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1. i. **3G Architecture**

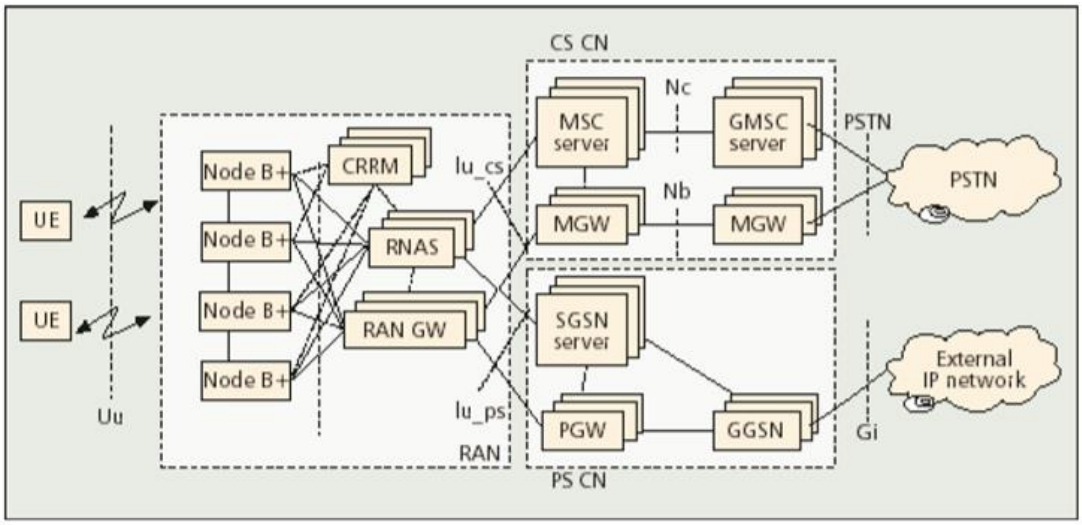

Figure 1 : 3G Architecture

The Core Network (CN) is the part of the 3G (UMTS) network that provides services to final users; it can be connected to different types of networks supporting different communication protocols. The CN is composed of the Circuit Switched CN (CS CN) and a Packet Switched CN (PS CN).In the CS CN, the Mobile services Switching Centre (MSC) switches the CS transactions and manages the user mobility. It is interconnected to external networks (like the PSTN networks as shown in fig1 above) through the Gateway MSC (GMSC). The MSC is subdivided into MSC server and Media GateWay (MGW), where all user data are managed. A MSC server can manage more MGWs, allowing a higher network scalability when new implemented services increase data flow. When this happens, it is sufficient to increment the MGWs number.

The PS CN is composed by two elements: the Serving GPRS Support Node (SGSN), that manages the different sessions (including various QoS requirements) and mobility, and the Gateway GPRS Support Node (GGSN) that performs the QoS mapping among different networks, the packet filtering and the connection with other packet switching external networks (such as Internet). The streaming server providing multimedia services can reside either in the external packet data network, or just before the GGSN. The PS CN is connected to the Radio Access Network (RAN) through the RAN GateWays (RAN GW) and the RAN Access Server (RNAS). The RAN GW is a routing point for the user traffic between CN and UTRAN. All radio resource management functionality is pooled in the Common Radio Resource Manager (CRRM).

It is therefore possible to provide the radio resource management network-wide to all radio technologies, which allows an efficient utilization optimization. The RNAS main task is to provide an interface to the CN.

RAN GWs and RNAS form the Radio Network Controller (RNC). Each SGSN can manage hundreds of RNCs. All processing related to the radio interface of the RNC is relocated into the Node B+, whose main functions are : macro diversity control, handover related functions, power control and frame scheduling. Data are provided to the User Equipment (UE), which is the radio terminal utilized by the user to exploit the UMTS network services.

