

Comparative Study of 5g and 4g- A Review

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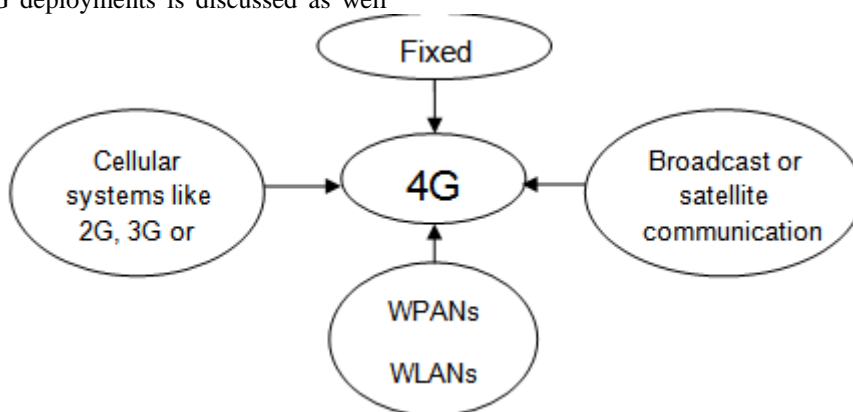
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ABSTRACT- 5G is the next generation of cellular communication systems. An agreement was established by international standard organizations on the key requirements proposed for 5G. The expectations are extremely high, which is understandable, since 5G will support many more users than the current mobile generation, new applications will emerge that will demand larger bandwidths and it will handle the consequent surging mobile network traffic. The comparison between 4G and 5G wireless technology in relation to its speed, frequency band, switching design basis and forward error correction is studied. The 5G wireless technology helps to solve the problems of poor coverage, bad interconnectivity, poor quality of service and flexibility. An ideal 5G wireless technology to accommodate the challenges and shortfalls of 4G deployments is discussed as well

as the significant system improvements on the earlier wireless technologies.

I. INTRODUCTION-

4G- 4G is all about convergence; convergence of wired and wireless networks, wireless technologies including GSM, wireless LAN, and Bluetooth as well as computers, consumer electronics, communication technology and several others. 4G is a Mobile multimedia, anytime anywhere, Global mobility support, integrated wireless solution, and customized personal service network system. 4G wireless technologies is also referred to by "MAGIC" which stands for Mobile multimedia, Anywhere, Global mobility solutions over, integrated wireless and Customized services.



A Figure Showing Use of 4G Technology Across Various Networks

The Evolution of Mobile Networks

	1G	2G	3G	4G	5G
Approximate deployment date	1980s	1990s	2000s	2010s	2020s
Theoretical download speed	2 Kbps	384 Kbps	56 Mbps	1 Gbps	10 Gbps
Latency	N/A	629 ms	212 ms	60-90 ms	<1 ms

How does 4G work?

At the most basic level, a 4G connection works via an antenna that transmits over radio frequencies, enabling mobile devices to connect to mobile networks. The transmission and receiving capabilities of 4G are powered by MIMO (Multiple Input Multiple Output) and Orthogonal Frequency Division Multiplexing (OFDM) technologies. OFDM provides more speed than the primary technologies that powered 3G, which include TDMA (Time Division Multiple Access) and CDMA (Code Division Multiple Access) technology. With MIMO, 4G reduces network congestion in comparison to 3G, because more users can be supported. 4G is also an allIP (internet protocol)-based standard for both voice and data, different from 3G, which only uses IP for data, while enabling voice with a circuit-switched network. As an all-IP network, 4G is more efficient for mobile network providers to operate and optimize than managing different network technologies for voice and data.

