Technical Report

Select Emerging Technologies for Rural Connectivity

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Prepared for

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Submitted for review to

USAID/Philippines OEDG

May 2005

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Preface

This report is the result of technical assistance provided by the Economic Modernization through Efficient Reforms and Governance Enhancement (EMERGE) Activity, under contract with the CARANA Corporation, Nathan Associates Inc. and The Peoples Group (TRG) to the United States Agency for International Development, Manila, Philippines (USAID/Philippines) (Contract No. AFP-I-00-00-03-00020 Delivery Order 800). The EMERGE Activity is intended to contribute towards the Government of the Republic of the Philippines (GRP) Medium Term Philippine Development Plan (MTPDP) and USAID/Philippines' Strategic Objective 2, "Investment Climate Less Constrained by Corruption and Poor Governance." The purpose of the activity is to provide technical assistance to support economic policy reforms that will cause sustainable economic growth and enhance the competitiveness of the Philippine economy by augmenting the efforts of Philippine pro-reform partners and stakeholders.

This report was written by Jaime M. Faustino at the request of Romulo L. Neri, Socio-Economic Secretary and Director General of the National Economic Development Authority (NEDA).

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Select Emerging Technologies for Rural Connectivity Report

Objectives

Responding to a request from the Philippines Secretary of Socio-Economic Planning, this report will "review emerging cellular and satellite technologies and provide analysis and policy options to the Philippine government counterpart."

The specific tasks were to:

analyze the commercial and political viability of new cellular and satellite technologies. Specifically, two new technologies of interest are cellular broadband and VSAT-Wireless Service. At first glance, these look like promising technologies to deliver a range of applications to various constituencies in the regions such as schools, local governments, entrepreneurs, farmers etc. From the economic development perspective, these initiatives raise key questions:

- Are these viable options for increasing access to information and communications services in underserved and unserved areas?
- What policy options are available to the government to help deliver these services in a cost-effective manner?
- Is there a "public-private" business model that will work to promote the roll-out of these services?

This report:

- Outlines the goals of the Philippine government in ICT and universal access for remote rural communities, overseas contract workers and their families;
- Identifies key barriers to increased access to communications;
- Examines the new cellular broadband infrastructure and assesses this new infrastructure's ability for the government to meet its objective; and
- Outlines a framework for a public-private model to meet those objectives.

Philippine Government Policy Goals in Communications

Information and Communications Technology (ICT) has the potential to help facilitate economic development and address the universal access goals of a country. It is changing the way people live the world over. In developing countries, the application of ICT can be used to foster pro-poor economic growth, good governance, and social development. Benefits have been documented in areas such as governance, education, public health, and environmental and natural resource management.

Similarly, the Philippine Government recognizes the potential benefits of ICT for efficient governance and economic development.

According to ***Republic Act 7925*** or the ***Public Telecommunications Policy Act of the Philippines,***

"A fundamental objective of government is to develop and maintain a viable, efficient, reliable and universal telecommunication infrastructure using the best available and affordable technologies, as a vital tool to nation building and development;"

According to the ***Medium-Term Development Plan 2004-2010:***

1. ***The government will continue to promote investments that support the provision of physical infrastructure for high-speed connectivity, high capacity and secured network services at low cost.***

   The development of the country's digital infrastructure will be accelerated through continuously optimizing the participation of/partnership with the private sector. Provision of high-speed connectivity at low cost will drive the usage of ICT in all sectors and more importantly, enable the country to transform itself into a knowledge and software development and e-services hub of Asia. Given the availability of domestic broadband network capacity with international connectivity, more access points will be offered both in the urban and rural areas, to provide the population with equal access to the global economy.

   Efforts will also be pursued toward achieving the "last mile connection" from the network backbone to the end-user. It will also include the optimal use of existing government networks for public data communication process (e.g. Transco fiber optic transmission lines, TelOf network, etc.). Moreover, possible business opportunities and creative ways to optimize existing or new network and bandwidth capacity will be explored.

