

5G : Future Generation Technology

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ABSTRACT

The objective of this paper is comprehensive study related to 5G technology of mobile communication. Existing research work in mobile communication is related to 5G technology. In 5G, researches are related to the development of World Wide Wireless Web (WWW), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless Communication. Fifth generation focus on (Voice Over IP). VOIP enabled devices that user will experience a high level of call volume and data transmission. Fifth generation technology will fulfill the requirements of customers who always want advanced features in cellular phones. The main features in 5G mobile network is that user can simultaneously connect to the multiple wireless technologies and can switch between them 5G technology is a very important advantage which will change the way we look at these different wireless technologies & will also change the way bandwidth users look at it as they can access their phones quite differently.

Keywords : 5G Architecture, Evolution from 1G to 5G, *WLAN, GSM*.

I. INTRODUCTION

Mobile and wireless networks have made remarkable development in the last few years. At the present time many mobile phones have also a WLAN adapter. One may expect that near soon many mobile phones will have Wax adapter too, besides their 3G, 2G, WLAN, Bluetooth etc. adapters[3]. We are using IP for both generations, 2.5G or 3G Public Land Mobile Networks (PLMN) on one side and WLAN on the other, raised study on their integration. Concerning the 4G, its focus is toward flawless incorporation of cellular networks such as GSM and 3G. Multi mode consumer terminals are seen as must have for 4G, but special security mechanisms and special operating system support in special wireless technologies remain a test. Nevertheless, integration among different wireless networks (e.g. PLMN and WLAN) is implemented in practice even nowadays. now days different wireless and mobile technologies are present such as

third generation mobile networks (UMTS Universal Mobile Telecommunication System, cdma2000), LTE (Long Term Evolution), WiFi (IEEE 802.11 wireless networks), WiMAX (IEEE 802.16 wireless and mobile networks), as well as sensor networks, or personal area networks (e.g. Bluetooth, ZigBee). Mobile terminals include variety of interfaces like GSM which are based on circuit switching. Fifth generation technology provide facilities like camera, MP3 recording, video player, large phone memory, audio player etc. that user never imagine and for children rocking fun with Bluetooth technology and Piconets.



Fig.1 Evolution of different networks over the years

II. TEVOLUTION

Mobile communication has become more popular in last few years due to fast revolution in mobile technology. This revolution is due to very high increase in telecoms customers. This revolution is from 1G the first generation, 2G second generation, 3G the third generation, and then the 4G the fourth generation, 5G the fifth second generation.

A. First Generation (1G)

1G emerged in 1980s. It contains Analog System and popularly known as cell phones. It introduces mobile technologies such as Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT). It uses analog radio signal which have frequency 150 MHz, voice communication modulation is done using a technique called Frequency-Division Multiple Access (FDMA).

B. Second Generation (2G)

2G emerged in late 1980s. It uses digital signal for voice transmission and has speed of 64 kbps. It provides facility of SMS (Short Message Service) and use the bandwidth of 30 to 200 KHz

C. Third Generation (3G)

It uses Wide Band Wireless Network with which clarity is increased. The data are sent through the technology called Packet Switching. Voice calls are interpreted through Circuit Switching. Along with verbal communication it includes data services, access to television/video, new services like Global Roaming. It operates at a range of 2100 MHz and has a bandwidth of 15-20 MHz used for High-speed internet service, video chatting.

D. Fourth Generation (4G)

4G offers a downloading speed of 100 Mbps. 4G provides same feature as 3G and additional services like MultiMedia Newsletters, to watch T.V programs with more clarity and send Data much

h faster than previous generations [3]. LTE (Long Term Evolution) is considered as 4G technology.

4G is being developed to accommodate the QoS and rate

requirements set by forthcoming applications like wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), minimal services like voice and data, and other services that utilize bandwidth. In the United States, Sprint (previously Clearwire) has deployed Mobile WiMAX networks since 2008 while MetroPCS become

the first worker to offer LTE overhaul in 2010.

3G and 4G gear made for other continents are

not always well matched because of different frequency bands. Mobile WiMAX is not available for the European market as of April 2012. This short range radio technology is ideal for wireless personal area networks (WPANs).

III. CHALLENGES IN TMIGRATION

A. Multi mode user terminals

By means of 4G, there will be a necessity to design a single user terminal that can operate in different wireless networks and conquer the design troubles such as restrictions on the size of the device, its cost and power utilization. This trouble can be solved by using software radio approach.

B. Choice among various wireless systems.

Every wireless system has its distinctive characteristics and roles. The choice of most appropriate technology for a specific service at a specific place and at specific time. This will be applied by making the choice according to the best possible fit of consumer QoS (Quality of Service) requirements.

