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ELECTRICAL ELECTRONICS ENGINEERING

- **With the aid of a well labelled architectural diagram, provide detailed explain on the working principle of 3G, 4G and 5G networks**

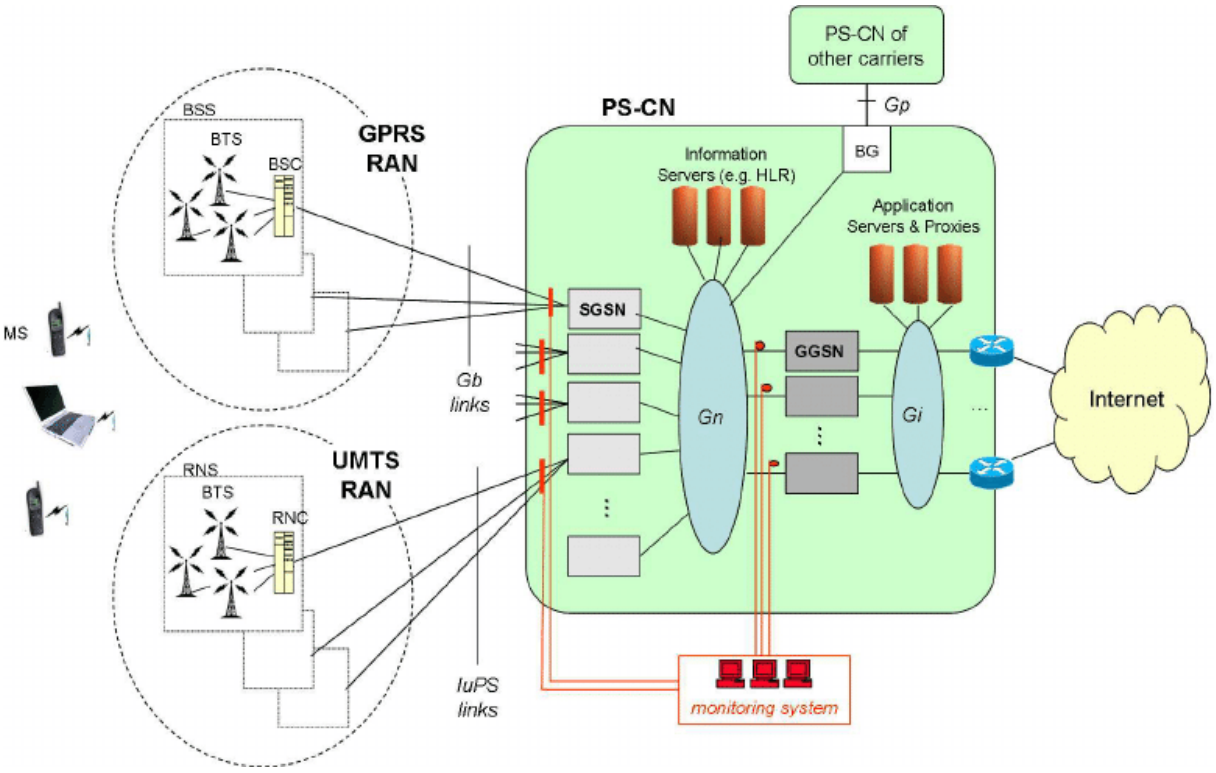
WHAT IS 3G?

If you want augmented bandwidth, multiple mobile applications and clarity of digital signals, then 3G (Third Generation Technology) is your gateway. GSM technology was able to transfer circuit switched data over the network. The use of 3G technology is also able to transmit packet switch data efficiently at better and increased bandwidth. 3G mobile technologies proffers more advanced services to mobile users. It can help many multimedia services to function. The spectral efficiency of 3G technology is better than 2G technologies. Spectral efficiency is the measurement of rate of information transfer over any communication system. 3G is also known as IMT-2000.

