

5G Future Technology: Research Challenges for an Emerging Wireless Networks

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Summary

By every Year world has seen many improvements and better quality of service in mobile communication. From 1st Generation to 2.5nd Generation & From 3rd Generation to 5th Generation of Mobile Communication. This paper mainly focuses on 5th Generation mobile communication technology.

5th Generation mobile communication is expected to represent more enhancement to current telecommunications technologies, like changes in radio interaction and in spectrum. 5 Generations mobile wireless networks will be faster, easily accessible, more reliable.

This paper spot on numerous rising technologies which will change & define the future of telecommunication standards Service like e-payments and electronic documents and many more like smooth high quality video streaming a user can avail in 5th generation mobile technology, video chats gives a feeling of reality by which a person can feel he can reach other side through the screen, faster data speeds, Ultra-low latency, Better Speed of internet etc.

This paper mainly focuses on the challenges 5g will face in future. One of the major issue 5G might face it would be Handover challenge in 5G mobile Network.

Key words:

5G, 5 Generation, e-payments, e-transactions, Handover

1. Introduction

Today world's economy depends on many things from which one of the backbone business foundation stone is the economical, advanced use of Information Technology in the communication sector with its latest inventions [18]. Information Communication systems have reserved a important space in the trade and economy. Wireless mobile communications with its varieties and categories of supporting systems and devices have overcome the all traditional communication systems and have given strength to increase the global economic systems. [9]

The significance of mobile wireless communications is reflected in a fast speed of technological innovation. The second generation (2G) mobile communication system that start in near to end of 20th century and the 3G system was launched in 2001 [10], uses a sophisticated radio interface

for 4G. [11]. Figure 1 shows the generation growth of technology w. r. t. years and bandwidth ranges for different eras of communication.

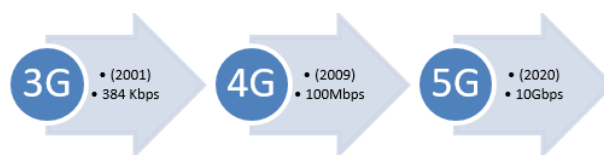


Fig. 1 5G Networks dramatically faster than the 3G and 4G networks

What does the 5G network look like, which should be normalized around 2020? It is very early to claim it with certainty. However, it was generally accepted idea that the 4G network is less than 5G network [19]. The 5G network should reach 1000 times the system capacity, 10 times the spectral efficiency, the energy efficiency and the data rate (i.e. Gb/s for low mobility and maximum data rate of 1 GB/s for high mobility) and 25 times the average cell rate. The goal is to connect the whole world and the seamless and ubiquitous communication between everyone (from person to person), everything (from machine to machine), wherever they are (when), when (anytime) necessary, whatever devices / services / electronic networks they want (anyway) [20].

This means that some of special scenarios which are not supported by 4G the 5G networks must be able to support such communication networks (e.g. for high-speed users). High-speed Networks can easily reach 350 to 500 km/h, while 4G network scanning only supports communication scenarios up to 250 km/h. [12]

The term 5G refers to the future of telecommunication. It represents a big step forward compared to the current cellular technology as an example of revolutionary changes in the radio interface[6]. For technical reasons, 5G networks will be faster, easier to access and more reliable than current cellular technology [1]. This should lead to new applications in different areas, such as health, transport and entertainment. 5 Mobile technologies should be introduced

to the market by 2020, which would significantly improve the quality of service to customers from the point of view data and the expansion of various smart devices. It is expected that 5G will deal with high data transfer rates that would exceed 10 gigabytes per second[8].

2. Review for Present and Previous Generation Networks

2.1 Evolution

Due to rapid changes in Cellular communication it becomes more popular in last few years. This revolution is from 1G-2G, 3G- 4G now looking forward to 5-the fifth second generation of cellular communication.

2.2 1G- First Generation of Cellular Communication:

1G revealed in 1980. It was based on analogue system which was known for cell phones. It introduced cellular technologies like Mobile Telephone System (MTS) & Advanced Mobile Telephone System (AMTS), (FDMA) Frequency Division Multiple Access technique was used in 1G, voice calls were transmitted at a frequency rate of 150MHz and works between two radio frequency towers[2],[18]

2.3 2G- Second Generation of Cellular Communication:

2G revealed in late 1980s. digital services were used in 2G Cellular communication. 64kbps speed were used in 2G. Major benefits of 2G over 1G cellular communication were devices consumes less power batteries, voice quality was improved, safety to the data and voice calling.

30 KHz to 200 KHz of Bandwidth were used by 2G mobile Network system. After 2G, 2.5G cellular system provide data rate up to 144 kbps [2].

2.4 3G- Third Generation of Cellular Communication:

Packet switching technology were used in 3G, Voice calls use to interpret through Circuit Switching. It functions at an assortment of 2100x106 b/sec and has a bandwidth of 15-20x106 b/sec. 3G has the ability to transfer data both (Voice & Non-Voice) over the same network. The Major goal of 3G is to allow for more coverage with minimum investment [2], [7].