C. Security

Reconfigurable, adaptive and lightweight protection mechanisms should be designed.

D. Attacks on Application Level

Software applications which will offer a new feature to the consumer but will commence new bugs.

E. Jamming and spoofing

Spoofing is fake GPS signals being sent out, in which case the GPS receiver considers that the signals arrive from a satellite and computes the wrong coordinates. Criminals can make use of such techniques. Jamming occurs when a transmitter sending out signals at the same frequency shifts a GPS signal.

IV. WHY NEED TO FT 5G?

- Very High speed, high capacity, and low cost per bit [7].
- It supports interactive multimedia, voice, video, Internet, and other broadband services, more effective and more attractive, and have Bi-directional, accurate traffic statistics [5].
- 5G technology offers Global access and service portability.
- It offers the high quality services due to high error tolerance.
- It is providing large broadcasting capacity up to Gigabit which supporting almost 65,000 connections at a time.
- More applications combined with artificial intelligent (AI) as human life will be surrounded by artificial sensors which could be communicating with mobile phones [6].

V. THEORETICAL FRAME WORK

5G Technology is a name used in various research papers and projects to indicate the next most important stage of mobile communication standards beyond the 4G standards. Presently, 5G is not a term officially used for any particular specifications. 3GPP standard release beyond 4G and LTE [1]. The implementation of standards under a 5G umbrella would likely be around the year of 2020.

Key terms of 5G Technology:

1. 5G is a completed wireless communication with almost no limitation; somehow people called it REAL wireless world

2. Additional features such as Multimedia News papers, also to watch T.V programs with the clarity as to that of an HD T.V.
3. We can send Data much faster than that of the previous generations.
4. 5G will bring almost perfect real world wireless or called "WWW: World Wide Wireless Web"
5. Real wireless world with no more limitation to access and zone issues.

VI. SOFTWARE TO FT 5G

- 1) 5G determination be solitary unified ordinary of dissimilar wireless network, counting LAN technology, LAN/WAN, WWW World Wide Wireless Web, combined IP & seamless mixture of broadband.
- 2) Software distinct radio (SDR), small package layer, completion of Packets, Encryption, supplement, Anti-Virus.

VII. CONCEPT OF 5G TECHNOLOGY

A. Physical/MAC layers

Physical and Medium Access Control layers i.e. OSI layer 1 and OSI layer 2, define the wireless technology and shown in Fig.1. For these two layers the 5G mobile networks is likely to be based on Open Wireless Architecture [7].

B. Open Transport Protocol (OTA) layer

The mobile and wireless networks differ from wired networks regarding the transport layer. In all TCP versions the assumption is that lost segments are due to network congestion, while in wireless network losses may occur due to higher bit error ratio in the radio interface. Therefore, TCP modifications and adaptation are proposed for the mobile and wireless networks, which retransmit the lost or damaged TCP segment over the wireless link only

A. Application layer

Regarding the applications, the ultimate request from the 5G mobile terminal is to provide int

elligent QoS management over a variety of networks. Today, in mobile phones the users manually select the wireless interface for particular Internet service without having the possibility to use QoS history to select the best wireless connection for a given service. The 5G phone shall provide a possibility for service quality testing and storage of measurement information in information databases in the mobile terminal.

B. Network layer

The network layer will be IP (Internet Protocol), because there is no competition today on this level. The IPv4 (version 4) is worldwide spread and it has several problems such as limited address space and has no real possibility for QoS support per flow. These issues are resolved in IPv6, but traded with significantly bigger packet header. Then, mobility still remains a problem[7]

The system comprising of a main user terminal and then a number of independent and autonomous radio access technologies. Each of the radio technologies is considered as the IP link for the outside internet world. The IP technology is designed exclusively to ensure sufficient control data for appropriate routing of IP packets related to a certain application connections i.e. sessions between client applications and servers somewhere on the Internet.

