5G TECHNOLOGY EVOLUTION

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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. The paper throws light on the evolution and development of various generations of mobile wireless technology along with their significance and advantages of one over the other. In the past few decades, mobile wireless technologies have experience 4 or 5 generations of technology revolution and evolution, namely from 1G to 4G. Current research in mobile wireless technology concentrates on advance implementation of 4G technology and 5G technology. Currently 5G term is not officially used. 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.**

Keywords: **wireless technology, Radio Access Technology, network, 5G mobile, ICT, various generations, disadvantages**

INTRODUCTION

Mobile wireless industry has started its technology creation, revolution and evolution since early 1970s. In the past few decades, mobile wireless technologies have experience 4 or 5 generations of technology revolution and evolution. [1] The telecommunication service in World had a great leap within last few years. 6 billion people own mobile phones so we are going to analyze the various generations of cellular systems as studied in the evolution of mobile communications from 1st generation to 5th generation. We can analyze that this could be due to increase in the telecom customers day by day. In the present time, there are four generations in the mobile industry. These are respectively 1G- the first generation, 2G- the second generation, 3G- the third generation, and then the 4G- the forth generation,5G-the fifth second generation.[1] 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), Wi-Fi (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. All wireless and mobile networks implements all-IP principle, that means all data and signaling will be transferred via IP (Internet Protocol) on network layer. 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.

I. EASE OF USE

The fifth generation wireless mobile multimedia internet networks can be completely wireless communication without limitation, which makes perfect wireless real world – World Wide Wireless Web (WWWW). 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 (Ultrawideband), 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. This generation is expected to be released around 2020. The world of universal, uninterrupted access to information, entertainment and communication will open new dimension to our lives and change our life style significantly. [2]
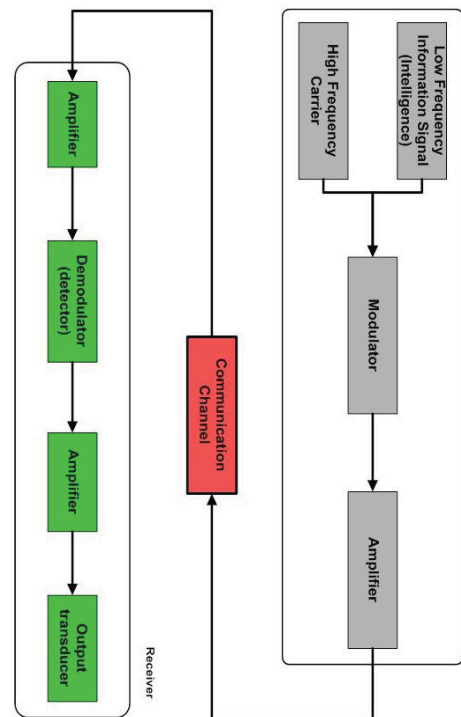

Fig 1: Wireless Communication System

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, 2Gthe second generation, 3G- the third generation, and then the 4G- the forth generation,5G-the fifth second generation [2]. The next generation of mobile internet connectivity, 5G, is expected to officially launch worldwide by 2020. Each generation of mobile internet has brought significant speed and performance boosts to user devices but 5G is also expected to enable emerging technologies such as autonomous vehicles and the Internet of Things (IoT) to finally become a reality for both businesses and consumers.

