5G Network of Communication Technology

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Abstract - Wireless communication system growth has been changing rapidly. The main goal of the paper is a deep study on 5th Generation Wireless Technology, this is also called Real wireless world. 5G is a new type of networks which is design to connect almost all things together as well as objects, devices, and technologies. The key aim of the fifth-generation wireless network is to have fast speeds, less latency, base station's (BSs) efficiency and high Quality of Service (QoS) for consumers as compared with the fourth-generation networks. To deal with technologies and connectivity in the form of machines, objects and devices, the broadband data usage increased at superior rate. This paper briefly discusses on the architecture and applications of 5G. Fifth-generation provides more features than fourth-generation. This also focuses on comparison of fourth generation and fifth generation technology, in relative to their latency, speed, frequency, core network, and design of network.

Index Terms: 5G Network, Quality of Service (QoS), 5G Network Slicing Architecture.

I. Introduction of 5G -

5G is the fifth wireless technology of network after 4G. 5G also be called Real Wireless World. Wireless communication system growth has been changing rapidly. With no limitations, it is complete wireless communication. 5G has incredible transmission speed. 5G is new type of networks, that designed to connect virtually everything and everyone together including objects, machines, and gadgets. The deep objective of the fifth-generation wireless systems is to have comparatively fast data speeds, less latency, inspiring progresses in base station's efficiency and superior Quality of Service (QoS) for consumers compared to the current 4G [1][2].

The information traffic over cell networks is continually increasing. To support this traffic, the 5G would have the option to meet this emerging of information traffic.

5th Generation services categorized into three categories, is called Network Slicing. (1.) Enhanced mobile broadband (eMBB). It is a design that offers high speed web network, fast transfer speed, less latency, Ultra HD real time recordings, computer generated reality etc.
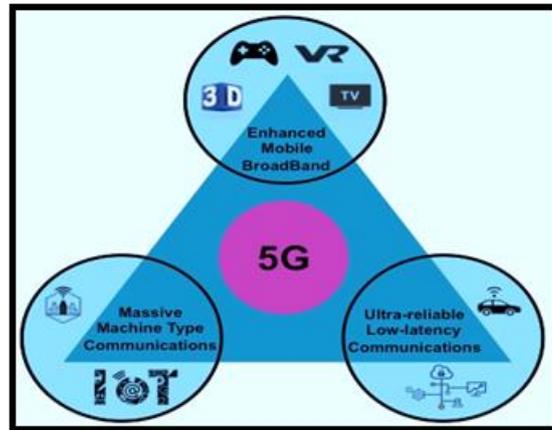

Figure 1. Categories of 5G

(2.) Massive machine type communication (mMTC), It is very important concept of 5G. It gives long reach and broadband machine type communication at profitable cost with less power utilization. mMTC brings a high information rate service, low power, large coverage by means of less gadget complexity in IoT applications. (3.) ultra-Reliable low latency communication (uRLLC) offers low latency and high reliability, greater Quality of service (QoS). uRLLC is planned for on-request continuous connection, like remote operations, intelligence transport system, vehicle to vehicle communication etc. [3][4].

Quality of Service is a network capacity to reach greatest transfer speed and manage other network performance. It additionally includes managing and controlling network properties by defining priorities for varieties of information such as video, sound, records on the web. QoS is completely used to control net traffic produced for video on request, real time media, videoconferencing, and web-based gaming. [5].

Figure 2. 5G Network

The 5G network is the World-Wide Wireless Web (WWWW). The fundamental convention for running on 5th Generation is IPv6. Its goals to give unlimited access to data and it provide higher capacity to share data anywhere, at any moment through anybody in world. Its mobile technology most powerful because 5G advances covers everything of the high-level features and will be in huge interest in future. The fifth-Generation portable is all-IP based for remote organization interoperability. 5G has many characteristics. Table of characteristics such as peak data rate, per user information rate, latency, mobility, density, frequency, region traffic limit, network design and core network [6].

Reduced latency will support new applications like IoT, and AI. Sometimes these characteristics are recognized as the strong pillars of 5G Network. we discuss each characteristic of fifth-Generation in details. The table 1 gives the insight into these characteristics of 5G network.

