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A Survey on Wireless Technology 5G

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ABSTRACT: Theaim of this paper is to study and describe the mobile technology – 5G. The development of World Wide Wireless Web (WWWW), Dynamic Ad-hoc Wireless Networks (DAWN) and Real Wireless communication leads to advance research in 5G. The most important standards for 5G technology are IEEE 802.11 (WLAN), IEEE 802.16 (WMAN) and Ad-hoc (WPAN). The 5th Generation mobile technology (5G) gives much priority to the customers compare to others technology. In 5G technology, the multiple technologies can simultaneously connect by the user which can switch between them.

KEYWORDS: 5G, DAWN, WLAN, WPAN, WWWW

I. INTRODUCTION

There is a protracted journey of wireless communication from past four decades from 1st generations (1G) to Fifth generation (5G). Fifth generation wireless communication technology, terribly high information measure that nobody will expertise before. It's expected from 5g that it's most powerful than alternative wireless technology with new advanced options. In Current days' mobile technologies square measure victimization Third and Fourth generation (3G and 4G) mobile networks. However, the future mobile network that is 5G during which there'll be a mobile multimedia system internet networks during which there's utterly wireless communication with no limitations, that makes the globe good, wireless. Over Fourth generation and Fifth generation ought to build profit to the globe and might add additional services.

II. WHY 5G?

- It has very high speed, very high capacity and low cost per bit.
- 5G provides large broadcasting capacity up to some Gigabit which supports almost 65,000 connections at a time. [2]
- 5G have the ability to gather all the networks on a single platform.
- 5G technology supports heterogeneous services.
- The traffic statistics used by 5G technology makes it more accurate.
- 5G supports virtual private networks.
- It offers high resolution for phone addict users and also has Bi–directional large bandwidth shaping.

III. DIFFERENT GENERATION OF MOBILE TECHNOLOGY

A. *FIRST GENERATION (1G)*

1G emerged in The Eighties. 1G contains Analog System that it had been typically referred to as the mobile phone. The mobile technologies MTS, IMTS, AMTS, PTT were employed by 1G. It uses analog radio radiation of frequencies 150MHz and used technique FDMA (Frequency Division Multiple Access) for voice decision modulation. It's poor and low capability voice links with no security.

Disadvantages: Less data rate, using analog cellular technology, FDMA multiplexing and using circuit switching.

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B. *SECOND GENERATION (2G)*

2G was first introduced in the late 1980s. It has a speed of 64 kbps and uses the digital signal for voice transmission. It offers SMS (Short Message Service) facility and uses the bandwidth of 30KHz to 200KHz.It uses Packet Switching and Circuit Switching technique and offers data speed up to 144 kbps.

Disadvantages: Unable to handle complex data, required a strong signal, weak digital signal, short network coverage.

C. *THIRD GENERATION (3G)*

Wide Brand Wireless Network is being used by Third Generation (3G) because of which clarity of the signal is increased. Packet Switching is the technology through which the data are sent, through Circuit Switching Technique voice calls are interpreted. It works at a range of 2100MHz and has a bandwidth of 15MHz to 20MHz which is used for high-speed internet service, video calling, etc.

Disadvantages: Required higher bandwidth, expensive services.

D. *FOURTH GENERATION (4G)*

Fourth Generation (4G) offers a 100Mbps downloading speed and more. It provides the same feature as 3G with further [2] services or options like live T.V programs with High Definition (HD) quality and sends information a lot of quicker than the previous generation. Future Evolution (LTE) is taken into account as 4G technology. 4G has been being developed to avail Quality of Service (QoS) and like wireless broadband access, transmission electronic communication Service (MMS), Digital Video Broadcasting (DVB), lowest services like voice and information, and alternative services that utilize information measure.

Disadvantages: Implementation difficult, required complicated hardware, battery drainage fast.

