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5G Network Evolution and Revolution

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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. To meet the demands, drastic improvements need to be made in cellular network architecture this paper presents the results of detailed survey on the fifth generation cellular network architecture and some of the key developing technologies that are helpful in improving the architecture and meeting the demands of users. The prime focus is on the 5G cellular network architecture, massive multiple input multiple output technology, and Device-to-Device communication. Along with some of the emerging technologies that are addressed in this paper include interference management, spectrum sharing with cognitive radio, ultra-dense networks, multi-radio access technology association, full duplex radios, millimeter wave solutions for 5G cellular networks, and cloud technologies for 5G radio access networks and software defined networks. In this paper, a general probable 5G cellular network architecture is proposed, which shows that D2D, small cell access points, network cloud, and the Internet of Things can be a part of 5G cellular network architecture.*

Keywords— 5th Generation, Cloud, D2D, Massive MIMO, mm-wave, Relay, Small-cell.

I. INTRODUCTION

From a technical point of view, fifth generation mobile wireless – or 5G, as it's unremarkably renowned – is a lot of regarding "evolution" than "revolution." In different ways 5G merely builds upon the mobile infrastructure established by the present wireless standard, 4G LTE. From the point of view of the imagination, however, 5G is poised to redesign the technological world as we all know it. The new standard that is predicted to be installed by 2020 can support data transmission rates of between 10 and 20 gigabits per second per mobile base station, at speeds ten to a hundred times quicker than typical 4G connections. These abilities can build it potential to enhance device technologies, video game, AI and machine learning for unprecedented applications. The imaginings of our future may be a Wireless networked society with unbounded access to data and sharing of information that is accessible everyplace and each time for everybody and everything. To understand this imagination, new technology components got to be inspected for the evolution of existing wireless primarily based technologies. Gift wireless principally based technologies, just like the third Generation Partnership Project (3GPP) LTE technology, HSPA and Wi-Fi, will be combining new technology elements that may be serving to meet the wants of the long run. However, there could also be certain circumstances that can't be sufficiently self-addressed on with the evolution of in progress existing technologies. The encouragement of fully new wireless primarily based technologies can balance this technologies that area unit required for the long term understanding of the wireless networked society.

II. GENERATIONS OF MOBILE NETWORK TECHNOLOGY

2.1 Evolution of Mobile Technologies

Mobile communication has become a lot of in style in previous couple of years thanks to quick revolution in mobile technology. This revolution is thanks to terribly high increase in telecoms customers. This revolution is from 1G- the primary generation, 2G- the second generation, 3G- the third generation, and so the 4G- the fourth generation, 5G-the fifth second generation.

2.1.1 First Generation (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).

2.1.2 Second Generation (2G):

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arise in late 1980s. It uses digital signals for voice broadcast and has speed of 64 kbps. It provides capability 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 swapped domain and provide data rate up to 144 kbps.

2.1.3 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. Sideways with verbal announcement it comprises of information services, access to television/cinematic, new services like world Roaming.

2.1.4 Fourth Generation (4G):

is generally denoted as the descendant of the 3G and 2G standards. 3rd Generation Partnership Project (3GPP) is currently standardizing Long Term Evolution (LTE) Advanced as forthcoming 4G standard along with Mobile Worldwide Interoperability for Microwave Access (WIMAX). It also 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.

2.1.5 Fifth Generation (5G):

5G mobile technology has changed the means to use cell phones within very high bandwidth. With an tremendous increase in the demand of the users, 4G will now be easily replaced with 5G with an progressive access technology named Beam Division Multiple Access (BDMA) and Non- and quasi-orthogonal or Filter Bank multi carrier (FBMC) numerous access. The idea behind BDMA technique is enlightened by considering the case of the base station communicating with the mobile stations. In this communication, an orthogonal beam is assigned to each mobile station and BDMA technique will divide that antenna beam according to locations of the mobile stations for giving numerous accesses to the mobile stations, which harmoniously increase the capability of the system

