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Key Concept of 5G: Future Mobile Technology

Prof.N. S. Gawai
Assistant Professor, Department of Electronics & Telecommunication Engineering, Yavatmal, India
nitingawai@rediffmail.com

Abstract

The great revolution in cellular communication is changing our lives in term of way we work, learn and interact .In 5G researches are focused on development of World Wide Wireless Web (WWWW),Dynamic Adhoc Wireless Networks(DAWN) and Real Wireless World .This paper intends to focus on 5G Architecture,Nanocore Technology,Cloud Computing along with IP Platform. The paper focuses on Hardware And Software requirements of 5G technology, the Nanocore Architecture and Beam Division Multiple Access(BDMA) as applicable to 5G technology that intends to provide improved and flexible services to large number of user at low cost.

Keywords: 5G Architecture, BDMA, Nanoscale Architecture, Cloud Computing.

Introduction

5G is a packet switched wireless system with wide area coverage and high throughput.5G technology has changed the means to use cell phones within very high bandwidth 5G wireless uses OFDM and millimeter wireless that enables data rate of 20 mbps and frequency band of 2-8 GHzs. The 5G communication system is envisioned as the real wireless network capable of supporting wireless world wide web (WWWW) in future.

In reality, 5G does not exist yet but the future network next to 4G we say as 5g. It is expected that 4G standard will be concluded within two years.5G network will not be only capable of carry more data but also will have more speed. So far, we heard about only LTE advanced, which give peak download speed of 1Gbps and upload speed of 512 Mbps, but you cannot drain its full capacity with your mobile device. As frequency is a finite resource 5G, network might solve the problem of frequency licensing and spectrum management issues .5G seems to provide hundreds of channels without streaming. The 5G terminal might have software defined radios also it has different modulation schemes and error control schemes. The wireless broadband may soon become readily available to everybody while, being at home, driving the car or sitting in the park and because of this, our need to have information at any time and to be connected at all places, all the time. The world of universal, uninterrupted access to information, entertainment and communication will open new dimension to our lives and changes our life style significantly.5G (or beyond 4G) systems will be capable of supporting WWWW allowing a highly flexible network such as a dynamics ADHOC wireless network (DAWN).in this view advanced technologies including intelligent antenna and flexible modulation are keys to optimize the ADHOC wireless networks.

With 5G technology the global cell phone is around the corner. The global mobile phone will hit the localities who can call and access from India to United States local phone with this new technology. 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.

5G Mobile Network Architecture

Figure 1 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. Routing of packets should be carried out

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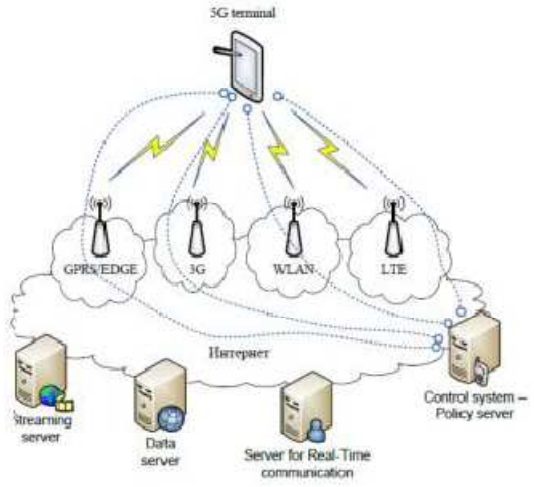
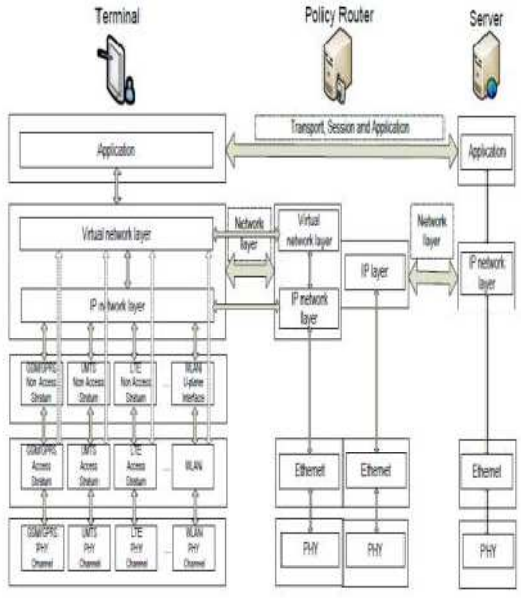
in accordance with established policies of the user.



