

5G Technology: Ultimate Solution for Advanced Mobile Communication

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Abstract: *The main aim of this paper is to represent a detailed study about the development of 5G technology of mobile communication. 5G stands for Fifth Generation mobile technology. The paper deals with different aspects of 5G mobile technology which includes the concept of 5G, 5G architecture, features, application and advantages of 5G along with the challenges in migrating to 5G. In the study related to 5G, the most important technologies are 802.11 Wireless Local Area Network (WLAN), 802.16 Wireless Metropolitan Area Network (WMAN), Ad-hoc Wireless Personal Area Network (WPAN) and wireless networks for digital TV and radio broadcast. The 5G mobile network concept is seen more as user centric instead of operator centric in which the user has been given the prime and top most priority compared to others. With 5G pushed over a VOIP-enable device, people will experience a handful of services in a much better way than earlier. The paper also describes about IPv6 and flat IP architecture which is necessary for the development of 5G.*

Keywords: 5G, WLAN, WMAN, VOIP

1. INTRODUCTION

With the rapid advances in the field of mobile and telecommunication sector, 5G has become one of the key research areas in today's world. The mobile communication has been widespread due to evolution of generation mobile technology from 1G to 5G. In the evolution. First came, the 1G mobile system which is used analog systems along with technologies like MTS, AMTS, IMTS and PTT. The second generation used digital signals for voice transmission along with SMS (short messaging service). Third generation of mobile technology uses Wide Band Wireless network along with packet switching. Fourth Generation mobile technology offered high downloading speed and services like multimedia and high definition Television programs. The 5G mobile technology came after the 4G mobile technology. Although 5G has not been officially cited by any institution and has not been specified precisely. The 5G mobile technology is seen inclined more towards the user than the operator which made it more user friendly. 5G will also include pervasive networks which will provide ubiquitous computing along with World Wide Wireless Web(WWWW).[11]

2. CHALLENGES IN MIGRATION FROM 4G

Multi mode user terminals

By means of 4G, a need will arise to design a single user terminal which will be able to operate in different wireless networks and will overcome the design troubles such as restrictions on the size of the device. This trouble can be easily solved by using software radio approach.

Choice among various wireless systems

With the rapid advancements in the wireless systems, each and every wireless system has its distinctive characteristics and roles. The choice for the most appropriate technology will be dependent for a specific service at a specified place and at specified time. The most appropriate technology will be chosen which meets the demands and the best possible fit of consumer QoS (Quality of Service) requirements.

Security

Reconfigurable, adaptive and lightweight protection mechanisms should be designed.

Network infrastructure and QoS support

Integrating the current non-Internet Protocol and Internet Protocol based systems and providing QoS assurance for end-to-end services that engage different systems is a challenge.

Charging and Billing

It becomes extremely difficult to bring into account, collect and handle the Consumers' account information from many service providers. In the same way consumers' billing is also a difficult task.

Attacks on Application Level

Software applications which will offer some new features to the consumer but will also start and produce new bugs.

Spoofing and Jamming

Spoofing is a fake GPS signal being sent out, in which the GPS receiver considers that the signals arrives from the satellites and computes the wrong coordinates. Such wrong computation can lead to more criminal activities and increase the crime rate. Jamming occurs when a transmitter sending out signals at the same frequency shifts a GPS signal.

Data Encryption

If a GPS receiver will communicate with the main transmitter then the communication link between these two is easy to break and the consumer must use the encrypted data [1].

3. CONCEPT OF 5G TECHNOLOGY

The 5G terminals will contain vertical handoffs as they have access to various wireless networks. The vertical handoffs should be avoided as the 5G technology will invite a lot of new technologies. The 5G technology will also contain some error control schemes along with modulation techniques [2, 3].

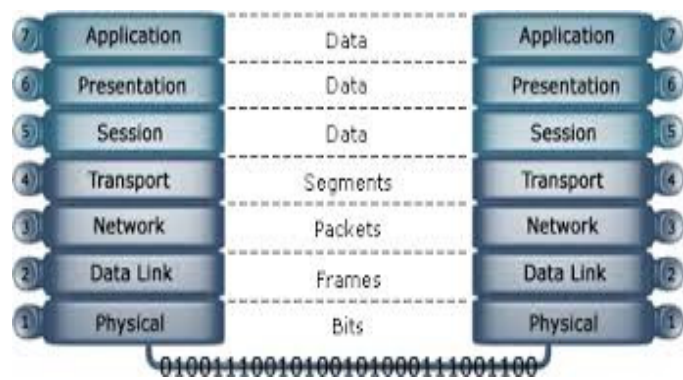


Fig.1 OSI Model[12]

