Volume 3, Issue 2, February 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Fundamentals and Development in Mobile Communication

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Abstract—The goal of the next generation of mobile communications system is to provide a wide range of communication services to everyone everywhere and at anytime. The services provided to the mobile phone users are like high speed data transmission, improved video quality and multimedia services as well as voice signals. The first generation systems were represented by the analog systems which were designed to carry the voice traffic while its subsequent digital counterparts are included in second generation systems. The third generation are used for higher transmission rate bandwidth of signals and are oriented towards multimedia message capacity.

Keywords— cellular, generation, spectrum, gsm, wcdma

I. INTRODUCTION

Acceleration in improvement of manufacturing and technology get started at the time of 2nd world war, and these technologies used in one way and two way radio and television system. [1] Many new opportunities opened for mobile radio communication between widely separated locations with space age. Above the earth at a high point satellite can link distance location. In the place of high frequency terrestrial system having limited bandwidth or no. of short range microwave relays satellite is used as a link for distance location from a point located at a high above the earth. By the mid of 1960, communication of geostationary satellite orbit was handled by launch vehicles. Now a day, in the field of telecommunication technology, which is directly communicate with hand held telephone on earth and is made up of satellite. Production growth of personal communication system and cellular radio accelerated in the Late 1970. As 1G, 2G and 3G are introduced the growth was highly spurred. [2]

II. RADIO CLASSIFICATION

The radio spectrum is divided into sub bands based on each frequency range's suitability for a given set of applications. Suitability is determined as a function of the atmospheric propagation characteristics of the given frequencies as well as system aspects, such as required antenna size and power limitations. Based on these considerations, the radio spectrum has been divided into the following sub bands:

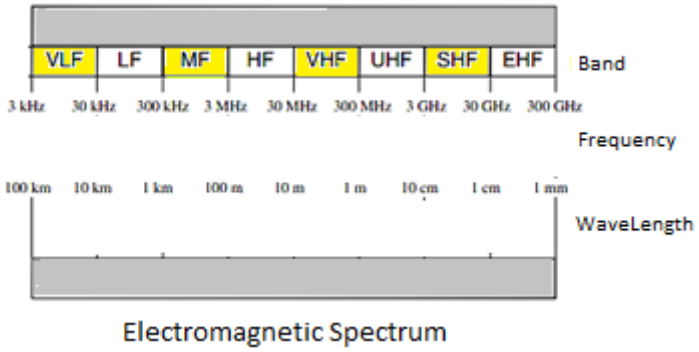

Fig.1 EM spectrum

A. Extremely Low Frequency (ELF)
300 – 3000 Hz (λ = 1000 – 100 km)

B. Very Low Frequency (VLF)
3 – 30 kHz (λ = 100 – 10 km)

The wave propagates between the surface of the Earth and the Ionosphere. It can penetrate deep underground and underwater. As the required antenna size is proportional to the wavelength, the large wavelength in this case mandates the use of large antennas.

Applications: mining, underwater communication (submarines), SONAR.

C. Low Frequency (LF)
30 – 300 kHz (λ = 10 – 1 km)

Here ground wave is the dominant mode and the radiation characteristics are strongly influenced by the presence of the Earth. The antennas which are used for these ranges are still quite large and high power transmitters are used.

Applications: broadcasting, radio navigation.

D. Medium Frequency (MF)

300 – 3000 kHz (λ = 1000 – 100 m)

The propagation characteristics are similar to the LF but the increased in bandwidth allow MF band application for commercial purpose. Ground wave gives usable signal strength up to 100 km from transmitter.

Applications: AM radio broadcasting (550 – 1600 kHz).

E. High Frequency (HF)

3 – 30 MHz (λ = 100 – 10 m)

Ground wave propagation also exists in HF band but the sky wave is the main propagation mode. The ground wave is used for communication over shorter distances than the sky wave. As propagation loss increases with increase in frequency, the use of repeaters is required.

Applications: Broadcasting over large areas, amateur radio, citizens band (CB) radio.

F. Very High Frequency (VHF)

30 – 300 MHz (λ = 10 – 1 m)

Diffraction (bending of waves due to obstruction) and reflection give rise to communication beyond the horizon. Propagation distances are thousands of kilometers. The diffraction and reflection enables reception within buildings.

Applications: broadcast TV, FM radio (88 – 108 MHz), radio beacons for air traffic control.

G. Ultra High Frequency (UHF)

300 – 3000 MHz (λ = 1 m – 10 cm)

Reflections from atmospheric layers are possible. Effects of rain and moisture are negligible.

Applications: broadcasting, satellite (TV) broadcasting, all (1G to 3G) land mobile phones, cordless phones, some air traffic control.

H. Super High Frequency (SHF)

3 – 30 GHz (λ = 10 – 1 cm)

Range becomes limited by obstacles as frequency increases. Propagation is limited by absorption, rain and clouds.

Applications: Satellite service for telephony and TV, mobile services in future.

I. Extremely High Frequency (EHF)

30 – 300 GHz (λ = 10 – 1 mm)

Very high losses due to water, oxygen and vapor.

