Wireless Communications - 5G Networks and Architecture

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Abstract:- The number of people using mobile phones In the world has exceeded 6 billion and this figure is continuing to grow. For the past several years, mobile data traffic such as Internet access, the downloading of music, and video communication has been nearly tripling every year. Hence, the search for new technology is always the main intention of the prime wireless communication giants to out innovate their competitors. In addition, the main purpose of the fifth generation wireless networks (5G Wireless networks) is planned to design the best wireless world that is free from limitations and hindrance of the previous generations. 5G technologies will change the way most high bandwidth users access their Mobile Radio Communication (MRC). So, this paper represents, great evolution of 1G to 4G yield 5G, introduction to 5G technologies, why there is a need for 5G, advantages of 5G networks technology, exceptional applications, Quality of Service (QoS), 5G network architecture-The Master Core as well as hardware and software for the 5G Master Core technology.

Keywords: - 5G, Quality of Service, Architecture, Mobile Radio Communication

I. INTRODUCTION

The number of mobile phone users in the world has exceeded 6 billion and looks to grow further. Above all, mobile data traffic such as Internet access and video communication has been nearly tripling every year for the past several years. With cloud computing, smart phones and sensors all expected to be widespread in the future, mobile data traffic will likely show explosive growth, and this has further raised expectations for high-speed wireless access. We have different mobile and wireless communication technologies, which are mass deployed, such as WiMAX (IEEE 802.16 wireless and mobile networks). Wi-Fi (IEEE 802.11 wireless networks), LTE (Long Term Evolution). 3G mobile networks (UMTS. cdma2000) and 4G as well as accompanying networks, such as personal |area networks (e.g.. Bluetooth. ZigBee) or sensor networks. Mobile terminals include variety of interfaces, such as GSM is one. which are based on old-fashioned circuit switching, the technology that is going into its last decade of existence. These technologies (mainly cellular generations) differ from each other based on four main aspects: radio access, data rates, bandwidth and switching schemes [2]. These differences have been noticed in previous generations (1G. 2G. 2.5G and 3G etc.). In accordance to we are exploring the most advance cellular technology, could be 5G. 5G Technology stands for 5th Generation Mobile Technology. 5G technology has changed to use cell phones within very high bandwidth. 5G is a packet switched wireless system with wide area coverage and high throughput. 5G technologies use CDMA and BDMA and millimeter wireless that enables seed is greater than 100Mbps at full mobility and higher than lGbps at low mobility.

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The 5G technologies include all types of advanced features which make 5G technology most powerful and in huge demand in the near future. It is not amazing, such a huge collection of technology being integrated into a small device. The 5G technology provides the mobile phone users more features and efficiency. A user of mobile phone can easily hook their 5G technology gadget with laptops or tablets to acquire broadband internet connectivity. Up till now following features of the 5G technology have come to surface- High resolution is offered by 5G for extreme mobile users, it also offers bidirectional huge bandwidth [3]. Higher data rates and the finest Quality of Service (QoS) (i.e. discussed below in the paper). Now a days, all wireless and mobile networks are forwarding to all-IP principle, that means all data and signaling will be transferred via IP (Internet Protocol) on network layer [4].The purpose of the All-IP Network (AIPN) is to completely transform ("to change in composition or structure") the 100+ years of legacy network infrastructure into a simplified and standardized network with a single common infra structure for all services. In order to implement 5G technology. Master Core technique is needed to apply All-IP Network (AIPN) properly. Hence, the Master core is designed. The 5G Master Core is a convergence of Parallel Multimode (PMM), 5G-IU technology. These technologies have their own impacts on existing wireless networks which make them into 5G.

II. EVOLUTION OF WIRELESS TECHNOLOGIES

2.1 Review of Previous Fourth Generations Systems

2.1.1 First-Generation Systems (1G)

The 1st generation was pioneered for voice service in early 198CTs. where almost all of them were analog systems using the frequency modulation technique for radio transmission using frequency division multiple access (FDMA) with channel capacity of 30 KHz and frequency band was 824-894 MHz [7]. which was based on a technology known as Advance Mobile Phone Service (AMPS).