WORKING PRINCIPLE OF 3G

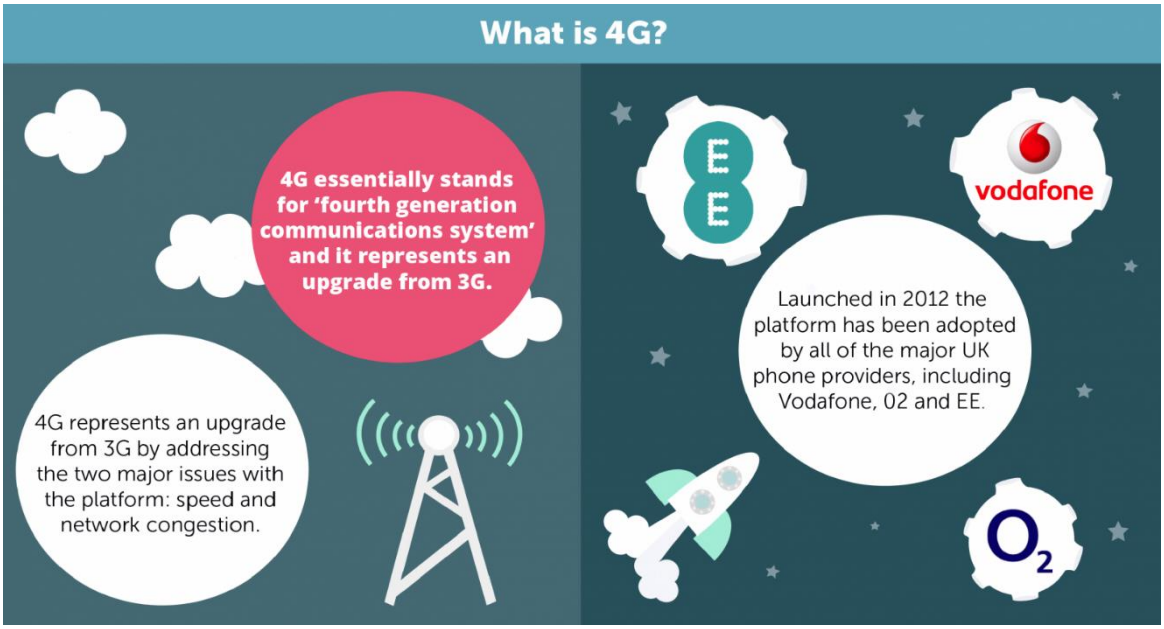
3G technologies make use of TDMA and CDMA. 3G (Third Generation Technology) technologies make use of value added services like mobile television, GPS (global positioning system) and video conferencing. The basic feature of 3G Technology (Third Generation Technology) is fast data transfer rates. However, this feature is not currently working properly because, ITU 200 is still making decision to fix the data rates. It is expected that 2mbit/sec for stationary users, while 348kbits when moving or traveling. ITU sell various frequency rates in order to make use of broadband technologies. Network authentication has won the trust of users, because the user can rely on its network as a reliable source of transferring data.3G technology is much flexible, because it is able to support the 5 major radio technologies. These radio technologies operate under CDMA, TDMA and FDMA.CDMA holds for IMT-DS (direct spread), IMT-MC (multi carrier). TDMA accounts for IMT-TC (time code), IMT-

SC (single carrier). FDMA has only one radio interface known as IMT-FC or frequency code. Third generation technology is really affordable due to the agreement of industry. This agreement took pace in order to increase its adoption by the users. 3G (Third Generation Technology) system is compatible to work with the 2G technologies. 3G (Third Generation Technology) technologies holds the vision that they should be expandable on demand. The aim of the 3G (Third Generation Technology) is to allow for more coverage and growth with minimum investment.



WHAT IS 4G?

4G essentially stands for 'fourth generation communications system' and it represents an upgrade from 3G by addressing the two major issues with the platform: speed and network congestion. Since it launched in late 2012, the platform has been adopted by all of the major UK phone providers, including Vodafone, 02 and EE.



