15/ENG04/002

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1 (i) **3G**

UMTS (Universal Mobile Telecommunications System)- UMTS, short for Universal Mobile Telecommunications System, is a 3G networking standard used throughout much of the world as an upgrade to existing GSM module.

1. UMTS makes use of WCDMA, a technology that shares much with CDMA networks used throughout the world, though it is not compatible with them.
2. Base level UMTS networks are generally capable of downlink speeds as 384 kbps.
3. The UMTS architecture takes advantage of the existing GSM and GPRS networks which serve as a core network in UMTS infrastructure.

The UMTS is made up of 3 main components: a) User Equipment:

It is assigned to a single user and contains all the functions needed to access UMTS services. It contains: – Mobile Equipment (ME) : It is a radio terminal which is used to connect the UMTS subscriber with the fixed part of UMTS system via the radio interface Uu.

– UMTS Subscriber Identity Module (USIM): A smartcard which contains the subscriber identity, authentication algorithms, encryption keys etc.

b) UMTS Terrestrial Radio Access Network (UTRAN):

It handles cell-level mobility. It is a system of base station and controller handling function related to mobility. It contains:

1. Nodes B (Base Stations):

• It converts the data between Uu radio interface and the Iub interface connecting a Node B with the RNC. • It performs physical level processing such as channel coding, data interleaving, rate matching, modulation etc.

2. Radio Network Controllers (RNC):

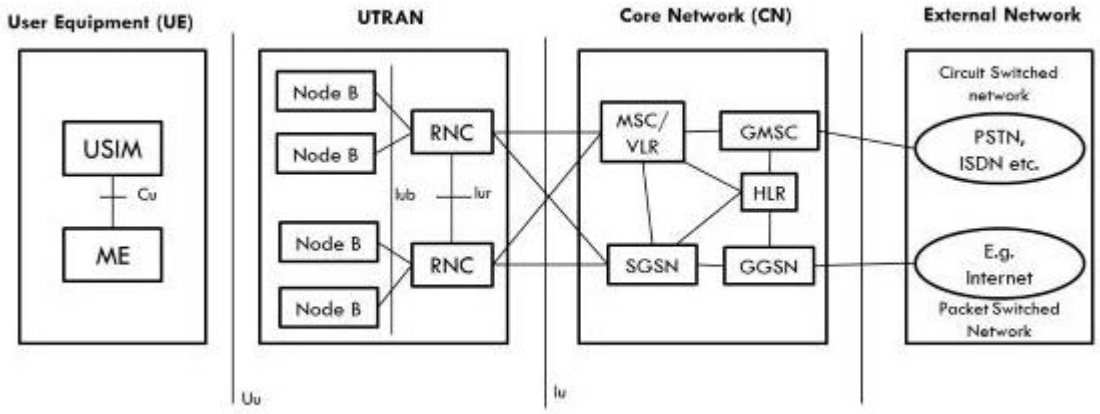
• RNC's controls and manages radio resources to Node B. • RNC performs the data-link layer processing and participates in handover operations. • RNC is considered a single access point of UTRAN for the core network. • It's connected to a single MSC/VLR to route circuit-switched traffic and to a single SGSN to route packet switched traffic.

c) Core Network (CN):

The core network is shared with GSM and GPRS. The CN contains functions for intersystem handover, gateways to other networks and performs location management. It contains:

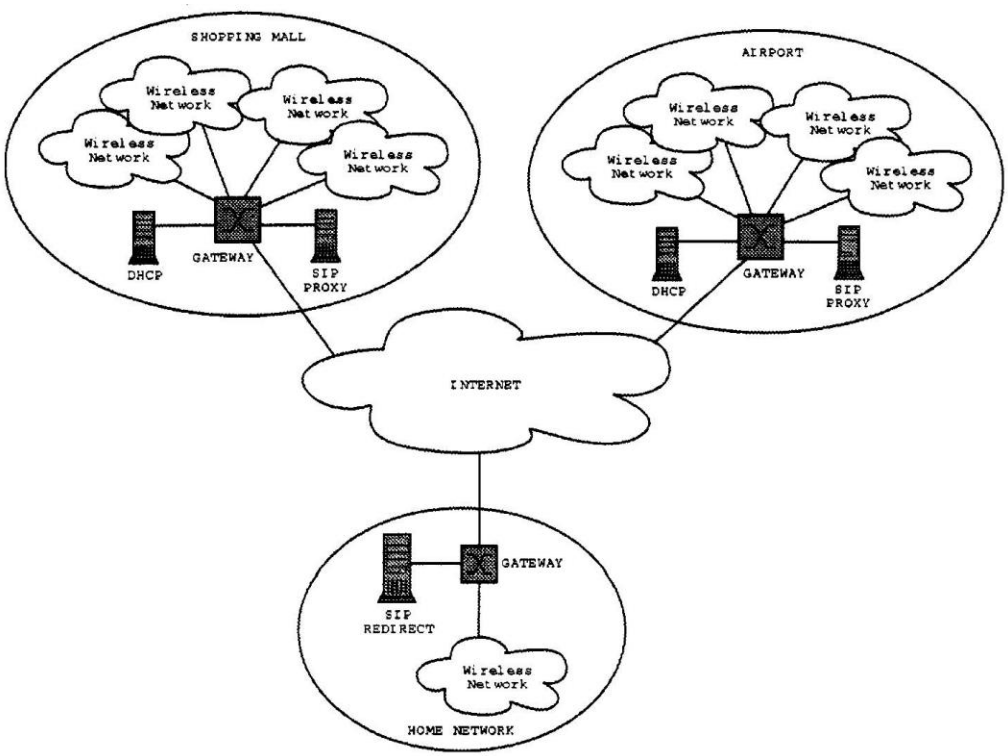
1. Home Location Register (HLR)