2. ***The sustainability of these investments in physical infrastructure will depend heavily on market demand for broadband, which will be achieved by the provision of market attractive value-added features.***

   The role that government will play is in the development and provision of e-government content. This will allow government service to be delivered directly to the citizens, both locally and internationally through web technologies.

3. ***A prime market attractive value-added feature of a progressive digital infrastructure is VoIP or Internet telephony.***

   Issues relative to opening the market to VoIP will be resolved and a clear legal regime covering VOIP, convergence of web, email and voice services through Internet telephony will be provided. Simultaneously, VoIP services will be rolled out.

   This will immensely benefit overseas Filipino workers and their families and ensure the accessibility and affordability of these services for all. On the other

hand, other prime public service value-added features that include distance education, e-health and the delivery of e-learning to all public schools through the Internet will be pursued and supported through the establishment of community e-centers (CeCs) throughout the country.

4. ***The private sector will lead the deployment and expansion of digital infrastructure, especially to unserved and underserved areas, as well as the convergence of telecommunications, IP technology, broadcast media, cable TV, and other technologies to realize the full potentials of ICT as a tool for knowledge creation and diffusion."***

The Philippine government, through the National Development Economic Development Authority (NEDA), envisions a country with access for voice and internet in every *barangay*. The government is initiating an ICT project to partner with the private sector to share their resources and expertise in providing affordable and efficient Internet access for all Filipinos.

A major policy goal is to increase access to communications of Overseas Filipino workers (OFWs) and their families, especially in the rural areas where connectivity is low. OFWs contribute significantly to the country's economoc growth and development. ***In 2004, OFW remittances reached an estimated $8.5 billion***, the highest level recorded since 1970 according to the *Bangko Sentral ng Pilipinas*. Remittances, which rose 11.8 percent year-on-year, provide the cushion against an unstable and weak economy brought about by a fiscal deficit and spiraling oil prices. The number of OFWs continues to grow every year. The latest government statistics shows that the overseas Filipino population has increased to 7.58 million, distributed in 197 countries. Roughly 2.9 million are overseas Filipino contract-based workers.

To reduce the social costs associated with the OFW phenomenon, the Philippine government will design programs to increase access and affordability for OFWs and their families, most of which live in provinces outside the National Capital Region. Only 18% of OFWs comes from the NCR. Two-thirds of them come from the provinces. Given the low teledensity in the regions, communication is a challenge. Low teledensity is a function of uneven facilities distribution and high cost of telecommunications services.

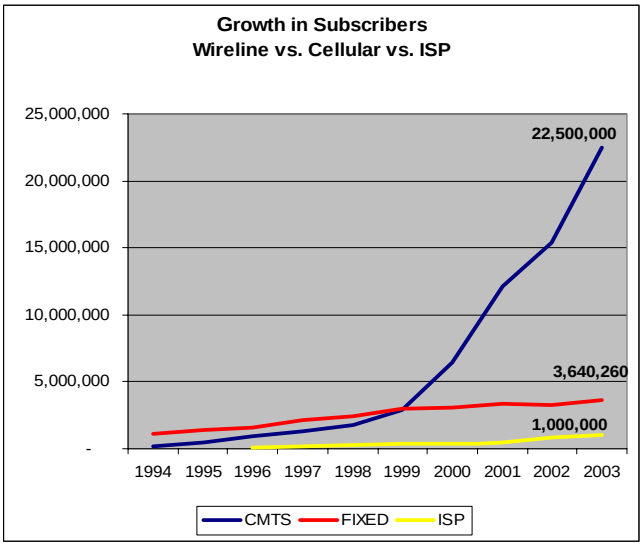
In 2002, close to half of the cities and municipalities are still without fixed line connections. Based on 2003 statistics, the NCR made up almost 26% of installed fixed lines and 15% of actual subscribed lines. Region IV, for example, has a population of over 12 million but subscribes to a measly 560,000 lines compared to the NCR with a population of 11 million and a subscription of 1.6 million. This mainly explains the low Internet usage in the provinces. Access to infrastructure is indeed crucial to usage.

