

# 5<sup>th</sup> Generation Network Technology: A Review

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**Abstract :** Today we are fully dependent on technology, every second we use technology. But only this isn't any destination of advanced technology as per our future dreams and expectation have more requirement. We have enough knowledge to make it better for our future with that. That's why every new version of technology rises with solving drawbacks of previous one. Today all sectors which are providing us platforms for technological development are growing with new determination to give good future. And wireless services are the fastest growing among them. We can see its network growth in past few years at wide level. So we can say that it is the most preferred services for all and showing its requirement for future as per the concept like IOT comes in lime light for future. Presently wireless traveled from 1G to 4G with a great success and our next steps is towards 5G and beyond. We can imagine that the 5G technology will change the experience for call quality, data transmission and mobile features. In this paper we will discuss about past achievement, present condition and future scope for wireless network with 5G technology, its basic architecture, challenges and major effect on our life and future.

**IndexTerms - 5G, Wireless, Mobile Networks, Communication, Future Technology**

## I. INTRODUCTION

Wireless communication is life line of technology. It is the most active sector where new technology develop itself for future. The first wireless technology we can consider as '0G' technology launched in 1970's which is commonly known as Radio wireless transmission technology [3]. This technology was wide spread and give us a wire free network, but it provides only very low quality voice calls facility but data transfer facility is not there. Still it open new door of development for wireless communication. It continue till 4G with providing 1G, 2G, 3G and other sub-sections of network generations. Now wireless technology is well develop for present but it isn't fulfill all requirements of future, So 5G and more is need of future [7].

5G technology is packed switched wireless system with wide area coverage and high throughput. It will provides us 25mbps connectivity speed and high resolution of network. 5G will gives us excellent quality services to solve network errors automatically [7]. 5G will be more advanced to give www (world wide wireless web) [4]. 5G may not have any limit. The 5G technology will give a high quality wireless network which is never experienced by us.

5G networks absolutely change the experience of wireless communication with its speed, performance and quality. It will change the means of cell phones with its higher bandwidth. 5G will hide the difference between PC and mobiles rather both would act vice versa [1]. 5G has main priority to add more services and features over 4G. It will a big challenge to increase speed of data transmission when more than double of the human population devices will connected to 5G.

Thus 5G network is very fast and reliable accessed by a single IP. We have only a challenge to make it accessible for common man who can easily take benefits with suitable packs offered by the companies. As per today 4G features are showing their quality in 4G cell phones we can get an idea about 5G wireless communication networks and its benefits. So 5G only needs some efforts to make it possible for us [7].

## II. LITERATURE SURVEY: 1G TO 5G

The technology starts with its ground and step by step goes towards its future. Wireless communication also start with 1G and presently reached to 4G and its next step is 5G. Take a short view on its past achievements:

### A. 1G: (First Generation )

1G networks was developed in 1980's with the help of AMPS (Advanced mobile phone system) technology in US which is the first mobile system. 1G was based on Analogue signals with frequency of 150 MHz. It gave a speed of 2 kbps but data transfer services wasn't available in 1G. The poor quality voice call was only one features that was provided by 1G without any security. It allows to call in only one country others are consider as TACS. The handsets are also bulky and expensive [2].

### B. 2G: (Second Generation)

2G networks was launched in 1990's and stay till 2004 on the top. It is based on digital signals and provide a speed of 64 kbps. It gave semi global connectivity facility for calls. Its key services are web browsing, SMS (Short message service), and MMS (Multimedia message service). The 2G technology is used GSM based network. Its advanced version like 2.5G and 2.75G was also available. The advanced version of 2G gives a maximum speed upto 144 kbps on GPRS based network [9].

### C. 3G: (Third Generation)

3G was launched in 2004 and keep its top position till 2010 till 4G came. 3G was a big transform in wireless technology as it provided features like video calls, GPS, mobile TV and other multimedia services. It provides 3 mbps connectivity speed. 3G solve the global roaming problem. It used CDMA technology at 20 MHz of frequency for its connectivity. The Wi-Fi is another key function provide by this generation. The difficulty for 3G is only related to its higher frequency [2] [7].

