show that they still utilize the conventional communication infrastructure such as fixed telephone lines.

6.2.4. Internet users: regional and group average

The lowest Internet subscriber number is found in South and South-West Asia with 8.6 per 100 populations but data also shows the highest average CAGR between 2003 and 2008 of 27.8% in the sub-region. Within the sub-region, developing countries such as Afghanistan (83.7%), Maldives (31.5%), and Nepal (29.2%) have higher average CAGR in terms of the Internet subscribers. On the other hand, the highest number, 44.2, is found in the Pacific (including Australia and New Zealand), but the data indicates negative growth between 2003 and 2008 (-0.4%). As for developing country groups, while the ESCAP average in 2008 is 17.4, the average Internet subscriber number recorded among LDC, LLDC, and SIDS are below the average. The figure for LDC is particularly low at 0.6. Among LDC countries, most of the average CAGR is above the ESCAP average (19.8%) but two countries, Cambodia and Bangladesh, are at 13% and 13.8% respectively. LLDC in LDC such as Afghanistan, Lao, and Nepal shows good growth rates of 83.7%, 37%, and 29.2% respectively.

6.2.5. Broadband Internet: regional and group average

Data extracted from S-01(Source: UNESCAP Statistics Division)

Internet users :Regional and group average

Country/Name	2003	2004	2005	2006	2007	2008	CAGR(%)
ESCAP	1.1	1.6	2.1	2.7	3.3	3.9	30.0
East and North-East Asia	2.6	3.9	5.0	6.2	7.4	8.6	26.9
South-East Asia	0.13	0.20	0.31	0.47	0.87	0.93	48.0
South and South-West Asia	0.02	0.05	0.18	0.31	0.48	0.67	99.1
North and Central Asia	0.17	0.33	0.78	1.45	2.12	2.31	68.7
Pacific	2.3	4.6	8.8	16.2	20.8	22.0	57.1
LDC	0.000	0.001	0.002	0.005	0.028	0.020	145.2
LLDC	0.004	0.011	0.017	0.043	0.268	0.573	167.6
SIDS							-

The broadband users in these regions are still low with the 2008 ESCAP average of 3.9 per 100 populations. The highest 2008 number is the Pacific (including Australia and New Zealand) with 22, although data from 15 out of 21 countries in the Pacific have not been provided. South and South-West Asia indicate the highest average CAGR between 2003 and 2008 with 99.1%, but the absolute value of broadband users is very low with 0.67; i.e., roughly seven people out of 1000 have access to broadband.

In developing country groups although data has not been calculated of SIDS due to lack of information, other LDC and LLDC show very slow broadband growth. The figure for LDC in 2008 indicates the average of 0.02 per 100 populations, meaning that only 2 out of 10,000 people and five out 1,000 LLDC people have broadband access. It seems that there needs to be prioritization to establishing the penetration of Internet before accessing broadband.

7. Methodology of ICT connectivity

With the advancement of technology, ICT has improved drastically over the last decade. Technological developments continue to bring about significant changes in social, cultural, and economic life. In this chapter, the latest technologies are introduced to support identifying an appropriate ICT access solution for connecting un-connected and under-serviced areas of LDCs, LLDCs and SIDS in Asia and the Pacific, which cover wide ranges of geographical conditions. These technologies are categorized as broadband, wireless, and space technology, and each technology has limits in terms of bandwidth, reliability, cost, and area coverage. Combining its advantages, the hybrid technology may be the best solution to bridge the digital divide.

7.1. Trend and emerging technologies

For many decades, telecommunications services were delivered through fixed lines, which are reliable, and broadband, but they were expensive to install and time consuming to deploy. Fixed lines have been mainly diffused in major cities and highly populated areas; therefore, ICT was extraneous for people who live in rural areas because the cost of installation has been high and geographical obstacles, such as mountainous terrain, prevent the installation of cables.

The advent of wireless technology gives alternative means of telecommunication access to people who live in isolated areas. Wireless technology covers a wide range of areas without the use of physical cables for the last mile, and it is relatively easy to install the wireless equipment. The trend of wireless technology seems to be helping the expansion of access in rural and isolated areas in Asia and the Pacific. Although wireless technology has recently gained spotlight as possible solutions to various socio-economic challenges in the region, it may not be a perfect solution. Wireless coverage has expanded drastically, yet there are still limitations of access to areas such as sparsely populated plateau and remote islands on a commercial basis. To overcome this obstacle, an alternative solution might be to combine with space technology. Even though this satellite solution is costly, space technology can reach anywhere in the world.

7.2. Broadband technology (Fixed lines)

In general, broadband solutions can be classified in two groups; fixed line technology and wireless technology, since the emergence of wireless technology now makes broadband services available on the network. The fixed line solutions provide connection services from the service provider to end users on a physical network. The physical networks have evolved by expanding the bandwidth and increasing reliability from telephone cable, ADSL, to fiber optic cables. Considering the populations in large cities and geographical conditions, the most applicable physical access solutions for Asia and the Pacific are fiber optic cables and submarine cables as part of the national backbones.

7.2.1. Fiber optic cables

The replacement of traditional copper cables with fiber optic cables has been fueled by one of the fastest growing transmission technologies in terms of high bandwidth, long distance coverage, longer life expectancy, and lower system cost. Fiber optic cables are similar to copper cables, but one of the significant differences is fiber optic cables use light pulses, guiding the light introduced at one end of the cable through to the other end[v], to transmit data through fiber lines instead of using electronic pulses through copper cables. This innovative technology has made it possible to connect long distances with high bandwidth.

Fiber optic cables are classified into two groups, single mode and multi mode, and the differences are transmission speed and distance coverage. Single mode fiber, a relatively narrow diameter of cable, carries higher bandwidth than multimode fiber, which covers up to 50 times more distance than multimode[vi]. While multimode is made of thicker glass fibers, it promises high bandwidth at the high speed over medium distance at a lower cost than single mode. Fiber optic cables use an Internet protocol called IEEE 802.3, which is a part of Local Area Network (LAN) technology. IEEE 802.3 promises a relatively slower data transmission speed of 10 mbps, while IEEE 802.3u has a faster transmission rate of 100 Mbps. Recent technology made available to Gigabit transmission (1000 Mbps) called IEEE 802.3z has become the standard for fiber optic cables[vii]. The following table shows the different modes of IEEE 802.3 with different specifications[viii].

Table 1: Broadband Technology: Fiber Optic Cables Comparison[ix]

IEEE 802.3z Fiber Mode	Operating Wavelength (nm)	Fiber Core/Cladding Diameter (um)	Fiber Mode	Bandwidth (MHz*km)	Link Distance (m)
1000Base-SX	850	50/125	Multimode	400-500	500-550
1000Base-SX	850	62.5/125	Multimode	160-200	220-275
1000Base-LX	1300	50/125	Multimode	400-500	550
1000Base-LX	1300	62.5/125	Multimode	500	550
1000Base-Lx	1300	9	Single Mode	N/A	5000
1000Base-SLX	1550	9	Single Mode	N/A	10,000
1000Base-ELX/ZX	1550	9	Single Mode	N/A	70,000

7.2.2. Submarine cables

Submarine cables, consisting of fiber optics and electrical tubes are laid on the ocean floor to transfer electrical data between continents. Fiber optic cables become main network and have two systems; repeater systems and repeaterless systems. Repeater systems are network communication devices used to amplify the signals by introducing line optical amplifier in order to relay the data between long distances undersea[x]. On the other hand, repeaterless systems are more economical and reliable solutions for transmissions up to 380 km without using amplifiers which led to lower costs[xi].

The characteristics of submarine cables are similar to optical cables mentioned earlier; the major difference is that they run undersea and not underground. The deployment of submarine cables is emphasized in this section. Millions of kilometers of submarine cables are installed around the world connecting continents with high-speed data transmissions. For example, Fiber-Optic Link around the Globe (FLAG) runs the world longest cables, stretching from London via the Suez Canal, through India, along the coast of China to Japan[xii]. The total length is over 27,000 km, including 1020 km of two underground cables connecting 12 countries[xiii]. Another example is the Southern Cross cable, operated by Southern Cross network, to support hi-speed broadband connections in the Pacific. It has deployed 28,900 km of submarine cables and 1,600 km of underground cables, connecting Australia to the mainland U.S.A. via Hawaii and other islands in the Pacific[xiv].

