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### **REVIEW ARTICLE**

# **Nanocore - A Review on 5G Mobile Communications**

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### **ABSTRACT**

The next generation mobile technology which is expected to be launched by 2020 is named as 5G as it is an upgraded version of the existing and establishing network 4G, widely known as LTE (Long Term Evolution) network. 5G itself will be capable of crossing the existing benchmarks of speed and connectivity. This paper will take a review in 5G networks having a wide view about the upcoming future generation which will be technically touching the real heights. The focus is mainly on the core potentials to be taken in the current telecommunication system to shape a vision of 5G. Incorporating the different technologies which include the research and development topics in the related fields are also taken care in this paper which covers technologies like Nanotechnology, Cloud Computing, Flat IP concept, BDMA and more. The paper addresses the various aspects of the infrastructure transform for service providers to upgrade themselves from the communication providers to the digital lifestyle enabler. A new approach for the next generation wireless communication and emerging scientific developments is also covered in the same.

**Keywords:** 5G Nanocore; Cloud Computing; Flat IP concept; Nanotechnology

## **1. INTRODUCTION**

5G, the 5<sup>th</sup> Generation mobile technology will be the one which will change the face of the mobile communication with the introduction of very high bandwidth [1]. Major distinguishing features of 5G are wide network availability with the high throughput which basically works on the packet switched wireless system. OFDMA will be the salient feature which will be used in 5G so as to achieve the high speed data transfer touching the rate of around 1Gbps [2]. Another mile stone that can be envisaged is the emergence of a network which is capable of supporting World Wide Wireless Web (www) which is expected by 2020.

Technology which will be used in the 5G network is the most powerful as well as demanding also. The challenging part will be the integration of the wide range of technologies into a small device. The expected efficiency that a mobile phone user can expect in 5G will be more than 1000 lunar modules. Adaptability and compatibility will also be the highlighted features since a 5G enabled mobile device can easily get connected to the PAN in the twinkle of an eye. High Resolution is the main feature offered by 5G for the high end users. Bidirectional huge bandwidth is another milestone to be achieved by the upcoming technology [3]. Error free transmission will be ensured due to the policy based Quality of Service. Unequalled steadiness is guaranteed by the transporter type gateway. Sustainability can be figured out up to 60,000 connections and can be counted more as expected.

## **2. DIFFERENT ASPECTS OF 5G SYSTEMS**

Evolutionary and Revolutionary are the two classes of 5G systems [1]. The capability of supporting www (World Wide Wireless Web) and allowing highly flexible network such as Dynamic Adhoc Wireless Network (DAWN) are the main characteristics of the Evolutionary class [4]. The introduction and deployment of intelligence in technology which will make the network capable of interconnecting the entire world without any limits is the main feature of Revolutionary view. Artificial intelligence which will enable the Machine to Machine (M2M) communication will be an example for the same.

## **3. FIFTH GENERATION (5G) – Real Wireless World System**

Wireless connectivity without limitation which will bring the real world wireless [5], World Wide Wireless Web (www) is the main functionality of 5G and this will be made real by the following technologies like OFDMA, IPv6 and many more are in the list. Flat IP concept is the main lead of 5G which makes it easier for different Radio Access Networks to get upgraded on to a single Nano Core network [6]. The security concern that arises due to the flat IP concept is defended by the Nanotechnology. Making the 5G network acceptable for any network is taken care by the Flat IP concept. The main advantage of Flat IP is that it provides a new way to identify devices using the symbolic names unlike the hierarchical architecture method that has

been used by the normal IP address [7]. The proper shifting of the architecture will help the network operator in many ways as given below.

- Minimize the network elements in the data path.
- Evolving the radio access and enables applications with lower tolerance
- Development of flexible core network independently
- Decouple the cost of delivering service from the volume of data transmitted.
- To create a platform that will enable the broadband operators competitive in many perspectives.

## 4. 5G ARCHITECTURE

### 4.1 Nanocore:

Globalization is the latest offering of the sophisticated technology. Convergence in the technology is the main agenda of network systems for making it possible in the case of performing similar tasks. The simple explanation of the digitization is the transformation of atoms to bits, the digitization of all media content. The words, sounds, images, etc will get transformed into digital information and we will be able to expand the potential relationships between them and thereby enabling them to flow across the platforms available and newly introduced ones.



