A Study on 5th Generation Mobile Technology - Future Network Service

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Abstract - 5G **(5th generation mobile networks or 5th generation wireless systems) designates the next major phase of mobile telecommunications standards superior to the current 4G standards. 5G is also referred to as future (ahead of 2020) mobile communications technology. Presently, 5G is not a term that is used for any particular specification or in any official document, but yet made public by telecommunication companies and standardization bodies such as 3GPP, Wi MAX Forum or ITU-R. New standard releases beyond 4G are in progress by standardization bodies, but now these are not considered as new mobile generations since implementation and rollout of systems compliant with 4G is still under way; the goals of a 5G-based telecommunications network would ideally answer the challenges that a 4G model would present once it has entered widespread use.**

Index Terms— **Flat IP Network, BDMA, 5G Architecture-Nanotechnology, Cloud Computing.**

I. INTRODUCTION

There are many changes in the world of communication. Landline phones are not much used today. All most all people throughout the world possess mobile phones. These handsets not only keep us connect with the world but also serve as entertainment gadgets. From 1G to 2.5G and from 3G to 5G the world of telecommunications has seen several improvements along with enhanced performance with every day passing. 5G technology [1] is on its way to change the communication the way by which most of the users access their handsets. Users will have enhanced level of call volume and data transmission with 5G pushed over a VOIP enabled gadget with innovative market giants. Presently great cell phones are available one after another, with unbelievable traits. Apple remained successful in shaking the electronic world by putting forth its latest iPhone 4G that take the market by storm. Huge features are embedded in such a small electronic piece. In the present world almost all mobile devices consists mp3 player or/and camera. With 5G technology one can connect mobile phone to laptop for broadband internet access. The special features like video player, camera, messengers, mp3 recorder and games have made today's mobile phone a handheld computer. The world is already utilizing 4G services [2] and it is beyond imagination that what will be engulfed in 5G as everything is already embedded such as smallest mobile phones, greatest memory, high dialing and transmitting speed, Microsoft office, audio and video player etc. With Pico net and Bluetooth technology data sharing has become very easy. Initially Infrared technology was used to connect two handset devices to share data. It enables data sharing between two gadgets within a range of 50 meters. With the increase in speed and data sharing the cell phone manufactures focused on mobile broadband that can open a new window of communication and navigation in the world of telecommunication. A new revolution in telecommunications is about to start. The global mobile phone will hit the localities who can call and access from China to Germany's local phone with this new technology. The utilization of this gadget will move forward with enhanced and accessible connectivity around the world. The offices will shrink into handset with this cell phone that is going to resemble PDA (personal digital assistant) of twenty first century.

II. FEATURES OF 5G NETWORKS

- 5G networks will be very fast and reliable.
- With the arrival of 5G, the concept of hand held devices will be revolutionized. All the services and applications will be accessed by single IP as telephony, gaming and many other multimedia applications.
- 5G provides features like messenger, photo gallery, and multimedia applications, telephony, camera, mp3player etc. There would be no difference between a PC and a mobile phone rather both would act vice versa.
- High speed, high capacity, and low cost per bit. It supports voice, video streaming, interactive multimedia, Internet, and other broadband services, bidirectional and accurate traffic statistics.
- New radio system introduction is possible, where the same frequency spectrum is shared by different radio technologies. This can be done by finding unused spectrum and then adapting to the technology of the radio technology with which the spectrum is being shared.
- In 5G network every mobile will have an IP address (IPV6) [3] according to the location and network being used.
- With this technology the traffic statics will be accurate, this also may support virtual private networks and advanced billing interfaces.
- 5G technology may broadcast data in Giga bit that supports nearly 70,000 connections.

- Through 5G technology one can use worldwide cellular phones and this technology also strike the china mobile market and a user being proficient to get access to Germany phone as a local phone.
- 5G technology has extra ordinary data capabilities and has ability to tie together unrestricted call volumes and infinite data broadcast within latest mobile operating system.
- 5G technology has a bright future because it can handle best technologies and offer priceless handset to their customers. In the coming days 5G technology takes over the world market.
- 5G Technology has an extremely high capability to support Software and Consultancy.
- The Router and switch technology used in 5G network provides high connectivity.
- The 5G technology distributes internet access to nodes within the building and can be deployed with union of wired or wireless network connections.

