

# A Review on 5G Technology

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**Abstract**— 5G Technology stands for 5th Generation Mobile technology. 5G is a name used in some research papers and projects to denote the next major phase of mobile telecommunications standards beyond the upcoming 4G standards. Currently, 5G is not a term officially used for any particular specification or in any official document yet made public by telecommunication companies or standardization bodies such as 3GPP, WiMAX Forum or ITU-R. New standard releases beyond 4G are in progress by standardization bodies, but at this time 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

The world has seen a lot of changes in the realm of communication. Today we no more use landlines. Everyone possesses a mobile phone that functions nine to seven. Our handsets not only keep us connected with the world at large but also serve the purpose of entertainment gadget. From 1G to 2.5G and from 3G to 5G this world of telecommunications has seen a number of improvements along with improved performance with every passing day. 5G technology is on its way to change the way by which most of the users access their handsets. Users will go through a level of call volume and data transmission with 5G pushed over a VOIP enables gadget. With increasing awareness of customers with respect to upcoming technologies, affordable packages and good looks; it is very important that mobile producers must give an altogether decent package for keeping up the customer loyalty. The most important and leading motive of leading mobile phone manufacturers is the creation of best and latest technology to compete with innovative market giants. We have seen great cell phones one after another, with unbelievable traits. Apple has remained successful in shivering the electronic world by putting forth its latest iPhone 4G that take the market by storm.

In such a small electronic piece huge features are getting embedded. There are very few mobiles left without mp3 player or/and camera. People are focusing on getting everything without spending a penny more. Keeping in mind the user's pocket, economic cell phones are introduced with maximum features. With 5G technology you can hook you mobile phone to your laptop for broadband internet access. The characteristics especially video player, camera, mp3

recorder, messengers, photo treatment and games have made today's mobile phone a handheld computer. The developed world is already utilizing 4G and it is beyond imagination that what will be engulfed in 5G as everything is already embedded such as smallest mobile phones, speed dialing, largest memory, audio and video player, Microsoft office, etc. Pico net and Bluetooth technology has made data sharing a child's play. Initially infra red kept us bound for properly aliening two handset devices for data sharing. We still remember the disturbance and irritation caused in transferring data but the advent of Bluetooth changed the history. It enabled us to share data between two gadgets within a range of 50 meters. With the swiftness in 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.

5G technology will change the manner in which cellular plans are offered worldwide. A new revolution is about to begin. The global cell phone is around the corner. 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 way in which people are communicating will altogether upgrade. The utilization of this gadget will surely move a step ahead with improved and accessible connectivity around the world. Your office will shrink into your handset with this cell phone that is going to resemble PDA (personal digital assistant) of twenty first century.

## II. 5G MOBILE NETWORK

5G networks make use of this flat IP concept to make it easier for different RAN to upgrade in to a single NanoCore network. Our 5G network uses Nanotechnology as defensive tool for security concern that arises due to flat IP. 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. This is of more interest to mobile broadband network operators. With the shift to flat IP architectures, mobile operators can:

- Reduce the number of network elements in the data path to lower operations costs and capital expenditure.
- Partially decouple the cost of delivering service 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.

- Evolve radio access and packet core networks independently of each other to a greater extent than in the past, creating greater flexibility in network planning and deployment.
- Develop a flexible core network that can serve as the basis for service innovation across both mobile and generic IP access networks
- Create a platform that will enable mobile broadband operators to be competitive, from a price/performance perspective, with wired networks.

Flat network architecture removes that voice-centric hierarchy from the network. Instead of overlaying a packet data core on the voice network, separate and much-simplified data architecture can be implemented that removes the multiple elements from the network chain.

