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Challenges and Opportunities of Wireless Mobile Communication in India- A Study

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Abstract

The wireless mobile communication markets are witnessing unprecedented growth fueled by an information explosion and a technology revolution. Mobile communication system add and important capability to our communication society. There are several standardized wired and wireless communication technologies available for various smart grid applications. With the recent growth in wireless communication, it can offer standardized technologies for wide area, metropolitan area, local area , and personal area network. Moreover wireless technologies not only offer significant benefits over wired, but also more suitable for remote end applications. Some challenges and opportunities related to wireless communication technologies have been discussed in brief. This paper gives a brief overview of some of the challenges and the opportunities of mobile wireless communication.

Index Terms:- Mobile Communication, Smart Grid, Opportunities, Wireless Communication, Challenges, GSM, Wimax, 3G Technology, Etc.

INTRODUCTION

INDIA is the second largest and one of the fastest growing markets with strong demand of ICT services. Like all over the world, the unprecedented surge is towards mobile communications in India. GSM mobile and CDMA networks for wireless local loop as well as for complete mobility have come in a big way in urban areas. The competition and falling revenues are soon expected to force operators to extend cellular networks to rural areas.

Even after seven years of Internet services started in India, the number of Internet users is just one percent of the population. The Department of IT, Ministry of Communication and IT has set an ambitious target of 100 million Internet connections by the year 2008 and one million Internet enabled IT kiosks/ cyber cafes to be established covering the entire country. Wireless networks capable of handling data and video along with the voice at affordable prices could be the answer in achieving these targets.

1. COMMUNICATIONS IN INDIA

India's telecommunication network is the second largest in the world based on the total number of telephone users (both fixed and mobile phone). It has one of the lowest call tariffs in the world enabled by the mega telephone networks and hyper-competition among them. It has the world's third-largest Internet user-base with over 137 million as of June 2012. Major sectors of the Indian .

telecommunication industry are telephony, internet and television broadcasting.

Telephone Industry in the country which is in an ongoing process of transforming into next generation network, employs an extensive system of modern network elements such as digital telephone exchanges, mobile switching centers, media gateways and signaling gateways at the core, interconnected by a wide variety of transmission systems using optical fiber or Microwave radio relay networks. The access network, which connects the subscriber to the core, is highly diversified with different copper-pair, optic-fiber and wireless technologies. DTH, a relatively new broadcasting technology has attained significant popularity in the Television segment. The introduction of private FM has given a fillip to the radio broadcasting in India. Telecommunication in India has greatly been supported by the INSAT system of the country, one of the largest domestic satellite systems in the world. India possesses a diversified communications system, which links all parts of the country by telephone, Internet, radio, television and satellite.

2. TELEPHONY

The telephony segment is dominated by private-sector and two state-run businesses. Most companies were formed by a recent revolution and restructuring launched within a decade, directed by Ministry of Communications and IT, Department of Telecommunications and Minister of Finance. Since then, most companies gained 2G, 3G and 4G licenses and engaged fixed-line, mobile and internet business in India. On landlines, intra-circle calls are considered local calls while inter-circle are considered long distance calls. Foreign Direct Investment policy which increased the foreign ownership cap from 49% to 74%.

Currently Government is working to integrate the whole country in one telecom circle. For long distance calls, the area code prefixed with a zero is dialed first which is then followed by the number. For international calls, "00" must be dialed first followed by the country code, area code and local phone number. The country code for India is 91. Several international fiber-optic links include those to Japan, South Korea, Hong Kong, Russia, and Germany. Some major telecom operators in India include Airtel, Vodafone, Idea, Aircel, BSNL, MTNL, Reliance Communications, TATA Teleservices, Infotel, MTS, Uninor, TATA DoCoMo, Videocon, Augere, and Tikona Digital.

3. MOBILE COMMUNICATION

Mobile communication allows transmission of voice and multimedia data via a computer or a mobile device without having connected to any physical or fixed link.

Mobile communication is evolving day by day and has become a must have for everyone. Mobile communication is the exchange of voice and data using a communication infrastructure at the same time regardless of any physical link. Mobile communication technologies not only benefit businesses to perform their operation faster and efficiently but also raising the standard of human lives. Mobile communication or mobile computing is just the two different names for the ability to use the mobile technology while on the move, most of the portable computers and computing equipment which are particular for the use in stationary place or configuration.

