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DakNet: A Low-Cost Internet Connectivity for Developing Regions

[1]Nikhil Basur, [2]Vikash Kumar Singh

[1]Student, [2]Assistant Professor, Department of Computer Science and Engineering, Sikkim Manipal Institute of Technology, Sikkim, India.

[1]nikhil_202027006@smit.smu.edu.in, [2]vikash.s@smit.smu.edu.in

Abstract: Current trend in world technology advancements have changed the way people communicate with each other. The massive growth of internet boosted up developing countries to adopt the new scenario but still some loop holes remained like the Internet Communication Technology advanced in urban areas of developing countries but the rural and remote areas were still lacking behind. The current connectivity technologies for rural kiosks in developing countries, such as dial-up, Very Small Aperture Terminals (VSAT) and long-distance wireless, tend to be both expensive and failure prone. So how can the rural areas be connected to the Internet? The solution is- DakNet. This paper outlines a migration path towards universal broadband connectivity, motivated by the design of a wireless store-and-forward communications network.

Keywords: DakNet, Ad-Hoc, Wi-Fi, Asynchronous, MAP (Mobile Access Point), Hub, Kiosk

I. INTRODUCTION

Many developing countries continue to face the challenge of how to increase access to information communication technologies (ICTs) in rural and remote areas. Telecommunication companies are usually reluctant to extend their network due to high infrastructure costs, low population density, and limited ability to pay for the services. First Mile Solutions (FMS) counters this problem by providing telecommunications equipment that can cheaply connect rural and remote populations1 to the Internet through an innovative technology: DakNet [6]. DakNet, is a network which uses wireless technology serves the digital connectivity and also the ad-hoc connectivity. DakNet takes advantages of the existing transportation and communication infrastructure to provide digital connectivity [9]. “Dak” is a Hindi word which means “Post” in English that used to be the traditional form of communicating messages. This traditional process suffered from delay and it was relatively unreliable and slow. DakNet as the name suggests “Dak over the network” which is a wireless network. It provides internet facility to rural areas at very low cost and in a simple manner. It was developed by MIT (Massachusetts Institute of Technology) by First Mile Solutions cofounders Richard Fletcher and Amir Alexander Hasson. [7]

II. LITERATURE REVIEW

Real time communications need large capital investment and hence high level of user adoption to receiver costs. The average villager cannot even afford personnel communications device such as a telephone or computer to recover cost, users must share the communication infrastructure Studies show that the current market for successful rural Information and Communication Technology (ICT) services does not appear to rely on real-time connectivity, but rather on affordability and basic interactivity [8]. This is where DakNet comes into picture.

DakNet allows rural villages to exchange messages and video through a mobile ISP. By mounting a wireless card on a vehicle that travels around to remote villages and exchanges updated information with each kiosk it encounters through Wi-Fi. Villagers are able to send message and record videos through these kiosks. That data is stored in the outbox of the kiosk. [1] When the mobile vehicle comes around it exchanges the data in the outbox and the inbox. Those awaiting messages are able to check the inbox for any messages or videos. All information is downloaded to the central system at the office station. [9]

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Main components of DakNet architecture are:

– Mobile access point

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– *Hub*

– *Kiosk*

Mobile Access Point: The data transmitted over short point-to-point links. It combines physical and wireless data transport to enable high-bandwidth intranet and internet connectivity among kiosks (public computers) and between kiosks and hubs (places with reliable Internet connection).Data is transmitted by means of a mobile access point, which automatically and wirelessly collects and delivers data from/to each kiosk on the network.[3] Low cost WIFI radio transceivers automatically transfer the data stored in the MAP at high bandwidth for each point-to-point connection. Mobile Access Point is mounted on and powered by a bus or motorcycle, or even a bicycle with a small generator. MAPs are installed on vehicles that normally pass by each village to provide store-and-forward connectivity.

Fig 1: MAP equipment to be secured on Vehicle.

The figure above (Fig 1) shows the Mobile Access Point that is to be mounted on the Vehicle. The MAP (Mobile Access Point) has an omnidirectional antenna, a custom embedded PC running Linux with 802.11b wireless card and 512 Mbytes of compact flash memory, a 100-mW amplifier, cabling, mounting equipment.

Hub: It is a common connection point for devices in a network. It is used to connect segments of a LAN. It contains multiple ports. Packet at one port copied to all other ports-all segments see all packets. When the vehicle passes near an internet access point the hub-it synchronizes all the data from different kiosks using the internet.

Kiosk: It is an intermediator providing a computer related service such as ATM. In each village there is kiosk. It requires a user interface that can be used without training. It enable user to enter and display information on the same device. Either directional.