III. KEY CONCEPTS USED IN 5G WIRELESS COMMUNICATIONS

Key concepts suggested for discussing 5G and beyond 4G wireless communications are:

- Dynamic Adhoc Wireless Network (DAWN), [4] essentially identical to Mobile Adhoc network (MANET), Wireless mesh network (WMN) or Wireless grids [5], combined with smart antennas and flexible modulation.
- Internet Protocol Version6 (IPv6), IP address is assigned according to location and connected network.
- High altitude stratospheric platform station (HAPS) systems.
- Real wireless world with no limitation for access and zonal issues.
- 5G utilizes user centric network concept instead of operator centric (as in 3G) or service-centric (as in 4G) World Wide wireless web (WWWW) [6], i.e. comprehensive wireless based web applications that include full multimedia capability beyond 4G speeds.

IV. THE NEED FOR 5G

The major differences, from a user point of view, between present *generations* and expected 5G techniques are:
Increased maximum throughput; Lower out age probability; High data rates and better signal coverage may be available at the edges of cell areas; Lower battery consumption; Multiple concurrent data transfer paths; Around 1Gbps data rate in mobility; More secure and better cognitive radio/SDR Security; Spectral efficiency is high; 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. It does not harm human health; Cheaper traffic fees because of low infra structure and deployment costs. The sample 5G mobile phone [7] is shown in the fig.1

Fig.1: 5G Mobile Phone

V. 5G MOBILE NETWORK

5G networks utilize the concept of flat IP [8] to make easier for different RAN to upgrade in to a single NanoCore network.5G network uses Nanotechnology [9] as safeguarding tool for security concern that arises due to flat IP. Flat IP network is the main concept to make 5G acceptable and compatible for all types of technologies. Wireless operators are turning to flat IP network architectures, to meet customer demand for real-time data applications delivered over mobile broadband networks. Flat IP architecture provides a way to identify devices that use symbolic names, which is not used in the hierarchical architecture, such as that used in "normal" IP addresses. By shifting to flat IP architectures, the mobile operators can:
• Decrease the number of network elements in the data path to reduce the cost for operations and capital expenditure.
• Slightly decouple the delivering service price from the volume of data transmitted to align infrastructure capabilities with emerging application requirements.
• Minimize system latency and enable applications with a lower tolerance for delay; upcoming latency enhancements on the radio link can also be fully realized.
• Radio access and packet core networks evolve independently of each other to a greater extent than in the past, creating greater flexibility in network planning and deployment.
• Develops a flexible core network that can serve as the basis for service innovation across both mobile and generic IP access networks
•In terms of price perspective, platform can be created that will enable mobile broadband operators to be competitive when compared with wired networks. Flat network architecture discards that voice-centric hierarchy from the network. Simple and separate data architecture can be implemented that removes the multiple elements from the network, instead of combining packet data core on the voice network.
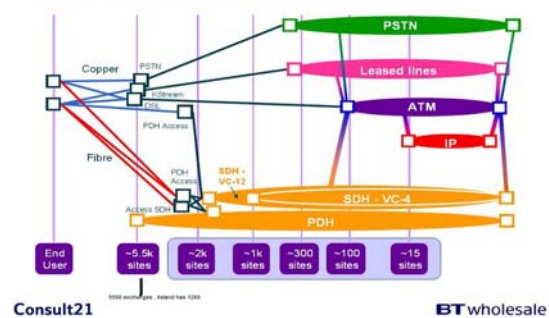

Fig.2 : Current network used for communications

The current network which is used in present communications is shown in the fig. 2. 5G Mobile network is shown in fig. 3.
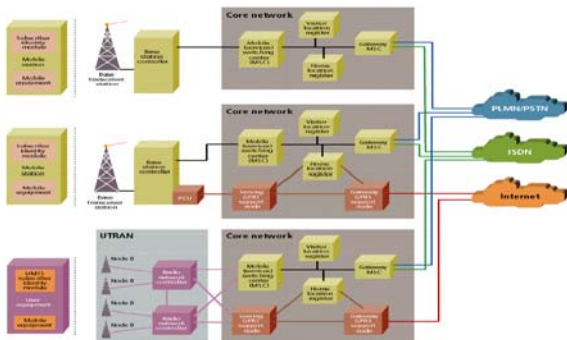

