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DakNet Executive Summary

Introduction

Expanding access to information and communication technology in the developing world has the potential to improve service delivery; strengthen communication pathways among social networks; provide access to informational and educational information; and allow organizations to become more strategic decision makers. From education, to telemedicine, to value-chain streamlining, to e-Government, information and communication technologies (ICTs) – when available – can be a valuable tool. However, access to ICTs remains a challenge in the developing world. According to a 2010 report from the International Telecommunications Union, only one in five people has internet access in the developing world (as of late 2009), and "Broadband access remains the single most expensive and least affordable service in the developing world." Whereas people in developed countries spend about 1.5% on ICT services, people in developing countries spend about 17.5% on average (International Telecommunication Union, 2010). Clearly, there is a huge disparity in ICT access between the developing and developed worlds, and although worldwide cellular telephone coverage doubled from 2005 to 2009 (from 33% to 67% of individuals having access to cellular telephones), there is still much to be done.

Economics of ICTs in the Developing World

Despite this underdeveloped infrastructure and the fact that 80% of the world (most of the developing world) lives on less than $10 a day,[1] studies have shown that even the world's poorest are willing to spend part of their income on telecommunications. For example, in India, studies have shown that for every 1% increase in income, there is a 1.4% increase in communications-related expenditures, and that while 5-6% of GDP per capita was spent on communications services in 2002, this was expected to increase as telecommunications became cheaper and more widely available (Christopher Blattman, 2002). Thus, if a commercial venture were to target even the poorest market segment in the world, even if each individual sale were only marginally profitable, by selling to such a large number of people (approximately 4 billion) it could still profit.

Given this latent demand, there is an incentive to figure out how to provide telecommunications in the developing world in an inexpensive way, given that traditional telecom infrastructure development requires an enormous initial investment. This is especially challenging in rural areas, in which people are dispersed over wider areas. Furthermore, even if a local telecommunications provider does provide for data services, the connections speeds cab be either extremely slow or else unreliable,[2] which invites newer technologies and systems into the market.

[1] World Bank Development Indicators 2008

[2] In 2009, a South African company sent a single 11-month-old pigeon named Winston to their central office to the coastal city of Durban with a data card strapped to its leg. By the time the pigeon arrived and the card was downloaded only 4% of the same 4GB was transferred over the Telkom line (the leading provider) (BBC News http://news.bbc.co.uk/2/hi/8248056.stm).

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The DakNet Solution

DakNet targets people in the developing world who do not currently have access to telecommunications infrastructure, and who live in areas where public or private telecommunications investment is unlikely to take place in the short term. Rather than focusing on real-time communications, it combines a number of existing technologies – low-cost WiFi radio transceivers, store-and-forward technology, and a physical transport mechanism – to create a very low cost asynchronous communications infrastructure (Hasson, 2003). The network works as follows (Figure 1):

1. WiFi radio transceivers are mounted on top of transport entities (cars, buses, motorcycles) to create Mobile Access Points (MAPs).
2. An information kiosk is set up in each participating village, where users come to retrieve and share information (outgoing information is stored until retrieved by MAPs).
3. MAPs regularly drive through a village, automatically detect a wireless signal from each kiosk (as they come into range) and upload/download data at relatively high bandwidth using unlicensed spectrum.
4. When the MAPs reach a metropolitan area, they can again upload and download data to/from an uplink, via fiber, copper, satellite, or WiMax connection (which is more cost effective in urban areas).