APPLICATIONS OF 4G-

- 4G Ultra high speed internet access – E-mail or general web browsing is available.
- 4G Data intensive interactive user services such as online satellite mapping will load instantly.
- 4G Multiple User Video conferencing subscribers can see as well as talk to more than one person.
- 4G Location-based services a provider sends wide spread, real time weather or traffic

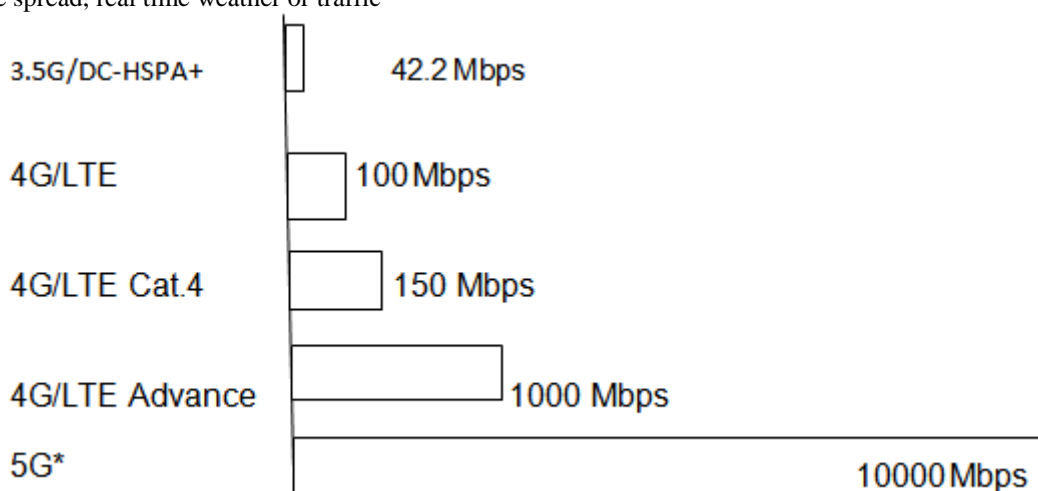
- Conditions to the computer or phone, or allows the subscriber to find and view nearby businesses or friends whilst communicating with them.
- 4G Tele-medicine a medical provider monitors or provides advice to the potentially.

5G- 5G is the 5th generation mobile network. 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, objects and devices. 5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra low latency, more reliability, massive network capacity, increased availability, and a more uniform user experience to more users.

How fast is 5G-

5G speed tops out at 10 gigabits per second (Gbps). 5G is designed to deliver peak data rates up to 20 Gbps based on IMT (International Mobile Telecommunications2020) requirements. Qualcomm Technologies flagships 5G solutions, the Qualcomm Snapdragon X65 is designed achieve up to 10 Gbps in downlink peak data rates.

5G is designed to provide much more network capacity by expanding into new spectrum, such mmWave. 5G can also deliver much lower latency for a more immediate response and can provide an overall more uniform user experience so that the data rates stay consistently high even when users are moving around



Parameters for 5G Wireless Technology-

Details about the performance of 5G Wireless Technologies according to various parameters are given here:

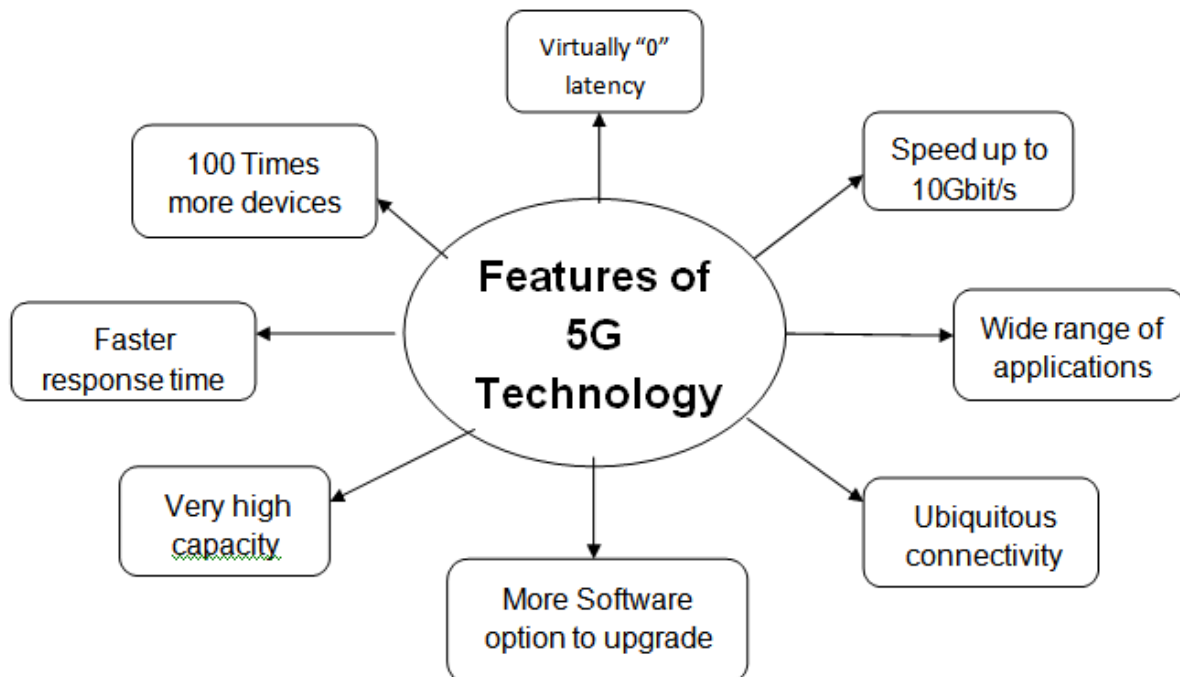
Peak data rate	At least 20Gbps downlink and 10Gbps uplink per mobile base station.
Real-world data rate	Download speed of 100Mbps and upload speed of 50Mbps.
Spectral efficiency	30bits/Hz downlink and 15 bits/Hz uplink. This assumes 8x4 MIMO
Latency	Maximum latency of just 4ms (compared to 20ms for LTE)
Connection density	At least 1 million connected devices per square kilometer (to enable IoT support)

5G Works- Like other cellular networks, 5G networks use a system of cell sites that divide their territory into sectors and send encoded data through radio waves. Each cell site must be connected to a network backbone, whether through a wired or wireless backhaul connection. 5G changes the way data is encoded, and offers many more options to carriers in terms of airwaves to use. 5G networks use a type of encoding called OFDM, which is similar to the encoding that 4G LTE uses. The new system opens up "high-band," shortrange airwaves that didn't work with 4G technology. But 5G can run on any frequency, leading to three very different kinds of 5G experiences low, middle, and high.

**II. 4G AND 5G FEATURES-
 FEATURES OF 4G-**

- Support for interactive multimedia, voice, streaming video, Internet, and other broadband services
- IP based mobile system
- High speed, high capacity, and low cost per bit
- Global access, service portability, and scalable mobile services
- Seamless switching, and a variety of Quality of Service driven services
- Better scheduling and call admission control techniques
- Better spectral efficiency

FEATURES OF 5G-



- Practically possible to avail the super speed i.e. 1 to 10 Gbps.
- Latency will be 1 millisecond (end-to-end round trip).
- 1,000x bandwidth per unit area.
- Feasibility to connect 10 to 100 numbers of devices.
- Worldwide coverage.
- About 90% reductions in network energy usage.
- Battery life will be much longer.
- The whole world will be in a Wi-Fi zone.

III. COMPARE 5G WITH 4G-

Specifications	4G	5G
Full form	Fourth Generation	Fifth Generation
Peak Data Rate	1 Gbps	10 Gbps
Data Bandwidth	2Mbps to 1Gbps	1Gbps and higher as per need
Spectral Efficiency	30 b/s/Hz	120 b/s/Hz
TTI (Transmission Time Interval)	1 ms	Varying (100 μs (min.) to 4ms (max.))
Latency	10 ms (radio)	<1 ms (radio)
Mobility	350 Kmph	500 Kmph
Connection Density	1000/Km ²	1000000/Km ²
Frequency Band	2 to 8 GHz	3 to 300 GHz
Standards	4G access convergence including OFDMA, MCCDMA, network-LMPS	CDMA and BDMA
Technologies	Unified IP, seamless integration of broadband LAN/WAN/PAN and WLAN	Unified IP, seamless integration of broadband LAN/WAN/PAN/WLAN and advanced technologies based on OFDM modulation used in 5G
Service	Dynamic information access, wearable devices, HD streaming	Dynamic information access, wearable devices, HD streaming, any demand of users
Multiple Access	CDMA	CDMA, BDMA
Core network	All IP network	Flatter IP network, 5G network interfacing(5G-NI)
Average Speed	25 mbps	200-400 mbps
Deployment	2006-10	2020