#### D. 4G: (Fourth Generation)

4G was launched in 2010 with 100 mbps connectivity speed. It uses LTE technology to give us services. It can give data rates upto 1Gbps. 4G provides features like high quality video and audio, online newspaper and online games etc. 4G has easy roaming system to connect whole world. But some countries can't access this services because of its bandwidth issue. 4G has high quality services and security system. 4G also gives its developed versions like 4.5G having LTE advanced technology [9].

#### E. 5G: (Fifth Generation)

5G will be launched till 2020 with a great data speed and features. It will provide www (world wide wireless web) and will give data rates more than 1Gbps. 5G will provide connectivity speed of 1 Gbps. It will have bidirectional bandwidth and less network traffic for future Internet. So 5G will be the technology which gives good features with satisfied services offering priceless packs of access [3].

### III. NETWORK ARCHITECTURE FOR 5G

The network architectures for 5G has so many questions about its frequency and MAT (multiple access technology). Presently many countries is testing and working on 5G architecture. The complete architecture isn't come in sight. So the perfect architecture haven't declared yet. Now, we will discuss about its basic considered architecture of 5G. Basically 5G architecture has two parts, first one is NG-RAN (Next generation radio access network) and other one is Core Network as shown in Figure 1. Here terms used aren't taken officially so it may be change in future.