WORKING PRINCIPLE OF 4G

4G works much in the same way as 3G, simply faster. Using high-speed download and upload packets, 4G allows you to access broadband style speeds whilst away from your Wi-Fi. Users can often access speeds of up to 21Mb on the go, but this is, however, affected by location. A larger city, for example, will exhibit faster speeds than a small village.

4G is essentially a highly advanced radio system. You may even have seen masts dotted around the landscape. These masts broadcast the signals necessary for 4G to work and the challenge is for engineers and coders is to cram as much data into these signals as possible. By extension, this means the network is faster and more efficient.

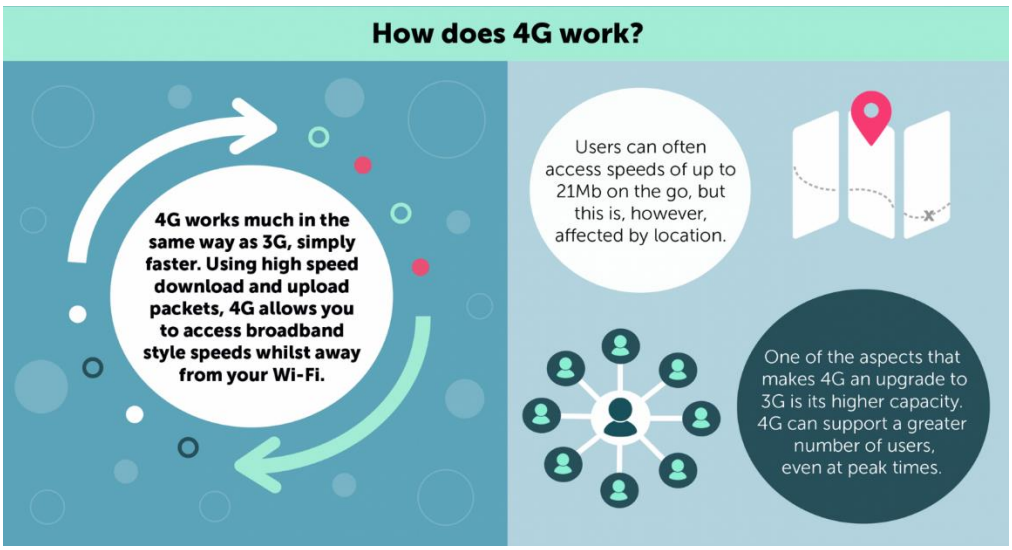
Like 3G, 4G is a protocol that sends and receives data in packets. However, 4G differs from 3G in how it works. 4G is entirely IP based, which means it uses internet protocols even for voice data. Conforming to this one standard means it is less likely for data to become scrambled while traversing the various networks, meaning a more seamless experience for us users!

Like all mobile broadband, 4G works through your device communicating with a base station. Base stations are technical speak for the masts that we've all seen popping up throughout the country. This mast relays data from your device to the internet and back again.

One of the aspects that makes 4G an upgrade to 3G is its higher capacity. 4G can support a greater number of users, even at peak times. For example, a 3G tower may only be able to give 100 people the best possible connection speed, but a 4G tower can theoretically give 400 people the best service.

4G also features reduced latency, which if you're a mobile gamer is essential. With reduced latency, you'll see a much quicker response to your commands. So for gamers, if they are playing a fighting game, for example, this can mean the difference between winning and losing.

Once 4G infrastructures become more common, users will see more seamless streaming on the move from services like YouTube, better video calls and even better battery life. At the moment 4G signals are rarer outside of big cities, so phones expend a lot of energy looking around for a 4G signal.



WHAT IS 5G?