Figure 1: Submarine Cables: FLAG Global Transmission Network[xv]

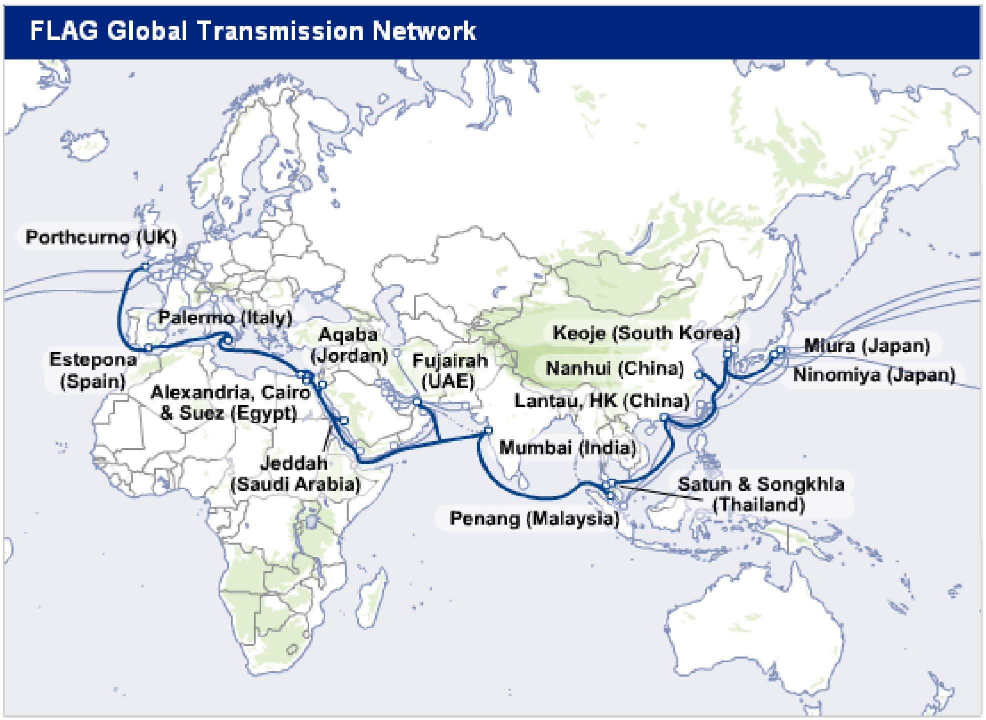
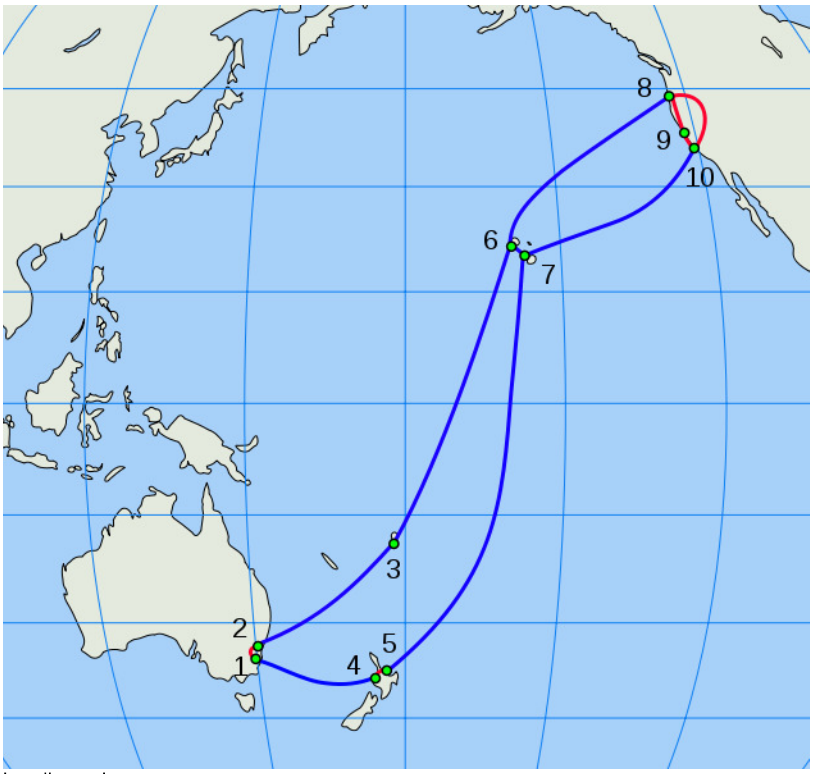


Figure 2: Submarine Cables: Southern Cross Cable[xvi]



Landing points

1. Alexandria, NSW, Australia
2. Brookvale, NSW, Australia
3. Suva, Fiji
4. Whenuapai, New Zealand
5. Takapuna, New Zealand
6. Kahe Point, Hawaii, USA
7. Spencer Beach, Hawaii, USA
8. Hillsboro, Oregon, USA
9. San Jose, California, USA (Terrestrial Connection only)
10. Morro Bay, California, USA

7.3. Wireless technology

Wireless technology uses radio or microwave in various frequencies between 2.5 and 43 GHz to provide a connection between a service provider site and end user receivers[xvii]. There are a wide range of frequencies upon which wireless technology can operate, depending on licensing which is ruled by governments. In general, higher frequencies have more advantages than lower frequencies. Higher frequencies can transmit more bandwidth, but they also become easier to attenuate, meaning that transmission cannot travel easily through obstacles such as bad weather conditions. While lower frequencies are more effective when transmitting through obstacles, the transmission rate is lower[xviii]. Wireless technology can be classified into two main categories; wireless computer networks and cellular system. The most notable access methods in each category are introduced in this paper; they are WiFi and WiMax for wireless network computer, and GSM and 3rd Generation for cellular systems.

7.3.1. WiFi

WiFi is one the most popular methods of wireless access, consisting of at least one base station and client servers. Base stations are also called access points[xix], and a computer with WiFi equipment can connect to the Internet when it is within the area covered by WiFi signals, commonly called hotspots. Transmission rates are between 11Mps and 54 Mps, and WiFi network operates in the 2.4 and 5GHz radio band[xx]. This system is currently installed in many urban densely populated places, and some suburban areas. It could be applicable to rural areas where fixed lines are already deployed, and will allow expanded access cover areas from the end of fixed lines.

7.3.2. WiMax

WiMax is an emerging technology and believed to be the next generation of WiFi. The method of access is similar to WiFi with base stations and client servers. By eliminating WiFi's shortcomings, for example, limited coverage area, WiMax covers long distance up to 50km[xxi]. Transmission rates are up to 80Mbps[xxii], which also exceeds the maximum speed of WiFi. A WiMax system can cover a wide range of areas such as high altitude rural mountains and isolated islands. However, because this is a new technology, the implementation costs are still high. If this obstacle is removed, WiMax can be installed in many rural areas where there is no ICT access.

Table 2: Wireless Technology: WiFi WiMax Comparison[xxiii]

	Standard	Frequency (GHz)	Speed (Mbps)	Range	Advantages	Disadvantages
WiFi (a)	802.11a	5	54	50m	Speed	Cost
WiFi (b)	802.11b	2.4	11	100m	Low Cost	Speed
WiFi (g)	802.11g	2.4	54	100m	Speed	Cost, Range
WiMAX	802.16	2~66	80	50km	Speed, Range	Cost

7.3.3. GSM (Global System for Mobile communication)

GMS is a digital cellular technology used for used for transmitting voice and data[xxiv]. GSM methodology, which is considered a second-generation mobile network (2G) deals with compressed digitalized data, a switch from analog, as first generation (1G) to digital. Since it is digital, it can handle a wider variety of features such as voice, fax, and paging and short message services[xxv]. GSM provides data transmission of 9.6 kbps and uses the 900 MHz and 1800 MHz[xxvi]. Terrestrial GSM networks cover more than 80% of the world's population in more than 218 counties[xxvii].

7.3.4. 3rd generation mobile network

In the last decade, the 2nd generation systems have evolved into the 3rd generation mobile network (3G) by way of 2.5G and 2.75G (See table below). 3G was a program originated by the ITU (International Telecommunications Union) under the IMT-2000 (International Mobile Telecommunication-2000) project[xxviii]. An improved feature in 3G is that it supports higher data transmission rates of 144 kbps to 2 Mbps and 1885 MHz to 2200 MHz of frequency band.[xxix]This system is also designed to offer increased capacity, which makes it able to process high speed data application and to serve voice calls simultaneously.

Table 3: Wireless Technology: GSM 3G Comparison[xxx]

Standard	Generation	Frequency band	Throughput
GSM	2G	Allows transfer of voice or low-volume digital data.	9.6 kbps
GPRS	2.5G	Allows transfer of voice or moderate-volume digital data.	21.4-171.2 kbps
EDGE	2.75G	Allows simultaneous transfer of voice and digital data.	43.2-345.6 kbps
UMTS	3G	Allows simultaneous transfer of voice and high-speed digital data.	0.144-2 Mbps

7.4 Space technology

Space technology keeps advancing as technology of data compression and electronic transmission improves. Although terrestrial networks such as fiber optic cables and wireless networks are proliferating on the ground, they haven't reached "last mile" in a number of communities and might not expand to provide such services where the commercial and technological viability can't be established. Therefore, satellite services are also considered a very important method to support economic and social improvement in Asia and the Pacific to fill these gaps. Applying space technology may be able to overcome traditional geographic and social barriers by providing ICT access from space. In this chapter, VSAT, the most significant space technology is introduced.

7.4.1. VSAT

VSAT technology is a two-way communication system using satellites. The network consists of satellite ground stations, satellite communication link and VSAT receivers which are located in geographically challenged areas throughout the world [xxxi]. Since VSAT is a satellite-based communication method, it helps bring access to remote and isolated communities. The transmission rate is 4Mbps [xxxii]. Because the transmission rate is lower, it is mainly used for telecommunication and data transmissions. Other wireless technologies still require fixed lines connected to a base station, while VSAT communicates directly to satellites wirelessly.

7.5. Issues for consideration; mobile phones

Cellular systems such as mobile phones have become one of the most common methods of wireless communications in the world. Furthermore, the trend of mobile phones displacing fixed lines has made the technology accessible to millions of people in rural areas who previously had to wait for fixed lines. The reason for the rapid increase of mobile phones in developing countries is the same as for developed countries. They are convenient and can be reached anytime and anywhere. Moreover, the literacy rate of people who live in rural areas of developing countries may not be high, so voice based communication appears to fill their needs of accessing ICT by talking on the wireless phone.