2.2 Design of 5g Mobile Network Architecture

A mobile user to connect whether inside or outside, an outside base station present in the central of a cell helps in communication. So for inside users to communicate with the outside base station, the signals will have to travel through the walls of the indoors, and this will result in very high diffusion loss, which harmoniously costs with concentrated spectral competence, date rate, and energy competence of wireless communications. To overwhelmed this challenge, a new concept or manipulative technique that has come in to animation for scheming the 5G cellular architecture is to separate outside and inside setups. With this designing technique, the diffusion loss through the walls of the building structure will be somewhat reduced. This idea will be reinforced with the help of enormous MIMO (Multiple Input and Multiple Output) technology, in which geologically detached collection of antenna's are situated which have tens or hundreds of antenna units all around. Since present MIMO systems are using either two or four antennas, but the idea of enormous MIMO systems has come up with the idea of employing the benefits of big collection of antenna elements in terms of huge capacity achievements. To construct a large gigantic MIMO network, initially the outside base stations will be tailored with large antenna collections and among them some are detached around the hexagonal cell and associated to the base station through optical fiber cables, supported with gigantic MIMO expertise. The mobile users current outside are typically fitted with a convinced amount of antenna components but with collaboration a large virtual antenna collection can be built, which composed with antenna collections of base station form virtual enormous MIMO associations. Furthermore, every building will be installed with large antenna arrays from outside, to communicate with outdoor base stations with the help of line of sight components. The wireless access points inside the building are associated with the large antenna of collections through cables for collaborating with indoor users. This will significantly improves the energy efficiency, cell average throughput, data rate, and spectral efficiency of the cellular system but at the expense of increased infrastructure budget. For inside communication, certain technologies like WiFi, Minor cell, extreme wideband, millimeter wave communications, and noticeable light communications are useful for minor range communications having huge data rates.

Mobile minor cells are located inside the moving automobiles to communicate with the customers inside the automobile, while the gigantic MIMO unit involving of large antenna collections is placed external the automobile to communicate with the external base station. The network function virtualization (NFV) cloud contains of a User plane entity (UPE) and a Control plane

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entity (CPE) that achieve complex layer functionalities connected to the User and Control plane, correspondingly. Special network functionality as a service (XaaS) will provide service as per need, supply pooling is one of the examples. XaaS is the association between a radio network and a network cloud. The 5G cellular network architecture is explained in the figure below. It has equal significance in terms of front end and back end network correspondingly. In this paper, a general 5G cellular network architecture has been proposed as shown in Fig. 1. It describes the interconnectivity among the dissimilar developing technologies like Gigantic MIMO network, Reasoning Radio network, mobile and stationary small-cell networks. This planned architecture also describes the role of network function virtualization (NFV) cloud in the 5G cellular network architecture. The theory of Device to Device (D2D) communication, small cell access points and Internet of things (IoT) has also been amalgamated in this proposed 5G cellular network architecture. In overall, this proposed 5G cellular network architecture may provide a good platform for future 5G regularization network.

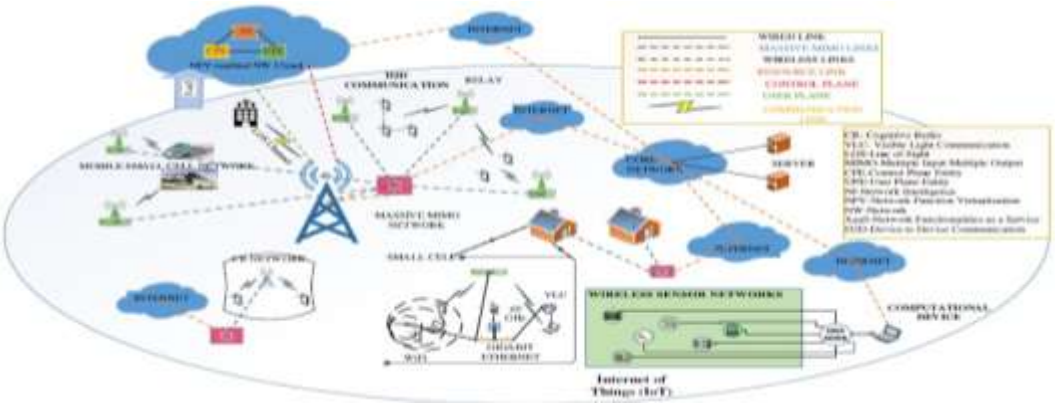

Fig 1: A General 5G cellular network architecture.

2.3 Developing Technologies for 5g wireless networks

To deliver a commercial connected platform for an assortment of applications and requirements for 5G, we will study the below technology components:

- Radio-links: comprises the development of new broadcast waveforms and new methods of multiple access control and radio resource management.
- Multi-node and multi-antenna transmissions: contains designing of multi-antenna transmission/reception technologies constructed on massive antenna conformations.
- Network dimension: comprises considering the request, traffic and mobility organization, and novel methods for well-organized intervention management in composite heterogeneous placements.
- Spectrum usage: comprises since extended spectrum band of procedure, as well as operation in new spectrum rules to provide a complete system idea for new spectrum rules that cautiously addresses the needs of each practice situation.
- Device-to-Device (D2D): communications references to straight communication amongst devices permitting local conversation of user plane traffic without going through a network infrastructure. Device to Device Communication system can be clarified by envisioning a two level 5G cellular network and named them as macro cell level and device level. The macro cell level comprises of the base station to device communications as in an orthodox cellular system.
- Massive Machine Communications (MMC): will procedure the basis of the Internet of Things with a extensive variety of application fields including the automotive industry, public safety, emergency services and medical field.
- Moving Networks (MN): will improve and spread linking together possibly large inhabitants of together moving communication devices.
- Ultra-dense Networks (UDN): will be the main driver whose goals are to rise capacity, escalation energy effectiveness of radio links, and enable better manipulation of under-utilized spectrum.
- Ultra-reliable Networks (URN): will enable high degrees of accessibility.

