5G in Mobile Communication: An Overview

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Abstract : In this paper various trends in 5g mobile communication has been discussed. As there are various generation like 1G, 2G, 3G, and 4G and in each generation technology has improved itself. The continuing growth in demand from subscribers for better mobile broadband experiences is encouraging the industry to look ahead at how networks can be readied to meet future extreme capacity and performance demands. The technologies used for 5G are 802.11 wireless local area network (WLAN) and 802.16 wireless metropolitan area network (WMAN). New mobile generations are typically assigned new frequency bands and wider spectral bandwidth per frequency channel like up to 30 kHz for 1G, 200 kHz for 2G, 20 MHz for 3G, and 100 MHz for 4G however the frequency bandwidth for 5G is yet to be decided but it is expected to be near by 5GHz. Mobile broadband is the key use case today and it is expected to continue to be one of the key use cases driving the requirements for 5G. It working features will go far better and beyond then current mobile Internet access devices and covers rich interactive work, media and entertainment applications. Later on in 5G there will be quality improvements in term of bandwidth, data rates, security and fast communication at affordable prices.

1. INTRODUCTION

Last two decades has shown a lot of improvement in mobile communication and technology is getting better day by day. Even today one can't imagine life without smart phones, high speed internet and data services. We are in world that we want things be happen at just one click and 5G will provide that. Instead of Internet Protocol version 4(IPv4) it will use IPv6. It should be pointed out that some of the performance comparisons in 4G LTE are not accurate in actual conditions, for example, 5G Wi-Fi is expected to be about 6 times faster than 4G LTE. Existing systems like 4G-LTE, LTE-Advanced and Wi-Fi are merged with some new revolutionary technologies which are designed to meet new requirements, such as virtually zero latency which is to support the tactile Internet, machine control and many other different things. 5G in mobile will be the set of technical components and systems which needed to handle these requirements and overcome the limits and drawbacks of current systems. 5G contains macro dense networks. Massive Dense Networks which are also known as Massive Distributed MIMO provides 5G Green Dense Small Cells. A transmission point which is equipped with a very large number of antennas that simultaneously serve multiple users. With large MIMO multiple messages for several terminals can be transmitted on the same time-frequency resource, maximizing beam forming gain while minimizing interference. A major issue in beyond 4G systems is to make the high bit rates available in a larger portion of the cell. The issue is addressed by cellular repeaters and macro diversity techniques, also known as group cooperative data, where also users could be potential cooperative nodes thanks to the use of direct device-to-device (D2D) communications. [1]

1.1 From 1G to 5G:

Earlier and even today low speed data services are provided by 2G system which do not meets our future system .This gave rise to demand for a new system called 3G,which promised to provide high speed data services. Recent (4G) mobile communications system LTE was developed to provide high capacity and highest rate data service for mobile multimedia which is still to run in most of the countries [4]. The description of 1G to 4G is given below:

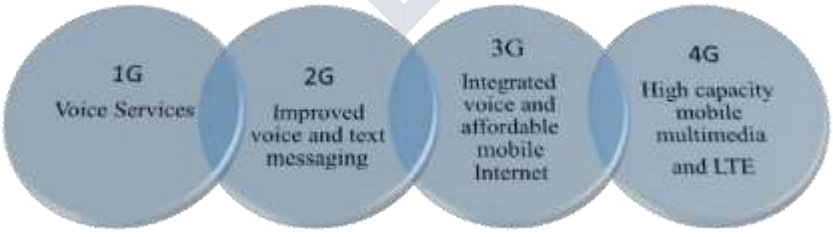

Figure 1: 1G to 5G

1.2 Need of 5G and Vision

Things are changing very quickly and we need to transform ourselves according to the demands of world and future. The next generation mobile communications system will not be used for human interaction alone. There will be a huge growth in machine type communications, the devices will also not only be remotely controlled and managed by people, but will also communicate with one another and this all will require more reliable communication links and also lower transmission delays machines which can simply process information much faster than people.3G and 4G provide data to be downloaded in term of Mbps but we need to think towards Gbps now. Even though data is downloaded in Mbps but it do not meet our needs. The future is in gigabytes and even in terabytes. "Gigabit" mean data reception and transmission speeds of Gigabits per second to users and machines. Again,

this does not mean providing high-capacity networks everywhere, but the centers of big cities will be the first places where the demand for a new system will be felt. The overall demand growth in both user data rates and network capacity is still the main driver for technological evolution. Higher capacities -of networks will require better performance, cell densification and access to new, broader carriers in new spectrum. The capacity growth can of course be met with existing systems, but after 4-5 years, limits will be reached and 5G technologies will be needed.

