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Mobile Communication System and Technologies

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Abstract: Communication has become an important part of today's life. The wired connection between the devices has lost its importance and everywhere the wireless communication has captured the market. The wireless communication is significantly being used in most of the communication part. Today we cannot imagine life without smartphones. The evolution of different technologies has improved the features like quality, efficiency and performance. The main objective of this paper is to briefly give an idea about how the different technologies of the mobile phones came into market. The first generation was the analog based cellular system. Then came the second generation where the concept of short message service was brought into the market. The third generation was the higher version of the second generation which provided higher quality of audio and video data. The fourth generation brought huge change in the cellular system which more number of features in it which was beneficial to the users. Each technology has its advantages and disadvantages which has been elaborated in this paper. Currently 5G has not been brought up in the market.

Keywords: Wireless communication, 1G,2G,3G,4G,5G.

I. INTRODUCTION

The mobile technology has already started in the early 1970.Few generation ago, no one would have thought of having moved so far in terms of advancement and technology. The mobile phone system was first developed in Japan and was launched in Sweden, Norway, Finland [1]. Earlier it was very difficult to communicate between two people living at two different places. Generations by generations advancement begin, and the older technologies were replaced. But now being present at one place a person can communicate anywhere in the world easily. Wireless communication has become more useful than we have thought of few decades ago. Earlier the wired communication was used to communicate at far places. Lots of disturbance in the form of noise were there between the channels. Every year some new technologies are being developed to improve the standards in the mobile system. Wireless communication has several advantages in which some of them are, increase in efficiency would lead to faster transfer of data between the users in very small amount of time, no requirement of cables or adapters to use the networks, it is easier to be installed and maintained anywhere whether it could be office or home. The evolution from 1G to 5G has been described which gives a clear picture on how the technology changed the market and became helpful to the users. It compares the technology and gives a detailed review about different generations [2]. The main difference between 1G and 2G generations were the radio signals used, in 1G there were the analog signals and in 2G system there were the digital signals. By the development in each generation the data rates were improved, but after the evolution of 4G network there was drastic change in the data rate provided to the users. The HD movies could be downloaded in minutes now but it would use to take hours when 2G or 3G networks were used. The various challenges towards the migration of 5G has been described which could be the terminals with multi-mode to the users, selection of the wireless system for the 5G technologies, security, encryption of data [3]. The 5G technology focuses on three basic platforms which are nanotechnology, cloud computing platform [4]. Overall the major issues were the traffic which was persistent in all the technologies, since the bandwidth will be large in 5G system so it should be highly taken care of in this system [5]. The different technologies are described in various chapters. The technologies from first generation to fifth generation in described in chapter 2 to chapter 7 respectively. Migration towards 5G is mentioned in chapter 8. The concluding section of the paper is elaborated in chapter 9.

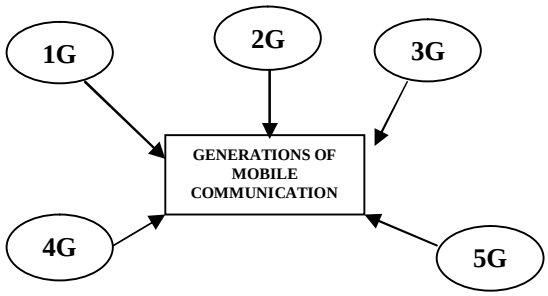

Fig 1: Generation of mobile communication system

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II. ZERO GENERATION TECHNOLOGY (0G)

After world war-II the concept of wireless telephone with 0g came into picture. During that period mobile operators would set up the required calls and we had very less number of channels available. It would not support any change in the frequency channel. It is also referred to pre-cellular mobile telephony technology. Since they are ancestors of the first-generation technology it is called as 0g systems. The users were primarily the celebrities, construction foreman etc. It only had facility of voice communication.

III. FIRST GENERATION TECHNOLOGY(1G)

It is the first generation in wireless mobile technology. They came in 1980 in market. These cell phones were of analog type. These systems provided the handover and the roaming facility to the users. This generation cell phone was unable to provide the communication between different countries. This was the major drawback of this system. This network had poor voice links and it lacked in terms of security as the voice calls between the users were played back in the radio towers. These cell phones had speed up to 2. 4kbps.The first mobile phone was launched in US which was the Advance mobile phone system(AMPS). The calls were confined only in one country.1G was not so popular among the users because of the problems like less capacity, no security, poor voice quality, very less battery life [5].

IV. SECOND GENERATION TECHNOLOGY(2G)

It is the second generation of wireless cell phones technology. It was launched in Finland in the year 1991.2G brought up new features in the mobiles like text message, picture message and MMS which gained a lot of attraction among the customers. The concept of email was brought in this generation [6]. It even provided security on both the ends i.e. the sender and receiver side. The text message was encrypted which means that the data transferred would reach only on the receiver side and only they could read it. It used the digital technology such as the TDMA and CDMA.