Parameter	Key values of 5G
Data rate	Largest reachable data rate per device is 20 gbps.
Per User Data-Rate	Reachable data rate i.e. covered by a mobile user is 100 mbps.
Latency	It is basically, time taken by network to solve the query of the user or device is below10 ms.
Frequency	5G operates at frequencies of about 28 GHz and 39 GHz.
Mobility	Superior speed at which a characterized QoS and consistent exchange between radio hubs which required a place with various layers or Radio Access Technologies can be accomplished is 500 kmph (for example for high-speed trains).
Density	Complete number of connected and available devices per area unit is 10^6 devices per km^2.
Traffic	Complete traffic throughput served per geographic region is 10 mbps/m^2.
Network design	Network design of 5G is heterogeneous Network which has

	three verticals eMBB, uRLLC and mMTC.
Core Network	The core network has depended on cloud network or SDN (Software defined network).

Table: 1. Characteristics of 5G Network

In 5G, the combination of two layers which is (i) physical, and (ii) data link layer that is called the open wireless architecture (OWA). It also maintains virtual multi-wireless network. In 5G, the work of network layer is utilized to route the information from source to objective. Network layer is sub-partitioned in two layers (I) Upper network layer for portable terminal (ii) Lower network layer for interface. All the router will be based on IP addresses to which would be distinctive to every IP network around the world. The Open Transport Protocol (OTP) layer performs the operations of both Transport layer and Session layer. In 5G technology, by utilizing OTP the higher bit rate deprivation is overcome. The application layer has responsible for superior QoS. It generates the information into exact structure that is it decrypt the information which is encryption structure. The table 2 gives the insight into these layers of 5G Network [7].

1G, 2G, 3G, 4G	5G
Application Layer *Presentation Layer*	Application (Service)
Session Layer *Transport Layer*	OTP (Open Transport Protocol)
Network Layer	Upper Network Layer
	Lower Network Layer
Data Link Layer *Physical Layer*	OWA (Open Wireless Architecture)

Table: 2. 5G Layers

5G offers huge broadcasting of information in gb. The terminals of 5G have software defined radios. It gives many channels without streaming. 5G innovation upholds virtual private organization. It offers bidirectional transfer speed and less traffic. It delivers 25 mbps connection speed of information transmission greater than one gb. Slicing is an extraordinary component of 5G. The downloading and updating speed of 5th Generation network is very high. [8].

II.   Comparison of 4G and 5G -

The analogy of fourth-generation and fifth-generation in comparative with its latency, speed, core network, standards, technologies, network design, service, switching design basis, multiple access, frequency, handoff, and design is studied.

The 5G services are used to tackle the troubles of poor coverage, low quality of service, adaptability, and poor interconnectivity.
The importance of the comparative review is assessed for a speed and productive connection and broadcast of gadgets like hardware and remote.
(i) In this, the 4G are fourth-generation of cell network and 5G are fifth-generation of cell network.
(ii) The 4G network was developed in 2009 and 5G network was developed in 2016.
(iii) In 4G, the latency rate is 10-100 milliseconds and in 5G, a reduced latency of less than 1 millisecond. latency is a time taken by network to solve the query of the user.

(iv) 4G can reach speed up to 2 Mbps -100 Gbps and speed of 5G is 1 Gbps - 25 Gbps. 5G provide superior speed to HD video real time along with low data rate speeds for sensor nets.

(v) Frequency of 4th G is 2 - 8 GHz and frequency of 5th G is 3 - 300 GHz. Frequency is used to measure the processing speed and the rate of radio signal to send and receive communication signals.
(vi) In 4G, the core network is hardware dependent and in 5G, core network is Software define network (SDN) based cloud based. Core network is the structure that links collected the different networks.
(vii) In 4G, the Standards utilized are Orthogonal Frequency Division Multiple Access, Multi-Carrier Code-Division Multiple Access and in 5G, standard utilized are Code Division Multiple Access, Beam Division Multiple Access. Paradigms can provide set of instructions which are used for exchange of information amongst devices.
(viii) In 4G, the two main technologies utilized that are Long Term Evolution and Worldwide interoperability for Microwave Access and in 5G, innovation utilized is 3GPP. Technology includes use of data systems to accomplish and deliver digital resources over a network.
(ix) Network design of 4G is base station operated and
network design of 5G is heterogeneous. Network design is system design that contracts with data transport mechanisms.
(x) services of 4G are Dynamic data access, wearable gadgets, HD broadcasting, worldwide roaming and speed of 5G are Dynamic data admission, wearable gadgets, HD broadcasting, any request of clients.
(xi) Connection density in 4G is $1000/km^2$ and connection density in 5G is $1000000/Km^2$. It is the ability to support the successful delivery of messages.
(xii) Handoff in 4G network is horizontal and vertical and handoff in 5G is also horizontal and vertical. It is the process of transferring data from one channel to another.
(xiii) 4G designed for Mobile broadband services and 5G designed for three verticals eMBB, mMTC, uRLLC called network slicing.

