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A Scalable Architecture for Providing E-Tourism to the Rural Areas Using Wireless Ad Hoc Networks

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Abstract: As information is the life-blood of the travel industry, effective use of technology is fundamental to the tourism sector as we have approached the 21st century. The internet has provided a new economic environment in which to conduct business. E-commerce is a growing sector and many tourism businesses are involved in developing their internet services including traditional travel agents, tour operators, national tourist offices, airlines, hotels and other accommodation providers and car hire firms. But in South Asian region, mostly the rural areas are devoid of these modern facilities. Some of these promising tourist spots can appear to be even more attractive to the tourists if we can ensure e-tourism facilities in those areas. This study demonstrates a framework to support the e-tourism facilities in the rural and remote area through wireless ad hoc network. In this approach, every villages as well as rural areas will be connected to the mobile access point. Tourists with wireless nodes like mobiles, PDAs, laptops will be actually the part of the ad hoc network when they will visit those areas and get access to the e-tourism facilities.

Key words: Wireless ad hoc network, Mobile Access Points (MAP), Data Processing Center (DPC), Internet Working Unit (DIMIWU)

INTRODUCTION

Tourism as the world's largest business is a complex system of integrated parts. Technology not only facilitates this integration, but also attracts people to travel. Tourism is undeniably a powerful tool for development and developing fraternity. Researchers are now working to invent newer technologies that can be integrated with tourism so that people become more attracted to tourism especially in the tourism in the rural area where modern facilities are not available.

Recently mobile computing has enjoyed a tremendous improvement and enhancement. One of the Most Important of These Fields Concerns Mobile Ad Hoc Networks (MANETs), where the participating nodes do not rely on any existing network infrastructure. A mobile ad hoc network is a collection of wireless nodes that can be rapidly deployed as a multi-hop packet radio network without the aid of any existing network infrastructure or centralized administration (Corson and Ephremides, 1989). Wireless Ad hoc network is an ideal solution in the situation where networking applications are badly needed even in absence of Internet connection. This emerging technology could effectively be used for providing e-tourism facilities to the tourist in the rural tourist spots.

This study presents a detailed framework for providing e-tourism facilities in the remote and rural tourist spots by using the existing handheld devices (mobile, PDA's, Laptops) carried by the tourists. This will also be helpful for connecting the hard-to-reach rural areas and the government more efficiently. The proposed framework ensures providing effective tourism facilities where establishing fixed infrastructure is quite expensive. It can also provide frequently accessed services such as weather forecasts, avalanche conditions, snow reports etc. to the tourists. This study also addresses the practical or operational challenges that could hinder the implementation of such a framework in the rural areas of the developing countries.

RELATED WORKS

Researchers are now working to invent newer technologies that can be integrated with tourism so that people become more attracted to tourism. They foresee a lot of activities in the tourist sector and believe mobile phones and PDA's (Personal Digital Assistants) will be key tools to reach tourists and trying to develop some concrete application. Some important technologies have already been developed to make the tour-period more comfortable and relaxing.

The RTT is a Remote Tourist Tracking software tool that allows tracking, monitoring and exploring different harsh regions (http://www.aui.ma/etech/english/geogsm.

htm). The groups of tourists' vehicles will be equipped with a GPS receiver and a GSM modem that will allow the tracking system in the remote application server to track the tourists and their vehicles. RTT can be used for contacting the tourist for guidance purposes or to alert him of any danger or in case he is taking a wrong itinerary, this should be achieved by SMS.

Map View PDA is an XML Web Services-Based Map Viewing System for PDAs (http://www.aui.ma/etech/english/geogsm.htm). This can also provide tourists with several functionalities like automatically loading maps and manipulating them, regardless of user's location, viewing the user's location, searching for a facility or a landmark, obtaining real-time information about a facility or a landmark.

The objective of the Geo-GSM tool is to provide proximity information services to GSM users using SMS messages and without any specific localization device (http://www.aui.ma/etech/english/mapviewPDA.htm). Typical queries that the Geo-GSM can handle are: what is the nearest Café, what is the phone numbers of the hotels that are in proximity, what is the address of the nearest medical center, how far is the Police Station. In order to get specific proximity information, GSM users send an SMS to the operator running the Geo-GSM system. Information about the SMS and the customer's location is captured and displayed on a map-based graphical interface to the operator. The customer then describes the goods or services he is looking for.

BACKGROUND OF WIRELESS NETWORK

Ad hoc networks are the key to the evolution of wireless networks (Rabbi and Arefin, 2006). Ad hoc networks are typically composed of equal nodes that communicate over wireless links without any central control. Although military tactical communication is still considered the primary application for ad hoc networks, commercial interest in this type of networks continues to grow. Applications such as rescue missions in times of natural disasters, law enforcement operations, commercial and educational use and sensor networks are just a few possible commercial examples.