2.1.2 Second Generation Systems (2G)

The 2nd generation was accomplished in later 1990*s. The 2G mobile communication system is a digital system: this system is still mostly used in different parts of the world. This generation mainly used for voice communication also offered additional services such as SMS and e-mail. In this generation two digital modulation schemes are used: one is time division multiple access (TDMA) and the 2nd is code division multiple access (CDMA) [8] and frequency band is 850-1900 MHz. In 2G. GSM technology uses eight channels per carrier with a gross data rate of 22.8 kbps (a net rate of 13 kbps) in the frill rate channel and a frame of 4.6 milliseconds (ms) duration. The family of this generation includes of 2G. 2.5G and 2.75G.

2.1.3 Third Generation Systems (3G)

Third generation (3G) services combine high speed mobile access with Internet Protocol (IP)-based services. The main features of 3G technology include wireless web base access, multimedia services, email, and video conferencing. The 3G W-CDMA air interface standard had been designed for "always-on" packet-based wireless service, so that computer, entertainment devices and Telephones may all share the same wireless network and be connected internet anytime, anywhere. 3G systems offer high data rates up to 2 Mbps. over 5 MHz channel carrier width, depending on mobility/velocity, and high spectrum efficiency. The data rate supported by 3G networks depends also on the environment the call is being made in: 144 kbps in satellite and rural outdoor. 384 kbps in urban outdoor and 2Mbps in indoor and low range outdoor [5]. The frequency band is 1.8-2.5 GHz.

2.1.4 Fourth Generation Systems (4G)

4G usually refers to the successor of the 3G and 2G standards, hi fact, the 3GPP is recently standardizing LTE Advanced [9] as future 4G standard. A 4G system may upgrade existing communication networks and is expected to provide a comprehensive and secure IP based solution where facilities such as voice, streamed multimedia and data will be provided to users on an "Anytime, Anywhere" basis and at much higher data rates compared to previous generations. One common characteristic of the new services to be provided by 4G is their demanding requirements in terms of QoS. Applications such as wireless broadband access. Multimedia Messaging Service (MMS). video chat, mobile TV. HDTV content and Digital Video Broadcasting (DVB) are being developed to use a 4G network.

2.1.4.1 LTE advanced

LTE release 10. also referred to as LTE-Advanced, is claimed to be the true 4G evolution step. Earlier releases of LTE are included as integrated parts of LTE release 10. providing a more straightforward backwards compatibility and support of legacy terminals, for example. The main requirement specification for LTE advanced as approved in [9] are:

- Peak Downlink data rate: 1 Gbs. Peak Uplink data rate: 500 Mbps.
- Transmission bandwidth: Wider than approximately 70 MHz in DL and 40 MHz in UL.
- User throughput at cell edge 2 times **higher** than that in LTE.
- Average user throughput is 3 times **higher** than that in LTE.
- Spectrum efficiency 3 times **higher** than that in LTE: Peak spectrum efficiency downlink: 30 bps/Hz. Uplink 15 bps/Hz.
- Mobility: Same as that in LTE.
- Coverage should be optimized or deployment in local areas/micro cell environments with Inter Site Distance (ISD) up to 1 tan.

III. FIFTH GENERATION SYSTEMS (5G)

5G Wireless Communication System is not deployed yet. The big challenge for the design and deployment of 5G wireless system can be faced easily as proposed features and architecture (mentioned below) that will increase system capacity and quality within the limited available frequency spectrum, whose frequency band and Data Bandwidth will be '3-300GHz" and ' lGbps & higher (as demand)" successively. The remarkable issue, there don't have any limitation in 5G as respect to user demands in the next 200 years. The 5G **also** implies the whole wireless world interconnection (WISDOM—Wireless Innovative System for Dynamic Operating Mega communications concept), together with very high data rates of the Quality of Service (QoS) applications.