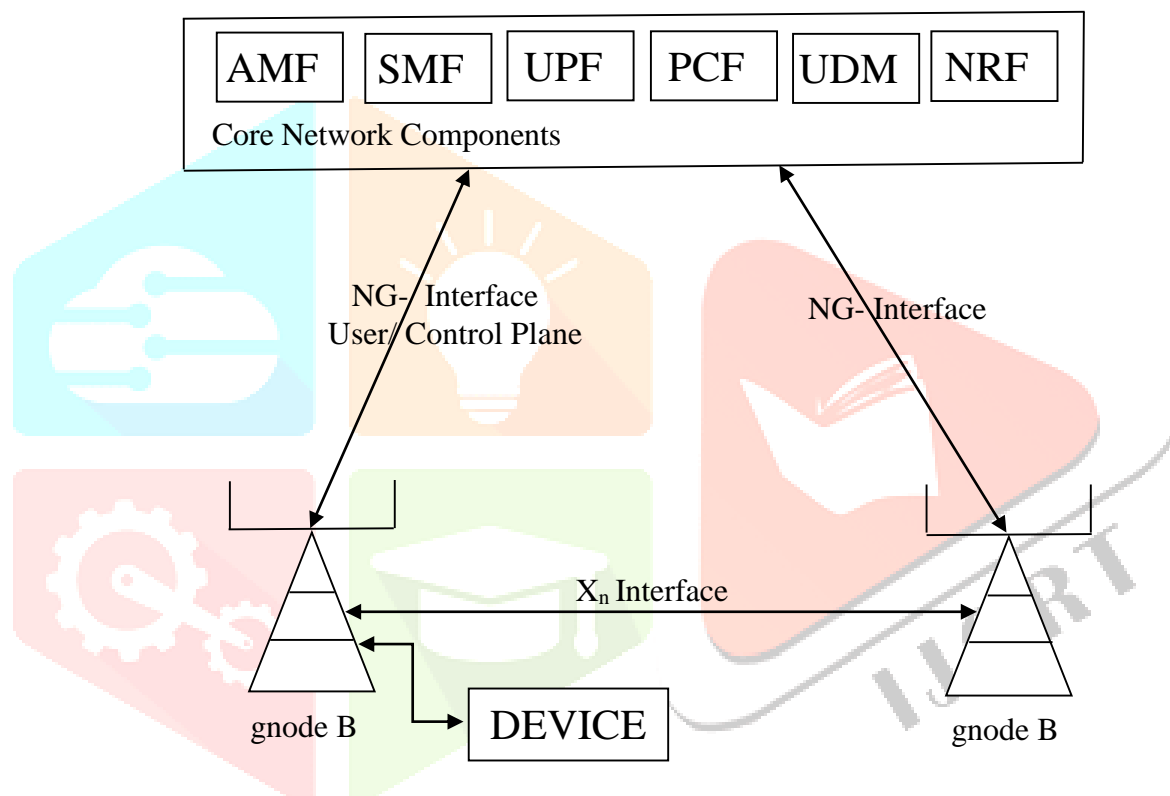


Fig. 1 The Basic Architecture of 5G Network

5G network have gnodeB terminals which is connected to user's device same as nodeB of 3G networks and enodeB of 4G networks. The networks interface is defined an Xn Interface between gnodeB terminals of user and service provider. It is same as X2 Interface of 4G networks. Here 'n' is unknown term which may be replaced by any number in future. The gnodeB interface with its terminal is known as NG-RAN. The testing of 5G is using SCMA (sparse code multiple access) technique as MAT (multiple access technology) [5].

The 5G network has three main factors which is responsible for its performance.

- **Millimeter waves**- The waves used in 5G network. 5G will be based on these waves.
- **Beam forming**- This factor is used to define a network beam to a specified location without spreading that in an area.
- **Massive MIMO**- It is used to provide us network signal from multiple access centers in place of single access center with good data rates.

The frequency for 5G network is not conformed yet but in testing of 5G networks Europe is going to take standardly its frequency about 3.4 to 3.8 GHz and other countries will also use same frequency for 5G networking. The research is also going on for 20GHz and more but as the frequency increase it is harmful for health and environment whereas the high frequency waves can't cross building and trees etc. at high frequency easily as the waves has millimeter properties [5].

The NG-RAN is connected Core network with NG Interface with user plane and control plane. The user plane is used for calling facilities and internet data management whereas the control plane is used for online billing and authentication process etc. The core network are connected in same platform without any layer. This gives a better performance to 5G network as 3G and 4G

have core network components in different layers. The core network has mainly six components as AMF (Access and mobility management), SMF (Session management function), UPF (User plane function), PCF (Policy control function), UDM (Unified data management) and NRF (Network repository function). The all components have different work to make a full network architectures as follows:

- 1) *AMF*- It is used for authentication purpose and mobility management. It provides data access on network.
- 2) *SMF*- It helps to manage session and give a unique IP address to user. It gives good quality and rated services to user.
- 3) *UPF*- It helps to manage connectivity and provide Intro/Intro RAT facility to connect 5G to 4G or any other network without any disturbance. It also provide various channel access.
- 4) *PCF*- It controls billings, data usages records, and day to day user activity.
- 5) *UDM*- It has operational management control which control full network management and also find fault of network and handle them.
- 6) *NRF*- It is a new things which include to 5G network it provide facility to make new registration in no network area through Wi-Fi or other services [5].

So 5G architecture have a great opportunity to develop its network for future. There are so many things which should be added or should be changed.

#### IV. PRESENT STATUS OF 5G TECHNOLOGY

The fundamental concepts of new technology are being developed from the previous technology. As technology need more features, the research starts with a great determination. And we know that wireless is one of the most perfect sector for this as it has so many requirement for future. So now-a-days many countries with some major companies begin testing on 5G technology. In May 2012, First 5G system is presented by Samsung Electronics South Korea. After a few time in October 2012, UK government open first Research center NYU WIRELESS especially for research on 5G technology. The funded by National Science Foundation and 10 major wireless companies in 2014 [13].

USA's Federal communications commission (FCC) targets to achieve 5G technology by 2020 with high connectivity speed from MMW (millimeter waves). South Korea uses 5G connectivity for Pyeongchang (Taebaek Mountains) Winter Olympics 2018 provided by KT Corporation. Sweden and Estonia also want to implement 5G for IOT development and affordable services to their citizens. NTT DOCOMO, Japan start testing on 4k and 8k video streaming with 5G [20].

