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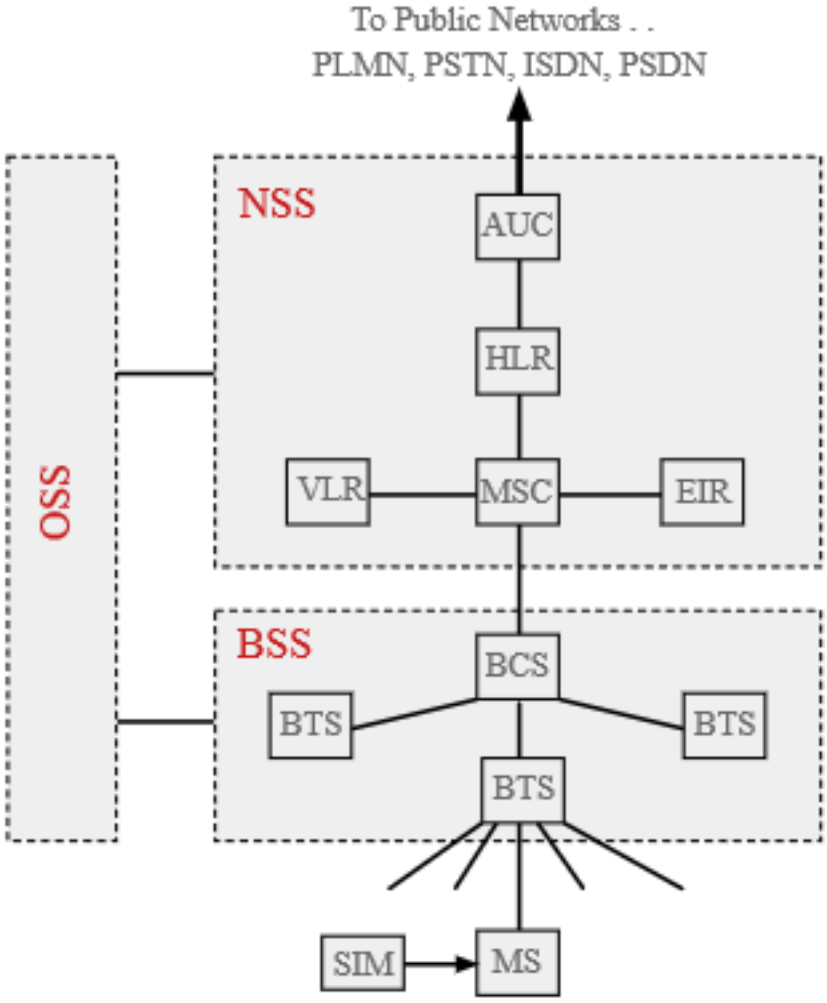
15/ENG04/058

1(i) <u>Working principle of 3G:</u>

3G simply stands for “third generation.” It surpasses previous generations it is generally intended for multimedia; cellphones i.e. 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.

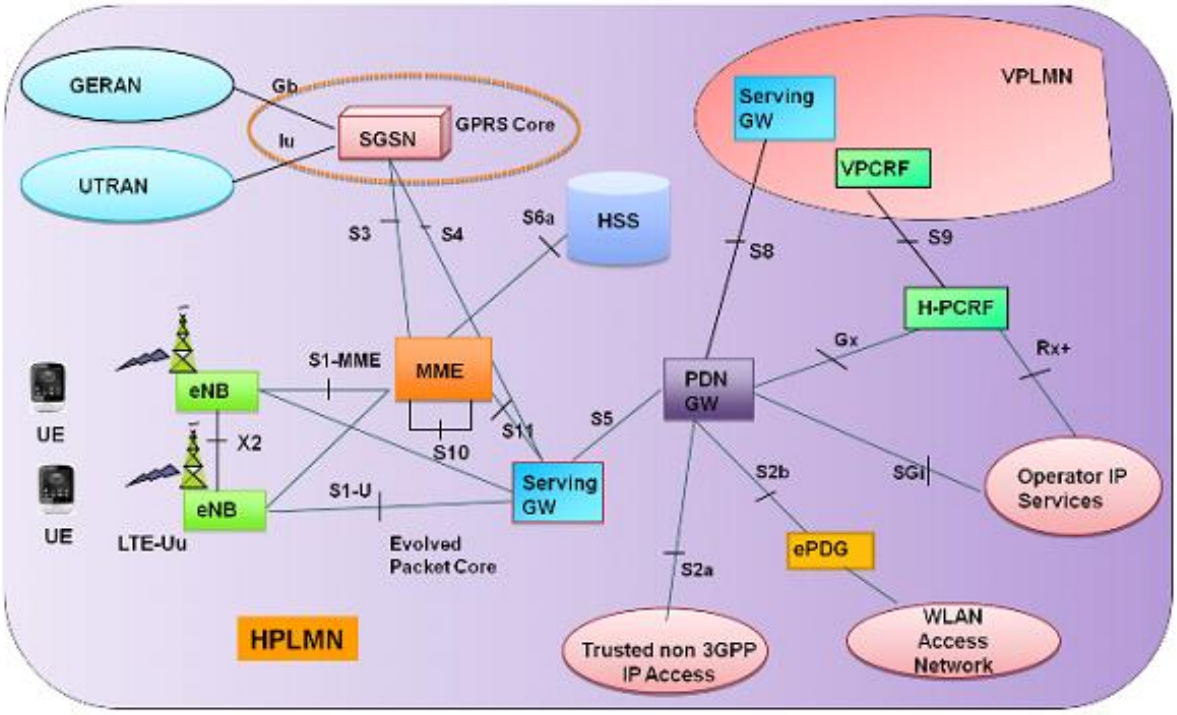
3G technologies make use of TDMA and CDMA. 3G (Third Generation Technology) technologies make use of value added services like mobile television, GPS (global positioning system) and video conferencing. The basic feature of 3G Technology (Third Generation Technology) is fast data transfer rates. However, 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.

