

Comparative Study of 5G Mobile System

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Abstract:

The evolution of mobile wireless communication from First Generation (1G) to Fourth Generation (4G) has brought revolution in the communication among the people of the world. It is expected that Fifth Generation (5G) brings another revolution by offering very high data speed. It incorporates many sophisticated technologies and uses important concepts like wisdom for the better performance than their predecessors. In this paper efforts have been made to provide information regarding First Generation to Fourth Generation supplemented by the characteristics of each generation mobile system. In addition the salient features pertaining to Architecture and Operation of 5th Generation Mobile System shall also be discussed.

Keyword

Time division multiple access, Code Division Multiple Access Advance Mobile Phone System, Mobile Telephone Systems, Improved Mobile Telephone Service Global System for Mobile Communications.

1 Introduction

First generation was an Advance Mobile Phone System (AMPS) introduced in 1981. It was analog system based on speed up to 2.4Kbps. It enabled users to make voice calls within the country. Second generation (2G) was more efficient and more reliable as compared to first generation (1G) and supported text and multimedia messaging. Second generation (2G) comprised of Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). Third generation (3G) integrated all existing platforms such as TDMA, GSM and CDMA under a single umbrella. From then a new Digital era of communication comes into existence with proposed speed and reliability capable of joining existing global standards, such as CDMA, GSM and TDMA. The Fourth generation (4G) was introduced in the year 2000. Despite the ultra-high speed, crossing the barrier of 100Mbps and touching new levels of 1Gbps, this medium was more reliable than its insert and impotently with an improved security. Fifth generation (5G) in all setup to be launched in 2015. It will provide even better security and high bandwidth with no signal loss and errors.

2 Literature Review

5G wireless or mobile networks will support 1,000-fold gains in capacity, connections for at least 100 billion devices, and a 10 Gb/s individual user experience capable of extremely low latency and response times. 5G radio access will be built upon both new radio access technologies (RAT) and evolved existing wireless technologies (LTE, HSPA, GSM and WiFi). Breakthroughs in mobile network

innovation will also drive economic and societal growth in entirely new ways. 5G will realize networks capable of providing zero-distance connectivity between people and connected machines.

The evolution of wireless access technology is about to reach its fourth generation. Wireless access technology has formed different evolutionary path, but with a common aim related to performance and efficiency. The First generation has accomplished the basic mobile voice, while the Second generation has dealt with capacity and coverage. The third generation focused for higher data rate, multimedia support and spread spectrum followed by Fourth generation, providing access to a wide scope of telecom services including innovative mobile services, along with a support for low to high mobility application furnish in Fig. 1

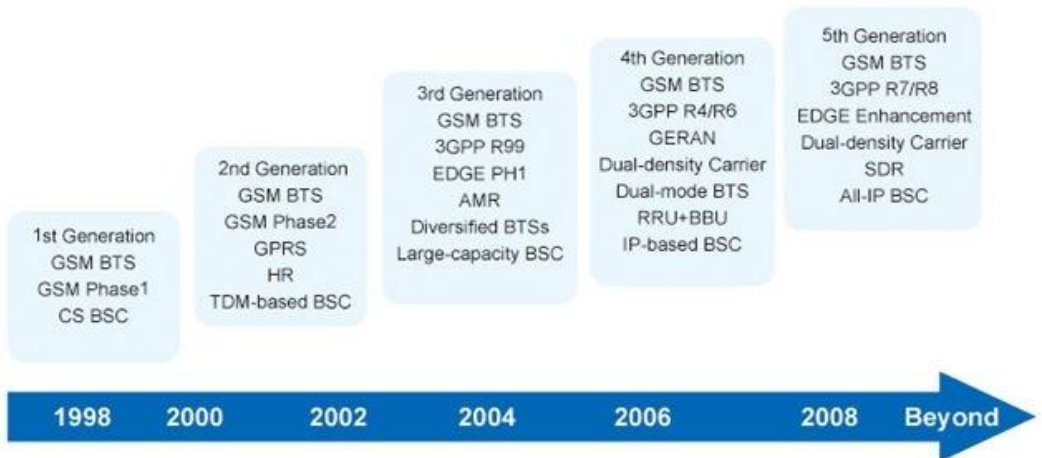


Fig. 1

First Generation:

First generation (1G) introduced in 1981 was based on analog system. However, the main difference between the first generation and second generation was analog and digital Signaling respectively. First generation (1G) technology changed 0G technology, which contained mobile radio telephones such as Mobile Telephone Systems (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push To Talk (PTS). In 1G, a voice call gets modified to a high frequency of about 150 MHz and more as it is transmitted between radio towers. It is done by using a method called Frequency-Division Multiple Access (FDMA). It has lesser capacity and changeable handoff, reduced voice links and no security at all. Voice calls are then played back in radio towers. 1G phone the mobile market displayed an annual growth rate of 30 to 50 percent during 1990. Its subscribers increased to 20 million.

