

5G NETWORK AND INTERNET OF THINGS

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Abstract:-

Wireless Technology have made significant strides in recent decades. The first generation i.e paging services was followed by the 2nd and 3rd generations (voice and messaging services and Internet access), and then by the fourth generation (4G or Long Term Evolution [LTE]) with video streaming. The 5th Generation (5G) is expected to be available globally ending 2019. The period of time more opportunities of 5G technology are certainly promising.

Mobile communication across 5G technology is the key role of this work. Current research works in mobile communication across 5G technology in entire world submitted such a great necessary development towards 5G Technology in different work patterns including hardware and software. 4G technology main inclusions several standards under a common roof, similar to previous generations of communication technologies.. To all intents and purposes 4G is good for now, however if look at it in 5 or 10 years, 4G will obviously not be ready to meet requirements for brand new applications bobbing up within the next few years. 5G Technology are increases mainly rate, reduce the end-to-end latency, and improve coverage. These main properties are particularly important for several applications associated with IOT(Internet of Things), which they're recognized as ones of the Technology components of the resolving of 5G architecture. the most purpose of this content is that the key notes of mobile communication through 5G (Fifth Generation) Technologies of which is seen as consumer oriented. In 5G technology and Mobile consumer has given first priority then others. 5th Generation Technology is to create use of Mobile Phones within very high bandwidth. Consumer never experienced the utmost valued technology as 5G.The 5G technologies comprise all kinds of experienced features which make 5G technology most governing technology within the vicinity of future.

In wireless communication, Fifth Generation (5G) Technology could also be a recent generation of mobile networks. during this paper, evaluations within the sector of mobile communication technology are presented. In each evolution, multiple challenges were faced that were captured with the help of of next-generation mobile networks. Among all the previously existing mobile networks, 5G provides a high-speed internet facility, anytime, anywhere, for everybody, for everyone. 5G is slightly different thnaks to novel features such as interconnecting people, controlling devices, objects, and machines. 5G mobile system will bring diverse levels of performance and capability, which may function serve as new user experiences and connect new enterprises. Therefore, it's essential to grasp where the enterprise can utilize the advantages of 5G. This article's main aim is to spotlight a variety of the foremost recent enhancements made towards the 5G mobile system and discuss its future research objectives.

Future 5G wireless networks will aspect new contests, furthermore as growing claim on network capacity to support a large number of devices running application necessitating high data rates and always-on connectivity; hugely and supportive the emerging business models within the wireless network market demanding networks to be more open. New challenges initiative new resolutions and involve changed plans within the network positioning, management, and operation of future 5G wireless networks equated to those of current wireless networks. One amongst of the key purposes of future 5G wireless networks is to compliantly provide service- customized networks to a large number of variety services using integrated cloud reserve and wireless/wired network possessions, which can be presented by several infrastructure providers and/or operators.

Keywords: 5G; millimeter wave (mmW); massive multiple input and multiple output (MIMO); small cell; mobile edge computing (MEC); Beamforming; machine learning, Future, 5G, Wireless, Capacity.

Introduction:-

5G Technology stands for 5th generation mobile technology. 5G represent the next major phase of mobile telecommunication ethics beyond the upcoming 4G standards. 5G technology is contribution the service in Product Manufacturing, Documentation, supporting electronic communications, etc. As the purchaser become more and more aware of the mobile phone technology, he or she will look for a decent package all together including all the advanced features a cellular phone can have. Hence the search for new technology always the main motivations of the top cell phone to out more innovate their competitors. The aim of a 5G based telecommunication network would perfectly answer the challenges that a 4th Generation prototype would present once it has entered ubiquitous use.