Fig. 1. Nanocore

The concept of nanocore is the mutual combination of three technologies given below [7].

- Nanotechnology
- Cloud Computing
- All IP Platform

## 4.2 Nanotechnology:

This is the application of nano science to make the control process to a nano meter scale which will be in between 0.1 and 100nm. This particular field is known as Molecular Nano Technology (MNT) [8]. Atom by atom and molecule by molecule based control of the structure of matter. The telecommunication industry will radically get changed into the latest Nanotechnology in little year time. Putting the impact in both mobile as well as core network is the mode of operation of the nanotechnology. Perfection in security and the better impact on the sensor makes the nanotechnology the most significant in its row. The most common and general identity of a human being nowadays is the mobile device. The nano equipment in the 5G nano core is the mobile phone itself as they are geared up with the nanotechnology. Wireless industry mainly aims at the implementation of the intelligence which will ensure that the computation and communication are available as desired. The introduction of intelligence in the mobile devices will help in embedding the devices in the human environments that can create a new platform which will enable the ubiquitous sensing, computing and communication. The nano equipments will be loaded with some of the core features like self cleaning, self powered, sensible to the environment with which it is been interacting, flexible and also transparent.

Introduction of the Graphene's transistor is the milestone to be achieved [9]. A transistor which is been built using the new material by name Graphene, mainly consists of a form of graphite that consists of a single layer of carbon atoms which has been arranged in the form of honeycomb pattern. The particular structure will help the electrons to travel through it very quickly and gives greater efficiency than the commonly existing transceiver chip material. The latest achieved frequency by the Graphene's transistor is 26GHz which is miles away from the current technology standards. Frequencies above 1THz are been used for the military for seeing the concealed weapons and medical uses for imaging without using harmful x-rays. At conventional frequencies, transceivers based on grapheme will be able to make both the cell phone and base stations more sensitive for the betterment in picking weak signals. The main challenge is to distinguish the radio signals from the other waves around it. A more sensitive mobile device with a better signal to noise ratio will be able to take better advantage of the signal available from the nearest cell tower.

Cell phones enhanced with the carbon nanotube will be introduced soon which comes under the nanotechnology [9]. Other main upcoming functionalities are microscopic microphones, liquid lenses, compasses linked with global positioning system satellites are the very crispy and latest idea of electronic noses and many more. Getting maximally sensitive to the sounds we want and at the same time, minimally sensitive to the sounds we do not want will be made possible by the use of multiple microphones. This will efficiently cut down the audible noise over the phone. Liquid lenses is the conceptual idea in which the static lenses which we are

using nowadays will be replaced with Intelligent lenses which will have the sense to stay focus on what we are aiming at and this will effectively make way to reduce the jitter.

### 4.3 Cloud Computing:

Technology used for maintaining data and applications that uses the internet and central remote server is known as Cloud Computing. In 5G, the central remote server will be the main provider of content. Clouding will introduce a layer in which the consumers can use the applications without installation and also personal files can be accessed with the use of internet access. In Nanocore the same concept will be used in which the user tries to access his private account from a global content provider in the form of cloud. 5G will add on the real time applications through the Nanocore clouding [7].

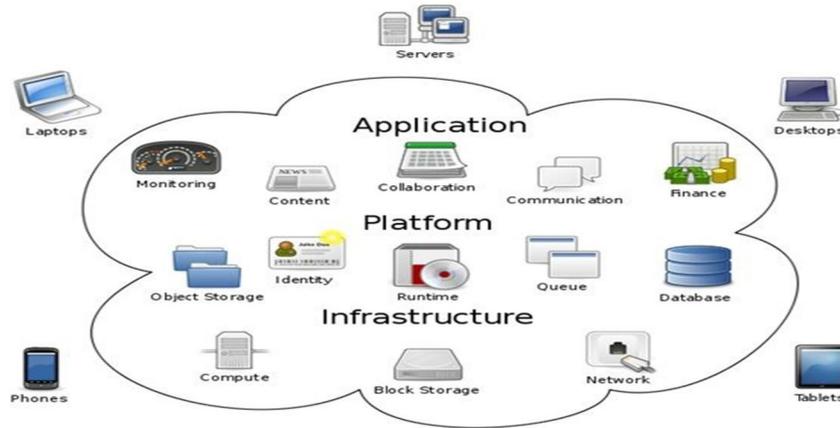


Fig. 2. Segments of Cloud Computing

The Cloud computing has three segments as follows:

- Applications
- Platform
- Infrastructure

Applications means, software services on demand. They will be varied in pricing schemes and the way by which the software is being delivered to the end user. The products which are used to deploy internet is generally referred to as the platform segment of cloud computing. The third and the final segment in cloud computing is the infrastructure and is the backbone of the entire concept. The infrastructure vendors will allow the user to build applications in this platform. Satisfying the customer demand is attained in 5G by the mutual integration of all the three

segments. The CAPEX (Capital Expenditure) of 5g has been reduced by the cloud computing deployment. Less burden of billing is the return service for the user.

#### **4.4 ALL IP Network:**

A common platform is required to interact for the convergence of different technologies to form a single 5G Nanocore [10]. The essential part of the 5G network will be the Flat IP architecture. So as to meet the increasing requirement of the mobile telecommunication market, All IP Network (AIPN) has been introduced by the 3GPP system. Migrating into AIPN will meet the requirements of the customer for the real time data applications delivered over the mobile broadband networks. Provision of the complete edge performance in terms of both performance and costs is the primary focus of the enhanced packet switched technology. The touched benefits of the IP architectures are reduction of the system latency, improved user experience, globally seamless access, core network evolution, decoupled radio access, cost effectiveness and much more. Placement of the stringent performance demands on IP based equipments and devices, which leads to the growing demand of the multicore technology. Strong demands have been seen in the Next Generation Network (NGN) infrastructures both in wired and wireless layers [7].

Another important challenge in the telecommunication field is that the network should be in such a way that it should be flexible and improved to provide larger number of connections to multiple users without losing the quality within the limited frequency spectrum available with the increased system capacity. Communication made possible within limited spectrum and time is the biggest challenge to be tackled properly without any loop holes. Meeting this target is achieved by the implementation of multiple access techniques like OFDMA, FDMA, TDMA, CDMA, etc. OFDMA (Orthogonal Frequency Division Multiple Access) technique divides and allocates the available frequency resources to maximize the resource utility efficiency [11]. In OFDMA, the multiuser capability is achieved by assigning each user a subset of OFDM (Orthogonal Frequency Division Multiplexing) subcarriers. OFDM is a digital transmission technique that uses a large number of carriers spaced apart at slightly different frequencies.

In FDMA the corresponding frequency division and allocation will take place and in CDMA and TDMA, code and time division multiplexing will happen accordingly. FDMA (Frequency Division Multiple Access) is a technology by which the total bandwidth available to the system is divided into frequencies. Unlike FDMA, CDMA (Code Division Multiple Access) separates calls by code. Every bit of a conversation is been tagged with a specific and unique code. The system gets a call, it allocates a unique code to that particular conversation, and now the data is split into small parts and is tagged with the unique code given to the conversation of which they are part of. In TDMA (Time Division Multiple Access) the division of calls happens on time basis. The system first digitizes the calls, and then combines those conversations into a unified digital stream on a single radio channel. Now it divides each cellular channel into three

time slots that means three calls get put on a single frequency and then, a time slot is assigned to each call during the conversation, a regular space in a digital stream.

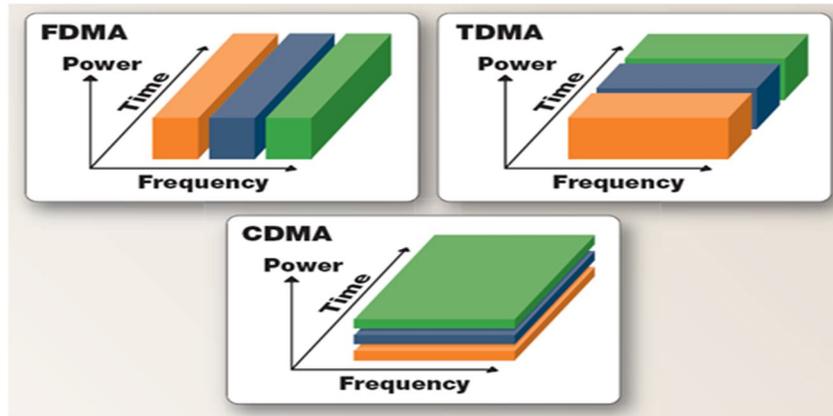


Fig. 3. FDMA, TDMA & CDMA

The users transmit in rapid succession, one after the other, each using its own time slot. This allows multiple stations to share the same transmission medium (e.g. radio frequency channel) while using only a part of its channel capacity. In near future it is expected that the capacity required in a mobile communication network will keep on climbing as the number of mobile stations are increased and apparently the data required in respective mobile stations is increased.

