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# ADVANCEMENT OF COMMUNICATION TECHNOLOGY FROM 1G TO 5G

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**Abstract:** *The paper is designed to introduce the fundamental information for future or next Generation Technology. The paper covers the difference from 1G to 5G and challenges to be faced for deploying 5G networks. 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. In the past few decades, mobile wireless technologies have experience 4 or 5 generations of technology revolution and evolution, namely from 1G to 4G.Current research in mobile wireless technology concentrates on advance implementation of 4G technology and 5G technology. Currently 5G term is not officially used. In 5G research is being made on development of World Wide Wireless Web (WWWW), Dynamic Adhoc Wireless Networks (DAWN) and Real Wireless World. We propose novel network architecture for next generation 5G mobile networks.. In the proposed architecture the mobile terminal has the possibility to change the Radio Access Technology - RAT based on certain user criteria. 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 Master Core as well as hardware and software for the 5G Master Core technology.*

***Keywords:*** *Evolution of wireless technologies, 5G technology, Architecture, Need of 5G.*

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## I. INTRODUCTION

We are living in modern science. We cannot 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, Zig Bee) 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 seed is greater than 100Mbps at full mobility and higher than1Gbps 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). 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 [3].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 infrastructure for all services [15]. In order to implement 5G technology, MasterCore technique is needed to apply All-IP Network (AIPN) properly. Hence, the Mastercore is designed. The 5G MasterCore is a convergence of Parallel Multimode (PMM), Nanotechnology, Cloud Computing, and All IP Platform (Broadly mansion in section….) also 5G-IU technology. These technologies have their own impacts on existing wireless networks which make them into 5G.

**Figure 1: Wireless Communication Network**

## II. EVOLUTION OF WIRELESS TECHNOLOGIES

**First generation (1G)** wireless mobile communication system is not digital technology, but analog cellular telephone system was used for voice service only during the early 1980s. This Advanced Mobile Phone System (AMPS) was frequency modulated analog mobile radio system using Frequency Division Multiple Access (FDMA) with 30kHz channels occupying the 824MHz − 894MHz frequency band and a first commercial cellular system deployed until early1990's.[1]

**Second generation (2G)** wireless mobile systems are digital cellular systems. Comparing with the first generation, the second generation wireless system used digital modulation scheme, such as time division multiple access (TDMA) and code division multiple access (CDMA). Based on the two techniques, there were three primary 2G mobile communication systems. They are TDMA (IS-136), CDMA (IS-95), and GSM. TDMA (IS-136), as a completely digital system , was deployed in North America in 1993, but operated in the AMPS frequency band of 824MHz-894MHz. CDMA (IS-95) systems using Direct Sequence Spread Spectrum (DSSS) are working on the 1850-1990 MHz frequency band to support CDMA carriers.[1]

**Third generation ( 3G)** establish an international standard for 3G mobile is being moderated through the ITU, under the auspices of its IMT-2000 program. It was inveterate in late 2000.It provides transmission speed up to 2Mbps. Third generation (3G) services combine high speed mobile access with Internet Protocol (IP)-based services. Apart from transmission speed innovative enhancement was made in Quality of services. Add on services such as global roaming, better voice quality, always on made 3G as a significant generation.[2]

**Fourth-Generation (4G)** is a term used to describe the next complete evolution in wireless communications. The approaching 4G (fourth generation) mobile communication systems are projected to solve still remaining problems of 3G (third generation) systems and to provide a wide variety of new services, from high-quality voice to high-definition video to high data-rate wireless channels. The term 4G is used broadly to include several types of broadband wireless access communication systems, not only cellular telephone systems. One of the terms used to describe 4G is MAGIC—Mobile multimedia, anytime anywhere, Global mobility support, integrated wireless solution, and customized personal service.

**Fifth Generation (5G):** While considering a smooth migration for 5G it is apparent that it should be valid for all sorts of radio access technologies So that it could make better revenue for current global operators as well as interoperability will become more feasible. To make 5G practical for all sorts of radio access technologies there should be a common platform unique for all the technologies. One of those unique platforms is Flat IP network. Certainly Flat IP network is the key concept to make 5G acceptable for all kind of technologies. To meet customer demand for real-time data applications delivered over mobile broadband networks, wireless operators are turning to flat IP network architectures. Flat IP architecture provides a way to identify devices using symbolic names, unlike the hierarchical architecture such as that used in "normal" IP addresses.