Fig. 3: 5G Mobile Networks

A. Design of 5G Network

Figure 4 shows model of the proposed design for network architecture for 5G mobile systems, which is IP based model for wireless and mobile networks interoperability. The system contains   user terminal (which has an important role in the new architecture) and a number of autonomous radio access technologies. Within each terminal, each of the radio access technologies is viewed as the IP link to the outside Internet world. But, there should be separate radio interface for each Radio Access Technology (RAT) in the mobile terminal. For example, if four different RATs should be accessed simultaneously so four different access-specific interfaces are required in the mobile terminal, and all of them must be active at the same time, with the aim to have this architecture to be functional.
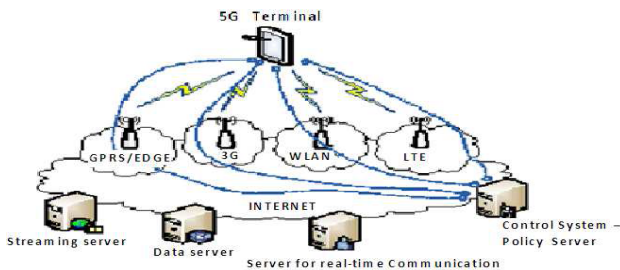

Fig. 4: Design of 5G Mobile Network

VI. **5G ARCHITECHTURE –THE NANOCORE**

The 5G architecture [10] uses Nanocore which is an association of Nanotechnology, Cloud Computing and IP Platform technologies. These technologies have their own influence on exiting wireless network which prepares them as 5G. 5G architecture is shown in the figure. 5.
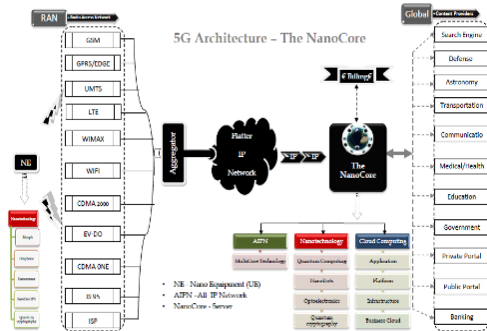

Fig. 5 : 5G Architechture-The Nanocore

A. *Nanotechnology:*

Nanotechnology is the application of Nanoscience to control process on nanometer scale, i.e. between 0.1 and 100nm.This field is also known as molecular nanotechnology (MNT).MNT deals with control of the structure of matter based on atom-by-atom and molecule by molecule engineering. The term nanotechnology was introduced in 1974 by Nori Taniguchi at Tokyo international conference on production engineering. Nanotechnology is the upcoming industrial revolution. Both mobile and the core network have the impact of nanotechnology. Nanotechnology has its own impact on sensor as well as security.

B. *Nano Equipment (NE):*

 In 5G Nanocore the mobiles are referred to as NanoEquipment as they are adapted to nanotechnology. The wireless industry is aiming at ambient intelligence: computation and communication always available and ready to serve the user in an intelligent way. So this requires that the devices are mobile. Mobile devices with the intelligence collectively embedded in human environments – home, office, public places – will create a new platform that allow universal sensing, computing, and communication.

The specialties of Nano Equipment given as follows:
• Self Cleaning – the phone will get cleaned by itself
• Self powered – the phone acquires power from natural resources like the sun, water, or air.
• Sense the environment – the phone will tell the weather, temperature information and the amount of pollution in air, etc.
• Flexible – it can be bent easily but will not break
• Transparent – 5G phones are "see through" phones

C. *Cloud Computing:*

Cloud computing technology [11] uses the Internet and central remote server to maintain data and applications. In 5G network central remote server is the content provider. Cloud computing allows consumers to use applications without installation and access to their personal files at any computer with Internet access. The same concept can be used with Nanocore where the user tries to access his/her private account from a global content provider through Nanocore in form of cloud. Tremendous opportunities are provided for operators with the development of cloud computing. As cloud computing depends on the networks, it exhibits the significance of networks and promotes network development. It also requires reliable and secure service providers, capabilities that operators can create new value-added services and experiences by integrating industry content and applications in the digital supermarket model. This could make the users to acquire much more real-time application to utilize 5G network efficiently and effectively. Quantum Cryptography provides secure and reliable services. Cloud computing services are paid services. The Nanocore devours the resources and pay for what it uses. Cloud computing consists of three main segments which are as follows:

1. Applications – These are, on demand software services. On demand software services are of different varieties and vary in their pricing scheme and the delivery to the end

users. Earlier, end-user use to purchase a server that can be accessed by the end user over the internet.