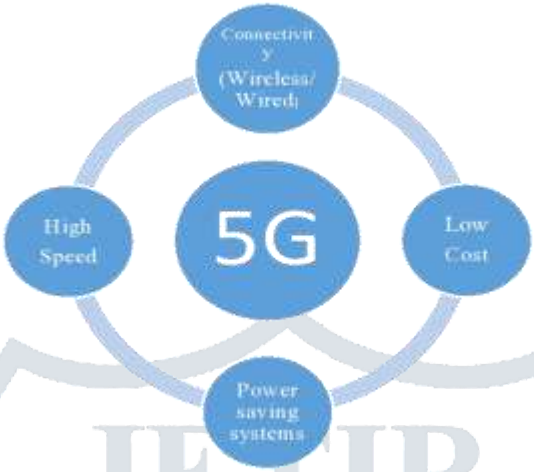

Figure 2: Need of 5G

2. CHALLENGES IN MIGRATION TO 5G

2.1 Multimode user terminals

In future for 5G networks, there will be a need to design single user terminals to operate in different wireless networks. The other problem is device size, its cost and power consumption. The problem can be solved by a software called radio approach [5].

2.2 New types of connected devices

From electricity bills to car, household appliances to shopping malls and many more will be supported by future mobile networks [3]. There will be wide range of new services which will run on them.

2.3 Reliability

It's really important to maintain reliability between networks when we talk about future communication. Although it's a tough task to do. Reliability requirements are very tough in industrial communication applications and for societal functions such as smart city management and traffic safety. There will be a need to modify broadband system that we are using today.

2.4 Availability of spectrum

By 2020 there will be a need of more spectrum. Frequency ranges will be needed then to improve the quality of service and network. Larger bandwidths will be needed enabling extremely high service levels for special scenarios.

2.5 Security

Since there are various wireless networks and their complexity made the things much more complicated in term of security issue. We need to adopt adaptive and lightweight security methods.

2.6 Bugs

There is one thing which is to be guaranteed in 5G that is bugs. These may be found in new applications and they are need to be fixed at that time.

2.7 Overlapping

Overlapping means occurs when transmitter is sending some kind of signal at same frequency displaces a GPS signal.so it need to be fixed.

2.8 Hacking of signals

There are many fake signals being sent out by GPS. There are some fake signals in which GPS thinks that they are sent by satellite and calculates the wrong coordinate. The techniques is known as spoofing. Normally the criminals and hackers uses this technique.

3. CONCEPT OF 5G

There is a model called OSI model upon which 5G works. This OSI model further have different layers named as Physical layer, Network layer, Open transport protocol and application layer.

3.1 Physical/MAC layers

Physical and Medium Access Control layers has two parts i.e. OSI layer 1 and OSI layer 2, which is for the wireless medium. 5G network in mobile is supposed to be based upon these two layers.

3.2 Network layer

The network layer is based on IP (Internet Protocol). Normally there are two types of IP i.e. Ipv4 and Ipv6. The Ipv4 (version4) is widely used but on the other hand it has some problems too, such as address space is limited and there is no support for quality of service (QoS). The issues are fixed in Ipv6, but due to trading with larger packet header, mobility is still a problem. There is Mobile IP standard on one side as well as many micro-mobility solutions (e.g., Cellular IP, HAWAII etc.). Different mobile networks will use Mobile IP in 5G, and each mobile terminal will be FA (Foreign Agent), keeping the CoA (Care of Address) mapping between its fixed Ipv6 address and CoA address for the current wireless network. On the other hand, one mobile network will be attached to several other mobile networks or wireless networks at the same time. In this case, mobile network will maintain different IP addresses for each of the interfaces, while each of these IP addresses will be care of address (CoA) for the foreign agent placed in the mobile Phone. Thus fixed Ipv6 will be used in the mobile phone by 5G phone manufactures. The 5G mobile phone will maintain multi-wireless network environment. For this there will be separation of network layer into two different sub-layers in 5G which are named as Lower network layer and Upper network layer. Lower layer network is for each interface and Upper layer network is for the mobile terminal. The middle layer between the Upper and Lower network layers is to maintain address translation from Upper network address (Ipv6) to different Lower network IP addresses (Ipv4 or Ipv6).