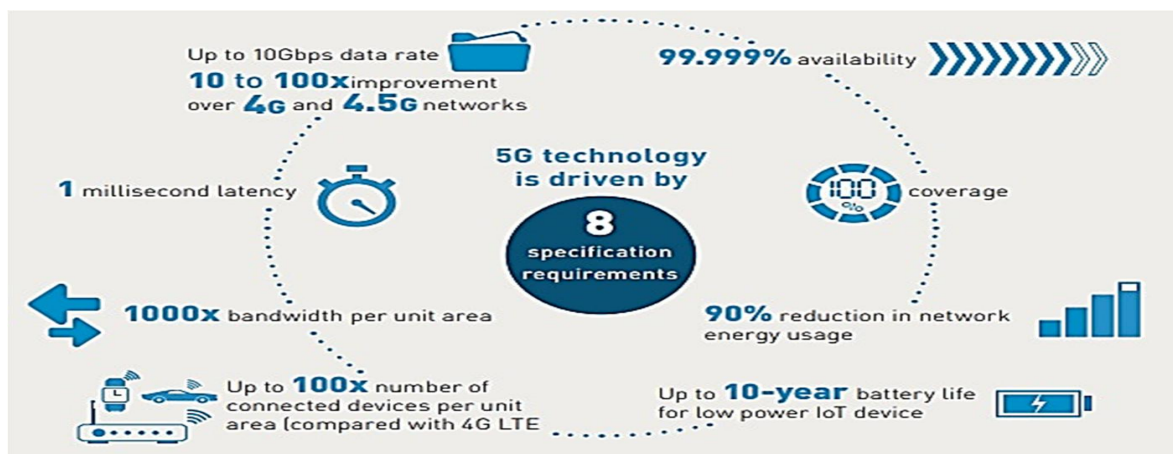
No one company or person owns 5G, but there are numerous companies within the mobile ecosystem that are causative to bringing 5G to life. Qualcomm has played a **serious** role in originating the numerous introductory technologies that drive the industry forward and structure 5G the subsequent wireless standard. Mobile & wireless networks have made significant improvement within the previous couple of years. At **this** time many mobile phones have also a WLAN adapter. One may expect that near soon many mobile phones will have Wax adapter too, besides their 3G 2G Bluetooth etc. adapters. We are using IP for generations, 2.5G or 3G Public Land Mobile Networks on one side and WLAN on the opposite, developed study on their incorporation. With regard **to** the 4G, its point of interest is towards flawless integration of cellular networks **like** GSM and 3G. The multiple consumers put plants **because it** should be for 4G, but private security mechanisms and personal support for the OS within the wireless test techniques remain However, **the applying** of a **mix of various** wireless networks (such as PLMN and WLAN) is in practice until **this** time. Although, different wireless networks from only terminal are used absolutely, there's no combining of dissimilar wireless access technologies for an equal session (e.g., FTP download). The predictable Open Wireless Architecture in is targeted to

supply open baseband processing modules with open interface parameters. The OWA is said to MAC/PHY layers of future (4G) mobiles. New error-control schemes will be downloaded from the net and augmentation is seen towards the customer terminals as a spotlight on the 5G mobile networks. The 5G terminals will have software defined radios and modulation scheme and also the 5G mobile terminals will have access to diverse wireless technologies at the identical time. And also 5G mobile terminal should be proficient to merge special flows from different technologies network will be reliable for managing user-mobility.

What is 5G?

5G technology may be a breakthrough. The following generation of telecom networks (fifth generation or 5G) has started beating the market end of 2018 and can still increase worldwide. Elsewhere the speed of development, the technology is predictable to unleash a large 5G IoT (Internet of Things) ecosystem where networks can assist communication wants for billions of connected devices, with the correct trade between speed, latency, and cost.

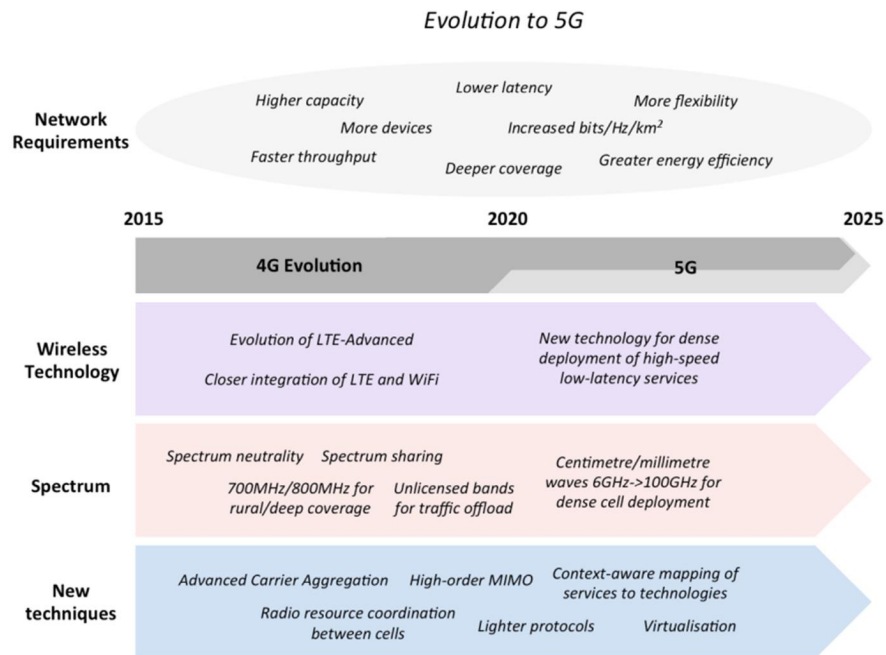
5G technology is driven by 8 specification requirements:



What makes 5G faster?

The use of shorter frequencies (millimeter waves between 30GHz and 300GHz) for 5G networks is why 5G are often faster. This high- band 5G spectrum affords the predictable boost not only in speed but also in capacity, low latency, and quality. However, 5G download speed may vary widely by are

Evolution to 5G:-



A unique objective for 5G networks is to support the appreciation in mobile data consumption, with users craving higher data speeds and traffic volumes expected to extend by hundreds. It's likely that 5G networks will need to transport reference data speeds of 100Mbit/s and peak speeds of up to 10Gbit/s. Not only will there be a requirement to deal with the whole volume of traffic, but the meditation of traffic in some locations, like business districts and commuter used today for 4G networks and also the cloud (SEs, HSM, certification, Over-The-Air provisioning, and KMS). The quality for strong mutual authentication for The need for 5G security, privacy, and also the trust are as robust as for 4G, if not stronger, with the tender impact of IoT services. Local SEs in devices can secure network admittance and support secure topographic point like emergency call management and virtual networks for IoT.

Challenges in Migration from 4G to 5G:-

Presently, 5G isn't a term officially used for any particular specifications. 3GPP standard release beyond 4G and LTE. 5G Technology could be a name employed in a spread of research papers and projects to point to **the subsequent most vital** stage of mobile communication values beyond the 4G standards. The execution of standards under a 5G umbrella would likely be round the year of 2020. The subsequent are the most constraints for migrating from 4G to 5G.

A. Multi mode user terminals

his trouble caused by means of 4G will be solved by using software radio approach. There'll be **a vital to style one** user terminal that may operate in numerous wireless networks and overcome the look troubles like boundaries on the dimensions of the device, its cost and power utilization

B. Choice among various wireless systems

Every wireless system has its distinctive characteristics and roles. The selection of best suited technology for a particular service at a particular place and at precise time are applied by making the selection in line with the simplest possible fit of consumer QoS (Quality of Service) requirement.

C. Security

Mechanisms with adaptive, reconfigurable, and lightweight protection should be designed.

D. Network infrastructure and QoS support

Integrating the present non-IP and IP-based systems and providing QoS assurance for end-to-end services that engage different systems may be a challenge

E. Charging and Billing

It is hard to accumulate, handle and accumulate the Consumers' account information from many service providers. Consumers' billing is additionally a difficult task. Attacks on Application Level Software applications will offer new feature to the patron, but will commence new bug.

F. Jamming and spoofing

Criminals can make use of such techniques. Jamming occurs when a transmitter sending out signals at the identical frequency shifts a GPS signal. Spoofing is fake GPS signals being sent out, during which case the GPS receiver considers that the signals arrives from a satellite and computes the incorrect coordinates encryption. If a GPS receiver will communicate with the most transmitter then the communication link between these two isn't tough to interrupt and consumer must use encrypted data.

Spectrum management

A combination of low (less than 1 gigahertz [GHz]), medium (between 1 GHz and 10 GHz) and high (above 10 GHz) frequencies is required to fulfill the coverage, capacity and speed requirements of 5G technology. In Canada, spectrum management is that the responsibility of Innovation, Science and Economic Development Canada (ISED). Various telecommunications companies have asked ISED to issue more licences for 5G technology. In step with a global report on 5G technology, Canada lags behind several Countries, like Australia, Japan, the UK and also the U.S., within the mid-band spectrum.

