Evolution from 3G to 5G

ANKIT[1], TARUN MEHTA[2]
[1,2]*Dept. of Electronics & Communication Engineering, Poornima College of Engineering, Jaipur*

Abstract -- The innovation in the mobile technology had brought the 5G wireless technology which stands for Fifth Generation. The 5G technology will be connected by the wireless with several numbers of devices at simultaneously which will bring the life into live. This paper reviews that how the innovation have taken place from the various generation like 1G,2G,3G,4G and now 5G. Also, this paper focuses on how 5G network provides reasonable broadband wireless connectivity all preceding generations of mobile communication. The some of the technology have been listed like cloud computing, WWWW (World Wide Wireless Web) and etc. It shows that the 5G is advanced in technology wise than its previous generation. By using all this technology the mobile will be lighter weight than its previous generation.

Indexed Terms -- Long Term Evolution, Device to Device, Millimeter wave, Internet of Things, Multi input, multi Output.

I. INTRODUCTION

In today's life, the mobile became the third hand of the human. In, the early days the landline phone which was connected by the wire network. Later the phone had changed the size into small i.e., cellular phone which has been connected by the wireless network. The cellular phone had a rapid development from a generation like 1G,2G,3G,4G,5G and soon. This Generation has been into innovation since, 1980. The First generation (1G) of wireless telecommunication technology used analog transmission techniques which were basically used for transmitting voice signal. The Second generation (2G) makes the more advances than the 1G which resulting in the digital voice data and makes to emit less radio power from the handsets. The Third Generation (3G) offers the multimedia services add high speed data transfer to mobile devices. The worldwide web (www) became the primary communication interface, which serves the various needs of human through web browser at their ends. The 4G [Fourth Generation] mobile communication can provide a 10 times increase in data transfer over 3G.

The worldwide web (www) became the primary communication interface, which serves the various needs of human through web browser at their ends. The Fourth Generation (4G) mobile communication can provide a 10 times increases in data transfer over 3G. The 5G will be in advances with multiple inputs multiple output (MIMO) technology, which uses multiple small antennae to service each individual data stream. The 5G will use the very much advanced technology to differ from the previous generation. In 5G technology we will use the many advanced technology to connect to the device with high spectrum to speed up the data transfer without any losses while covering the long distance. The 5G technology will reduce the time in getting the data from the antenna by using powerful tools. Large phone memory, more dialing speed, more clarity in audio and video will be provide in the 5G. We will use the cloud computing in the 5G technology which make the life into live, is the great feature of the development of this technology.

II. INTERNET GROWTH IN WORLD WIDE

The Internet is defined as the worldwide interconnection of individual networks operated by government, industry, academic and research center. The Internet has made distances shorter and the world smaller. Around 40% of the world population has an internet connection today. The first billion was reached in 2005. The second billion in 2010.The third billion in 2014 and it will keep on increasing in the growth of internet. The Fig.1 shows how the internet users have been vary from the global population. From this figure it is easily understand the rapid growth of internet users in last few years. The Fig.2 shows the top five internet users in world wide. The china is the

top most country in internet users by 478.51(53%), the second country will be the USA with 201.6(22%), the third will be India with 81.79 (9%), the fourth country will be Japan with 73.66(8%) and the final country will be Russia by 68.12(8%). About 2 billion of those will be in the developing world. The amount of mobile internet users in worldwide will be nearly to the 788.32 million subscribers in end of 2015. The internet users will be more from the developing countries in the worldwide. The mobile internet usage becoming more than the desktop internet usage because of it's compact and speed available in the mobile internet like 3G and 4G.

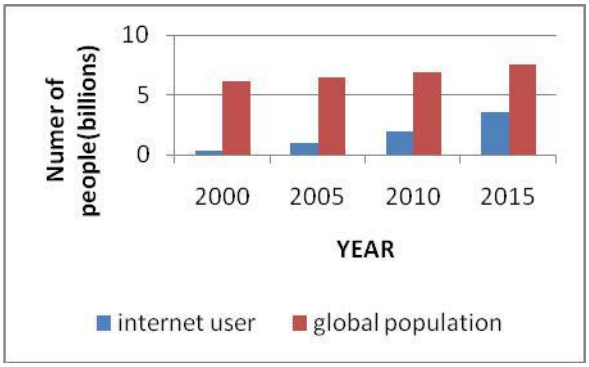

Fig. 1: - Global Population and Internet User

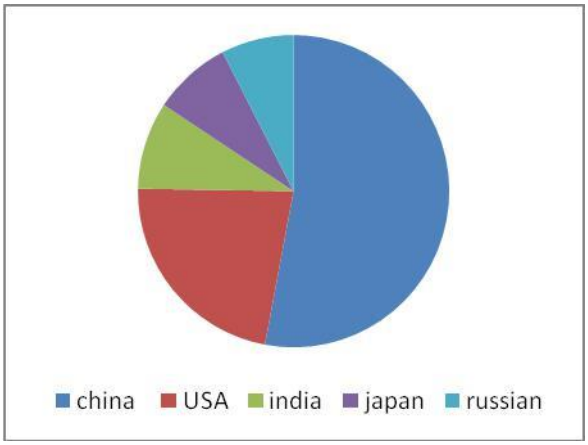

Fig. 2: - Top five Internet users countries in global

III. EVOLUTION

Paragraph Mobile communication is becoming the more powerful technology in last few years which brings the human into innovative and making a fashion. The innovation starts from the generation like 1G, 2G, 3G, 4G, and 5G as shown in Fig 3.