3.3 Open Transport Protocol (OTA) layer

OTA layer works differently for wireless networks as compare to wired networks. In all TCP versions, segments are lost and it is assumed that segments are lost due to congestion in network, On the other hand in wireless networks there will be losses due to high bit error ratio in the radio interface. Therefore, TCP are used for the mobile networks as well as wireless networks, through which the lost or damaged TCP segment can be retransmit over the wireless link. In 5G mobile, terminals will be suitable to have transport layer that is easy and possible to be downloaded and installed. In such mobiles there is a possibility to download new version which is targeted to a specific wireless technology installed at the base stations.

3.4 Application layer

The 5G mobile terminal is to provide excellent quality of services over different and variety of networks.The mobile internet users today manually select the wireless port different Internet service without having the possibility to use QoS history to select the best wireless connection for a given service. In future the 5G phone will provide possibility for quality of service (QoS) testing and storage of measured information in the mobile terminal. There are different quality of service (QoS) parameters, such as delay, jitter, losses, bandwidth, reliability that will be stored in a database in the 5G mobile running in the mobile terminal as system processes, which in the end will provide the best suitable wireless connection upon required QoS automatically.

4. FEATURES

Figure 3: Features of 5G

5. CONCLUSION

In this paper we have studied about 5G. Although it is yet to come and will take time to come but has very bright future. The technology is going toward the high data rates. The number of use cases for a next generation mobile communications system will grow rapidly and the scenarios will place much more diverse requirements on the system. We have also defined concept for such 5G mobile networks. The architecture includes two type of networks. One is wired network and the other one is wireless network. We still see improvements and demanding requirements for spectral efficiency in terms of average bit/s/Hz/cell for ultra-dense deployments. Moreover, this will probably not be as important as in the past for the design and use of 3G and 4G radio access technologies, which were mainly needed for wide area deployments using high frequency bands, large bandwidth for transmission combined with low transmit power automatically limits the coverage. Work still need to be done in term of cost, maintenance, data rates, bugs need to be fixed so that the user can enjoy this technology.

6. REFERENCES

[1] B. Kouassi, I. Ghauri, L. Deneire, Reciprocity-based cognitive transmissions using a MU massive MIMO approach. IEEE

[2] Suk Yu Hui, Kai Hau Yeung, "Challenges in the Migration to 4G Mobile Systems", IEEE Communications Magazine, December 2003

[3] Nokia Solutions and Networks5G Use Cases and Requirements Future Works NSN White paper April 2014 International Conference on Communications (ICC), 2013

[4] Prof. Yongwan Park Feb. 2014 5G Vision and Requirements Of 5G Forum, Korea

[5] Asvin Gohil, Hardik Modi, Shobhit K Patel 5G Technology of Mobile Communication: A Survey 2013 International Conference on Intelligent Systems and Signal Processing (ISSP)

[6] Mobile Phones: Jargon Explaine

[7] Krishnan, Suresh (2012) Connecting sensors to LTE. Master's thesis, Concordia University.

[8] Osman Yilmaz; Zexian Li; Kimmo Valkealahti; Mikko Uusitalo; Martti Moisio; Petteri Lundén; Carl Wijting IEEE WCNC 2014 WS on Device-to-Device and Public Safety Communications (WDPC), Istanbul, Turkey (2014)

[9] Kevin F. king(2009-10-14)."Geolocation and federalism on the internet:Cutting Internet Gambling's Gordian Knot"