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5th Generation Networks - Networks of New Era

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Abstract

Abstract - In this Paper We want to talk about the Current or Future Generations of Network and Successor of 4g networks - 5th Generation Network, 5g is a new era of technology comes with new technologies like OFDM(Orthogonal Frequency division Multiplexing) , Radio Wave Technologies, BDMA(Beam Division Multiple Access) etc are some technologies of 5th Generation Networks, also about situation of 5g in India.

In this paper We will discuss these points

1.What is 5g
2.Why we need 5g
3.What 5g delivers us
4.Technologies in 5g
5.Future of 5g in India and world
6.Satellite Technology
7.5g open source architecture
8.5g open core network and its functionality

Keywords: 5th Generation, 5G , BDMA, Core, Open source, OFDM, Radio Technology, Radio Spectrum, Satellite Technology

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1. Introduction to 5th Generation Network

We are all living in 2021 means in 21th century the era of technology ,era of mobiles , era of intranet, we are living fast and modern era in which what matters is speed and technology,this is a era of automation and intelligence (Ionescu et al., 2021) .This is the era of smart work instead of hard work.So in smart work speed is the most important factor in this century and era. We are standing and going to new speeds , new technologies like Artificial Intelligence , Li-Fi and many more. So in terms of Speed of networks , data transmission etc (Colaco et al., 2020) . We are heading towards or we can say we are standing with 5th generation of network technology which is the current and future generation mobile technology .It is a new global worldwide standard of networks after previous technologies of

networks(1G,2G,3G and 4G).5G is the new advanced type of network which not only connects and delivers but works virtually also (Kiesel et al., 2021). It supports multiple functions and also works not only in mobile devices but also in different objects, machines like refrigerators, televisions etc autonomous cars etc. The main thing which make 5g special and different is its feature or we can say its super feature which was not present in previous technologies is its super speed of data transmission which will go 100x faster than 4G.It will be in the terms of ultra multi-gbps peaks the second main super feature of 5g is it gives very low latency rate means safe to use.Its network capacity will be super fast and reliable,it will increased availability and gives a more easy and uniform experience to users. It support Worldwide wireless web(wwww).This is an advanced and updated version of WWW. This deals with wireless system technology and it will help 5g to make it more secure ,easy and fast to deliver.

Who Owns 5g and History of 5g

Specifically we can not say that 5g has an owner or head. There are different organizations in different countries of the world.For example an organization named Qualcomm is playing an important and major role in inventing various and different foundational ways and methods that help us to adopt 5G easily and as soon as possible. also another Organization named 3GPP is also working on 5G , it is a group of some different small companies, also some network operators and vertical service providers.

2. Literature Review

In April 2008 it was first NASA started working on it, they want to develop a fifth generation communication approach , Later in late 2008 "5g mobile communication system" named IT R&D Program of South Korea was launched , Then on October 8, 2012 University of Surrey with some other mobile operators providers secured a deal to work to develop a new Network standard that uses less energy and less radio spectrum. In July 2013, India and Israel agreed to work on the development of 5G telecom technologies. On April of 3,2019 , SOUTH KOREA became the first ever country to adopt 5th Generation Technology , Same day USA was the second country to launched 5g in the country

a. A Brief Overview on 5G Research Activities

This paper was Published on November,2014, basically this paper describes about 5th generation research activities held in Europe and some other parts of the world.The main focus points were technologies , literature and programs at that time. We can say this paper is not enough to show the real 5g we are watching today.

b. 5G Technology - Evolution and Revolution

This paper was published on 3rd of March 2014, This paper deals with the evolution of mobile and communication devices and technology . In this paper we found 5g is still in developing phase and still developing through some technologies like DAWN etc, they also mentioned about technologies like LAS-CDMA, MCCDMA etc. but they are assuming some points without any base like your mobile will type what your brain thinks, assuming future is not a good thing without any base.

c. 5G Technology of Mobile Communication - A Survey

This paper was published in 2013. In this paper we got to know about how 5th generation technology works in mobile devices and how they are worth for end to end communication (Agiwal et al., 2021) . The important technologies which are mentioned in this paper were 802.11, 802.16 etc. Main focus of this paper was on mobile technology only.

