

Comprehensive Overview of Emerging Cellular Technology

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ABSTRACT

Emerging cellular technology is what mobile phone networks are based on, and this technology gives the mobile phone name as the 'cell phone'. As it capable of changing their status with time, they are said to be the new and enhanced version of older technology but it is still controversial in the market technologies. Cellular technology has been increasing its growth rapidly from last 20 years. It involves the evolution of cellular technology in the field of 1G, 2G, 3G, 4G and upcoming 5G mobile network. GSM platform was introduced by global Platforms in the year 1980's and asked the telecom companies to reduce their cost and advance their affordability. With each upcoming technology their limitations become key factor to emerge as the new technology. With the changing time latest technologies were designed to increase the efficiency of cellular networks and speed capabilities, which lead to the formation of new concept from time to time.

Keywords

Cellular Technology, GSM, LTE, HSPA, CDMA

1. INTRODUCTION

Today telecommunication market segment is becoming major players are emerging in this market and they are struggling and overcome other network to take dominant position. This competitive business environment has been travelling, and will continue doing so, to globalize the technologies, and in particular radio access technologies. So the selection of technology has great effect on the global market to each and every cellular operator.

Network service providers and other equipment suppliers all are trying to fulfill the telecom market promise to provide the best service to their respective users, by stimulating economy to produce goods and services. So their main aim behind broadband communication system is that, whether over the wires or to the radio waves all type of information can travel via the same media.

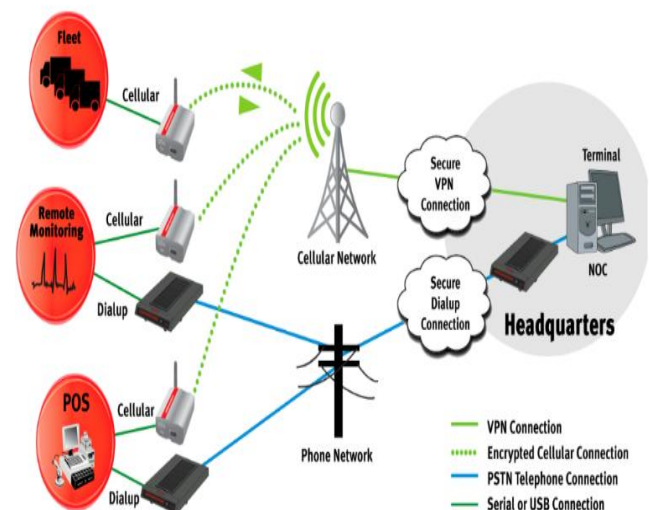


Fig.1: Overview of cellular technology

The remote areas to the developing world, most developed regions of the world; cellular connection has become a major problem. They are working out several permutation and combination of technologies to make their way easier and smoother. In this context it becomes very important to know that most of the technologies that helped technologist in developing world realize their main goal as "getting the 'unconnected' connected in the limited period of time".

2. BACKGROUND OF CELLULAR TECHNOLOGY

Mobile operator uses the electromagnetic spectrum to provide their services. Radio spectrum is been commonly shared between broadcasting, cellular communication and army purpose. Before the arrival of mobile network the capacity, can be increased by dividing the frequency over the channels. So therefore, the overall available bandwidth is been reduced, thus influencing the mobile network. It was established in

1970 where the division of geographical areas, instead of frequencies. Provide us to use more efficient electromagnetic spectrum.

Depending upon the factors like Cost, Quality, Quantity, Availability, the evolution of mobile network and cellular services has been divided into breeding.

2.1 First Generation System:

It is termed as 1G, this era was characterized by analog telecommunication network when supported basic call services. The advancement started in 1970's by Japan taking their first step towards the development of cellular technology. It was then developed by the NMT (Nordic Mobile Telephones) in Europe and by 'Americas' expanded as AMPS (advanced mobile phone service) technology. The handset used in this technology is very expensive [1].