Parameters	4G	5G
Meaning	Fourth Generation	Fifth Generation
Get going from	In year 2009	In year 2016
Latency	10-100 ms	Lesser than 1 ms
Speed	2mbps – 1gbps	1gbps and higher
Frequency	2-8 ghz	3-300 ghz
Main Network	All IP network	Flatter IP network and 5G network Interfacing
Technical Paradigms	MC-CDMA/ OFDMA	BDMA/CDMA
Technologies	LTE, WiMax	3GPP
Network Design	Base station operated	Heterogeneous
Service	Dynamic data access, wearable gadgets, HD broadcasting, worldwide roaming	Dynamic data access, wearable gadgets, HD broadcasting, any request of clients.
Connection Density	1000/Km^2	1000000/Km^2
Multiple Access	CDMA	BDMA/CDMA
Handoff	Vertical and Horizontal	Vertical and Horizontal
Designed for	Mobile Broadband services	Network Slicing

Table: 3. Comparison between 4G and 5G

Above table analyzes 4G versus 5G mechanisms and discussion dissimilarities between them [7][9].

III.   5G Network Slicing Architecture -

5G contains both infrastructure as well as manufacturing design and physical construction of specific hardware and software that controls how the network transmit the data.

5G slicing architecture is also comparable to compound public transportation framework. Some conveyance components, for example, streets and bridges are universal, rather than lines of identical paths and automobiles. Even, additional methods and automobiles are personalized to the speed, spending plan and volume necessities of employer.
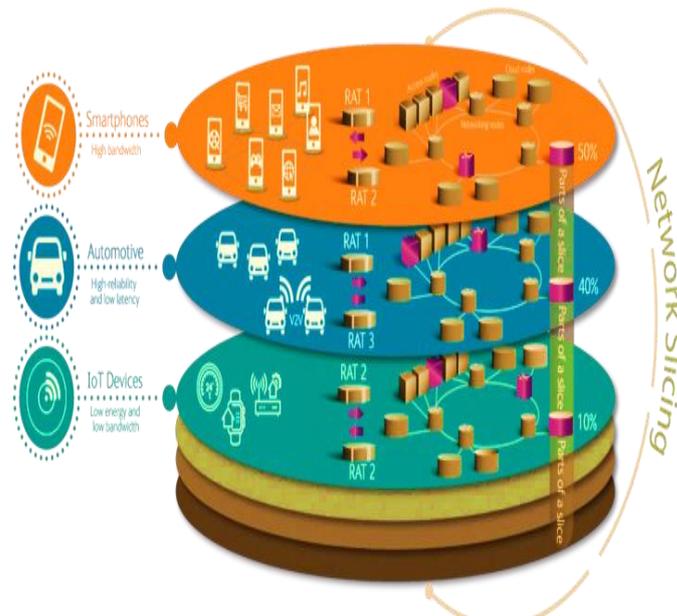

Figure 3. 5G Network Slicing Architecture

End to End (E2E) network slicing and logical separation from additional slices are essential occupants of the architecture, though every distinctive slice cross over numerous common network component. In a network slicing, software defined network (SDN) is an important element of the design used to control traffic flows by application program interfaces of a main control plane. Through the application layer, the control plane constructs resources to distribute services to the customer. SDN additionally comprises an infrastructure layer, which contains elementary net services. It is responsible for information sending and rule management from the control plane. The network slice supervisor plans service and monitors functionality of different layers. This approach support Network function virtualization is to position network functionality on virtual machines (VMs) on a virtualized server to run services that primarily ran on registered hardware. Network function virtualization might be used to deal with the lifecycle of slice and their structure resources. SDN is utilized to control the provisioning of Virtual Machines positioned in edge cloud or core clouds. It might offer a sound formation to effective SDN and NFV network slicing consumption of virtual and actual resources including Radio Access Networks (RAN's) through work of these technologies. [14][15].

VI. 5G Enabled Applications - 5G offers many applications to in every field to improve the life style of users with smart mobile, smart energy, advanced trade, social media, and smart medical services. The very important applications of 5G networks will be mentioned.

