

5G: Future Technology for Advanced Communication!

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Abstract—With the rapid advancement in the technology and communication standards, the needs and wants of the present generation has become different from successors. We need to implement new technologies, which is more judicious and economical and empower the future generation to communicate, work and transfer data more faster than previous and in more secure way. Generation of mobile networks or 5th generation wireless network systems (5-G) will contain a new phase of mobile telecommunications standards, but beyond the current 4G networks. So, 5G has speeds beyond, what the current 4G can offer to people. Thousands of users will be supported by data rates of several tens of megabits per second. Spectral efficiency and the coverage of the 5G will be significantly enhanced compared to 4G which is its biggest advantage. Along with high data speed, 5G will also provide a great support and will be a backbone in the upcoming network & communication technologies. 5G will be boon for future networking. 5G is based on the development of World Wide Wireless Web (www), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless World. 5G is the need of the society of 2020 and beyond. In this paper, we have thrown light on 5G concepts of wireless, its applications and its architecture on which the mobile terminal has the favourable chances to change the Radio Access Technology -RAT. Expected year of outcome of 5G is 2020 to meet business and consumer demands according to the next generation mobile alliance. It is expecting to roll out the IPV6 version of internet protocol soon, which can provide IP address to any computing device which can connect to internet. This paper discusses all these topics, future challenges and precursory.

Keywords:— 5G architecture, 5G framework, IoT, 5G structure 4G, 5G.

I. INTRODUCTION :

The word 'G' in wireless networks refers to the 'generation' of underlying wireless network technology. In today's era, wireless communication or networks is in the main lime light. Evolution of wireless technology was started in 1970's. In 1982, 1G system was introduced and 2G system was commercially deployed in 1992. In 2001, there was a drastic change in wireless network with the upcoming of 3G system. A fully compliant 4G system with IMT Advanced were first standardized in 2012. Thus, wireless technologies has experienced many changes. With the evolution of the 5G Technology, it will change the means to use wireless technology like Mobile communication with a very high speed bandwidth. 5G will be amongst the most talking technology of current time and demand of future that will have vast scope of applications. 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). [1]. In April 2008, NASA partnered with Machine-to-Machine Intelligence (M2Mi).

[3] According to the Sources 5G generation standards may be rolled out in approximately early 2020s. However, significant debate continued, on what 5G is about. Technologies in fifth generation will going to offer 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.[2] Due to 5G, all the services and applications will be accessed by single IP address as telephony, gaming and many other multimedia applications. Upcoming (implemented in some countries) IPv6 (Version of Internet Protocol) is used by 5G. Besides high data rates and large bandwidth, 5G will also offer handling of billions of devices and less network congestion, allowing for better connectivity. The benefit of 5G can be easily afford by the common people. To compete with on going wireless technologies in market, 5G has to bring something pioneering in the market. The brilliance of 5G can be predicted by the features and offers that are offered in 4G technology. Voice rates, internet packs, free voice calling are the main features that came up with the emergence of 4G technologies. So, it is expecting the calling rates will be going to be more cheaper than ever, internet packs for mobile will be make available at such a lower rate that any one can afford to buy them. Along with these, another amazing features will be the part of 5G. This upcoming technology is expected to be a mixture of network tiers of different sizes, transmission powers, back haul corrections and radio access technology accessed by unpretending number of intelligent and heterogeneous wireless devices. 5G will help support the massive growth in the Internet of Things (ITT) and enable devices to communicate with each other seamlessly through the convergence of mobile communications and computing.