d. 5G Security issues

This is a short book type material which mainly tells or defines what security issues will 5g face in future, for example it will not be a 100 % secure network, also it will come with asymmetric encryption that was also not a good choice, radio interface is not secure. It deals with some new technologies like URLLC and mMTC etc. We have to take some major steps like secondary authentication to secure 5g.

e. A review on 5g Technology

This paper was published on January 1, 2012. It was basically a review about the emerging and developing technology of that time. This paper describes the architecture of 5g network, nano technology and cloud computing, till the paper got published, the word 5g or 5th generation was not officially used by any Telecommunication organization

f. Security Issues in 5g device to device communication

This paper was published in May,2017.In this paper we found that they work on device to device communication only.They basically told us the projects of that time like Samsung is working on 5g and they record a speed of 7.5 Gbps, also they light up the idea of distributed communication scheme. They also mentioned some 5g technologies like WIMAX,NFV etc but at last they end up with communication challenges that will be there in end to end communication.

g. Mobile and Wireless Communication enablers for the 2020 Information society(METIS)

This is a project where the mobile and wireless communication technology foundation is made for doing some research work (Rao et al., 2018).This is a group of 29 organizations and companies,this was held between November 2012 to April 2015. It is a foundation to future generation network

h. 5G: Future Mobile Technology Vision 2020

This paper was published in September 2012, as the name specifies this paper deals with the future.In this paper we found some technologies like WIMAX 802.16m etc. It connects around mobile technology only and talks about supporting IPv6 and flat IPs. This paper only assumes the future with some predictions only.

3. Need and Essentiality of 5th generation networks

The main thing or if we think first is that why we want 5g, why this is essential for us.Is 4g is not worth and enough? The answer is simple: everybody needs change in life, they want to update themselves, they want to upgrade themselves (O'Connell et al., 2020). So this is normal that we need change, we need more and more accuracy, fast and more reliable etc. That's why 5g is needed, It will give more facility ,options in the term of services, what we need to upgrade ourselves.Here is some important points which makes 5g essential

a. Connective Tissue to IoT

Internet of things is the future of technology coming tomorrow. We all know how important this is to us in the future. Researchers predict IoT will play an important role in the future in every field like medical,agriculture and industrial etc. The 5g will be capable of controlling medical equipment and agricultural equipment..

b. Capability and Speed

All we want for a good, may be some time super and ultra speed for data transmission so 5g makes it easy and it is capable of what we want. We can say it is 100x faster than 4g and also more capable means it can support all spectrums and bands too with ease. It will respond to our command in just a 0.001 second only which is ultra fast.

c. Better Web Experience

5g will give us a much better web experience which will be more efficient and good. It will be possible with the technique we will develop, different and efficient wireless networks on cloud which allow any one of us to make our own network.

d. Provides much low latency rate

The 5th generation network technology comes with a very low latency rate that gives hand on real time access in more decreasing rate up to 10x.

e. Operating with cloud technology

The future, the tomorrow deals with cloud technology which works with much ease, gives reliability and security and security and much safe to use.

3.1 What 5g delivers us?

Now the question is what are the things, technology and speciality of 5g. What 5g delivers us , so the answer is here

- It delivers the bandwidth capacity of up to 1GBps, and it will reach 100 GBps in future.

- Connections were always an issue in previous technologies but 5th generation networks are large and long stable, connection oriented and will increase communication.

- It will respond as fast as we blink our eyes and is proved practically and possible. It will responds low as 1 milliseconds.

- 5g will also work with various different fields like autonomous cars etc, so they can be alert of any other body.It will also work with bridges.

- It will support and work on millimeter waves which provide higher frequency and the antenna will also get smaller in size.

- Stable and more redundantly core.

- 5g will use new radio technology that means a radio band known as SUB6 which is capable of 600 MHz to 6 GHz and higher will be as 24 GHz to up to 86 Ghz.

- It will use a lot of mini so called cells instead of big cell towers which will make it more efficient.

- Transmission can easily be done by using small cell techniques and technology like beamforming.

- Signal Interference will be less and signal boosting will be high.

What Technologies 5g use?

Technology is an important thing in Today's world. It is the mechanism or Fundamental unit of anything so now we will discuss what technologies 5g use to deliver (Nakazato et al/, 2022).

- Massive MiMo – Its stands for multiple inputs and multiple outputs it will help and boost the capacity of today's network by a factor of 22 and more.It will create multiple paths for transmission if one gets failed, we can use others.