E. *FIFTH GENERATION (5G)*

5G is a Fifth Generation broadband technology. 5G is a new network system that has very high data rate and reliable, and low-latency than the previous generation. 5G build on the foundation created by 4G, the technologies to be used in 5G, are still being defined. The 5G networks use encoding type called as OFDM. The air interface designed for much lower latency and greater flexibility. 5G networks can use low frequencies or high as “millimetre wave” and that frequency can transmit large amounts of data, but few blocks at an instant of time. 5G networks are more likely to be networks of small cells like as size of a home router than to be large towers, it is to expand network capacity. The aim is to have high speed available and high capacity at low latency than 4G. The latency rate of 4G is around 50 milliseconds, but 5G reduces to about one millisecond. This is particularly important for driverless cars and industrial applications. The aim of 5G is to get high speed to 20Gbps, which is 40 times faster than 4G network. And its speed has been being tested up to 7.5Gbps and uninterrupted 1.2Gbps while traveling 100km/h [5]. 5G network is set to provide up to a million of connections per square kilometer.

Table. I
COMPARISON OF ALL DIFFERENT GENERATION OF MOBILE TECHNOLOGY

Generation\ Features	1G	2G	3G	4G	5G
Initiated	1980	1990	1998	2008	After 2019
Data Bandwidth	2 kbps	64 kbps	2 mbps	150 mbps-1gbps	More than 1gbps
Technology	Analog cellular	Digital cellular	CDME, EDGE	LTE	WWWW
Service	Voice	Digital voice, SMS, MMS	Internet, audio and video streaming	Dynamic information access, Wearable devices, HD mobile TV	IoT, Device to Device
Switching Technique	Circuit	Circuit, packet	Packet	All packet	All packet
Core Network	PSTN	PSTN	Packet network	Internet	Internet
Hands off	Horizontal	Horizontal	Horizontal	Horizontal and Vertical	Horizontal and Vertical
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Drawbacks	Poor capacity, bad voice connection, not secure	Need strong digital signal to help cellular phones	Required to accommodate higher network capacity	Being deployed	Yet to be implemented

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IV. TECHNOLOGIES USED IN 5G

A. *FLAT IP BASED NETWORK*

The basic concept of the 5G mobile technology is designed by taking into account the users requirement. The user has been given the top most priority instead of the operator-centric concept as in 3G or the service-centric for 4G. The 5G has been made up of OSI model consisting of different layers from a physical layer to the application layer [1].

The network layer at 5G networks can be divided into several sublayers to provide all IP connectivity anywhere and anytime [1]. The use of the Internet Protocol (IP) in the network layer is inevitable, given the IP system is the best and most used system to support and expand the network layer nowadays [1].

All-IP Network system has started very well from the development of LTE. Flat IP architecture is a one of the key concept, used to make acceptable to all kinds of technology. Evolve Packet Core is also a part of Flat IP architecture.

- IP implementation does not require any additional proprietary middleware or gateways.

B. *COGNITIVE RADIO*

Cognitive radio is a very smart communication which takes into the accounts the surroundings and uses the methodology to understand by developing to learn from the environment and alter its systems to make correspondence in the real time to different operating parameters with two primary objectives in the mind that is highly reliable communication, efficient utilization of radio spectrum. By that terminal Cognitive terminal is a very smart terminal with the intelligence to choose the appropriate network from all the existing networks. The choice is making on some information such as resources, demand and time. The 5G technology proposes a universal terminal which includes all of the radio predecessors features into a single device.

V. HOW 5G DOES WORKS?

In 5G, it likely sits on the frequency bands up to 6GHz where the previous version occupied only 20MHz. The reason new 5G technologies occupy higher frequencies is because they are not in use and move information at faster speed. In 5G, the problem is that higher frequencies do not travel as far as lower frequencies. So, Multiple Input and Output antennas (MIMO) will use to boost the signals.