The 5G networks will also bring intelligence across the entire network, from the device to the data centre. The 5G technology will be kept as an open platform on different layers from the physical layer up to the application layer. [4] The emerging demands on 5G are far more comprehensive than previous generations. This leads to an assumption

that 5G cannot be met by one single solution. The primary technologies and approaches to address the requirements for 5G systems can be classified as follows: - Densification of existing cellular networks with the massive addition of small cells and a provision for Peer-to-Peer (P2P) communication (ex: Device-to-Device (D2D) and Machine-to-Machine (M2M) communication enabled multi-tier heterogeneous networks.) All these technologies will provide fast data access capacity along with the simultaneous transmission and reception, massive multiple-input-multiple-output and mm wave technology and improved utilization of virtual wireless resources. The future 5G will be cloud based radio access network.[5]

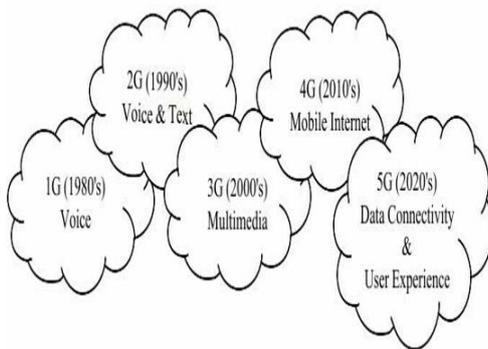


Fig.1: Evolution of Mobile Network upto 5G.

II. WHY 5G ?

[6]Today , when we are in the middle of the so called fast 4G revolution , in that the superfast mobile data service is still in its infancy in both coverage and speed capabilities. While the current technologies capable of offering internet speeds of up to 150Mbps in areas offering double LTE connections, and LTE-A (or 4G+ on EE) available in London and select cities in the UK,(In India too) increasing that to 300Mbps, why on Earth do we need anything more like 5G technology that is going to be expected many folds faster than previous ones ?Infact, if we go to the end of maximum speed of 4G which will be in coming years, we can achieve mobile broadband speeds of up to 1Gbps – one gig. That’s staggering to contemplate, especially as we don’t even have fixed line broadband that fast yet. So why the need for 5G?

Now to answer the question "Why do we need 5G ?" following statements express the answer much better :

The one of the major -major benefit of 5G over the previous 4G , is not only it's speed or bandwidth of data transmission which could possibly be between 10Gbps to 100Gbps but the latency. Talking about the current scenario 4G is capable of providing between 40ms and 60ms, which is low-latency but not enough to provide real-time response. Examples like Multiplayer gaming requires a lower latency than that to ensure that when you hit a button, the remote server responds instantly and for this 5g will be there to do it's work. Possibly and respectively the latency of 5G can be as low as 1ms or can go higher to 10 ms which is far lower

than current 4G latency time .Example of this is that it would allow a spectator in a football stadium to watch a live stream of an alternative camera angle of the action that matches what is going on the pitch ahead with no perceivable delay ,that sounds so amazing !! .This is the power of 5G and many are there in the queue to. Initial ideas behind 5G is that an infrastructure will be in place to avoid that. It will be more adaptive to user’s needs and demands and therefore able to allocate more or less bandwidth based on the application and usage .

The capacity is also an important factor which can become the reason for roll out of 5G. The Internet Of Things which is so called future technology and is in research and development phase(although some implementation of IoT has been done like Concept of smart home by Google) will be in it's full phase in coming few years. Machine will be communicating with other machines without the human intervention and this will be all possible with the help of 5G and it's concepts. Imagine that , when a person reach home after a long tedious , tiring, exhaustive day and as soon as he reached to its home doors will open(a security mechanism which we authenticate him and then opens the door), AC will get on and a soft music will be played automatically sensing his mood to give him relax. All the lighting of the home will go dim to give him the relaxation and sense of peace . All this wonderful stuffs requires the machine to machine communication, data analysis of sensors data and 5G .By 2020 , it is expecting that there will be 50 billion devices in the globe that will be connected to internet . These can range from existing smartphones, tablets and smartwatches, to fridges, cars, augmented reality specs and even smart clothes. The 5G system will automatically send tiny packets of data across the network and recognise this and allocate bandwidth respectively, thereby not putting unnecessary strain on individual connection points. The work has already begun for 4G implementation, but it will be more vital by 5G future. As part of a "heterogeneous network", the points, or cells, will be used for LTE-A and the technology will be increased and refined to adapt to 5G too. Mobile devices will automatically talk to each device connected to internet through a single IP address to provide the best and most efficient service no matter where the user is. Imagine , algorithms will know how fast a device is travelling, so that it can adapt to which cell it is connected to.