The basic difference between then present systems and 1G was the change of cellular technology and hence it is also known as First generation of analog cellular network [1]. In First generation of telecommunication technology the cellular network contains many different and several cells and so the usage of same frequency many times w results in great spectrum usage and thus results in the increment of the system capacity i.e. large number of users can accommodate at a same time easily.

2.1.1 Limitations of 2G Technology:

1. It has low capacity, unreliable handoff, poor voice links.
2. Analog Signals does not allow advance encryption methods hence there is no security of data.

2.2 Second Generation System

We can observe that many systems which are unsuitable with each other. To avoid this, work in the field of development of technology will completely harm the environment system. Such pattern was introduced by European commission and presented in early 1990s, as the next generation called as second generation (2G), which was knows as justified system and the matured version of 1G technology [2].

Second generation systems includes GSM (Global Systems for Mobile Communications). CDMA One (IS-95) is also one of the part of 2G system because it offered advantages such as to increase the coverage, capacity (around 10 times of AMPS), quality, also an improved version security system, etc.[2].

Second generation cellular network is all set by the standards made by the cellular telecommunication which are functioned and maintained by the International Telecommunication Union (ITU). Because of this technology, 2G can hold more calls per amount of given bandwidth and it also offers services like SMS and Email.

2.2.1 Limitations of 2G Technology:

1. Weaker digital signal: If the digital signals are used it will not be enough to reach up to the cell tower. The main problem occurs at high frequency.
2. Reduces range of sound: GSM has a fixed range of about 35 km which will results in technical limitation.

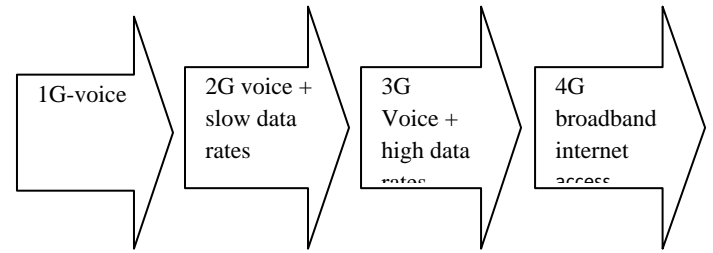


Fig.2: Evolution of cellular technology [3]

2.3 Third Generation System:

Third generation Mobile telecommunication(3G) is set of standards that came about as a result of the international telecommunication unions (ITU) known as IMT -2000 (international mobile telecommunication-2000).3G system are established to provide faster and easier wireless communication.

This improvement of data speed as faster and high quality network which support good service like video streaming video calling ,high speed browsing which lead to advent of 3G. It has high speed range consist of 144 kbps to greater than 2mbps. It uses W-CDMA as important standard [4].

3G took long time to gain the worldwide adaptation. The main reason behind it is that some 3G networks were not allowed to use the same frequency as that of older 2G. This was the time when wireless operator had to introduce their own and new frequency and install to cell sites [4].Although it was first introduced in 2001 but it gained primary importance sometime in 2007.

2.3.1 Limitation of 3G Networks

1. The cost of cellular data for 3G network is very high.
2. It requires different handsets which are costly in the market.
3. Power consumptions were very high

2.4 Fourth Generation System

The fourth generation has been introduced but we are still not in it yet. Yes, many of the mobile carrier service providers and various Smartphone manufactures actually advertise 4G now. The official definition of 4G is termed as LONG TERM EVOLUTION-ADVANCED (LTE-A). The platform has not been fully completed yet but the manufactures are still improvising it and taking out enhanced version of LTE system that consumes wider bandwidth channel and greater number of antennas for simulation purpose. The theoretical assumed data rate is around 1 Gbps. But update is still yet to come [5].

IMT 2000 was not completely suitable to deal with problems like high data rates, capacity, and next breed system (referred as 4G) [5]. A 4G network will complete replacement from all the present networks and it has capability to provide secure and safe Internet protocol solution where voice, data, and multimedia can be accessible to the users on anytime, anywhere the need on very basis data rates.

- Their main aim is to provide high quality data services dealing with high data transfer speed, around 100 mbps.
- It provides speed more than 20 Mbps.
- It may be possible that it will roam around between various network and technology.