5G, set launch in 2020, is wireless broadband that represents the fifth generation of mobile cellular networks and promises speeds 10 to 20 times faster than today's 4G cellular networks. Based

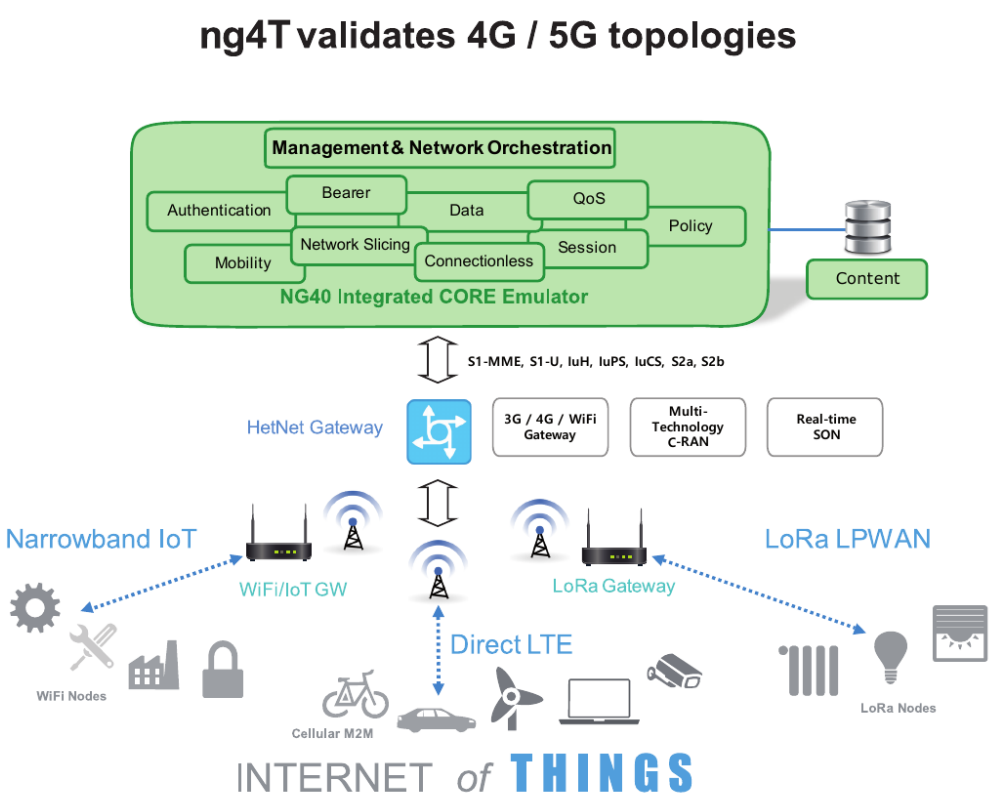
on 802.11ac standard 5G is actually an umbrella term, according to Ivan Seskar, co-chair of the IEEE 5G Initiative Testbed Working Group and IEEE Senior Member, that represents a multitude of technologies like millimetre waves, beamforming, small cells, massive MIMO and full duplex**.**

WORKING PRINCIPLE OF 5G

Tim Sherwood, VP of Mobile Strategy at Pune, India-based Tata Communications, explained the concept further:

“5th generation wireless systems are enhanced networks that will provide greater speed, lower latency and the ability to connect several devices at once. It will dramatically increase the speed at which data is transferred across the network. 5G will make it easier for people to download and upload video and support thousands of internet-connected devices,” he said. CMS Wire also spoke to Jason Elliott, 5G Market Development Manager at Espoo, Finland-based Nokia, to get his take on 5G. According to Elliott, 5G is going to be a huge technological shifts that will drive fundamental changes in our communications infrastructure “It’s so much more than just faster internet — it will be a transformative experience. Today, we may be at the beginning of a change that is more far-reaching than the launch a decade ago of the iPhone, which started a revolution in the mobile handset market, as well as changing the lives of consumers and the business models of many industries."