In TDMA the signals were divided in time slots whereas in TDMA each user was allocated a different code to communicate over the channels was the most successful standard and was used in most of the country. GSM used TDMA which would multiplex up to 8 calls per channel in the frequency range of 900 and 1800 MHz bands. Further new technologies were developed based upon the GSM system which was 2.5G.

GPRS was introduced in the 2.5 generation system. It was an extension of 2G technology in terms of data rates.2.5G description is given because half of the technologies were of 2G and the rest half added some new versions in it i.e. it implements the packet switched system along with the circuit switched system.

The data rate provided by GPRS is from 56 kbps to 384 kbps. It provides the facilities like multimedia messaging, electronic mail, www access.

The evolution from the GPRS to EDGE is introduced along with the 8PSK encoding. EDGE was used with the GSM technology first in United States. It introduced a concept of 3GPP which is a three- fold enhancement which could be in GSM or GRPS networks. It is also an extension of GSM. Faster transmission of data and information is possible in EDGE which is the reason for most being used standard during that period. It is a radio technology and also considered to be part of third generation technologies. EDGE technology is generally used over GSM due to its feasibility in carrying the packet and circuit switch data. The benefit of using EDGE technology is that no extra hardware or software or any extra charges is required to be installed in the system to use it.

The 2.5 generation and 2.75 generation technologies were developed between the 2G and 3G mobile technology.

V. THIRD GENERATION TECHNOLOGY(3G)

With the advancement in technologies lead to greater demand of Internet and Intranets with more data rate among the users. New communication tools were required to converge the home and office applications. With this need, the concept of third generation came into market. ITU (International Telecommunication Union) made a plan to work in the frequency band of 2000 MHz range along with the wireless communication standard which will support all different countries in the world. This plan was called as IMT-2000.

It provides a wide range of network capacity through better spectral efficiency. The advancements in this technology were the improved audio and video streaming, higher data speed, TV through internet support and video conferencing support [7].

HSPDA (High-Speed Downlink Packet Access) is a mobile standard in 3.5 generation. It provides a data transmission rate of more than 8.1Mbit/sec.HSUPA (High Speed Uplink Packet Access) is a mobile protocol being used in 3.75 generation. Gaming process between users in real-time was possible. Electronic mail in mobile could be used [8]. Both of them are complementary to each other.

VI. FOURTH GENERATION TECHNOLOGY(4G)

When 4G came into the market, the response was relatively not good. People disliked it. But later when it got up hold on the market, majority of the service providers accepted this technology.4G is the fourth-generation mobile communication technology following the 2G and 3G networks.4G helped the users to connect through the stream HD videos, web browsing and many other enhanced features in it. Due to these features, the smartphones were used as computers or laptops and people at some point stopped using the desktop as all features were there in the mobile phones and they could not find any requirement of laptops. The downloading or uploading speed provided by 4G is 14Mbps which is much faster than the other networks. The uploading of data was faster in terms of seconds whereas in 3G it used to take even hours to download. One of the major advantage is the better latency which is very useful in video conferencing. It provides a clear connection for video or voice calls. Setting up or installation process of 4G could be done in hours which could not be possible if it would be wired connection. Due to these features many industries or enterprises have started using the 4G technology.

VII.FIFTH GENERATION TECHNOLOGY(5G)

Officially 5G has not been developed in the market for the usage. It is expected that 5G technology would being a drastic change in the society as it would revolutionize the market, whether it could be data speed or quality of service or any other services.

Millimeter waves [9] work in the frequency range of 3 KHz to 300GHz but the disadvantage is that the signals could not travel through the buildings, to solve these smart cells network was brought into concept. The smart cells network would solve the hinderance problem and could switch to the new stations according to the need. MIMO system [11] would solve the capacity problem which was occurring in 4G network by a factor 0f 22 and this would help in the traffic occurring during the usage [10]. Hence the traffic handling due to the massive interference would be solved by the beam forming method. Simultaneous transmission and reception is expected to be solved by the 5G system [10]. It focuses on the development of World Wide Wireless Web (WWWW) [12].

Table 1: Comparison on the evolution of mobile communication system for first generation to fifth generation.

Technology	1G	2G	3G	4G	5G
Year of deployment	1970-1980	1990-2004	2004-2010	2010 onwards till now i.e. 2020	May be 2021
Data speed or bandwidth	2Kbps	64 Kbps	2Mbps	1Gbps	More than 1Gbps
Multiplexing	FDMA	TDMA/CDMA	CDMA	CDMA	CDMA
Switching	Circuit Switched	Packet Switched	All packet	All packet	All packet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal and Vertical	Horizontal and Vertical
Internet Protocol versions	-	IPv4	IPv4	IPv4	IPv6

VIII. CHALLENGES WITH MIGRATION IN 5G

There are various challenges in shifting towards the 5G technology:

A. The initial subscription plans could be higher than the technologies being used today. The infrastructure upgradation would be costlier during the initial stages of installation. The deployment uses will also be there during the initial phases.
B. The technology will be costlier, it would be difficult in the starting period to purchase it.
C. Security and privacy are needed to be taken care in 5G services.
D. It provides high resolution [11].
E. 5G technology will not be able to provide the coverage area to the users in the huge area. In the beginning, it will remain confined to small area due to large bandwidth.
F. It is expected that the 5G system would work in the radio frequency which is in the range of GHz. Most of the satellite communication is already being done, so there are chances of problem pertaining when 5G would come into practice [13].