If we talk about the mobile communication technologies we can count on many mobile technologies available today such as 2G, 3G, 4G, WiMAX, Wibro, EDGE, GPRS and many others. Mobile computing or mobile communication technologies based on different security standards and as well as the transmission protocol behind it. In this section

we have discussed in detail about 3G technologies. If you want augmented bandwidth, multiple mobile applications

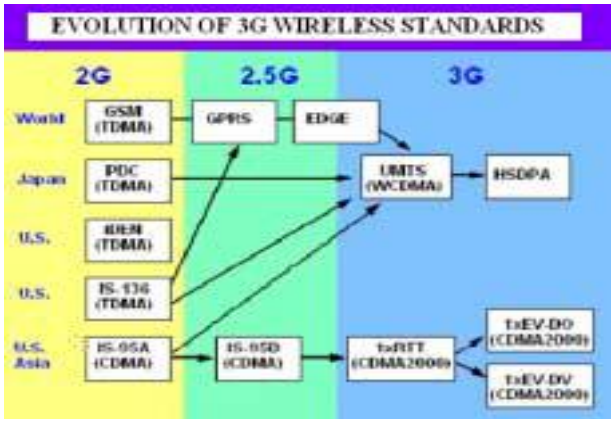
and clarity of digital signals, then 3G (Third Generation Technology) is our gateway. The use of 3G technology is also able to transmit packet switch data efficiently at better and increased bandwidth. 3G mobile technologies proffers more advanced services to mobile users. It can help many multimedia services to function. The spectral efficiency of 3G technology is better than 2G technologies. Spectral efficiency is the measurement of rate of information transfer over any communication system

To support the service, mobile operators maintain network of interconnected and overlapping mobile base stations that hand-off customers as those customers move among adjacent cells. Each mobile base station may support users up to several kilometers away. The cell towers are connected to each other by a backhaul network that also provides interconnection to the wire line Public Switched Telecommunications Network (PSTN) and other services. The mobile system operator owns the end-to-end network from the base stations to the backhaul networks to the point of interconnection to the PSTN. Third Generations (3G) mobile technologies will support higher bandwidth digital communications. To expand the range and capability of data services that can be supported by digital mobile systems, service providers will have to upgrade their networks to one of the 3G technologies which can support data rates of from 384Kbps up to 2Mbps.

4. ADOPTION OF 3G TECHNOLOGIES

3G was relatively slow to be adopted globally. In some instances, 3G networks do not use the same radio frequencies as 2G so mobile operators must build entirely new networks and license entirely new frequencies, especially so to achieve high-end data transmission rates.

Other delays were due to the expenses of upgrading transmission hardware, especially for Universal Mobile Telecommunication System (UMTS), whose deployment required the replacement of most broadcast towers.



Due to these issues and difficulties with deployment, many carriers were not able to or delayed acquisition of these updated capabilities.

4.1 3G TECHNOLOGY IN INDIA

In 2008, India entered the 3G arena with the launch of 3G enabled Mobile and Data services by Government owned Bharat Sanchar Nigam Ltd. (BSNL). Later, MTNL launched

3G in Delhi and Mumbai. Nationwide auction of 3G wireless spectrum was announced in April 2010.

The first Private-sector service provider that launched 3G services is Tata DoCoMo, on November 5, 2010. And the second is by Reliance Communications, December 13, 2010.

Bharti Airtel launched their 3G services on 24 January 2011 in Bangalore and also launched in Delhi & Jaipur on March 4, 2011. Aircel also launched 3G in Kolkatta in the month of February. Other providers like Vodafone, Idea and others launched 3G services in first quarter of 2011.

People in India are looking forward to more information, faster data access and multimedia services through their mobile phones. 3G technology is here to turn this dream into reality. It's a technology anxiously awaited by telecom operations and subscribers in India.

According to Telecom Regulatory Authority of India a total of 32.5 MHz was making available for allocation. Telecom Regulatory Authority of India (TRAI) also recommended auctioning 200 MHz for broadband wireless access services like Worldwide Interoperability for Microwave Access (WiMAX) and has proposed a national frequency management board to oversee spectrum availability and its efficient use.

3G spectrums has been provided to GSM players like BSNL, MTNL, Bharti, and Vodafone and some international companies have also shown interest to carry out an interface check on a non-commercial basis ahead of the start of 3G mobile services. Trial spectrum has been given for a period of one month. This will be only 1/1000th of the actual 3G spectrum capability. Apart from PSU majors, spectrum for carrying out 3G trials has been given to all those who have applied under the National Frequency Allocation Plan on the