There are other features which attract rural people, such as pre-paid systems, short message service (SMS), and basic Internet services. The third generation mobile phones (3G) have become increasingly accessible even among developing countries, and they have improved the wide band digital communications of the second generation. The fourth generation mobile phones (4G) aim at additional broadband, and could allow mobile phones to broadcast visual audio programs[xxxiii]. The expansion of bandwidth and lowering costs are the key issues for further deployment of mobile phones in developing countries.

8. The case studies of ICT implementation projects in Asia and the Pacific

In this chapter, the current status of ICT initiatives, both regional and national projects in Asia and the Pacific, are introduced as case studies based on reports published by development agencies such as international organizations, private sector, financial institutions, and research institutes. The aim of this section is to present a quick overview of what is being done by reviewing the previous or on-going initiatives in Asia and the Pacific, and to help identify what could be further needed in the region. The projects are primary selected with focus of LDC, LLCD, and SIDS.

8.1 Regional ICT Implementation Projects

Regional projects are relatively large scale, consisting of several neighboring countries in the regions. Those member states cooperate with each other to improve information infrastructure not only within the country but also between countries. The projects target broader development challenges which impede developing countries from prospering, such as enhancing education, health, and infrastructure. By implementing ICT solutions, those projects also provide strong interconnections between neighboring member states to expand economic opportunities by facilitating the movement of goods, services and information.

Figure 3: Sub-regional Cooperation Initiatives[xxxiv]

8.1.1. South Asia Sub-regional Economic Cooperation (SASEC)

South Asia Sub-regional Economic Cooperation (SASEC), was established in 2001 by Bangladesh, Bhutan, India (Northeastern region) and Nepal with the support of Asian Development Bank (ADB), and aims to promote sub-regional cooperation in priority areas such as transport, tourism, and ICT. The SASEC Information Highway project is one of their core projects, by enhancing the availability of broadband connection among the countries. The project consists of three key components: 1) establishing SASEC regional networks to integrate the member countries to reduce cost, 2) building village networks to expand broadband wireless connectivity to rural communities to improve better accessing services such as tele-medicine, e-learning, and e-government services:

and 3) setting up regional research and training centers to share and integrate information, knowledge, and services among the member countries[xxxv].

Figure 4: Information Superhighway map, SASEC[xxxvi]

The cost of this Information Highway project is estimated at 24 million (USD) and the projected term is accounted as two years[xxxvii]. The thrust of this project is the deployment of fiber optic cables between the countries and development of village networks. By implementing fiber optic cables through the SASEC region, the project intends to achieve cross boarder ICT connectivity in the sub-region. It has been estimated that over 600 km of fiber optic cables are required for the project, 55 km in Bangladesh, 133 km in Bhutan, and 433 km in India[xxxviii]. In order to link to this SASEC regional network, the ICT access enables reaching into the rural areas by establishing village networks in the four SASEC countries. The village network will enable Community e-Centres, in villages to become access points and to be linked with the regional network; and once a village is connected to the SASEC village network, it will be able to generate and maintain information by using the SASEC regional network. Plans are to build 110 CeCs: 30 each for Bhutan and Nepal, and 25 each for Bangladesh and India[xxxix].

8.1.2. Greater Mekong Sub-region (GMS) Economic Cooperation Program

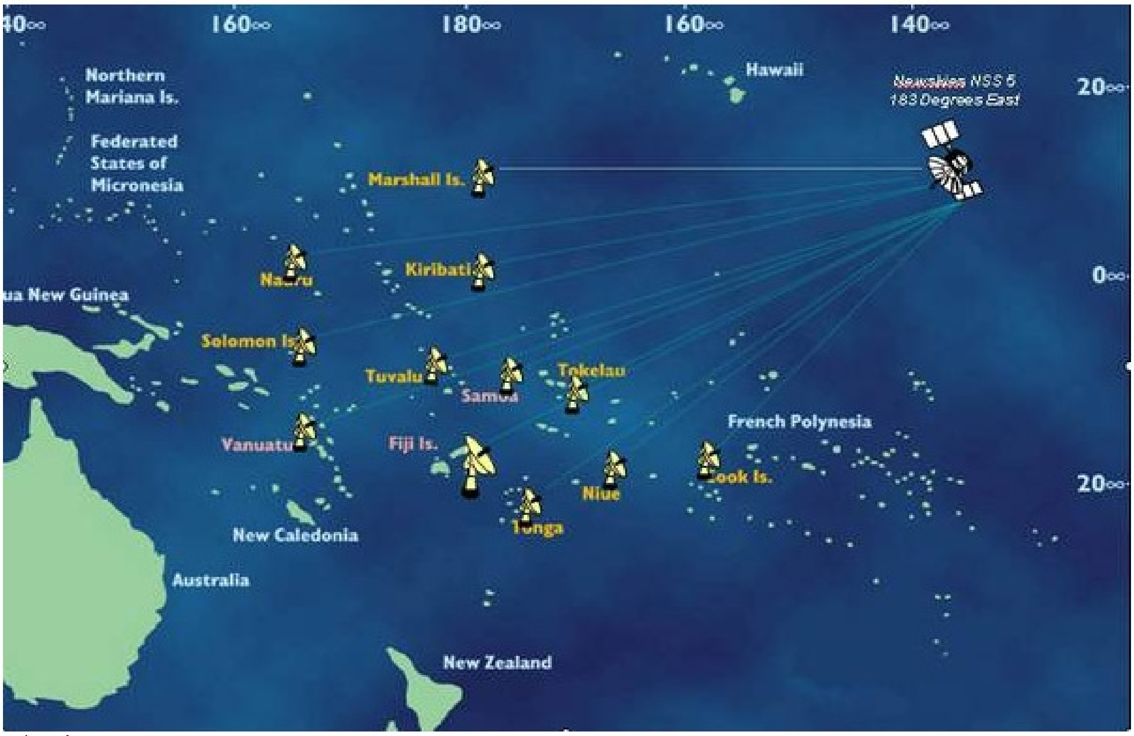
GMS consists of the countries along the Mekong River, including Cambodia, Lao PDR, Myanmar, Thailand, China (Yunnan Province) and Viet Nam which collaborate to achieve economic development in the sub-region. The program was formed with the help by ADB in 1992, and as a result of the project, improvements have been reported in various sectors, such as infrastructure, health education and business. Recent developments in the area of ICT include Information Superhighway Network (ISN)[xl], building modern interconnected telecommunication systems by deploying fiber optic cables throughout the sub-region. The goal of the project is to provide a high quality communication link in the sub-region to reduce the cost of telecommunication services and improve overall network reliability. The project budget is estimated to be approximately USD 66 million, and the projected term was four years from 2006 to 2010[xli]. The deployment of fiber optic cables within the sub-region is roughly 3600km.[xlii] The program also works for the development of rural communication, spending USD 0.8 million and four years establishing pilot communities among the GMS countries.[xliii]

Figure 5: Map of Greater Mekong Subregion[xliv]

8.1.3. Creation of Pacific Information Superhighway with the University of the South Pacific Network

The University of the South Pacific (USP), which established their main campus in Fiji in 1986, has expanded its reach in the Pacific region to 12 member countries (Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Samoa)[xlv] through the use of ICT. Taking into consideration disadvantageous geographical conditions of scattered throughout the Pacific Ocean, the program has successfully established satellite campuses in each member country[xlvi]. With the collaboration of ADB which funded USD one million, USP has implemented ICT based education, which forms part of Pacific Information Superhighway. Currently, the student body of USP is 22,000 and approximately half participate in distance and flexible learning (DFL)[xlvii]. There are 14 satellite campuses in the region providing satellite-based technology such as audio, videoconferences, E-curriculums, E-learning materials, and Internet services.

Figure 6: Coverage of USPNet[xlviii]



8.1.4. Central Asian Gateway (CAG)[xlix]

With the support of ADB and UNDP, the CAG project was launched to improve telecommunication systems in five countries in Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The project provided online access. Ten thousand visitors used the system in 2003[l] and 17,000 users came in 2004[li]. The program will expand to include the remaining CAREC members such as Afghanistan, Azerbaijan, and Mongolia[lii].

8.1.5. Innovative Information and Communications Technology in Education, and Its Potential for Reducing Poverty in the Asia and Pacific Region

The project, supported by ADB in a two year program with USD 0.92 million, is a pilot study for ICT in education, and aims to reducing the digital divide and poverty by promoting the spread of knowledge to remote areas. Selected member countries are Bangladesh, Mongolia, Nepal and Samoa, which represent unique characteristics of Asia and the Pacific, ranging from a country with highly populated area (Bangladesh), to a wide flat area (Mongolia), a mountainous terrain (Nepal), and an isolated island (Samoa).

The pilot studies are made up of three components: 1) implementation of studies to help developing ICT policy and strategy, 2) implementation of specific pilot studies in those selected member countries, and 3) supporting the series of ICT in education related international conferences held by ADB[liii].

The pilot project in Mongolia and Samoa is focused on e-resource such as helping to identify the best way to distribute e-textbook. On the other hand, the pilot project in Bangladesh and Nepal is more focused on e-teacher, topics including how to facilitate decentralized teacher training strategy and information sharing in remote schools. After conducting pilot projects, they have learned that there was a need for sharing updated information in order to help financial donors identify the cost effective solutions.

