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Development of 5G Mobile Network Technology and Its Architecture

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Abstract— Fifth generation (5G) is a upcoming mobile network technology which will probably be launched in India by 2018-2020 by various leading mobile operators. This paper is focused on all foregoing generations of mobile technology, developmental aspect of 5G technology and basic architecture/concept behind this mobile technology. Few researches have already been done on 5G mobile technology and these researches are mostly related to the development of World Wide Wireless Web (WWWW) and Dynamic Adhoc Wireless Networks (DAWN). 5G technology has few very unique features in term of speed/bandwidth which is greater than 1 Gbps, frequency band which is between 3GHZ to 300GHz, high definition video telephony, high definition multimedia streaming, multimedia newspapers, HD online TV, etc. which makes this technology differ and unique among all the available existing mobile technologies worldwide. Fifth generation is based on IPv6, flat IP and VOIP (Voice Over IP) technologies and through these feature, user will experience a high level of data transmission and call volume service.

Keywords— LTE, 5G, 5G Architecture, Mobile Technology, WWWW, OTA, etc.

I. INTRODUCTION

The development of wireless technology started in early 1970's. In the next four decades the development of mobile wireless technology projected from 1G to 5G technology. 5G technology is the 5th generation technology for mobile wireless technology. 5G Technology is highly intelligent technology which adds up a large number of specifications to the 4G technology and makes it completely wireless without any limitation. 5G provides very high bandwidth with many other advanced features such as spectral efficiency, energy efficiency, etc., making it perfectly wireless for real world and so makes powerful and beneficial for the users. The fifth generation wireless mobile technologies offer tremendous data capabilities and unrestricted calls and in addition an infinite data broadcast with latest mobile operating system. The idea of WWWW (World Wide Wireless Web) is started with 4G technology and is completed with the 5G mobile technology. It is expected to release in 2020. This technology helps in creating a universally connected world with uninterrupted access to information, communication and entertainment. This will definitely change our lifestyles in a significant manner.

II. EVOLUTION OF MOBILE NETWORK TECHNOLOGY

The step for wireless communication was led by an Italian inventor, G. Marconi by communicating a letter upto distance of 3km (from starting point to its destination point) with the help of electromagnetic waves. After this initiation, wireless communication became a very important part of present styles of living. With the passing of time a number of modifications keep on taking place as per the need, which led to different generations of wireless technologies:

- ***1G (First Generation):*** 1st Generation Mobile Network were developed in 1980s and completed by early 1990s. It was based on analogue system. It used analogue radio signals with frequency 150MHz and voice call modulation was done with the help of Frequency Division

Multiple Access (FDMA). Its speed was up to 2.4 kbps. Its main feature was it allows user to make voice calls within a country.

- ***2G (Second Generation):*** It was launched in 1991. It was based on digital system. It can give you speed up to 64 kbps. Main services provided are digital voices and SMS facility with more clarity, using the bandwidth of 30 KHz to 200 KHz. It gave semi global facility. Vital eminent technologies were GSM and Code Division Multiple Access (CDMA).

- ***3G (Third Generation):*** It developed between late 1990s and early 2000s. Its transmission speed lies between 125kbps to 2 Mbps. Data are sent through Packet switching technology and circuit switching was used for interpretation of voice calls. It provides superior voice quality. It also provides the facility of Video Conferencing, E-mailing, Online banking-billing, Global Roaming, mobile TV etc.

- ***4G (Fourth Generation):*** It was developed in 2010. It is faster and more reliable compared to earlier networks. Its speed is up to 100Mbps. It provides improved communication network based on IP. It provides high performance in low cost. Long Term Evolution (LTE) is considered as main technology for 4G. Multimedia Messaging Service (MMS), digital video broadcasting, High Definition (HD) TV, Video chat are the services provided by 4G in addition to features of 3G.

- ***5G (Fifth Generation):*** It is next coming phase of wireless networks. It provides 10 times more capacity than other existing systems. It expected speed will be up to 1Gbps. It is completely wireless communication with almost no limits supporting Wireless World Wide Web (WWWW). It is more reliable and faster in lower cost. It provides high capacity, large phone memory, faster data transmission, supports interactive multimedia, etc.

