ASSIGNMENT - 1ST

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Generations of Wireless Communication Tech.

- **INTRODUCTION**

Wireless communication is the transfer of information over a distance without the use of enhanced electrical conductors or "wires". The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometers for radio communications). When the context is clear, the term is often shortened to "wireless". It encompasses various types of fixed, mobile, and portable two-way radios, cellular telephones, Personal Digital Assistants (PDAs), and wireless networking.

In 1895, Guglielmo Marconi opened the way for modern wireless communications by transmitting the three-dot Morse code for the letter 'S' over a distance of three kilometers using electromagnetic waves. From this beginning, wireless communications has developed into a key element of modern society. Wireless communications have some special characteristics that have motivated specialized studies. First, wireless communications relies on a scarce resource – namely, radio spectrum state. In order to foster the development of wireless communications (including telephony and Broadcasting) those assets were privatized. Second, use of spectrum for wireless communications required the development of key complementary technologies; especially those that allowed higher frequencies to be utilized more efficiently. Finally, because of its special nature, the efficient use of spectrum required the coordinated development of standards.

The term is used to describe modern wireless connections such as those in cellular networks and wireless broadband internet, mainly using radio waves. The Mobile wireless industry has started its technology creation, revolution & evolution since early 1970s. In the past few decades, mobile wireless technologies have been classified according to their generation, which largely specifies the type of services and the data transfer speeds of each class of technologies.

i. ZERO GENERATION TECHNOLOGY (0G – 0.5G)

0G refers to pre-cellular mobile telephony technology in 1970s. These mobile telephones were usually mounted in cars or trucks, though briefcase models were also made. Mobile radio telephone systems preceded modern cellular mobile telephony technology. Since they were the predecessors of the first generation of cellular telephones, these systems are sometimes referred to as 0G (zero generation) systems. Technologies used in 0G systems included PTT (Push to Talk), MTS (Mobile Telephone System), IMTS (Improved Mobile Telephone Service), AMTS (Advanced Mobile Telephone System), OLT (Norwegian for Offentlig Landmobil Telefoni, Public Land Mobile Telephony) and MTD .

0.5G is a group of technologies with improved feature than the basic 0G technologies. These early mobile telephone systems can be distinguished from earlier closed radiotelephone systems in that they were available as a commercial service that was part of the public switched telephone

network, with their own telephone numbers, rather than part of a closed network such as a police radio or taxi dispatch system. These mobile telephones were usually mounted in cars or trucks,

though briefcase models were also made. Typically, the transceiver (transmitter-receiver) was mounted in the vehicle trunk and attached to the "head" (dial, display, and handset) mounted near the driver seat. They were sold through various outlets, including two-way radio dealers. The primary users were loggers, construction foremen, realtors, and celebrities, for basic voice communication.

Early examples for this technology are:

1. The Autoradiopuhelin (ARP) launched in 1971 in Finland as the country's first public commercial mobile phone network.

2. The B-Netz launched 1972 in Germany as the countries second public commercial mobile phone network (but the first one that did not require human operators anymore to connect calls).

ii. FIRST GENERATION TECHNOLOGY (1G)

In 1980 the mobile cellular era had started, and since then mobile communications have undergone significant changes and experienced enormous growth. First-generation mobile systems used analog transmission for speech services. In 1979, the first cellular system in the world became operational by Nippon Telephone and Telegraph (NTT) in Tokyo, Japan. Two years later, the cellular epoch reached Europe. The two most popular analogue systems were Nordic Mobile Telephones (NMT) and Total Access Communication Systems (TACS). Other than NMT and TACS, some other analog systems were also introduced in 1980s across the Europe. All of these systems offered handover and roaming capabilities but the cellular networks were unable to interoperate between countries. This was one of the inevitable disadvantages of first-generation mobile networks.