- Beam forming – It is a network traffic signaling system for cellular network signals which will help to send any data to a specific destination where it belongs with a high speed. It eliminates broadcasting..

- Small Cell - This technology acquires thousands of small mini Power mini stations instead of a big tower. It will help in making the networks strong and efficient.

- Millimeter Waves - The Future technology will be depend On millimeter waves that will gives higher frequency and speed up to 30GHz to 300GHz.

Some other previous 5th generation's technologies are as follows

Now in this section we will discuss that how long 5th generation network and technology will go far in future. Here are some points which will be the Back bone of 5th generation networks.

- Full duplex
- TD-LTE, AVGP, Wi-Max
- Beam division multiple access etc.

What will the Future of 5g (Back Bone?)

Now in this section we will discuss that how long 5th generation network and technology will go far in future. Here are some points which will be the Back bone of 5th generation networks.

- Peer to Peer Possible
- Full Duplex using Hardware
- Multipath for everything
- Software Defined Networks
- Context Aware Resource Allocation

- Peer to Peer will work in different and various fields like autonomous cars that help to establish a connection to communicate between them this will enables and make the secure network.

- Transmission in same bandwidth will be possible through 5g. There will be no need of more than one bandwidth and we will experience the light speed of up to 10 Gbps (Saxena et al., 2017).

- It will support multi-path technology which will help to make transmission easy, reliable and fast. For example if one path will break due to some connection issue, then we will use another path to complete the transmission.

- With the help of network virtualization and its benefits, it is possible that in future we will use software that automatically define the network itself and it is proved.

- We will work on different paths for every different work. For example our gaming will not disturb out call they have their different paths. This will be possible with 5g.

- Exact location with help of beam forming that will be in the exact coordinates (x, y).

Transmission and Communication through Satellite Technology

The future will be what we only predict and assume (Hussain et al., 2019). But main thing is that it is possible to achieve if we work smart and in right direction. I mean to say that in future data transmission and communication that is internet is possible through Satellite Technology. Here are some basic fundamental things about Satellite Technology.

- It will cover 100% Planet area to provide internet while Current technology is not capable of it. Like DTH is already successful

- They will cover like GPS, Galileo Constellation, the Russian constellation GLONASS etc.

- There will be no more GEO limitation. Satellite Technology makes it possible.

- Low Earth Orbit (LEO) will work between 1000km to 5000km. Its latency will be lowest 600-700 miles/Sec

- There will be thousand of satellites for coverage

- Satellite Communication is possible through LASER LINK technology, which will work as a backbone of Satellite technology. And gives best result and make the chances as low of failure

- Internet connectivity in our mobile devices will be possible with the help of phased array which work as a ground Communication

- It will give the speed up to 1Tbps

- In this there are small antennas which will use constructive Interference to band signal this is possible with the help of phase shift technology.

- Reusable rockets which can work up to 4-5 times will help to make it possible. It is actually proved and practically possible in SpaceX.

Who are making it possible?

- Space-X Star link- It is already working and already developed its Rudimentary Constellation
- Blue-origin Kuiper of Amazon Organization.
- One web Satellite corp.

Some other Information about Satellite Technology

- Very large capital cost
- High running cost
- Very long Return of Investment up to 5-6 years
- LEO is not more stable and reliable maximum 5 years
- Billion dollars investment
- Not for Common people, High cost

4. Situation of 5G in India

What India is doing on 5g (Trial of 5g)

Telecom Ministry permits Mobile operators like Bharti Airtel, Vodafone idea and MTNL to test 5g technology. In testing companies will work on 3 bandwidth ranges

- Minimum Band frequency spectrum will be 3.2 GHz to 3.67 Ghz
- Mid Band frequency spectrum will be 24.25 to 28.8 Ghz
- High Speed spectrum will be up to 20 Gbps

5g roll out in India:

5g reach to its last stages of development. It means will 5g will be roll out soon in the end of the year. 5g will be expected in year by 2022-2023. It will be first available in metro cities. According to Department of Communications (DoT) clarify that 5g will roll out in india by 2022. DoT also noted that in the beginning 13 cities across the country 5g will roll out.

Before this year in 5g network was tested in some cities in india by some telecom operators like Jio, Airtel and Vi.

DoT noted in September 2021 a reference was sent to TRAI seeking for the auction of spectrum identify for reserve price, block size etc.