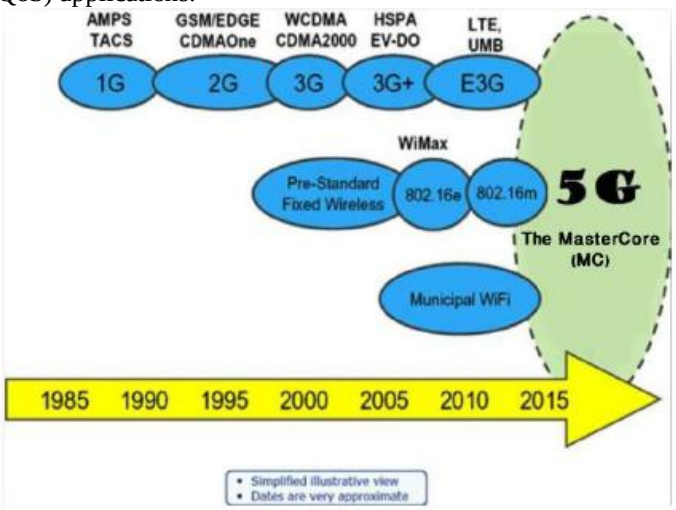

Figure1: Evaluation of Mobile Technology

	Table 1: Basic comparison among 3G, 4G and 5G Technology		
Technology/ features	3G	4G	5G
Data Bandwidth	2Mbps	2Mbps to lGbps	lGbps& Higher (as demand)
Frequency Band	1.8-2.5 GHz	2-8GHz	3-300GHz
Standards	WCDMA CDMA 200 TD-SCDMA T191	All access convergence including: OFMDA.MC - CDMA Network-LMPS	CDMA & BDMA
Technology	Broad bandwidth GDMAJP technology	Unified IP And seamless combination of broadband LANAVAN/ PAN and WLAN;	Unified IP and seamless combination of broadband. LANAVAN/PANAVLAN and technologies for 5G new deployment (could be OFDM etc.);

Service	Integrated high quality audio, video and data	Dynamic information access, wear-able devices, HD streaming; global roaming:	Dynamic information access, wear-able devices, HD streaming: any demand of users: upcoming all technologies: global roaming smoothly:
Multiple Access	CDMA.	CDMA	CDMA ft BDMA
Core Network	Packet Network	All IP Network	Flatter IP Network & 5G Network Interfacing (5G-Nr)
Definition	Digital Broadband, packet data	Digital Broad band. Packet data. All IP	Digital Broadband. Packet data Alf IP. Very high throughput
Hand off	Horizontal	Horizontal & Vertical	Horizontal & Vertical
Start from	2001 [121	2010 fl21	2015 [121

3.1 Need for 5G

This paper mainly focuses on how a 5G network can provide more facilities approach to a common man to utilize his available possessions in an enormous way to make him to feel the real progress. As a user point of view, the major difference between current generations and expected 5G techniques must be something else than increased maximum throughput: other requirements include [1]:

- It could make better revenue for current global operators as well as interoperability will become more feasible.
- Improved and innovative data coding and modulation techniques, which includes filter bank multi carrier way in schemes.
- For wireless access and back haul use of millimeter wave frequencies is very useful.
- With the support of different conduction points with related coverage and surrounding the option of a supple usage of resources for uplink and down link transmission in each cell is achieved by superior intrusion and mobility management.
- To make 5G practical for all sorts of radio access technologies there should be a common platform unique for all the technologies.
- Lower battery consumption.
- Lower outage probability.
- Better coverage and high data rates available at cell edge.
- Multiple concurrent data transfer paths.
- Possible to lGbps and higher data rate in mobility.
- More secure; better cognitive radio 'SDR Security.
- Higher system level spectral efficiency.
- World Wide Wireless Web (WWWW). Wireless-based web applications that include full multimedia capability beyond 4G speeds.
- More applications combined with Artificial Intelligent (AI) as human life will be surrounded by artificial sensors which could be communicating with mobile phones.
- Not harmful to human health.
- Cheaper traffic fees due to low infrastructure deployment costs.
- Smart beam antenna systems.