8.1.6. PAN Localization

Although the Internet has been dominated by English, only 5% of people in Asia understand English[liv]. Promoting the acceleration of ICT usage in Asia and the Pacific, language localization is one of the solutions, and the project has been initiated with support from the International Development Research Centre (IDRC). The targets of language localization member states include 11 countries. However the project began in 2007 and is supposed to end in 2011. There is no updated documentation on the web.

8.1.7. PAN Asia Networking Distance and Open Resource Access

Since more than half of the world's population is converged in Asia and the population has grown rapidly, educational systems will become further strained. With the support of PANdora and IDRC, the project is set up to deliver distance learning technology in 11 member states in Asia[lv].

There are also private sector initiatives to expand ICT access to remote and rural areas. Here is one example illustrated in the below box.

Box 1: Nokia Siemens Networks Village Connections

Nokia Siemens Networks Village Connections

Close to three billion people, roughly half of the population lives in rural areas of world, and around 60 % of the population of Asia lives in villages[lvi]. People who live in rural areas need access to ICT to gain economic and social benefits that technology can bring in. In order to help achieve the WSIS commitments, Nokia Siemens Networks, a global telecommunication enterprise, has launched a project called "Village Connection". The purpose of the project is to provide mobile communication to those three billion unconnected people. The growth of mobile subscriptions has been skyrocketing, surpassing the subscription of fixed telephone lines. Currently there are 2.5 billion mobile subscribers, mostly in urban areas in the world[lvii], and Nokia Siemens has attempted to bring mobiles to the next billion, targeting those rural areas.

There will be many obstacles deploying mobile access to rural areas. Nokia Siemens Networks considers cost as the most challenging hurdle; they focused on reducing cost of products and implementation. Recent trends and dissemination of mobiles have reduced the cost to own and use a mobile phone from 11 USD to 5 USD in 2years[lviii]; however, those people who live in rural can spend only 2-3 USD per month[lix]. To meet this demand of limited allowances, the first Village Connection was deployed and has been tested in India since 2005. This pilot test has succeeded by reducing the implementation cost by applying Global System for Mobile (GSM) as the access point. GSM Access points (GAP)[lx] provide wide area coverage in the villages; access points can cover the radius of 20-30 km, which led to a reduction in building costly antenna towers [lxi]. The pilot project demonstrated that village subscribers generated 400 calls per day by 40 users[lxii]. Village Connection with Internet Kiosk also provides solutions that bring voice, Short Message Service (SMS), and Internet access to rural locations. After the first successful pilot project in India, Nokia Siemens Networks initiated approximately 50 pilot projects in Africa, the Asia and the Pacific and Latin America[lxiii].

In 2009, in collaboration with ITU, Nokia Siemens Networks initiated another test in the Pacific where challenges of distances, water, and geography make implementation more complex[lxiv]. In this pilot, they focused on three key areas, delivering low-cost services and bringing the business mode to rural areas[lxv]. Early and current trials indicate that Village Connection projects and technology will have great potentials to provide affordable solutions and enhance the WISIS commitment by providing mobile communication to next billion in rural areas.

8.2. National ICT Implementation Projects

Compared to regional projects, national projects are relatively small scale with limited budgets; however, the target area is more focused. Some examples of national level ICT projects are introduced below and include not only the project funded byinternational institutions but also by non-governmental organizations and private enterprises.

8.2.1. Nepal: ICT Development Project

Nepal, both LDC and LLDC, is located where the Himalaya mountain range runs, and about 24 million[lxvi] people are spread throughout the mountainous and hilly areas, which hinder sustainable growth and development. This has been an obstacle to accessing information and obtaining opportunities. To solve this problem, ADB, which provided USD 25 million, has initiated the ICT implementation, primarily in rural areas. The expected project completion date is June 2014.[lxvii]

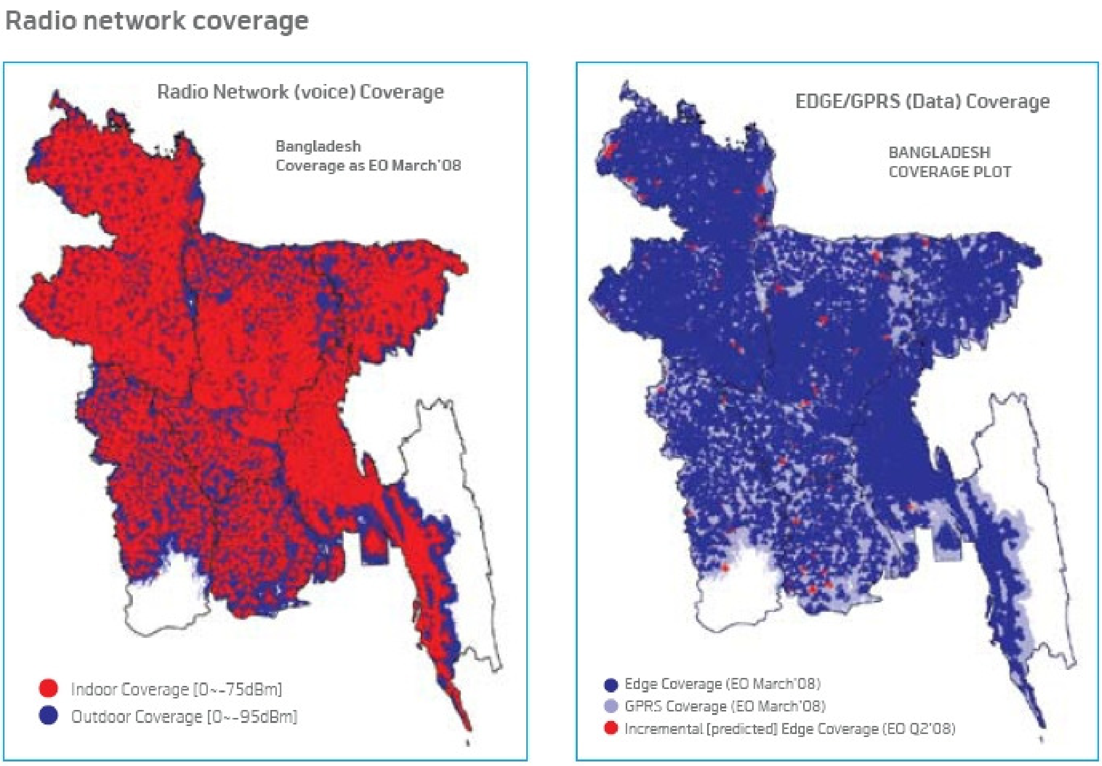
Figure 7: ICT dissemination in Nepal [lxviii]

The project comprises four categories, of which "Rural E-community" is one. Rural E-Community focuses on four areas; 1) Wireless Broadband Network, 2) Village Networks, 3) Telecenters, and 4) Community Mobilization and Capacity Development [lxix]. The target areas are 38 out of 75 rural districts, and the project is supposed to deploy wireless networks and establish 114 telecenters in those districts. The project also plans to build village networks in 11 districts. It has been estimated that the project, if completed, would reduce the geographical barrier from accessing ICT in rural areas.[lxx]

8.2.2. Bangladesh: Telecommunication Assistance Project (GrameenPhone)

In support to improve telecommunication networks in Bangladesh, World Bank initiated the Telecommunication Assistance Project in 2003.The project goal aims to separate the policy and operational role of the government by restructuring Bangladesh Telegraph and Telephone Board (BTTB) and the Ministry of Post and Telecommunications (MOPT)[lxxi]. World Bank also helped to support the private telecommunication firms, such as GrameenPhone, to accelerate the dissemination of mobile phones throughout the country.

Figure 8: GrameenPhone Network Coverage in Bangladesh[lxxii]



GrameenPhone has made major progress with expansion of mobile phones by a village phone program. As of 2007, the project provided mobile phones to approximately 50 million people, established 500 Community Information Centers (CIC), and provided the network signal to over 90 percent of the population[lxxiii].

8.2.3. Cambodia: Improved Access to Communication in Rural Cambodia

Although the population of Cambodia in 2006 was 14.4 million, 18 percent live in urban areas and 82 percent live in rural areas. Approximately 50 percent of mobile subscribers are converged in the urban area[lxxiv]. The objectives of the project, supported by the World Bank, are to bring basic communication services to low-income families in rural areas, and to demonstrate output-based aid (OBA)[lxxv]. The target areas are four rural provinces located in north and northwestern Cambodia, Pursat, Preah Vihear, Otdar Meanchey, and Banteay Meanchey.[lxxvi]

Table 4: Statistics of the providences, Cambodia[lxxvii]

Province	Total Population	Districts	Communes	Villages
Banteay Meanchey	680,251	8	64	635
Otdar Meanchey	147,913	5	24	231
Preah Vihear	143,565	7	49	208
Pursat	391,481	6	49	501

Table 5: Estimated numbers of beneficiaries in the provinces, Cambodia[lxxviii]

Province	Expected number of beneficiaries[5]	Districts	Communes	Villages
Banteay Meanchey	105,997	7	13	136
Otdar Meanchey	61,944	4	11	72
Preah Vihear	41,860	7	24	99
Pursat	51,168	3	[6]	45
Total	**260,969**	**21**	**52**	**352**

The budget of USD 2.5 million and 3.5 year project duration are expected to ensure provision of public access points to 80 percent of the villages in the targeted provinces[lxxix], and the total expected beneficiaries are estimated at 261,000 people or 52,200 households[lxxx].