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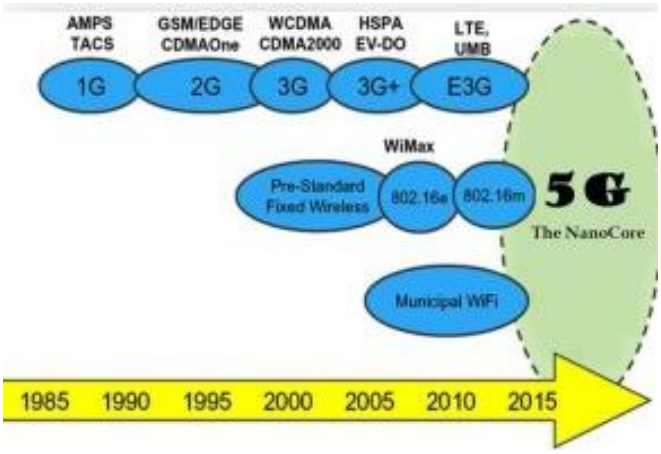


**Figure 2: Evolution of Mobile Technologies**

## III. FIFTH GENERATION SYSTEM (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 emand)‘ 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.

**Figure 3: Fifth Generation Mobile**

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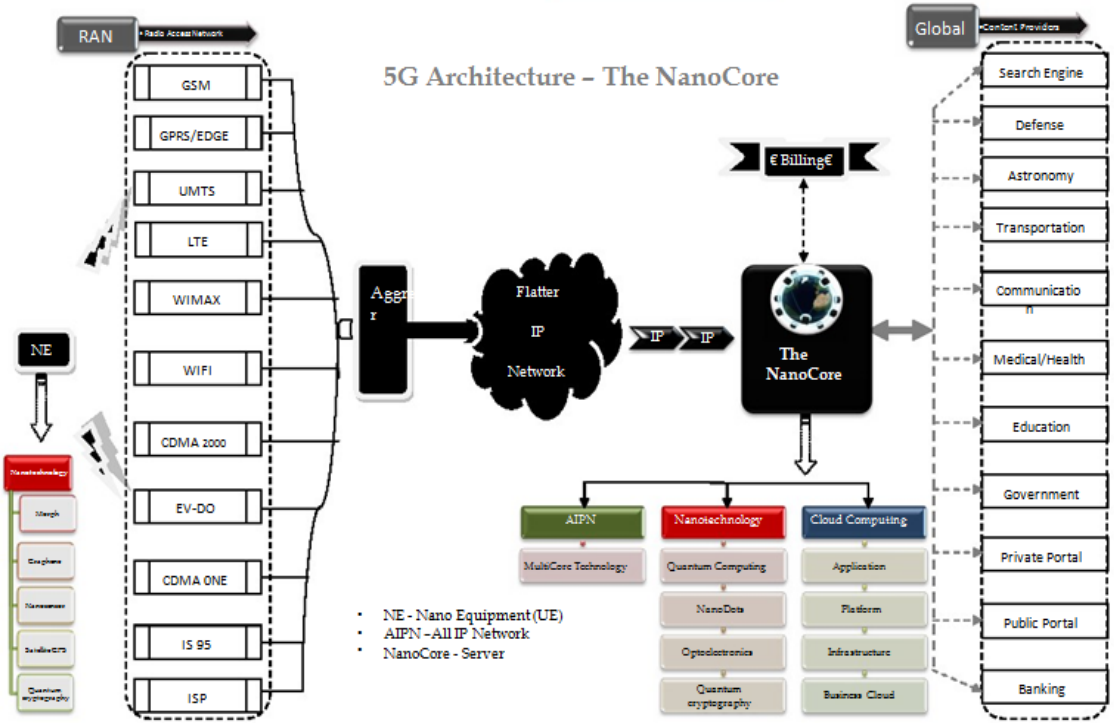


**Figure 4: Fifth Generation (5G) Architechture- The Nano Core**

**Basic Concepts in 5G**: 5G provides a real wireless world with no limitations in the data accessing. They support artificial intelligence to a greater extent. They support IPV6 technology. They prefer one unified global standard and supports pervasive computing. The users can be simultaneously connected to multiple wireless technologies. 5G extends its support to the areas of cognitive radios or smart radios allowing different radio technologies to share the same spectrum in an efficient adaptive manner. They use high altitude stratospheric platform station. They provide high resolution and large bandwidth support for faster data transmission. Strong and faster error-correction mechanism will be provided by 5G. They are providing a network connectivity speed of 25 Mbps. 5G technologies can be applied in medical fields also. They can be used for sensing various natural disasters. Key concepts include Dynamic Adhoc network (includes smart antennas and flexible modulation) and IPV6. The major services provided by 5G includes dynamic information access and wearable devices with AL capabilities. They prefer CDMA multiplexing. The entire network is packet switched.