3.2. Qualify of Service (QoS)

Next Generation Networks (NGN) consists of support functionalities for data transport, and control transport, as well as functionalities for support of services and applications. The measurement of traffic is a basic control activity in order to provide Quality of Service. **[6].** In addition 5G communication system is designed by the finest Quality of Service (QoS). Quality of Service (QoS) refers to a network's ability' to achieve maximum bandwidth and deal with other network performance elements like latency, error rate and uptime. Quality' of service also involves controlling and managing network resources by setting priorities for specific types of data (video, audio, files) on the network. QoS is exclusively applied to network traffic generated for video on demand. IPTV. VoIP, streaming media, videoconferencing and online gaming. The primary goal of quality' of service is to provide priority to networks, including dedicated bandwidth, controlled jitter, low latency and improved loss characteristics. Its technologies supply the elemental building blocks that will be used for future business applications in campus, wide area networks and service provider networks. There are three fundamental components for basic QoS implementation:

- Identification and marking techniques for coordinating QoS from end to end between network elements.
- QoS within a single network element.
- QoS policy, management, and accounting functions to control and administer end-to-end traffic across a network.

3.3 Exceptional applications

The 5G Master Core has some exceptional applications with common features as;

- One can know weather, temperature, and location etc. of each other when conversation is going on.
- Students can attend any class of any institute of the world without going there (by WCSM).
- A doctor can treat patients of other countries from a place.
- Possible to monitor any place of the world from anywhere.
- Batteries can be charged by using network without charger.
- It could be possible to visualize lively all the planets and the Universe.
- One can complete his/her works without going to the office.
- One can be able to locate his/her child when she he is unfortunately missed.
- One can be able to predict tsunami/earthquake before it occurs.

3.4 A proposed 5G Network Architecture

Terminals and network components are dynamically upgraded (and adapted) to new situation. Network operators use the upgradeability to introduce value-added services more easily. Upgradeability is based on cognitive radio. Cognitive radio technologies include the ability of devices to determine their location and location's information (i.e. temperature, weather etc.). sense spectrum used by neighboring de\ices, change frequency, adjust output power and even alter transmission parameters and characteristics. A cognitive radio is a transceiver (beam) that is able to understand and respond to its operating environment. Thus cognitive radio concerns mobile devices and networks which are computationally intelligent about radio resources and related communications to explore user communication needs and provide wireless services, be appropriate to those needs. Hence, the radio is aware and cognitive about changes in its environment and responds to these changes by adapting operating characteristics in some way to improve its performance. In addition, the appropriate proposed architecture of the 5G Master Core technology is shown below in figure 2.

3.4.1 The Master Core

The 5G potential will require the design of a single wireless user terminal able to self-explanatory operate in different heterogeneous access networks. A fully upgradable terminal changes its communication functions depending on network and/or user demands.

In addition, the main challenge for an upgradable Master Core is to deal with increasing number of different radio access technologies based on solid interoperability criteria and mechanisms. A core could be a convergence of the aforementioned nanotechnology. Parallel Multimode (PMM) technology, cloud computing and cognitive radio, upgradable and based on All IP Platform and 5G-IU is called the Master Core. The 5G Master Core is an upgradable and multi-technologies core. The Master Core upgradability could be a self-adaptation and made adaptation to a dynamically-changing environment or mission oriented adaptation to meet a given set of mission requirements with die aim of improving service delivery and spectrum, utilization.

The Master Core changes its communication functions depending on network status and/or user demands. Upgradability could be in both software and hardware. Hardware upgradability is mainly performed by operators, adding additional equipments to increase network capacity at a specific time. However, in software upgradability and with die power of SDR, network is dynamically upgradable, which means that the programs (running on the upgradable processing elements) as well as the communication links between die processing elements are upgraded at run-time. Upgradable hardware and software segments have been shown in the Master Core Technology (MCT) in Figure 3. Different processing elements are used for different purposes.