In Canada, there are already plans to order a part of the 600-megahertz (MHz) band for 5G technology. However, the assignment of a part of the three,500 MHz and three,800 MHz bands has been delayed, as these bands are already in use, particularly for fixed wireless service in rural areas. ISED is therefore holding consultations on the way to maximize these bands to fulfill everyone's needs, and it's aiming to hold a public auction in 2020 to allocate a little to 5G technology. ISED has also proposed to review all bands above 20 GHz so as to assign a part of them to 5G technology within five years.

Regulation of wireless infrastructure

In 2018, there have been approximately 13,000 wireless antenna locations in Canada. This number is predicted to extend because the IoT evolves dramatically with the introduction of 5G technology. It's estimated that the amount of connected objects could jump by several billion within the next decade, leading to a major increase in connectivity needs. Small cell

antennas (the size of a shoebox) are going to be accustomed expand the network and meet increased connectivity needs. they might be installed on various varieties of infrastructure, like street lights, bus shelters and public buildings.

Several telecommunications companies have raised concerns to ISED about the management of small cell antenna locations. In their view, it should be difficult to access these locations owned by various stakeholders, which might hinder the large-scale deployment of this sort of antenna. Additionally, some stakeholders believe that the regulations surrounding antennas might not be adapted to the requirements of 5G technology. In fact, these regulations were made with earlier networks in mind that used fewer but larger antennas. Additionally, some companies have recommended that ISED establish a national framework of best practices to facilitate the deployment of small cell antennas.

Key Terms of 5G Technology:-

While considering a smooth migration for 5G it's apparent that it should be valid for all styles of radio access technologies. in order that it could make better revenue for current global operators furthermore as interoperability will become more feasible. To make 5G practical for all styles of radio access technologies there should be some key terms of 5G technology as follows:

1. People called it REAL wireless world 5G **may be a** completed wireless communication with almost no limitation; somehow Additional features **like** Multi- media Newspapers, also **to look at** T.V programs with the clarity on that of an HD T.V.
2. **we will** send Data much faster than that of the prior generations and 5G will bring almost perfect real-world wireless or called Worldwide Wireless Web
3. Real wireless world with no more limitation to access and zone issues and wearable devices with AI capabilities.
4. Internet protocol version 6 (IPv6), where a visiting care-of mobile IP address is assigned in keeping with location and also the connected network.
5. One unified global standard and protracted networks providing ubiquitous computing: The user can simultaneously be connected to many wireless access technologies and seamlessly move between them. These access technologies are often a 2.5G, 3G, 4G or 5G mobile networks, Wi-Fi, PAN or the other future access technology. In 5G, the concept could also be further developed into multiple concurrent data transfer paths.
6. Cognitive radio technology, also **called** smart-radio: This dynamic radio resource management is achieved **in a very** distributed fashion, and relies on software defined radio allowing different radio technologies to share the identical spectrum efficiently by adaptively finding unused spectrum and adapting the transmission scheme to the necessities of the technologies currently sharing the spectrum.
7. High altitude stratospheric platform station (HAPS) systems.

5G Technology Requirements:-

As a results of this blending of requirements, many of the industry initiatives that have progressed with work on 5G identify **a** collection of eight requirements:

1. 1-10 Gbps connections to finish points within the field (i.e. not theoretical maximum)
2. 1 millisecond end-to-end round-trip delay (latency)
3. 1000× bandwidth per unit area

4. 10-100× number of connected devices
 5. (Perception of) 99.999% availability
 6. (Perception of) 100% coverage
 7. 90% reduction in network energy usage
 8. Upto ten-year battery life for low power, machine-type devices
- Because these requirements are specified from different perspectives, they are doing not make a completely coherent. List **it's** difficult to create mentally a brand new technology that would meet all of those conditions simultaneous.

Advantages of 5G Technology

- High determination and bi-directional large bandwidth shaping.
- Technology to wrinkle all networks on one platform.
- More active and effective.
- Technology to simplify subscriber administration tools for **the fast** action.
- Most likely, will provide **an enormous** broadcasting data (in Gigabit), **which is able to support quite 60,000** connections.
- Easily manageable with the previous generations.
- Technological sound to support heterogeneous **topographic point** (including private network).
- Possible to afford uniform, uninterrupted, and unflinching connectivity across **the globe**.