Fig. 3: - Evolution of mobile technology

a) 1G Technology:

Since 1980, the 1G had joined the innovation of the cellular phone in the some part of the world. IT was developed under the condition of the analog system using the frequency modulation technique for transmission using advanced mobile phone service (AMPS) and frequency division multiple access (FDMA). The channel capacity will be 30 KHz AND its speed up to 2.4Kbps.Data transmission between the wire part of connection and PSTN (Packet Switched Telephone Network) was done using Packet-switched network [5]. By using the analog radio signal the voice links have been poor capacity and there is no security.

b) 2G Technology:

Since 1990, the 2G emerged by using some of the advance technology to overcome the First Generation. The cellular phone contains the games which make the person to convert into next generation (i.e., 2G). The 2G provide the CDMA (Code Divide Multiple Access) gives a unique code to each call and spreads it over the available frequencies. 2G networks were the first to offer data services and SMS text messaging, but their data transfer rates are lower than those of their successors.2G capabilities in India are GSM 900, GSM 1800[4]. Signals were transmitted in the digital format and this dramatically improved the quality of calls and also reduced the complexity of data transmission.

c) 3G Technology:

Since In 1998, the innovation of the 3G had taken place which overcome some of the feedback of the 2G network. In the 3G network the new feature where introduced like Bluetooth, Wi-Fi to share data between two devices (mobile, laptop &etc).The new

technology is used to send the data through packet switching. It increases the voice clarity & the transfer of the data has been increased the 2100MHz by using this we use the mobile TV and we had access the high speed internet services. The speed of data transmission on a 3G network ranges between 384KBPS to 2MBPS [6]. High Speed Packet Access (HSPA) is an amalgamation of two mobile telephony protocols, High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA), that extends and improves the performance of existing 3rd generation mobile telecommunication networks utilizing the WCDMA protocol.

d) 4G Technology:

In 2008, the advanced in the network communication had come to the in the form of 4G/LTE (Long Term Evolution).The LTE-A will provide the high speed data transfer where download speed will be up to 1Gbps and upload will be up to 500Mbps (to your office or home) [7].The 4G will have the better coverage where no network has provide before. If you like to surf the Web and especially stream video, 4G can be heaven. If you connect a laptop to your mobile link, 4G makes a huge difference. The 4G will have tight network security and ultra wide band technology.

e) Limitation of 4G:

In There are many advantages in 4G even though it had some of the basic problems .It has to overcome the quality of service problem like IP and video streaming. It has to face the security threats like IP spoofing, intrusion attacks which will lead to missing of information. Handover is the type of switching mobile nodes from one access place to another present network. Handover will make mobile user unhappy while the GPRS to WLAN has the communication disturbance. These are the some of the disadvantages which might arise in the 4G technology [11]. ultra wide band technology.

f) Necessary of 5G:

The 5G will not only for the communication of the human being and also for the communication between the things of the humans have invented in the form of "Internet of Things (IoT)". Thousands of millions of machines will be sensing, processing and transmitting information without the human control. The 5G will make everything into smart like car, homes and people. 5G want to provide the low latency that will allow the remote control of robots performing dangerous work in construction and maintenance.

Currently in the industrial processes, machines and sensors are connected by the wire line but in the future these methods can be replaced by the flexible and reliable wireless technology [12]. This will be the beginning for machine type communication in the user mobile.

IV. 5G TECHNOLOGY

The 4G has not yet complete its revolution but the world wide the next generation activity where into the action in the form of 5G (Fifth Generation).Since 2013, the project of 5G has been in the way of contributing the advance technology to the world. The 5G will be the faster than the 4G network which result in the high speed data transfer i.e., 1TB of data in the seconds. [2] The 5G will have more features like MIMO; cloud computing, IoT and etc.

The 5G will have the more voice clarity that you have never experience before. The 5G will have artificial intelligent in the future using this generation. In 5G we will use the WWWW where there is no limitation of the wireless network. The streaming video will be in the HD form, where there will not have any conjunction of the signals.