A. *MIMO CONCEPT*

MIMO is a technology to transmit with the use of multiple antennas for transmission and reception. Simultaneous transfer of data is possible using MIMO technology thus offer efficient data rate. More the number of antennas more transmission and reception can be done. [3]

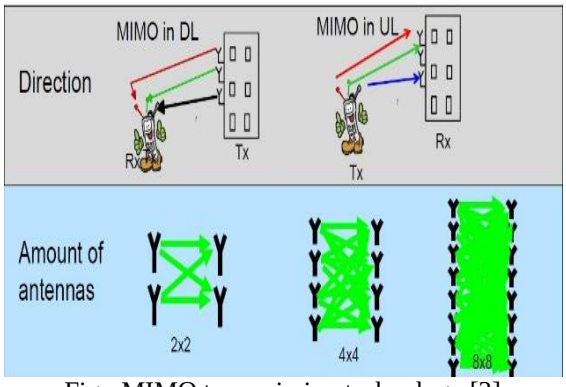

Fig.: MIMO transmission technology [3]

B. *CARRIER AGGREGATION*

Carrier Aggregation (CA) is a technique used in the previous version to improve the system efficiency. In this, two or more carrier signals are combined to support larger bandwidth which allows up to 100 MHz. Carrier aggregation

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uses three techniques for combining; Intra-band contiguous: here, two carriers are transmitted ate neighbour channels. Intra-band non-contiguous: here, two carriers are transmitted with the channel spacing. Inter-band: Here different Long Term Evolution are used for transmission simultaneously.

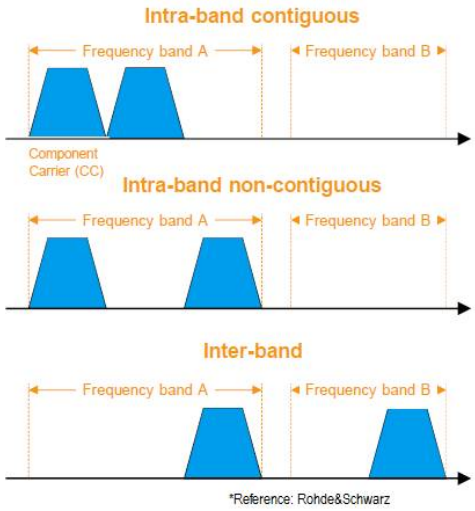

Fig.: Carrier Aggregation [3]

C. *SMALL CELL CONCEPT*

To increase network efficiency, the cells are subdivided into micro and pico cells. The reusability of spectrum allows to add more users to a network and handle network more efficiently.

D. WI-FI OFFLOADING

Wi-Fi off-loading is one of the main features of the future networks. It allows the user to connect to a network using wi-fi network and the cellular network. It would be better and suitable for some of the places where cellular network quality is bad, but the user still can connect to the network without cellular reception.

E. DEVICE TO DEVICE COMMUNICATION

D2D communication is a technique where network authorizes two adjacent devices to communicate each other directly. After, the network has the control on the devices and allows an operator to regulate the traffic routing. While absents of a network, one device can connect to another device.

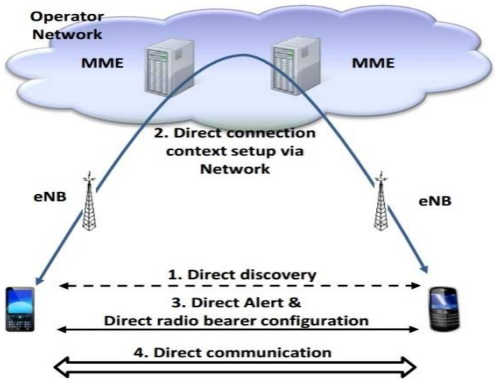

Fig.: D2D Communication [3]

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F. CLOUD – RADIO ACCESS NETWORK

C – RAN is a network technology used for the effective communication with centralized information processing carried out within the cloud system. The signals will be processed at a remote location and base stations will be connected through most efficient fiber optic connections. C – RAN gives a lot of advantages in system implementation, maintenance and more efficient. [3]

As an improved version of LTE – 4G technology, many tests and trials have to be conducted before implementing 5G. It requires an upgrade of base station capabilities, licenses, spectrum distribution, cooperation between network operators and device upgrading. Recently Ericson has tested 5G network speed and makes a record of data transmission which is few Gigabytes per second and it will improve in future networks. [3]

VI. 5G NETWORK LAYERS

In 5G network layer, terminal contain vertical handoff as they have access to all different wireless networks. The vertical handoffs will be debarred by the 5G technology as an invite and developing lot of new technologies. The 5G technology will have the facilities error control schemes along with modulation techniques.