8.2.4. Maldives: Mobile Cell Broadcasting for Commercial Use and Public Warning

The Maldives is located in the Indian Ocean where natural disasters such as tsunamis and floods often occur. It is a country of 1192 islands and 290,000 citizens, and is heavily reliant on fishing and tourism[lxxxi]. Because of rising sea levels and climate changes, the country could face ecological and environmental problems. It is estimated that Male, capital of Maldives, will be 15 percent inundated by seawater by 2025 and 50 percent by 2100[lxxxii]. Facing a serious future and unexpected natural disasters, citizens and tourists must be warned of any disaster events, since tourism contributes to more than 30 per cent of the country's income.

The Maldives used microwave transmission networks[lxxxiii] for disaster warnings, but many of the networks were damaged by the tsunamis in 2004. Therefore, Telecommunications Authority of the Maldives (TAM) has launched a study of sending warning messages, the so-called "Mobile Cell Broadcasting" supported by UNDP. A pilot study has been conducted and at this stage a message can be sent to a mobile network covering 42 locations with approximately 500 users[lxxxiv]. Conventional warning systems such as sirens and loud speakers are costly since they require installing them on every island. Radio and TV broadcasting are more ubiquitous tools to announce a public warning, but they are less applicable to providing information in timely manner. TAM is currently considering sending commercial information, including service, airport, and tourist information[lxxxv]. Mobile broadcasting is cost effective and flexible enough to provide information timely and this will lead to a next generation of public warning systems.

8.2.5. Indonesia: e-Indonesia

Indonesia, consisting of more than 17,000 islands with an estimated population of 230 million people, has its own characteristics in developing ICT infrastructure. One of the unique characteristics is the ICT initiative implementation which is supported by private and non-governmental sectors.

Before 1994, only two players in the Indonesian telecommunication sector existed: Telecommunication Indonesia (Telkom) and Indonesian Satellite Corporation (Indosat). During the last decade, several telecommunication service providers were established and they promoted their own projects[lxxxvi]. In 2003, the Ministry of Communications established an independent government institution called Indonesian Telecommunication Regulatory Body (BRTI)[lxxxvii].

8.2.6. Sri Lanka: e-Sri Lanka

If successful ICT policy and implementation are political commitments from a top level approach[lxxxviii], e-Sri Lanka will follow this in terms of strong government initiatives. e-Sri Lanka, coordinated by Information and Communication Technology Agency (ICTA), has been successful with ICT initiatives, and this model assists other e-governments such as in India, Brazil, Ghana, Pakistan, and Rwanda[lxxxix]. Found in 2003, ICTA has provided leadership to accelerate the process of ICT form economic reform and growth. Since it is an independent organization, ICTA oversees the rigidity of the government bureaucracy, and is more flexible and responsive to fast changing technology of ICT implementation[xc].

The e-Sri Lanka project was started by initiatives of ICTA and has the support of World Bank with 83 million USD budgeted over a 5 year project[xci]. The vision of e-Sri Lanka is "to bring the advantages of ICT to every village, to every citizen, to every business, and to transform the way government works"[xcii]. This vision has led to active and successful implementation of ICT, The most prominent projects are called Nenasala (telecenters) and e-Villages. Both projects devote ICT implementation in rural areas; this is characterized by a bottom-up approach, and aims to meet the goal of WSIS.

Box 2: e-Choupal Rural Transformation

e-Choupal: Rural Transformation

The e-Choupal, one of India's largest rural ICT initiatives, was launched in 2000 by a domestic conglomerate, Indian Tobacco Company. The purpose of this project is to improve efficiency in the rural agricultural sector by promoting ICT. Despite the fact that agriculture shares 23% of India's GDP and employs 66% of its workforce, those rural areas severely suffer from weak ICT infrastructure[xciii]. The model was designed to serve farmers as a social gathering place (choupal means gathering place in Hindi)[xciv] and using information technology provide them appropriate information such as weather, news, and market prices for their agricultural products. Six e-Choupals pilot projects were conducted in central India and a typical e-Choupal supports about 600 farmers in 10 villages within a 5 km distance.[xcv] e-Choupal consists of a PC with Windows platform, connection lines of either telephone line or VSAT, and power supply with UPS[xcvi].

In six years, the project successfully expanded to 5400 e-Chouapl across six states serving 35,000 villages with more than 3.5 million farmers growing commodities such as soybeans, coffee, wheat, and rice[xcvii & xcviii]. As a result of project implementations, transaction costs have been reduced from 8% to 2% and the farmer price realizations have grown from 20% to 25%. Accessing and exchanging of market information reduces rural isolation, and create market transparency. By bridging the gap of real time information access to the poor and illiterate farmers, e-Choupal becomes a reliable ICT platform by promising a low cost and a highly effective channel of distribution of goods and services into rural areas. ITC plans to expand e-Choupal to 15 states in over 100,000 villages by 2012.[xcix] Since e-Choupal has been one of the most successful ICT rural transformations, other developing countries have attempted to replicate the model, especially in African countries, such as Uganda, Senegal, Tanzania, and Kenya.[c]

9. Recommendations

Although various development agencies have been implementing ICT initiatives in Asia and the Pacific, it is still challenging to reach the goal of WSIS by 2015 and narrow the digital divide. After reviewing the statistics figures and some past and current ICT projects both at the national and regional levels, it seems that many developing countries still face common challenges in expanding ICT access. The following approaches are recommendations for accelerating ICT access expansion effectively and efficiently in Asia and the Pacific in the coming years.

9.1. Horizontal approach: Strengthen regional cooperation

With over half of the world populations, various geographic areas persisting digital divide and income gaps in Asia and the Pacific, it is almost impossible to introduce a single holistic ICT solution, while there may be so much each country, especially LDCs, LLDCs and SIDS, can do. From the analysis of ICT statistics in the earlier chapter, data shows that there are distinctive trends by region and LDC groups. It can be assumed that those regions and groups may have similar situations and obstacles which prevent successful ICT deployment. The obstacles include geographical conditions, social exclusion, limited financial resources, and/or education levels. To a varying degree, the combinations of those obstacles exist among LDCs, LLDCs and SIDS throughout the region and it is important to identify commonalities and overlapping areas of particular problems in geographic regions and LDC groups. To find common challenges among the regions and groups and address the challenges, countries could cooperate with each other by sharing information and experiences.

9.2. Vertical approach: Consolidate seamless connections

Judging from regional and national ICT project reports, a variety of initiatives have attempted implementation of ICT initiatives in a wide range of scope and scale and focused on a number of ICT access modes. Scales range from the regional, to community level, and ICT access mode vary from fixed telephone line and wireless to satellite technology. Various ICT networks have been established by many developing agencies in different areas at different times, thus not necessarily ensuring inter-connection for the maximum benefits of such a variety of networks.

Therefore, when an implementation stage and level of ICT access initiative is reviewed vertically, many disconnects are found which could have been addressed if carefully planned. This disconnected networks and independent ICT projects of different scale discourage the countries to ensure that the national ICT policy is implemented for maximum impacts and ensure people benefits from existing infrastructure and services. Although adaptation rates of technology vary from a country to another, seamless and sustained network connections should be consolidated throughout the country. Therefore, various aid agencies need to carefully plan ICT initiatives to contribute to the big picture.

10. Conclusion

Based on the above preliminary research on the current status of the digital divide, latest and emerging technologies, and ICT for development initiatives in Asia and the Pacific, this report concludes that the LDCs, LLDCs and SIDS still face numerous difficulties in terms of implementation of ICT initiatives, introducing ICT access and assessing the ICT access need of people in the region. This report then recommends holistic and comprehensive ICT implementation approaches among the developing countries of Asia and the Pacific, namely 1) reinforcing regional cooperation initiatives, 2) adopting appropriate technologies and maximizing the benefits of existing infrastructure and initiatives, and 3) raising public awareness.

First, when proposing ICT implementation, geographical features in Asia and the Pacific may be one of the most important factors. From coastal regions to mountainous terrains, jungles and vast flat lands, Asia and the Pacific are blessed with wonderful geographic diversity and natural endowment. At the same time, these conditions could place obstacles to achieve social and economic development, and create income gaps and the digital divide between people living in urban and remote areas. In order to share experiences, challenges and good practices in common among LDCs, LLDCs and SIDS, regional cooperation should be further encouraged

Second, since development agencies have recognized the importance of ICT in economic and social development, and striving for the effectiveness of ICT in accelerating socio-economic development, the provisioning of ICT services have been built into development strategies in a number of member states. Recent developments in wireless and mobile technologies have opened up new possibilities of allowing the un-connected and under-serviced people to access ICT at a faster rate with lower costs than with the traditional methods. Furthermore, the latest satellite technology promises to connect any place around the world. Therefore, selecting and combining technologies is the key solution to expand and sustain the last mile connectivity.

Third, from the end users' perspective, raising public awareness and creating demand are important factors to determine the sustainability of ICT initiatives. It is essential to identify what is urgently needed by end users and which mode of access will be suitable for the people to fill the last mile gap.