Disadvantages of 5G Technology

However, 5G technology is examined and abstracted to solve all radio signal problems and hardship of mobile world, but because of some security reason and lack of technological development in most of the geographic sections, it has following limitations

- Technology is silent under process and research on its possibility goes on.
The speed, this technology is pleasant seems tough to attain (in future, it would be) due to the useless technological support in most parts of the planet.
Many of the old devices wouldn't be ready to 5G, hence, all of them have to be swapped with a brand new one expensive deal.
- Developing infrastructure needs high cost.
- Security and privacy problems yet to be solved.

Commercial Service Providers of 5G

5th Generation Technology contains High-Speed internet browsing, streaming, and downloading with very high reliability and low latency. 5th Generation Technology Network will change your working style, and it will increase new business developments and provide innovations that we cannot imagine. This section covers top service providers of 5th Generation Technology network.

Ericsson: Ericsson can be a Swedish multinational Networking & Telecommunications company, Investing around 25.62 billion USD in 5G network, which makes it the most important telecommunication company. It claims that it's the sole company performing on all the contents to create the 5G network a worldwide standard for the other generation wireless communication. Ericsson developing the primary 5G Radio Prototype that permitted to the operators to line up the live field trials in their network, Its helps operating understanding

how 5G reacts. It will play an important role within the developing of 5G Hardware. It presently issues 5G services in over 27 countries with content providers like China Mobile, GCI, LGU+, AT&T, Rogers, and plenty of more.

Verizon: It is American Multinational Telecommunication which was formed in 1983. Verizon begins offering 5G services in April 2020, and by December 2020, it has agile provided 5G services in 30 cities of the USA. They arrange that by the end of 2021, they would position 5G in 30 more new cities. Verizon establish a 5G network on mmWave, a very high band spectrum between 30 to 300 GHz. As it is a significantly less used spectrum, it supply very high-speed wireless communication. MmWave offers ultra-wide bandwidth for next-generation mobile networks.

AT&T: AT&T is an American multinational company that was the first to strongly a 5G network in reality in 2018. They built a gigabit 5G network connection in Waco, TX, Kalamazoo, MI, and South Bend to target this. It is the first company that goals 1–2 gigabit per second speed in 2019. AT&T reimburse that it provides a 5G network connection among 225 million people worldwide by using a 6 GHz spectrum band.

T-Mobile: T-Mobile US (TMUS) is an American wireless network operating which was the main service provider that offers a real 5G national wide Network. The organization know that the high-band 5G was not practical in Nationwide, so they used a 600 MHz spectrum to building a specific portion of its 5G network. TMUS is arrangement that by 2024 they will double the total extent and triple the full 5G capacity of T-Mobile and Sprint combined. The sprint buyout is helping T-Mobile move the next the company's current market price to 129.98 USD.

5G Applications:-

5G is more speed than 4G and provides remote-controlled operation over a authentic network with zero set back. It come up with down-link maximum throughput of up to 20 Gbps. In addition, 5G also helps to 4G WWW (4th Generation World Wide Wireless Web) and is built on the Internet protocol version 6 (IPv6) protocol. 5G imparts no limited internet connection at your suitable, anytime, anywhere with extremely high speed, high throughput, low-latency, higher reliability, greater scalability, and energy-efficient mobile communication technology.

There are more number of applications of 5G mobile network are as follows:

High-speed mobile network: 5G is a progress on all the earlier mobile network technologies, which provide very high speed downloading speeds of up to 10 to 20 Gbps. The 5G wireless Network prepares as a Fiber Optic internet connection. 5G is non identical from all the conventional mobile transmission technologies, and it provide both voice and high-speed data connectivity efficiently. 5G provide very low latency communication of less than a millisecond, help ful for independent driving and mission-critical applications. 5G will use millimeter waves for data transmission, offering higher bandwidth and a huge data rate than lower LTE bands. As 5G is a fast mobile network technology, it will allow virtual access to high processing power and security and safe access to cloud services and enterprise applications. Small cell is one of the best quality of 5G, which intends lots of primary like high coverage, high-speed data transfer, power saving, easy and fast cloud access, etc.