2. Platform - The platform segment refers to products that are used to set up and expand Internet. Net Suite, Amazon, Google, and Microsoft have also developed platforms that allow users to access applications from centralized servers. Google, Net Suite, Rack space cloud, amazon.com and sales force are active.

3. Infrastructure – This is the backbone for the entire concept. Infrastructure vendor's environments such as Google gears allow users to construct applications. Cloud storage, such as Amazon's S3, is also part of the infrastructure segment. 5G Nanocore will efficiently and effectively utilize all the above 3 segments to satisfy the customer demands. The concept of cloud computing will minimize the CAPEX of 5G network deployment. In turn this will create a low billing for the end user for all types of services that the user utilizes through Nanocore.

D. All IP Network:

All IP Network supports converging different technologies to form a single 5G Nanocore, shown in the figure.6. Common platform is required to interact. Flat IP architecture act as an essential part of 5G network. The All-IP Network (AIPN) evolved from 3GPP system to meet the increasing demands of the mobile telecommunications market. Wireless operators are turning to flat IP network architectures, to meet customer demands for real-time data applications delivered over mobile broadband networks. It primarily focuses on enhancements of packet switched technology; AIPN provides a continued evolution and optimization of the system concept in order to provide a competitive edge in terms of both performance and cost. The advantages of flat IP architectures are:

• Less costs
• Universal seamless access
• reduced system latency
• decoupled radio access and core network evolution.

There is strong and fast growing demand for advanced telecommunications services for wired and wireless Next Generation Network (NGN) infrastructures. Within a few years, more than 10 billion fixed and mobile devices will be connected via the Internet and already more than one billion are existing. All these services are going to be utilized with the support of IP-based architecture.
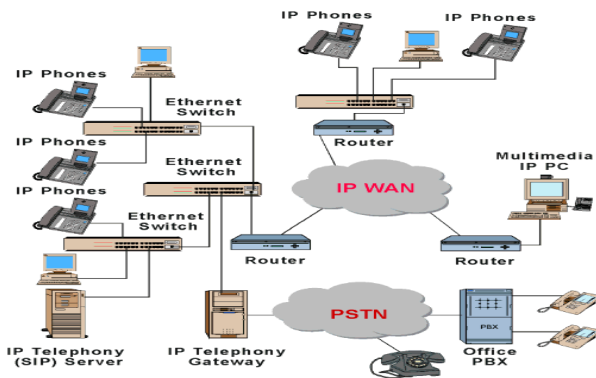
Fig 6: All IP Network

VII. BEAM DIVISION MULTIPLE ACCESS (BDMA) FOR 5G

The main aim of mobile communication systems is to provide enhanced and flexible services to a larger number of mobile users at lower costs. To provide enhanced and flexible services, multiple access technique is required. Examples of multiple access techniques [12] are as follows:

1. Frequency Division Multiple Access (FDMA) – This technique divides frequency resource and allocates them to respective mobile stations, allowing multiple accesses, shown in .

2. Time Division Multiple Access (TDMA) - This divides time resource, and allocates respective mobile stations and allows multiple accesses.

3. Code Division Multiple Access (CDMA) - CDMA technique allocates orthogonal codes to respective mobile stations, which provides the mobile stations with multiple access.