2. Mobile Station Controller / Visitor Location Register (MSC/VLR).
3. Gateway MSC: Connect UMTS to external circuit switch n/w (e.g PSTN)
4. Serving GPRS Support Node (SGSN): It serves the Packet-switched traffic.
5. Gateway GPRS Support Node (GGSN): Connects UMTS to external packet switched. (e.g. Internet)



4G

The fourth generation (4G) of mobile networks offer mobile services based on high-speed wireless connections, IP mobility, intelligent terminals, and World Wide Web type services. 4G operators are the most likely service and content providers to use different kinds of radio access technologies. Radio access can be based on private corporate LANs, public wireless LANs or mobile LANs installed on trains, airplanes, and so on. Handhelds, laptops, and mobile phones will be used to access the Internet and local services. **4G location area (4GLA)** diameter can be from 100m to 1 kilometer. The figure below presents the 4G-network architecture. The idea is to use Session Initiation Protocol (SIP). Every home location area contains a SIP redirect server, which is responsible for maintaining the current location of users. The home SIP redirect server is analogous to HLR in GSM network architecture. When a call is made, the home SIP redirect server returns the current address of called party. The SIP client of the caller then makes another call to this particular address (or addresses - SIP redirect server can return several addresses).



Every location area where visitors are allowed, contain a visitor SIP proxy (Outbound proxy), which is analogous to VLR in GSM network. Every visitor in a foreign network registers with the home SIP redirect server if they want to be reachable. This registration can be done in several ways as described in. We propose that only Outbound proxy intercept and User-initiated proxy registrations are used. Both these registration methods use Outbound proxy to forward SIP registration messages. In the case of Outbound proxy intercept, terminals send registration messages to their home network, but Outbound proxy intercepts these messages and changes the visitor address to point itself. In the case of the User-initiated proxy registration, the terminal recognizes it is visiting a foreign network and sends registration messages to the Outbound proxy that then forwards the messages to the terminal's home network. Thus, all incalls and outcalls involving a visiting user travel through the outbound SIP proxy.

The use of Outbound proxy for all registrations allows network operators to collect statistics and possible billing information and also to reduce the number of SIP registrations. In this way, several location areas can be combined to one **4G service area (4GSA)**. By using hierarchical registration, the home location area SIP redirect server is updated only when a terminal moves from one service area to another. SIP redirect server redirects SIP calls to the Outbound proxy that forwards calls to the terminal in its current location in the visited network. With SIP, users can be reached globally. The same effect could be achieved using Mobile IP, but the triangle routing creates problems. The data transferred from a server to the user's terminal is routed via a home agent, which is a non-optimal situation. The usage of SIP enables direct point-to-point data transfer.

5G

Most operators will initially integrate 5G networks with existing 4G networks to provide a continuous connection. A mobile network has two main components, the 'Radio Access Network' and the 'Core Network'.

The Radio Access Network – consists of various types of facilities including small cells, towers, masts and dedicated in-building and home systems that connect mobile users and wireless devices to the main core network.

Small cells will be a major feature of 5G networks particularly at the new millimetre wave (mmWave) frequencies where the connection range is very short. To provide a continuous connection, small cells will be distributed in clusters depending on where users require connection which will complement the macro network that provides wide-area coverage.