So we can say that there are so many who start efforts to develop 5G for Future. Here we have a list of them: [21]

Countries	Companies
1. United States of America	AT&T, Verizon, T mobile, Sprint Corporation
2. Canada	TELUS
3. Mexico	America Movil
4. Chile	Entel
5. Argentina	Movistar and Ericsson
6. Brazil	Helio Oyama
7. South Korea	SK telecom, LG,KT corporation,
8. Japan	NTT DOCOMO, Softbank
9. China	China Mobile
10. India	Vodafone
11. Norway	Telenor
12. Germany	Deutsche Telekom
13. United Kingdom	EE
14. Switzerland	Swisscom
15. Australia	Optus, Vodafone, Telstra
16. Sweden and Estonia	Telia
17. France	Orange
18. Russia	Megafon

Currently, we have a little clear view that how 5G will be defined in future, even though work is also progressing on the vision for 5G future.

Thus the race is already underway between countries to be the first to begin large-scale 5G trials, and later to introduce commercially available services so we have a large community to present 5G technology to us in a short period.

#### V. CHALLENGES AGAINST 5G TECHNOLOGY

The vision of 5G networks is not easy to achieve. There are several challenges to be solved before it come in sight of world, as mentioned below: [4] [11]

- 1) The high traffic from IOT devices is first major problem to manage the 5G network.
- 2) The data rates for 5G should be faster than others.

- 3) Scalability and Flexibility is another issue for 5G network.
- 4) Interference handling is a big challenge for 5G.
- 5) 5G should be eco-friendly.
- 6) It rise some health issue also for us.
- 7) Security and privacy of data.
- 8) Unknown access from users and devices will make a trouble.
- 9) Energy optimization for 5G network and system is a major deal.
- 10) Remove all limitation for easy access is a challenge for 5G technology.
- 11) Provide low cost services with high quality is a highly requirement of users.

## VI. ADVANTAGES AND DISADVANTAGES OF 5G

We know that there are both benefits and losses in a new invention. New Technology gives us advanced life standards but it also make some unwanted problems. 5G technology has also both Advantages and Disadvantages as follow: [6] [9] [22]

### A. Advantages

- High resolution and bi-directional large bandwidth
- Easily combine with previous generation
- Provide supervision tool for quick actions
- Parallel multiple services
- Efficient and effective services
- High connectivity speed about 25 mbps
- Technology to provide a platform for all network
- Uniform and uninterrupted connectivity
- Control PC and Laptop from Smartphones
- Wide access on web makes education more easy
- Telemedicine makes medical sector more advanced
- Monitoring and management become much easier
- The secrets of Universe and Galaxies will open
- Natural disaster can be detected faster\
- Privacy and security improve
- Artificial Intelligence provider
- Low battery consumption
- DTD (Device to device) communication

### B. Disadvantages

- The technology is under process and how much time required to come out haven't idea
- The 5G cost is too much high
- 5G has security and privacy issues
- 5G infrastructure needs to be developed
- Old devices can't work on 5G technology
- 5G has a high frequency become a health issue

## VII. APPLICATION OF 5G TECHNOLOGY

The features like minimum latency, uniform connectivity and high speed data transformation are the key concept of 5G technology that are expected to provide a large range of applications and services. In this section, we discuss the most prominent applications of 5G networks as follows: [7] [8]

- 1) Wireless world with no more limitation of access
- 2) Wearable Devices with AI (Artificial Intelligence)
- 3) One global village concept based on 5G
- 4) User can use a better personal experience
- 5) Smart platform based on IOT like concepts
- 6) Automation of various Industries
- 7) Advanced Health and care system
- 8) Robotics can develop with the help of 5G

## VIII. FUTURE SCOPE FOR 5G AND MORE

As we know that new technology is a solution of previous one same as 4G is solution of 3G's limits and problem. So 5G is required to solve current problem on 4G network. Future has a great scope for development and the advanced wireless network is most required for all this. So 5G get a great and responsible scope in for future technology.