Major policy changes since the early 90s have substantially increased the access and affordability of communications services for OFWs. Since the initial liberalization policy shift, the number of cellular phones in the country has increased from less than 1 million to nearly 25 million in 2004.

The Remaining Barriers

Despite this tremendous progress, there are significant barriers to increased access to communications services. To fully appreciate these barriers, it is important to note the primordial importance of mobile services in the Philippine communications market. Unlike the past, mobile carriers are the dominant player (Please see Table 1). As such most calls originate and terminate on a mobile phone.

Table 1.



Source: ITU, NTC.

Due to their dominant position, there are a number of markets, which are affected by this duopolistic structure.

One is the **outbound international market**. It is not a surprise to many that the current calling rates for the two dominant mobile carriers is 40 US cents a minute. It is not difficult to note the lack of competition in this market.

A second, related market, is the **inbound international termination market**. With their market power (most calls will end on their handset), the dominant carriers can determine these termination rates. This was the subject of a US Department of Justice and Federal Communications Commission action in 2003. More information on the allegations can be found at www.fcc.gov.[1]

A final market is the **national long distance termination charges**. Again with their market power, the dominant cellular companies can set their rate to terminate a call on their networks. Many have observed that neither the international nor domestic termination rates are "cost-based." Efforts by the National Telecommunications

[1] "International Bureau Takes Action to Protect U.S. Consumers and U.S. Carriers on the U.S.-Philippines Route" at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-231916A1.pdf.

Commission to introduce "more cost-oriented" pricing met stiff resistance from the dominant carriers.

As long as these key markets remain insulated from full competition, the Philippine government's policy goal of increasing universal access will remain elusive. In contrast, the profitability of the dominant firms is dependent on keeping competition limited to other areas.

Wireless Broadband Technology

The burgeoning of internet applications has opened windows of opportunities for providing efficient and cheap communications services. Many countries around the world have already made huge progress in using the convergence of technologies to provide data, voice and multi-media services not only for business purposes but also to connect people and communities in remote areas. The availability of the internet, and more specifically broadband, have led to the wide use of Voice over Internet Protocol for cheaper voice calls.

Most people in the Philippines access the internet through dial-up or wired broadband. Over time, WiFi, wireless fidelity has become popular. However, dial-up and wired broadband services require access to telephone lines, which are wanting in rural areas, while WiFi offers a very limited range.

The next section examines cellular broadband technologies, ***EVDO (Evolution Data Only), CDMA (Code Division Multiple Access)*** and ***LMDS (Local Multi-point Distribution Service)***, and satellite technology, ***VSAT (Very Small Aperture Terminal)***, that promise to increase access and affordability to the communications services in the Philippines, especially in the rural areas.

EvDO (Evolution Data Only)

Evolution Data Only or Evolution Data Optimized, often abbreviated as EvDO, EV-DO, EvDO, 1xEV-DO[2] or 1xEvDO, provides wireless broadband access without a WiFi hotspot. It is a high-speed network protocol used for wireless Internet data communications adopted by many CDMA mobile phone providers in Japan, Korea, Israel, the United States, and Canada as part of the CDMA2000 standard.[3] EvDO is two to three times faster than dialup, with a typical speed of 60 to 100 Kbps upload and download. It supports up to 2.4 Mbps bandwidth with the use of a set of radio frequency channels. EvDO protocol supports asymmetric communications, with majority of the bandwidth allocated to downloads.

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[2] 1xEVDO is based on the 1xRTT standard, the standard technology used for GPRS.

[3] EvDO is the first stage of the CDMA2000 standard. The next stage will be EV-DV or Evolution Data & Voice. Also EvDO Rev A is under development and will be deployed 2006.

Compared to WiFi, EvDO can work over existing cell phone networks and make a connection anywhere there is a mobile phone signal. In contrast, WiFi users must be within 300 feet a base station or hotspot. WiFi's popularity stems largely from the fact that it is an inexpensive and relatively simple technology to get into operation.