**5G Mobile Network Architecture:** Fifth generation mobile systems are all-IP based technology. Here all-IP based mobile applications and services such as mobile portals, mobile health care, mobile commerce, mobile banking, mobile government

etc. are offered through Cloud Fifth Generation Architecture [8] Computing Resources. It is possible to configure on demand network access through computing resources. This allows the consumers to use applications without installation and can access their personal data anywhere at any time. 5G is based on the concept of super core, where all the network operators are connected to a single core and have single infrastructure irrespective of their access technologies. It brings the concept of MVNOs (Mobile Virtual Network Operators) a reality. Fig 4 Shows the architecture of 5g technology. The fifth generation technology is going to be a new revolution in the mobile market as it can handle best technologies and offer priceless handset to the customers. They have extraordinary data access capabilities. Maybe in the coming years the 5G technology may take over the entire market. 5G can provide high data connectivity using its routers and switches. The 5G technology has a glowing future. They provide low cost per bit. They support interactive multimedia, voice, streaming video and other broad band services. They are expected to support virtual private network. The traffic strategies by 5G technology makes it more accurate. Beyond 5G the future enhancement of Nano-core will be extraordinary as it includes artificial intelligence also. The key challenges in 5G include the integration of various standards like 3GPP, 3GPP2, ITU etc. Moreover there is no common platform or architecture for interconnecting different standards. Research is going on to connect users simultaneously to multiple wireless technologies. The main component of fifth generation technology is the 5G nano core. It is a combination of technologies like nanotechnology, cloud computing and All- IP network. All these technologies have their own impact on the existing wireless communication networks which in turn lead to the concept of 5G. Fig 5. Shows the basic architecture of Nanocore components.

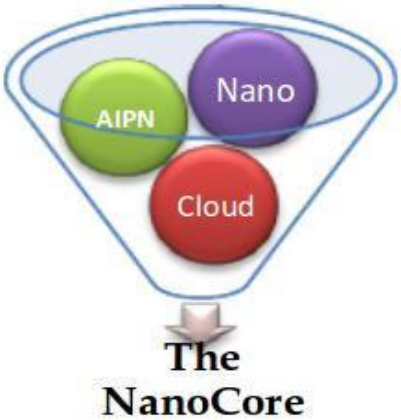


**Figure 5: Nanocore Elements**

**Nanotechnology**: Nanotechnology also known as Molecular Nanotechnology (MNT). It is a technology that uses Nano science for controlling various processes on a nanometer scale ie, between 0.1 and 100nm. It will lead to a next great industrial revolution. They are considered as one of the most significant technology in the wireless communication network. It has a direct impact on the mobile and sensor networks as well as on the core network.

**Nano Equipment (NE)**: In this advanced world, mobile phone becomes an identity of each individual. The fifth generation called these mobiles as Nano Equipment. The main goal of this is to facilitate communication as well as computation for the users in an intelligent manner. These Nano Equipment should exhibit the features like flexibility, transparency environment sensibility, self-powering (getting charged from resources like sun, air, water etc..) and also they should clean by themself. The Nano Equipment consists of devices like Morph, Graphene's Transistor, Liquid lens, intelligent batteries and Nano Sensors. Nano core requires reliable capacity and high speed to maintain equilibrium to security aspects. But the most recent standards like Wimax and LTE can achieve this requirement. To fulfil this need, the Nano core along with Nanotechnology is combined. For creating such a platform, nanocore requires high performance, flexibility and extensibility in the hardware and software infrastructure.

**Quantum Computing**: Quantum computing is the computation intelligence based on the concept of quantum theory in which the behavior of energy and matter is explained at the atomic and subatomic level. Information is in the form of electrons is transmitted in today's digital systems. According to quantum computing, the upcoming technology would be based on the principles of quantum mechanism in which small particles of light and matter can be considered. Here a quantum bit can be expressed as both 0 and 1. They will support a higher speed which is 8 times faster than that of normal computing. They provide improved storage capacity, improved speed and improved security. They can use the concept of Quantum cryptography for the purpose of improved security.