Cost effective and socio-economically beneficial ICT applications contribute to reduce the social divide and improve quality of life through enhanced access to health services, sustainable development and other benefits of ICT; therefore, providing access to information and ICT services should remain a high priority in Asia and the Pacific. It is hoped that this paper succeeded to provide sufficient background information regarding the current digital divides, and major ICT for development initiatives in Asia and the Pacific, and help identify obstacles and solutions for broad based ICT for development initiatives in the region.

Appendix

Table 6.1.1. Fixed-telephone in National level

Data extracted from E-01(Source: UNESCAP Statistics Division)

Fixed telephone lines per 100 populations			
Country/Name	2003	2008	CAGR(%)
Australia	52.6	44.5	-3.3
Republic of Korea	53.3	44.3	-3.6
Japan	47.3	40.2	-3.2
Nepal	1.4	2.8	14.4
Myanmar	0.8	1.4	13.4
Bangladesh	0.5	0.8	10.9

Table 6.1.2. Mobile cellular subscribers in National level.

Data extracted from E-02(Source: UNESCAP Statistics Division)

Mobile subscribers per 100 populations			
Country/Name	2003	2008	CAGR(%)
Australia	72.1	105.0	7.8
Republic of Korea	71.2	94.7	5.9
Japan	68.1	86.7	5.0
Pakistan	1.5	49.7	101.0
Uzbekistan	1.2	46.5	106.2
Bhutan	0.4	36.5	150.1
Tajikistan	0.7	34.4	115.1
Afghanistan	0.9	29.0	101.3
Nepal	0.3	11.3	105.0
Turkmenistan	0.2	6.9	103.9

Table 6.1.2. Mobile cellular subscribers in National level

Data extracted from E-02(Source: UNESCAP Statistics Division)

Mobile subscribers per 100 populations			
Country/Name	2003	2008	CAGR(%)
Kazakhstan	8.9	96.1	61.0
Azerbaijan	12.7	75.0	42.6
Armenia	3.7	61.0	74.8
Uzbekistan	1.2	46.5	106.2
Kyrgyzstan	2.7	40.1	71.5
Mongolia	12.8	34.7	22.0
Tajikistan	0.7	34.4	115.1
Afghanistan	0.9	29.0	101.3
Bangladesh	0.9	27.9	97.8
Lao PDR	2.0	23.8	64.6
Nepal	0.3	11.3	105.0
Turkmenistan	0.2	6.9	103.9

Mobile subscribers per 100 populations			
Country/Name	2003	2008	CAGR(%)
Singapore	86.1	138.1	9.9
Fiji	13.4	71.1	39.5
French Polynesia	24.3	70.4	23.8
Tonga	11.1	48.8	34.3
Samoa	5.9	48.1	52.2
Micronesia (F.S.)	5.4	24.8	35.4
Vanuatu	3.8	11.1	23.9
Papua New Guinea	0.3	4.6	72.3
Solomon Islands	0.2	2.1	54.2
Marshall Islands	1.1	1.3	3.7
Kiribati	0.6	0.8	8.0
Cook Islands	18.4		-
Nauru			-
Niue	34.5		-
Palau			-
Tuvalu			-

Table 6.1.3. Mobile cellular as share of total telephone in National level

Data extracted from E-03(Source: UNESCAP Statistics Division)

Mobile share of total telephones Percentage			
Country/Name	2003	2008	CAGR
Cambodia	94.1	98.9	1.0
Afghanistan	84.5	98.7	3.2
Bhutan	8.8	90.1	59.1
Tajikistan	16.3	87.4	40.0
Uzbekistan	15.7	86.8	40.7
Kyrgyzstan	25.9	81.8	25.9
Nepal	18.1	80.2	34.8
Turkmenistan	2.4	43.2	78.4
Myanmar	15.5	34.6	17.5

Table 6.1.4. Internet users in National level

Data extracted from E-04(Source: UNESCAP Statistics Division)

Internet users per 100 populations			
Country/Name	2003	2008	CAGR(%)
Republic of Korea	65.9	77.8	3.4
Japan	48.4	69.2	7.4
Singapore	53.8	67.3	4.6
Malaysia	35.0	62.6	12.3
Cambodia	0.3	0.5	13.0
Bangladesh	0.2	0.3	13.8
Myanmar	0.0	0.1	27.3
Timor-Leste		0.1	

Table 6.1.5. Broadband Internet in National level

Data extracted from E-05(Source: UNESCAP Statistics Division)

Broadband Internet per 100 populations			
Country/Name	2003	2008	CAGR(%)
Republic of Korea	23.701	32.1	6.3
Japan	11.722	23.7	15.1
Singapore	10.041	21.7	16.7
Malaysia	0.447	4.8	60.9
Kazakhstan	0.007	3.6	252.7
Viet Nam	0.011	1.5	165.7
Azerbaijan	0.005	0.7	169.7
India	0.013	0.5	103.5
Iran (Islamic Rep.)	0.001	0.4	232.2
Cambodia	0.003	0.1	80.9

Table 6.2.1. Fixed telephone lines in regional and group average

Data extracted from S-01(Source: UNESCAP Statistics Division)

Fixed telephone lines: Regional and group average							
Country/Name	2003	2004	2005	2006	2007	2008	CAGR(%)
ESCAP	13.4	14.8	16.1	16.5	16.4	16.4	4.2
East and North-East Asia	23.5	26.5	28.8	29.5	28.9	28.7	4.1
South-East Asia	5.5	6.9	8.4	10.7	11.6	13.4	19.6
South and South-West Asia	5.1	5.4	5.9	5.4	5.3	5.2	0.3
North and Central Asia	19.9	21.2	22.1	24.0	24.4	24.5	4.3
Pacific	39.0	38.2	36.7	35.8	34.8	33.3	-3.1
LDC	0.6	0.7	0.9	0.9	1.0	1.1	11.7
LLDC	5.6	6.0	6.3	6.6	6.9	7.1	4.6
SIDS	5.0	5.0	5.1	5.1	5.1	5.1	0.047

Table 6.2.2. Mobile cellular subscription in regional and group average

Data extracted from S-01(Source: UNESCAP Statistics Division)

Mobile subscribers :Regional and group average							
Country/Name	2003	2004	2005	2006	2007	2008	CAGR(%)
ESCAP	15.7	20.1	25.4	32.4	41.0	50.6	26.4
East and North-East Asia	26.9	31.7	35.9	40.8	46.9	52.7	14.4
South-East Asia	15.0	21.1	26.8	33.9	50.6	69.1	35.7
South and South-West Asia	4.4	6.3	10.2	17.6	25.6	35.1	51.6
North and Central Asia	18.3	36.7	60.2	78.7	89.9	106.2	42.1
Pacific	53.4	60.8	67.7	72.1	78.5	81.3	8.8
LDC	0.9	1.8	4.6	9.4	16.6	21.7	88.5
LLDC	3.0	5.0	9.4	18.2	29.6	39.8	68.1
SIDS	5.0	6.7	8.3	10.2	16.0	16.8	27.7

Table 6.2.3. Mobile cellular as share of total telephone in regional and group average

. Data extracted from S-01(Source: UNESCAP Statistics Division)

Mobile share :Regional and group average (%)							
Country/Name	2003	2004	2005	2006	2007	2008	CAGR(%)
ESCAP	53.8	57.5	61.1	66.1	71.3	75.4	7.0
East and North-East Asia	53.0	54.1	55.1	57.7	61.5	64.4	4.0
South-East Asia	73.4	75.4	76.1	76.1	81.3	83.8	2.7
South and South-West Asia	46.1	53.7	63.4	76.5	82.8	87.1	13.6
North and Central Asia	48.0	63.3	73.2	76.6	78.7	81.3	11.1
Pacific	57.8	61.4	64.8	66.8	69.3	71.0	4.2
LDC	58.9	71.5	84.1	91.1	94.2	95.1	10.1
LLDC	34.4	45.7	60.0	73.5	81.1	84.9	19.8
SIDS	49.6	57.0	62.0	66.8	76.0	76.9	9.2

Table 6.2.4. Internet users in regional and group average

Data extracted from S-01(Source: UNESCAP Statistics Division)

Internet users :Regional and group average							
Country/Name	2003	2004	2005	2006	2007	2008	CAGR(%)
ESCAP	7.1	8.9	10.1	12.3	15.0	17.4	19.8
East and North-East Asia	11.9	14.2	15.8	17.7	22.6	28.1	18.8
South-East Asia	5.4	6.7	8.8	12.0	14.1	14.2	21.3
South and South-West Asia	2.5	4.0	4.6	6.7	7.9	8.6	27.8
North and Central Asia	6.3	9.5	11.5	14.2	16.9	17.0	22.2
Pacific	45.1	46.4	47.0	41.0	42.7	44.2	-0.4
LDC	0.2	0.2	0.4	0.6	0.6	0.6	27.5
LLDC	1.4	1.8	2.9	4.6	5.7	5.9	32.7
SIDS	3.8	4.3	4.7	5.1	5.5	5.6	8.0

Table 6.2.5. Broadband Internet in regional and group average

Data extracted from S-01(Source: UNESCAP Statistics Division)

Internet users :Regional and group average							
Country/Name	2003	2004	2005	2006	2007	2008	CAGR(%)
ESCAP	1.1	1.6	2.1	2.7	3.3	3.9	30.0
East and North-East Asia	2.6	3.9	5.0	6.2	7.4	8.6	26.9
South-East Asia	0.13	0.20	0.31	0.47	0.87	0.93	48.0
South and South-West Asia	0.02	0.05	0.18	0.31	0.48	0.67	99.1
North and Central Asia	0.17	0.33	0.78	1.45	2.12	2.31	68.7
Pacific	2.3	4.6	8.8	16.2	20.8	22.0	57.1
LDC	0.000	0.001	0.002	0.005	0.028	0.020	145.2
LLDC	0.004	0.011	0.017	0.043	0.268	0.573	167.6
SIDS							-