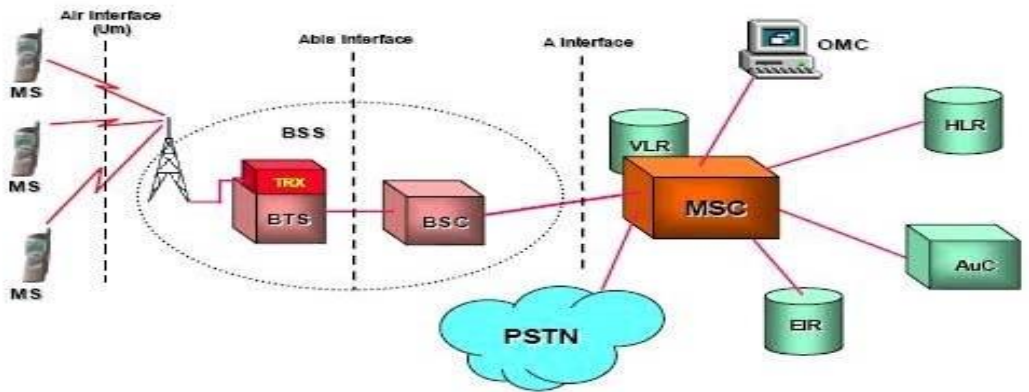


Fig. 2

Second Generation

The second generation technology was introduced in 1990-91 as it was intended mainly for voice transmission with digital signal and speed upto 64kbps. Second generation comprised of three technology platforms: TDMA, FDMA and CDMA. Second generation founded on the low band digital signal, during the start of second generation in 140 countries there were approximately more than 248 billion users. Second generation is the combination of both TDMA and FDMA. The same are originated with the inclusion of following system.

- High Speed Circuit Switches Data (HSCSD).
- General Packet Radio Service (GPRS).
- Enhanced Data Rates for Global Evolution (EDGE) technologies.

High Speed Circuit Switches Data provided a solid ground towards 3G wideband mobile data networks. This technology advance the data rates up to 57.6 Kbps by introducing 14.4 Kbps data code and collecting 4 radio channel time slots.

General Packet Radio Service was an extension to the radio access network it requires all different packet based IP data link. GPRS come up with severd improvements in several new components besides altering the current GSM and TDMA networks.

Edge technology is a standard that takes a specified to improve the throughput per time slots.

Third Generation

Third generation allows both sender and receiver to send or receive large quantities of data using the telephone. The speed of 3G ranges from 144Kbps to 3.1Mbps. Third generation has reactively a

high speed as compare to previous generation for example it can takes 16-18 seconds per frame to transfer a standard using 3G networks, one can send large data more efficiently and with less period of time. In 3G we have Universal Mobile Telephone Service (UMTS) data transmission mechanism which is also referred as WCDMA, CDMA 2000. Despite advancement in all the dimensions, 3G technology has a disadvantage of being costly as compare to 2G. 3G has two more data transmission mechanisms which are TDMA and CDMA. TDMA allows multiple users to share same frequency channels by dividing the signal into different time.

CDMA is a form of multiplexing and allows many signals in order to lodge a single channel.