Applications: Communications at short distances (within line of sight), broadcasting through satellite for HDTV (for communication between satellites in space, not space to earth).

III. WIRELESS SYSTEMS AND STANDARDS

The wireless technology evolution has been going on since the late 1950s, though the first commercial systems came into being in the late 1970s and early 1980s. Here is a brief overview of the wireless technologies and the networks that made an impact on the development and the fast evolution of the wireless communications. [3]

A. First generation cellular system

The early 1970s saw the emergence of the radio technology that was needed for the deployment of mobile radio systems in the 800/900 MHz band at a reasonable cost. In 1976, the World Allocation Radio Conference (WARC) approved frequency allocations for cellular telephones in the 800/900 MHz band, thus setting the stage for the commercial deployment of cellular systems. In the early 1980s, many countries deployed first generation cellular systems based on frequency division multiple accesses (FDMA) and analog FM technology. With FDMA there is a single channel per carrier. When a MS accesses the system two carriers (channels) are actually assigned, one for the forward (base to mobile) link and one for the reverse (mobile to base) link. Separation of the forward and reverse carrier frequencies is necessary to allow implementation of a duplexer, a complicated arrangement of filters that isolates the forward and reverse channels, thus preventing a radio transceiver from jamming itself. [4] In 1979, the first analog cellular system, the Nippon Telephone and Telegraph (NTT) system, became operational. In 1981, Ericsson Radio Systems AB fielded the Nordic Mobile Telephone (NMT) 900 system, and in 1983 AT&T fielded the Advanced Mobile Phone Service (AMPS) as a trial in Chicago. Several other first generation analog systems were also deployed in the early 1980s including TACS, ETACS, NMT 450, C-450, RTMS, and Radiocom 2000 in Europe, and JTACS/NTACS in Japan. The basic parameters of NTT, NMT, and AMPS are shown in table 1.2. The NMT 900 system uses frequency interleaved carriers with a separation of 12.5 kHz such that overlapping carriers cannot be used with the same base station. In the NTT, NMT, and AMPS systems, a separation of 45 MHz is used between the transmitter and receiver frequencies, so as to implement the duplexer.

B. Second generation cellular system

Cellular system becomes completely digitalized in second generation. By introducing the concept of base station controller (BSC) over several base stations the computational burden of MSC is reduced. Multiple access technology had

some advantage such as sharing of the radio hardware among multiple users and provides a longer capacity to handle more users per MHz of spectrum. Location is a parameter that has great importance in 2G. [5] Second generation cellular systems have different specification. These are as follows:

1) GSM in Europe
2) 15-54 in North America
3) PDC in Japan
4) 15-95 in North America

In this generation (2G) several other function is also performed by mobile unit except voice transmission and reception. These are data encryption, data encoding, received power level reporting etc.

C. Third generation cellular system

Firstly 3G is introducing in Europe and in North America with the names IMT-2000 and CDMA 2000 respectively. IMT-2000 has adopted by ITU under the banner harmonized globe 3G in both system two way transmission has supported by FDD (Frequency division duplex). IMT-2000 is wideband direct sequence code division multiple access while CDMA 2000 is multicarrier code division multiple access.[6]

High transmission rate and support of multimedia service these are most attractive feature of 3G as compared to 2G. For higher transmission rate bandwidth of signal should be larger as compared to the coherence bandwidth of propagation channel.[7]

D. Fourth generation cellular system

According to the data of last 20years, 4G today wireless system is developed [11] in form of digital, multimedia and high data rate system. In future wireless system is totally based on 4G cellular system which requires high speed data rate.[12]

Requirements of 4G system made up by ITU are following:

Transmission rate should be 1Gbps in saturated condition.

Transmission rate should be 100Mbps in moving condition.

E. Specification of WCDMA

The WCDMA is a wideband Direct-Sequence Code Division Multiple Access (DS-CDMA) system, i.e. user information bits are spread over a wide bandwidth by multiplying the user data with quasi-random bits (called chips) derived from CDMA spreading codes.[8] In order to support very high bit rates (up to 2 Mbps), the use of a variable spreading factor and multicode connections is supported.[9] An example of this arrangement is shown in figure 1.2.

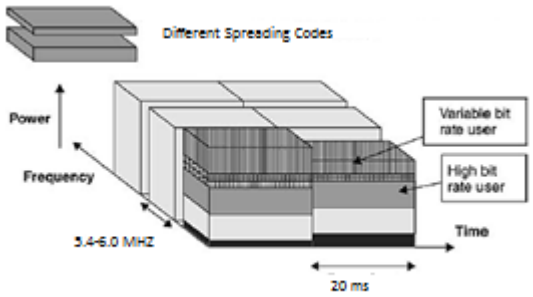

Fig. 2 Allocation of bandwidth in WCDMA in the time frequency code space

F. GSM(global system for mobile communication)

Due GSM is developed by group special mobile in 1982; the main aim behind the introduction of GSM was to replace in compatible analog system. At present GSM is handled by ETSI) European Telecom Standard Institute). [10] ETSI is also named GSM as Global System for Mobile Communication.