III. WORKING OF DAKNET

1. A village-based DakNet Service Provider (DSP) is equipped with a PC or laptop. Villagers can sign up for a DakNet prepaid account and use the DSP's PC or laptop to order shopping items, request job information etc. offline.[5]
2. Most DSPs are located next to a relatively well-maintained road. User data (such as email, e-shopping orders etc.) are transferred to the fixed access point (FAP) at a kiosk or DSP Centre. From the FAP, the data are then transferred to a bus fitted with a wireless transceiver that stops outside the DSP Centre. [10]
3. When the bus arrives at the main bus station in the state capital of Bhubaneswar, stored user data are forwarded via a wireless node to the main office of United Villages – also in Bhubaneswar – and thence onto real-time Internet. [5]
4. The system also works in reverse: the buses deliver information from the Internet to user accounts at the same time as they are receiving user data. The buses also deliver goods ordered through e-shopping.[4]

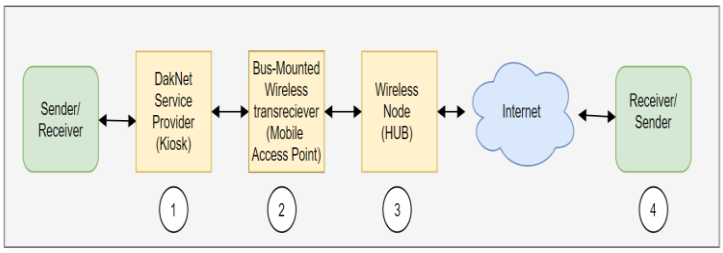

Fig 2: DakNet store-and-forward drive-by Wi-Fi model

As shown in the figure above (Fig 2)

1. When the sender wants to send the data, the data is first stored in the Kiosk.
2. The Kiosk then forwards the data to the nearby MAP.
3. When the vehicle passes near an internet access point (HUB) - it synchronizes all the data from different kiosks with the HUB.
4. This data is updated in the server and the receiver on the other end receives the data.

IV. COST OF IMPLEMENTATION

The total cost of the DakNet MAP equipment used on the bus is $580, which includes

- A custom embedded PC running Linux with 802.11b wireless card and 512 Mbytes of compact flash memory;
- A 100-mW amplifier, cabling, mounting equipment, and a 14-in omnidirectional antenna
- An uninterruptible power supply powered by the bus battery.

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The average total cost of the equipment used to make a village kiosk or hub DakNet-ready was $185. Assuming that each bus can provide connectivity to approximately 10 villages, the average cost of enabling each village was $243 ($185 at each village plus $580 MAP cost for 10 villages) [2].

A back-of-the-envelope calculation for DakNet suggests that a capital investment of $15 million could equip each of India's 50,000 rural buses with a $300 MAP and thereby provide mobile ad hoc connectivity to most of the 750 million people in rural India. This figure represents a cost that is orders of magnitude lower than other rural communication alternatives. Costs for the interactive user devices that DakNet supports—including thin-client terminals, PDAs, and VoIP telephones—may also soon become far more affordable than traditional PCs or WLL equipment. PDA-like devices using an IEEE 802-like wireless protocol retail for $100, with a manufacturing cost of approximately $50 (www.cybiko.com). System-on-a-chip technology is lowering these costs even more, potentially enabling wireless PDAs at prices as low as $25 (www.mobilesolve.com).[1]

V. CONCLUSION

The government has proposed to roll out the DakNet Wi-Fi project - involving the linking up of computers to networks without using wires - as a connectivity medium aimed at the rural masses. According to First Mile Solutions founder Amir Alexander Hasson, who helped initiate the two DakNet Wi-Fi pilot projects in Tikawali, a village near Faridabad, Haryana, and Dodabalapur district in Karnataka, "We are using IEEE 802.11b equipment at 2.4 GHz. We don't use base stations, but rather our custom DakNet Mobile Access Point (MAP) that is mounted on and powered by a vehicle." Giving the project details, Mr Hasson said, "Essentially, a van roam roams around the Dodabalapur district in Karnataka, stopping at different villages long enough for the local computer to connect to it wirelessly and transfer the data stored in it. From the van to the central database is also a Wi-Fi hop, thus resulting in a wireless end-to-end transfer of information - which is what Wi-Fi is all about. The project involves creating an online database of land records." Essentially, the DakNet-enabled vehicle drives past a kiosk where it picks up and drops off land record queries and responses. Each day, this is synchronized with a central database. Data is transported through the access point, which automatically and wirelessly collects and delivers data from each kiosk on the network. The transfer of data can take place up to a radius of 1.25 km around the kiosk.

This paper shows the cost and implementation of DakNet and how DakNet can be useful in providing internet in rural areas. DakNet provides an endless method of upgrading to always on broadband connectivity. It provides low deployment cost and enthusiastic reception by rural users has motivated dozens of inquiries for further deployments. This provides millions of people their first possibility for digital connectivity. Increasing connectivity is the most reliable way to encourage economic growth. This technology wider makes the world to enter into a digital world connectivity.

DakNet is a great blessing for villagers, not almost all villages are connected to big cities through internet. But Research & Developments are still going on to develop an interoperable and cross platform to streamline the deployment process and make the DakNet more and more cheaper and fast.

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