After experiment of spectrum is allotted in different bands which is included in mid-band (3.2 to 3.67GHz) millimeter-wave band (24.25 GHz to 28.5 GHz) and in the Sub-Gigahertz band (700 GHz). The TSPs were also allowed to use their existing spectrum owned by them (800 MHz, 900 MHz, 1800 MHz and 2500 MHz) for the conduct of 5g trials.

Jio 5g:

Jio is considered to be first to explore of 5g network revolution in India. The chairman of Jio company's Mukesh Ambani, said he will take over leadership of 5g network. Jio also said the 5g network is the upgrade version of 4g network. Government also announced that the auction of 33003600 MHz which is recently famous network for 5g deployments in worldwide.

Airtel 5g plans:

The CEO of Airtel who currently announced that 5g network is currently underdeveloped and spectrum are use in this 5g network is very high. The main problem of 5g network is the cost of spectrum is very high. Airtel announced in 2017 the deploy of the first state-of-the-art Massive multiple input and multiple output (MIMO) which is important in 5g networks. This company already deployed the technology in several cities in india.

Vi 5g Plans:

Vi become ready to launch 5g network as soon as spectrum is available in the auction. The company has upgraded its 4g networks to 5g networks and its architecture like dynamic spectrum refarming (DSR) and MIMO.

"Our network is very 5Gready. When the 5g auction take place, we will be able to launch 5G. However, there is a need to develop 5G use cases in india. India is unique and some global use cases may not be relevant,". Ravinder Takkar, CEO of Vodaphone Idea, said at last year's general meeting of shareholders.

Some other Important Things India is doing on 5g

MIST (Myanmar, India, Singapore, Thailand) Cables- India is planning to connect these countries with optic fibre cable to make the biggest network to make its connection in different part of world like Japan, USA etc which is possible through Asia Submarine Cable express (ASE) because Singapore is a junction of all over the world. Already different parts are interconnected with it like crossing line connects it to Japan. Jupiter Line connects America.

5g Open Source Architecture

Open Source allows user to share, modify and use via an openly available design. The code may be permitted for sharable depending up to the software ownership. It can to be under open source Initiative (OSI).

What is 5g open source architecture?

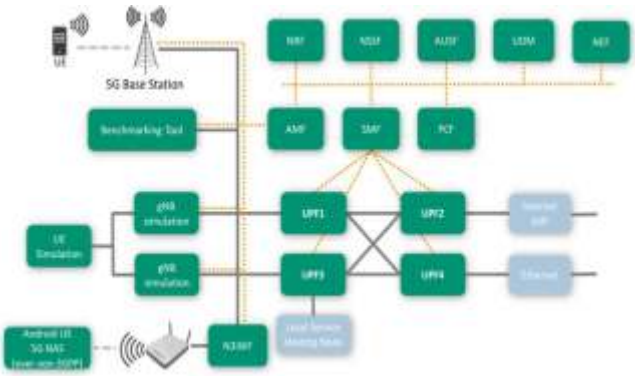
It is the processor technology or we can say chipset in our devices which can supports and gives us many more features 5g connectivity, a much secure and fingerprint recognition system, HDR screen and many more. It will be

possible on same processor and it can consistently established uniformity across Band.

- **Multimedia Experience** - It provide many multimedia Options like A-I picture quality and A-I super ultra resolution and many more

- **Hybrid Type Multiprocessing** - It gives permission to CPU and GPU to match the performance and efficiency of Smart Devices with the specific software.

- **AI Processing System** – It will permit them to do Deep Learning Acceleration (DLA). It is capable to process FP16 etc in only in one unit. That makes the smart phones best performable and efficient to work properly and fast.



Open Source Representation of 5g Architecture and its Functioning (Reference-open5Gcore.org)

Open 5g Core

Fraunnofer FOKUS open 5g core is the world first implemented 5g core network. It works on 15, 16 core network functionality. It is operatable with 5g NR bases and equipment too.

It is consistently based for 5g testing deployment for trials as well as its further development of function oriented features.

It provides a fast and targeted 5g innovation fast implementation and real- world experience.

OPEN Core Version 6 Functionality

- It gives the basics and fundamental 5g core network facility. (Like AMF, SMF and UPF)

- It provides the service based Architecture means it will work on service what the user want on HTTP/2 open API

- It will provides integrated standard facility with 5g NR [N1, N2, N3]

- It will provide the Data path with diversity support and local and backend control.