As for how 5G will work, WIRED reported that 5G networks will operate in a high-frequency band of the wireless spectrum, most likely between 30 GHz and 300 GHz, in what's known as the millimetre wave spectrum — which is something we’ll touch on later in this article.



- **Outline the advantage and disadvantages of 3G, 4G and 5G**

Advantages OF 3G Network

1. The customers will get a high-speed network for their communication which is far better than the 2G technology, particularly in data communication.
2. The customer will get wireless broadband.
3. Customers can see video or satellite based programs like TV programs using this technology.
4. Customers can use all the facilities at the same time.
5. It may also be cheap than the other traditional media we are using, as a result of a price war.

Disadvantages OF 3G Network

1. Since in telecom sector, there is much competition, so the companies have a very marginal price for their facilities.

2. The companies, who will not get a license from the spectrum distribution authorities will suffer to use only 2G, which will badly affect their business. In this situation, these companies will either disappear from this sector or will run with losses. Because of the customers will start to use the services of the companies having the 3G technology.
3. Due to the use of the DTH & the 3G technology, everyone will use this multi-purpose services to avoid time loss and keeping records for different service providers. So, the traditional cable business will be badly affected by implementing this new technology.
4. The radiation of magnetic waves generated with the heavily use of the wireless system will affect our life also. More uses of the services will have more effect on us. The radiation of the magnetic waves is danger for our life. Long use can affect our brains.
5. The mobiles are not suitable devices to see TV or web browsing. So, initially this service may be used in mass but in future, mobile cannot be used to see the TV or for Internet surfing. Which will affect the business of the 3G.

4G Technology advantages

1. 4G wireless network is a pure data connection, it is an end-to-end Internet Protocol connection, the cellular providers have the opportunity to offer the data access to a wide variety of devices, 4G technology provides mobility, it is more flexible, it is more reliable, it is easier to standardize and it offers affordability.
2. You can easily access Internet, IM, Social Networks, streaming media, video calling and the other broadband services, it is very stable when connected to the internet without any disruption & it doesn't throttle.
3. WiMAX, LTE, and HSPA+ are all versions of 4G, WiMAX is used by Sprint, LTE is used by Verizon and AT&T, HSPA+ is used by AT&T and T-Mobile, 4G LTE network supports the global access,

the service portability & scalable mobile services, it supports IP based mobile System-High speed, high capacity & low cost per bit.

4. 4G LTE network is very fast & 10 times faster than the 3G network, It offers extremely high voice quality, It is very fast when downloading huge files over a wireless network, It very good & clear when streaming videos, watching online videos, playing online music, watching online TV & the others streaming stuffs.

4G Technology disadvantages

1. Obtaining the information from the people illegally becomes easier, 4G technology involves the possibility of some interference though not much, it is capable of being attacked (jamming frequencies) and the invasion of the privacy increased.
2. The consumer is forced to buy a new device to support the 4G, New frequencies means new components in the cell towers, Higher data prices for the consumers, your current equipment cannot be compatible with the 4G network, it has different network bands for different phones It is expensive & hard to implement.
3. 4G LTE network has higher data prices for the consumers (expensive), The consumers are forced to buy a new device to support 4G LTE, it consumes a lot of battery when in use, it consumes the data very fast & your battery becomes hot when it is used for a very long time (like a microwave).
4. 4G LTE network needs complex hardware, 4G technology is still limited to certain specified carriers & regions but the number of cities which have 4G coverage is increasing by the day, it would take its own time for this network to be available in all the major cities of the world.

Advantages OF 5G

1. High resolution and bi-directional large bandwidth shaping.
2. Technology to gather all networks on one platform.
3. More effective and efficient.
4. Technology to facilitate subscriber supervision tools for the quick action.
5. Most likely, will provide a huge broadcasting data (in Gigabit), which will support more than 60,000 connections.