The general purpose processors are fully programmable to perform different computational tasks. The block diagram of the Master Core architecture is shown in Figure 2.

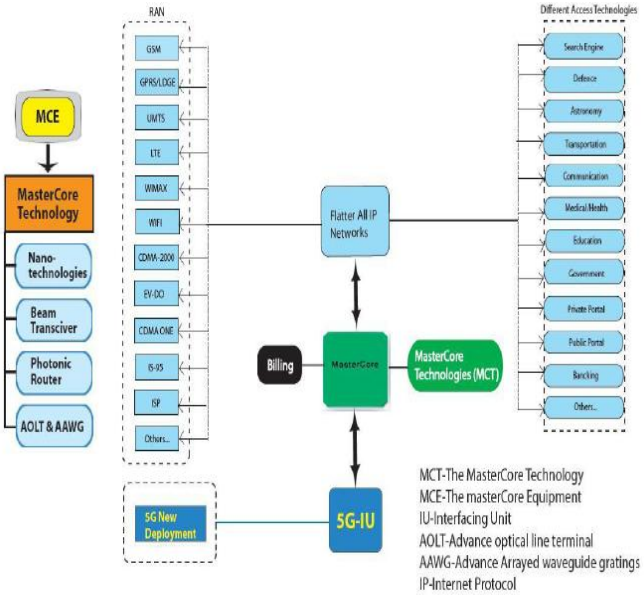

Figure 2: The MasterCore Architecture

3.4.2 The MasrerCore Technologies (MCI)

The 5G MasterCore is a convergence of below mention technologies. These technologies have their own impact on exiting wireless network winch makes them in to 5G. The different segments of the MasterCore Technology (MCT) In 5G Wireless Communication Systems, The Master core can be operated into parallel multimode such as All IP Network Mode, 5G Network Mode, where in All IP Network Mode controls all network technologies of RAN and DAT (Different Access Networks) up to 5G new deployments. 5G Network Mode manages all new deployments based on 5G as a result 5G network systems will be more efficiency, powerful and less complicated. Any service mode can be opened under 5G-NDM (New Deployment Mode) as WCSM (World Combination Service Mode).WCSM provides some services among subscribers that can be used in special purposes for example, a lecturer writes on white board that display on another board without video in any country of the world and vice versa besides conversation and video. For Parallel Multimode. any new service can be added easily so that system of the network no needs to change. In feet all modes run at a time continuously (i.e. parallel).

3.5 MC Hardware and Software

3.5.1 Hardware

In MasterCore technology, assembly of hardware is set into several units to maintain whole network system properly, also to troubleshoot in core network instantly. As a result, efficiency of the core is suitable with demanded services. Hardware classified into different units as:

a) Remote Server Control Unit (RSCU) provides a great opportunity to control remote server of users* networks. It indicates the immediate condition of remote server.

b) Network Control Unit (NCU) provides control of the communications among MS.

c) Upgradeable Storage (US) refers to increase the storage as necessity as demand.

d) Upgradeable Central Control Unit (UCCU) provides the facilities to control all units centrally.

3.5.2 Software

Software Defined Radio (SDR) benefits from today's high processing power to develop multi-band, multi-standard base stations and terminals. Although in future the terminals will adapt die air interface to the available radio access technology, at present this is done by the infrastructure. Several infrastructure gains are expected from SDR_ For example, to increase network capacity at a specific time (e.g. during a sports event), an operator will reconfigure its network adding several modems at a given. Base Transceiver Station (BTS). SDR makes tins reconfiguration easy. In the context of 4G systems, SDR will become an enabler for the aggregation of multi-standard pico/rnicro cells. For a manufacturer, this can be a powerful aid to providing multi-standard multiband equipment with reduced development effort and costs through simultaneous multi-channel processing.

1) 5G will be single unified standard of different wireless networks, including wireless technologies (e.g. IEEE 802.11), LAN/WAN' PAN and WWW, unified IP and seamless combination of broad band.