**Cloud Computing**: Cloud computing is a technology used by a group of computers, connected using Internet for the purpose of data management and maintenance. It consists of a central remote server. This allows the users to access data at anytime, anywhere without any additional installations. This concept is the basis for nanocore technology. The

users obtain more real-time applications and thus they can utilize the 5G services to a great extent. Security and reliability is provided using quantum cryptography. The three important segments in cloud computing includes applications, platform & infrastructure. Each segment acts differently in different situations. Fig6. shows a basic structure of cloud computing.

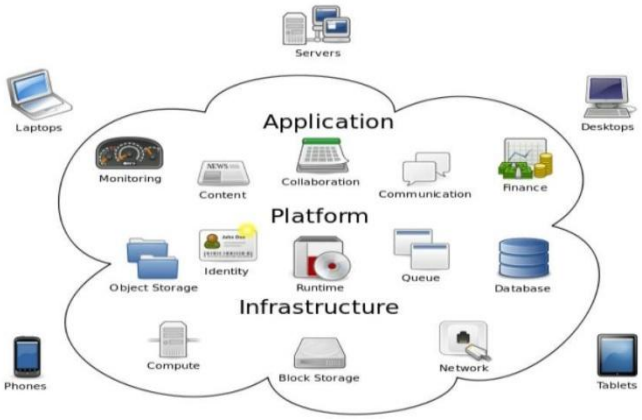


**Figure 6: Cloud Computing**

**Applications:** 5G provides higher on-demand services. These on-demand services differ widely in their pricing schemes and other factors like mode of delivery etc. the products used for the deployment of internet come under the platform segment. For example, Google, Amazon etc. developed their platforms to allow users to access data and other applications from centralized servers. The third segment called infrastructure act as the backbone of cloud computing. The cloud computing concepts reduces the CAPEX of 5G network and also provides less billing service to the end user.

**All-IP network**: The All-Ip which is an extended version of 3GPP can increase the demands of mobile telecommunication market. The wireless network operators turning to flat IP network architecture to meet the various needs of customers. APIN is providing a complete edge in terms of performance and cost. The important benefits of IP architecture are reduced system latency and universal seamless access. The increasing demand of IP-based services can improve the performance demand of various IP-based equipments and devices. This can result in increasing demand for multicore technology. Data in a flat mobile IP network model flows freely. The All-IP has the ability to adapt and move sessions from one terminal to another based on certain criteria. It has a provision for advanced application services as well as other ubiquitous services. There exist some methods inside All-IP for ensuring quality of service (QOS).

**Multi Core Technology**: As 5G provides all-IP based technology, it is necessary to incorporate multicore technology. This supports powerful data processing in the telecommunication system.

## IV. DESIGN OF 5G MOBILE NETWORK ARCHITECTURE

Figure 7 shows the system model that proposes design of network architecture for 5G mobile systems, which is all-IP based model for wireless and mobile networks interoperability. The system consists of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous radio access technologies. Within each of the terminals, each of the radio access technologies is seen as the IP link to the outside Internet world, there should be different radio However interface for each Radio Access Technology (RAT) in the mobile terminal. For an example, if we want to have access to four different RATs, we need to have four different access specific interfaces in the mobile terminal, and to have all of them active at the same time, with aim to have this architecture to be functional Figure 4 shows the system model that proposes design of network architecture for 5G mobile systems, which is all- IP based model for wireless and mobile networks interoperability. The system consists of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous radio access technologies. Within each of the terminals, each of the radio access technologies is seen as the IP link to the outside Internet world. However, there should be different radio interface for each Radio Access Technology (RAT) in the mobile terminal. For an example, if we want to have access to four different RATs, we need to have four different accesses - specific interfaces in the mobile terminal, and to have all of them active at the same time, with aim to have this architecture to be functional. The first two OSI levels (data-link and physical levels) are defining the radio access technologies through which is provided access to the Internet with more or less QoS support mechanisms, which is further dependent upon the access technology (e.g., 3G and WiMAX have explicit QoS support, while WLAN has not) . Then, over the OSI-1 and OSI-2 layers is the network layer, and this layer is IP (Internet Protocol) in today's communication world, either IPv4 or IPv6, regardless of the radio access technology. The purpose of IP is to ensure enough control data (in IP header) for proper routing of IP packets belonging to a certain application connections - sessions between

client applications and servers somewhere on the Internet. Routing of packets should be carried out in accordance with established policies of the user.