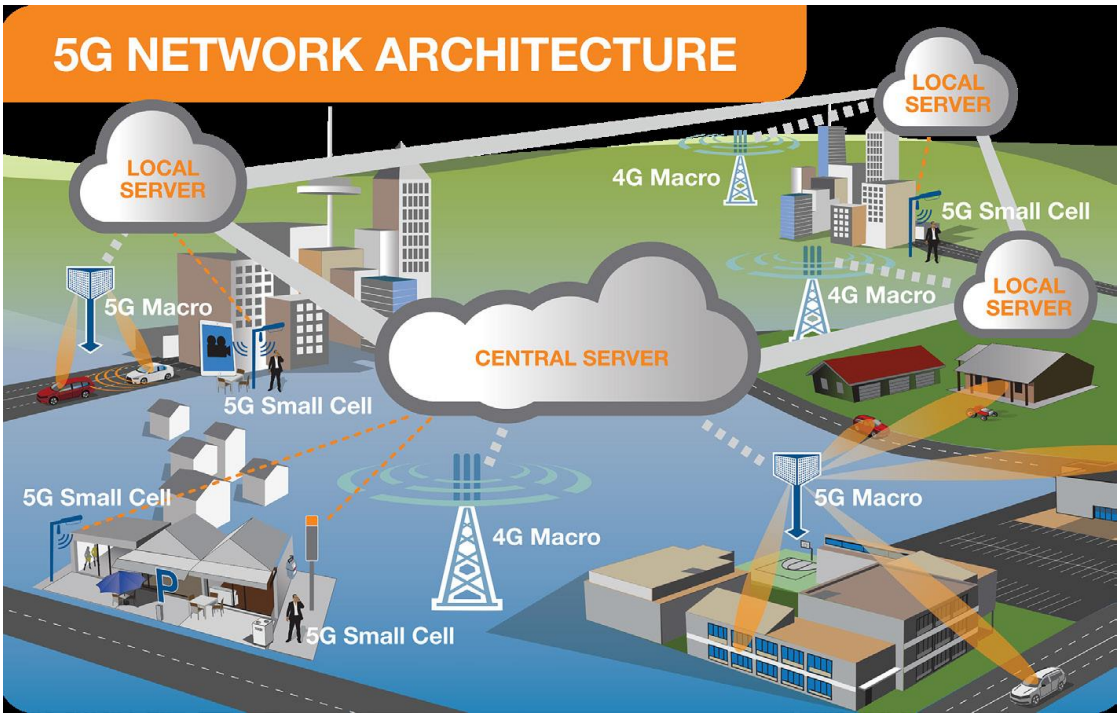
5G Macro Cells will use MIMO (multiple input, multiple output) antennas that have multiple elements or connections to send and receive more data simultaneously. The benefit to users is that more people can simultaneously connect to the network and maintain high throughput. Where MIMO antennas use very large numbers of antenna elements they are often referred to as 'massive MIMO', however, the physical size is similar to existing 3G and 4G base station antennas.

The Core Network – is the mobile exchange and data network that manages all of the mobile voice, data and internet connections. For 5G, the 'core network' is being redesigned to better integrate with the internet and cloud based services and also includes distributed servers across the network improving response times (reducing latency).

Many of the advanced features of 5G including network function virtualization and network slicing for different applications and services, will be managed in the core.

Network Slicing – enables a smart way to segment the network for a particular industry, business or application. For example emergency services could operate on a network slice independently from other users.

Network Function Virtualization (NVF) – is the ability to instantiate network functions in real time at any desired location within the operator's cloud platform. Network functions that used to run on dedicated hardware for example a firewall and encryption at business premises can now operate on software on a virtual machine. NVF is crucial to enable the speed efficiency and agility to support new business applications and is an important technology for a 5G ready core.



(ii) **Advantages of 3G**

- Faster data rates.
- Support multimedia applications such as video and photography.
- Value added services like mobile television, GPS, video call and video conference.
- High speed mobile internet access.
- Increased capacity.

Disadvantages of 3G

- Requires 3G compatible handsets.
- The cost of upgrading to 3G device is expensive.
- Power consumption is high.
- 3G requires closer base stations which is expensive.

Advantages of 4G

- Quickly download files over a wireless network
- Extremely high voice quality
- Easily access Internet, IM, social networks, streaming media, video calling

- Higher bandwidth
- 4G is 10 times faster than 3G

Disadvantages of 4G

- New frequencies means new components in cell towers.
- Higher data prices for consumers
- Consumer is forced to buy a new device to support the 4G
- It is impossible to make your current equipment compatible with the 4G network

Advantages of 5G

- High resolution and bi-directional large bandwidth shaping.
- Technology to gather all networks on one platform.
- More effective and efficient.
- Technology to facilitate subscriber supervision tools for the quick action.

Disadvantages of 5G

- The risk of overcrowding the frequency range of the 5G wireless spectrum is greater as more devices are connected to one channel.
- 5G network Technology will take more time for security and privacy issues.
- Coverage indoor distance up to 2 meters and 300 meters outdoors can be achieved due to greater losses at higher frequencies as 5Gmm wave influences from such losses (rain losses, attenuation due to rain, etc.).
- 5G is more costly compared to other Mobile Network Technology because many technical/ official engineers are required to install and maintain it.