<table>
<tr><td>Application Layer</td><td rowspan="2">Application
(Services)</td></tr>
<tr><td>Presentation Layer</td></tr>
<tr><td>Session layer</td><td rowspan="2">Open Transport Protocol (OTP)</td></tr>
<tr><td>Transport Layer</td></tr>
<tr><td rowspan="2">Network layer</td><td>Upper network layer</td></tr>
<tr><td>Lower network Layer</td></tr>
<tr><td>Data link Layer(MAC)</td><td rowspan="2">Open Wireless Architecture (OWA)</td></tr>
<tr><td>Physical Layer</td></tr>
</table>

Fig.: OSI Layers and 5G Network Layers

A. PHYSICAL/MAC LAYERS

The physical layer, OSI layer-1 has a major responsibility for coordination. It co-ordinates the functions required to carry a bit stream over the physical layer. The transmission and interface media have some electrical and mechanical specifications which are determined by the physical medium. The devices and interfaces on the physical layer have to perform some functions and procedure for the transmission to occur which are also governed by the physical layer. The physical layer takes into consideration that the physical characteristics of devices, interfaces, and medium, voltage fluctuations, bits representation, physical data rate, synchronization of bits, configuration of the line, transmission mode, and physical topology.

B. NETWORK LAYER

In the network layer, the limitations of number connection which were carried out by Internet Protocol version 4 (IPv4) had been solved by IPv6 but required bigger packet header. The Network layer, OSI layer-3 is responsible for the packet delivery from the source to the destination through multi- channel networks. The Network layer is applicable only when their source to destination delivery arises or require.

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The 5G devices will maintain the virtual multi-wireless networks environment. For that purpose, network layer should be separated into two sub-layers in 5g devices i.e.: Lower network layer for an interface of each, and Upper network layer for the device terminal. This is due to the very first design of the Internet, where all the routing is based on the IP addresses which is different in each IP network worldwide. The middleware between the Lower and Upper network layers should maintain address translation from Lower network layer IP addresses (IPv4 or IPv6) to different Upper network layer IP address (IPv6), and vice versa.

C. OPEN TRANSPORT PROTOCOL (OTP) LAYER

The transport layer, layer-4 in the OSI model is the layer through which various wireless networks vary from each other. Transport layer performs process-to-process delivery of the entire message. The transport layer converts the packets that it received from the layer-3 network layer into segments and assures that the segments are ready for transmission. It brings out the relationship between the two packets which are delivered and ensure that the entire messages arrive as it was overseeing. The Transport layer also responsible for error control, flow control, control connection, segmentation and reassembly and service-point addressing.

For the 5G device terminals, it is very relevant to have transport layer this is possible to download and install. Such devices have the possibility to download version which is targeted to a specific wireless technology installed at the base stations [11]. This is called Open Transport Protocol (OTP).

D. APPLICATION LAYER

The application layer, layer-7 in the OSI model is responsible for providing services to the user and user interface. The application layer enables the user to access the networks, whether human or software too. The application layer provides and supports services such as file transfer and remote file access, e-mail, shared database management access, and other types of information services. The application layer also consists of a virtual network terminal which allows the user to create use any Host ID. Nowadays, in the devices, the users manually select the wireless interfaces for specific Internet service without having the possibility to use Quality of Service history to select the best wireless connection. The Quality of Service (QoS) parameters, like jitter, delay, bandwidth, reliability, will be stored in a database in the 5G devices with objective to be used by brilliant algorithms running in the device terminal as the system processes, at the end will provide the best wireless connection upon required Quality of Service.