3G technology is much flexible, because it can 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 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 ARCHITECTUAL DIAGRAM

Working principle of LTE or 4G:



4G Architectural diagram

4G is a standard for wireless data communications technology and an evolution of the GSM/UMTS standard. Basically, the LTE standard only supports packet switching with its all-IP network. The reason why LTE is designed only for packet switching is because it aims to provide seamless Internet Protocol (IP) connectivity between user equipment (UE) and the packet data network (PDN), without any disruption to the end users' applications during mobility. Due to this characteristic, voice calls and text message natively (which are typically handled by circuit-switched networks like GSM and CDMA). In LTE architecture, Evolved UTRAN (E-UTRAN) is an important role which is the air interface of LTE upgrade path for mobile networks meanwhile it is accompanied by an evolution of the non-radio aspects under the term "System Architecture Evolution" (SAE), which includes the Evolved Packet Core (EPC) network. Together LTE and SAE comprise the Evolved Packet System (EPS). Besides that, LTE network uses an eNodeB (evolved node B, essentially an LTE base station), a MME (Mobile management entity), a HSS (home subscriber server), a SGW (serving gateway), and a PGW (a packet data network gateway). These are considered as part of the EPC except eNodeB.

First, let us look into EPS in detail, the following figure showing those elements in EPS network. In LTE, main function of EPS is to provide the user with IP connectivity to a PDN for accessing the Internet, as well as for running service such as Voice over IP (VoIP). An EPS bearer is

typically associated with a QoS. Multiple bearers can be established for a user in order to provide different Qos streams or connectivity to different PDNs. Figure above shows the overall network architecture, including the network elements and the standardized interfaces. At a high level, the network is comprised of the CN (EPC) and the access network E-UTRAN. While the CN consists of many logical nodes, the access network is made up of essentially just one node, the evolved NodeB (eNodeB), which connects to the UEs. Each of these network elements is interconnected by means of interfaces that are standardized in order to allow multi-vendor interoperability. This gives network operators the possibility to source different network elements from different vendors. In fact, network operators may choose in their physical implementations to split or merge these logical network elements depending on commercial considerations.

The core network (called EPC in SAE) is responsible for the overall control of the UE and establishment of the bearers.

The main logical nodes of the EPC are:

• PDN Gateway (P-GW)

• Serving Gateway (S-GW)

• Mobility Management Entity (MME)

In addition to these nodes, EPC also includes other logical nodes and functions such as the Home Subscriber Server (HSS) and the Policy Control and Charging Rules Function (PCRF). HSS which contains users' SAE subscription data such as the EPS-subscribed QoS profile and holds those information about the PDNs to which the user can connect, while PCRF is responsible for policy control decision-making, as well as for controlling the flow-based charging functionalities in the Policy Control Enforcement Function (PCEF), which resides in the P-GW. From the figure above, MME which is the control node that processes the signaling between the UE and the CN. The protocols running between the UE and the CN are known as the Non Access Stratum (NAS) protocols.

The main functions supported by the MME can be classified as:

• Functions related to bearer management – This includes the establishment, maintenance and release of the bearers and is handled by the session management layer in the NAS protocol.