2.1 GHz band. GSM players operate on 900 MHz and 1,800 MHz, while CDMA players operate on 800 MHz. While Tatas have welcomed TRAI's Rs 1,400-crore (Rs 14 billion) base price for a nationwide rollout of 3G services, the rest of the players find the price too exorbitant. Bharti-Airtel is disappointed with the pricing as they were expecting it to be Rs 300-400 crore (Rs 3-4 billion). The reserve price is a disincentive for telecom companies in India. Bharti has appealed to lower the prices especially for rural penetration. The Cellular Operators Association of India and the Association of Unified Service Providers of India are studying TRAI's recommendations and have not given their comments. Japan was the first country to introduce 3G on a large commercial scale. In 2005, about 40 per cent of subscribers used only 3G networks. It is expected that during 2006 the subscribers would move from 2G to 3G and upgrade to the next 3.5 G level. The success of 3G in Japan also shows that video telephony was the killer application for 3G networks. Downloading music was the biggest draw in 3G services.

5. COMMUNICATION SYSTEM FOR SMART GRID

This section describes the communication framework of smart grid and challenges associated with it.

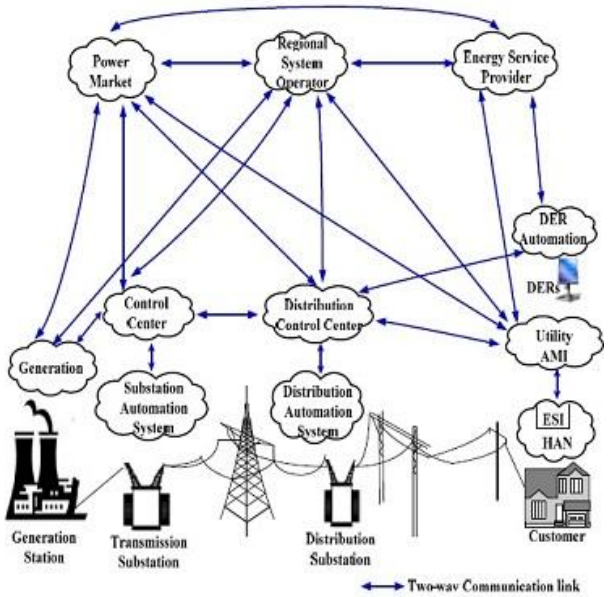


Fig. 1 Smart grid framework.

A. Smart Grid Framework

The lower layer domains related to electric power system are generation domain; transmission domain presented as regional Control Center (CC) and Substation Automation System (SAS); distribution domain is consist of Distribution Control Center (DCC) and Distribution Automation System (DAS); customer domain includes DER plant automation, and residential or industrial customer automation system. Higher regulatory layer domains include regional system operator, energy service provider, and power market. The figure shows the two-way communication interfaces among these lower and higher layer domains.

B. Major Challenges for Communication Systems in a Smart Grid

Communication systems refer to:

1) the communication media, and 2) the developing communication protocols. The smart grid communication systems must be robust enough to accommodate new media,

as they emerge from the communication industries, while preserving interoperable and secured systems. Major challenges related to smart grid communication systems are listed as follows:

1. Develop and/or identify interoperable communication protocols with standard semantic models for each domain of the smart grid, as well as, harmonize these communication protocols for inter-domain information exchange.
2. Identify suitable communication technologies for smart grid communication infrastructure.
3. Cyber security for intra-domain as well as inter-domain communication interfaces. Several activities are going on to address this communication infrastructure related challenges The following section provides the identification of few specific smart grid applications using latest wireless communication technologies.

6. WiMAX

Worldwide inter-operability for Microwave Access (WiMAX) technology is a part of 802.16 series standards for Wireless metropolitan Area Network (WMAN) [16]. Main objective of WiMAX is to achieve worldwide interoperability for microwave access. In 2001, when the first draft of IEEE 802.16 standard was released, it defined the wide operating range of 10-66GHz for communication infrastructure.

WiMAX forum has published a subset of the range for interoperability. For fixed communication 3.5 and 5.8GHz bands have been dedicated, while for mobile communication frequency bands 2.3, 2.5 and 3.5 GHz have been assigned. The spectrums 2.3, 2.5, 3.5GHz are licensed; whereas5.8GHz is unlicensed spectrum. It provides data rate up to 70Mbps and distance up to 48km [11]. However, distance and network speed are inversely proportional to each other. Licensed spectrums allow higher power and longer distance transmission, which is more suitable for long distance communication. The bandwidth and the range of WiMAX provide the alternative of cable, DSL and T1 communication channel for last-mile access.

