National Journal of Multidisciplinary Research and Development
ISSN: 2455-9040
Impact Factor: RJIF 5.22
www.nationaljournals.com
Volume 3; Issue 1; January 2018; Page No. 1004-1008

Study of 5G network

Nishtha Gupta[1], Anjali Tyagi[2], Khushboo Sharma[3], Manish Kumar[4]
[1, 2, 3] Modern Institute of Technology and Research Center, Alwar, Rajasthan, India
[4] Assistant Professor, Department of CSE, Modern Institute of Technology and Research Center, Alwar, Rajasthan, India

Abstract
In this paper, we study about the 5G technology. It is expected to be operational by 2020.This paper provides an inclusive and comprehensive analysis of recent development toward 5G.It gives information about the development of 5G in different countries and the progress of 5G in india.5G generation is based on cognitive radio which implies the whole wireless world interconnection. New applications and use cases anticipated for 5G include safe, self-driving cars, remote controlled robots etc. This paper is focused on the specifications of future generation and latest technologies used in future wireless mobile communication networks.

Keywords: 5G network, technologies, mobile communication

1. Introduction

Mobile communications have become part of our lives and their development has dramatically changed our way to communicate. In 180's we used mobile phones that only work to make a call. After 10 years later we have 2G mobile communication. This digital communication system allowed users to transmit data like text messages. The 3G smart phones with multimedia functions like internet access, video calls. The 4G delivered data eight times faster than 3G.We could watch movies and video calls without much buffering and lag but in 2020 we will have 5G.5G will connect everything virtually together from driverless car to your home and it will do it at incredible speeds up to 200 times faster than 4G. It currently takes around six minutes to download a complete film and with 5G it will take under a second.5g is the key that will unlock a world of new possibilities pay and start new technological revolution. This is not just fasted internet it is the fifth generation of mobile communication.5G will connect new industries and devices enable new services and empower new user experiences. That requires a new kind of network that will be scalable enough to support extreme variations of use cases providing a unifying connectivity fabric to meet the expanding connectivity needs in the next decade and beyond. The foundation of this fabric is the 5G new radio a unified air interface that will support diverse spectrum, diverse services and diverse deployment models.

Fig 1: 5G Introduction

2. Evolution of wireless technology

a) First Generation

Fig 2: 1G smart phone

1G refers to first generation of wireless technology.
These are analog telecommunication and it is introduced in 1980.

b) Second Generation

Fig 3: 2G smart phone

2G system, fielded in the late 1980s and finished in the late 1990s was planned mainly for voice transmission with digital signal and the speeds up to 64kbps.GSM and CDMA is 95 were prominent technologies.

(c) Third Generation

Fig 4: 3G smart phone

3G wireless system, was developed in the late 1990sand might be well-done in the late 2000s.3G is not only provided the transmission speeds from 125kbps to 2Mbps but also included many services, such as global warming.

(d) Fourth Generation

Fig 5: 4G Smart Phone

4G is around five to seven times faster than 3G, offering theoretical speeds of up to 150Mbps.LTE is considered as 4G technology.

e) Fifth Generation

Fig 5: 5G Smart Phone

5G is very much faster than other networks. Its speed is 10 to 20 Gbps.

3. Standards for 5G network

- Data rates of tens of megabits per second for tens of thousands of users
- Data rates of 100 megabits per second for metropolitan areas
- 1 GB per second simultaneously to many workers on the same office floor
- Several hundreds of thousands of simultaneous connections for wireless sensors
- Spectral efficiency significantly enhanced compared to 4G
- Coverage improved
- Signaling efficiency enhanced
- Latency reduced significantly compared to LTE.

4. How is 5G different from other networks

The other networks use radio waves to transmit data and internet where 5g uses mm (millimeter) waves to transmit data.

a) MMWAVE technology and its benefits

Millimeter wave which is also known as extremely high frequency (EHF) or very high frequency (VHF) by the International Telecommunications Union (ITU) can be used for high speed wireless broadband communication. It allows higher data rates up to 10 Gbps. Millimeter waves have short wavelengths that ranges from 10 millimeters to 1 millimeter. They have high atmospheric attenuation and are absorbed by gases in the atmosphere, which reduces the range and strength of the waves. Milimeter wave spectrum is the band of spectrum between 30 GHz and 300GHz.The wavelength is 1mm to 10mm.

