5G Wireless Technology : Evolution and Revolution

Sweta Singh, Parul Malhan
Student, B.Tech, Department of Electronics and Computers Engineering
Dronacharya College of Engineering, Gurgaon-123506, India

***Abstract*- In this paper, an attempt has been made to review various existing generations of mobile wireless technology in terms of their portals, performance, advantages and disadvantages. 5G Technology is the non-official name used to denote the next major phase of mobile telecommunications standards beyond the upcoming 4G standards. This 5th generation wireless system is something very extra-ordinary and its experience will be beyond our imagination. It will provide wider range of facilities from the current 4th generation/ IMT- Advance technology. It offers services in documentation supporting electronic transaction (e-payments, e-transactions) e.t.c. The 5th generation will provide a totally wireless communication system all over the world without limitations. In 5G, research is being made on development of World Wide Wireless Web (WWWW), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless World. In this paper we propose novel network architecture for next generation 5G mobile networks. In the proposed architecture the mobile terminal has the possibility to change the Radio Access Technology - RAT based on certain user criteria.**

***Index Terms*- Evolution from 1G-5G, 5G Network Architecture, Need of 5G**

I. INTRODUCTION

We are living in a world of modern science. We cannot think a single moment without science. Science makes our life easy and comfortable. Modern world is being compressed due to the development of science and its technologies. During the last few decades, the world has seen phenomenal changes in the telecommunications industry due to science and technology. From 1G to 2.5G and from 3G to 5G, this world of telecommunications has seen a number of improvements along with improved performance with every passing day. The 5th generation is anticipated to be a complete network for wireless mobile internet, which has the capability to offer services for accommodating the application potential requirements without suffering the quality. The ultimate goal of 5G is to design a real wireless world that is free from obstacles of the earlier generations. 5G Wireless Systems is a complete wireless communication with almost no limitation; somehow people called it REAL wireless world. But till present day 5G wireless system concept is only theory and not real, so it is not applicable for use. 5G (5th generation mobile networks or 5th generation wireless systems) is a technology used in research papers and projects to denote the next major phase of mobile telecommunication standards beyond 4G. 5G is not officially used for any specification or official document yet made public by telecommunication companies or standardization bodies. New standard releases beyond 4G are in progress by standardization bodies, but are at this time not considered as new mobile generations but under the 4G umbrella. The implementation of standards under a 5G umbrella would likely be around the year of 2020.

II. EVOLUTION OF MOBILE TECHNOLOGIES

In order to fully understand the future of mobility, it is important to examine the evolution of individual streams of mobile telecommunication technology. Telecom technology is changing our lives in ways we did not envision. Today, efficient packet switched networks carry media packets (voice, data, and video) to intelligent mobile devices that users carry everywhere. 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-the second generation, 3G- the third generation, and then the 4G-the fourth generation, 5G-the fifth second generation.