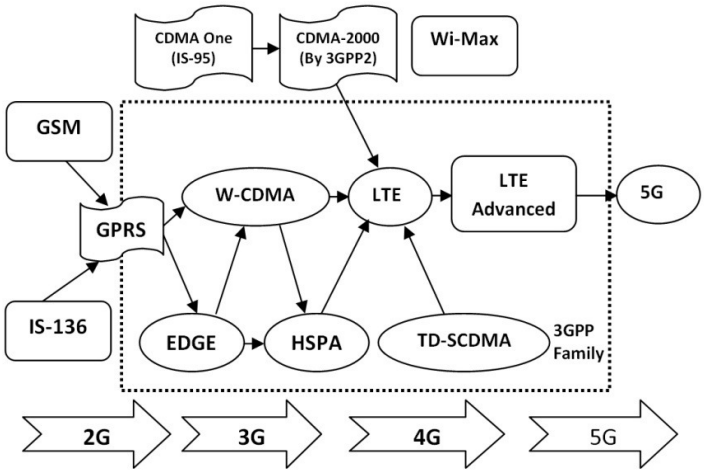

Fig.1. Evolution Phases of Mobile Network Technology

III. NEED OF 5G MOBILE TECHNOLOGY

Some defects and unavailability of some properties or functionalities in the existing system becomes the need for the development of the next generation, so here it is functionalities and lacking in 4G technologies. 4G technology is basically about the integration of different technologies and networks. 4G technologies combine various existing and future wireless technologies to ensure freedom of movement from one technology to another. 4G can supports 100Mbps data rate in full-mobility wide area coverage and 1Gbps data rate in low mobility local area coverage. 4G integrates all access technologies, services and applications unlimitedly to run through wireless over wire line

using IP address. But when we talk about 5G, it will bring us perfect real world wireless or WWWW: World Wide Wireless Web. The idea of 5G technologies started from 4G technologies. Talking about the working of 4G, although LTE provide benefits certain people with wide range of effective wireless communication technology. LTE is basically for use in commercial areas so cannot be used for creating an environment to be used by common people for downloading purpose, video call, etc. So, this became the main reason behind the development of 5G technology. Besides all the other benefits of 4G technology the most important concept of 5G technology is consumer oriented instead of service centric and operator oriented. In this technology priority is given to consumers as compared to other existing mobile technologies. So being user oriented, some features: cheaper traffic fees, security, high speed, artificial intelligence (AI), storage, etc, became the reason for the development of 5G technologies. 5G technology will provide very high band width. It includes all advanced features which will make it most dominant in near future. Major features which lead the development of 5G technology and migration from 4G technology:

- Security
- Multi Mode User Terminal
- Choice of selection of the best network among the various available wireless communication systems
- Charging and Billing
- Data Encryption
- Attack on Application Level
- Device to Device Communication

IV. NETWORK ARCHITECTURE OF 5G MOBILE TECHNOLOGY

The model of 5G technology is entirely IP based model for both mobile and wireless communication. The various components involved in the architecture making it very fast, secure and famous among the customers in all over the world are as follows:

- ***GPRS:*** General Packet Radio System (GPRS) is basically a step developed for internet access during third generation. It is the first step towards the end to end wireless communication. It provides data rates from 56Kbps to 114Kbps. It also promises to provide continuous connection of internet to mobile and computer users. It consumes comparatively less battery during internet access.

- ***EDGE:*** Enhanced Data GSM Environment (EDGE) provides an evolutionary path from 3G technology to GSM and TDMA. It provides maximum data transmission rate up to 473 Kbps. It is developed to increase the bandwidth of GPRS technology.

- ***3G:*** 3 Generation (3G) technologies developed to access wireless communication. It provides high quality, cost effective, wireless multimedia application, greater security features, video calls/ conferences and enhanced wireless application as compared to previously available services.

- ***WLAN:*** Wireless Local Area Network (WLAN) provides the facility of wireless connection and communication among the devices. It uses high frequency radio waves, micro waves, etc. for its functionality. Use of WLAN increases mobility, productivity, scalability as it provides high speed wireless connection.

- ***LTE:*** LTE stands for Long Term Evolution. LTE works by using all IP network architecture. It supports data as well as voice communication. LTE supports MIMO (Multiple Input Multiple Output), because of which higher data rate is achieved. As a result LTE is a standard for high speed

data transmission for mobile networks, providing a high speed up to 100 mbps. AS it uses improved architecture, handoff from one region to other is smooth. This results in smooth data flow without any interruption.

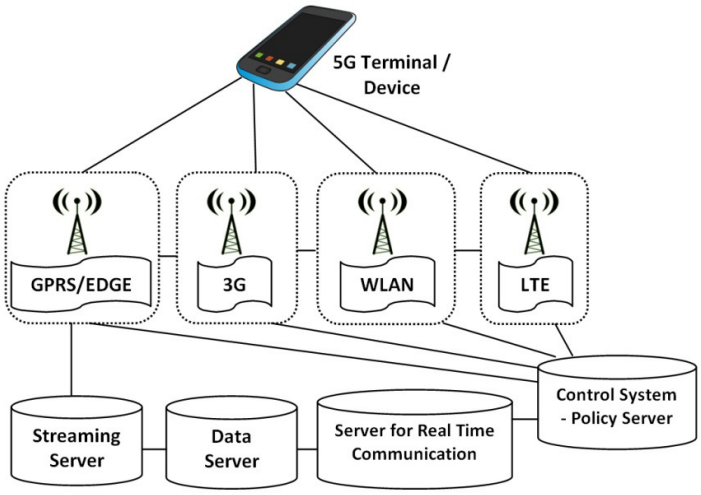

Fig.2. Architectural view of 5G Mobile Technology

V. NETWORK LAYERS OF 5G MOBILE TECHNOLOGY

The main focus of 5G technology is user mobility as the mobile terminals have access to different wireless technologies simultaneously & can combine some features of other networks also and so finally selects the strongest wireless network. The concept behind the working of the 5G technology is explained as follows:

Table-1. Network Layers of OSI and 5G Technology

OSI Network Model	Model of 5G Technology
Application Layer	Application (Services)
Presentation Layer	
Session Layer	Open Transport Protocol (OTP)
Transport Layer	
Network Layer	Upper Network Layer
	Lower Network Layer
Data link Layer(MAC)	Open Wireless Architecture
Physical Layer	

- ***Physical/Data link Layer:*** The first two layers of the OSI model for the 5G technology are based on Open Wireless Architecture.

- ***Network Layer:*** The Network Layer is an Internet Protocol (IP). IPV4 (Internet Protocol Version 4) is spread worldwide with some limitations like limited address space which are resolved in IPV6 (version 6) but were traded with bigger packet header. So, mobility still remained a problem. Then Mobile IP came into existence and 5G technology will use mobile IP. As a result mobile can be attached to several wireless networks simultaneously. 5G mobile network shall maintain virtual multi wireless networks. For this purpose, there lies a separation in network layer to form two sub layers for 5G mobile phones viz. Lower Network Layer and Upper Network Layer.

- ***Open Transport Protocol (OTA) Layer:*** TCP modifications are proposed for both wireless and mobile networks. The TCP retransmit the lost or damaged TCP segments over wireless links. In 5G it plays a very important role as it encounters with high installed speed and higher download**.** These mobiles can reasonably download updated version which is targeted to specific wireless technologies from the base station. This is here known as Open Transport Protocol (OTA).

- ***Application Layer:*** An intelligent behaviour facility of selecting best wireless connection out of different networks is provided in 5G. Terminals have access to quality testing and information storage in this layer. A large number of algorithms are used for giving the intelligent behaviour to the 5G technology.

VI. COMPARISON BETWEEN 4G AND 5G MOBILE TECHNOLOGIES

S.N.	Specifications	4G (IV Generation)	5G (V Generation)
1.	**Bandwidth**	Up to 100 Mbps	Greater than 1Gbps
2.	**Frequency Band**	2GHz to 8GHz	3GHz to 300GHz
3.	**Technologies**	Unified IP, seamless integration of broadband LAN/WAN/PAN and WLAN	4G, advanced technologies based on OFDM modulation and IPV6
4.	**Services**	Global roaming, Dynamic Information Access, HD streaming, Wearable Devices	Wearable Devices, Dynamic information access, HD streaming, Devices with AI capabilities
5.	**Standards**	IP based on LAN/WAN/PAN	IP based on LAN/WAN/PAN and WWWW
6.	**Multiple Access**	CDMA	CDMA, BDMA, FBMC
7.	**Core Network**	All IP Networks	5G Network Interfacing, Flatter IP Network
8.	**Initiation year**	2010	2015
9.	**Antenna Type**	Sub Wavelength Antenna	Array Antenna
10.	**Radiation Pattern**	Omni-directional	Fan-beam Directional
	Switching	Packet Switching	Packet Switching
11.	**Diversity and MIMO**	Present	Present
12.	**Deployment Year**	2000-2010	By 2020

VII. FEATURES OF 5G MOBILE TECHNOLOGY

Fifth generation wireless technology is providing a large number of utility for consumers at highest priority. The fifth generation wireless technology provides a number of features which makes it perfect wireless for real world. Some of these features are:

- 5G technology provides higher bandwidth.
- 5G technology provides high quality services based on policy to avoid error.
- An advanced billing interface which is more effective and attractive is provided by 5G technology.
- 5G technology provides high resolution and bi-directional large bandwidth shaping.
- 5G technology provides a unified global standard which facilitates service portability and global mobility.
- 5G technology works on lower power consumption.
- 5G technology provides better network coverage.

- 5G technology provides huge broadcasting data with very high connectivity speed of 25Mbps which was never before.
- 5G technology is expected to provide downloading speed up to 1Gbps in LAN,
- The traffic statistics of 5G technology makes it more accurate.
- Through remote management offered by 5G technology a user can get a better and faster solution.
- 5G technology also provides tools of subscriber supervision for fast action.

VIII. CONCLUSION

The design of the 5G technology is an open platform on different layers, from physical to application layer. The present work of 5G technology is focused upon providing specified services with WWWW functionalities in lowest cost ever, keeping the users in the top of the priority. There are lot more to come, which is definitely going to change the lifestyles of the societies. As 5G is only a step behind to arrive in Indian market with inexpensive rates, much reliability and will take connectivity speed and global mobility to new heights. The 5G wireless technology is going to deployed completely by 2020.

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