(DVB), minimal services like voice and data, and other services that utilize bandwidth. [2] E. Fifth Generation (5G): 5G Technology stands for 5th Generation Mobile technology. 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 Piconets has become in market [1].
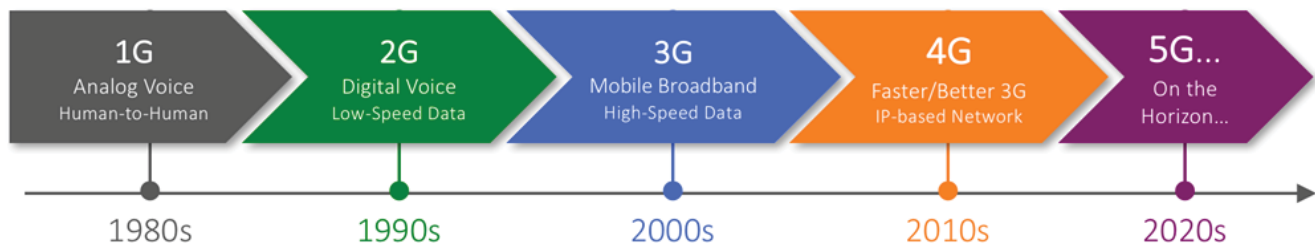

Fig 2: Evolutional Changes in Mobile Technologies[7]

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 system(IMTS)and push to talk(PTT).It uses analog radio signal which have frequency 150 MHz, Voice call modulation is done using a technique called frequency division multiple access(FDMA).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[2]. B. Second Generation (2G): 2G emerged in late 1980s. It uses digital signals 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. 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 [2] C. Third Generation (3G): It uses Wide Brand 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 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[2]. D. Fourth Generation (4G): 4G offers a downloading speed of 100Mbps.4G provides same feature as 3G and additional services like MultiMedia Newspapers, to watch T.V programs with more clarity and send Data much 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

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 [3].

3-figure shows the system model that proposes design of network architecture for 5G mobile systems, which is allIP 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 access - 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. [9]. 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 [9].
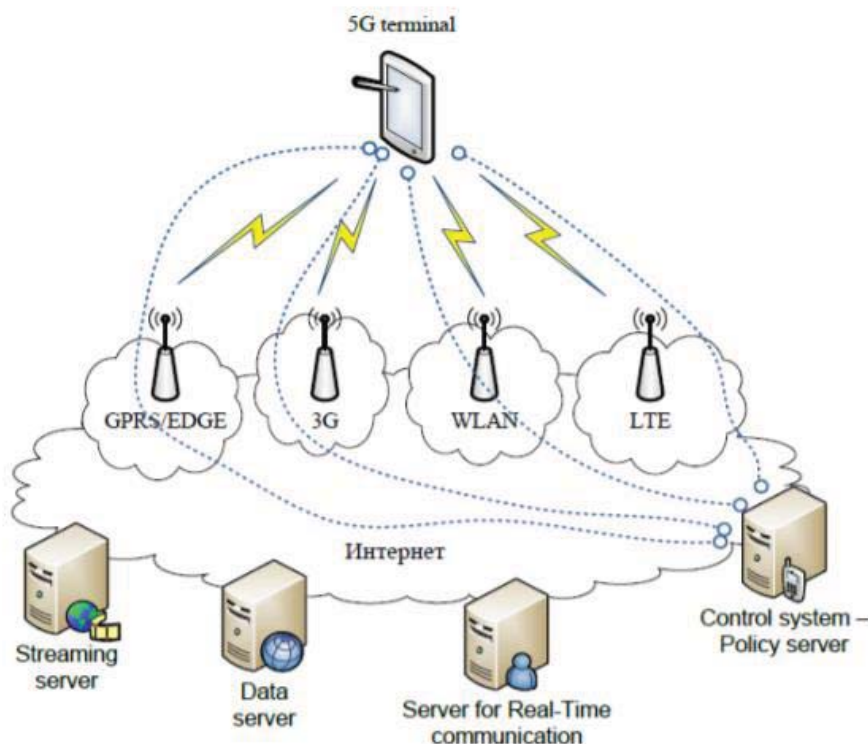

Fig 3: 5G Mobile Network Architecture

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.