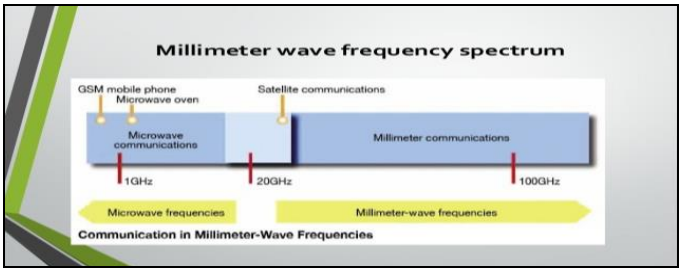

Fig 6: MMV technology

The higher the frequency the more data it can transmit. Other networks transmit data using radio waves, which depend on the type of electromagnetic signal is measured as a different frequency. The higher the frequency the smaller the wavelength. Millimeter waves have higher frequency so it promises higher data capacity than we currently have now. Another advantage to the shorter wavelengths found in millimeter waves technology is that antennas used to transmit and receive the signals which can be made easily. This means that phones that use millimeter wave technology can take advantage of multiple antennas in a single device, which could result in a more efficient use of the available spectrum and faster internet when multiple users are connected.

5. Biggest challenges while implementing 5G

As like other technologies 5G has also some big challenges.

5G use-cases will impact each of us in multiple areas of our lives—from education and healthcare to transportation and banking. While 5G technology will make these industries move technically forward, network operators will be

challenged to make this technology commercially viable. This means ensuring that the cost of using the 5G mobile network enables rather than inhibits the use-case. With the vast range of use-cases, operators will need to define and manage many new commercial arrangements and pricing structures. The majority of the IOT use-cases will become realistic only at the moment that the required price tag can be achieved with the reality of volume production.

1. Technological Challenges

- **Inter-cell Interference:** This is one of the major technological issues that need to be solved. There is variations in size of traditional macro cells and concurrent small cells that will lead to interference.

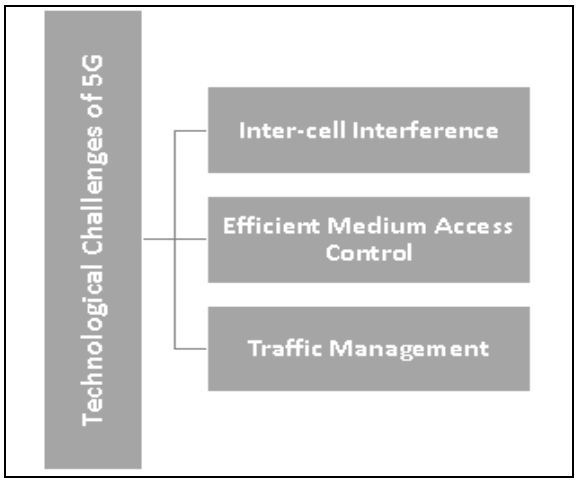

Fig 7

- **Efficient medium access control:** In a situation, where dense deployment of access points and user terminals are required, the user throughput will be low, latency will be high, and hotspots will not be competent to cellular technology to provide high throughput. It needs to be researched properly to optimize the technology.
- **Traffic Management:** In comparison to the traditional human to human traffic in cellular networks, a great number of Machine to Machine (M2M) devices in a cell may cause serious system challenges i.e. radio access network (RAN) challenges, which will cause overload and congestion.

2. Common Challenges

- **Multiple Services:** Unlike other radio signal services, 5G would have a huge task to offer services to heterogeneous networks, technologies, and devices operating in different geographic regions. So, the challenge is of standardization to provide dynamic, universal, user-centric, and data-rich wireless services to fulfill the high expectation of people.
- **Infrastructure:** Researchers are facing technological challenges of standardization and application of 5G services.
- **Communication, navigation, & sensing:** These services largely depend upon the availability of radio spectrum, through which signals are transmitted. Though 5G technology has strong computational power to process the huge volume of data coming from different and distinct sources, but it needs larger infrastructure support.