VII. 5G NETWORK ARCHITECTURE

The Fifth generation network system is all IP based network model for wireless networks and mobile networks ability. The All-IP network is capable of fulfilling all the rising demand in the market cellular communications. The Fifth Generation technology is a common platform for all radio access technologies. The All-IP network uses packet switching technique and its continuous evolution provides improved performance and cost. The Fifth Generation Architecture consist of a number of an independent, autonomous radio access technologies (RAT) and the user terminal. In Fifth Generation network architecture all-IP based mobile applications and services such as mobile banking, mobile commerce and etc, are offered through Cloud Computing Resources (CCR). Cloud computing is a model for beneficial on-demand network access configurable computing resources such as storage, servers, applications, services and networks. Cloud computing allows the users to use applications without any installation and access their personal data at any mobiles or computers with internet access.

CCR links the Reconfigurable Multi-Technology Core (RMTC) with remote reconfiguration data from RRD attached to Reconfiguration Data models (RDM). The main challenge for an RMTC is to deal with increasing different radio access technologies. The core is a convergence of the nanotechnology, cloud computing, and radio, and based on All IP Platform. Core changes its communication functions depending on the status of the network and/or user demands. RMTC is connected to different radio access technologies ranging from 2G/GERAN to 3G/UTRAN and 4G/EUTRAN in addition to 802.11x WLAN and 802.16x WMAN. Other standards are also enabled such as IS/95, EV-DO, CDMA2000...etc. Interoperability process criteria and mechanisms enable both terminal and RMTC to select from heterogeneous access systems. [2,4]

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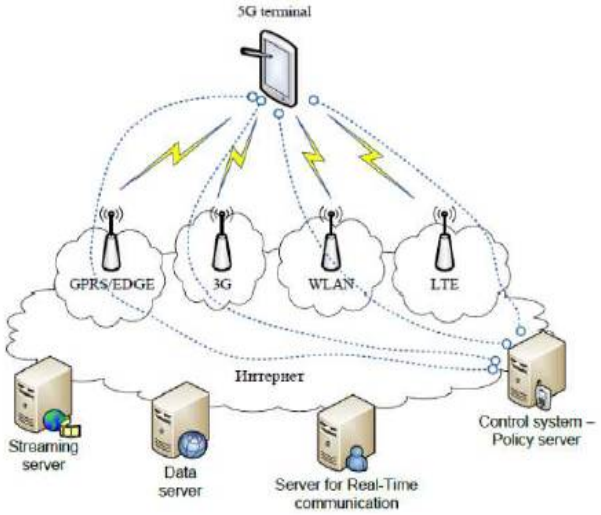

Fig.: 5G Network Architecture [4]

VIII. CONCLUSION

In this paper, we have surveyed 5G mobile technology. The 5G mobile technology is designed as an open platform on different layers. 5G technology is about to begin and going to give tough completion to mobiles and computers. In the world of mobile communication technology from 1G,2G,3G, and 4G to 5G. The 5G devices will have access to different wireless technologies at the very same time. 5G offers high speed and resolution for passionate mobile phone consumer.

IX. FUTURE SCOPE

The future enhancement of 5G technology will be incredible as it combines with the Artificial Intelligent. The 5G will use the technology Internet of Things (IoT). The IoT will be used to connect all the devices to the internet through the sensors. The use of IoT technology will lead to building the smart cities and country.5G network technology will bring a new era in the mobile wireless communication technology. The 5G devices will have access to various wireless technologies at the same time and the terminal should be able to combine various flows from various technologies. 5G technology offers high resolution for the for the crazy phone user. We can monitor any place of the world and observe the space, and watch HD channels in tablets and mobile from anywhere. The 5G will use the technology Internet of Things (IoT). The IoT will be used to connect all the devices to the internet through the sensors. The use of IoT technology will lead to building the smart cities and country. The future enhancement of 5G technology will be incredible as it combines with the Artificial Intelligent.

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