The 5G technology will be available for the usage; will be more over in 2018 to 2020. The fig 4 Shows that how the world can be connected to 5G networks and how it brings all the previous generation into it and the electronic made devices are connected to the network

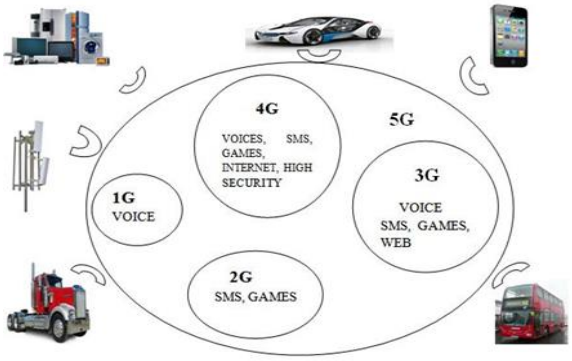

Fig. 4: - A World where everything is connected

a) MIMO:

The next level of the antenna technology has been arising in the form of MIMO (multiple inputs, multiple outputs). The MIMO is the advanced technology for wireless communication between antennas. This technology will use the multiple antennas at mobile station (transmitter) and base station (receiver) [10].The communications circuit are combined for minimize errors and optimize data speed for antennas at each end. By using the single antenna at the source and destination that makes a problem into multipath effects. In wireless internet, it can cause an increase in the number of errors and reduction in data speed.

This multipath effect can be overcome only by the use of two or more antennas along with the transmission of multiple signals at the source and the destination. The application of MIMO technology will be in the wireless local area networks (WLANs), for mobile communication, and in the digital television (DTV).

The fig.5 shows how MIMO multiplexing working between the two antennas (transmitter and receiver) by using radio propagation channels. The one of several forms of smart antennas technology is MIMO; the others are SIMO (single input, single output) and MISO (multiple input, multiple output). electronic made devices are connected to the network.

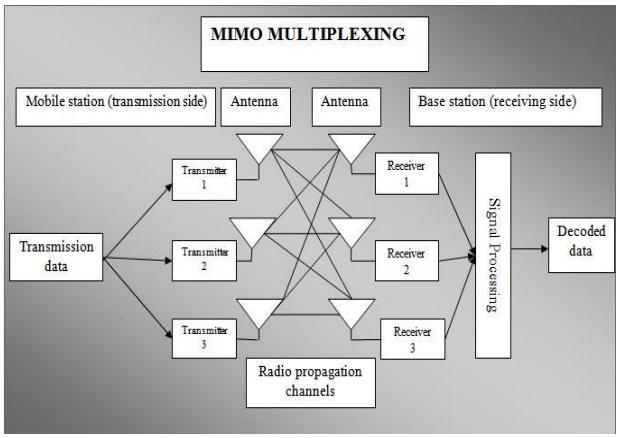

Fig. 5: - MIMO Multiplexing

b) Cloud computing:

next The 5G will be required to store the large amount of data and result in some traffic, to overcome this problem cloud computing is used. Cloud computing will provide an extra-ordinary backend for any application on mobile devices to access some of the resources like services, software, storage, computing power and etc. Cloud computing is mainly used for the user in the cloud, can be access the cloud service from any geographical location from any devices .The cloud computing used now should be more flexible and easy to access while using the advanced generation i.e,5G [3].

The data rate of mobile will be measured in the multiple of Gbps. The fig.6 shown clearly how and what are ways to connected by the cloud computing. By using this technology the more free space will be available for the user. The cloud computing will make the user to be free from the documents, apps, services to be carry with them.

Fig. 6: - Cloud computing

c) Millimeter wave Technology:

The Millimeter wave technology is widely used in sectors such as mobile & telecom, consumer & commercial, healthcare, and others. Because of the small wavelength, smaller antennas may achieve a very tight beam width, which makes re-using frequencies easier, and network design and interference management much easier. Millimeter wave communication have to be a important part of the 5G mobile technology to provide multi-gigabit communication services such as high definition television (HDTV), ultra-high definition video

(UHDV), and so on .To fulfill this requirement the research have been focused out in the upcoming bandwidth like 28 GHz band, the 38 GHz band, the 60 GHz band, and the E-band (71–76 GHz and 81–86 GHz) [1].The millimeter wave technology will provide more flexibility and transparency or passes through any object like concrete, glasses, wood and so on. Fig.7 shows how the waves have been spreader from the tower to the antennas and then to mobile phones. The waves will carry out the signal to the network system.