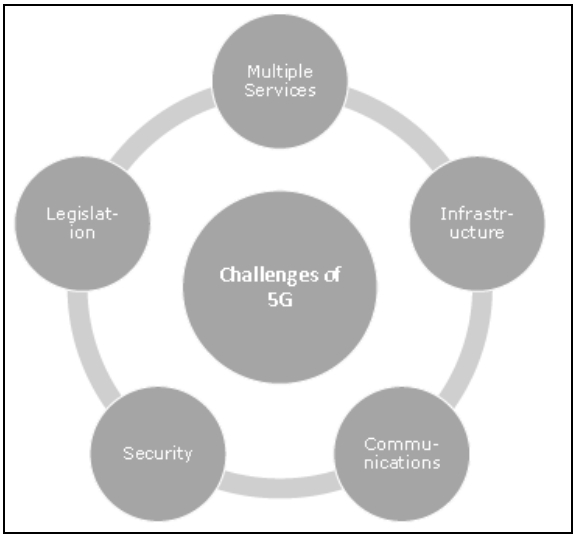

Fig 8

- **Security and Privacy:** This is one of the most important challenges that 5G needs to ensure the protection of personal data. 5G will have to define the uncertainties related to security threats including trust, privacy, cyber security, which are growing across the globe.
- **Legislation of cyber law:** Cybercrime and other fraud may also increase with the high speed and ubiquitous 5G technology. Therefore, legislation of the Cyber law is also an imperative issue, which largely is governmental and political (national as well as international issue) in nature.

3. Origin of 5G

We can see 5G network in early 2020s, considering the same "every 10 years" pattern as previous generation holds through. LTE came in 2011 so by some simple calculation we can expect 5G in 2020. Countries that want to stay competitive in the global economy are adapting 5G technology. Here are six countries that are leaders in adapting to 5G technology-

a. The United States the Federal Communications Commissions' (FCC) Spectrum Frontiers has laid the groundwork for the use of 5G technology in the United States by 2020.
b. South Korea - South Korean carrier KT Corp. (ADR) (NYSE:KT) plans to launch a 5g network during the Winter Olympics in 2018.(TYO:6701) using extremely high frequencies for transmitting data at up to 3.2 Gbps in the Taebak Mountains, where the 2018 Olympics will took place.
c. Sweden and Estonia - Swedish-Finning operator Telia company AB(STO:TELIA) and Swedish provider Telefonaktiebolaget LM Ericsson(NASDAQ:ERIC) stated that Stockholm, Sweden and Tallinn, Estonia will also use 5G technology in 2018.
d. Turkey - Turkey's 5GTR Forum, consisting of mobile network companies, Turkish public institutions, non-governmental organizations and domestic producers is

facilitating a faster transition to 5G technology by 2020.

e. Japan - Japan's goal is to launch 5G mobile service in 2020.
f. China - China is set to have 5G technologies commercially available in 2020. However, because Chinese authorities control the implementation of the technology, the process may be slow.

6. Key requirements of 5G

In recent years there have been several views about the ultimate form that 5G wireless technology should take. There have been two views of what 5G wireless technology should be:

- **Hyper connected view:** This view of the requirements for 5G wireless systems aims to take the existing technologies including 2G, 3G, 4G, Wi-Fi and other relevant wireless systems to provide higher coverage and availability, along with more dense networks. Apart from having requirements to provide traditional services, a key differentiator would be to enable new services like Machine to Machine, M2M applications along with additional Internet of Things, IoT applications. This set of 5G requirements could require a new radio technology to enable low power, low throughput field devices with long battery lifetimes of ten years or more.
- **Next generation radio-access technology:** This view of the 5G requirements takes the more technology driven view and sets specifications for data rates, latency and other key parameters. These requirements for 5G would enable a clear demarcation to be made between 4G or other services and the new 5G wireless system.

7. 5G requirements summary

By accounting for the majority of needs, the following set of 5G requirements is gaining industry acceptance.

- 1-10Gbps connections to end points in the field.
- 1 millisecond end-to-end round trip delay - latency
- 1000x bandwidth per unit area
- 10-100x number of connected devices
- Perception of) 99.999% availability
- Perception of 100% coverage
- 90% reduction in network energy usage
- Up to ten year battery life for low power, machine-type devices

8. Advantages of 5G

a. High resolution and bi-directional large bandwidth shaping.
b. More effective and fast.
c. Faster speed than any other network.
d. Our future is going to be very smart like self driving car, automated homes and other things. These things needed very fast internet like 5G.
e. Suppose our self driver less car took half second too long to make a turn and suddenly you get damage on your body. So if high speed net available their machines can take decision fast.
f. More peoples can connect to a single 5G network.
g. It has higher speed over long distance.
h. Extended battery life.