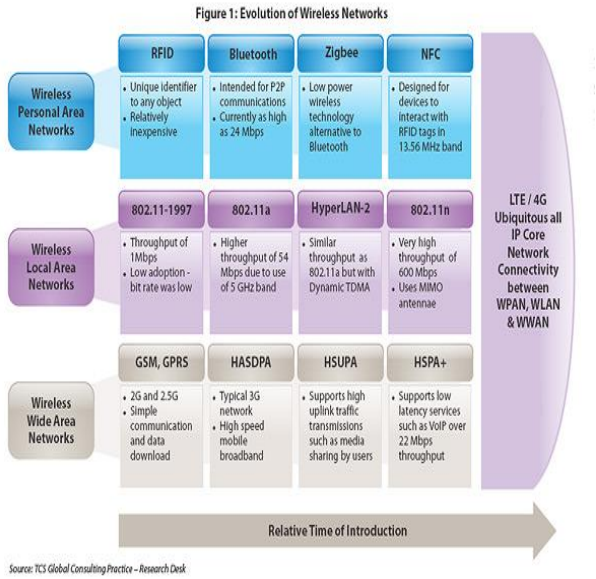

Figure 1: Evolution of Wireless Networks

A. First Generation (1G):

The First Generation (1G) was pioneered for voice service in early 1980‘s, where almost all of them were analog systems using the frequency modulation technique for radio transmission using frequency division multiple access (FDMA) with frequency band of 824-894 MHz , and channel capacity was 30 KHz which was based on a technology known as Advance Mobile Phone Service (AMPS). It introduces mobile technologies such as mobile telephone system (MTS), advanced mobile telephone system (AMTS), improved mobile telephone system (IMTS) and push to talk (PTT). It has low capacity, unreliable handoff, poor voice links and no security at all since voice calls were played back in radio towers making these calls susceptible to unwanted eavesdropping by third parties.

B. Second Generation (2G):

The Second Generation (2G) emerged in late 1980s. It uses digital signals for voice transmission and has speed of 64 kbps. It provides facility of e-mail and SMS (Short Message Service) and use the bandwidth of 30 to 200 KHz. In this generation two digital modulation schemes are used; one is time division multiple access (TDMA) and the 2nd is code division multiple access (CDMA) and frequency band is 850-1900 MHz. In 2G, GSM technology uses eight channels per carrier with a gross data rate of 22.8 kbps (a net rate of 13 kbps) in the full rate channel and a frame of 4.6 milliseconds (ms) duration. The family of this generation includes of 2G, 2.5G and 2.75G. Next to 2G, 2.5G system uses packet switched and circuit switched domain and provide data rate up to 144 kbps. E.g. GPRS, CDMA and EDGE.

C. Third Generation (3G):

The Third Generation (3G) services combine high speed mobile access with Internet Protocol (IP)-based services. It uses Wide Band Wireless Network with which clarity is increased. The main features of 3G technology include wireless web base access, multimedia services, email, and video conferencing. The data are sent through the technology called Packet Switching. 3G systems offer high data rates up to 2 Mbps, over 5 MHz channel carrier width, depending on mobility/velocity, and high spectrum efficiency. The data rate supported by 3G networks depends also on the environment the call is being made in; 144 kbps in satellite and rural outdoor, 384 kbps in urban outdoor and 2Mbps in indoor and low range outdoor. The frequency band is 1.8 - 2.5 GHz. 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 2100MHz and has a bandwidth of 15-20MHz used for High-speed internet service, video chatting.3G uses Wide Band Voice Channel that is by this the world has been contracted to a little village because a person can contact with other person located in any part of the world and can even send messages too.

D. Fourth Generation (4G):

The Fourth Generation **(**4G) usually refers to the successor of the 3G and 2G standards. In fact, the 3GPP is recently standardizing LTE Advanced as future 4G standard. A 4G system may upgrade existing communication networks and is expected to provide a comprehensive and secure IP based solution where facilities such as voice, streamed multimedia and data will be provided to users on an "Anytime, Anywhere" basis and at much higher data rates compared to previous generations. 4G offers a downloading speed of 100Mbps. 4G provides same feature as 3G and additional services like Multi-Media Newspapers, to watch T.V programs with more clarity and send Data much faster than previous generations. 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.

E. Fifth Generation (5G):

The Fifth Generation **(**5G) Technology stands for 5th Generation Mobile technology. 5G mobile technology is not deployed yet. The big challenge for the design and deployment of 5G technology can be faced easily as proposed features and architecture (mentioned below) that will increase system capacity and quality within the limited available frequency spectrum, whose frequency band and Data Bandwidth will be _3-300GHz' and _1Gbps & higher (as demand)' successively. The remarkable issue, there don't have any limitation in 5G as respect to user demands in the next 200 years. 5G mobile technology has changed the means to use cell phones within very high bandwidth. User never experienced ever before such a high value technology. Nowadays mobile users have much awareness of the cell phone (mobile) technology. The 5G technologies include all type of advanced features which makes 5G mobile technology most powerful and in huge demand in near future. A user can also hook their 5G technology cell phone with their Laptop to get broadband internet access. 5G technology including camera, MP3 recording, video player, large phone memory, dialing speed, audio player and much more you never imagine. For children rocking fun Bluetooth technology and Pico nets has become in market. The 5G also implies the whole wireless world interconnection (WISDOM—Wireless Innovative System for Dynamic Operating Mega communications concept), together with very high data rates of the Quality of Service (QoS) applications.