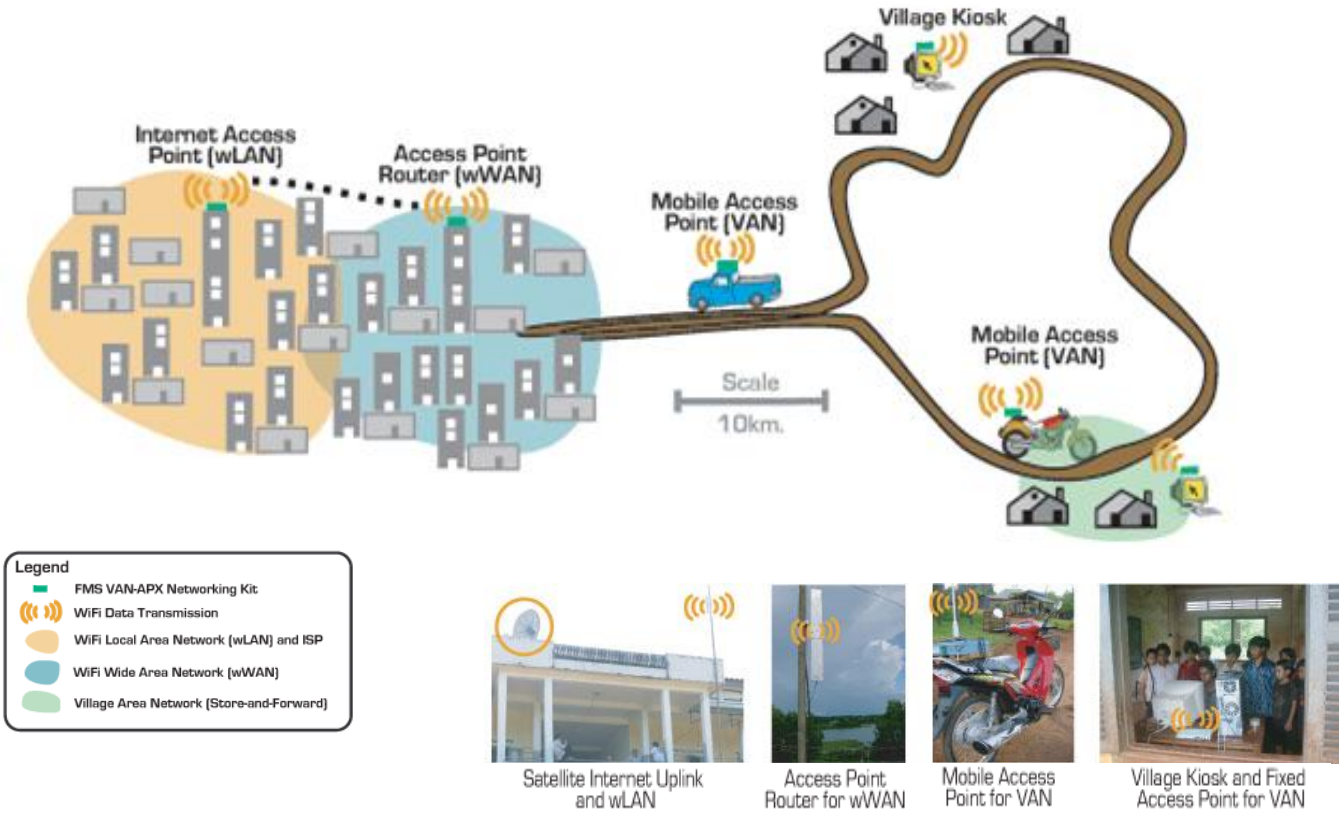

Figure 1: Diagram of DakNet network (Carol Chau, 2005)

Though DakNet only provides *asynchronous* communication, there are a number of applications that it supports, such as information distribution and broadcasting as well as information collection. Successful deployments have been carried out in India (the Bhoomi Project) to create a decentralized land record database, and in

Cambodia, where it was used for various telemedicine, educational, and asynchronous voicemail applications. DakNet is particularly suited for transmitting larger quantities of data that can be about a day old. In the India deployment, each "session" (data transfer between kiosk and MAP) lasts on average 2:34 MM:SS, and the average transfer rate was around 2.47 Mbps. It is also important to note that as more high-end infrastructure is developed, DakNet kiosks can seamlessly transition to using networked WiFi (rendering the MAPs obsolete). Though only NGOs are currently using DakNet, the company hopes to entice private ISPs to license the technology.

Competing Technologies

There are a number of technologies (which are ever-growing) that have been developed to expand connectivity in the developing world. Satellite technologies are certainly available in rural areas, but are still extremely expensive. WiMax is another wireless technology that can provide up to 30 Mbps, but it relies on licensed spectrum and requires a minimum density to be profitable. WiLDNet, a UC Berkeley implementation of line of site wireless communication[3], can transmit data at up to 5 Mbps (Rabin Patra, 2006), but even line of site technologies can be prohibitively expensive if many towers are needed to relay signals. Furthermore, regional laws often prohibit construction of such towers.[4] Mesh networks are able to transmit data over short distances but cannot span distances in and of themselves, and delay tolerant networking (DTN) has typically only been used for smaller transmissions that do not require high bandwidth.

Conclusion

DakNet is an inexpensive, viable ICT that can streamline information dissemination, data collection, and asynchronous communication in the absence of other telecommunications infrastructure. Though it does not support real-time communication, it can transfer large quantities of data quickly, and can even be used without any internet backbone technology as an Intranet. Depending on the local political and economic conditions, it might be the best solution available for sending and receiving data over distance.

[3] "Line of Sight" radio transmissions requires a clear path between antennas and typically using the use the 802.11 MAC protocol and operate in the 2.4Ghz ISM band. UC Berkeley's TIER Group modified the 802.11a standard to optimize transmission over distance (between 50-100km).

[4] During a trip that several iSchool students took over the summer to East Africa, a number of the NGOs with whom we spoke said that it would be challenging to get permission from the Ethiopian Telecommunications Office (a Government-run telecommunications monopoly) to construct line-of-site towers.

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