Bill Stone, Verizon Wireless executive director of network planning, said EvDO may prove to be a breakthrough for the entire wireless industry. He likens EvDO's potential to energize the mobile communications business to the introduction of the cellular phone in the 1980s and its subsequent surge in popularity in the 1990s, when mobile phones moved from analog to digital technology.[4]

One of the biggest issues related to EvDO is the need to set aside a slice of limited, valuable airwaves to transmit data. Some wireless industry analysts in the United States say that the scarcity of airwaves and ongoing tumult in the telecommunications industry makes the rollout of EvDO far from a sure thing.

Examples of EvDO Providers Abroad

- Bell Mobility is currently constructing an EvDO network in Canada, with trials underway in the Greater Toronto Area. Full rollout is expected in 2005.
- Pelephone 80% of populated area in Israel. Full rollout is expected in 2005.
- Telstra Corporation of Australia (*http://www.telstra.com.au/*) is upgrading its CDMA network to support EV-DO in many major metropolitan areas.

CDMA (Code Division Multiple Access)

According to industry experts, CDMA consistently provides better capacity for voice and data communications than other commercial mobile technologies, allowing more subscribers to connect at any given time, and it is the common platform on which 3G technologies are built.[5]

CDMA is a "spread spectrum" technology, allowing many users to occupy the same time and frequency allocations in a given band/space. As its name implies, CDMA assigns unique codes to each communication to differentiate it from others in the same spectrum. In a world of finite spectrum resources, CDMA enables many more people to share the airwaves at the same time than do alternative technologies.

The CDMA air interface is used in both 2G and 3G networks. 2G CDMA standards are branded cdmaOne and include IS-95A and IS-95B. CDMA is the foundation for 3G services: the two dominant IMT-2000 standards, CDMA2000 and WCDMA, are based on CDMA.

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[4] Christopher Stern, "A New Wireless Web Link: Phone Firms Testing High-Speed Technology Called EvDO," Washington Post, January 23, 2003.

[5] http://www.cdg.org/worldwide/index.asp

Table 2.

CDMA	Desription
cdmaOne (2G networks)	Describes a complete wireless system based on the TIA/EIA IS-95 CDMA standard, including IS-95A and IS-95B revisions; represents the end-to-end wireless system and all the necessary specifications that govern its operation; provides a family of related services including cellular, PCS and fixed wireless (wireless local loop)
CDMA2000 (leading the 3G revolution)	Represents a family of ITU-approved, IMT-2000 (3G) standards and includes CDMA2000 1X and CDMA2000 1xEV technologies; deliver increased network capacity to meet growing demand for wireless services and high-speed data services; CDMA2000 1X was the world's first 3G technology commercially deployed in October 2000
CDMA Deployments	CDMA is the fastest growing wireless technology and it will continue to grow at a faster pace than any other technology. It is the platform on which 2G and 3G advanced services are built.

Source: www.cdg.org

LMDS (Local Multi-point Distribution Service)

LMDS is a broadband wireless point-to-multipoint communication system operating above 20 GHz (depending on licensing) that can be used to provide digital two-way voice, data, Internet, and video services.

LDMS means:

L (local)—denotes that propagation characteristics of signals in this frequency range limit the potential coverage area of a single cell site; ongoing field trials conducted in metropolitan centers place the range of an LMDS transmitter at up to 5 miles

M (multipoint)—indicates that signals are transmitted in a point-to-multipoint or broadcast method; the wireless return path, from subscriber to the base station, is a point-to-point transmission

D (distribution)—refers to the distribution of signals, which may consist of simultaneous voice, data, Internet, and video traffic

S (service)—implies the subscriber nature of the relationship between the operator and the customer; the services offered through an LMDS network are entirely dependent on the operator's choice of business

More recent advances in a point-to-multipoint technology offer service providers a method of providing high-capacity local access that is less capital-intensive than a wireline solution, faster to deploy than wireline, and able to offer a combination of applications.