2)

	2G	3G	4G	5G
Year introduced	1993	2001	2009	2018
Technology	GSM	WCDMA	LTE,WiMAX	MIMO, mm Waves
Access System	TDMA, CDMA	CDMA	CDMA	OFDM, BDMA

Switching type	Circuit switching for voice and packet switching for data	Packet switching except for air interference	Packet switching	Packet switching
Internet service	Narrowband	Broadband	Ultra broadband	Wireless World Wide Web
Bandwidth	25MHz	25MHz	100MHz	30GHz to 300GHz
Applications	Voice calls, short messages	Video conferencing, mobile TV, GPS	High speed applications, mobile TV, wearable devices	High resolution video streaming, remote control of vehicles, robots, and medical procedures

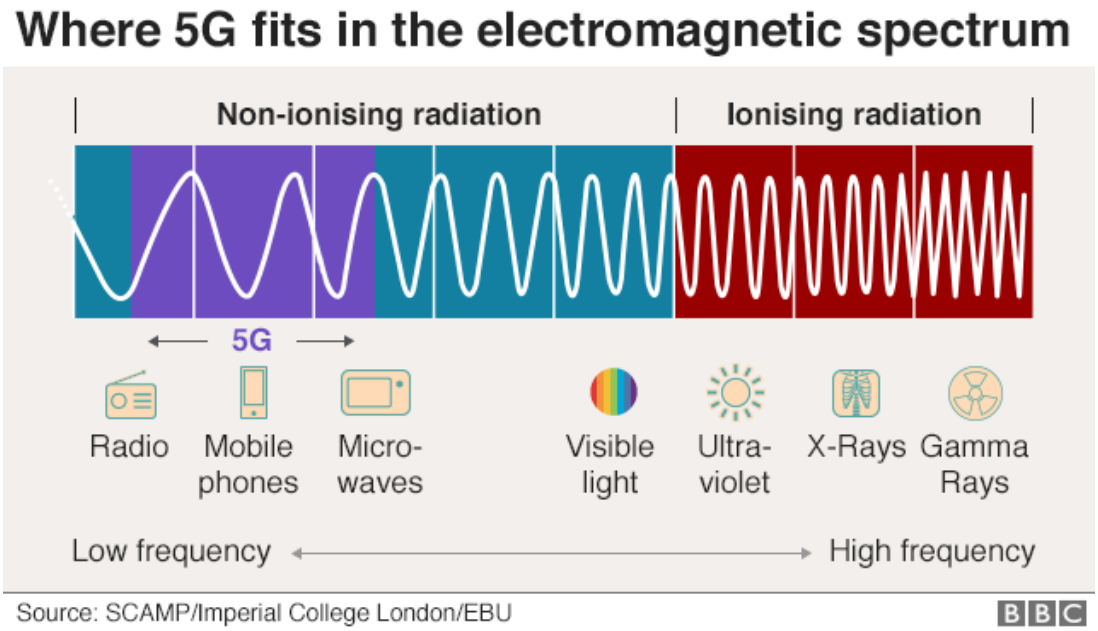
3(i) No, there is no correlation between 5G and corona virus.

(ii) The theories going around appear to fall broadly into two camps:

- One claims 5G can suppress the immune system, thus making people more susceptible to catching the virus.
- The other suggests the virus can somehow be transmitted through the use of 5G technology.

Dr Simon Clarke, an associate professor in cellular microbiology at the University of Reading, says both these notions are “complete rubbish”.

He said, “Radio waves can disrupt your physiology as they heat you up, meaning your immune system can't function. But [the energy levels from] 5G radio waves are tiny and they are nowhere near strong enough to affect the immune system. There have been lots of studies on this.”



The radio waves involved in 5G and other mobile phone technology sit on the low frequency end of the electromagnetic spectrum. Less powerful than visible light, they are not strong enough to damage cells - unlike radiation at the higher frequency end of the spectrum which includes the sun's rays and medical x-rays.

It would also be impossible for 5G to transmit the virus, Adam Finn, professor of paediatrics at the University of Bristol, adds.

"The present epidemic is caused by a virus that is passed from one infected person to another. We know this is true. We even have the virus growing in our lab, obtained from a person with the illness. Viruses and electromagnetic waves that make mobile phones and internet connections work are different things. As different as chalk and cheese," he says.

It's also important to note another major flaw with the conspiracy theories - coronavirus is spreading in UK cities where 5G has yet to be deployed, and in countries like Iran that have yet to roll out the technology.