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5G Technology

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Abstract *—this paper gives a short ideaof 5GTechnology.5G wireless technology is a complete wireless communication with almost no limitations. It can be called real wireless world. It lets you to access internet in a very fast way. 5G network have low latency so the lack of reaches the server is very fast. We are able to connect variety of devices to the mobile network for ex: different sensors, different smart devices like cars,TV, bulbs etc. the download speed can be 10 to 20 times faster than we have now. 5G technology uses high frequency waves which is known as Millimeter Waves so it can carry huge amount of information. It can travel short distance. object like trees , building etc. can block these waves so the 5G network consist of many small Base Stations to help signal to reach everywhere therefore we need to install small stations to increase the range the process is very Expensive and it's likely that 5G will be launch inside densely populated areas. In remote villages and places it may take more time to reach.*

Keywords— Base Station, Low Latency, Millimeter Waves, Wireless Communication, 5G Technology

I. INTRODUCTION

5G TECHNOLOGY is the new version of cellular technology that will provide low latency, seamless coverage,high data rate, and highly reliable communications. It will increase energy efficiency, spectrum efficiency, network efficiency as well as efficiency of other systems. Besides providing faster & reliable access, it will act as an information duct built to connect billions of Internet of Things (IOT) devices.[8]

New capabilities of mobile communication networks enabled by 5G technology will allow higher quality video services with mobility at high speed, business automation delivered through billions of connected devices, delivery of critical services such as telephonic-surgery and automatic vehicle assured by low latency and ultra-reliable networks, and improved productivity assisted by real time data analytics. Unlike existing mobile communication networks, 5G networks will allow tailoring of requirements for each of these different use cases within the same network. [8]

1.1 Challenges in 5G ORTechnology immerging as foundation of 5G

1.1.1. Millimeter Waves :

Our smart-phone and other electronic devices in our home uses very specific frequency on the radio frequency typically those under 6GHz. but these frequencies are starting to get more crowded. Cares can only squeeze so many bits of data on same amount of radio frequency spectrum as more devices come online the connection gets slower and drop the connection. the solution is to broadcast the data on a shorter millimeter waves which are lies between 30GHz to 300GHz these section of spectrum is never been use before on mobile devices so it can open more bandwidth for everyone.

But there are some cache, millimeter waves can't travel through buildings and other obstacles so the solution of these problem is the next technology which is small cell.

1.1.2. Small Cell :

Wireless network which we are using today depended on high power cell tower to broadcast the signal over long distance. Buthigher frequency millimeter waves are not able to transfer through obstacles which means if you move behind one you will lose the signal.

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Small cell network will solve that problem using thousands of low power mini base stations. These base station could be closer than the traditional towers form in a set of relays team to transfer signal around obstacles. These would be specially use in cities. As user move behind obstacles his smart-phone would automatically switch to new base station in better range of his devices allowing him to keep his connection.

1.1.3.Massive MIMO (multiple input multiple output):

Massive MIMO substantially increase spectral efficiency to boost capacity and coverage. Massive MIMO is a technology where the number of base station antennas are very large. In Massive MIMO hundreds or thousands of base station antennas simultaneously serves hundreds of user in same frequency resource. Massive MIMO increase throughput and capacity by using many antenna element to create simultaneous data streams to a large number of users.

But cellular antennas that we use today are broadcast data in every direction at a same time. Therefore it cause serious interference which brings us to the next technology which is Beam forming. [9]

1.1.4.Beamforming:

It is a traffic signaling system for cellular signals instead of broadcasting data in every direction it would allow stations to send focus stream of data to specific user so we can prevent interference and its waymore efficient .that means stations could handle more incoming and outgoing data streams at once.

Ex: if you are in a cluster of buildings and trying to make a phone call, your signal return from surrounding Of buildings and crisscross with other signal from user in other area and massive MIMO base station receives all of these signals and keep track of the timing and direction of the arrival . it then uses signal processing to triangulate them exactly were each signal coming from and plots the best transmission round back through the air to each phone .sometimes they rebound single packets of data in opposite directions of buildings and other objects to keep signals interfering with each other . The result is relevant data stream is to use which brings us to next technology which is full duplex.[9]

1.1.5. Full duplex:

If you ever use the walkie-talkie then you know that the order of communication .you have to take turns between talking and listening that's kind of a drag. Today's cellular base stations have that exactly the same holdup. Basic antenna can do only one job at a time either transmit or receives. These is because of the radio waves which travel both forward and backward along with same frequency.