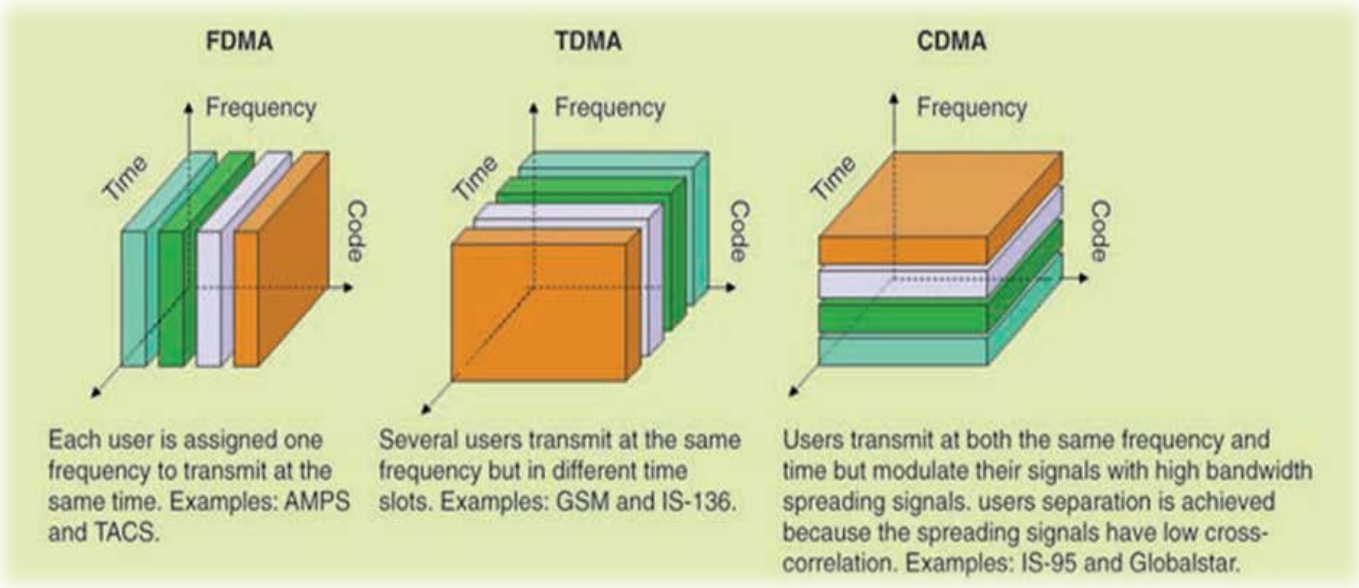
In the United States, the Advanced Mobile Phone System (AMPS) was launched in 1982. The system was allocated a 40-MHz bandwidth within the 800 to 900 MHz frequency range by the Federal Communications Commission (FCC) for AMPS. In 1988, an additional 10 MHz bandwidth, called Expanded Spectrum (ES) was allocated to AMPS. It was first deployed in Chicago, with a service area of 2100 square miles2. AMPS offered 832 channels, with a data rate of 10 kbps. Although Omni directional antennas were used in the earlier AMPS implementation, it was realized that using directional antennas would yield better cell reuse. In fact, the smallest reuse factor that would fulfill the 18db signal-to-interference ratio (SIR) using 120-degree directional antennas was found to be 7.

Hence, a 7-cell reuse pattern was adopted for AMPS. Transmissions from the base stations to mobiles occur over the forward channel using frequencies between 869-894 MHz. The reverse channel is used for transmissions from mobiles to base station, using frequencies between 824-849 MHz. AMPS and TACS use the frequency modulation (FM) technique for radio transmission. Traffic is multiplexed onto an FDMA (frequency division multiple access) system.

iii. SECOND GENERATION TECHNOLOGY (2G 2.75G)

By the late 1980s, it was clear that the first generation cellular systems—based on analog signaling techniques—were becoming obsolete. Advances in integrated circuit (IC) technology had made digital communications not only practical, but, actually more economical than analog technology.

Digital communication enables advanced source coding techniques to be utilized. This allows the spectrum to be used much more efficiently and, thereby, reduces the amount of bandwidth required for voice and video. In addition, we can use error correction coding to provide a degree of resistance to interference and fading that plagues analog systems, and to allow a lower transmit power. Also, with digital systems, control information is more efficiently handled, which facilitates network control. Second generation digital systems can be classified by their multiple access techniques as either Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) or Code Division Multiple Access (CDMA).



In FDMA, the radio spectrum is divided into a set of frequency slots and each user is assigned a separate frequency to transmit. In TDMA, several users transmit at the same frequency but in different time slots. CDMA uses the principle of direct sequence spread-spectrum: the signals are modulated with high bandwidth spreading waveforms called signature waveforms or codes. Although the users transmit at both the same frequency and time, separation of signals is achieved because the signature waveforms have very low cross correlation.

In practice, the TDMA and CDMA schemes are combined with FDMA. Thus the term "TDMA" is used to describe systems that first divide the channel into frequency slots and then divide each frequency slot into multiple time slots. Similarly, CDMA is actually a hybrid of CDMA and FDMA where the channel is first divided into frequency slots. Each slot is shared by multiple users who each use a different code.

