

A Future Communication Technology: 5G

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Abstract

5G word pertain to 5th generation communication is also known as tactile internet. A lot of improvements had been seen in telecommunication that is from 1G to 2G; 2G improves to 2.5G and 3G came in to the picture. More improved technology was introduced with advancement in 4G that is 4th Generation. As the 4G technology features improved as an advance version of 3G in terms of speed, data bandwidth & improvement of used technology. As research work in mobile communication is focusing on 5G technology and researches are progressing towards the World Wide Wireless Web (WWW), Dynamic Adhoc Wireless Networks (DAWN) & totally real wireless world. We are expecting that 5G will be introduced in communication by 2020 which is basically user oriented. In that user can avail specific feature of 5G such as very high speed & massive data bandwidth at the low cost per bit. This paper contains how the technologies are improving from first generation to current and what are the approaches/methodologies are followed and how can we further improve and can improved future communication technology that will be termed as fifth generation.

Keywords: WWW, LTE-E, 5G, Immense MIMO, Millimeter wave, Cellular and network architecture

I. Introduction

1. Evolution/Enhancement Of 5g Communication:

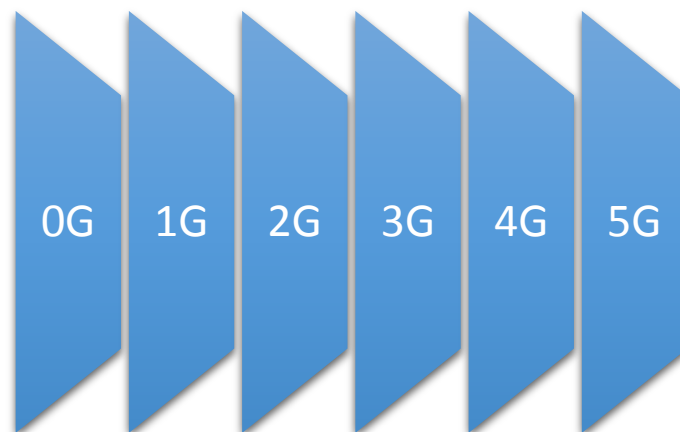


Figure 1. Evolution/Enhancement of 5G Communication

i. 0g

Evolution Of Communication Starts With Classical Mobile Telephony In That PTT (Push To Talk) Which Provides Half Duplex Communication, MTS (Mobile Telephone Service– 1946-USA) And Also Improved Version Of MTS That Is IMTS (Improved Mobile Telephone System) Which Provides Full Duplex System. AMTS (Advance Mobile Telephone System) and OLT Are Other Technology Which Is Used To Improve Connectivity between Users. These Are All The Very First Stage Technologies Used In The World Of Communication And Considered As 0G.

ii. 1g

FDMA [Frequency Division Multiple Access] Use Of Analog Communication In 1G For Cell Phones Mobile Telephony. It Provides Voice Calls With Speed Up To 2.5 Kbps [2].

iii. 2g

In Finland [1990], A Standard System Is Introduced In Communication That Is GSM (Global System For Mobile Communication) With Digital Voice Technique With Implementation Of FDMA, TDMA With Improved Speed Around 64 Kbps, Known As 2G [3]. After That 2g To 2.5G Circuit Switching And Packet Switching Technique Are Used By System Which Gives Data Rate Of 144 Kbps Such As GPRS, CDMA And EDGE.

iv. 3g

The Improvement In Communication Speed From 144kbps To 2Mbps Provides In 3G With Packet Switching Technology. 3G Technology Provides A Better, Uninterrupted Way Of Video Conferencing, Video Calling, Voice Over IP (VOIP), Online Gaming, Access To Global Roaming And Mobile TV Etc. 3G Technology Is Used Wide Band Voice Channel Which Provides Fast Communication. 3.5G Provides Faster Downloading Internet Service.