4. Orthogonal Frequency Division Multiple Access (OFDMA) – This technique divides and allocates an orthogonal frequency resource to enhance resource utility efficiency. Limited frequency and time are divided among multiple users for usage, in the mobile communication system as the capacity of the mobile communication system is limited depending on the given frequency and time. In future the capacity required in a mobile communication system may increase due to the increase in number of mobile station and an amount of data required in respective mobile stations is also increased. The Multiple access techniques are shown in the figure. 7.
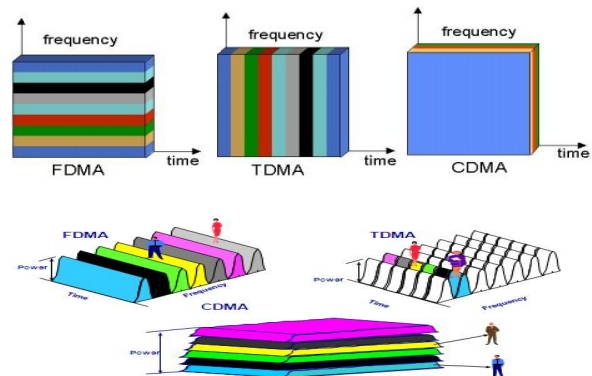
Fig7: Multiple Access Technology

A. Concept of BDMA:

An orthogonal beam is allocated to each mobile station, when a base station communicates with mobile devices. The BDMA technique [13] divides an antenna beam according to locations of the mobile stations to allow the mobile stations to give multiple accesses, thereby significantly increases the capacity of the system. Mobile stations and a base station can be in Line of Sight an (LOS) state, when they know each other's positions; they can transmit beams which direct to each other's position to communicate without interfering with mobile stations at the edges of the cell area. BDMA technology is represented in figure. 8.
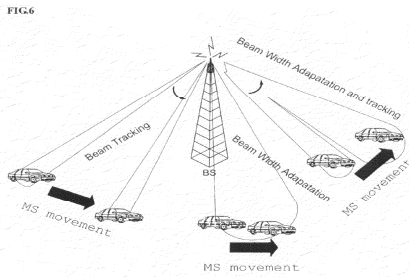
Fig.8 : BDMA Technology

- The base station transmits beams at distinct angles to transmit data simultaneously to multiple mobile stations, when mobile stations are arranged at different angles with respect to base station.
- One mobile station may not use one beam, but mobile stations positioned at a same angle share one beam to communicate with the base station.
- The mobile stations which share the same beam divide same frequency/time resources and use orthogonal resources.
- According to the mobile communication environment, base station can change the number, direction and width of the beam easily and adaptively.
- The beams may be divided three-dimensionally; so that spatial reuse of frequency/time resources can be maximized.
- Initially, base station and mobile stations do not know each other's positions; the mobile stations have to detect their positions and moving speeds, and then transmit.
- Next, the base station computes direction and a width of a downlink beam based on the position and moving speed information of the mobile station received from the mobile station.
- Consequently, the downlink beam is transmitted by the base station to the mobile station with the computed direction and width.
- Once the mobile station receives the computed direction and width of the downlink beam, it keeps in sight of direction of the downlink beam to fix a direction of an uplink beam, and transmits the uplink beam in the fixed direction.
- The beam is updated periodically between the mobile station and the base station, after the mobile station fixes the uplink beam.
- The FDD-BDMA frame is similar to that of TDD-BDMA; the main difference is that the initial mobile station information slot is allotted by dividing a frequency resource, and not by dividing a time resource. Another difference is, instead of a preamble of the TDD-BDMA there is a base station broadcast in the FDD-BDMA.
- The BDMA is can be applicable for cellular wireless communication systems for the next generation mobile communication. Further BDMA can act as a radio interface for 5G.

VIII. CONCLUSION

While the future is becoming more difficult to predict with each passing year, an accelerating pace of technological change can be expected. This paper presents 5G technology which depends on nanotechnology, Cloud computing and All IP technologies which are the next great technology wave. This paper also proposes a multi bandwidth data path scheme for 5G real wireless operations and WWWW.

This Paper may help to promote stronger links between people working in different fields creating future concepts of mobile communication, Internet services, Cloud computing, All IP network, and Nanotechnologies. The 5G technologies include all kinds of advanced features which makes 5G mobile technology most powerful and in huge demand in near future. 5G may be more intelligent technology that interconnects the entire world without limits. The future scope can be beyond 5G technology, with the future enhancement of Nano-core, it will be incredible as Nanocore is integrated with artificial intelligent (AI), for example, with the help of mobile phone, intelligent Robot can be controlled. Mobile phone can automatically type the message what the brain thinks.

Still further 6G technology, 6G wiki, 6G network, 6G mobile are getting familiar with new mobile technology getting evolved.

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