- Able to support smoother handover.

2.4.1 Limitation of 4G Technology:

1. It has high data rates.
2. Customers require purchasing new equipment's to maintain 4G network.
3. The 4G is presently accessible in very few cities in India.
4. Since 4G cellular technology is very new in market, it will likely to have many bugs, which can be very annoying to the users.

In 4G mobile networks, though have many advantages, also includes many disadvantages. While this technology is becoming popular day by day, it would still take its time to emerge as the most popular network. Mobile carrier service providers and users are mainly interested in investing in 4G because it is very demanding and affordable and they understand its merits and demerits.

2.5. Fifth Generation System

5th generation mobile networks termed as 5G, it is the updated version of old existing 4G. Instead of faster connections speed, 5G is planning for maximum strength than the existing 4G, by allowing large number of mobile broadband users in an area, to use high speed and unlimited data in Gigabytes per month [6].

Currently there is no standard of 5G available in market. According to Next Generation Mobile Network Alliance it must follow the following conditions:

1. Data rate should be tens of Mb's per second for ten of thousand users.
2. It should ensure 100 Mb's per second for metropolitan areas.
3. Latency reduces significantly compare to long term evolution (LTE).
4. Spectral efficiency is improved as compare to 4G.

Table.1: Comparison of Cellular Network [7]

Generation	year	Data rate	Use
1G	1981	2 Kbps	Basic voice service using analog protocols
2G	1992	64 Kbps	Design primarily for voice using digital standards (GSM/CDMA)
3G	2001	2 Mbps	First mobile broadband utilizing IP protocols (WCDMA/CDMA2000)
4G	2010	100 Mbps	True mobile broadband, unified standards (LTE)
5G	2020 (?)	10 Gbps	Tactile internet with service-aware device and fibre like speed

The Next Generation Mobile Network Alliance gave an idea that 5G will completely join the market in around 2020 to

fulfill customer's needs [6]. Although updated platforms define capabilities beyond those which were offered by the 4G, those new capabilities have been introduced and grouped under the ITU-T 4G standards.

3. OVERVIEW OF SOME KEY TECHNOLOGIES

3.1 GSM

In 1980's GSM was the first broadcast operated digital cellular system developed according to the pan European initiative. In 219 countries and territories worldwide; its stock share was of more than 89%.

GSM uses TDMA (Time Division Multiple Access) technology and the universal mobile telecommunication system (UMTS), it provides high speed packet access (HSPA). It is secured by encrypting all the information and prevents from overwriting and manipulation. GSM users are identified by their Subscriber Identity Module (SIM) card. So the identity number, authentication key and algorithm are secured [2].

3.2. CDMA

Code Division Multiple Access (CDMA) is the major competing technology to GSM. The original CDMA is known as CDMA One.

It was first launched for the military purposes in World War II by English allies against Germany, by interrupting their signal and jamming them. They transmitted over several frequencies, instead of one. This avoided German interruption. Nominal width of the CDMA channel is 1.23 MHz

3.3 HSPA

Two mobile telephone protocols, namely High Speed Downlink Packet Access (HSDPA) and High speed Up Link Packet Access (HSPA) were combined to form High Speed Packet Access (HSPA). It is an improved version of CDMA network. HSPA can provide data rates up to 14 Mbps in down link and 5.8 Mbps uplink, depending on network device capabilities [7].

3.4 LTE

The fourth generation of mobile technology design to provide uplink peak rates of at least 50 Mbps and downlink peak rates of at least 100 Mbps is LTE (Long Term evolution). Both frequency division duplexing and time division duplexing is supported by LTE [5].

4. CONCLUSION

Radio communication platforms are still very much active and are in a developing state. New ideas and new developments are continuously growing in these fields by the researcher. Researchers are coming up with new ideas which are cost efficient, better quality, more secure and affordable. With operating powers becoming cheaper day by day more complex algorithm can be used to improve performance. Thus it is assumed that in the upcoming year's cellular technology will transform more technical and effective in the form of coming network generations.

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