Ex: the train is loaded with the data and the frequency of traveling is 1GHz and if there is second train is coming from opposite direction on same track. So we are going to get some interference. The solution is that the train should take the turns or to put other train on different track so you can make it lot more efficient by working around reciprocity. Researchers have use silicon transmitters to create high speed switches that hold the backward role of these wave. It is like a signaling system that can movement internally reroute train that means there is a lot more things done and track is lot faster.

1.2. 5G Use Case

We can categorized 5G use cases into three different use case classes i.e.enhanced Mobile Broadband, massive Machine-Type Communication, and Ultra- Reliable Low-Latency Communications.

1.2.1. Enhanced mobile broadband

This usage scenario comes with new application areas such as virtual reality, augmented and virtual reality,video monitoring, and mobile cloud computing, enterprise collaboration and also enhanced indoor and outdoor broadband EMMB is the primary use case for 5G. It provide high speed broadband to highly crowded areas. It enables high speed streaming on mobile as well as home screen

Requirement: 10 GB data rates for the enhanced Mobile Broadband. [11] [3]

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1.2.2. Massive machine-type communications -

It uses maximum number of connected devices which transmits a relatively small volume of non-delay sensitive data. Devices are to be low cost and have a very long battery life. This use cases covers IOT,remote monitoring, asset tracking, smart cities,smart agriculture, energy monitoring, smart home etc.

Requirement: 1 MN/Km2 connection (1 million devices per square kilometer).[11] [3]

1.2.3. Ultra-reliable and low-latency communications -

This use case has solid requirements for capabilities such as availability, throughputand latency to support the delivery of critical communications. Some examples include autonomous self-driving cars, smart grids, remote patient monitoring and industrial automation etc. [11][3]

It enabling smart vehicles to communicate with each other, and creating opportunities for connected, autonomous cars and trucks. For example, an autonomous vehicle (AV) operated via a cloud-based, autonomous driving system must be able to stop, accelerate or turn when told to do so. [3]

Requirement: 1 MS latency for Ultra-Reliable Low-Latency Communications.

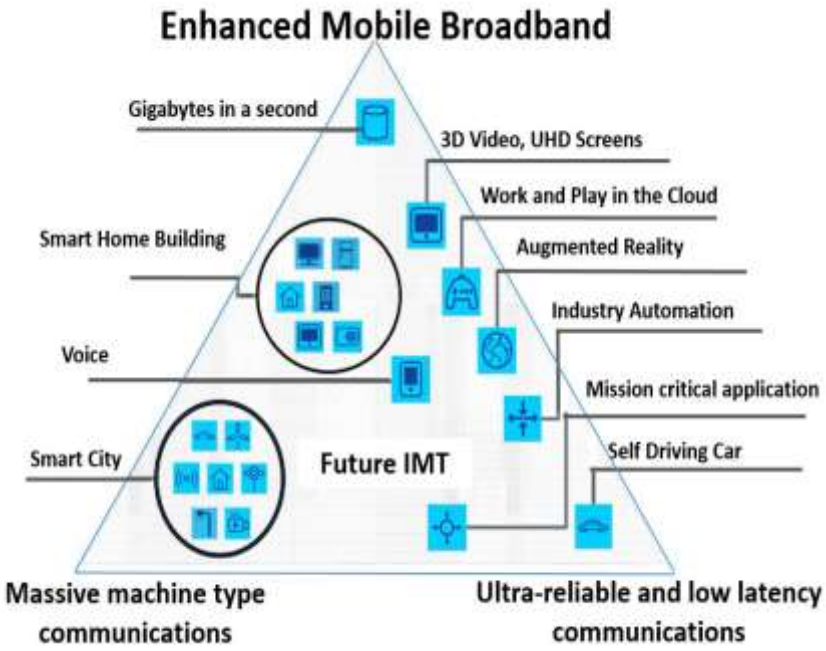

Figure 1: 5G Use Case Scenario

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II. 5G DEPLOYMENT AND ARCHITECTURE

2.1. 5G deployment can be divided into three phases.