Functional Architecture for 5G Mobile Networks

Fig.1



Protocol Layout for the Elements of the Proposed Architecture

Fig.2

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 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 e new one. This approach is not- flexible, and it is based on today's Internet communication. In order to solve this deficiency we take care of the abstraction levels of network access technologies to higher layers of the protocol stack. 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 figure.2 we have a control system in the functional architecture of the networks, which works in 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. Protocol setup of the new levels within the existing protocol stack, which form the proposed architecture, is presented in Figure 2. 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

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

5G Super Core Architecture

By increasing bit rates, the newer generations from 2G to 5G were always identified. As we know 4G provide capacity and adequate RF coverage for high-volume data application and lower latency for voice application. This newer technology intends to integrate network technologies rather than expansion of older technology figure.3.

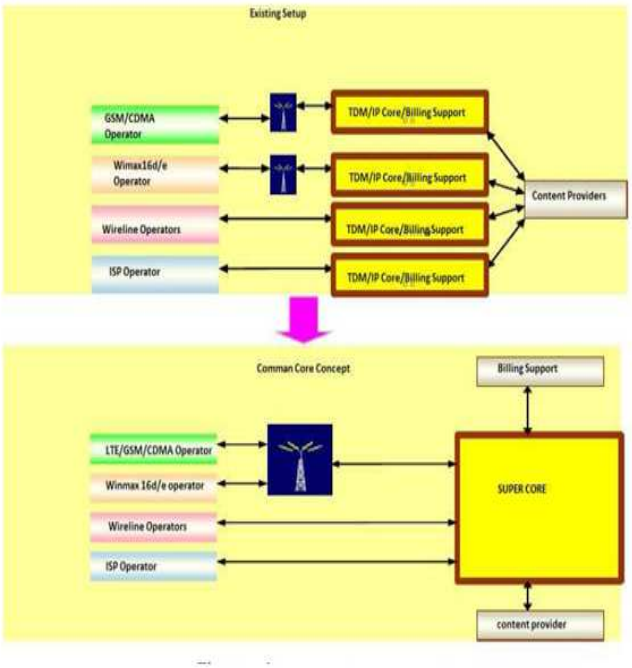

Fig3: Super Core Architecture

The application of new network is to integrate various engineering practices as health core, Mechanical, Chemical, Banking, etc. Flat IP architecture will reduce the burden on aggregation point and traffic will directly move from base station to the media gateways. A common ALL IP network will be emerged when transmission from TDM, ATM platforms to flat network. Super core is based on IP platform. Massive capacity is used to connect all network operators with the one super core. Each engineering practice has its own standards. The systematic and time-consuming processes are required to integrate these standards. One common architecture is required, which creates a common platform for all engineering practices to regularize the inter connectivity issue as well as knowledge sharing.

5G Architecture –The Nanocore

This research is intended to take a view of 5G networks from a next generation network (NGN) perspective. The 5G nanocore is a convergence of three technologies are