2.5 4G- Fourth Generation of Cellular Communication:

4G allows the users to enjoy speed of downloading around 100Mbps to 1Gbps. Features of 4G & 3G are almost same

like Online streaming Data much faster than previous generations. 4G networks use to consider as LTE. Development of 4G mainly focuses to achieve high speed data rate for home internet connections. Major features of 4G are High network capacity, Huge Data rate, and High quality of service, security & privacy [3]. Figure 2 highlights the different cellular standards for digital data used in different generations of communication. This scenario gives the idea for evolutions of mobile data.

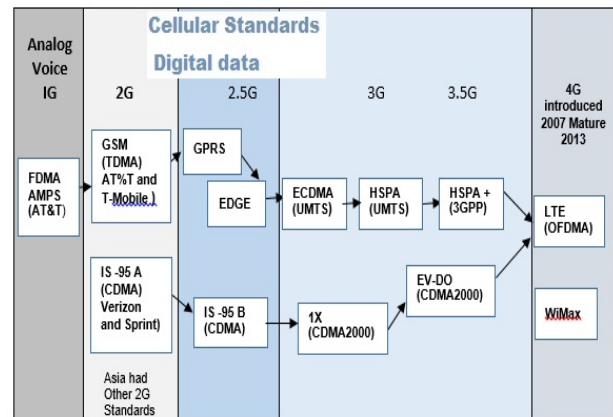


Fig. 2 Mobile Data Evolution

3. 5G of Cellular Communication

Features 5G (Fifth Generation) vary overwhelming majority of cellular communication, but in another speed, large capacity, bandwidth allocation for each user is recognized by 5G networks as part of this burden we can easily produce a compact. This can be achieved by earnings combined with three categories:

I. Extreme and unloading area spectral densification to improve efficiency. Other than the active area of the lymph per unit Hz.

II. The bandwidth increases, and in particular by moving to mm wave spectrum, but also to better use unlicensed by the number of feet in the only 5 GHz WiFi band.

III. By intensification of Spectral competency, will result (in particular by advances in MIMO) to facilitate the more units of data packets per hop. In that way different hops will join other hops and jointly will form a network that will be capable to handles several bit or Hertz per second transmission of data. Other ideas in the above categories, for example, through the cooperation in the management of BS mediation [15] [16] to contribute to the plans, but the opportunity to surf the ideas must share come the above categories. Authors of [17] has very beautifully designed the conceptual scenario for 5G heterogeneous wireless

cellular architecture of future. To give credit to authors of [17] here we are projecting the same Figure 3 for readers.

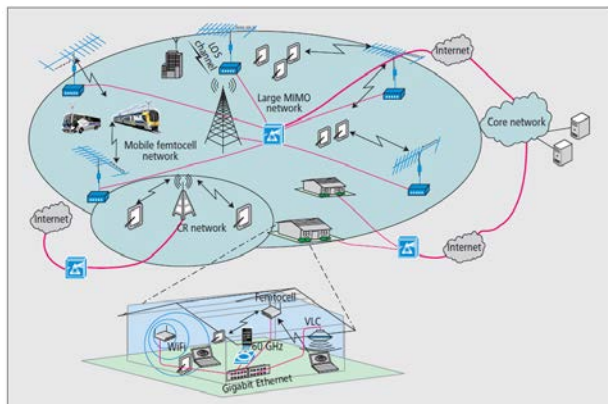


Fig. 3 5G heterogeneous wireless cellular architecture [17]

4. Comparative Analysis between different Generations

In this section we have produced certain tables to compare the past, present and future technology (under discussion) with respect to several attributes. Table 1 shows all those characteristics of comparisons.

Table 1: Comparative Analysis of Different Generations Attributes

Technology Features	1G	2G	3G	4G	5G
Start/Deployment	1970-1980	1990-2004	2004-2010	Now	Soon (Probably by 2020)
Data Bandwidth	2kbps	64 kbps	2Mbps	1Gbps	More than 1Gbps
Technology	Analog Cellular Technology	Digital Cellular Technology	CDMA 2000, UMTS, EDGE	Wimax, LTE	
Service	Mobile Technology (Voice)	Digital Voice, SMS, Higher Capacity	High Quality Audio	Dynamic information Access	
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	All Packet	All Packet
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet

5. Network Trust

Network Trust is a concept introduced by the computer network developer's. It includes:

- Secure guest access (Restricted Network for Guest)
- User authentication (authentication related to network access)
- endpoint integrity (Devices Health Check)
- Clientless end point management (Managed and secure User Connectivity)
- Reliability (Providing a perceived connection reliability of 99.999%)
- Coordinated security (accuracy and smart response.)
- Hands off Management (the zero latency)

According to some Internet Security company definition, by means of trusted network computer or device must be absolutely safe from unauthorized sources attack. [4].

To implement a trust communication in a network the trust between two major parties in these scenarios is must A consumer and a regulators that fulfill the demands of both parties on the communication services.

Traditional factors in between both party's trust to 5G networks are security of user data, security of subscriber's devices and network infrastructure.