Disadvantages of 5G

1. Many of the old devices would not be competent to 5G, hence, all of them need to be replaced with new one — expensive deal.
2. Developing infrastructure needs high cost.
3. Security and privacy issue yet to be solved.
4. Technology is still under process and research on its viability is going on.
5. The speed, this technology is claiming seems difficult to achieve (in future, it might be) because of the incompetent technological support in most parts of the world.

- **In tabular form, establish adequate differences between 2G, 3G, 4G and 5G**

Table 1: Comparison of *1G-4G* Technologies

Technology / Features	1G	2G/2.5G	3G	4G	5G
Start/ Deployment	1970/ 1984	1980/ 1999	1990/ 2002	2000/ 2010	2010/ 2015
Data Bandwidth	2 kbps	14.4-64 kbps	2 Mbps	200 Mbps to 1 Gbps for low mobility	1 Gbps and higher
Standards	AMPS	2G: TDMA, CDMA, GSM 2.5G: GPRS, EDGE, 1xRTT	WCDMA, CDMA-2000	Single unified standard	Single unified standard
Technology	Analog cellular technology	Digital cellular technology	Broad bandwidth CDMA, IP technology	Unified IP and seamless combination of broadband, LAN/WAN/ PAN and WLAN	Unified IP and seamless combination of broadband, LAN/WAN/PAN /WLAN and wwww
Service	Mobile telephony (voice)	2G: Digital voice, short messaging 2.5G: Higher capacity packetized data	Integrated high quality audio, video and data	Dynamic information access, wearable devices	Dynamic information access, wearable devices with AI capabilities
Multiplexing	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	Circuit	2G: Circuit 2.5G: Circuit for access network & air interface; Packet for core network and data	Packet except circuit for air interface	All packet	All packet
Core Network	PSTN	PSTN	Packet network	Internet	Internet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal and Vertical	Horizontal and Vertical

- **Is there any correlation between 5G and Corona virus?**

This is incorrect, the new coronavirus is a virus and there is no evidence that 5G is harmful to people's health.

- **Do you support the state, if yes or No, in not more than 500 words Justify your answer**

5G is the next generation of wireless network technology, following on from 4G. Like 4G, 3G and 2G before it, 5G mobile data is transmitted over radio waves—a small part of the whole electromagnetic spectrum (which includes microwaves, visible light and X-rays). These radio waves are non-ionising, meaning they don't damage the DNA inside cells.

Public Health England has said that there's no "convincing evidence" that exposure below the International Commission on Non-Ionizing Radiation guidelines can cause adverse health effects. These guidelines go up to 300GHz, whereas the maximum for 5G will probably only be in the tens of GHz.

As 'evidence' that the new coronavirus is a cover-up for 5G, the post shows a screenshot of a Google search result for "symptoms of 5g exposure." While the image seems to be a genuine screenshot of what comes up when you search this phrase online, the displayed in the Google result is not from an official source and seems to be written to sell a number of products.

And regardless, the claimed symptoms of 5G exposure shown don't match the symptoms of the new coronavirus. The post claims that symptoms of 5G exposure include nausea, hair loss and bone marrow damage but the symptoms of Covid-19 include fever and coughing. Other symptoms include shortness of breath, aches and pains, nasal congestion, runny nose, sore throat or diarrhoea.

The post goes on to say that China was the first place to have over 100,000 5G towers and people in Wuhan were the first to contract the new coronavirus.

It's true to say China has over 100,000 5G towers. As of April 2019, China had a reported 1.9 million transmitter sites. However, it's unclear whether China was the first country to reach this 100,000 figure. South Korea was reportedly the first country to commercially launch 5G services.

The post also says that Bill Gates has created the new coronavirus to control the world and is creating a vaccine for it. This is incorrect. The claim may refer to a patent application for a different

coronavirus filed by the Pirbright Institute, which receives funding from the Bill and Melinda Gates Foundation, although not for this patented work.