Deployment Phase 1 –in these phase Fixed Wireless Access services in the millimeter-band with 0.5 to 1 Gbps link in 2019. And mobile services in the < 3 GHz band in 2020. In 2021, lots of countries will have deployed 5G broadband services [2]

Deployment Phase 2 – in these phase5G based IOT technology is expected to begin deploy in 2021. While small IOT networks built around earlier technologies like NB-IOT have been deployed, the entry of 5G IOT will boost these trends [2]

Deployment Phase 3 –in these phase low latencyand highly reliable wireless services will launch in early 2022 and offer new applications like car platooning (coordination between self-driving vehicles),telephonic-surgery and drone navigation[2]

In India, 5G deployment strategy may have different plans and scenarios. If early deployment is adopted, the equipment could be more expensive and being early, it will also be 694letch needing costly maturing. On the other hand, early adoption will fast track the country's embrace of 5G benefits and also increase opportunities to develop innovative and new use cases that support Indian needs.

2.2. 5G Network architecture

Global System for Mobile communications was developed to carryvoice services in a circuit switched manner. Data services were also possibleover a circuit switched modem connection but with very low data rates. Starting with step one which is an Internet Protocol (IP) based packet switched solutionand it was taken with the development of global system for mobile to General Packet Radio Service(GPRS) and both using the sameaccess method and air interface.[9]

A new access technology i.e. Wideband Code Division Multiple Access was developed to get the higher data range in Universal Mobile Terrestrial System(UMTS). The access network in UMTS follows a connection of circuit switched for voice services and connection of a packet switched for data services. UMTS had to still depend upon the circuit switched core for paging in incoming data service. To overcome this shortcoming, pure IP based Evolved Packet System (EPS) was developed.[9]

In EPS system, both voice services and data services are carried by the IPprotocol. A new access solution called Long Term Evolution (LTE) which isbased on Orthogonal Frequency Division Multiple Access (OFDMA) is usedto achieve high data rates. The LTE access network is a network ofsmart base stations (evolved NodeB) without any centralized intelligentcontroller, generating a flat architecture. Distributing the intelligenceamongst the base-stations in LTE, reduced the time required for setting-up the connection and for handover.[9]

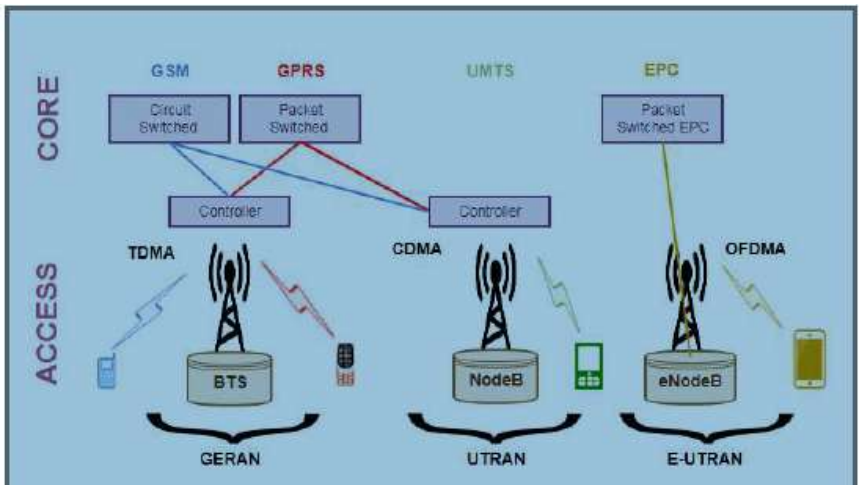

Figure2:5G Network Architecture

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III. CONCLUSION

5G technology is expected to play a key role in digital economies,creating new business opportunitiesand improving economic growth. Larger bandwidth and low latency times will allow the development of new services and the improvement of existing ones.

Deployment of 5G network will require substantial investment in the core, Radio Network and Spectrum. However, the 5G services will open-up many new revenue generating streams also as it will cater to variety of solutions to new verticals besides enhanced mobile broadband solutions. 5G will provide disruptive capabilities, which will be an economy booster by promoting new ways to develop and organize the business sector.

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