2.5G – GPRS (General Packet Radio Service)

2.5G, which stands for "second and a half generation," is a cellular wireless technology developed in between its predecessor, 2G, and its successor, 3G. The term "second and a half generation" is used to describe 2G-systems that have implemented a packet switched domain in addition to the circuit switched domain. "2.5G" is an informal term, invented solely for marketing purposes, unlike "2G" or "3G" which are officially defined standards based on those defined by the International Telecommunication (ITU). GPRS could provide data rates from 56 kbit/s up to 115 kbit/s. It can be used for services such as Wireless Application Protocol (WAP) access, Multimedia Messaging Service (MMS), and for Internet communication services such as email and World Wide Web access. GPRS data transfer is typically charged per megabyte of traffic transferred, while data communication via traditional circuit switching is billed per minute of connection time, independent of whether the user actually is utilizing the capacity or is in an idle state.

2.5G networks may support services such as WAP, MMS, SMS mobile games, and search and directory.

2.75 – EDGE (Enhanced Data rates for GSM Evolution)

EDGE (EGPRS) is an abbreviation for Enhanced Data rates for GSM Evolution, is a digital mobile phone technology which acts as a bolt-on enhancement to 2G and 2.5G General Packet Radio Service (GPRS) networks. This technology works in GSM networks. EDGE is a superset to GPRS and can function on any network with GPRS deployed on it, provided the carrier implements the necessary upgrades. EDGE technology is an extended version of GSM. It allows the clear and fast transmission of data and information. It is also termed as IMT-SC or single carrier. EDGE technology was invented and introduced by Cingular, which is now known as AT& T. EDGE is radio technology and is a part of third generation technologies. EDGE technology is preferred over GSM due to its flexibility to carry packet switch data and circuit switch data.

The use of EDGE technology has augmented the use of black berry, N97 and N95 mobile phones. EDGE transfers data in fewer seconds if we compare it with GPRS Technology. For example a typical text file of 40KB is transferred in only 2 seconds as compared to the transfer from GPRS technology, which is 6 seconds. The biggest advantage of using EDGE technology is one does not need to install any additional hardware and software in order to make use of EDGE Technology. There are no additional charges for exploiting this technology. If a person is an ex GPRS Technology user he can utilize this technology without paying any additional charges.

iv. THIRD GENERATION TECHNOLOGY (3G – 3.75G)

3G refers to the third generation of mobile telephony (that is, cellular) technology. The third generation, as the name suggests, follows two earlier generations. The first generation (1G) began in the early 80's with commercial deployment of Advanced Mobile Phone Service (AMPS) cellular networks. Early AMPS networks used Frequency Division Multiplexing Access (FDMA) to carry analog voice over channels in the 800 MHz frequency band.

3G technologies enable network operators to offer users a wider range of more advanced services while achieving greater network capacity through improved spectral efficiency. Services include wide area wireless voice telephony, video calls, and broadband wireless data, all in a mobile environment. Additional features also include HSPA data transmission capabilities able to deliver speeds up to 14.4Mbit/s on the downlink and 5.8Mbit/s on the uplink. Spectral efficiency or spectrum efficiency refers to the amount of information that can be transmitted over a given bandwidth in a specific digital communication system. High-Speed Packet Access (HSPA) is a collection of mobile telephony protocols that extend and improve the performance of existing UMTS protocols.

3G technologies make use of TDMA and CDMA. 3G (Third Generation Technology) technologies make use of value added services like mobile television, GPS (global positioning system) and video conferencing. The basic feature of 3G Technology is fast data transfer rates. 3G technology is much flexible, because it is able to support the 5 major radio technologies. These radio technologies operate under CDMA, TDMA and FDMA.