1. Nanotechnology
2. Cloud computing
3. All IP platforms

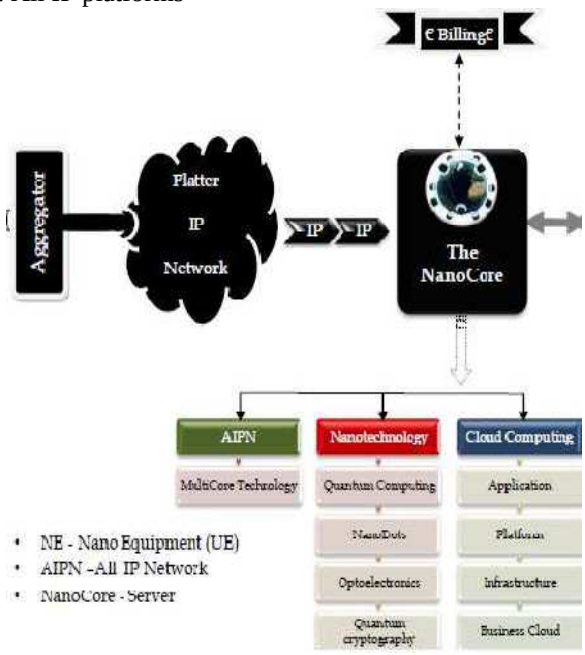

Fig 4: 5G Architecture-The Nanocore

Nanotechnology

Nanotechnology is the application of nanoscience to control process on nanometer scale that is between 0.1 and 100nm.The field also known as molecular nanotechnology (MNT) deals with control of the structure of matter based on atom-by-atom and molecule by molecule engineering. Nanotechnology seems to be the next industrial revolution, and the telecommunication 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

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security. This is considered as a most significant in telecommunication.

Nano equipment (NE)

Since mobile phone is not only communication device for people, but it becomes an identity of person .These mobiles are called 'Nano equipment" in the language of 5G nanocore as they uses the concept of nanotechnology. One of the aim of wireless industry is that, computation and communication always available and ready to serve the user in an intelligent way. For this, devices must be mobile, mobile devices together with the intelligence that will be embedded in human environments that are home, office ,public places which will create a new platform that enables ubiquitous sensing, computing and communication specs of nanoequipments gives as follows:

- Sensing of environment that is the phone will tell you the wather, the amount of air pollution present, etc.
- Flexible that is bend but not break.
- Self cleaning that is the phone cleans by itself.
- Self powered that is the phone derives its energy/power from the sun, water or air.
- Transparent that is "see through" phones.

Cloud computing

It allows us to use application without installation to consumers and business and also to access their personal files at any computer with internet access. Cloud computing maintains data and application by means of internet and central remote server. This concept is helpful in nanocore, as user tries to access their private account from a global content provider through nanocore in form of cloud. The cloud computing needs secure and reliable service providers, capabilities that operators have deep expertise in. operators will enter the cloud computing market and develop advance services and experiences by integrating industry content and applications in digital supermarket model with the help of quantum cryptography ,secure and reliable service can be provided. Much more real- time application will be obtain to user by means of cloud to utilize 5G network efficiently .the nanocore devour the resources and pay for what it uses. Thus, the customer using cloud computing will have the less expenditure for the nanocore there by also reducing the cost of purchasing physical infrastructure by renting the usage from a third party provider (content provider).this cloud computing has three main segment which are as follows:

1. Platform:-these are the 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.
2. Application:-application segment of cloud computing based on, on demand software services. These on demand software services come in different varieties as they vary in their pricing scheme and how the software is delivered to the end users.
3. Infrastructure:-infrastructure is the backbone of the entire concept, which is the third segment in cloud computing. Infrastructure venders' environment such as Google gears allows users to build applications. Cloud storage, such as Amazon' S3, is also considered to be part of the infrastructure segment.

Cloud computing will create a less billing to the end user for all kinds of services that can be utilizes through nanocore.5G nanocore will efficiently utilizes all above 3 segments to satisfy their customer demands.

All IP Network (AIPN)

To meet the increasing demands of mobile telecommunications markets, the All IP Network (AIPN) is develop by 3GPP system. We require a common platform to interact for converging different technologies to from a single 5G nanocopre. Flat IP architecture act as an essential part of 5G network. Wireless operators are turning to flat IP network architectures to meets customer demand for real-time data applications delivered over mobile broadband networks.AIPN primarily focused upon enhancements of packet switched technology to provide a continued evolution and optimization of the system concept in order to provide a competitive edge in terms of both performances and cost.

There will be increasing demands for advanced telecommunications services on wireless next generation network (NGN) infrastructures. All these services are going to be deployed over full IP-based architecture. The advantages of flat IP-architecture will be

1. Universal seamless access.
2. Reduced system latency.
3. Lkow costs.
4. Decoupled radio access and core network evolution.
5. Improved user experience.

Beam Division Multiple Access (BDMA)

In order to achieve target of increasing system capacity and quality within the limited available frequency and time for wireless technology, multiple access technique is required as the goal of communication system is to provide improved and flexible services to a larger number of mobile user at lower costs. Some multiple access technology are already in use, they are frequency division multiple access (FDMA), time division multiple access (TDMA), code

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division multiple access (CDMA), orthogonal frequency division multiple access (OFDMA) techniques, etc.