References

[i] UNESCAP(2009), Member;
http://www.unescap.org/about/member.asp

[ii] UNESCAP(2009), Least Developing Countries;
http://www.unescap.org/LDCCU/LDCs/LDC.asp

[iii] UNESCAP(2009), Landlocked Developing Countries;
http://www.unescap.org/LDCCU/LLDCs/LLDC.asp

[iv] UNESCAP(2009), Small Island Developing States;
http://www.unescap.org/LDCCU/PICs-SIDs/SIDS.asp

[vv] Timbercon Photonic design at the speed of light, Fiber Optic Cable;
http://www.timbercon.com/Fiber-Optic-Cable.html

[vi] Timbercon Photonic design at the speed of light, Fiber Optic Cable;
http://www.timbercon.com/Fiber-Optic-Cable.html

[vii] Javvin network management & security, Ethernet IEEE802.3 Local Area Network (LAN) protocols Overview;
http://www.javvin.com/protocolEthernet.html

[viii] Fiber Optic For Sale Co. Complete Supply Solutions, Fiber Optic Gigabit Ethernet;
http://fofs.editme.com/FiberOpticGigabitEthernet

[ix] Fiber Optics For Sale Co. Complete Supply Solutions;
http://fofs.editme.com/FiberOpticGigabitEthernet

[x] ITU, Characteristics of optical fibre submarine cable systems;
http://www.itu.int/ITU-T/studygroups/com15/sg15-q8.html

[xi] Mitsubishi Global Communication, Repeaterless systems;
http://global.mitsubishielectric.com/bu/communication/transmission/submarine/products/repeaterless.html

[xii] Wired.com, Fiber Optic Cable Cuts Isolates Millions From Internet. Future Cuts Likely;
http://www.wired.com/threatlevel/2008/01/fiber-optic-cab/

[xiii] BNET, FLAG- Fiber-optic link around the globe;
http://findarticles.com/p/articles/mi_qa5367/is_199802/ai_n21420007/?tag=content;col1

[xiv] Southern Cross Cable Network,
http://www.southerncrosscables.com/public/Backhaul/default.cfm

[xv] Wired.com, Fiber Optic Cable Cuts Isolates Millions From Internet. Future Cuts Likely;
http://www.wired.com/threatlevel/2008/01/fiber-optic-cab/

[xvi] Answer.com, Southern Cross Cable;
www.answers.com/topic/southern-cross-cable

[xvii] Broadband technology Overview, White Paper,pp.7;
http://www.corning.com/docs/opticalfiber/wp6321.pdf

[xviii] Broadband technology Overview, White Paper,pp.7;
http://www.corning.com/docs/opticalfiber/wp6321.pdf

[xix] Wireless Technologies Bridging Digital Divide, pp.5(PDF);
http://online-journals.org/i-jet/article/viewArticle/5

[xx] Kioskea.net, Introduction to WiFi
http://en.kioskea.net/contents/wifi/wifiintro.php3

[xxi] What is WiMax?, How WiMax Works;
http://www.wimax.com/education

[xxii] Wireless Technology: Bluetooth, WiFi, WiMax;
http://www.awirelesslife.com/wireless.html

[xxiii] Wireless Technology: Bluetooth, WiFi, WiMax;
http://www.awirelesslife.com/wireless.html

[xxiv] GSM World, GSM Technology What is GSM?
http://www.gsmworld.com/technology/gsm/index.htm

[xxv] Networking Tutorials. What is GSM?
http://www.networktutorials.info/gsm_technology.html

[xxvi] GSM World, GSM Technology What is GSM?
http://www.gsmworld.com/technology/gsm/index.htm

[xxvii] GSM World, GSM Technology What is GSM?
http://www.gsmworld.com/technology/gsm/index.htm

[xxviii] ITU homepage, ITU activities on IMT-2000;
http://www.itu.int/home/imt.html

[xxix] Kioskea.net, Mobile telephony;
http://en.kioskea.net/contents/telephonie-mobile/reseaux-mobiles.php3

[xxx] Kioskea.net Mobile telephony,
http://en.kioskea.net/contents/telephonie-mobile/reseaux-mobiles.php3

[xxxi] Digital Review.org, Appropriate ICT for the Asia and Pacific,
http://www.digital-review.org/themes/27-appropriate-ict-for-the-asia-pacific.html?93d8e68695e76f3bf28837adbeb3725c=99e4971fe678e51b347f8b7a53ef76db&start=2

[xxxii] Maximizing Performance in Long Distance Wireless Networks for Developing Regions, Electrical Engineering and Computer Sciences, University of California at Berkeley, pp.191;
http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-27.pdf

[xxxiii] Digital Review.org, Appropriate ICT for the Asia and Pacific,
http://www.digital-review.org/themes/6-mobile-and-wireless-technologies-for-development-in-asia-pacific.html?93d8e68695e76f3bf28837adbeb3725c=5c60472cb822a2ea0bdbf643f5e98a7c&start=1

[xxxiv] ADB in Regional Integration: The Case of the Greater Mekong Subregion, pp.4;
http://www.amchamvietnam.com/download/758/L2Rvd25sb2FkLzc1OA==

[xxxv] ADB, Report and Recommendation of the President to the Board of Directors, pp.4(PDF);
http://www.adb.org/Documents/RRPs/REG/40054-REG-RRP.pdf

[xxxvi] ADB, Report and Recommendation of the President to the Board of Directors, pp.12(PDF);
http://www.adb.org/Documents/RRPs/REG/40054-REG-RRP.pdf

[xxxvii] ADB, Report and Recommendation of the President to the Board of Directors, pp.7(PDF);
http://www.adb.org/Documents/RRPs/REG/40054-REG-RRP.pdf

[xxxviii] ADB, Report and Recommendation of the President to the Board of Directors, pp.20(PDF);
http://www.adb.org/Documents/RRPs/REG/40054-REG-RRP.pdf

[xxxix] ADB, Report and Recommendation of the President to the Board of Directors, pp.35(PDF);
http://www.adb.org/Documents/RRPs/REG/40054-REG-RRP.pdf

[xl] ADB, Memorandum of Understanding (MOU), Of the Planning and Construction of GMS Information Superhighway Network;
http://www.adb.org/Documents/Others/GMS/Sector-Activities/MOU-Information-Superhighway-Network.pdf

[xli] ADB, Project /TA Concept Profile, pp.2 ;
http://www.adb.org/Documents/Profiles/GMS/Data/TEL015.doc

[xlii] ADB Project AT concept profile(), GMS INFORMATION SUPERHIGHWAY NETWORK (ISN) CONSTRUCTION;
http://www.adb.org/Documents/Profiles/GMS/Data/TEL015.doc

[xliii] ADB Project AT concept profile(), PROMOTION OF RURAL COMMUNICATIONS DEVELOPMENT IN THE GMS;
http://www.adb.org/Documents/Profiles/GMS/Data/TEL017.doc

[xliv] Australian Government AusAID, The Greater Mekong Subregion, Australia's Strategy To Promote Integration and Cooperation, pp.7(PDF);
http://www.ausaid.gov.au/publications/pdf/mekong.pdf

[xlv] The University of the South Pacific(), Introduction page; http://www.usp.ac.fj/index.php?id=usp_introduction

[xlvi] The University of the South Pacific(),Campus Service (USPNet);
http://www.usp.ac.fj/index.php?id=3336

[xlvii] ADB, Creation of the Pacific Information Superhighway with the University of the South Pacific Network; http://pid.adb.org/pid/TaView.htm?projNo=42291&seqNo=01&typeCd=2

[xlviii] The University of the South Pacific(), Remote Campus Service (USPNet); http://www.usp.ac.fj/index.php?id=3336

[xlix] UNDP, Project Fithe Last updated: 17 April, 2007; http://europeandcis.undp.org/home/show/576C91D8-F203-1EE9-BDD83189A89315F9

[l] UNDP, Outline of the central Asian gateway project; http://www.undp.tj/files/cooperation/central_asia_gateway.pdf

[li] Project Document Central Asian Gateway(2004), Central Asian Gateway(CAG) Project, Phase2; http://europeandcis.undp.org/home/show/48CE660C-F203-1EE9-B8FB19D4142406E6

[lii] Greater Mekong Subregion Agricultural Information Network(), ADB helping Central Asian Gateway Expand Coverage; http://www.gms-ain.org/Z_Show.asp?ArticleID=1096

[liii] ADB, Technical Assistance Innovative Information and Communications Technology in Education, and Its Potential for Reducing Poverty in the Asia and Pacific Region, pp 4-5; http://www.adb.org/Documents/TARs/REG/39035-REG-TAR.pdf

[liv] IDRC, PAN Localization Phase II; http://www.idrc.ca/en/ev-83014-201_103669-1-IDRC_ADM_INFO.html

[lv] IDRC, PAN Asia Networking Distance and Open Resource Access; http://www.idrc.ca/en/ev-67360-201_102791-1-IDRC_ADM_INFO.html