BDMA (Beam Division Multiple Access) is the latest allocation technique in which an orthogonal beam is allocated to each mobile station. In this technique, an antenna beam will get divided and allocated into the locations of the mobile stations to provide multiple accesses and thereby increasing the capacity of the system. Since mobile stations and the base stations are in Line of Sight state, they can transmit beams which directed to each other's position for proper communication, without making any kind of interference with cell edge mobile stations. When the mobile stations are positioned at different angles compared to the base station, the base station will transmit the beams in such a way that different angles will be covered and at the same time multiple mobile stations will be taken care. The working is like one mobile station does not use one beam exclusively, but the mobile stations positioned at similar angles will keep on sharing the one beam to communicate with the base station. Mobile stations that are sharing the same beam will divide the same frequency or time resources and will use the orthogonal resources.

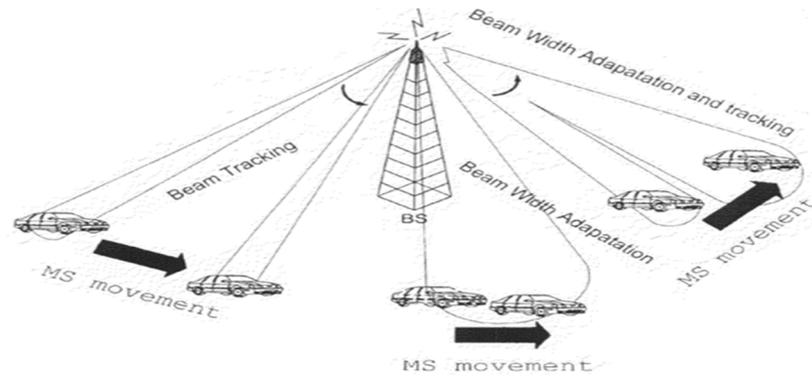


Fig. 4. BDMA

According to the mobile communication environment, a base station can change the direction, number and respective widths of the beams adaptively with the almost easiness. Three dimensional mode of division will happen in the case of beams and hence a spatial reuse of frequency or time resources can be maximized. The first slot of communication is the base station and the mobile station does not know each other's position. The mobile station will detect their positions and the moving speeds and will transmit the entire information to the base station. The second stage is taken care by the base station. The base station will calculate the direction along with the width of a downlink beam which is based on the position and moving speed information received from the mobile station. After the calculation part is over, the base station will transmit the downlink beam to the mobile station with all the calculations regarding the direction and width.

## 5. NANOCORE – SHARING

Infrastructural level of sharing is normal thing in the telecom and there are two types of infra sharing as given below.

- Active Infra Sharing
- Passive Infra Sharing

So as to achieve a single shared Nanocore for their own network enhancements, a passive infra sharing which leads to the commercial deployment has to done in short span of time. The net effect of this is the reduction of the CAPEX (Capital Expenditure) requirements by creating a very affordable & less cost to the end user for all kinds that he utilizes through the Nanocore. The flexible functionality of the Nanocore will make itself handled by a global vendor or can be shared among the small vendors which can be manageable to their own extends. Quality aspects can be made better by this method. In the long run all the functionalities can be successfully added once the existing operators become Mobile Virtual Network Operator (MVNO).

## 6. FUTURE SCOPE

The introduction of the Artificial Intelligence (AI) will make the Nanocore incredible as it puts forward the functionality to take control on an intelligent robot using the mobile device. Artificial Sensors will be working in such a way that more automated functionalities which will help the user to type a text once his brain starts thinking of the message content. Artificial Intelligence will be the real trump card in the next generation communication network.

## 7. CONCLUSION

An accelerating pace of technological change is expected in the upcoming era. It can be concluded that the stepping stone to touch 5G is made possible by the above explained technologies which includes Nanotechnology, Cloud computing and All IP. This paper tried to help to promote much stronger links between people who will be working and dealing with the very latest future concepts of communication networks, clouding, Internet services and moreover all the functionalities of Nanotechnologies.

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