v. 4g

Mobile Broad Band Everywhere Is Continuously Used With New Application. Services Come In Telecommunication As A 4G [LTE] Technology [1]. 4G Is Based Upon Two Technologies, The Multicarrier Scheme That Is OFDM Which Is Also Known As BDMA (Band Division Multiple Access) And CDMA. In This Generation User Is Availing Massive Speed Up To 100 Mbps With 1Gbps Data Bandwidth. Some Specific Features Were Provided As WIMAX LTE WIFI With Service Dynamic Information Access, Wearable Devices And Provides HDTV Content, Digital Video Broadcasting (DVB) And Also Mobile TV With More Tremendous Effectiveness Of Quality.

vi. 5g (Lte-E): (Long Term Evolution-Enhanced)

5G Terminology Is Not Officially Or Technically Adopted As It Is Indeed In Research Phase In Communication Field. This New Expected Technology Is Submitted Into The Standard Arms. The Idea Was Raised For New Proposal Of Technology In 2012-2013 And Expected Release Will Be Around 2020 And The Expectation Of Communication World Is Totally Wireless As WWW [1]. The Commencement Of The Concept With The Following Amazing Ultra Densification, Mm Wave And Massive MIMO (Multiple Input Multiple Output), The 5G Will Include Massive Featuring Of Very Fast Communication, More Advanced Security, SDR Security (Software Define Ratio), Multiple Data Transfer Path, Better Cognitive Radio And Huge Bandwidth.

Features

In The Emerging World Of Communication, In 5th Generation (5G) The Communication Will Get Smarter Because Of Some Specific Features Will Be Introduced In Next Generation.

User Will Avail The Highest Speed Of 1gbps Till Now Ever Experienced And Provides Massive Bandwidth Of 10gbps In Communication. Very Low Latency Will Occur In The Upcoming Communication <1ms. More Accuracy Will Be Provided With Advance Correlation Techniques, Smooth Streaming Of Video And High Resolution In Context Of HDTV. Highly Secured Data Transmission Offers By Newer Technology, High Clarity Of Voice And Quality Of Video Calling, Less Power Consumption For Low Power Devices. 5th Generation (5G) Will Be Providing Large Data Broadcasting Which Will Support Almost 65000 Connections [2]. Almost All The User Will Access The Internet Via IPV6 According To Their Location ISP (Internet Service Provider) Network [2].

II. Issues ion Current Technology

High densification of traffic volume on their capacity constrain mobile network as predicted 1000 fold of data traffic increase 2020 & beyond [1].

- Users are facing the latency problem in online Gaming, Video calling, video conferencing, internet telephony etc.
- There is more chance of hacking, data theft, problem of viruses because of many users are connected to 4G with various internet devices.
- More consumption of power battery life of device.
- The cost of components in cell tower and power consumption are concern.
- The use of MIMO antenna's is quite complex.
- The need of additional Man power to operate the system is required [1].

III. Standard

3.1 TDMA

Time Division Multiple Access is a digital wireless telephony transmission technique which allows each user at different time slots at same frequency. TDMA allows user the operate do service like Fax, voice band, video conferencing etc.

3.2 WWWW

“World Wide Wireless Web” is capable of supporting wireless-based Web application which includes the features of full graphics and multimedia capability beyond speed of 4th generation.

3.3 UMTS

“Universal Mobile Telecommunication System” is 3rd generation mobile telephone standard in Europe and UMTS proposed by ETSI.

3.4 WAP

Wireless Application Protocol is defined for the user to use Transmission Control Protocol/Internet Protocol (TCP/IP) and browsing of web for the mobile communication systems.

3.5 CDMA2000

Code Division Multiple Access is also known as IS-136. The capacity of IS-136 is to deliver a radio interface system.

3.6 WCDMA

Wide Band Code Division Multiple Access is derived from CDMA & it is also known as IMT-2000 direct spread. It supports mobile/portable voice, image, data & Audio/video Communication.

3.7 PSTN

Public Switched Telephone Network is referred as Plain Old Telephone Service (POTS) which is the world's collection of interconnected voice-oriented public telephone network, both government and commercial owned.