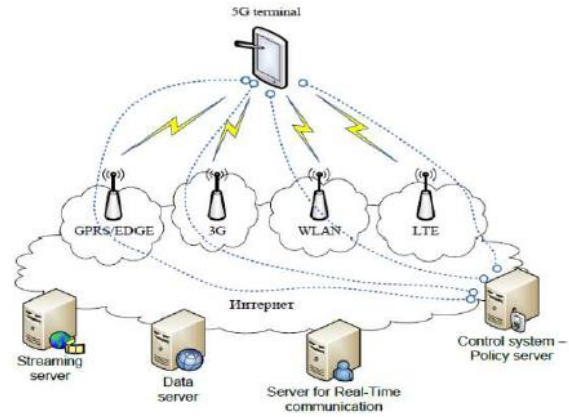


Fig.4 Functional Architecture of 5G Wireless Technologies

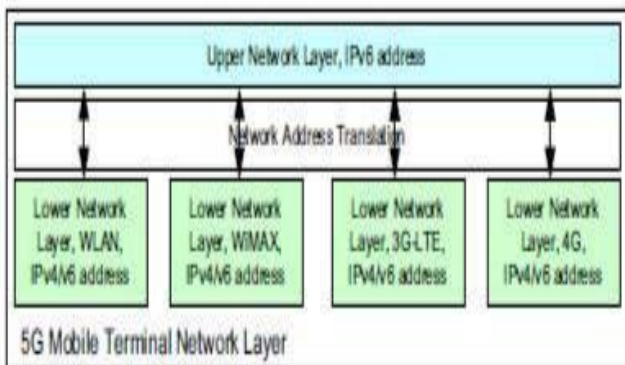


Fig.2 5G mobile terminal network layer

APPLICATION LAYER	APPLICATIONS of SERVICE
PRESENTATION LAYER	
SESSION LAYER	OPEN TRANSPORT PROTOCOL
TRANSPORT LAYER	
NETWORK LAYER	UPPER NETWORK LAYER
DATA LINK LAYER	LOWER NETWORK LAYER
PHYSICAL LAYER	OPEN WIRELESS ARCHITECTURE

OSI stack

5G network stack

Fig.3 Protocol stack for 5G

Fig.6 shows 5G mobile phone design.[5] 5G is being developed to accommodate the QoS and rate requirements set by forthcoming applications like Wireless Broadband Access, Multimedia Messaging Service (MMS), Video Chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), [3] minimal services like voice and data and other services that utilize bandwidth. The definition of 5G is to provide adequate RF coverage, more bits/Hz and to interconnect all wireless heterogeneous networks to provide seamless, consistent telecom experience to the user.



VIII. 5G NETWORK ARCHITECTURE

Fig. 5 5G mobile phone design

A. The Master Core Technology:

The 5G Master Core is convergence point for other technologies, which have their own impact on existing wireless network. Interestingly, its design facilitates Master Core to get operated into parallel multimode including all IP network mode and 5G network mode. In this mode (as shown in the image given below), it controls all network technologies of RAN.

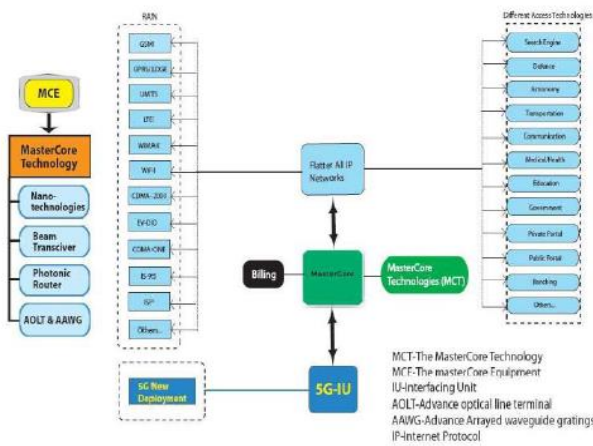


Fig.6 Master core architecture

B. Evolved Packet Core (EPC)

Evolved Packet Core is the IP based core network defined by 3GPP (Telecom standard) for use with LTE and other access technologies. The goal of the EPC is to provide simplified all IP core network architectures to efficiently give access to various services such as the ones provided by IMS (IP Multimedia Subsystem). EPC consists essentially of a Mobility Management Entity (MME) & access agnostic gateway for routing of user datagram. EPC will be a completely new architecture for wireless operators, one that emulates the IP world of data Communication rather than the voice centric world of wireless. EPC is based on flat IP network theory. Fig. 7 shows flat IP Architecture.

Mobile networks have been designed up to this point for circuit switched voice. Wireless networks were designed in a hierarchical fashion to aggregate, authenticate, manage and direct calls.

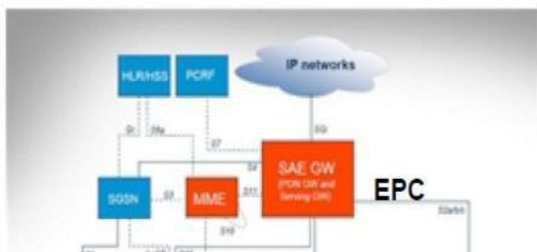


Fig.7 Flat IP Architecture

Surprisingly, any service mode can be opened under 5G New Deployment Mode as World Combination Service Mode (WCSM). WCSM is a wonderful feature of this technology; for example, if a professor writes on the white board in a country – it can be displayed on another white board in any other part of the world besides conversation and video. Further, a new services can be easily added through parallel multimode service.