Figure 2: Evolution in Mobile Technologies

III. 5G NETWORKS

5G Technology stands for 5th Generation Mobile technology. 5G network is very fast and reliable. The concept of hand held devices is going to be revolutionized with the advent of 5G. Now all the services and applications are going to be accessed by single IP as telephony, gaming and many other multimedia applications. As it is not a new thing in market and there are millions of users all over the world who have experienced the wireless services wireless technology. It is not easy for them to shrink from using this new 5G network technology. There is only need to make it accessible so that a common man can easily afford the profitable packs offered by the companies so that 5G network could hold the authentic place. There is need to win the customer trust to build fair long term relation to make a reliable position in the telecommunication field. To complete with the preceding wireless technologies in the market 5G network has to tender something reliable something more pioneering. All the features like telephony, camera, mp3 player, are coming in new mobile phone models. 4G is providing all these utility in mobile phone. By seeing the features of 4G one can gets a rough idea about what 5G Networks could offer. There is messenger, photo gallery, and multimedia applications that are also going to be the part of 5G. There would be no difference between a PC and a mobile phone rather both would act vice versa.

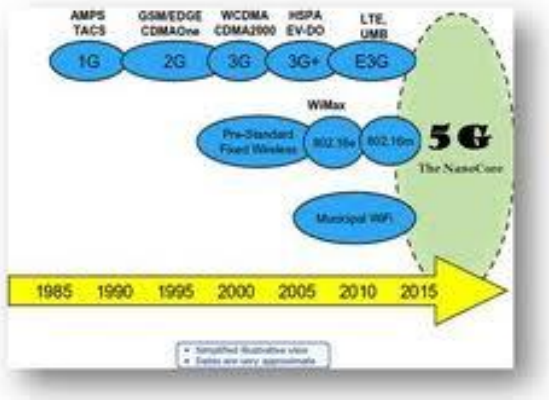

Figure 3: Evolution of Mobile Technologies up to 5G Networks

IV. DESIGN OF 5G MOBILE NETWORK ARCHITECTURE

Figure 4 shows the system model that proposes design of network architecture for 5G mobile systems, which is all- IP based model for wireless and mobile networks interoperability. The system consists of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous radio access technologies. Within each of the terminals, each of the radio access technologies is seen as the IP link to the outside Internet world. However, there should be different radio interface for each Radio Access Technology (RAT) in the mobile terminal. For an example, if we want to have access to four different RATs, we need to have four different accesses - specific interfaces in the mobile terminal, and to have all of them active at the same time, with aim to have this architecture to be functional.