In future, it is needed 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. But, currently in mobile communication system, a capacity of mobile communication system is limited depending on given frequency and time as limited frequency and time are divided to be used among multiple users. Thus, in order to increase a capacity of the system, there is a demand for a technical development, which uses other resources than frequency, time resources.

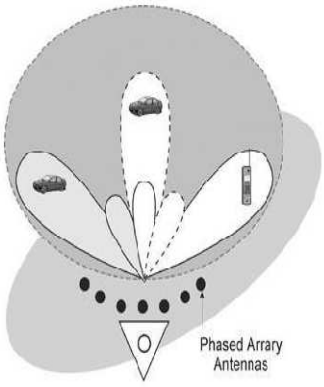

Fig. 2: Beam Division Multiple Access

Concept of BDMA

In BDMA, it divides the antenna beam according to the location of mobile stations because base station allocates separate beam to each mobile station.BDMA increases the capacity of the system. Mobile station finds its position and moving speed transmit it omnidirectionally to the base station as initially, base station and mobile station don't know each other positions. The base station calculates a direction and width of a downlink beam based on moving speed and position of mobile station. Mobile station and base station can communicate with each other by the separate beam when both are in LOS state. In BDMA, using the phase array antenna multiple beams of distinct patterns is formed. Base station transmits the different beam at the different angle to transmit data simultaneously when mobile stations are located at a different angle with the base station. If mobile stations are at the same angle with base station, after that they share same beam. According to a communication envirment, the base station can change the width of beams, number of beam and direction. The beam is three dimensionally divided so it is three dimensionally divided so it can accommodate more users. With matching of radiation pattern of mobile station and base station antennas, the radiation efficiency of antenna can be maximized. Mobile stations and base station share same beam which lower MCS level or peak to average power ratio problems when mobile stations are at the same angle with base station.

Hardware and Software

5G Hardware

Smart Antennas

Switch Beam Antennas: Switched Beam Antennas support ratio positioning via Angle of Arrival (AOA) information collected from nearby devices.

Adaptive Array Antennas: These arrays can be used for interference rejection through special altering, position location through direction ending measurements, and developing improved channel models through angle of arrival channel sounding measurement Adaptive Antenna Array provides improving capacity of wireless systems and improved safety through position location capabilities.

UWB Networks

Higher bandwidth at low energy levels UWB complements existing longer range radio technologies such as Wi-Fi, WiMAX, and cellular wide area communication that bring in data and communication from the outside world. This short range radio technology is ideal for wireless personal area networks (WPANS). For relaying data from host devices to devices in the immediate areas (up to 10 meters or 30 feet), UWB provides the needed cost-effictive,power-efficient, high bandwidth solution.

Bandwidth

4K megabits per second, which is 400 times faster than today's wireless networks.

Multiplexing

CDMA (Code Division Multiple Access) CDMA employs analog-to-digital conversion (ADC) in combination with spread spectrum technology. Audio input is first digitized into binary elements. The frequency of the transmitted signal is then made to vary according to a defined pattern (code), so it can be intercepted only by a receiver whose frequency response is programmed with the same code, so it follows exactly along with the transmitter frequency. There are trillions of possible frequency-sequencing codes, which enhance privacy and makes cloning difficult.

5G SOFTWARE

1) Software Defined Radio, Packet layer, implementation of packets, encryption, flexibility etc.
2) 5G will be single unified standard of different wireless networks, including wireless technologies (e.g. IEEE 802.11), LAN/WAN/ PAN and WWWW, unified IP and seamless combination of broad band.

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Conclusion

5G Technology going to be a new mobile revolution in mobile market. In this paper ,we explain different mobile technology we want to include in a future mobile network .5G technology has a bright future because it can handle best technologies and offer priceless handset to their customers.5G will promote concept of nanocore, BDMA and super core ,where all the network operators will be connected one single core and have one single infrastructure regardless of their acccesss technologies. The paper also explained architecture which is the main contribution of the paper. We conclude that nanotechnology, cloud computing, All IP are the next great technology wave. There are lots of improvements from 1G, 2G, 3 G, and 4G to 5G in the world of telecommunications. The new coming 5G technology is available in the market in affordable rates ,high peak future and much reliability than its preceding technologies.

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