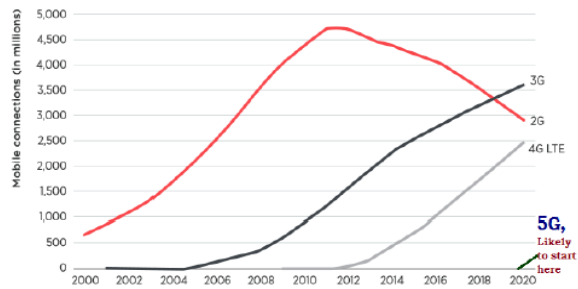


Fig.8 Showing the timeline of previous generation technologies

C. Expected Time Length:

By considering the multiple utility and various fashionable salient features, researchers are anticipating that this technology will be in use until 2040s. 5G technology is adorned with many as well as distinct features, which applicability is useful for a wide range of people irrespective of their purposes[4].

IX. APPLICATIONS OF 5G

Some of the significant applications are:

- It will make unified global standard for communications.

- Network availability will be everywhere and will facilitate people to use their computer and such kind of mobile devices anywhere anytime.
- Because of the IPv6 technology, visiting care of mobile IP address assigned as per the connected network and geographical position.
- Its application will make world real Wi-Fi zone.
- Its cognitive radio technology will facilitate different version of radio technologies to share the same spectrum efficiently.

X. T DISADVANTAGE TO FT5GT TECHNOLOGY

5G technology is researched and conceptualized to solve all radio signal problems and hardship of mobile world, but because of some security reason and lack of technological advancement in most of the geographic regions, it has following shortcomings:

- Technology is still under process and research on its viability is going on.
- The speed, this technology is claiming seems difficult to achieve (in future, it might be) because of the incompetent technological support in most parts of the world.
- Many of the old devices would not be competent to 5G, hence, all of them need to be replaced with new one expensive deal.
- Developing infrastructure needs high cost.



Fig.9 Disadvantages of 5G technology

XI. T5G-TCHALLENGES

Challenges are the inherent part of the new development; so, like all technologies, 5G has also big challenges to deal with. As we see past i.e. development of radio technology, we find very fast growth. Starting from 1G to 5G, the journey is merely of about 40 years old (Considering 1G in 1980s and 5G in 2020s). However, in this journey, the common challenges that we observed are lack of infrastructure, research methodology, and cost.

To understand these questions, the challenges of 5G are categorized into the following two headings:

- Technological Challenges
- Common Challenges

A. Technological Challenges:

Intercell Interference – This is one of the major technological issues that need to be solved. There

are variations in size of traditional macro cells and concurrent small cells that will lead to interference[1].

Efficient Medium Access Control – In a situation, where dense deployment of access points and user terminals are required, the user throughput will be low, latency will be high, and hotspots will not be competent to cellular technology to provide high throughput. It needs to be researched properly to optimize the technology.

Traffic Management – In comparison to the traditional human to human traffic in cellular networks, a great number of Machine to Machine (M2M) devices in a cell may cause serious system challenges i.e. radio access network (RAN) challenges, which will cause overload and congestion.

B. Common Challenges:

Multiple Services – Unlike other radio signal services, 5G would have a huge task to offer services to heterogeneous networks, technologies, and devices operating in different geographic regions. So, the challenge is of standardization to provide dynamic, universal, user-centric, and data.

Infrastructure – Researchers are facing technological challenges of standardization and application of 5G services.

Communication, Navigation, & Sensing – These services largely depend upon the availability of radio spectrum, through which signals are transmitted. Though 5G technology has strong computational power to process the huge volume of data coming from different and distinct sources, but it needs larger infrastructure support.

XII. CONCLUSION

In this paper we have surveyed 5G technology for mobile communication. The 5G technology is designed as an open platform on different layers, from the physical layer up to the application. Presently, the current work is in the modules that shall offer the best Operating System and lowest cost for a specified service using one or more than one wireless technology at the same time from the 5G mobile. A new revolution of 5G technology is about to begin because 5G technology going to give tough competition to normal computer and laptops whose market place value will be affected. The development of the mobile and wireless networks is going towards higher data rates and all IP principle. Mobile terminals are obtaining each year more processing power, more memory on board, and longer battery life for the same applications. 5G include latest technologies such as cognitive radio, SDR, nanotechnology, cloud computing and based on all IP platform. It is expected that the initial Internet philosophy of keeping the network simple as possible, and giving more functionalities to the end nodes, will become reality in the future generation of mobile networks, here referred to as 5G.

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