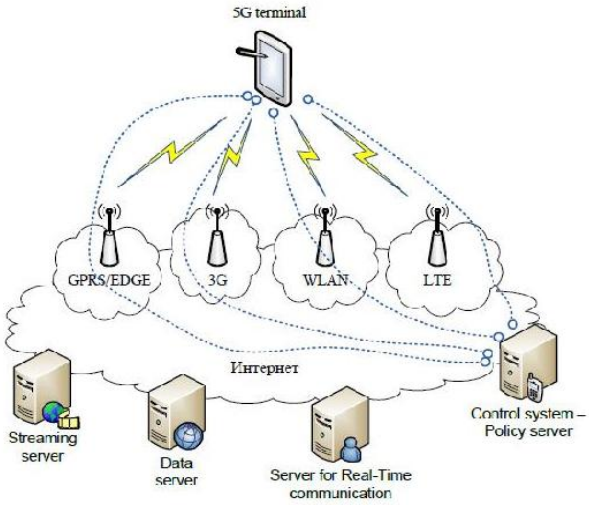

Figure 4: 5G mobile network Architecture

The first two OSI levels (data-link and physical levels) are defining the radio access technologies through which is provided access to the Internet with more or less QoS support mechanisms, which is further dependent upon the access technology (e.g., 3G and WiMAX have explicit QoS support, while WLAN has not) . Then, over the OSI-1 and OSI-2 layers is the network layer, and this layer is IP (Internet Protocol) in today's communication world, either IPv4 or IPv6, regardless of the radio access technology. The purpose of IP is to ensure enough control data (in IP header) for proper routing of IP packets belonging to a certain application connections - sessions between client applications and servers somewhere on the Internet. Routing of packets should be carried out in accordance with established policies of the user.