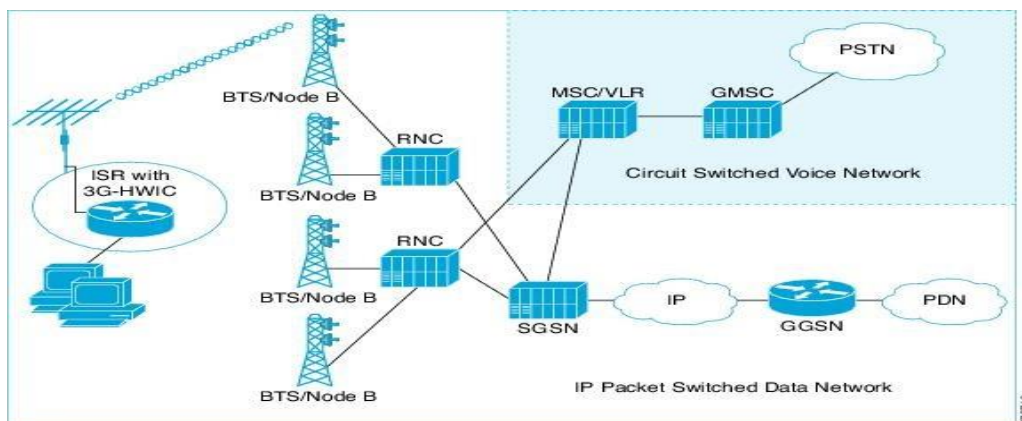


Fig. 3

Third generation stands dominant among previous generations as it has an extensive range of market-focused applications, International mobility and roaming. Third generation developed the data transmission speed up to 144Kbps. in mobility.

Fourth Generation

Fourth generation is an IP based, means that every user has a unique IP address which provides users with dedicated bandwidths. It supports high quality video and high quality High Definition (HD) TV streaming and allows users on easy access easily with a greater flexibility in terms of mobility. Fourth generation also provides improved security services but without compromising high speed data transmission through the network. The technology standard has two main Data transmission mechanism. Long Term Evolution (LTE) and Worldwide Interoperability For Microwave Access (WIMAX). Fourth generation is the successor of second generation and third generation (3G) Fourth generation offer extremely smooth global roaming ubiquitously with lesser cost.

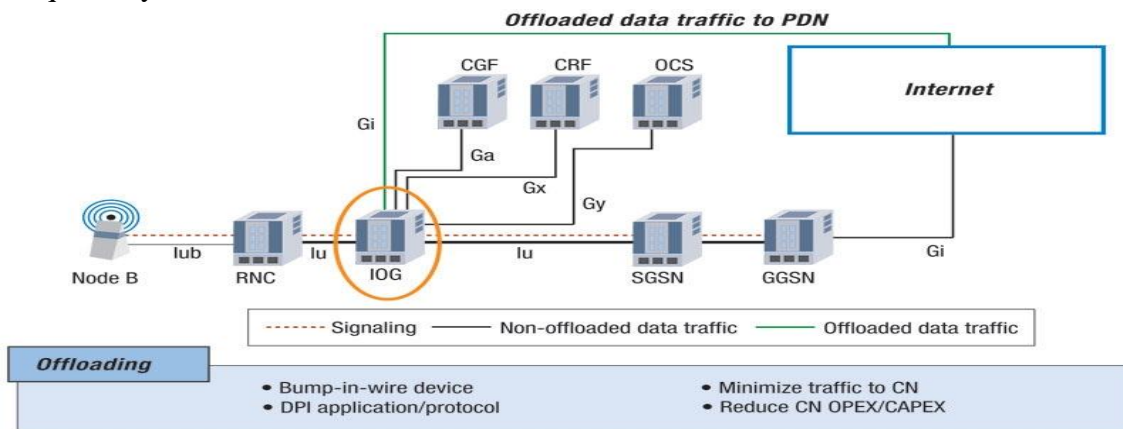


Fig. 4

Fifth Generation

Fifth generation will be introduced between 2015-2020 and expected to be high speed and more reliable than fourth generation. With a high speed, up to 1Gbps and lower cost than previous generations. Fifth generation it provides a high secured high bandwidth

service with no errors and signal loss with such high speed and reliability a new era of mobile network going will be unleashed. Fifth generation is cloud based and supports IPv6 128 bits.