Base station	Cell tower	Small cell
OFDM encoding	20 MHz channels	100 to 800 MHz channels
Cell density	200 to 400 users per cell	100 times better than 4G

IV. MERITS AND DEMERITS OF 5G-

Merits of 5G-

- 5G wireless technology will enable ultra-high Internet speeds for Indian mobile phone customers, ushering in a new digital era in the nation.
- **Socio-economic change:** Industry 4.0, smart cities, financial inclusion, agriculture, health, and education are just a few of the key areas where 5G technology will bring about change.
- **Global positioning:** The adoption of 5G technology will support the home tech revolution and advance India's status as a global economic and technological powerhouse.
- **Newer opportunities:** will give start-ups new chances to develop creative solutions to current problems, produce jobs, and support India's economic resiliency.
- **Infrastructure/Link Technology:** A number of science and technology-driven applications that are helpful in daily life, such as Connected Ambulance (Emergency healthcare) and Community Clinic (Mass healthcare/treatment), will be connected by 5G technology.
- Fixed Wireless Access (FWA) for Broadband Access in Rural Areas
- Routers with high security
- Platform for AI-based Cyber Threat Detection
- IoT-based smart agriculture programmed utilizing HD cameras and drones
- More effective and efficient.
- Technology to facilitate subscriber supervision tools for the quick action.

Demerits of 5G-

- **Battery drain/heat-** Devices that run on the 5G network will give off a lot of heat and run down quickly. Heat is a byproduct of battery drain. However, there is a market opportunity here. Companies will be incentivized to create battery technology that can adequately cope or thrive using the 5G technology.
- **Cyber security Risk:** Another drawback of 5G technologies is it increases the risk of hacking thus impinging on cyber security. Moreover, lack of encryption during the

connection process also makes the devices using 5G technology an easier target for cyberattacks and data theft.

- **Weak Upload Speeds:** Experts believe that despite its ability to have faster download speeds, 5G technology will have less upload speed compared to 4G and 4G LTE. This is another drawback of 5G technology.
- **Coverage issues in Rural Areas-** As of now, 5G network is a dream come true for the urban areas. As per the speculations, carriers will deploy 5G towers in densely populated areas to provide impeccable data and voice services. In contrast, those dwelling in the rural areas will not likely have the benefits of 5G Network. At present, numerous remote areas lack access to any form of cellular connectivity whatsoever.
- **Broadcast Distance-** The 5G network is speculated to be effective in the populated areas only and the frequency waves can only transfer to a short distance. For example, Wi-Fi does not travel as far as 2.4 GHz WI-Fi, and 5G cellular will not be able to travel as far from the tower.

V. CONCLUSION-

Nowadays, Mobile has turned out to be a very important part of the everyone's life. In this paper we have discussed about 4g and 5g technologies and their advantages, disadvantages and the performance of different generations. This area still has a vast area of research opportunities. The arrival and implementation of 5G in the upcoming years will take the wireless and telecommunication to a completely newer level. It is going to provide various new features and services. All IP framework and high data rates have been the basic advancements in the newer mobile network generations.

FUTURE SCOPE- Probability to remove drawbacks of 5G:

5G network technology will reveal a new era in mobile communication technology. The 5G mobile phones will have access to different wireless technologies at the same time and the terminal should be able to combine different flows from different technologies In the upcoming, 5G

will offer higher qualities of services, lower latency, and higher bandwidth, which will help improve user experiences both in the consumer and business space. The speed and bandwidth improvement of 5G is likely to result in demands for more data and more content. This emerging technology promises faster speeds, lower latency and greater capacity. The potential of 5G is wide-ranging, enabling advances in health care, transportation, public safety and other areas. It also will impact sustainability across the internet of things (IoT) environment, in which devices are becoming increasingly interconnected.

eSIMs are the future of connectivity, and whether it is for calling and texting or global data, they have unparalleled power. Now that 5G is in the mix, the faster speeds will require an equally advanced cellular data platform to support it, which can be best delivered via eSIM programming.