Table 1 Comparison of various cellular standards

NAME	AMPS	GSM/DCS -1900	IS-136 USDC	IS-95	cdma2000	WCDMA/ UTRA
Generation	1	2	2	2	3	3
Year introduced & origin	1983 US	1992/1994 Germany	1996 US	1993 US	2002 US	2002 Europe
Region of Coverage	US	Europe, India, US (PCS)	US	US, Hong Kong, Middle-East, Korea	US	Europe
Frequency Band Uplink (MHz) Downlink (MHz)	824-849 869-894	Cellular /PCS 890-915/ 1850-1910 935-960/ 1930-1990	Cellular/PCS 824-849/ 1850-1910 869-894/ 1930-1990	Cellular/PCS 824-849/ 1850-1910 869-894/ 1930-1990	PCS 1850- 1910 1930- 1990	1920 - 1980 2110 - 2170
Multiple Access Scheme	FDMA	TDMA	TDMA	CDMA	CDMA	CDMA
Bandwidth per Channel	30 kHz	200 kHz	30 kHz	1.25 MHz	1.25, 3.75, 7.5, 11.25, 15 MHz	5, 10, 20 MHz
Modulation type	FM	GMSK	π/4 - DPSK	QPSK and OQPSK	QPSK and BPSK	QPSK and BPSK
Max. output power Base: Mobile:	20 W 4 W	320 W 8 W	20W 4 W	1.64 kW** 6.3 W	1.64 kW** 2 W	Unspecified 1 W
Users/Channel	3	8	3	Up to 63	Up to 253	Up to 250
Data Rate	19.2 kbps*	22.8 kbps	13 kbps	19.2 kbps	1.5 kbps to 2.0736 Mbps	100 bps to 2.048 Mbps

* Using Cellular Digital Packet Data (CDPD). ** Total Effective Isotropic Radiated Power (EIRP) for all the carriers within the channel bandwidth.

3.5G – HSDPA (High-Speed Downlink Packet Access)

High-Speed Downlink Packet Access(HSDPA) is a mobile telephony protocol, also called 3.5G (or "3½G"), which provides a smooth evolutionary path for UMTS-based 3G networks allowing for higher data transfer speeds. HSDPA is a packet-based data service in W-CDMA downlink with data transmission up to 8-10 Mbit/s (and 20 Mbit/s for MIMO systems) over a 5MHz bandwidth in WCDMA downlink. HSDPA implementations includes Adaptive Modulation and Coding (AMC), Multiple-Input Multiple-Output (MIMO), Hybrid Automatic Request (HARQ), fast cell search, and advanced receiver design.

3.75G – HSUPA (High-Speed Uplink Packet Access)

The 3.75G refer to the technologies beyond the well defined 3G wireless/mobile technologies. High Speed Uplink Packet Access (HSUPA) is a UMTS / WCDMA uplink evolution technology. The HSUPA mobile telecommunications technology is directly related to HSDPA and the two are complimentary to one another. HSUPA will enhance advanced person-to-person data applications with higher and symmetric data rates, like mobile e-mail and real-time person-toperson gaming. Traditional useful applications along with many consumer applications will benefit from enhanced uplink speed. HSUPA will initially boost the UMTS / WCDMA uplink up to 1.4Mbps and in later releases up to 5.8Mbps.

v. FOURTH GENERATION (4G)

4G refers to the fourth generation of cellular wireless standards. It is a successor to 3G and 2G families of standards. The nomenclature of the generations generally refers to a change in the fundamental nature of the service, non-backwards compatible transmission technology and new frequency bands. The first was the move from 1981 analogue (1G) to digital (2G) transmission in 1992. This was followed, in 2002, by 3G multi-media support, spread spectrum transmission and at least 200 kbit/s, soon expected to be followed by 4G, which refers to all-IP packet-switched networks, mobile ultra-broadband (gigabit speed) access and multi-carrier transmission. Pre-4G technologies such as mobile WiMAX and first-release 3G Long Term Evolution (LTE) have been available on the market since 2006and 2009 respectively.

It is basically the extension in the 3G technology with more bandwidth and services offers in the 3G. The expectation for the 4G technology is basically the high quality audio/video streaming over end to end Internet Protocol. If the Internet Protocol (IP) multimedia sub-system movement achieves what it going to do, nothing of this possibly will matter. WiMAX or mobile structural design will become progressively more translucent, and therefore the acceptance of several architectures by a particular network operator ever more common.Some of the companies trying 4G communication at 100 Mbps for mobile users and up to 1 Gbps over fixed stations. They planned on publicly launching their first commercial wireless network around2010. As far as other competitor's mobile communication companies working on 4G technology even more quickly. Sprint Nextel was planned to launch WiMAX over 4 G broadband mobile networks in United States. Some of the other

developed countries like United Kingdom stated a plan to sale via auction of 4G wireless frequencies couple of years back. The word "MAGIC" also refers to 4G wireless technology which stands for Mobile multimedia, Any-where, Global mobility solutions over, integrated wireless and Customized services.

vi. FIFTH GENERATION (5G)

5G (5th generation mobile networks or 5th generation wireless systems) is a name used in some research papers and projects to denote the next major phase of mobile telecommunications standards beyond the upcoming 4G standards, which are expected to be finalized between approximately 2011 and 2013. Currently 5G is not a term officially used for any particular specification or in any official document yet made public by telecommunication companies or standardization bodies such as 3GPP, WiMAX Forum or ITU-R. New 3GPP standard releases beyond 4G and LTE Advanced are in progress, but not considered as new mobile generations.

