A Comparative Study of Various Generations in Mobile Technology

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Abstract: *- Mobile communication is one of the hottest areas with advanced techniques. It is developing extremely fast in present times and deals with all the fields of mobile and wireless communications. This paper deals with the comparative study of wireless cellular technologies. First Generation, Second Generation, Third Generation, Fourth Generation and Fifth Generation are comes under wireless cellular technologies. A cellular network or mobile network is a radio network distributed over earth areas called cells. Each cell is served by at least 1 fixed-location transceiver and transceiver is known as a cell site or base station. In a mobile network, each cell uses a different set of frequencies from other neighboring cells and avoids interference. The First Generation was referred as cellular and which was later abbreviated to "cell". Cell phone signals were analog in nature. 1G device was comparatively less heavy and expensive. Second Generation mobile phones used GSM technology. Global System for Mobile communications uses digital modulation and it improves voice quality with limited data service. The Third Generation allowed mobile telephone customers to use voice, graphics and video applications. Fourth Generation is for cell phones or/and hand held devices. The fifth generation wireless 5G development is based upon 4G, which at present is struggling to meet its performance goals. Most important advantages of 5G network is providing myriads of services to end users. The importance of this paper is to study a speedy and effective network connection for communication of devices.*

Keywords: - Cellular network, FIRST Generation, SECOND Generation, THIRD Generation, FOURTH Generation and FIFTH Generation.

I.INTRODUCTION

The past few years have witnessed exceptional growth in the wireless industry. The first generation mobile systems were the analogue systems, which came in the early 1980s. They were called as a NMT (Nordic Mobile Telephone). It offered mainly speech related services and highly incompatible with each other. 2G denotes initial digital systems, which came in 1990s. They offered services such as short messaging and lower speed data. CDMA2000 and GSM are the primary 2G technologies. 3G requirements were specified by the ITU. ITU as part of the International Mobile Telephone 2000 (IMT- 2000) and provide 144 kbps speed. UMTS-HSPA and CDMA2000 EV-DO are the primary 3G technologies.

4G technology based mobile phones are equipped with a WLAN adapter. In the future several mobile phones will have Wi-MAX adapter. WLAN raised research on their integration. 4G has focus towards seamless integration of cellular networks. The proposed Open Wireless Architecture (OWA) in 5G is targeted to provide open baseband processing modules with open interface parameters and to support existing architectures as well as future wireless communication standards. The OWA is targeted to MAC/PHY layers of future (5G) mobile terminals [1, 3]. This referenced work provides a ground for definition of a concept beyond 4G mobile networks, as in the 5G mobile networks. In the future concept the mobile user is on the top of all. The 5G terminals have software defined radios and modulation scheme with new error-control schemes [3, 5]. The development is seen towards the user terminals 5G mobile networks and terminals have access to different wireless technologies at the same time. The terminal able to combine different flows from different technologies [1, 7 and 12]. The fifth generation communication system is envisioned as the real wireless network and capable of supporting wireless World Wide Web (www). There are two different views of 5G systems: evolutionary and revolutionary. In the evolutionary view of 5G systems will be capable of supporting the www allowing a highly flexible network such as a Dynamic Adhoc Wireless Network (DAWN). In this view, advanced technologies including intelligent antenna and flexible modulation are keys to optimize the adhoc wireless networks. In revolutionary view, 5G systems would be an intelligent technology capable of interconnecting the entire world without limits [1, 3 and 8]. An example application could be a robot with in-built wireless communication with artificial intelligence.

II. EVOLUTION OF MOBILE CELLULAR NETWORKS

A study of 1G, 2G, 3G, 4G and 5G wireless networks was conducted with the use of referenced networking materials. 5G as a future preferred network was studied and to develop a comparative discussions among the 5 networks. Figure 1 shows the evolution of cellular network. This diagram shows the introducing year and technologies.