[lvi] Nokia Siemens Networks, Go Rural – Community Coverage, pp.2; http://www.itu.int/ITU-D/asp/CMS/Events/2009/PacMinForum/doc/PPT_Theme-1_NokiaSiemens.pdf

[lvii] Nokia Siemens Networks, Village Connection – bringing the benefits of affordable mobile access to rural communities, pp2; http://www.nokiasiemensnetworks.com/NR/rdonlyres/5799A2E9-18CC-4071-9C4B-94655759591D/0/Village_Connection_WP.pdf

[lviii] Nokia Siemens Networks, Unite Magazine, Bringing mobile communications to the next billion; http://unite.nokiasiemensnetworks.com/adwords/article/view/id/153

[lix] Nokia Siemens Networks, Affordable connectivity to rural villages; http://www.nokiasiemensnetworks.com/global/Insight/new_growth_markets/village_connection.htm

[lx] Nokia Siemens Networks, Village Connection – bringing the benefits of affordable mobile access to rural communities, pp5; http://www.nokiasiemensnetworks.com/NR/rdonlyres/5799A2E9-18CC-4071-9C4B-94655759591D/0/Village_Connection_WP.pdf

[lxi] Nokia Siemens Networks, Village Connection – affordable voice and internet connectivity for rural areas, pp.5; http://www.nokiasiemensnetworks.com/NR/rdonlyres/D975319B-A8C6-40AF-943E-931BDCAB3ADC/0/VillageConnection_A4_Internet.pdf

[lxii] Nokia Siemens Networks, Go Rural – Community Coverage, pp.10; http://www.itu.int/ITU-D/asp/CMS/Events/2009/PacMinForum/doc/PPT_Theme-1_NokiaSiemens.pdf

[lxiii] Nokia Siemens Networks, Village Connection - our solution to promote rural connectivity; http://www.nokiasiemensnetworks.com/global/AboutUs/Corporate+responsibility/bringing-connectivity/village-connection.htm?languagecode=en

[lxiv] Senior Officers Meeting For the Pacific ICT Ministerial Forum: “Connecting the Unconnected” Concept Note, pp.2; http://www.itu.int/ITU-D/asp/CMS/Events/2009/PacMinForum/doc/Concept%20Theme-1%20Village%20Connection%20-%20NSN-ITU.pdf

[lxv] ITU Background Note, Affordable Access: Domestic and International Connectivity in the Pacific, pp.8; http://www.itu.int/ITU-D/asp/CMS/Events/2009/PacMinForum/doc/Background%20Note-Theme1&%202-Affordable%20Access.pdf

[lxvi] ADB(2006), Technical Assistance Report, Nepal: Preparing the ICT Development Project, pp.1; http://www.adb.org/Documents/TARs/NEP/38347-NEP-TAR.pdf

[lxvii] ADB(2008), Grant Agreement (Special Operations), ICT Development Project, pp.9; http://www.adb.org/Documents/Legal-Agreements/NEP/38347/38347-NEP-GRJ.pdf

[lxviii] ADB, Project Administration Memorandum, Nepal: ICT development Project, pp.3; http://www.adb.org/Documents/PAMs/NEP/38347-NEP-PAM.pdf

[lxix] ADB(2006), Technical Assistance Report, Nepal: Preparing the ICT Development Project, pp.3; http://www.adb.org/Documents/TARs/NEP/38347-NEP-TAR.pdf

[lxx] ADB (2007), Report and Recommendation of the President to the Board of Directors, pp.16; http://www.adb.org/Documents/RRPs/NEP/38347-NEP-RRP.pdf

[lxxi] The World Bank, Projects and Operations; Telecommunications Technical Assistance Project; http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P081849http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P081849

[lxxii] GrameenPhone, Annual Report 2007, pp.56; http://www.grameenphone.com/assets/annual_reports/pdf/gp_annual_report_07.pdf

[lxxiii] The World Bank, Projects and Operations; Mobile Phones Create Opportunities for Villagers in Bangladehs; http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/0,,contentMDK:21338024~menuPK:64282138~pagePK:41367~piPK:279616~theSitePK:40941,00.html

[lxxiv] The Global Partnership on Output-Based Aid; Cambodia GPOBA Commitment Document, pp.7; http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/06/04/000333038_20090604014018/Rendered/PDF/486210replacem1s0previous0document1.pdf

[lxxv] The World Bank, Project and Operations: Cambodia Telecoms; http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P102475

[lxxvi] The World Bank, Integrated Safeguards Datasheet Appraisal Stage, pp.2: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/10/28/000076092_20081102150037/Rendered/PDF/Integrated0Saf1et010Appraisal0Stage.pdf

[lxxvii] The Global Partnership on Output-Based Aid; Cambodia GPOBA Commitment Document, pp.7; http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/06/04/000333038_20090604014018/Rendered/PDF/486210replacem1s0previous0document1.pdf

[lxxviii] The Global Partnership on Output-Based Aid; Cambodia GPOBA Commitment Document, pp.8; http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/06/04/000333038_20090604014018/Rendered/PDF/486210replacem1s0previous0document1.pdf

[lxxix] The World Bank, Integrated Safeguards Datasheet Appraisal Stage, pp.1: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/10/28/000076092_20081102150037/Rendered/PDF/Integrated0Saf1et010Appraisal0Stage.pdf

[lxxx] The Global Partnership on Output-Based Aid; Cambodia GPOBA Commitment Document, pp.1; http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/06/04/000333038_20090604014018/Rendered/PDF/486210replacem1s0previous0document1.pdf

[lxxxi] Mobile Cell Broadcasting for Commercial Use and Public Warning in the Maldives, Natasha Udu-gama, pp.6; http://lirneasia.net/wp-content/uploads/2009/07/CB_Maldives_FINAL_2009_041.pdf

[lxxxii] Mobile Cell Broadcasting for Commercial Use and Public Warning in the Maldives, Natasha Udu-gama, May 2009, pp.6; http://lirneasia.net/wp-content/uploads/2009/07/CB_Maldives_FINAL_2009_041.pdf

[lxxxiii] Emergency Telecommunications initiatives for Disaster Management, ITU/ESCAP Disaster Communication Workshop, pp.2; http://www.itu.int/ITU-D/asp/Events/ITU-ESCAP-BangkokDec2006/presentations/Maldivies.pdf

[lxxxiv] Emergency Telecommunications initiatives for Disaster Management, ITU/ESCAP Disaster Communication Workshop, pp.13; http://www.itu.int/ITU-D/asp/Events/ITU-ESCAP-BangkokDec2006/presentations/Maldivies.pdf

[lxxxv] Broadcasting for Commercial Use and Public Warning in the Maldives, Natasha Udu-gama, May 2009, pp.21; http://lirneasia.net/wp-content/uploads/2009/07/CB_Maldives_FINAL_2009_041.pdf

[lxxxvi] Indonesia's Digital Divide and E-commerce: Opportunities and Challenges, MarykeSilalahi Nuth,, pp.5; http://www.tiimi2008.com/9.pdf

[lxxxvii] Indonesia's Digital Divide and E-commerce: Opportunities and Challenges, MarykeSilalahi Nuth,, pp.5; http://www.tiimi2008.com/9.pdf

[lxxxviii] National Information and Communication Infrastructure (NICI) e-Strategies: Best practice and Lesson Learnt; www.uneca.org/AISI/nici/Documents/NICI-Book.pdf

[lxxxix] Nagy K. Hanna, Transforming Government and Empowering Communities: the Sri Lankan Experience with e-Development (World Bank, 2008)

[xc] Shoban Rainford, e-Sri Lanka: An Integrated Approach to e-Government Case Study, pp.4; http://www.apdip.net/projects/e-government/capblg/casestudies/SriLanka-Rainford.pdf

[xci] World Bank, e-Sri Lanka Development Project Appraisal Document; http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2004/09/10/000009486_20040910112659/Rendered/PDF/28979a.pdf

[xcii] e-Sri Lanka: An ICT Development Roadmap (2002)

[xciii] Support For This Digital Dividend "What Works" Case Study Provided by: The Microenterprise Development Division of the United States Agency For International Development (USAID), through the SEEP Network's Practitioner Learning Program,pp.1; http://www.digitaldividend.org/pdf/echoupal_case.pdf

[xciv] Support For This Digital Dividend "What Works" Case Study Provided by: The Microenterprise Development Division of the United States Agency For International Development (USAID), through the SEEP Network's Practitioner Learning Program,pp.1; http://www.digitaldividend.org/pdf/echoupal_case.pdf

[xcv] New media and Development Communication http://www.columbia.edu/itc/sipa/nelson/newmediadev/Empowering%20Farmers%20-%20India.html

[xcvi] New media and Development Communication http://www.columbia.edu/itc/sipa/nelson/newmediadev/Empowering%20Farmers%20-%20India.html

[xcvii] Stockholm Challenge, ICT eChoupal http://www.stockholmchallenge.se/data/itc_echoupal

[xcviii] *...And ITC's e-Choupal gets Stockholm Award*

http://www.indianexpress.com/news/...and-itcs-echoupal-gets-stockholm-award/4388/

[xcix] ITC's E-Choupal: A Mirage of the Poor? http://www.ibscdc.org/Case_Studies/Strategy/Innovation%20Management/INM0108C.htm

[c] New media and Development Communication http://www.columbia.edu/itc/sipa/nelson/newmediadev/Empowering%20Farmers%20-%20India.html