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- Characteristics of 5g Technology
- The technology 5G offers the high resolution for sharp, passionate cell phone every day and give customers 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.

III. FIGURES AND TABLES

TABLE 1:
Evolution of Mobile Technologies

Generations	Access Technology		Data Rate	Frequency Band	Bandwidth	Forward Error Correction	Switching	Applications
1G	Advanced Mobile Phone Service (AMPS) (Frequency Division Multiple Access (FDMA))		2.4 kbps	800 MHz	30 KHz	NA	Circuit	Voice
2G	Global Systems for Mobile communications (GSM) (Time Division Multiple Access (TDMA))		10 kbps	850/900/1800/1900 MHz	200 KHz	NA	Circuit	Voice + Data
	Code Division Multiple Access (CDMA)		10 kbps		1.25 MHz			
2.5G	General Packet Radio Service (GPRS)		50 kbps		200 KHz		Circuit/ Packet	
	Enhanced Data Rate for GSM Evolution (EDGE)		200 kbps		200 KHz			
3G	Wideband Code Division Multiple Access (WCDMA) / Universal Mobile Telecommunications Systems (UMTS)		384 kbps	800/850/900/1800/1900/2100 MHz	5 MHz	Turbo Codes	Circuit/ Packet	Voice + Data + Video calling
	Code Division Multiple Access (CDMA) 2000		384 kbps		1.25 MHz		Circuit/ Packet	
3.5G	High Speed Uplink / Downlink Packet Access (HSUPA / HSDPA)		5-30 Mbps		5 MHz		Packet	
	Evolution-Data Optimized (EVDO)		5-30 Mbps		1.25 MHz		Packet	
4G	Long Term Evolution Advanced (LTE-A) (Orthogonal / Single Carrier Frequency Division Multiple Access) (OFDMA / SC-FDMA)		DL 3Gbps UL 1.5Gbps	1.8GHz, 2.6GHz	1.4MHz to 20 MHz	Turbo codes	Packet	Online gaming + High Definition Television
	Worldwide Interoperability for Microwave Access (WIMAX)(Scalable Orthogonal Frequency Division Multiple Access(SOFDMA))	Mobile WIMAX	100-200 Mbps	2.3GHz, 2.5GHz, and 3.5GHz initially	3.5MHz, 7MHz, 5MHz, 10MHz, and 8.75MHz initially			
5G	Beam Division Multiple Access (BDMA) and Non- and quasi-orthogonal or Filter Bank multi carrier (FBMC) multiple access		10-50 Gbps (expected)	1.8, 2.6 GHz and expected 30-300 GHz	60 GHz	Low Density Parity Check Codes (LDPC)	Packet	Ultra High definition video + Virtual Reality applications

IV. CONCLUSION

In this paper, a thorough inspection has been done on the performance necessities of 5G wireless cellular communication organizations that have been definite in terms of volume, data rate, spectral efficiency, dormancy, energy efficiency, and Superiority of service. A 5G wireless network construction has been elucidated in this paper with gigantic MIMO technology, network function virtualization (NFV) cloud and device to device communication (D2D). Convinced short range communication

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technologies, like Wi-Fi, Small cell, Visible light communication, and millimeter wave communication technologies, has been explained, which affords a promising future in terms of better quality and enlarged data rate for inside users and at the corresponding time reduces the pressure from the outside base stations. 5G technologies offers marvelous data competencies and unobstructed call volumes and infinite data broadcast self-possessed within latest mobile operating system. Fifth generation makes a significant change and add more facilities and welfares to the world over 4G. Fifth generation should be more intelligent technology that communicates the entire world without limits. This generation is expected to be released around 2020. The world of universal, never-ending access to information, entertainment and communication will open new dimension to our lives and change our life style suggestively.

5G can revolutionize the mobile expertise with supercharged wireless network, which might support up to ten to twenty GBPS of knowledge transfer speed. Internet of Things (IoT) is another broad space for development victimization amplified 5G wireless network. IoT can connect each objects, appliances, sensors, devices and applications into web. 5G wireless network are used by good appliances which may be organized and accessed from remote locations, circuit cameras can offer top quality period video for security functions.

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