Figure 1 illustrates an example ad hoc network. The participating nodes act both as end hosts and routers forwarding traffic from the source to the destination host. A well-designed architecture for mobile ad hoc networks involves all networking layers, ranging from the physical to the application layer.

Advantages wireless ad hoc networks: Some of the significant benefits of ad hoc networks.

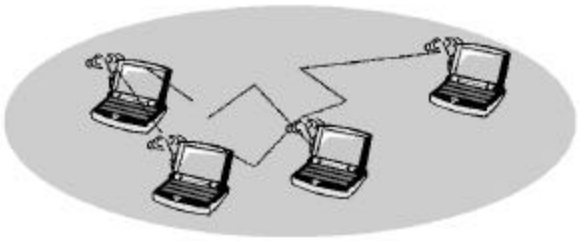

Fig. 1: A mobile ad hoc network

Ease of deployment: Ad hoc networks are easily deployable as they do not need any fixed infrastructure of central administration.

Speed of deployment: Ad hoc networks are deployable on the fly. They are autonomous and infrastructure-less or semi-infrastructure.

Cost of deployment: There is no incremental cost for deployment; however, costs may rise depending upon the nodes associated with the network.

Anywhere, anytime: Wireless ad hoc networks could be deployed anywhere, anytime especially in the hostile or geographically harsh areas where fixed network deployment is difficult.

PROPOSED ARCHITECTURE

Considering the benefits and features of wireless ad hoc networks, we propose an efficient and cost effective framework for providing e-tourism services to the rural areas especially in the developing countries. In most of the developing countries, the governments are quite unable to provide necessary services to the people of the rural and especially in remote areas. On the other hand, as most of the rural areas are either hard-to-reach or technologically lagging and thus tourists cannot get most of the benefits of modern tourism technologies. Figure 2 describes the basic architecture of the proposed model.

The central part of the proposed architecture is the CDC (Central Data Center). The CDC contains necessary e-technology facilities which will provide structured information and assist the potential tourists in finding suitable information conveniently and efficiently. CDC is connected with DPCs (Data Processing Center) through wireless media. The function of the CDC is to deliver the requested data to DPC.

DPCs (Data Processing Center) are capable of wireless communications. DPCs are normally located in urban areas. DPCs receive the requests from MAPs (Mobile Access Point) and forward the request to the

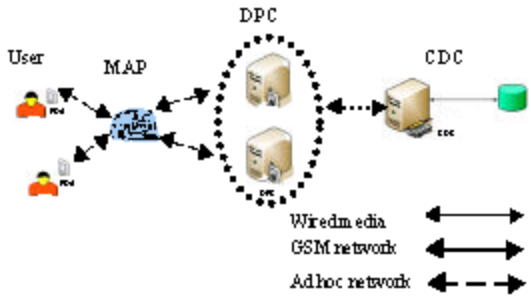

Fig. 2: Proposed framework aided with wireless technologies

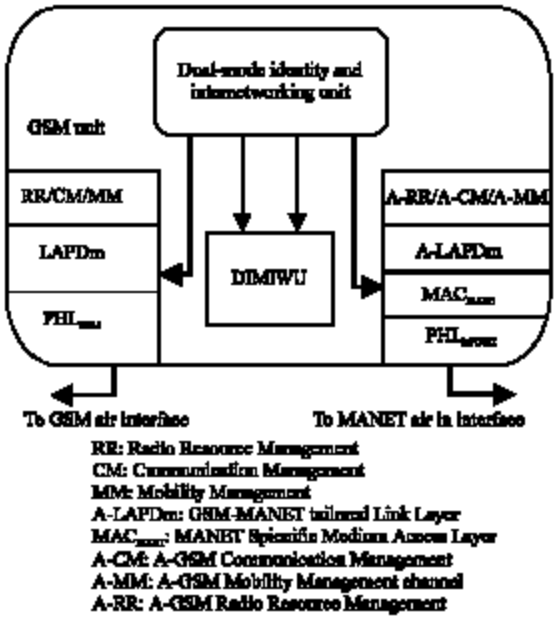

Fig. 3: GSM-MANET Dual Mode Terminal

CDC. The incoming data from CDC is temporarily stored and processed in DPCs. Once the processed data is ready, it is transmitted to the MAPs. Each DPC also contains the local database containing the necessary information related to that particular location e.g attractive tourist spots, actual prices and availability of different services like holiday packages, travel, lodging and leisure services, weather forecasting.

Moreover, each DPC works as an integrated dual mode terminal as it is connected with the CDC through traditional wireless network (GSM, CDMA etc) on the other hand, it is connected with the MAP through Adhoc network. As a result, each DPC performs integration of GSM and ad hoc network. Figure 3 illustrates the architectures of the GSM-MANET dual mode terminal.