9. References

1. Schulz P, *et al*., Latency Critical IoT Applications in 5G: Perspective on the Design of Radio Interface and Network Architecture in IEEE Communications Magazine. 2017; 55(2):70-78.
2. Simsek M, Zhang D, Öhmann D, Matthé M, Fettweis G. On the Flexibility and Autonomy of 5G Wireless Networks in IEEE Access, 2017.
3. Zhang D, Festag A, Fettweis G. Performance of Generalized Frequency Division Multiplexing Based Physical Layer in Vehicular Communication in IEEE Transactions on Vehicular Technology, 2017.
4. Matthé M, Gaspar IS, Mendes L, Zhang D, Danneberg M, Michailow N, *et al*. Generalized Frequency Division Multiplexing: A Flexible Multi-Carrier Waveform for 5G in 5G Mobile Communications, 2017.
5. Braun PJ, Pandi S, Schmoll R, Fitzek F. On the study and deployment of mobile edge cloud for tactile Internet using a 5G gaming application" in 14th IEEE Annual Consumer Communications & Networking Conference (CCNC), 2017, 154-159.
6. Gonzalez A, Kühlmorgen S, Festag A, Fettweis G. Resource Allocation for Block-Based Multi-Carrier Systems Considering QoS Requirements in Proceedings of the IEEE Global Communications Conference, 2017.
7. Bender S, Seiler P, Klein B, Dörpinghaus M, Plettemeier D, Fettweis G. Pathways towards Tb/s Wireless in Proceedings of the IEEE International Conference on Ultra Wideband, 2017.
8. Wunderlich S, Gabriel F, Pandi S, Fitzek F. We don't need no generation – a practical approach to sliding window RLNC Inproceedings in Proceedings of the Wireless Days, 2017.
9. Silveira Ferreira J, *et al*., GFDM Frame Design for 5G Application Scenarios in Journal of Communication and Information Systems (JCIS). 2017; 1(32):54-60.
10. Ehrig M, *et al*., Reliable wireless communication and positioning enabling mobile control and safety applications in industrial environments" in Proceedings of the International Conference on Industrial Technology, 2017.
11. Chiang HL, Rave W, Fettweis G. Hybrid Beamforming Strategy for Wideband Millimeter Wave Channel Models in Proceedings of the 2017 ITG/IEEE Workshop on Smart Antennas, 2017.
12. Landau L, Dörpinghaus M, Fettweis GP. 1-Bit Quantization and Oversampling at the Receiver: Communication over Bandlimited Channels with Noise in IEEE Communications Letters, 99:1-1.
13. Mendes L, Michailow N, Matthe M, Gaspar I, Zhang D, Fettweis G. GFDM: Providing Flexibility for the 5G Physical Layer in Opportunities in 5G Networks: A Research and Development Perspective, CRC Press, 2016.
14. Zhang Q, Fitzek FHP. Mission Critical IoT Communication in 5G in Future Access Enablers for Ubiquitous and Intelligent Infrastructures. 2015; 159:35-41.
15. Szabo D, Gulyas A, Fitzek FHP, Lucani DE. Towards the Tactile Internet: Decreasing Communication Latency

with Network Coding and Software Defined Networking, European Wireless 2015; 21th European Wireless Conference; Proceedings of, Budapest, Hungary, 2015, 1-6.
16. Simsek M, Aijaz A, Dohler M, Sachs J, Fettweis G. 5G-Enabled Tactile Internet, in IEEE Journal on Selected Areas in Communications, to appear, 99:1(1).
17. Satyanarayanan M, Schuster R, Ebling M, Fettweis G, Flinck H, Joshi K, *et al*. An open ecosystem for mobile-cloud convergence, Communications Magazine, IEEE. 2015; 53(3):63-70.
18. Wunder G, Jung P, Kasparick M, Wild T, Schaich F, Chen Y, ten Brink S, *et al*. 5GNOW: Non-Orthogonal, Asynchronous Waveforms for Future Mobile Applications, IEEE Communications Magazine (ComMag), 2014, 12(52).
19. Fettweis, Gerhard, Siavash Alamouti. 5G: Personal Mobile Internet beyond What Cellular Did to Telephony, Communications Magazine, IEEE. 2014; 52(2):140-145.
20. Wübben D, Rost P, Bartelt J, Lalam M, Savin V, Gorgoglione M, *et al*. Benefits and Impact of Cloud Computing on 5G Signal Processing: Flexible centralization through cloud-RAN, IEEE Signal Processing Magazin (SPM). 2014; 6(31):35-44.
21. Michailow N, Matthe M, Gaspar IS, Caldevilla AN, Mendes LL, Festag A, *et al*. Generalized Frequency Division Multiplexing for 5th Generation Cellular Networks, Communications, IEEE Transactions on, 2014; 62(9):3045-3061.
22. ITU ITU-T Technology Watch Report: Tactile Internet, 2014.
23. Björnson E, Jorswieck E, Debbah M, Ottersten B. Multi-Objective Signal Processing Optimization: The Way to Balance Conflicting Metrics in 5G Systems.