A. Physical/Mac layers

The physical layer has a major responsibility of coordinating the functions required to carry a bit stream over a physical layer. The interface and transmission medium have some mechanical and electrical specifications which are regulated by the physical medium. The physical devices and interfaces have to perform some procedures and functions for transmission to occur which are also regulated by the physical layer. The physical layer takes into consideration the physical characteristics of interfaces and medium, representation of bits, data rate, synchronization of bits, line configuration, physical topology and transmission mode.[14]

B. Network layer

The limitations which were carried out by IPv4 (Internet protocol version 4) in the network layer were solved in the IPv6 (Internet protocol version 6) but it required a bigger

packet header. The network layer is responsible for the delivery of the packet from the source to the destination through multi-channel networks. The network layer is applicable only when a need arises to perform the source to destination delivery where two systems are attached to two different networks through connecting devices between the links. The 5G mobile concept will use fixed mobile IP along with a Foreign Agent (FA) and also having a different CoA (Care of Address) for each Mobile IP of Foreign Agent (FA) in the 5G mobile terminal. The network layer will also have responsibilities of Logical addressing and Routing. The Fig.2 [3] of the mobile terminal network layer consists of the Upper layer of IPv6(version 6) address while the lower network layer consists of IPv4/IPv6 along with WLAN,WIMAX,3G,LTE and 4G and in between the two layers the translation is done through network address translation. [4]

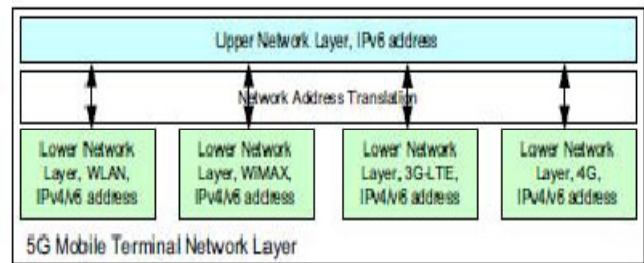


Fig.2 5G mobile terminal network layer [3]

C. Open Transport Protocol (OTA) layer

The transport layer in the OSI model is the layer through which different wireless networks differ from each other. The transport layer performs the task of process-to-process delivery of the entire message. The transport layer brings out the relationship between the two packets which are delivered and ensures that the whole message arrives as it was overseeing both error control and flow control at the source-to-destination level. The transport layer is also responsible for Service-point addressing, Segmentation and reassembly, connection control, flow control and error control. [4]

D. Application layer

The application layer is responsible for providing services to the user. The application layer enables the user, whether human or software to access the network. It provides user interfaces and support for services such as E-mail, remote file access and transfer, shared database management, and other types of information services. It also consists of a virtual network terminal which allows a user to use any Host ID. This is possible when the user’s software takes access from the host and thereby creating an illusion through which the host believes that it is communicating with one of its own terminals.[4]

4. DESIGN OF 5G MOBILE NETWORK ARCHITECTURE

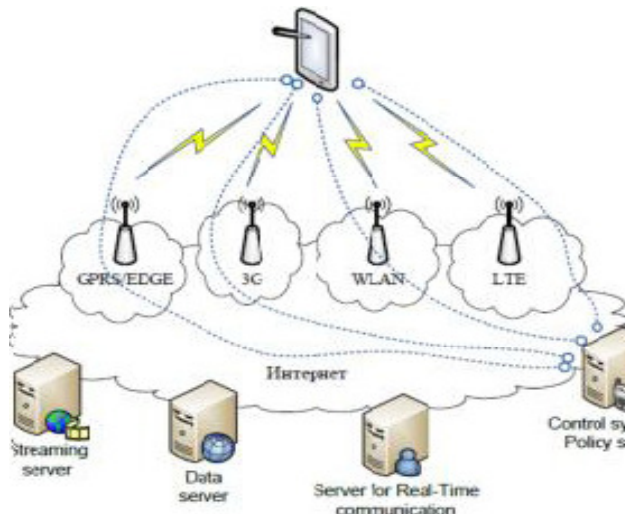


Fig.3 Functional Architecture for 5G mobile Network [5]

Fig.3 shows the system model that proposes the design model of the 5G mobile network architecture, which is all IP based model for both wireless and mobile networks interoperability. The system consists of a user terminal having a crucial role to play in the new architecture and also consists of a number of independent, autonomous radio access technologies.



Fig. 4 5G Mobile Phone Design

Within each of the terminals, each of the radio access technologies is seen as the outside link to the outside Internet world. However, different Radio interface for each Radio Access Technologies (RAT) in the mobile terminals should be present. For an example, if we want to have access to four different RAT's, it is necessary to have four different access specific interfaces in the mobile terminal and to have all of them active at the same time in order to have this architecture to be functional.[5]

Fig.4 shows the 5G mobile phone design [6].Fig.4 shows that 5G supports Open Wireless Architecture (OWA),Open Transport Protocol(OTP) along with many applications such as VoIP, Television in high definition, Entertainment, GPS, radio and many more.