Table 1: Comparative Analysis of Different Generations Attributes

Technology Features	1G	2G	3G	4G	5G
Start/ Deployment	1970- 1980	1990- 2004	2004- 2010	Now	Soon (Probably by 2020)
Data Bandwidth	2kbps	64kpbs	2Mbps	1Gbps	More than 1Gbps
Technology	Analog Cellular Technology	Digital Cellular Technology	CDMA 2000, UMTS, EDGE	Wimax , LTE	Unknown
Service	Mobile Technology (Voice)	Digital Voice, SMS, Higher Capacity	High Quality Audio	Dynamic information Access	Unknown
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	All Packet	All Packet
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet

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)[9]. As with other generations of wireless, commercial service providers are eager to deliver new services and grow their business. With 2G, we saw the advent of voice and SMS and 3G further delivered the initial promise of personal mobile computing. With 4G and the launch of the smartphone, we moved to an of era of data communications.

5G will be the most transformational, because not only will it deliver faster and enhanced mobile broadband (eMBB) to consumers, it will enable hyper-connectivity between machines, people and things and boost a range of new technologies and industrial capabilities. Ultra-reliability and low latency communications, one of the key components of 5G will advance IoT applications and enable new industry-specific wireless applications. For example, it will deliver the promise of connected cars and other smart "moving things" as they require a new level of intelligence delivered to the network edge.

V. Comparative Analysis between different Generations

In this section we have produced certain tables to compare the past, present and future technology (under

discussion) with respect to several attributes. Table 1 shows all those characteristics of comparisons.

The rollout will begin in the New Year, but it will take three-to-five more years for the technology and standards-development to move to mass market commercial deployment. Certainly, we're poised to begin to see limited fixed and mobile wireless services with faster, 5G components, but the vision of autonomous vehicles and networks designed to service specific vertical industry requirements are a bit further out on the horizon. Operators are already preparing their networks – through trials and technology upgrades to accommodate the move from a 4G to 5G world and associated new business opportunities. In many cases, businesses and governments are participating in trials to better understand what works and what's needed to ready their environments for new business use cases. I encourage everyone – from individuals to working groups to businesses and governments - to keep their fingers on the pulse of 5G developments, so they can envision and experience the possibilities.

To better understand and prepare for a 5G evolution, businesses should actively discuss with operators and other vendors who are building the technology today. It's incumbent on vendors and operators to show what can be done and how it will advance new business opportunities such as smart manufacturing and other Industry 4.0 initiatives. Governments also will need to create a fertile regulatory environment and access to spectrum to enable the technology to develop and flourish. That's how innovation happens.

VI. Network Trust

Network Trust is a concept introduced by the computer network developer's .It includes:

• Secure guest access (Restricted Network for Guest)
• User authentication (authentication related to network access)

• endpoint integrity (Devices Health Check)

• Clientless end point management (Managed and secure User Connectivity)

• Reliability (Providing a perceived connection reliability of 99.999%)

• Coordinated security (accuracy and smart response.)

• Hands off Management (the zero latency)

According to some Internet Security company definition, by means of trusted network computer or device must be absolutely safe from unauthorized sources attack. [4]. To implement a trust communication in a network the trust between two major parties in these scenarios is must A consumer and a regulators that fulfill the demands of both parties on the communication services. Traditional factors in between both party's trust to 5G networks are security of user data, security of subscriber's devices and network infrastructure.

VII. Benefits of 5G Networks.

High Data Rate:(By means of data rate how fast circuit can handle digital information)

• Energy Saving: (Decrease of energy consumption on user end)

• Money Saving: (Will save revenue by giving high networking facilities)

• Less Congestion to a MBS: (Less Congestion on Data traffic)

• More Effective: (Good in Quality of Service)

• Low Latency: (Fast Response in downloading)

• Supportive High Speed Multimedia: (Video Calling can be made more easily)

• Clarity in Voice and Audio Calling: (Enhanced Quality)

• User can get fast and Better solution through faster Network.

CONCLUSION

In this paper, 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. This generation is expected to be released around 2020. The world of universal, uninterrupted access to information, entertainment and communication will open new dimension to our lives and change our life style significantly.

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