The authors in [5] defined 5G (Fifth Generation) mobile network concept, as user-centric concept unlike service-centric concept as seen for 4G or operator-centric as in 3G. The 5G terminals are proposed to have software defined radios and modulation scheme. New error-control systems are projected to be downloaded from the Internet dynamically and the terminal should be capable to combine different flows from different technologies the terminals will have admission to different wireless technologies at the same time. Each network will be responsible for handling user-mobility, while the terminal will arrive at the last selection among different wireless/mobile access network suppliers for a paid service

COMPARISON OF ALL GENERATIONS OF MOBILE TECHNOLOGIES (1G-5G)

Generation	1G	2G	2.5G	3G	3.5G	4G	5G
Start	1970-1980	1990-2000	2001-2004	2004-2005	2006-2010	2011-Now	Soon (2020)
Data Bandwidth	2 Kbps	64 Kbps	144 Kbps	2 Mbps	More than 2 Mbps	1 Gbps	more than 1 Gbps
Technology	Analog Cellular	Digital Cellular	GPRS, EDGE, CDMA	CDMA 2000 (1xRT, EVDO) UMTS, EDGE	EDGE. Wi-Fi	WiMax LTE Wi-Fi	www
Service	Voice	Digital Voice, SMS, Higher Capacity Packet Size Data	SMS, MMS	Integrated High Quality Audio, Video & Data	Integrated High Quality Audio, Video & Data	Dynamic Information access, Wearable Devices	Dynamic Information access, Wearable Devices with AI Capabilities
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	Packet	All Packet	All Packet	All Packet
Core Network	PSTN	PSTN	PSTN	Packet N/W	Internet	Internet	Internet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal & Vertical	Horizontal & Vertical

Table 1

3 Methodology:

The authors in [1] proposed new design framework for network architecture of future 5G mobile networks, including protocols and algorithms. In the 5G network architecture different radio interface for each Radio Access Technology in the mobile terminal has been proposed. Protocol layout for the proposed architecture has been discussed in a very meaningful way. An exhaustive framework covering block diagrams for tunneling and handling handovers between IP tunnels has been talked about. The fuzzy logic concept has been employed for selection of RAT during handover. Simulation analysis is performed considering four types of service, i.e. voice calls, non-real-time data traffic real-time video telephony, high heat bit rate video To measure the carrying out for the upcoming network generation novel concept has been suggested. The researchers in [11] analyzed the existing QOS framework with respect to the dynamic and rapidly changing behavior of ad hoc networks. Proposed merging of ad hoc and cellular technology under 4G umbrella with the user centric concept wirelessly with multi terminals at a time, which will assure optimized performance in the next generation technology.

Issues & Challenges of Existing Generations in Mobile Communication

The prime challenge in heterogeneous wireless networks is referred to the maximization of spectral efficiency and battery power. Since wireless technology is widely being accepted and embraced in various arenas, more and more challenges are being faced to deliver quality of service and quality of experience, by providing “always best connected” service to the user. Following are few main requirements for building 5G wireless networks:

Huge capacity and high connectivity support

The following prediction depicts the huge increase of mobile users, thereby justifying the need for redesigning of networks to suffer such massive data holding, transmitting capacity and best connectivity [14].

Global mobile traffic is estimated to increase by thirteen fold between 2012 and 2017 [6].

By the end of 2013, the number of mobile-connected devices will surpass the number of people on earth and by 2017 there will be nearly 1.4 mobile devices per capita [6].

It is reckoned that two-third of the world's mobile data traffic would be video and 2.7 GB traffic per month is the estimated value to be generated by Smartphone's in 2017 which is 8 times more than generated in 2012 [6].

Endure for a High Quality of Services, Applications & Users

Some of the applications of the following generation would evolve in multiplatform environment. They would be available across several wireless technologies like LTE, WI-Fi, etc. and other handheld devices. More or less of such application includes virtual navigation, Tele-Medicine, Tele-geoprocessing, Crisis management, Education, Travelling-commerce and so on

Objectives of 5 G

Consistent Connectivity Experience

The next wave of the Digital Society will be characterized by an ICT network's capability for immediate service availability and on-demand adaptability. An instant immediacy in mobile services will lay the foundation for a whole new set of mobile apps to proliferate and push the capabilities of communications beyond what is currently possible. Widespread adoption of M2M services will be promoted when

there would be provision of higher network capacity needed for handling enormous connections [6].

Power to Handle Disruptive Growth in Network Capacity

Server workloads are growing by 10% a year. Network bandwidth demand is growing by 35%. Storage capacity is growing by 50%. Power cost growth is 20%. Throwing more capacity on demand is not the solution; there is a need to optimize capacity in novel ways. Over 1.5 billion Web pages are accessible, 450,000 iPhone apps are being accessed, over 200,000 Android apps are being used, 10,500 radio stations are surviving. All drives demand for IT [6 &7].

Fifth Generation Networks.