4K Video Streaming : Imagine the time when user/public will be able to see live streaming of 4K (also called Ultra HD , quality having 4 X High Definition) video of any sports match , live videos on social networking. 5G enhance the future of live streaming. By 2030, EE predicts that 76 % of its data traffic will be used streaming video. And a large amount of that will be at 4K or even 8K resolutions. Although the data rates of 4G can cope with that – it is expected that a 14Mbps connection should cope with streaming 4K video, 18Mbps for 8K – but if everybody was to do that at the same time, like statistics suggest, the network would have difficulty keeping up with demand.

And finally, the one of the major benefit to 5G technology is that standardization of the standards and spectrum bands which will be reserved for its deployment will have been agreed globally, by members during the World

Radiocommunications Conferences. Your 5G phone in the UK, for example, will work on the exact same system and spectrum band as in the US, South Korea and wherever else. Well this is the proposal only and many stages are there to convert this idea into a reality.

Wearable devices ex. fitness bands embedded with AI (Artificial Intelligence) that can say about your daily activities , health conditions , advise you to take a diet , can connect with a virtual doctor and many vast application areas are there which require 5G.

III. 5G STRUCTURE & ARCHITECTURE :

It is estimating that the architecture of 5G is going to be more advance in nature. The architecture design for 5G which is all-IP based model for wireless and mobile networks .[7]The system will be based on the user centric concept(while previous versions were based on the operator centric concept) in which there will be 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. In this architecture, mobile terminal has the capability to of changing thr RAT(Radio Access Technology). 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. Within each of the terminals, each of the RAT is considered 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 [7] .

The design of the 5G technology will be in such a way keeping in mind as an open platform on different layer from the physical layer up to the application layer; presently the current network is in module that shall offer the OS and the lowest cost for a specified surface using one or more than one wireless technology at the same time from 5G mobile. The first two OSI levels (data-link and physical levels) are defining the RAT through which the access to the Internet with more or less QoS support mechanisms is provided, 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(coming out in full phase in few years) , regardless of the radio access technology. The purpose of this layer is to completely ensure that enough control data (in IP header) for proper routing of IP packets belonging to a certain application connections -between client applications and servers somewhere on the Internet will be made. Routing of packets should be carried out in accordance with established policies of the user. 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) as shown in figure [8].

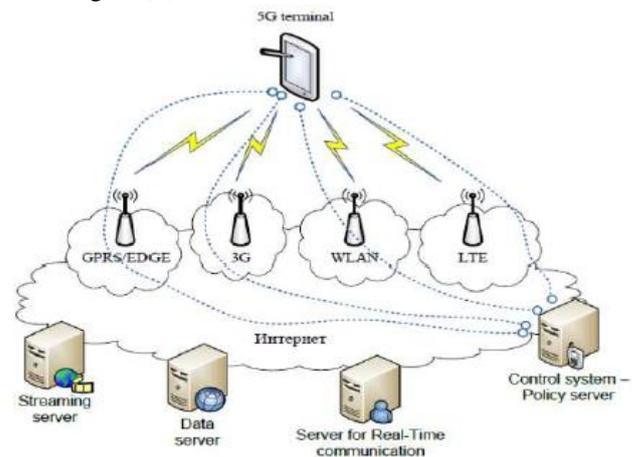


Fig 2: Mobile Network Architecture

At current situation we have a vast amount of wireless and mobile technologies present with us , such as 3G mobile network (CDMA 2000) , Wi-Fi (IEEE 802.11) , as well as accompanying network such as personal area network (Bluetooth) , we even have the GSM (3G is based on this old fashioned circuit switching) . We have a lot more technologies all depending on the IP principles. We do have a lot of RAT's and may have more New RAT's network but one thing which will be going to remain common for all the technologies is the IP address. [6] The main focus is on logical approach to design 5G which will be fully self-organizing with end-to-end network behaviour intelligence. [9]The 5G protocol stack consists of OWA layer, network layer, Open transport layer and application layer :

- OWA Layer: OWA layer is an acronym for Open Wireless Architecture layer. It functions as physical layer and data link layer of OSI stack.