• Functions related to connection management – This includes the establishment of the connection and security between the network and UE and is handled by the connection or mobility management layer in the NAS protocol layer.

The access network of LTE, E-UTRAN, simply consists of a network of eNodeBs.For normal user traffic (as opposed to broadcast), there is no centralized controller in E-UTRAN; hence the E-UTRAN architecture is said to be flat. The eNodeBs are normally interconnected with each other by means of an

interface known as "X2" and to the EPC by means of the S1 interface — more specifically, to the MME by means of the S1-MME interface and to the S-GW by means of the S1-U interface. The

protocols that run between the eNodeBs and the UE are known as the “AS protocols"
The E-UTRAN is responsible for all radio-related functions, which can be summarized briefly as:
• Radio resource management (RRM) – This covers all functions related to the radio bearers, such; as radio bearer control, radio admission control, radio mobility control, scheduling and dynamic allocation of resources to UEs in both uplink and downlink.
• Header Compression – This helps to ensure efficient use of the radio interface by compressing the IP packet headers that could otherwise represent a significant overhead, especially for small packets such as VoIP.
• Security – All data sent over the radio interface is encrypted.
• Connectivity to the EPC – This consists of the signaling toward MME and the bearer path toward the S-GW.

Working principle of 5G:

This is the 5th generation of mobile wireless systems. It integrates perfectly with the internet of things like other cellular networks, 5g uses 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 it is wired or wireless connection. It uses a type of encoding called OFDM, which is similar to the encoding 4gLTE uses.

1(ii). Advantages of 3G, 4G and 5G.

3G ADVANTAGES

a. Overcrowding is relieved in existing systems with radio spectrum
b. Bandwidth, security and reliability are more
c. Provides interoperability among service providers
d. Availability of fixed and variable rates
e. Support to devices with backward compatibility with existing networks
f. Always online devices – 3G uses IP connectivity which is packet based
g. Rich multi media services are available

3G DISADVANTAGES

a. The cost of cellular infrastructure , upgrading base stations is very high
b. Needs different handsets.
c. Roaming and data/voice work together has not yet been implemented
d. Power consumption is high
e. Requires closer base stations and are expensive

f. Spectrum-license costs, network deployment costs and handset subsidies subscribers are tremendous.

4G ADVANTAGES

a. Quickly download files over a wireless network
b. Extremely high voice quality
c. Easily access Internet, IM, social networks, streaming media, video calling
d. Higher bandwidth
e. 4G is 10 times faster than 3G

4G DISADVANTAGES

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

5G ADVANTAGES

a. High resolution and bi-directional large bandwidth shaping.
b. Technology to gather all networks on one platform.
c. More effective and efficient.
d. Technology to facilitate subscriber supervision tools for the quick action.
e. Most likely, will provide a huge broadcasting data (in Gigabit), which will support more than 60,000 connections.
f. Easily manageable with the previous generations.
g. Technological sound to support heterogeneous services (including private network).
h. Possible to provide uniform, uninterrupted, and consistent connectivity across the world.

5G DISADVANTAGES

a. Technology is still under process and research on its viability is going on.
b. 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.
c. Many of the old devices would not be competent to 5G, hence, all of them need to be replaced with new one — expensive deal.
d. Developing infrastructure needs high cost.
e. Security and privacy issue yet to be solved.

2. Differences between 3G, 4G and 5G

FEATURE	2G	3G	4G	5G
Core network	PSTN	Packet network	Internet	Internet
Web standard	www	www (IPv4)	www (IPv4)	Wwww (IPv6)
Frequency	1.8 GHz	1.6 – 2 GHz	2 – 8 GHz	3 – 30 GHz
Bandwidth	14.4-64 kbps	2 Mbps	200Mbos-1Gbps	1Gbps and above
Handoff	Horizontal	Horizontal	Horizontal& vertical	Horizontal& vertical

3. THERE IS NO CORREATION BETWEEN CORONAVIRUS AND 5G

Although the timing of the pandemic and 5G global developments aided in the campaign of this absurd belief. There's no proof, scientific, biological or logical explanation that the two are in anyway related. COVID19 is biologically created by the evolution of nature's viruses, not by a reaction to radio waves. exposure to high wavelength radio waves are known to either destroy or mutate body cells, tissue. They do not create viruses.

The fact that this theory of '5G causing the pandemic' was widely believed by Nigerians and the rest of the world; goes to show the high level of nefarious online activity, illiteracy and ignorance we face alongside the global pandemic.