LMDS systems use a cellular-like network architecture, though services provided are fixed, not mobile. In the United States, 1.3 MHz of bandwidth (27.5 B 28.35 GHz, 29.1 B 29.25 GHz, 31.075 B 31.225 GHz, 31 B 31.075 GHz, and 31.225 B 31.3 GHz) has been allocated for LMDS to deliver broadband services in a point-to-point or point-to-multipoint configuration to residential and commercial customers.[6]

Various network architectures are possible within LMDS system design. The majority of system operators will be using point-to-multipoint wireless access designs, although point-to-point systems and TV distribution systems can be provided within the LMDS system. It is expected that the LMDS services will be a combination of voice, video, and data. Therefore, both asynchronous transfer mode (ATM) and Internet protocol (IP) transport methodologies are practical when viewed within the larger telecommunications infrastructure system of a nation. The LMDS network architecture consists of primarily four parts: network operations center (NOC), fiber-based infrastructure, base station, and CPE. This tutorial primarily discusses base-station, customer-premises, and NOC designs.

LMDS has several advantages. Point-to-point fixed wireless networks have been commonly deployed to offer high-speed dedicated links between high-density nodes in a network. Moreover, since a large part of a wireless network's cost is not incurred until the customer premise equipment is installed, the network service operator can time capital expenditures to coincide with the signing of new customers. LMDS provides an effective last-mile solution for the incumbent service provider and can be used by competitive service providers to deliver services directly to end-users.

Benefits of LMDS include (1) low entry and deployment costs, (2) ease and speed of deployment (systems can be deployed rapidly with minimal disruption to the community and the environment), (3) fast realization of revenue (as a result of rapid deployment), (4) demand-based build-out (scalable architecture employing open industry standards ensuring services and coverage areas can be easily expanded as customer demand warrants), (5) cost shift from fixed to variable components (with traditional wireline systems, most of the capital investment is in the infrastructure, while with LMDS a greater percentage of the investment is shifted to customer-premise equipment [CPE], which means an operator spends dollars only when a revenue paying customer signs on), (6), no stranded capital when customers churn, (7) cost-effective network maintenance, and (8) management, and operating costs.

A second to this is the lack of accessibility. PLDT, for example, offers ADSL (Asymmetric Digital Subscriber Line) in selected areas for a minimum of PhP1,500 per

[6] International Engineering Commission

month. This service called *MyDSL*[7] offers speed of up to 128Kbps downstream and 64 Kbps upstream. Pre-paid dial-up services are available for as low as P30 (5 hours)[8] but speed is a slow 56 Kbps at best. Cable TV companies also offer Internet access in a package priced at PhP1,700 per month.[9]

VSAT (Very Small Aperture Terminal)

A very small aperture terminal (VSAT) is a device, known as an "earth station," used to receive satellite transmissions. The "very small" component in VSAT refers to the size of the VSAT dish antenna --- typically about 2 to 4 feet (0.55-1.2 m) in diameter --- that is mounted on a roof on a wall, or placed on the ground. This antenna, along with the attached low-noise blocker or LNB (which receives satellite signals) and the transmitter (which sends signals) make up the VSAT outdoor unit (ODU), one of the two components of a VSAT earth station. The second component is the indoor unit (IDU), a small desktop box or PC that contains receiver and transmitter boards and an interface to communicate with the user's existing in-house equipment such as LANs, servers, PCs, TVs, kiosks, etc. The indoor unit is connected to the outdoor unit with a pair of cables.

The key advantage of a VSAT earth station vis-à-vis a typical terrestrial network connection is that VSATs are not limited by the reach of buried cable. A VSAT earth station can be placed anywhere as long as it has an unobstructed view of the satellite. VSATs are capable of sending and receiving all sorts of video, data and audio content at the same high speed regardless of their distance from terrestrial switching offices and infrastructure.