GSM provide three services these are:-

1) Tele Service
2) Bearer or data service
3) Supplementary service

Telecommunication service provides voice communication via mobile phones throughout the world. Data services provide transformation of info between GSM and other network such as PSTN, ISDN etc. Generally information rate of GSM is 300-9600bps. Short message service that is SMS is also an Application of GSM that provides transmission of 160 characters from one mobile terminal to other mobile terminal.

G. Propagation Standards

Current IEEE standards are as follow:

1) 802.11 Standard: 802.11 is the original standard but now it does not apply in currently new products in many existing system it still found. Applications: In frequency hopping (FH) and direct sequence (DS) and 2 to 4GHz frequency used in the system using 802.11 over bandwidth to Mbps.

2) 802.11b Standard: In Europe the current standard which used in system is 802.11b because 802.11 are still not confirmed. Applications: Direct sequence (DS) 11 Mbps, 2,4GHz and Backward compatibility to 802.11(DS)

3) *802.11g Standard:* This standard is not available in Europe but in United States 802.11a standard is already available because in some European states 5GHz frequency band is used by many other technologies. This standard does not support dynamic frequency selection (DFS) and transmit power control (TPC), so it is also the reason that this standard does not available in Europe. Applications: Orthogonal frequency- division multiplexing (OFDM) and Backward compatibility is not supported.

4) *802.11a Standard:* To support higher data rate for 2 to 4GHz with maximum 22Mbps, 802.11g standard is compatible with 802.11b systems. This can be solved by many different ways which are not sure by developers that which way to turn.

5) IEEE 802.11b/g Standard: In the mid 1990s the wireless LAN industry began the transition 900MHz to 2.4GHz but they are not aware of challenges that are occur in the operation of 2.4GHz but there are many advantages of operation in 2.4GHz over 900 MHz i.e. greater number of available channels international operation etc. in the 2.4GHz band when the 802.11 has more data rate (53 Mb/s) than 802.11b/g is taken as a more powerful wireless LAN.

As we know that 802.11g gives higher performance with backward compatibility, types of transmission and modulation used by 802.11g is same as 802.11a and therefore same data rates are supported by 802.11g. OFDM is used in 802.11g standard. 802.11g is more efficient than 802.11b as it uses DSSS in OFDM, the spectrum is efficiently used and it is robust in term of multipath distortion and interference.

IV. CONCLUSIONS

Several propagation models are developed in wireless communication that is used in outdoor propagation and other research facilities in the world. To eliminate guess work while implementing a fixed wireless network propagation modeling must be done. It maximizes a utilization of fixed wireless network by defining information about the strength of signal of every meter in use.

ACKNOWLEDGMENT

The authors are grateful to their colleagues for their valuable comments.

REFERENCES

[1] Mishra, Ajay K. "Fundamentals of Cellular Network Planning and Optimization, 2G/2.5G/3G…Evolution of 4G", John Wiley and Sons, 2004.

[2] T. E. Kolding et al., "High Speed Downlink Packet Access: WCDMA Evolution," IEEE Vehic. Tech. Soc.News, Feb. 2003.

[3] ITU-R PDNR WP8F. "Vision, Framework and Overall Objectives of the Future Development of IMT-2000 and Systems beyond IMT-2000", 2002.

[4] Toh, C. K. "Ad Hoc Mobile Wireless Networks: Protocols and Systems", Prentice Hall, New Jersey, USA, 2002.

[5] Fumiyuki Adachi, "Wireless past and Future: Evolving Mobile Communication Systems". IEICE Trans. Findamental, Vol. E84-A, No.1, January 2001.

[6] Chen, Yue (2003). "Soft Handover Issues in Radio Resource Management for 3G WCDMA Networks", Queen Mary, University of London, [Online] Available: www.elec.qmul. ac.uk/research/thesis/YueChen2003.pdf

[7] P R Gould, "Radio Planning of Third Generation Networks in Urban Areas", 3rd International Conference on 3G Mobile Communication Technologies, 2002, Conf. Publ. No. 489, 8-10 May 2002, pp. 64 – 68.

[8] A.I. Zreikat and Al Begain K., "Soft Handover-based CAC in UMTS System", 10th International Conference on Telecommunications, vol.2, 23 Feb-1 March 2003, pp. 1307 – 1312.

[9] J. Yang and J.S. Lin, "Optimization of Power Management in a CDMA radio Network", 52nd IEEE Vehicular Technology Conference, vol.6, 24-28 Sept. 2000, pp. 2642 – 2647.

[10] M.MAl. Akaidi and H. Ali, "Performance Analysis of Antenna Sectorisation in Cell Breathing", 4th International Conference on 3G Mobile Communication Technologies, Conf. Publ. No. 494, 25-27 June 2003, pp.98 – 103.

[11] Pereira, Vasco & Sousa, Tiago. "Evolution of Mobile Communications: from 1G to 4G", Department of Informatics Engineering of the University of Coimbra, Portugal 2004.

[12] Kamarularifin Abd Jalil, Mohd Hanafi Abd. Latif, Mohamad Noorman Masrek, "Looking Into The 4G Features", MASAUM Journal of Basic and Applied Sciences Vol.1, No. 2 September 2009.