6. Traffic Challenges in 5G Networks

By 2020, access networks and mobile experience significant challenges compared to today. Traffic website book should increase laws 1000 times and thoughts the Number be higher than 10-100 times today, when it is pressed by society in network and communication information available on this access to any time and what to do anyway. The major contests is to provide any type of information to the user on clients requested style in accordance to the above mentioned choices, because the capacity of handling the devices will dramatically reach to the limits of thousands devices to Billions[13]. To face this issue answer is only to use minimum power consuming devices. This is very necessary to realize the purpose of areas to includes the architecture of the church system, the kind of knowledge that it would promise logical resolution through the plains and the imperial power; network deployment where (heterogeneous) ultra-senses layout does not have a positive effect; the radio transmission of life, as he had promised them, where the configurations of a huge catalyst is identified the introduction of antennas; and

finally, back hauling solutions must be more energy efficient than today. [14]

5G high speed network services is streaming video streaming plays a fundamental need and a huge M2M.Video significantly more and more out

of traffic in a 5G Network area. Now, it should increase with the monthly consumption data of 500 GB.

One of the Predication regarding mobile users' states that by 2020 there will be more than 5 Billion users will represent the 70% of world residents [5], Flow of mobile users & 4G networks will increase in next 5 years from present date. Total Mobile users who are having smart phones or tablets are predicted may generate more than 90% of traffic of data used by mobiles by the year of 2020. Table 2 describes the different mobile data traffic growth occurred or will expected to occur through entire globe. For better understanding same is represented in graph of figure 4.

Table 2: Global Mobile Data Traffic Growth

Global Mobile Data Traffic Growth 2015-2020		
S. No.	Year	Growth rate (EB)
1	2015	3.7 EB
2	2016	6.2 EB
3	2017	9.9 EB
4	2018	14.9 EB
5	2019	21.7 EB
6	2020	30.6 EB

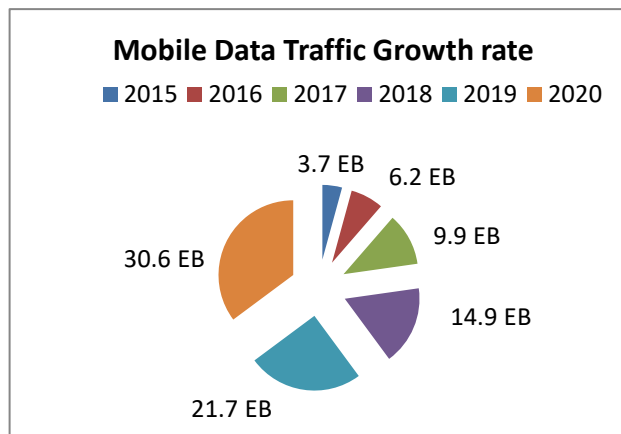


Fig. 4 Global Mobile Data Traffic Growth

7. Future Considerations

7.1 Optimizing Performance Metrics

More performance metrics should be considered for a smooth uninterrupted service. For this Delay, energy efficiency, reliability, Quality of service should be considered. A perfect framework should be developed for the evaluation of it performance for 5G network. That needs to develop algorithms.

7.2 Cognitive radio Network Management

One of the main issues in 5G interference CR (Cognitive radio) networks is how to manage the mutual relationship of CR and primary systems [2]. Transmitting power regulation is mandatory for the CR Network system. Interference cancellation techniques must be used to reduce the intervention of noise at CR receivers. Researchers have found the excellent resolution to this prominent problem by sending whole data to the organization that is authorized to gather the Meta data at a domain or hub point.

7.3 Reducing Signal processing complexity

Signal Complexity is an important technological challenge in developing large MIMO system.

Solution for this problem that the channel should be exact and more sufficient by distinguish each antenna and receiver.

8. Benefits of 5G Networks.

- **High Data Rate:**(By means of data rate how fast circuit can handle digital information)
- **Energy Saving:** (Decrease of energy consumption on user end)
- **Money Saving:** (Will save revenue by giving high networking facilities)
- **Less Congestion to a MBS:** (Less Congestion on Data traffic)
- **More Effective:** (Good in Quality of Service)
- **Low Latency:** (Fast Response in downloading)
- **Supportive High Speed Multimedia:** (Video Calling can be made more easily)
- **Clarity in Voice and Audio Calling:** (Enhanced Quality)
- **User can get fast and Better solution through faster Network.**

- **Large Broadcasting:** (Data can travel in GB/s)

9. Conclusion:

This piece of work authors express the necessity, problem, issue and future challenges regarding 5G networks. In this regard extensive back ground of previous and present networks is given with contrast to the future 5G. The main focus of study is for improving QoS parameter so that those will be mainly focused after the deployment of 5G mobile communications deployment in 2020.

In future major Objective will be to control all the parameters of QoS during the migration from 4G to 5G through the well manageable technical grounds.

Main focus for 5G development will be like algorithms for sorting of user traffic that will support changes in the market that includes demand of service of customers. Services that will use in future mobile network like Video services & services like M2M devices technology that exchange information and perform actions without the need of human's assistance.

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