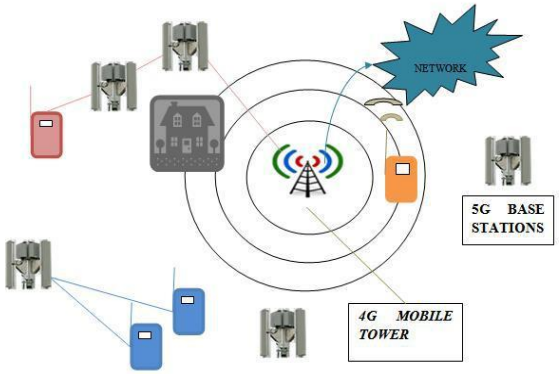

Fig. 7: - Millimeter wave frequency

d) Device to Device:

D2D (Device-to-Device) communication that enables direct communication between nearby mobiles is an exciting and innovative feature of 5G cellular networks. D2D communication refers to a radio technology that enables devices to communicate directly with each other, that is without routing the data paths through a network infrastructure. While the conventional cellular architecture consists of connections from base stations to user equipment, 5G systems may well rely upon a two-tier architecture consisting of a macro cell tier for base station to device communication, and a second device tier for device to device (D2D) communications [9]. The Device-to-device (D2D) communication is another technology that is to be use in the 5G which will depend on the two-tier architecture. D2D may even allow users to experience benefits in terms of smaller communication latency, increased data rate and reduced energy consumption. The fig.8 shows that the two devices are communicating using D2D technology.

Fig. 8: - Device to Device Communication

e) Internet of Things:

The Internet of Things (IoT) is the type of the technology that will be used in the 5G.The IoT will be used for connecting to all devices by the Internet through the sensors. The use of IoT leads to build the smart cities in the country. The applications of the IoT are as follows: consumer electronics, automotive and transportation, energy and utilities, factory and commercial buildings, and etc [13]. The IoT will have the machine to machine communication due to increasing of the devices used by the humans to improve the handling of the device in the easy manner. In the future all devices will be connected by internet and they can be control even through the internet. The usage of internet will be in huge level because of its need in the devices for wireless communication.

The IoT will be the human to machine communication in which the machines will be controlled by the humans through wire free signals. This technology will provide the time saving for the human being in many ways like going to stores .The work load of people will be reduced by giving some of the orders or commands to the machine to do some work. The Fig.9 shows how the IoT will be connected to the all the machine like train, cars, bikes and etc.

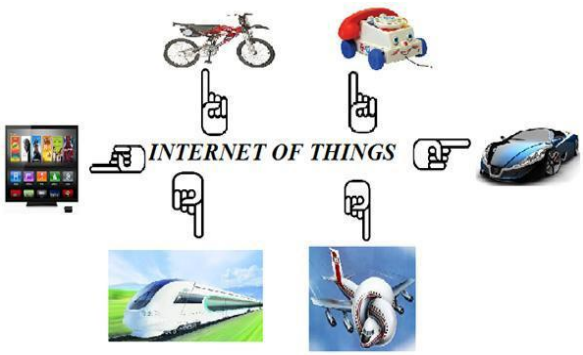

Fig. 9: - Every things where connected by Internet

The IoT even provide the wireless communication for our home application to provide the more flexibility for the home makers to make the work easy. This technology will make the human to feel better to handle or access from one place. On the same way the communication should be compatible and security for the users otherwise it will the severe causes for the customer who uses this technology.

f) 5G Technology Requirement:

As the technology has been booming, many of the companies had started their work on the 5G, they had initiated the some of the requirements. They are as follows below [5]:

- It needs 1-15Gbps connection to end points in the field
- Bandwidth per unit area requires 1000x
- The connection devices should be more or less than 100x
- The network coverage must be 100%
- Network energy usage will be 90% reduction

g) Features of 5G Technology:

Some of the main features of 5G technologies are as follows below:

- Faster Speed of internet.
- Much greater capacity.
- Less power consumption and reduced latency.
- Greater network flexibility.
- Support virtual private network.
- Many devices can connect by wireless.
- The uploading and downloading speed will be a peak.
- Traffic statistics will makes more accurate.
- It will use the supervision tools for fast action.

V. CONCLUSION

In this paper, we conclude that 5G network is very fast in the data transfer between two devices and reliable. All technology used in this paper will be believe that the wireless communication will be the powerful tool in the 5G mobile technology. The future will bring the 5G into the unexpected way of communication. The 5G will change the life style of human being in upcoming centuries.

REFERENCES

[1] Niu,YongLi, Depeng Jin Li Su, and Athanasios V.Vasilakos, A Survey of Millimeter Wave(mmWave) Communication for 5G :Opportunities and Challenges.

[2] Analysis Understanding 5g: Perspectives on Future Technological Advancements http://www.gsmaintelliance.com

[3] Pragya Guptal and Sudha Gupta, Mobile Cloud Computing : The future 3,September 2012.

[4] Mudit Ratana Bhalla and Anand Vardhan Bhalla, , Generation of mobile wireless technology: A survey, Vol 5,No.4,26 August 2010.

[5] S.Venkata Krishna Kumar, Poornima.T.V, A Study Of Wireless Mobile Technology, page 470,Vol 4, issue 1,January 2014.