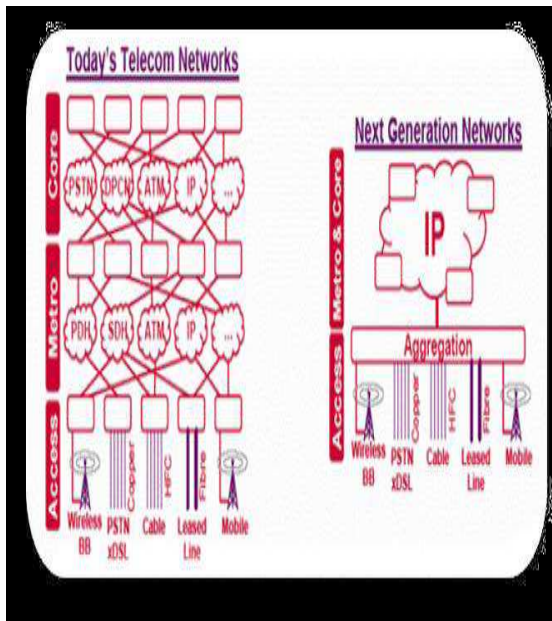


Fig. 1. 5G Mobile Network

**Design of 5G Network**

Figure 1 shows a system model that proposes design for a 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 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.

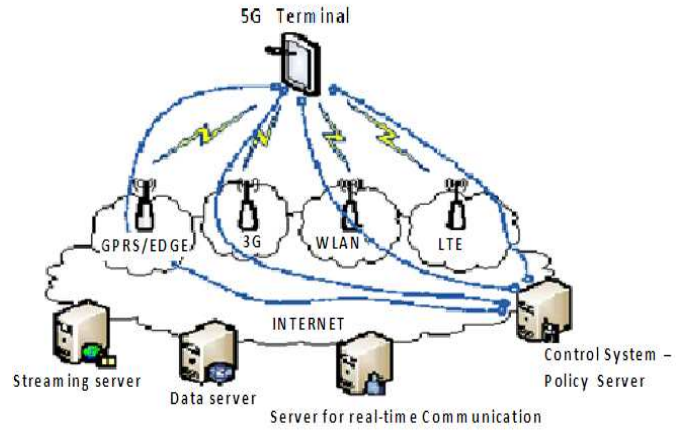


Fig.2. Design of 5G Mobile Network

**III. 5G ARCHITECTURE –THE NANOCORE**

The 5G Nancore is a convergence of below mention technologies. These technologies have their own impact on exiting wireless network which makes them in to 5G.

- Nanotechnology.
- Cloud Computing.
- All IP Platform.

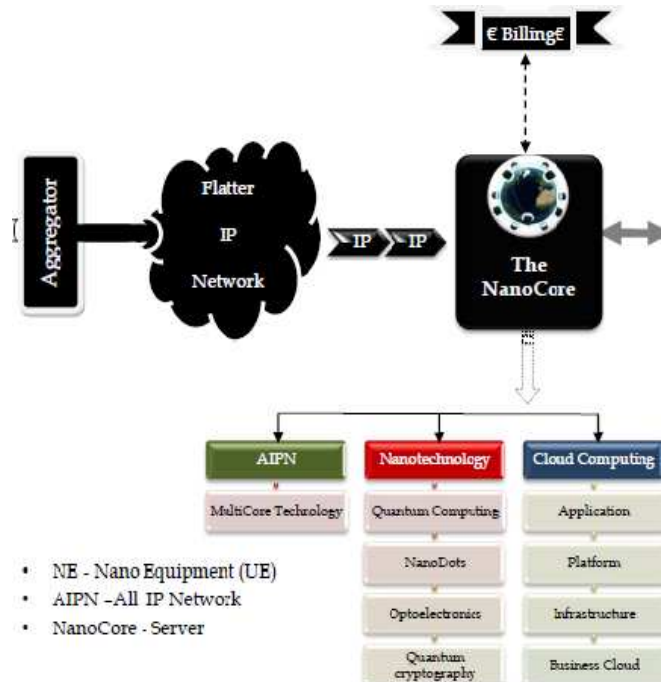


Fig.3. 5G Architecture-The Nanocore

**A. Nanotechnology:**

Nanotechnology is the application of nanoscience to control process on nanometer scale. i.e. between 0.1 and 100nm. The 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 by Nori Taniguchi in 1974 at the Tokyo international conference on production engineering. Nanotechnology is the next industrial revolution, and the telecommunications industry will be radically transformed by it in a few years.

Nanotechnology has shown its impact on both mobile as well as the core network. Apart from this it has its own impact on sensor as well as security. This is considered as a most significant in telecommunication. We will be discussing the same in our further slides.

