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REVIEW ON TECHNOLOGIES IN WIRELESS NETWORKS

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ABSTRACT

In Present communication, wireless networks are playing major role for sharing or use of information throughout all over of the world. Consumers are beginning to demand access anytime from anywhere.In this paper, we have explained the technologies used under wireless networks. Firstly, we started with cellular services including fast speed 4G networks. Cellular system uses radio waves to transmit data over long distances. They have been used to provide mobile services since the 1970s. They use a concept of "frequency reuse" to increase coverage area and also for multiple transmissions simultaneously. Next there is brief study about various technologies of wireless communication using different type of methods. The applications for users have been described for achieving the home level services. The currently used technologies as TDMA and CDMA have discussed.

Keywords: GPRS,ITS,WiMAX,DSRC,WLAN

I. INTRODUCTION

1.1Cellular Systems (2G/3G/4G)

Cellular system uses radio waves to transmit data over long distances. They have been used to provide mobile services since the 1970s. They use a concept of "frequency reuse" to increase coverage area and also for multiple transmissions simultaneously (Fig.1).In the first generation (1G), analog signals are used to transmit data. The Second Generation (2G) supports secure, digital transmission unlike its predecessor 1G. It has various forms such as the Global System for Mobile communications (GSM), digital AMPS (D-AMPS), Code-Division Multiple Access (CDMA), and Personal Digital Communication (PDC) techniques [1]. Amongst these GSM is predominately used.

GSM uses Frequency Division multiple access (FDMA) along with Time Division Multiple Access TDMA) technique. It operates in fourteen frequency bands but GSM-900 and GSM-1800 are used in many countries. GSM-900 uses 890–915 MHz for uplink and 935–960 MHz for downlink whereas GSM 1800 uses 1,710–1,785 MHz for uplink and 1,805–1,880 MHz for downlink. Those frequency bands are divided into several channels in order to transmit data [2]. GSM supports a data transfer rate of 9.6 Kbps. Its extension, called General Packet Radio Service (GPRS), introduces a packet oriented, mobile data service. It improves the data transfer rate through efficient bandwidth utilization as compared to GSM. GRPS and GSM together are called 2.5G. They support a data transmission speed of up to 170 Kbps and enables internet access [3].Enhanced Data Rates for GSM Evolution (EDGE)/Enhanced GPRS (EGPRS), uses Eight State Phase Shift Keying (8-PSK) in

combination with Gaussian Mean Shift Keying (GMSK) modulation techniques to achieve a higher data rate. It can be operated on any GSM frequency band and increases the data rate up to 384kbps. It is a more suitable standard to support email, wireless multimedia, video conferencing and web based infotainment applications than GPRS.

3G/UMTS (Universal Mobile Telecommunications System) operates in the band from 1.8GHz to 2.5 GHz. It uses more advanced adaptive modulation techniques such as Quadrature Phase Shift keying, or 64QAM (QPSK), Differential phase shift keying (DPSK), Bipolar phase shift keying (BPSK) and Pulse modulation (PM). It provides data transfer speeds up to 2 Mbps. 3G HSPA (High-Speed Packet Access) offers a downstream data transfer rate of 14 Mbps and an upstream data transfer rate of 5.74 Mbps. Incontrast, 3G HSPA+ (Evolved HSPA) achieves 42 Mbps in the downlink and 11 Mbps in the uplink. 3G HSDPA (High-Speed Downlink Packet Access) technique was developed to meet the requirements of bandwidth-intensive applications such as large file transfers, and fast Web browsing. It is an ideal technology to support real time application due to its low latency (70 to 100 ms). It can support data transfer speed of up to 14.4Mbps.The Fourth Generation (4G) technologies were developed to offer high speed, broadband, cheaper mobile services[4]. They support high mobility through soft handoffs and seamless switching . 4G/ LTE (Long Term Evolution) network uses the 1700 MHz and 2100 MHz frequency bands, and its data transfer speed is up to129Mbps. 3G Cellular network has already used for timely data dissemination in order to support VANET applications such as accident prevention and traffic jam avoidance.