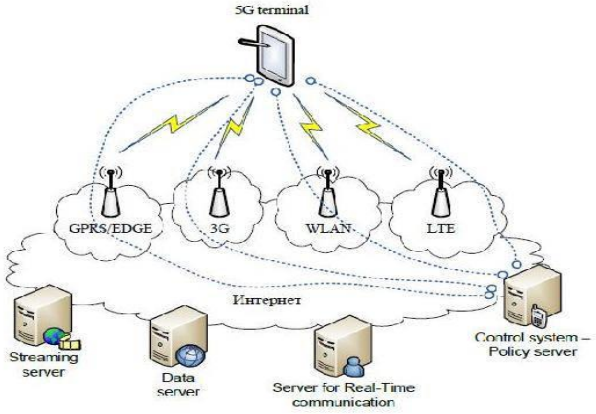


**Figure 7: Mobile Network Architecture**

## V. PROPOSED ARCHITECTURE

Application connections are realized between clients and servers in the Internet via sockets. Internet sockets are endpoints for data communication flows. Each socket of the web is a unified and unique combination of local IP address and appropriate local transport communications port, target IP address and target appropriate communication port, and type of transport protocol. Considering that, the establishment of communication from end to end between the client and server using the Internet protocol is necessary to raise the appropriate Internet socket uniquely determined by the application of the client and the server. This means that in case of interoperability between heterogeneous networks and for the vertical handover between the respective radio technologies, the local IP address and destination IP address should be fixed and unchanged. Fixing of these two parameters should ensure handover transparency to the Internet connection end-to-end, when there is a mobile user at least on one end of such connection. In order to preserve the proper layout of the packets and to reduce or prevent packets losses, routing to the target destination and vice versa should be uniquely and using the same path. Each radio access technology that is available to the user in achieving connectivity with the relevant radio access is presented with appropriate IP interface. Each IP interface in the terminal is characterized by its IP address and net mask and parameters associated with the routing of IP packets across the network. In regular inter-system handover the change of access

technology (i.e., vertical handover) would mean changing the local IP address. Then, change of any of the parameters of the socket means and change of the socket, that is, closing the socket and opening a new one. This means, ending the connection and starting a new one. This approach is not-flexible, and it is based on today's Internet communication. In order to solve this deficiency we propose a new level that will take care of the abstraction levels of network access technologies to higher layers of the protocol stack. This layer is crucial in the new architecture. To enable the functions of the applied transparency and control or direct routing of packets through the most appropriate radio access technology, in the proposed architecture we introduce a control system in the functional architecture of the networks, which works in complete coordination with the user terminal and provides a network abstraction functions and routing of packets based on defined policies. At the same time this control system is an essential element through which it can determine the quality of service for each transmission technology. He is on the Internet side of the proposed architecture, and as such represents an ideal system to test the qualitative characteristics of the access technologies, as well as to obtain a realistic picture regarding the quality that can be expected from applications of the user towards a given server in Internet (or peer). Protocol setup of the new levels within the existing protocol stack, which form the proposed architecture, is presented in Figure 8. The network abstraction level would be provided by creating IP tunnels over IP interfaces obtained by connection to the terminal via the access technologies available to the terminal (i.e., mobile user). In fact, the tunnels would be established between the user terminal and control system named here as Policy Router, which performs routing based on given policies. In this way the client side will create an appropriate number of tunnels connected to the number of radio access technologies, and the client will only set a local IP address which will be formed with sockets Internet communication of client applications with Internet servers. The way IP packets are routed through tunnels, or choosing the right tunnel, would be served by policies whose rules will be exchanged via the virtual network layer protocol. This way we achieve the required abstraction of the network to the client applications at the mobile terminal. The process of establishing a tunnel to the Policy Router, for routing based on the policies, are carried out immediately after the establishment of IP connectivity across the radio access technology, and it is initiated from the mobile terminal Virtual Network-level Protocol. Establishing

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tunnel connections as well as maintaining them represents basic functionality of the virtual network level (or network level of abstraction).