(i) Smart Mobility: The smart mobility provides benefits of traffic managing, effective routing, preventing accidents, energy saving, cost and production decrease. In this collection of apps, there is a solid request to support availability and extra-reliability, security and low power utilization.

(ii) Smart Energy: These applications include power plant checking and supervision, smart grid networking, energy commercial center and smart charging stations for electronic vehicles, new consumption saving services for homes and places of business.

(iii) Virtual Navigation: Even if the user in off-site, all time 5G offers client services. It delivers virtual route through which a client can right to utilize a data set in a road view by fast information transmission.

(iv) Smart Cities: Smart urban areas links virtualized home and business regions corresponding offices, and stores. All the advanced hardware resembles conditioners, LCD, printers, temperature support are linked in an isolated technique.

(v) Health Care Assistance: In this, patient can meet the specialist through video meeting help at anywhere and anytime. Patients need not go to the hospital/clinic.
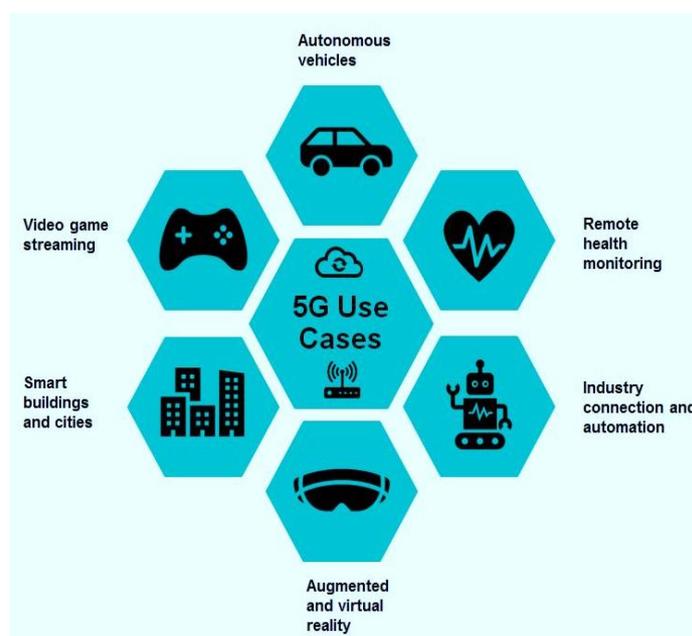

Figure 4. Applications of 5G

(vi) Virtualized Homes: Cloud-RAN design approves all the upper layer application services, so the client can get to the versatile TV with minimal expense appliance.

(vii) Industrial Support: 5G control and work the modern application services. It also maintains for modern robots, drones, sensors, cell phones with rapid availability.

(viii) Education: People can concentrate on online study from everyplace on the earth with 5th Generation web access.

(ix) Smart Health: The applications of portable based

condition diagnosis and monitoring, latest smart wearables, clinical and medical services. Health applications are growing consciousness of fitness and well-being. One more arising application in this space is the AR/VR empowered a medical procedure.

(x) Consumer Applications: Many consumers emerging applications contains mobile business, ultra-HD streaming, smart gaming, versatile AR/VR, and holographic innovation.

(xi) Tele-geo-processing: The plan of a geological framework in which a client can get the area according to popular request using the Geographical Information System and GPS.

(xii) Personal Admittance: 5G ready to supporting a wide scope of client tools. From versatile to numerous gadgets and furthermore maintains the information requests in the vein of voice contact, web access and media information [8] [16].

V.   Future of 5G -

5G offers improved revenue-generating potential for those who can develop and interduce high quality, adapted services in hours rather than weeks or months. The 5G comprise of all type of advanced features which makes mobile as more impressive, it also has more demand in current upcoming period. The structure requirement be powerful and flexible. Ensures you are ready for future, jumping to a cloud-based, software-defined structure today. 5G would not be capable of satisfying their requests in future. The 6G will be around 1 tbps, which is multiple times faster than 5G.

VI.   Conclusion -

This review paper describes a detailed overview of 5G technology. The wireless net gives scalability, productivity, and superior services. This paper discussed the characteristics, architecture, and applications of 5G technology. This also focus on correlation between 4G and 5G technology in comparative with its latency, speed, core network, frequency, design, and network plan are studied. In this, network slicing provides isolation and elasticity in service resources in 5G networks. They use combined SDN and NFV, which manage the network and provide superior QoS.

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