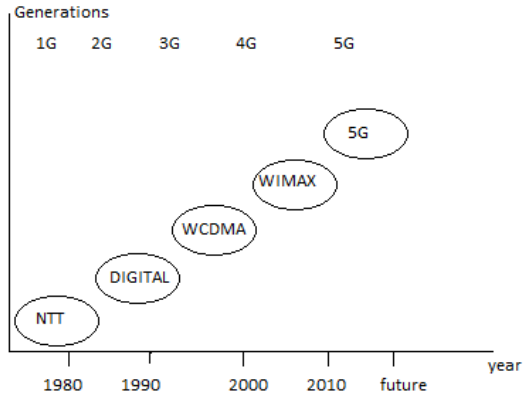

Fig1EVOLUATION OF CELLULAR NETWORK [6]

A. *First Generation*

First Generation system of wireless systems are based on analogue signals technology. Analogue systems were based on circuit switching technology. It is based on voice not for data. The efficient use of spectrum was not possible and roaming was also not possible. 1G stands for First Generation based on analogue system which was developed in 1980s and continue in use until replace by 2G.

In 1G, voice call gets modulated at frequency 150 MHz Voice call is transmitted between radio towers and this is done using a technique FDMA (Frequency Division Multiple Access). This technique fails in some field due to over all connection qualities.1G has low capacity and unreliable handoff. There is no security with poor links. Fixed transceivers and telephone are the example of 1G device. These devices used single cell and if device was moving into more than one cell than call is dropped.

B. *Second Generation*

Second Generation System of wireless systems is based on digital system. 2G system was 1 step forward of 1G. It provides a facility of SMS (Short Message Service). Its data rates of 384Kbps up to 2Mbps. 3G offers narrower bandwidth but over a wider calling area. The IMT-2000 framework sets the following goals for the so called 3G wireless systems:

bandwidth is 30-200kbps. During 2G exponential increase in subscribers and value added services. 2G mobiles used GSM technology in 1990s. It provides a good voice quality but limited data services.2G also offered some additional services like faxes, text message and voice mail. It uses GPRS (General Packet Ratio Services) which delivers packet switched data to existing GSM network. GSM provides many more services than original network.

1) ***GSM (GLOBAL SYSTEM FOR MOBILE COMMUNICATION):-*** This 2G network is capable of providing all the services such as data service and speech. GSM network is extension of fixed telephone network.
2) ***GSM AND VAS (VALUE ADDED SERVICES):*** - This is advancement in GSM technology which is combination of two platforms. VMS (Voice Mail System) +SMSC (Short Message Service Centre).
3) ***GSM AND GPRS (GENERAL PACKET RADIO SERVICES):*** - This enables the air interface for sending the data. This enables wireless access to the internet. The bit rate is reaching up to 150kbps in optimum conditions.
4) ***GSM ND EDGE (ENHANCED DATA RATE FOR GLOBAL EVOLUATION):*** - Under this technology, increase in data rate up to 384kbps. EDGE is superset of GPRS and function in any network with GPRS.

C. *Third Generation*

The third generation mobile technology is based on wide band wireless network and fulfilling the International Mobile Telecommunications 2000(IMT-2000) specifications. According to IMT-2000 standards, a system is required to provide data rates of at least 200 Kbit/s. 3G functions in the range of 2100 Hz. Its bandwidth is 15-20 MHz. It provides enhanced clarity and perfection like the real conversation. 3G offers a vertically- integrated, top-down and service-provider approach to delivering wireless Internet access. 3G is a technology for mobile service providers. Mobile service providers use licensed spectrum which provide wireless telephone coverage over large geographic serving area. It offers (near) ubiquitous and continuous coverage e.g. a consumer can carry on a telephone conversation while driving along a highway at 100Km/hour. 3G can support

- Global standards to allow for low cost
- High Quality of Service (QoS) especially for voice.

- Support for advanced services: Multimedia, High speed data
- Compatibility of service with fixed network

C. ***Fourth Generation***

The fourth generation (4G) is a conceptual framework and provides high speed wireless network that can transmit multimedia, data. 4G can support 100 Mbps peak rates in full-mobility wide area coverage and 1Gbps in low-mobility local area coverage [3, 5]. 4G Technology will have a data rate up to 20mbps. A successor of 2G and 3G is 4G which have 100mbps downloading speed. A 4G system must provide capabilities defined by ITU in IMT Advanced. 4G system does not support traditional circuit-switched telephony service, but all-Internet Protocol (IP) based communication such as IP telephony. In 4G, we can send data as much as faster than previous generations. It becomes very easy to send huge amount of data from pc to wireless device. E-mail, message and contacts are synchronizing easily and give power to users. 4G have broader bandwidth, high data rate and smooth as well as quicker handoff etc.