IV. Protocol Stack of 5G

Table 1. The Compatibility of 5g Network Layers with OSI Model is Designed [4]

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 (OWA)
Physical Layer	

OWA (Open Wireless Architecture) is included with physical and data link layer. OWA with these two layer define the wireless technology is to be used in better way.

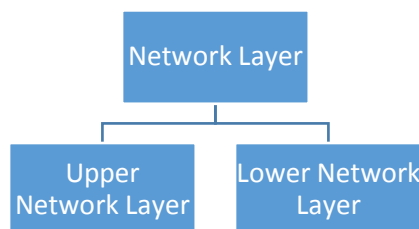


Figure 2.

The key function of this Layer to decide the routing path of data from source to destination. As several problem is faced while using IPV4 like limited address space and less QOS, these problems are solved in frequently use of IPV6 with bigger packet header.

As all the internet user either via mobile phone or any other devices uses IP so all devices including mobile phone will be a FA (Foreign Agent) and Care of Address (COA) synchronized mapping with IPV6 address and COA address for instantaneous wireless network used.

Interface is dealt with the Lower Network layer whereas mobile terminal is dealt with Upper Network Layer.

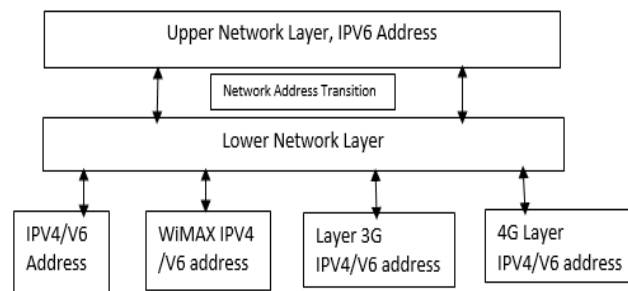


Figure 3. Terminology of Network Layer

Open transport layer performs the operation of both transport layer and session layer. In 5G, Open transport Layer is available at the BS (Base Station) so that BER (Bit Error Ration) in wireless network and segment loss at session layer are avoided in all TCP versions [4].

Good QOS (Quality of service) by Application Layer in 5G makes the data into a regular correct format.

Cellular Architecture

To support various applications and perform various tasks in communication world of 5th generation. There is a need of certain concrete understanding of some special required engineering. These engineering requirements are not needed to work simultaneously that is for different application there is a need of different engineering requirements such as for online Gaming where latency is the top concerned and whereas for uninterrupted and HD video streaming high data rate is required.

Requirement of Very High Data Rate of About 1000x

To tackle the problem of high mobile data traffic densification there is a need of some advanced technology that is considerable 5G (~2020). 5G target for 1000X data rate from 4G to 5G for that we need good capacity [1]. The total amount of data served by bits per second unit area the network in measuring 5G goes for EDGE rate ranging from 100Mbps to 1Gbps [1]. For that there is a requirement of measure technological advancement. The range of data rate is depending upon the size of cells, types of cells and other measures.

Low Latency

For the good performance and fast communication of 5G the latency (round trip latencies) should be as possible as low. In current 4th Generation of communication the latency is around 50ms. Whereas in 5th generation of communication latency is to be expected around less than 1 or 2ms based on the sub framing time [1]. For lower latency the sub framing structure must be shrinking down and server latency should be constrained lower latency will result in good performance of two-way gaming and cloud computing which makes a good tactile internet network.

Key Technologies

To get 1000X higher data rate across the mobile network and user there is a need of some specific technologies depending upon the below points.

Immense MIMO

In the world of communication wifi was introduced in 2006 and around it MIMO communication also introduced. On a single user number of antennas decide the limited dimension of SU-MIMO (Single User-MIMO). The problem of bottleneck path will overcome with the help of MU-MIMO (Multi User-MIMO). The signaling dimensions are so small and given by a number of antennas present at Base station and total aggregate antennas are available for those user [1]. The idea of massive MIMO gives some more advantages like enhancement in spectral efficiency with base station's densification and provide a very simple transmission and receiving system.