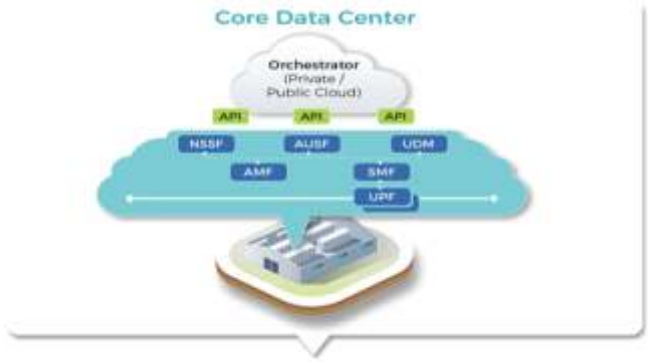
- It gives an advanced session manageable environment with traffic influence and Quality of Service

- It will also provide Network Slice Support

- It will also use any of non-3GPP support

- It will also maintain 5g NSA Accessibility

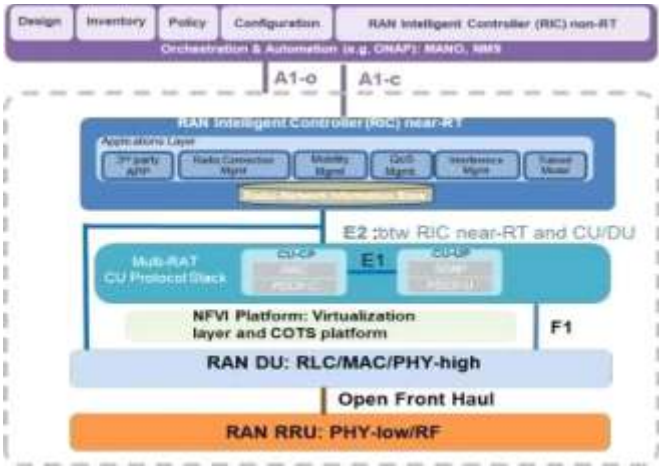
- It requires hardware facility which is highly depends on capacity



Open Core Network Functionality (Reference – telecominfraproject.com)

O-RAN Standards

O-RAN are the new functionality standards for the Radio Access Network supported ecosystem which sets the chances for new organization and networks operators to participate in the solution space (Marabissi et al., 2018).



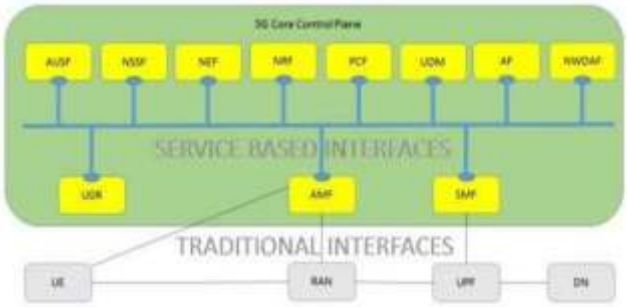
O-RAN Architecture and functionality (reference- The Status Open Source for 5G)

5G Core Network Service Based Quality and Functionality

The control panel is more efficient and worthy than 4g evolved Packet core (EPC). We can say them as network function

Some of them functionality points are as follows

- Access and Mobile Management- it will allow access authentication, authorization, mobility, reach ability and connection management
- Session Management- In this functionality it allows function management, UDP functionality selection, communication between CP and UP etc
- Policy Control Function
- Network Exposure Function
- Unified Data Management
- Authentication Server Function and many more…..



5g Service based Architecture and Functionality (Reference - The Status of Open Source for 5g)

5. Conclusion

In this paper we mentioned all about 5th generation technology and network, like how actually 5g works, why 5g is important to us as we need change and it is important to us to bring change in our era, new inventions practices etc are important, later on I mentioned the mechanism and fundamental behind 5g that is its technologies like small cell, OFDM, BDMA, Massive MiMo etc. then what will 5g gives us, and its future uses like speed, same bandwidth, multiple paths for data transmission etc later on I talked

about new future technology that is satellite Technology how will it work etc, India and its 5g situation and 5g Open source architecture and at last I mentioned about 5g open core network and its functionality and O-RAN architecture, service based architecture and its functionality.

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