2) Software Defined Radio. Packet layer, implementation of packets, encryption, flexibility etc. In figure 2 are shown different classification segments of 5G software such as:

a) Application: The MasterCore Application Software (MCAS) refers to all application software are needed as to provide services and managements.

Subscriber's Application Software (SAS) is installed centrally so that subscriber runs a program without installing on his own devices. All services of application software are provided from central server.

b) System: System Software is an Operating System (OS) for the 5G MasterCore networking.

c) Database: The MasterCore Database (MCDB) software refers to manage and store all data of whole system those are needed. Client's Database (CDB) software manages all data of user's server those contain all essential information of users and users' networks.

d) Security Management: **Securities (users to the** Mastercore) will be managed centrally by Security Management (SM) software.

3.6 5G-IU

5G-IU (5G Interfacing Unit) acts to make the most powerful of 5G wireless communication system. Because, all sorts of radio access technologies are combined in a common platform is complex form of aggregation. It will be more complex in future when added new radio access technologies. This is why, 5G-IU is used between new deployments and core network so that 5G wireless communication system is easily manageable. It has some advantages are:

- Lower costs to establish networks.
- Lessen equipments.
- Improve network efficiency.
- Reduce complexity.
- Easily maintain high security.
- Impossible to occur any trouble.

3.7 The Master Core Equipments (MCE)

Mobile phone has become more than a communication device in modern world it has turned into an identity of an individual. In 5G MasterCore these mobile and oilier de\ices (Laptop, local networking devices etc.) are referred as the MasterCore Equipments (MCE) as they are improved with nanotechnology. Beam Transceiver. Advance Optical Line Terminal (AOLT), Advance Arrayed Waveguide Gratings (AAWG). Nanotechnology refers Nano Equipments (NE) are Morph. Graphene's Transistor, GPS, Micro-Micro Phones. Liquid lens. Intelligent Batteries and Nanosensor [5]. We will broadly discuss about NE in our further papers. These are classified into two categories one is user's de\ice and another is internal devices of user's networks. AOLT and AAWG are used in user's networks (LAN. WAN, MAN etc.) to increase faster data rate. We will be discussing about AOLT and AAWG in our further slides. One of the central visions of the wireless industry aims at ambient intelligence, computation and communication always available and ready to serve the user in an intelligent and efficient way. This requires that the devices are mobile. Mobile devices together with the intelligence and efficient that will be embedded in human environments — home, office, public places - will create a new platform that enables ubiquitous sensing, computing, and communication Specs of MasterCore Equipments given as follow:

- Self Cleaning - the phone cleans by itself.
- Self powered - the phone derives its energy/power from the sun, water, or air.
- . Sense the environment - the phone will tell you the weather, the amount of air pollution present, etc.
- . Flexible - bend but not break.
- More Reliable.
- . Transparent — "'see through" phones.

IV. FUTURE ENHANCEMENT

5G network technology will reveal a new era in mobile communication technology. The 5G mobile phones will have access to different wireless technologies at the same time and the terminal should be able to combine different flows from different technologies. 5G technology offer high resolution for crazy cell phone user. 5G technology will provide supper and perfect utilization of cellular communication in future. We can monitor any place of the world from anywhere, observe space and watch TV channels at HD clarity in our mobile phones without any interruption. There will be exciting amusement unbelievable services. The 5G mobile phones will be a tablet PC and amazing. Many mobile embedded technologies will evolve.

V. CONCLUSION

In this paper we have discussed the existing and future wireless mobile communication generations and cellular systems focusing on four main key factors: switching schemes, bandwidth, data rates, and radio access, also 5G main development challenges and explained the necessity for 5G. The 5G mobile technology will be implemented in the current decade. We have proposed the MasterCore technology and its hardware and software implementation. We expect that this Paper helps to uplift stronger links between people working in different fields creating future concepts of mobile communication. Internet services. Quality of Service (QoS) and concept of the MasterCore. The new coming 5G technology is available in the market to fulfill user demands in affordable rates, bright and high peak future also much reliability as well as exceptional applications.

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