5G Technology stands for 5th Generation Mobile technology. 5G technology has changed the means to use cell phones within very high bandwidth. User never experienced ever before such a high value technology. Nowadays mobile users have much awareness of the cell phone (mobile) technology. The 5G technologies include all type of advanced features which makes 5G technology most powerful and in huge demand in near future.

The gigantic array of innovative technology being built into new cell phones is stunning. 5G technology which is on hand held phone offering more power and features than at least 1000 lunar modules. A user can also hook their 5G technology cell phone with their Laptop to get broadband internet access. 5G technology including camera, MP3 recording, video player, large phone memory, dialing speed, audio player and much more you never imagine. For children rocking fun Bluetooth technology and Piconets has become in market.

5G technology going to be a new mobile revolution in mobile market. Through 5G technology now you can use worldwide cellular phones and this technology also strike the china mobile market and a user being proficient to get access to Germany phone as a local phone. With the coming out of cell phone alike to PDA now your whole office in your finger tips or in your phone. 5G technology has extraordinary data capabilities and has ability to tie together unrestricted call volumes and infinite data broadcast within latest mobile operating system. 5G technology has a bright future because it can handle best technologies and offer priceless handset to their customers. May be in coming days 5G technology takes over the world market.

5G Technologies have an extraordinary capability to support Software and Consultancy. The Router and switch technology used in 5G network providing high connectivity. The 5G technology distributes internet access to nodes within the building and can be deployed with union of wired or wireless network connections. The current trend of 5G technology has a glowing future.

GSM (Global System for Mobile Communication)

GSM or global system for mobile communication is a digital cellular system. It was originated in Finland Europe. However now it is throughout the world. GSM (Global System for Mobile Communication) accounts for 80% of total mobile phone technologies market. There are over more than 3 billion users of GSM (Global System for Mobile Communication) now. GSM technology got its popularity, when people used it to talk to their friends and relatives. The use of GSM (Global System for Mobile Communication) is possible due to the SIM (subscribers identity module) GSM (Global System for Mobile Communication) is easy to use, affordable and helps you carry your cell phone everywhere. GSM (Global System for Mobile Communication) is a 2G technology. There are many frequency ranges for GSM (Global System for Mobile Communication) however 2G is the most used frequency.

GSM (Global System for Mobile Communication) offers moderate security. It allows for encryption between the end user and the service base station. The use of various forms of cryptographic modules is part of GSM technology.

EDGE Technology (Enhanced Data Rates for GSM Evolution Technology)

EDGE technology is an extended version of GSM. It allows the clear and fast transmission of data and information. EDGE is also termed as IMT-SC or single carrier. EDGE technology was invented and introduced by Cingular, which is now known as AT& T. EDGE is radio technology and is a part of third generation technologies. EDGE technology is preferred over GSM due to its flexibility to carry packet switch data and circuit switch data. EDGE is termed as backward compatible technology; backward compatible technology is that technology which allows the input generation of older devices. EDGE technology is supported by third generation partnership projects; this association helps and supports the up gradation of GSM, EDGE technology and other related technologies. The frequency, capability and performance of EDGE technology is more than the 2G GSM Technology. EDGE technology holds more sophisticated coding and transmission of data. EDGE technology can help you connect to the internet.

This technology supports the packet switching system. EDGE develops a broadband internet connection for its users. EDGE technology helps its users to exploit the multimedia services. EDGE technology do not involve the expense of additional hardware and software technologies. It only requires the base station to install EDGE technology transceiver. EDGE technology is an improved technology which almost supports all the network vendors. All they have to do is to upgrade their stations. EDGE technology has its edge because it can make use of both switch circuit technology and packet circuit technology. EDGE technology is also believed to support EGPRS or in other words enhanced general packet radio service. It is important to have GPRS network if one wants to use EDGE technology because EDGE cannot work without GSM Technology. Therefore it is an extended version of GSM Technology.