Internet Working Unit (DIMIWU) is a nonstandard, specially designed unit, responsible for providing access to a GSM/A-GSM network. It performs all the necessary user terminal protocol adaptations to the GSM/A-GSM protocol platform. DIMIWU also includes all physical layer functionalities such as channel coding, modulation and demodulation and the radio frequency parts. All of the supported terminals share the same access scheme and protocol stacks.

In the next step, Mobile Access Points (MAPs) play the major role. A MAP is a vehicle mounted wireless access point which uses low-cost Wi-Fi (Wireless Fidelity) technology (Pike and Osborne, 2004). These MAPs move around the tourist-spots in the rural areas where infra-structured network is not available and exchange information with the tourists. When a MAP comes near to a DPC, a wireless ad hoc network is automatically formed and all the raw data are exchanged between them. The 802.11b Wi-Fi technology operates in the 2.4 GHz range offering data speeds up to 11 megabits per second (http://www.mobilecommstechnology.com/projects/ieee802). There are two other specifications that offer up to five times the raw data rate, or 54 Mbps. One is 802.11g which operates on the same 2.4 GHz frequency band as 802.11b. The other alternative 802.11a occupies frequencies in the 5 GHz band. If offers less range of coverage than either 802.11b and 802.11g but offers up to 12 no overlapping channels, compared to three for 802.11b or 802.11 g, so it can handle more traffic than it's 2.4 GHz counterpart. Based on the need or particular situation, any of these specifications is chosen for a particular area for transmitting stored data from the kiosks to the MAPs.

These data are then taken and delivered to the DPCs (Data Processing Center) located at nearby towns by the MAPs. So, a Wi-Fi enabled MAP operates in two ways:

- Forms wireless ad hoc network when comes close to the tourists and exchanges data with the rural tourists using Wi-Fi radio transceivers.
- Again, forms wireless ad hoc network when comes close to the DPCs and delivers raw data to the DPCs using Wi-Fi radio transceivers.
- The proposed system considers that all the tourists visiting the rural spots are equipped with handheld terminals (mobile, pda, laptop etc.). Whenever any tourist comes closer to any MAP, an ad hoc network will be created. Using this ad hoc network, tourists can easily and cheaply access e-tourism services such as checking up-to-date travel information like departures and arrivals.

ADVANTAGES OF THE PROPOSED ARCHITECTURE

The ad hoc network can provide infrastructure-less network for inexpensive delivery of information,

concerning every single enterprise and destination. Thus, the proposed framework empowers the marketing and communication functions of remote, peripheral and insular destinations. It satisfies tourist needs for easy access to transparent and easy to compare information on a wide variety of choices of destinations, holiday packages, travel, lodging and leisure services, the actual prices and availability of such services. So, this proposed framework can be used to attract the tourists to visit the remote areas and to make their tour-period more comfortable and relaxing.

This architecture is not only useful for the e-tourism facilities but with a slight modification on the proposed architecture, it can also be useful for different types e-learning purposes such as teaching which is the best option for providing education in the remote area, computer supported medical diagnosis or e-medicine and e-health care etc (Balachandran *et al*., 2003). For this we just need to add one kiosk (acts as a sink) in each villages or rural areas which is equipped with computers including multimedia for storing acquired data.

Some of the rural areas have small cottage industries which produce traditional handi-crafts which often have a great demand in the other areas or sometimes in other countries. With the help of our proposed framework, the customers can provide their demand through online without the necessity of their physical presence in those remote areas if the villagers are equipped with the low cost terminals. At the same time, information about other goods and products could be supplied to the rural areas. So, it could be a means of expanding ecommerce even in the rural areas.

OPERATIONAL CHALLANGES

While our proposed framework seems to be promising for the development of rural areas, there could arise some operational and technical challenges for implementing such a framework.

Primary installation costs might be a bit high for the developing countries to bear.

Detailed planning is required to decide which areas should have Data Processing Centers (DPC), which areas should be chosen for deploying wireless sensors etc.

Computer literate people are required at each village kiosk. So, some of the people should be trained for this.

Some rural areas don't have good communication facilities. Roads are often not suitable for the movement of the MAPs.

In disastrous situations like, storm, heavy rainfall etc. the wireless technology might not come as useful.

CONCLUSION

The tourism sector cannot stand aside from the impact of the changes which electronic servicing has on businesses in general. In responding to this particular challenge, new e-Tourism services need to be created and implemented. The proposed architecture can provide sophisticated e-tourism facilities in the remote areas though the preliminary installation costs may be little bit expensive. But, once it is set up, it could run smoothly and serve for the greater benefits. In the context of the developing countries and also with the frame of future computing in mind, proposed architecture can undoubtedly be a solution for developing e-tourism services in the remote areas. Proposed approach is not only pertaining to the recent necessity but also a modern approach for e-tourism.

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