- Network Layer: It is used to route data from source IP device to the destination IP device/system. It is divided into lower and upper network layers.
- Open Transport Layer: This layer will going to provide the combined functionality of both transport layer and session layer.
- Application Layer: It formats the data as per proper format required. It provides the various security features like securing by encryption and decryption of the data. It selects the best wireless connection for given service.

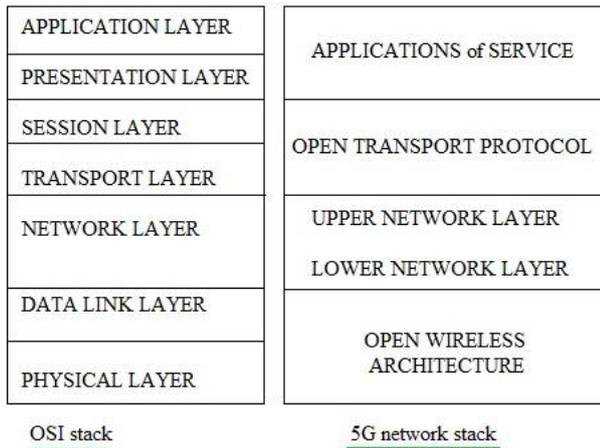


Fig 3: 5G Protocol Stack [9]

IV . USABILITY AREAS OF 5G :

5G technology is going to be adorned with many distinct features, whose applicability is useful for a wide range people irrespective of their purposes. 5G is a global as well as a pervasive network which will make global standards for all. It has a media independent handover. The technology will be required in the future due to its advanced features and is also known as the sixth sense technology. Its cognitive radio technology will facilitate different version of radio technologies to share the same spectrum efficiently. From a user perspective, 5G should significantly transform wireless service experience by enabling a uniform service experience anytime anywhere, and by providing a high level of service quality. Furthermore, from service perspective, 5G should enable delivering new services in a faster time-frame, and through more programmable interfaces.

There are a number of fields where 5G will be useful such as :

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

Cognitive radio technology (known as smart radio): making the same spectrum shared by the different radio technologies 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.

- 3D map

V. FUTURE SCOPE OF 5G :

Several researches and various discussions have already started across the world among technologists, researchers, academicians, vendors, operators, and governments about the innovations, implementation, viability, and security concerns and its future scope and replacement of 5G. As proposed, loaded with multiple advance features starting from the super high speed internet service to smooth ubiquitous service, 5G will unlock many of the problems. However, the question is — in a situation, where the previous technologies (4G and 3G) are still under process and in many parts yet to be started; what will be the future of 5G? Will there be any problem that will happen in 5G and Will there be 6G ?The main objective of the 5th generation technology is to provide incredible and remarkable data capabilities, unhindered call volumes, and immeasurable data broadcast within the latest mobile operating system. Hence, this technology will be more intelligent technology, which will interconnect the entire world without limits. Likewise, our world would have universal and uninterrupted access to information, communication, and entertainment that will open a new dimension to our lives and will change our life style meaningfully. Moreover, governments and regulators can use this technology as an opportunity for the good governance and can create healthier environments, which will definitely encourage continuing investment in 5G, the next generation technology. If we get the success of achieving the true and maximum limit of 5G , then there will not be any need of 6G on earth. If correct infrastructure is used, upgrading hardware’s and software’s requirement , then future is bright and very lightning fast. We have to keep in mind that 4G can take up to 1Gbps and 5G will be beyond our imagination !!

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