Millimeter Wave

A general wireless system is operated to the relatively small ranges of microwave frequencies. The wireless spectrum in the mm wave range of wavelength 1 to 10 mm does exist. Due to multipath propagations atmospheric losses, refraction, reflection and penetration through object cause the need of a strong wavelength wave for transmission. The unlicensed band (approx. 60 GHz) was suitable generally for short range of communication such as Wi-Fi (the standard band of 60GHz for wiGiG standard), fixed wireless (in the band of 28, 38, 71-76 and 81-86) [1].

Improvement in area spectral efficiency: In the search of solution of the high densification and offloading there is a need of Implementation of smaller cells which results in good network capacity. The spacing among the base stations though less or minimum it is used in distribution antenna system whose function are same as Pico cells due to high densification and offloading results in area spectral efficiency increases.

Network Architecture of 5g

In 5G there is a multiple RAT platform for the cellular communication with totally IP based wireless inter-operability mobile network [3]. All IP based mobile apps and services like M-government, M- banking, M-learning and other in 5G are accessed by cloud computing resources. Cloud computing provides access to configurable computing resources. Cloud computing provides faster access of applications without installation with data of user at any computer with the help of internet access [3]. Cloud computing resources are linked with referee configurable multi technology core which is connected to different RAT from 2G to 4G with various standards enabled. Cloud computing is remote re- configurable with RRD (Remote Re-Configurable Data) and connected via Re-Configurable Data Models (RDM). Inter-operability process provides the way to access between both terminals [3]. RMTTC provides the selection from the different access system.

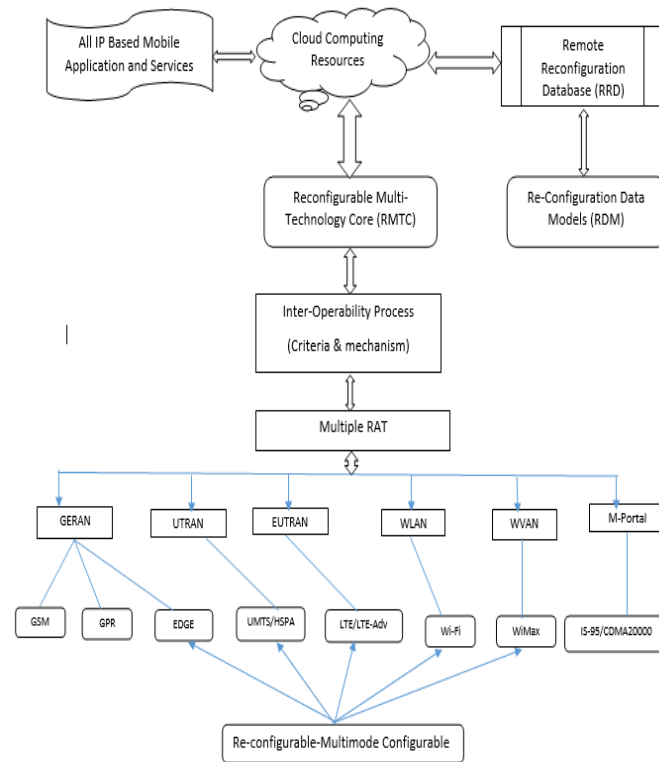


Figure 4. 5G Network Architecture

V. Future Aspects

The Future Technology in the world of communication 5G will provide very attractive user friendly service. The customers will wonder at the high enhanced speed access to Internet with more clarity video conferencing. It is expected in future that 5G will be a welcoming change in the communication world in 2020. Being cheap and the best 5G will be an applauded technology in the market thereby having very high speed at low cost per bit.

VI. Conclusion

As seen in the world of Communication the periodical development in communication progressed from 1G to 2G, 2G to 2.5G, 2.5G to 3G, 3.5G to 4G, there will certainly be a welcoming change to launch 5G. The network/system of 5G will be based on previous generation that is 4G. But 5G will be different in terms of user facility with more extra features and services like higher data speed, higher bandwidth, video conferencing without latency etc. as compared with previous technology.

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