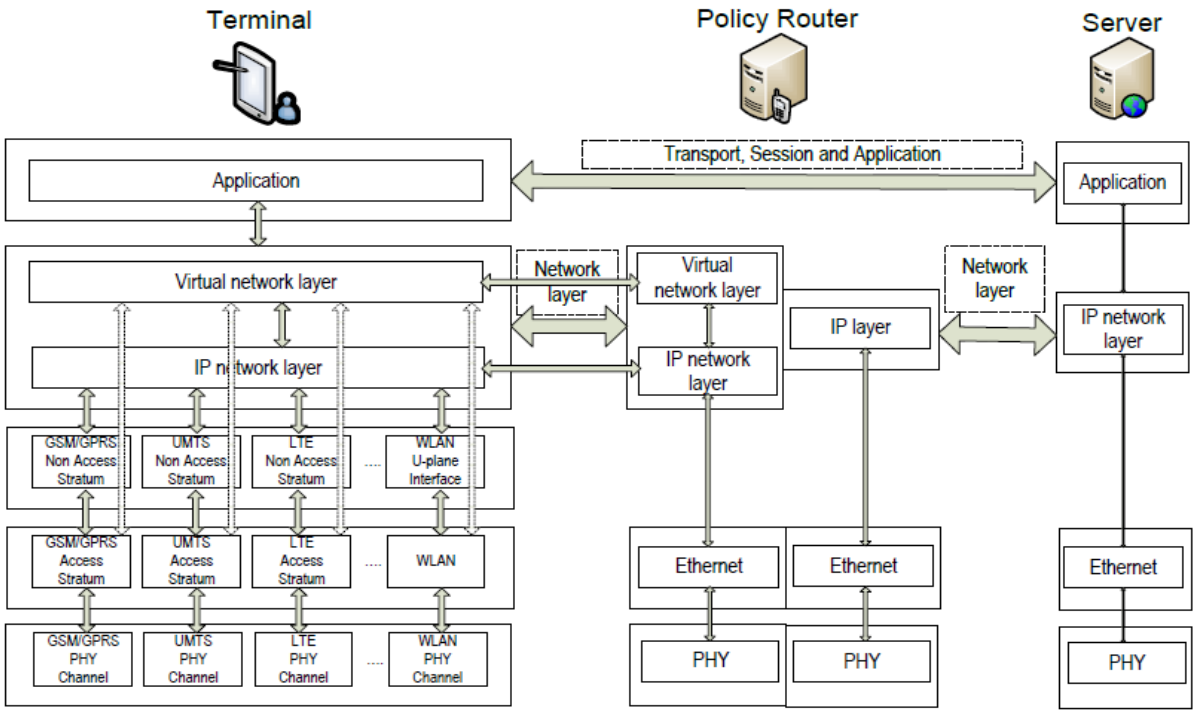

Figure 5: Protocol Layout for the Elements of the Proposed Architecture

Application connections are realized between clients and servers in the Internet via sockets. Internet sockets are endpoints for data communication flows. Each socket of the web is a unified and unique combination of local IP address and appropriate local transport communications port, target IP address and target appropriate communication port, and type of transport protocol. Considering that, the establishment of communication from end to end between the client and server using the Internet protocol is necessary to raise the appropriate Internet socket uniquely determined by the application of the client and the server. This means that in case of interoperability between heterogeneous networks and for the vertical handover between the respective radio technologies, the local IP address and destination IP address should be fixed and unchanged. Fixing of these two parameters should ensure handover transparency to the Internet connection end-to-end, when there is a mobile user at least on one end of such connection. In order to preserve the proper layout of the packets and to reduce or prevent packets losses, routing to the target destination and vice versa should be uniquely and using the same path. Each radio access technology that is available to the user in achieving connectivity with the relevant radio access is presented with appropriate IP interface. Each IP interface in the terminal is characterized by its IP address and net mask and parameters associated with the routing of IP packets across the network. In regular inter-system handover the change of access technology (i.e., vertical handover) would mean changing the local IP address. Then, change of any of the parameters of the socket means and change of the socket, that is, closing the socket and opening a new one. This means, ending the connection and starting e new one. This approach is not-flexible, and it is based on today's Internet communication. In order to solve this deficiency we propose a new level that will take care of the abstraction levels of network access technologies to higher layers of the protocol stack. This layer is crucial in the new architecture. To enable the functions of the applied transparency and control or direct routing of packets through the most appropriate radio access technology, in the proposed architecture we introduce a control system in the functional architecture of the networks, which works in complete coordination with the user terminal and provides a network abstraction functions and routing of packets based on defined policies. At the same time this control system is an essential element

through which it can determine the quality of service for each transmission technology. He is on the Internet side of the proposed architecture, and as such represents an ideal system to test the qualitative characteristics of the access technologies, as well as to obtain a realistic picture regarding the quality that can be expected from applications of the user towards a given server in Internet (or peer). Protocol setup of the new levels within the existing protocol stack, which form the proposed architecture, is presented in Figure 2. The network abstraction level would be provided by creating IP tunnels over IP interfaces obtained by connection to the terminal via the access technologies available to the terminal (i.e., mobile user). In fact, the tunnels would be established between the user terminal and control system named here as Policy Router, which performs routing based on given policies. In this way the client side will create an appropriate number of tunnels connected to the number of radio access technologies, and the client will only set a local IP address which will be formed with sockets Internet communication of client applications with Internet servers. The way IP packets are routed through tunnels, or choosing the right tunnel, would be served by policies whose rules will be exchanged via the virtual network layer protocol. This way we achieve the required abstraction of the network to the client applications at the mobile terminal. The process of establishing a tunnel to the Policy Router, for routing based on the policies, are carried out immediately after the establishment of IP connectivity across the radio access technology, and it is initiated from the mobile terminal Virtual Network-level Protocol. Establishing tunnel connections as well as maintaining them represents basic functionality of the virtual network level (or network level of abstraction).

V. WHY IS 5G REQUIRED?

This paper mainly focuses on how a 5G network can provide more facilities approach to a common man to utilize his available possessions in an enormous way to make him to feel the real progress. The major difference, from a user point of view, between current generations and expected 5G techniques must be something else than increased maximum throughput; other requirements include:

•Lower out age probability; better coverage and high data rates available at cell edge.
•Lower battery consumption.
•Multiple concurrent data transfer paths.
•Around 1Gbps data rate in mobility.
•More secure; better cognitive radio/SDR Security.
•Higher system level spectral efficiency.
•World Wide wireless web (WWWW).
•More applications combined with artificial intelligent (AI) as human life will be surrounded by artificial sensors which could be communicating with mobile phones. Not harmful to human health.
•Cheaper traffic fees due to low infra structure deployment costs.