5G network technology will open a new era in mobile communication technology. The 5G mobile phones will deliver admission to different wireless technologies at the same time and the terminal should be capable to combine different flows from different technologies. 5G is predicted to be an intelligent technology capable of interconnecting the entire universe without boundaries.

At present, 5G is not a term officially used for any particular specification or in whatever official document until now made public by telecommunication companies or standardization bodies likes WI-Max Forum or ITU-R. The new release will further enhance system performance and add new capabilities with new application areas [5].

The 5G (Fifth Generation Mobile and Wireless Networks) can be a complete wireless communication introducing the perfect real world wireless - World Wide Wireless Web (WWWW). 5G would be the next major stage of mobile telecommunications standards beyond the 4G/IMT-Advanced standards [18].

The 5G technologies include all types of innovative features which make 5G mobile technology most powerful and in immense demand in

near future. Users can hook their 5G technology cell phones with their Laptop to get broadband internet access. [22] Some of the applications, benefiting from mobile connectivity are home automation, emergency response, intelligent shopping smart transportation, sustainable urban environment, smart product management security and e-books [18].

In fifth generation, Network Architecture consists of a user terminal (which holds a crucial function in the new architecture) and a number of independent, autonomous Radio Access Technologies (RAT). The 5G mobile system is all-IP based model for wireless and mobile network interoperability. Inside each of the terminals, each of the radio access technologies is determined as the IP link to the external Internet world [1].

Towards Fifth Generation Networks

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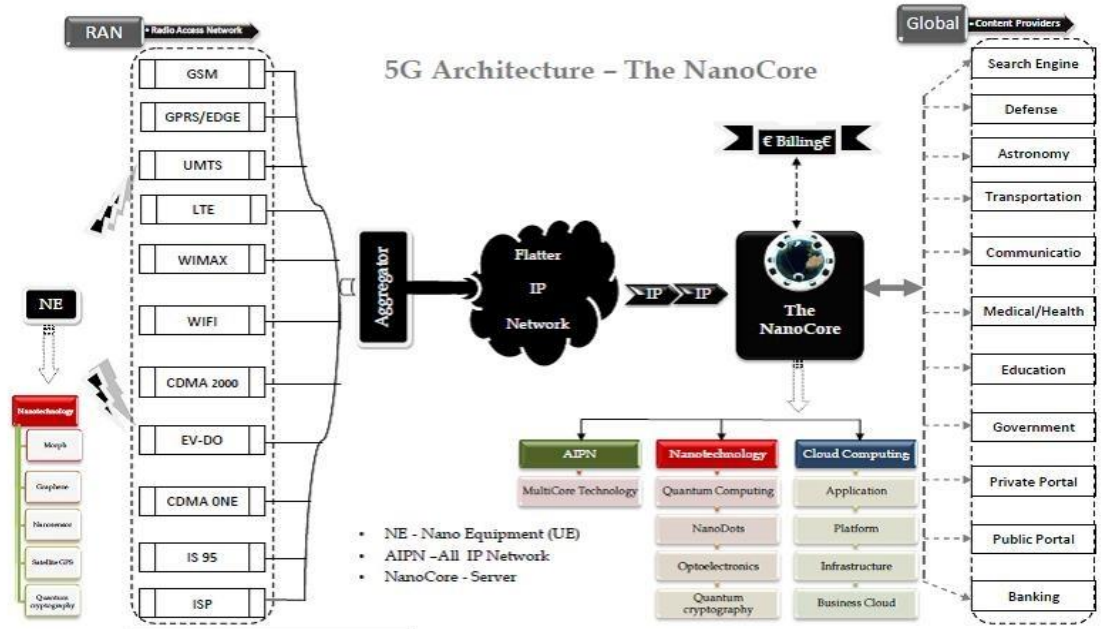


Fig. 5

4 Conclusion:

Fifth generation (5G) is the future generation which has a more speed and more capacity and high bandwidth more reliable and more secure. Fifth generation (5G) technology has additional ordinary data capabilities and has the capability to tie together clear call volumes and unlimited data broadcast with latest mobile operating system. Fifth generation (5G) has an extraordinary ability to support the software and consultancy. The recent trend of fifth generation (5G) technology has a bright future. The important feature of the fifth generation (5G) technology includes bidirectional large bandwidth and less traffic and

equally accessibility of network through the world 25mbps connectivity speed, data bandwidth greater than 1GB and low cost.

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