According to Gilat VSAT satellite networks (U.S.), satellite is the only telephony and broadband wide-area network technology that is available everywhere - in even the most remote urban and rural areas, rain forests or concrete jungles, anywhere in the world. All it takes is a clear view of the sky. It also explains that satellite is less expensive in the long run because satellite networks are much less costly to deploy, maintain and operate than terrestrial network technologies, which require heavy infrastructure, whether they are telephony networks (based on copper wiring, fiber optic cables, radio or microwave towers), or broadband data networks (such as Frame Relay, DSL, ISDN and cable).

In many countries such as the United States, VSAT is already being used by small businesses, schools, remote farms, Internet Service Providers, air traffic controllers, financial services, banks, etc.

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[7] www.pldtdsl.com/products/default.html.

[8] An example of a pre-paid card offering this service is *ISP Bonanza*.

[9] Internet access is available through Sky Cable and Destiny Cable.

Community Telecenters for Connectivity in Rural Areas

Based on the wireless features of the abovementioned broadband technologies, they are practical to use in rural areas, especially in remote communities. Using the shared cost model of the "telecenter," these technologies may be easily acquired and utilized by many households in a community. This model has been used since the 1980s until today, especially by countries that have poor connectivity.

Several years ago, with leadership from the Commission on Information and Communications Technology (CICT), the concept of Community e-Centers was developed in the Philippines. These are shared access public service center offering ICT applications that are strategically located in areas easily reached by the people. A CeC is typically equipped with telecommunication facilities such as telephony, fax, email and Internet access. It has personnel who will oversee the day-to-day operation of the center.

To implement this vision, a budget item in the 2005 National budget was included for the establishment of Community e-Centers in each Congressional District.

According to the MTPDP:

> The digital divide within the country will be reduced by establishing more public access points such as CeCs for delivery of e-government and other services to provide universal access to information and communications services in unserved areas, link communities, facilitate trade and commerce, and empower rural communities socially, economically and politically.

Seed funding will be provided for the development of public access points, which will support the provision of broadband services by the private sector to all municipalities and the connection of all secondary schools where computers will be provided.

To avoid the last mile problem, or wiring the households, wireless data communications technology is seen as a more viable solution, physically and financially.

Potential Private Sector Partner: Broadband Philippines

The Philippine Government can tap the resources and support of the private sector in pursuing its universal access goals. There are telecommunications companies that are capable and willing to deploy wireless broadband technologies given the right opportunity.

In the Philippines, *Broadband Philippines*, will soon launch an EvDO network and cellular service. Broadband Philippines is a duly enfranchised Local Exchange Carrier (LEC). With a mega-franchise similar to that of the incumbent operator, it has the infrastructure, capability and license to provide the necessary telecommunications and value-added services. Most importantly, because it is not a dominant carrier it does not

have a major market to protect. It is expected that Broadband Philippines will be an aggressive price leader similar to the strategy employed by Sun Cellular.

Broadband Philippines, with its nationwide broadband data license, is also allowed to build its own infrastructure. It currently offers EvDO for data and CDMA for both voice and data services. Currently, it is in the process of standardizing the price for voice call services using Internet protocol (IP). It target price is 50% less than public switched telecommunications network (PSTN) charges for outbound calls.

Government-Private Sector Partnership for Affordable Broadband Access

The elements for the successful deployment of Community e-Centers using broadband wireless technologies are present:

- A service provider committed to provide price-aggressive service
- Three national government agencies supportive of CeCs; namely, the Commission on ICT, the National Economic Development Authority and the National Telecommunications Commission
- Supportive congressional districts with allotted funds for the establishment of CeCs in their respective areas.

Making the Vision a Reality

Deploying wireless broadband needs intensive planning and coordination between the government and the private sector. The project may include several phases that will involve developing a business plan and introducing new services as the project moves along.

Community e-Centers with Wireless Broadband Technology		
Phase 1:	Single Service Application	Voice only through CDMA 1x (example)
	Franchise Business model and financials under development	
Phase 2:	Multiple services Application	Computers and Internet

A pilot calling center can be built to see the viability of the project. The government-private sector partnership can establish an OFW Community e-Center for the families of contract workers, especially those located in the rural areas.

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