G. The transmission of 5G signal has to be optimized by usage of full duplex which is not being done in any of the technologies which can be even 4G.

IX. CONCLUSION

Mobile communication would enhance the mobile network in the coming era when 5G would come into picture. In future it is expected that it would provide varieties of feature, more clarity in the voice or video calls etc. We can also imagine of 6G in the next generation of mobile communication system. It would be expected that wired connections would lose its importance in the market and everywhere the wireless communication would be used. Except cellular phone, new types of communication system would be brought up in the market.

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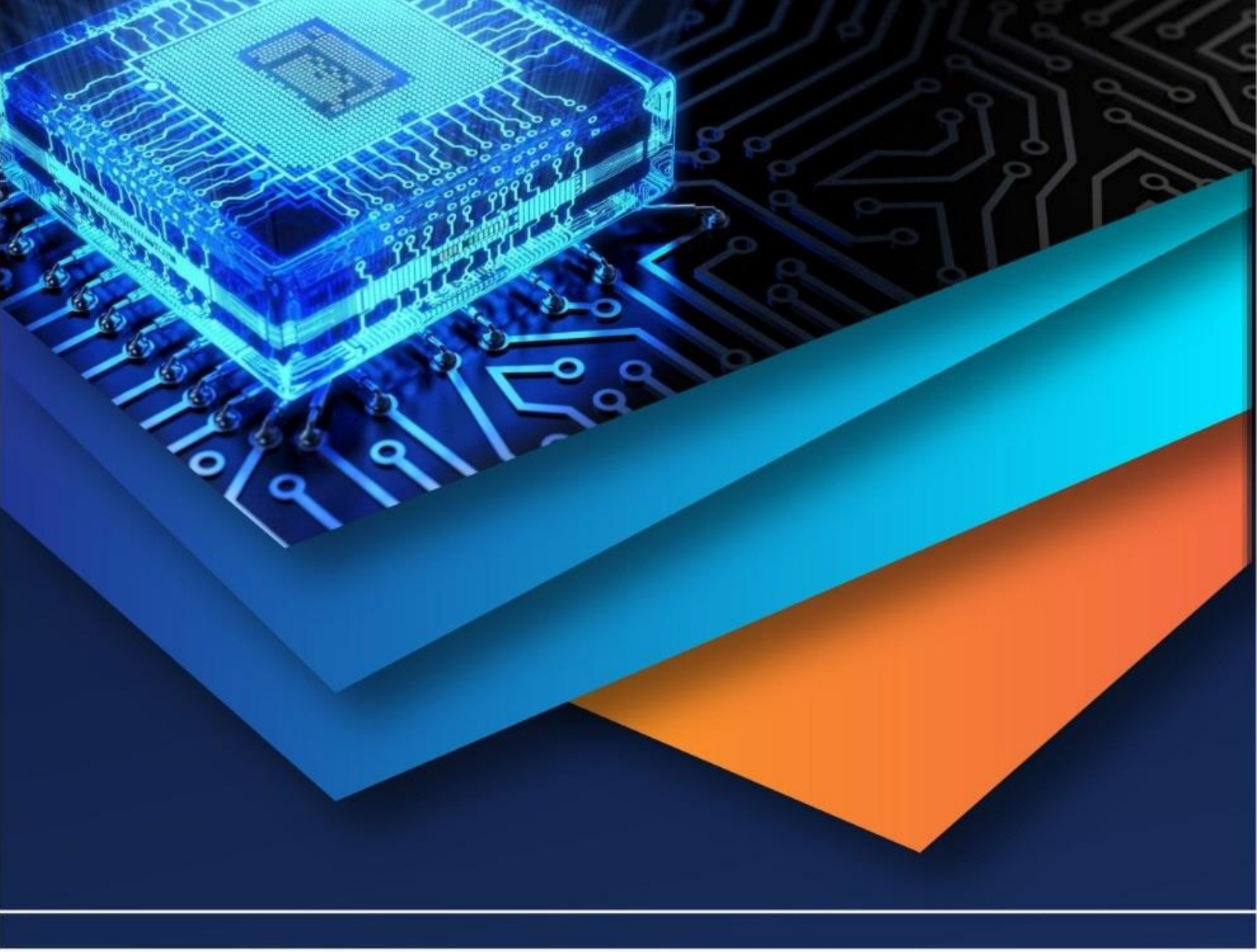

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