7. Cellular 3G/4G

The 3G (3rd Generation) / 4G (4th Generation) cellular technology operates on the spectrum range of 824-894MHz/1900MHz . These are the licensed frequency bands. Data transmission rate of this technology is 60-240Kbps, and distance converge is depend upon the availability of cellular service . This cellular network topology consists of cells, which are formed by many low power wireless transmitters. With the moment of mobile devices having cellular modem, transmission of data is also exchanged between cell to cell, which facilitates non interrupted data flow. This way it forms a point to point architecture. It can also receives data from serial or Ethernet interface and transmit data on a second interface over cellular network, to enable normally wired components to become wireless. This technology offers extensive data coverage, no maintains costs and network fully maintained by carrier .

Cellular technology for smart grid applications:

The advantage with cellular technology is that the existing infrastructure can be used at some extent. Also, with the recent growth in 3G / 4G cellular technology, the data rate and Quality of Service (QoS) are improving very fast.

8. ZigBee

ZigBee is reliable, cost effective, and low power home area wireless network developed by ZigBee Alliance based on an open global standard. It provides compatibilities with IEEE 802.15.4 standard. ZigBee operates on the unlicensed frequency range of 868MHz, 915MHz and 2.4GHz with DSSS modulation technique. It offers a data rate of 20-250 Kbps. It provides coverage of 10-100m. ZigBee supports the star, tree and Mesh topologies.

Transmission reach and battery life of the ZigBee devices vary depending upon the topology adopted. ZigBee employs 128-bit AES encryption for security . ZigBee is widely used for building automation, security systems, remote control, remote meter reading and computer peripheral applications.

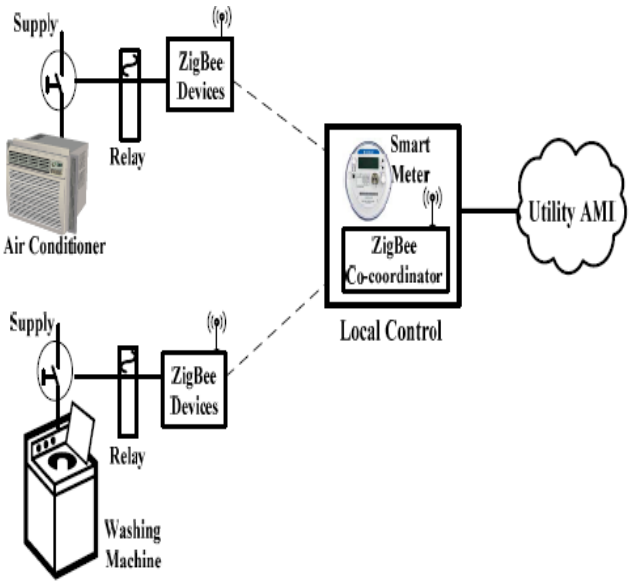


Fig. 6 ZigBee technology for smart home area network.

IEEE 802.20 may be used for smart grid applications, such as broadband communication for plug-in electric vehicles, wireless backhaul for electric grid monitoring and SCADA systems.IEEE 802.20 (MBWA) is new emerging technology, and hence, communication infrastructures for this technology are not readily available. Currently, use of this technology may be costly solution compare to cellular technology.

CONCLUSION

The potential smart grid applications for wireless LAN, WiMAX, ZigBee, 3G/4G cellular, digital microwave, discussed in this paper, have been tabulated as follows.
Implementation of wireless technology offers many advantages over wired, e.g. low installation cost, mobility, remote location coverage, rapid installation, etc. However, each technology has certain challenges, as discussed in the paper, which need to be address for its future use in smart grid environment. Few common concerns for wireless technologies are:

1) wireless technologies operating in unlicensed frequency spectrum are more susceptible to interference/noise effects;
2) wireless technologies with licensed spectrum has less interference, but they are costly solution comparatively

Wireless Technology	Data Rate	Approx. Coverage	Potential Smart Grid Applications
Wireless LAN	1-54Mbps	100m	distribution protection and automation
WiMAX	70Mbps	48Km	Wireless Automatic Meter Reading (WMAR)
Cellular	60-240Kbps	10-50km	SCADA and monitoring for remote distribution
ZigBee	20-250Kbps	10-100m	Direct load control of home appliances
MobileFi	20Mbps	Vehicular Std.	communication for PEVs and remote monitoring
Digital Microwave	155Mbps	60 km	transfer trip (point-to-point)
Bluetooth	721Kbps	1-100m	local online monitoring applications

3) security of wireless media is less inherently. Several activities to address these major challenges have already been initiated. If FCC will provide an unlicensed wireless frequency band dedicated for smart grid, issues related to interference and cost of licensed frequency band will be alleviated. Moreover, developments in wireless security standard may allow realization of many mission critical smart grid applications using wireless communication technologies.

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