



## 5G Wireless Communication Systems

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### Abstract: -

*As a subscriber becomes more aware of the mobile phone technology, he/she will seek for an appropriate package all together, including all the advanced features of a cellular phone can have. Hence, the search for new technology is always the main intention of the prime cell phone 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 (First Generation) 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 MasterCore as well as hardware and software for the 5G MasterCore technology.*

### Keywords: -

5G; All IP Network; Cloud Computing ; 5G architecture-The Master Core; Quality of Service (QoS); 5G-IU; Parallel Multimode (PMM)

### INTRODUCTION

We are living in modern science. We can not think a single moment without science. Science makes our life easy and comfortable. Modern world is being compressed due to the development of science and its technologies. During the last few decades, the world has seen phenomenal changes in the telecommunications industry due to science and technology. 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 [1]. 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 speed is greater than 100Mbps at full mobility and higher than 1Gbps at low mobility. 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 [2], higher data rates and the finest Quality of Service (QoS) (i.e. discussed below in the paper).



## EVOLUTION OF WIRELESS TECHNOLOGIES

This section mentions in short the evolution of wireless and cellular systems based on the four main key aspects: radio access, data rates, bandwidth and switching schemes.

### Review of Previous Fourth Generations Systems

#### First-Generation Systems (1G)

The 1st generation was pioneered for voice service in early 1980's, 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 [6], which was based on a technology known as Advance Mobile Phone Service (AMPS).

#### 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) [7] 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 full rate channel and a frame of 4.6 milliseconds (ms) duration [14]. The family of this generation includes of 2G, 2.5G and 2.75G.

#### 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 [13]. 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 [4]. The frequency band is 1.8 - 2.5 GHz [16].

#### Fourth Generation Systems (4G)

4G usually refers to the successor of the 3G and 2G standards. In fact, the 3GPP is recently standardizing LTE Advanced [8] 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.

#### *LTE advanced*

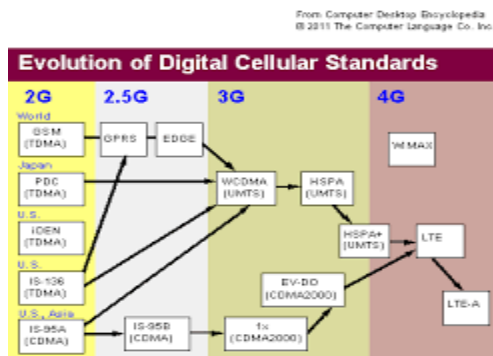
LTE release 10, also referred to as LTE-Advanced, is claimed to be the true 4G evolution step. Earlier releases of LTE are included as integrated parts of LTE release 10, providing a more straightforward backwards compatibility and support of legacy terminals, for example. The main requirement specification for LTE advanced as approved in [8] 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 km

**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 '1Gbps & 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.



Technology/features	3G	4G	5G
Data Bandwidth	2Mbps	2Mbps to 1Gbps	1Gbps & Higher (as demand)
Frequency Band	1.8 - 2.5 GHz [16]	2 - 8 GHz [16]	3-300GHz [16],[18]

Standards	WCDMA, CDMA-2000, TD-SCDMA, MA [19]	All access convergence including: OFDMA, MC-CDMA, Network-LMPS [19]	CDMA & BDMA
Technology	Broad bandwidth, CDMA, IP technology [19]	Unified IP and seamless combination of broadband LAN/WAN/PAN and WLAN [19];	Unified IP and seamless combination of broadband, LAN/WAN/PAN/WLAN [19] and technologies for 5G new deployment (could be OFDM etc.);
Service	Integrated high quality audio, video and data	Dynamic information access, wearable devices, HD streaming; global roaming;	Dynamic information access, wearable devices, HD streaming; any demand of users; upcoming all technologies; global roaming smoothly;
Multiple Access	CDMA	CDMA	CDMA & BDMA
Core Network	Packet Network	All IP Network	Flatter IP Network & 5G Network Interfacing (5G-NI)
Definition	Digital broadband and pocket data	Digital broadband pocket data all ip	Digital broadband pocket data all ip, high speed

**Nanotechnology**

Nanotechnology is the application of nanoscience to control process on nanometer scale between 0.1 to 100nm. The field is also known as Molecular Nanotechnology (MNT) where MNT deals with control of the structure of matter based on atom-by-atom and molecule by



molecule engineering. Nanotechnology is considered as the next industrial revolution, and the telecommunications industry will be radically transformed by it in a few years. As the future applications will require more memory and computing power to offer higher data rates, current technologies can not resolve these challenges. Fortunately, nanotechnology could provide effective solutions for power efficient computing, sensing, memory enlargement, and human-machine interaction, [9], [10].

Nanotechnology has shown its impact on both mobile as well as the core network as follows.

- The mobile device has become more than a communication device in modern world; computation and communication are ready to serve the user in an intelligent way. Mobile devices together with the intelligence, embedded in human environments, will create a new platform that enables ubiquitous sensing, computing, and communication. With nanotechnology mobile phones can act as intelligent sensors that have applications in many industries, among them transportation, communications, medicine and safety.
- The core network requires high speed and a reliable capacity to manipulate and interoperate increasing number of heterogeneous access technologies. At present, nanotechnologies are used in Digital Signal Processing (DSP) Fabrication, introducing new perceptions in DSP designing that increases the overall system speed & capacity.

Apart from this it has its own impact on sensor as well as security. This is considered as a most significant in telecommunication.

## 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, BSC, MSC and PSTN.
- 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.

## 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 the 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 this reconfiguration easy. In the context of 4G systems, SDR will become an enabler for the aggregation of multi-standard pico/micro 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.

## 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.

## The MasterCore 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 other devices (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 NanoEquipments (NE) are Morph, Graphene's Transistor, GPS, Micro-Micro Phones, Liquid lens, Intelligent Batteries and Nanosensor [4]. We will broadly discuss about NE in our further papers. These are classified into two categories one is user's device 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 throughl phones.

## 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 at the end of 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), Cloud computing, All IP network, Nanotechnologies 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.

## REFERENCES

- [1.] Ermolov V. et al. —*Significance of Nanotechnology for future wireless devices and*



*Communications”, The 18th Annual IEEE International Symposium on PIMRC’07*

[2.] ITU-T, Y.2173, —*Management of performance measurement for NGN”, September 2008.*

[3.] Chen, YP; Yang, YH (2007), —*A new 4G architecture providing multimode terminals always best connected services,” IEEE Wireless Communications, Volume: 14 Issue: 2 pp. 36-41.*

[4.] Xichun Li, AbudullaGani, RosliSalleh, Omar Zakaria 2009,| *The Future of Mobile*

*Wireless Communication Networks,”2009 International Conference on Communication Software and Networks [8] 3GPP TSG RAN TR 36.913 v8.0.0, Requirements for Further Advancements for E-UTRA (LTEAdvanced*

[5.] T. Janevski, —*Traffic Analysis and Design of Wireless IP Networks*||, *Artech House Inc., Boston, USA, 2003.*

[6.] *Wikipedia*

[7.] *Google*