E. Fifth Generation

Fifth generation is a upcoming technology. Some sources suggest that 5G technology will come approximately in 2020. 5G has speeds beyond what the current 4G can offer. The 5G terminals will have software defined radios and modulation schemes and new error- control schemes which can be downloaded from the Internet. The development is towards the user terminals as a focus of the 5G mobile networks. The terminals will have access to different wireless technologies at the same time as well as the terminal will be able to combine different flows from different technologies. In 5G, all networks will be responsible for handling user-mobility [9], while the terminal will make the final choice among different wireless or mobile access network providers for a given service. Such choice will be based on open intelligent middleware in the mobile phone.

The Next Generation Mobile Networks Alliance defines the following requirements for 5G networks [2]:

- Data rates of several tens of megabits per second should be supported for tens of thousands of users
- 1 gigabit per second to be offered at the same time to tens of workers on the same office floor
- Several thousands of simultaneous connections to be supported for massive sensor deployments
- Spectral efficiency should be significantly enhanced compared to 4G
- Coverage should be improved
- Signaling efficiency should be enhanced
- Latency should be reduced significantly

It is assumption that 5G will provide

- Low battery utilization
- Better coverage.
- High bit rates in larger portions of the coverage area
- Latency will be low.
- More number of devices will be supported
- Low infrastructure costs.
- High flexibility and scalability
- Trustworthy communication

These are the above objective for 5G technology in several research papers for study.

III. COMPARTIVE STUDY ON 1G, 2G, 3G, 4G and 5G NETWORKS

This table shows the comparative study of all the generations. To understand the requirements and uses of 5G could be raised once the 4G rollout is completed and experienced. Thus typical 5G concept would be raised in somewhere around 2013-2015. Expected speed will be multiple of Gigabit Ethernet [10, 11].

This technology would be mainly used in back hauling telecom networks rather than end user access. 4G offers theoretically closer to Gigabit Ethernet whereas users expect multiple Gigabit speed from 5G.

The table given on next page shows the comparison between the 5 different technologies

Table1. General Comparison between 1G to 5G technologies [4, 5, 8]

TECHNOLOGY/ FEATURES	1G	2G	3G	4G	5G
Start/ Development	1970/ 1984	1980/ 1999	1990/ 2002	2000/ 2010	2010/ 2015
Data/ Bandwidth	2kbps	14.4-64kbps	2mbps	2000mbps to 1Gbps for low Mobility	1Gbps and higher
Standards	AMPS	2G TDMA CDMS, GSM2.5;GPRS EDGE	WCDMA CDMA 2000	Signal unified standard	Signal unified standard
Technology	Analog Cellular Technology	Digital Cellular Technology	Broad Bandwidth CDMA, IP Technology	Unified IP and seamless combination of broadband, LAN/WAN/PAN and WLAN	Unified IP and seamless combination of broadband, LAN/WAN/PAN and WLAN and wwww
Services	Mobile technology (voice)	2G: Digital voice, Short Messaging 2.5G: Higher capacity Packetized data	Integrated Higher Quality audio, video and data	Dynamic Information Access, Wearable devices	Dynamic Information Access, Wearable devices with IA capabilities
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	Circuit	2G: Circuit 2.5G: Circuit for access network & air interface; packet for core network and data	Packet except service for air interface	All packet	All packet
Core Network	PSTN	PSTN	Packet network	Internet	Internet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal and vertical	Horizontal and vertical

IV. CONCLUSION

During this paper, we examine the performance of the earlier wireless communication systems. In this study, it was discovered that some problems are still unable to solve such as unending problems of communications with poor coverage, bad interconnectivity and poor quality of service. The advent of 5G will change the field of communication domain, bringing wireless experience to a completely new level. It will provide wealth of features. The mobile terminals of the 5G have more processing power and more memory on board. It is expected that the initial Internet idea of keeping the network simple as possible as well as giving more functionalities to the end nodes. It will become a reality in the fifth generation wireless system (5G). This technology helps to promote stronger links between people working in different fields creating future concepts of mobile communication, internet service, cloud computing and nanotechnology.

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