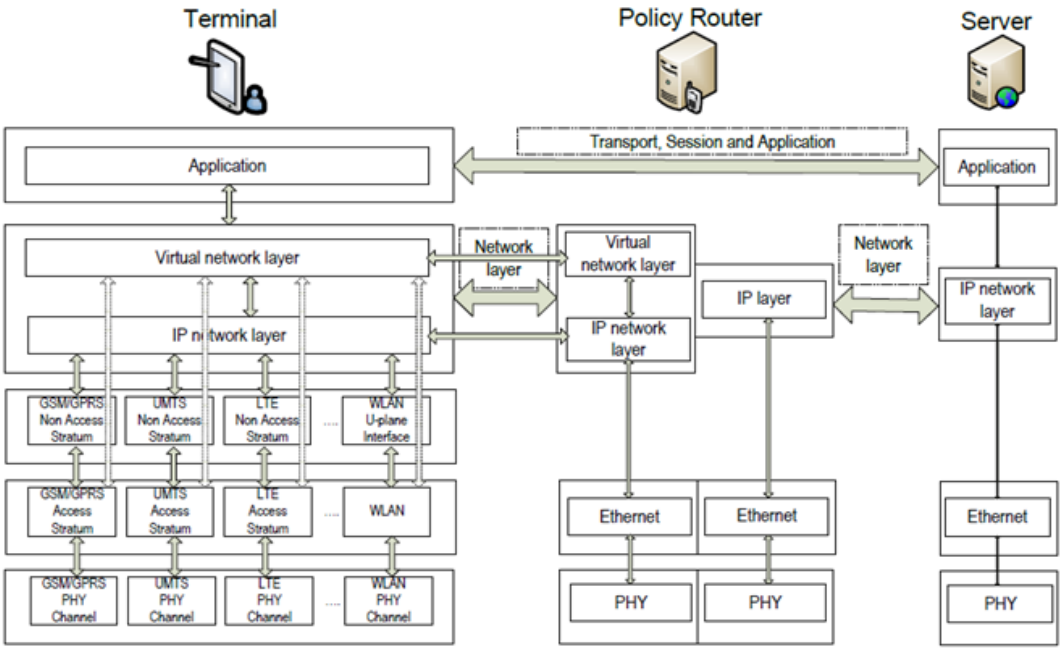


**Figure 8: Proposed Architecture**

## VI. NEED OF 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. The major difference, from a user point of view, between current generations and expected 5G techniques must be something else than increased maximum throughput; other requirements include:

- Lower out age probability; better coverage and high data rates available at cell edge.
- Lower battery consumption.
- Multiple concurrent data transfer paths.
- Around 1Gbps data rate in mobility.
- More secure; better cognitive radio/SDR Security.
- Higher system level spectral efficiency.
- World Wide wireless web (WWWW).
- 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 infra structure deployment costs.

## VII. CHARACTERISTICS & APPLICATIONS

**Characteristics of Fifth Generation(5G) are:**

- The technology 5G presents the high resolution for sharp, passionate cell phone every day and give consumers 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 closeties 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.

**Applications of 5G technology are:**

- Real wireless world with no more limitation with access and zone issues.
- Wearable devices with AI capabilities.
- Internet protocol version 6(IPv6), where a visiting care of mobile IP address is assigned according to location and connected network.
- One unified global standard.
- Pervasive networks providing ubiquitous computing: The user can simultaneously be connected to several wireless access technologies and seamlessly move between

them these access technologies can be a 2.5G,3G, 4G or 5G mobile networks, Wi-Fi, WPAN or any other future access technology. In 5G, the concept may be further developed into multiple concurrent data transfer paths.

- Cognitive radio technology, also known as smart radio: allowing different radio technologies to share the same spectrum efficiently by adaptively finding unused spectrum and adapting the transmission scheme to the requirements of the technologies currently sharing the spectrum. This dynamic radio resource management is achieved in a distributed fashion, and relies on software defined radio.
- High altitude stratospheric platform station (HAPS) Systems. The radio interface of 5G communication systems is suggested in a Korean research and development program to be based on beam division multiple access (BDMA) and group cooperative relay techniques.

## VIII. FUTURE SCOPE & CONCLUSION

**Future Scope:** 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. The future enhancement of Nano core will be incredible as it combines with artificial intelligent (AI).One can able to control his intelligent Robot using his mobile phone. Your Mobile can automatically type the message what your brain thinks. We might get a circumstance where we don't require any spectrum for communication. 5G technology will provide super 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.

## 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 Master Core 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 Master Core. The new coming 5G technology is available in the market to fulfil user demands in affordable rates, bright and high peak future also much reliability as well as exceptional applications.

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