**B. Nano Equipment (NE):**

Mobile phone has become more than a communication device in modern world it has turned into an identity of an individual. In 5G Nanocore these mobile are referred as NanoEquipment as they are geared up with nanotechnology. 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 way. This requires that the devices are mobile. Mobile devices together with the intelligence 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 NanoEquipments 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
- Transparent – “see through” phones

**C. Cloud Computing:**

Cloud computing is a technology that uses the internet and central remote server to maintain data and applications. In 5G network this central remote server will be our content provide. Cloud computing allows consumers and business to use applications without installation and access their personal files at any computer with internet access. The same concept is going to be used in Nanocore where the user tries to access his private account form a global content provider through Nanocore in form of cloud. The development of cloud computing provides operators with tremendous opportunities. Since cloud computing relies on the networks, it shows the significance of networks and promotes network development. It also requires secure and reliable service providers, capabilities that operators have deep expertise in. Operators can enter the cloud computing market and create new value-added services and experiences by integrating industry content and applications in the digital supermarket model. This could make our user to obtain much more real-time application to utilize his 5G network efficiently. Secure and reliable service can be provided with the help of quantum cryptography. Cloud computing customer avoids capital expenditure for the Nanocore thereby also reducing the cost of purchasing physical infrastructure by renting the usage from a third party Provider(Content Provider). The Nanocore devours the resources and pay for what it uses. Segments of Cloud Computing: Cloud computing has three main segments which are as follows:

1. Applications – It is based on, on demand software services. On demand software services come in different

varieties. They vary in their pricing scheme and how the software is delivered to the end users. In the past, the end-user would purchase a server that can be accessed by the end user over the internet.

2. Platform - The platform segment of cloud computing refers to products that are used to deploy 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 some of the active
3. Infrastructure – The third segment in cloud computing, known as the infrastructure, is the backbone of the entire concept. Infrastructure vendors environments such as Google gears allow users to build applications. Cloud storage, such as Amazon’s S3, is also considered to be part of the infrastructure segment.

5G Nanocore will efficiently utilizes all the above 3 segments to satisfy his customer demands. The concept of cloud computing will reduce the CAPEX of 5G network deployment. Inturn this will create a less billing to the end user for all kinds of services that he utilizes through Nanocore.

**D. All IP Network:**

Last but not the least. As already discussed for converging different technologies to form a single 5G Nanocore. We require a common platform to interact. Flat IP architecture act as an essential part of 5G network. The All-IP Network (AIPN) is an evolution of the 3GPP system to meet the increasing demands of the mobile telecommunications market. To meets customer demand for real-time data applications delivered over mobile broadband networks, wireless operators are turning to flat IP network architectures. Primarily focused upon 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 key benefits of flat IP architectures are:

- lower costs
- universal seamless access
- improved user experience
- reduced system latency
- decoupled radio access and core network evolution

The drive to all IP-based services is placing stringent performance demands on IP-based equipment and devices, which in turn is growing demand for multicore technology. There is strong growing demand for advanced telecommunications services on wired and wireless Next Generation Network (NGN) infrastructures, and fast growing demand for the same in the enterprise too. Within a few years, more than 10 billion fixed and mobile devices will be connected via the Internet to add to the more than one billion already connected. All these services are going to be deployed over full IP-based architecture.