5. REVIEW OF 5G KEY TECHNOLOGIES

There are several technologies which are expected to help fulfilling the need of improvement for 5G.These are Flat IP Based Network and Cognitive Radio(CR).

Flat IP Based Network

The basic concept of the 5G mobile concept is designed by keeping the requirements of user in mind and the user has been given the top most priority instead of the operator centric concept as in 3G or the service-centric concept for 4G.The 5G has been made up of OSI model consisting of different layers from physical layer to the application layer.[7]

The network layer at 5G networks will be divided into several sub layers to provide all IP connectivity anywhere and anytime. The use of the Internet Protocol (IP) in the network layer is inevitable, given the IP system is the best and most used system to support and expand the network layer nowadays. All IP Network (AIPN) system has started well since the development of the LTE.[7]

All IP Network (AIPN) system has started well since the development of LTE as an evolution of 3GPP system. Flat IP architecture is a key concept that is used to make 5G acceptable to all the kinds of technology. Evolve packet core (EPC) is also a part of flat IP architecture. It usually consists of Mobility Management Entity(MME) and access agnostic gateway for routing of user datagram to provide all simplified core IP networks[4].Fig.5 shows the diagram of flat IP architecture[4].With the shift to flat IP architectures, mobile operators will be able to:

- Reduce the number of network elements in the data path, thereby reducing operation costs and capital expenditure.
- Splitting the cost of service delivery from the amount of data that is sent to equate infrastructure capabilities to the requirements of emerging applications.

- Minimize system latency and enable applications with a lower tolerance for delay; upcoming latency enhancements on the radio links can also be fully realized.
- Develop a flexible core network that can be the basis of innovative services for mobile and generic IP access network.[7]

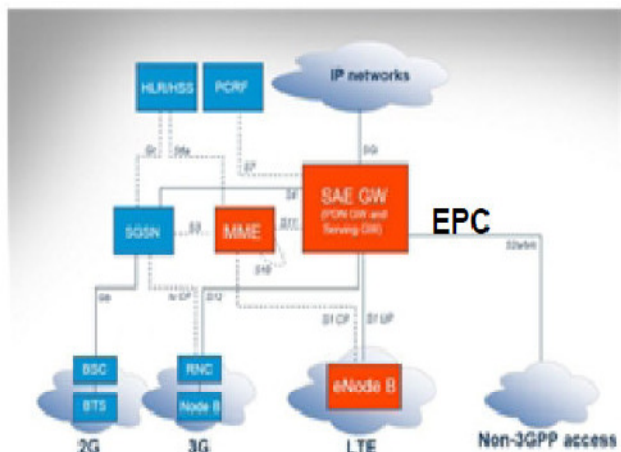


Fig.5 Flat IP Architecture [8]

B. Cognitive Radio

Cognitive radio is an intelligent communication which takes into account the surroundings and uses the methodology of understanding by building to learn from the environment and adapt its systems to make a correspondence to different operating parameters in real time, with two primary objectives in mind: highly reliable communication whenever and wherever needed; efficient utilization of radio spectrum.[7]

By that terminal Cognitive terminal is a smart terminal with intelligence to choose the proper network from all the existing wireless networks. The choice is based on some information such as time, demand and resource. The 5G technology proposes a universal terminal which should include all of the radio predecessors features into a single device.[7]

6. FEATURES

- 5G technology offers high resolution for cell phone users.
- 5G technologies offer Bidirectional large Bandwidth.
- The advanced billing interfaces of the 5G technology makes it more attractive and effective.[6]
- 5G technology also providing subscriber supervision tools for fast action.[6]
- The high quality services of 5G technology based on policy to avoid error.

- 5G technology is providing large broadcasting of data in Gigabit which supports almost 65,000 connections.
- The traffic statistics by 5G technology makes it more accurate.
- Remote Management is used to get better and faster solutions.
- The 5G technology is providing up to 25 Mbps connectivity speed.
- The 5G technology also supports virtual private network.
- The uploading and downloading speed of 5G will be very high.
- It offers connectivity round the clock all over the world.
- The Remote diagnostic is also one of the features included in the 5G mobile technology.
- Uploading and Downloading speed up to 1Gbps.[3,9,10]

7. CONCLUSION

From this paper, we surveyed about the 5G mobile communication system which was the main focus of the paper. The paper discusses the need for 5G mobile communication system from the earlier generation of mobile communication such as 1G, 2G, 2.5G, 3G, 4G. The 5G mobile technology is designed as an open platform consisting from physical layer to the application layer. The 5G technology is designed in such a way keeping in mind the purpose of user and the user will never experience such utmost service. The 5G mobile system will have many advantages of being low cost, globally accessible and high data bandwidth. It will also possess pervasive networks, radio resource management and VOIP devices. The 5G technology in the market will be available at cheaper or affordable rates to the user along with providing high reliability than the other services.

8. ACKNOWLEDGEMENT

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