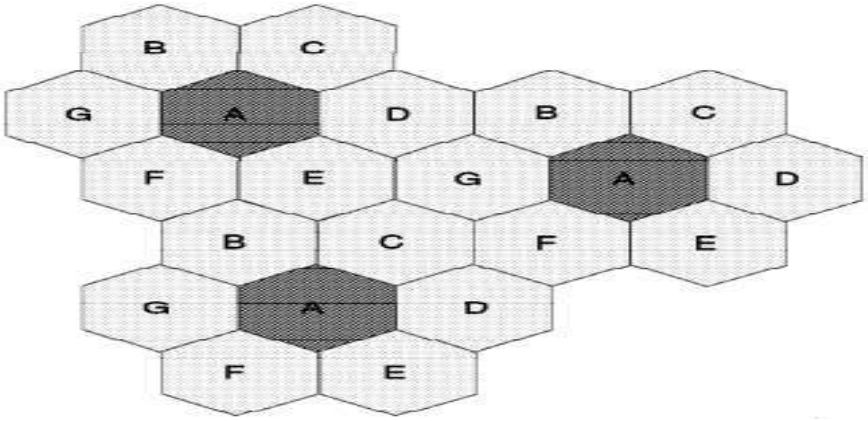

Fig.1 Cellular Network

1.1.1 Applications of 4G

With the increase in the data rates, the mobile phones are made to perform higher performance applications. In 4G the mobile phone is not only for calling but it is something extraordinary device that can be used for variety of purposes. One such application in 4G is context awareness. For example if the mobile user is passing by an office where he/she is having an appointment to meet someone and they have forgotten the appointment. If the office location, address and geographical location matches the one user has already stored in the phone, he/she will receive information about the appointment and will be reminded that you need to perform this activity. Telemedicine is another application of 4G. Using telemedicine a patient can send general reading like temperature, glucose level and blood pressure to the doctor online. Or if someone needs to know about their

family member's health continuously they can receive all the information through telemedicine by using 4G technology [5].

II. WIMAX STANDARD

WiMax (Worldwide Interoperability for Microwave Access) provides Internet access at the distance of up to 50km with a speed of 70Mbps. As it uses higher frequency band (2.5 GHz) compared to LTE, it provides high bandwidth which in turn increases throughput. The new standard, WiMAX Mobile (IEEE 802.16m), uses advanced modulation techniques such as Adaptive modulation and coding (AMC), Hybrid Automatic Repeat Request (HARQ) and Fast Channel Feedback (CQICH) to offer broadband access to mobile users[6]. It can offer downlink data rates of up to 63 Mbps and uplink data rates of 28Mpbs.

III. MBWA STANDARD

The IEEE 802.20 or Mobile Broadband Wireless Access (MBWA) was developed to provide wireless Internet access to highly mobile devices. Though it is attempted to provide various features such as low latency, high data rate of up to 4.5 Mbps, support for mobility up to vehicular speeds of 250 km/h. It is operated in licensed 3.5GHz and optimized to support IP packet transmission. It also supports seamless and fast handoffs.

IV. MICROWAVE

This standard (IEEE 802.15.4) uses a frequency between 0.3GHz and 300GHz and transmits data up to 16 Gbps over long distance. Unlike Infrared, it provides broad bandwidth and supports high transmission rate. It is already used in RADAR, Micro Ovens and Satellite Communications. Moreover, it is used to build wireless LAN that spans multiple cities. The key limitation of microwave is that it requires Line of Sight (LoS) communication . Like infrared, it can be used to support both safety and infotainment applications but with the LoS constraint issue.

V. WLAN/WI-FI STANDARDS

Wireless local area network (WLAN) or wireless fidelity (Wi-Fi) standards are widely used to create Adhoc networks due to their low cost, high data transfer rates and ease of deployment. These consist of several standards including 802.11a, 802.11ac, 802.11b, 802.11e, 802.11g and 802.11n. The IEEE 802.11b operates in the unlicensed 2.4GHz frequency band and achieves data rates of up to 11Mpbs using DSSS. IEEE 802.11a operates in the licensed 5 GHz frequency band and supports high data rate of 54Mbps. This standard is incompatible with 802.11b and costlier. 802.11g, an extension of 802.11b, has the same data rate of 802.11a through using an OFDM modulation technique. Like 802.11b, it is also vulnerable to air interferences from Bluetooth devices, Cordless phones due to usage of unlicensed 2.4GHz frequency band[7].

VI. DSRC/WAVE (IEEE 802.11p Wi-Fi Family Protocols)

Dedicated Short Range Communication (DSRC/IEEE 802.11p) was exclusively developed to meet the requirements of VANETs such as self organizing, self configuring, high mobility and dynamic topology.DSRC works using a 75MHz spectrum in 5.9 GHz frequency band in US whereas in Europe and Japan it operates on 30MHz spectrum in the 5.8 GHz band. It can provide services to both V2V and V2I up to 1km and supports data rate of up to 27Mbps.

VII. CONTINUOUS AIR-INTERFACE, LONG AND MEDIUM RANGE (CALM)

CALM is being developed by Working Group 16(WG16) of Technical Committee 204 (TC204) of ISO.
Like the WAVE standard, it is also operates in the 5.9 GHz band. Basically it is a collection of standards, procedures and management processes. It is intended to provide continuous and transparent communication across multiple communication standards and application interfaces. CALM media are classified into five categories: 5GHz wireless LAN systems (IEEE 802.11 WiFi/802.11p/CALM M5), Cellular systems, (GSM/HSDSC/GPRS and 3G UMTS), 60 GHz systems, Infrared communication and a Convergence Layer, supporting DSRC, broadcast and positioning.

VIII. BLUETOOTH

The ISM (industrial, scientific and medical) radio bands based Bluetooth (IEEE 802.15.1) protocol is used to transfer data at the rate of up to 1Mbps to 4Mbps over a distance of 10m. Bluetooth operates in the 2.4 GHz band and uses it uses Frequency Hopping Spread Spectrum technique to overcome signal interference [8].Though Bluetooth Version 3 can work on 6 GHz to 9 GHz frequency band, it uses 2.4 GHz band to communicate with other devices. Though Bluetooth 4.0 uses low energy for transmission, it is not compatible with earlier versions. It is predominately used to create a Personal Area Network (PAN).