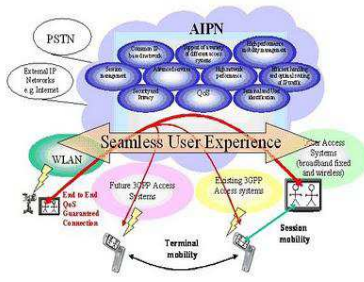


Fig 4. All IP Network

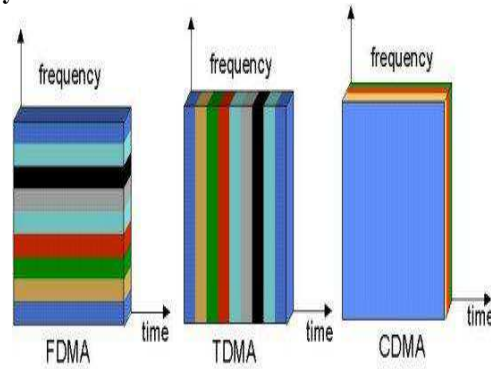


Fig 5. Multiple Access Technology

#### IV. BEAM DIVISION MULTIPLE ACCESS (BDMA) FOR 5G

The goal of mobile communication systems is to provide improved and flexible services to a larger number of mobile users at lower costs. This objective results in a big challenge for the wireless technology that is increasing system capacity and quality within the limited available frequency spectrum. The challenge in mobile communication system is to communicate using limited frequency and time. In order to achieve this target multiple access technique is required. There are Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Orthogonal Frequency Division Multiple Access (OFDMA) techniques, etc. as examples of typical multiple access technology developed up to now.

1. FDMA - The FDMA technique divides frequency resource and allots them to respective mobile stations, allowing to give multiple accesses.
2. TDMA - The TDMA technique divides time resource, and allots respective mobile stations to give multiple accesses.
3. CDMA - The CDMA technique allots orthogonal codes to respective mobile stations, which allows the mobile stations to give multiple access
4. OFDMA - The OFDMA technique divides and allots an orthogonal frequency resource to maximize resource utility efficiency.

In the mobile communication system, limited frequency and time are divided to be used among multiple users, and a capacity of the mobile communication system is limited depending on given frequency and time. It is expected that a capacity required in a mobile communication system will increase as the number of mobile stations increase in future and an amount of data required in respective mobile stations is increased. However, since frequency/time resources which respective systems can use are limited, there is a demand for a technical development, which uses other resources than frequency/time resources in order to increase a capacity of the system.

##### A. Concept of BDMA:

When a base station communicates with mobile stations, an orthogonal beam is allocated to each mobile station. The BDMA technique of the present invention divides an antenna beam according to locations of the mobile stations to allow the mobile stations to give multiple accesses, thereby significantly increasing the capacity of the system. Mobile stations and a base station are in an LOS (Line of Sight) state, when they exactly know each other's positions; they can transmit beams which direct to each other's position to communicate without interfering with mobile stations at cell edge.

- When mobile stations are positioned at different angles with respect to a base station, the base station transmits beams at different angles to simultaneously transmit data to multiple mobile stations.
- One mobile station does not use one beam exclusively, but mobile stations positioned at a similar angle share one beam to communicate with the base station.
- The mobile stations sharing the same beam divide same frequency/time resources and use orthogonal resources.
- A base station can change direction, the number, and widths of the beams adaptively and easily according to a mobile communication environment.
- The beams can be three-dimensionally divided; a spatial reuse of frequency/time resources can be maximized.
- In initial communication step, because a base station and mobile stations do not know each other's positions, the mobile stations detect their positions and moving speeds, and
- Transmit the detected positions and moving speeds information thereof to the base station.
- Next, the base station calculates a 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
- Subsequently, the base station transmits the downlink beam to the mobile station with the calculated direction and width.

- When the mobile station receives the calculated direction and width of the downlink beam, it tracks a direction of the downlink beam to set a direction of an uplink beam, and transmits the uplink beam in the set direction.
  - After the mobile station sets the uplink beam, a beam update is periodically performed between the mobile station and the base station.
  - The FDD-BDMA frame is almost the same as that of the TDD-BDMA. The difference is that the initial mobile station information slot is allocated by dividing a frequency resource, and not by dividing a time resource. A further difference is that there is a base station broadcast in the FDD-BDMA instead of a preamble of the TDD-BDMA.
  - The BDMA is applicable to a design of cellular wireless communication systems for the next generation mobile communication. Korean research and development has suggested BDMA as a radio interface for 5G.
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## V. CONCLUSION

While the future is becoming more difficult to predict with each passing year, we should expect an accelerating pace of technological change. 5G is not a term officially used for any particular specification or in any official document yet made public by telecommunication companies or standardization bodies such as 3GPP, WiMAX Forum, or ITU-R. We conclude that nanotechnology, Cloud computing, All IP are the next great technology wave. We hope that this Paper helps 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. We conclude that it is a great time to invest in startups. Nowadays mobile users have much awareness of the cell phone (mobile) technology. The 5G technologies include all type of advanced features which makes 5G mobile technology most powerful and in huge demand in near future.

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