Entertainment and multimedia: In first analysis in 2015, it was aimed that more than 50 percent of mobile internet traffic was used for video downloading. This shift will securely increase in the future, which will made video streaming more common. 5G will offers High-speed streaming of 4K videos with crystal clear audio, and it will be made a high definition virtual world on your mobile. 5G will advantage in the entertainment organization as it provides 120 frames per second with high resolve and higher active range video streaming, and HD TV channels can also be gain on the mobile devices without any disturbances. 5G offers low latency to high define the communication so augmented reality (AR), and virtual reality (VR) will be very simple implementation in the future. Virtual reality games are trending these days, and many corporates are investing in HD virtual reality games. The 5th Generation Network will offer high-speed internet connection with a best gaming experience.

Internet of Things—connecting everything: the 5G mobile network main role plays a significant role in developing the Internet of Things (IoT). IoT will connect many things with the internet like many appliances, sensors, devices, objects, and applications. These applications will accumulate lots of data from many other devices and sensors. 5G will offering very High-Speed internet connection for data collection, transmission, control, and processing. 5G is a very common network with unused spectrum accessibility, and it provides very low-cost formation that is why it is the most efficient technology for Internet of Things (IoT). In much areas, 5G offers advantage to IoT are as follows:

Smart homes: Smart home appliances and products are more demand in these days. The 5G Network uses smart homes more reality as it provides high-speed connection and observing of many smart appliances. Smart home appliances are easily search and make configuration from remote locations using the 5G network as it provides very high-speed low inactivity communication.

Smart cities: 5G wireless Network also maintain & developing Smart cities applications such as automation of Traffic management, monsoon weather update, regional area of Broadcasting, energy-saving, more sufficient power supply, smart lighting system, Ground water wealth management, mass management, emergency control, etc.

Industrial IoT: 5G wireless technology will offers a lots of main features for future Companies such as safety, process tracking, smart packing, shipping, Power efficiency, automation of equipment, predictive maintenance, and logistics. 5G smart sensor technology also provides smarter, safer, cost-effective, and energy-saving organizational Internet of Things (IoT) operations.

Smart Farming: 5G technology will play a crucial role in Forming and smart Agriculture activities. 5G sensors and GPS technology mainly will help to farmers track live attacks on crops and managed them quickly. These smart sensors can also be used for irrigation, pest, insect, and electricity control.

Autonomous Driving: The 5G wireless network provides very low inactivity of High-Speed communication, Main purpose for autonomous driving. It means self-driving cars will come to original life soon with 5G wireless networks. Using 5G autonomous vehicle's such

as cars can simply communicate with smart traffic signs, objects, and other vehicles running on the road. 5G's low remission feature for makes self-driving high real as of every millisecond is essential for autonomous vehicles, decision-making is done in microseconds to eascape accidents.

Healthcare and mission-critical applications: 5G technology will retrieve modernization in medicines where Hospital doctors, Nurses and practitioners can perform new medical procedures. The 5G network will offers net connection between all classrooms, so attending workshops; seminars, conferences and lectures will be made easier. Along 5G technology, patients are connecting with Doctors and take their guidance. Scientists are to build smart medical devices which can make help to people the with chronic medical conditions. The 5G network will improve the Healthcare Industry with smart accessorises, the internet of medical things, smart sensors, HD medical images & technologies, and smart analytics systems. 5G will be help to access cloud storage, so access Healthcare data will be very easy from any location worldwide. Doctors and medical practitioners can easily store and send more files like MRI reports within seconds using the 5G network.

Satellite Internet: In so many Remote areas, Base stations, ground are not available, so 5G will play a crucial role in offering connecting in such areas. The 5G network will offers connection using satellite systems, and the satellite system uses for constellation of many more small satellites to offered connection in cities, Towns and rural areas across the world.

5G Technology Future Scope:-

In Future, 5G will provide high qualities of services, lower inactivity, and highest bandwidth, which will be help more improve user experiences both in the consumer and business space, from cloud gaming, to Telehealth use cases.