IX. ZIGBEE

ZigBee (IEEE 802.15.4) uses the license-free 2.4 GHz band to transfer data at the rate of 250 Kbps up to 70 meters. It also uses lower frequency bands 915MHz (US) and 868MHz (Europe) to supports data transmission rates of 40 Kbps and 20Kbps respectively. This technology uses low powered radio signals to transfer data up to 100m using Offset Quadrature Phase Shift Keying (OQPSK)modulation.

X. INFRARED

It is another popular wireless access technique which uses invisible light to transfer data. It operates in the frequency band between 300 GHz and 400 THz. This broad spectrum is divided into three sub-bands: near-infrared, mid-infrared and far-infrared. Based on the typeof sub-band, it can transfer data from 115kbps to 4Mbps. Since infrared signals are affected by obstacles, it is mainly used for short range communication.

XI. ULTRA WIDEBAND (UWB)

UWB, which operates on unlicensed frequency band between 3.1 and 10.6 GHz, can support a STA with mobility of 10 kmph. It support low power operation, low power dissipation, robustness for multi-path fading and higher throughput of up to 480 Mbps. Like Bluetooth, it has a transmission range of 10m.

XII. ITS IN VANET

Intelligent transport systems are the rising technology in the near future to build cooperative vehicular networks in which a variety of different ITS applications are expected to communicate with a variety of different units. Therefore, the demand for highly customized communication channel for each or sets of similar ITS applications is increased.

XIII. HOME APPLICATIONS

In the home environment, wireless systems have been in existence for many years (Fig.2). The spread of these applications was a direct result of the availability of cheap, non-licensed wireless technology. Among the first applications were ultrasonic remote control units for TVs. These were sensitive to other background sounds and were replaced over time by infrared controls. Then, as transmitters and detectors in the infrared frequency range became generally available at an affordable price in the 1960s and 1970s we saw:

• Security motion detectors for burglar alarms
• Motion detectors for switching on lights or opening doors
• Remote locking/unlocking of car doors
• Remote opening of garage doors (now mainly radio activated)
• Remote TV/VCR/Radio controls

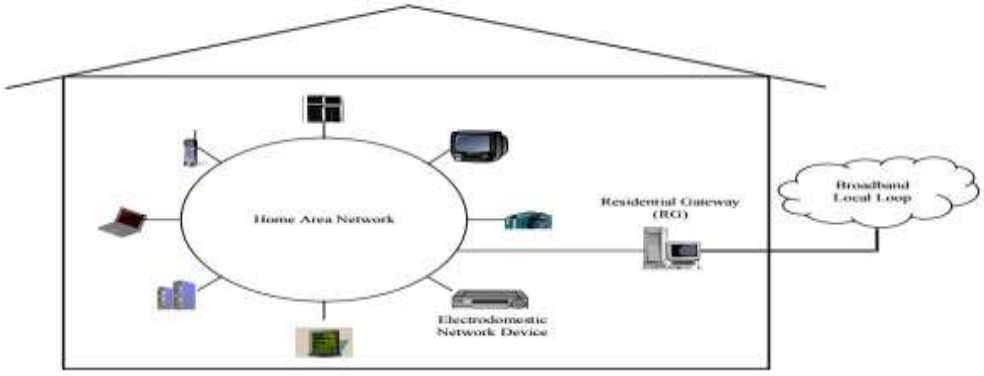

Fig.2 Home Applications

XIV. CURRENTLY USED TECHNOLOGIES

The two Technologies currently used are time-division multiple access (TDMA) or code-division multiple access (CDMA) these two technologies are collectively referred to as secondgeneration, or 2G.

TDMA

TDMA, or Time Division Multiple Access, is a technique for dividing the time domain up into sub channels for use by multiple devices. Each device gets a single time slot in a procession of devices on the network. During that particular time slot, one device is allowed to utilize the entire bandwidth of the spectrum, and every other device is in the quiescent state.

CDMA

CDMA, or Code Division Multiple Access, allows every device in a cell to transmit over the entire bandwidth at all times. Each mobile device has a unique and orthogonal code that is used to encode and recover the signal (Leon-Garcia and Widjaja 2000). The mobile phone digitizes the voice data as it is received and encodes the data with the unique code for that phone. This is accomplished by taking each bit of the signal and multiplying it by all bits in the unique code for the phone. Thus, one data bit is transformed into a sequence of bits of the same length as the code for the mobile phone. This makes it possible to combine with other signals on the same frequency range and still recover the original signal from an arbitrary mobile phone as long as the code for that phone is known. Once encoded, the data is modulated for transmission over the bandwidth allocated for that transmission [9].

XV. CONCLUSION

This paper presents an overview of wireless access technologies which could be to be used in Wireless Networks. For each standard, it discusses the elements and supports of applications. Wireless communication is growing at an explosive rate around the world. In the starting section of paper, the overview about cellular networks has given with reference to speed requirements. Further we have discussed about various wireless standards and conclude the text with currently used technologies.

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