VI. CHARACTERISTICS OF 5G TECHNOLOGY

• The technology 5G presents the high resolution for sharp, passionate cell phone every day and give consumers well shape and fast Internet access.
• The 5G technology provides billing limits in advance that the more beautiful and successful of the modern era.
• The 5G technology also allows users of mobile phones, cell phone records for printing operations.
• The 5G technology for large volume data distribution in Gigabit, which also maintains close ties to almost 65,000.
• The technology gives you 5G carrier distribution gateways to unprecedented maximum stability without delay.
• The information from the data transfer technology 5G organize a more accurate and reliable results.
• Using remote control technology to get the consumer can also get a 5G comfort and relax by having a better speed and clarity in less time alone.
• The 5G technology also support virtual private network.
• The uploading and downloading speed of 5G technology touching the peak.
• The 5G technology network offering enhanced and available connectivity just about the world.
• 5G network is very fast and reliable.

VII. APPLICATIONS OF 5G TECHNOLOGY

1) Real wireless world with no more limitation with access and zone issues.
2) Wearable devices with AI capabilities.
3) Internet protocol version 6(IPv6), where a visiting care-of mobile IP address is assigned according to location and connected network**.**
4) One unified global standard.

5) Pervasive networks providing ubiquitous computing: The user can simultaneously be connected to several wireless access technologies and seamlessly move between them these access technologies can be a 2.5G,3G, 4G or 5G mobile networks, Wi-Fi, WPAN or any other future access technology. In 5G, the concept may be further developed into multiple concurrent data transfer paths.

6) Cognitive radio technology, also known as smart radio: allowing different radio technologies to share the same spectrum efficiently by adaptively finding unused spectrum and adapting the transmission scheme to the requirements of the technologies currently sharing the spectrum. This dynamic radio resource management is achieved in a distributed fashion, and relies on software defined radio.

7) High altitude stratospheric platform station (HAPS) Systems. The radio interface of 5G communication systems is suggested in a Korean research and development program to be based on beam division multiple access (BDMA) and group cooperative relay techniques.

VIII. FUTURE SCOPE

5G network technology will reveal a new era in mobile communication technology. The 5G mobile phones will have access to different wireless technologies at the same time and the terminal should be able to combine different flows from different technologies. 5G technology offer high resolution for crazy cell phone user. 5G technology will provide supper and perfect utilization of cellular communication in future. The future enhancement of Nano-core will be incredible as it combines with artificial intelligent (AI).One can able to control his intelligent Robot using his mobile phone. Your Mobile can automatically type the message what your brain thinks. We might get a circumstance where we don't require any spectrum for communication. 5G technology will provide super and perfect utilization of cellular communication in future. We can monitor any place of the world from anywhere, observe space and watch TV channels at HD clarity in our mobile phones without any interruption. There will be exciting amusement unbelievable services. The 5G mobile phones will be a tablet PC and amazing. Many mobile embedded technologies will evolve.

IX. CONCLUSION

In this paper we have discussed the existing and future wireless mobile communication generations and cellular systems focusing on four main key factors: switching schemes, bandwidth, data rates, and radio access, also 5G main development challenges and explained the necessity for 5G. We conclude that 5G network is very fast and reliable. Fifth generation is based on 4G technologies. The 5th wireless mobile internet networks are real wireless world which shall be supported by LAS-CDMA (Large Area Synchronized Code-Division Multiple Access), OFDM (Orthogonal frequency-division multiplexing), MCCDMA (Multi-Carrier Code Division Multiple Access), UWB(Ultra-wideband), Network-LMDS (Local Multipoint Distribution Service), and IPv6. Fifth generation technologies offers tremendous data capabilities and unrestricted call volumes and infinite data broadcast together within latest mobile operating system. Fifth generation should make an important difference and add more services and benefits to the world over 4G. Fifth generation should be more intelligent technology that interconnects the entire world without limits. The 5G mobile technology is expected to be implemented at the end of the current decade. The world of universal, uninterrupted access to information, entertainment and communication will open new dimension to our lives and change our life style significantly. The new coming 5G technology will be available in the market to fulfill user demands in affordable rates, bright and high peak future also much reliability as well as exceptional applications.

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