By Sergey Seletskyi, Internet of Things (IoT) execution. Leader and Senior Solution Architect at Intellias. 5G networks will improve the Internet of Things (IoT). But it will receive years for the technology to cover most of the planet.

For most of the people, 5G will handle the wide-area wireless connection, and Wi-Fi will handle the regional wireless connectivity. Alternatively, there could surely come a time when only one of them will be necessary. It may seem unnecessary to think that Wi-Fi could go away, more over given how extensive it is today. Increased Spectrum – greater capacity, m a n y users and faster speed. In more countries the actual frequency bands for 5G are below 6 GHz and same frequencies to outstanding mobile and Wi-Fi networks.

5th Generation Technology is going to be a new mobile uprising in mobile market. Through 5G technology is now we can use worldwide cellular phones. With the coming out of cell phone dislike to PDA now your complete office in your accessibility or in your phone. 5G technology has amazing data capabilities and has ability to tie together non restricted call volumes and infinite data broadcast within the latest mobile operating system. 5G technology has a bright future due to it can handled best technology and provide invaluable handset to

their customers. May be in future days 5G technology retrieve over the world market. 5G Technologies have an raising capability to support Software and Consultancy. The Router and switch technology used in 5G network offering high connection. The 5G technology issues internet access to nodes within the building and can be deployed with union of wired or wireless network connectivity. The progression of the 5G technology has a glowing future.

Main Feature of 5G technology:

5G technology will provide high resolution for unstable cell phone user and multidirectional highest bandwidth shaping.

The modern billing communication of the 5G technology will produce it many attractive and productive.

5G technology will offer members management tools for fast action.

The excellent quality services of 5G technology depend on Policy to avoid error.

5G technology will offer the large broadcasting of data in Gigabit which supporting at most of 65,000 connectivity's.

5G technology will provide envoy class gateway with non-parallel stability.

The traffic information by 5G technology will make it more positive.

Across remote administration provide by 5G technology a user can get good and fast results.

The isolated diagnosis will give a great feature of 5G technology.

The 5G technology will offers up to 25 Mbps speed connectivity.

The 5G technology will encourage virtual private network.

The new 5G technology will receive all delivery services out of business prospect

The uploading and downloading speed of 5G Technology will be in touch the peak.

The 5G technology network will provide implementation and available connections just about the new world.

5G technology with reference to begin due to the 5G technology going to offer tough completion to normal computer and laptops whose marketplace value will be manage. There are many lots of improvements from 1G, 2G, 3G, and 4G to 5G in the world of telecommunications. The new coming 4G technology is accessible in the market in reasonable rates, high peak future and much reliability than its preceding technologies.

Conclusion & Future Scope:-

5G technology has outline as a platform open to number of layers, from the physical layer up to the application. A next generation of 5G Technology is about to begin due to the technology 5G going to offer the completion of hard core computers and laptops that will be high-flown in the normal market value. At present, the current work is in units that must provide the best operating system and at the lowest price to serve the describes the using one or many more than one wireless technology at the allocate time from the cell phone 5G. There are a many of changes from 1G, 2G, 3G, 4G 5 G well in the world of mobile communications. And mobile phones 5G access to non-identical wireless technologies in the identical time and the station should be able to combine non-identical streams of different

technologies. Available in the market at lowest prices, assumptions of high peak and a lot of dependability of the technologies have already new technology coming 5G. We can be able to watch HD TV channel in our cell phones without any Interruption. 5G network technology will release a novel era in mobile communication. 5G technology offer of the high accuracy consumer cell phone passionate. 5G and cell phones have a Tablet PC. Many of the solid mobile technologies evolve.

5G Technology represent for the 5th Generation Mobile technology. 5G mobile Technologies has altered the means to use Mobile phones within very high bandwidth. Customers never experienced regularly before such a high value technology. Now a day's cell phone users have much understanding of the Mobile phones technology. The 5G technologies includes all the types of creative structures which makes 5G mobile technology most effective and in a high demand innear future.

A customer can also catch their 5G technology mobile phones with their Laptop to get broadband internet connection. 5th Generation Technology associated with cameras, MP3, video play-actor, large phone memory, audio, video player and many more you never imagine. For children astounding fun Bluetooth technology and Pico nets has become in market.

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