We have more requirement than 4G provide us, as it shows by the following table:

Table7.1: - Monthly consumption per device type

Device	2014	2020
Laptop or PC	4.2 GB	17.3 GB
Tablets or iPad	1.9 GB	8.4 GB
Smartphones	1.0 GB	4.9 GB

The data shown in the table also represent need of update to new technology for wireless communication. The data consumption increase by 4 times in only 6 years. 5G has a great opportunity to provide a better broadband experience, smart vehicles and transport, Multimedia access for all time, critical control of remote devices and Internet of Things. So 5G is need of future. And if there is need for more, then there is no restriction for further development beyond 5G.

## IX. CONCLUSION

In this paper we discussed past, present and future of 5G technology and its architecture, challenges with its applications and major effects in the development of the 5G that is expected to provide very high speed data transfer and uniform connectivity among various types of devices. 5G is the next step technology in the wireless communication and will be a key concept of the Networked Society. In particular, 5G will accelerate the developments of the Internet of Things like concepts [13]. To begin connectivity for a wide range of applications and devices, the capabilities of 5G must stand above from previous generations of wireless communication. Then only the efforts will provide high data rates, ultra-low latency and high reliability. 5G gives a real wireless world with no more limitation with access and zone. It can download a movie within few seconds with high data speed. We found that every new generation came with adding some new features so absolutely 5G will give some surprises. Thus 5G will be a big step to advanced wireless systems for future.

## REFERENCE

- [1] <https://en.wikipedia.org/wiki/5G>
- [2] [https://en.wikipedia.org/wiki/List\\_of\\_mobile\\_phone\\_generations](https://en.wikipedia.org/wiki/List_of_mobile_phone_generations)
- [3] Sanskar Jain, Neha Agrawal, and Mayank Awasthi "5G - The Future of Mobile Wireless Communication Networks" Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 3, Number 5 (2013), pp. 569-574
- [4] Aleksandr Ometov, Ekaterina Olshannikova "Challenges and solutions for 5G proximity-based information exchange protocols"
- [5] <http://youtube.com/technicalguptgu/5g-architecture>
- [6] [https://www.tutorialspoint.com/5g/pdf/5g\\_advantages\\_disadvantages.pdf](https://www.tutorialspoint.com/5g/pdf/5g_advantages_disadvantages.pdf)
- [7] Himmit Khurana, Mahima Singh, Dayanand "5G: PERSPECTIVES ON FUTURE TECHNOLOGICAL ADVANCEMENTS IN COMMUNICATIONS" 22 November 2015
- [8] Nisha Panwar, Shantanu Sharma, and Awadhesh Kumar Singh "A Survey on 5G: The Next Generation of Mobile Communication"
- [9] [http://ids.nic.in/Tnl\\_Jces\\_May%202012/PDF1/pdf/1.5g\\_tech.pdf](http://ids.nic.in/Tnl_Jces_May%202012/PDF1/pdf/1.5g_tech.pdf)
- [10] GSMA Intelligence "Understanding 5G: Perspectives on future technological advancements in mobile" December 2014
- [11] Sonia Heemstra de Groot "5G and Beyond" 3 November 2016
- [12] Heejung Yu, Howon Lee and Hongbeom Jeon "What is 5G? Emerging 5G Mobile Services and Network Requirement"
- [13] Muhammad Irfan, Jan She, Naveed Ullah, Muhammad Sulaiman, Junaid Saleem "5G Wireless Technology- An overview of the current Trends" International Journal of Computer Applications Technology and Research Volume 5 issue 7, 489 – 494, 2016
- [14] <https://www.arcep.fr/uploads/tx.../Report-5G-issues-challenges-march2017.pdf> Article-"5G:ISSUES & CHALLENGES"
- [15] <https://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf> Article- "5G Vision"
- [16] [www.huawei.com/minisite/5g/img/GSA\\_the\\_Road\\_to\\_5G.pdf](http://www.huawei.com/minisite/5g/img/GSA_the_Road_to_5G.pdf) Article-"The Road to 5G: Drivers, Applications, Requirements and Technical Development" November 2015
- [17] <https://arxiv.org/pdf/1511.01643>
- [18] Bjorn Ekelund "Ericsson Research The Wireless World - 5G and Beyond"