4G Architecture

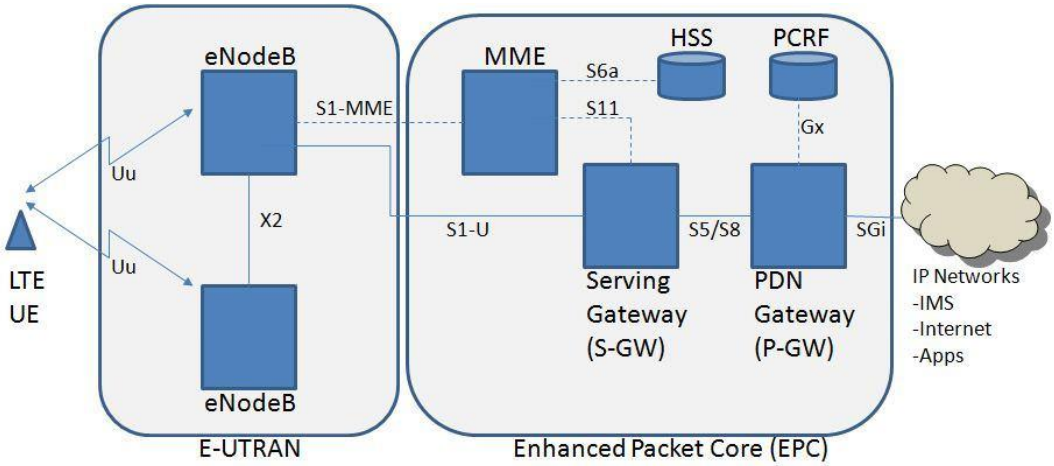

Figure 2 : 4G Architecture

The 4G Architecture offers many advantages compared to 2G and 3G architectures such as new routing techniques , efficient solutions for sharing dedicated frequency band, increases mobility and bandwidth capacity. This requirement are achieved by means of several EPS network elements that have different roles. The 4G network architecture consists of the following elements:

a) **Mobility Management Entity (MME**)
It is used for paging ,authentication, handover and selection of serving gateway.

b) SGW- Serving gateway
It is used to routing and forwarding user data packet.

c) PDN-GW Packet Data Network Gateway
It is used for user equipment (UE) IP allocation.

d) HSS -Home Subscriber Server
It is a user database used for service subscriber, user identification and addressing.

e) PCRF -Policy and Charging Rule Function

It provide quality of service and charging.

f) eNode B-evolved Node B

It is used as radio resources management and radio bearer control.

5G Architecture

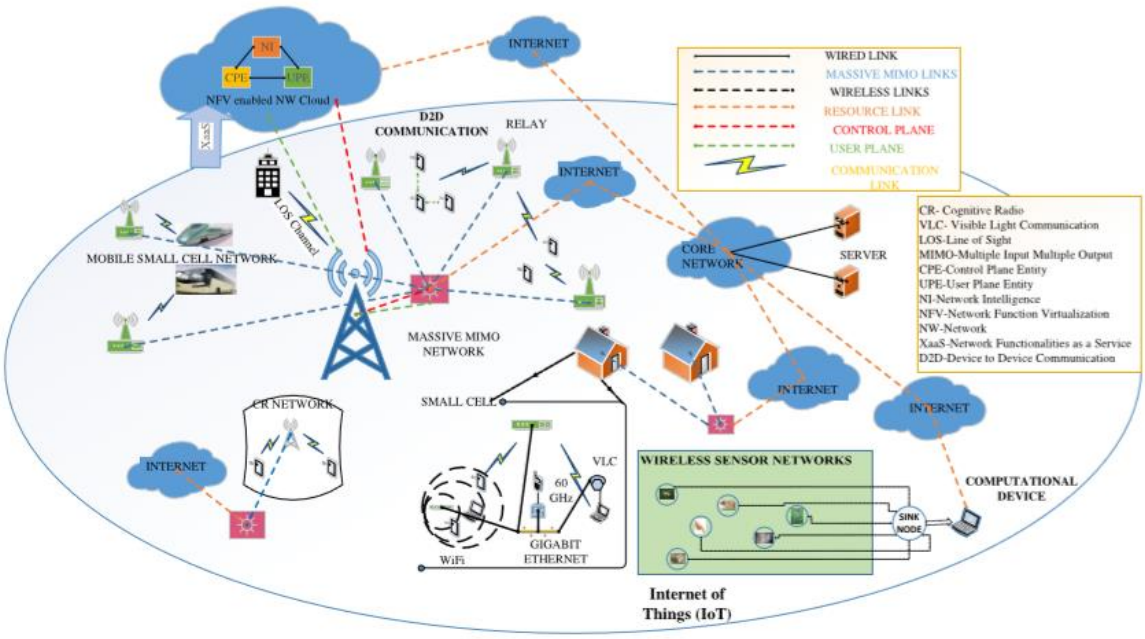

Figure 3: 5G Architecture

How 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 networks use a type of encoding called OFDM, which is similar to the encoding that 4G LTE uses. The air interface is designed for much lower latency and greater flexibility than LTE.With the same airwaves as 4G, the 5G radio system can get about 30 percent better speeds as a result to more efficient encoding. The very high gigabit speed is because 5G is designed to use much larger channels than 4G does. While most 4G channels are 20MHz, bonded together into up to 140MHz at a time, 5G channels can be up to 100MHz. That's a much broader highway, but it also requires larger, clear blocks of airwaves than were available for 4G.

That's where the higher, short-distance millimeter-wave frequencies come in. While lower frequencies are occupied by 4G, by TV stations, by satellite firms, or by the military, there had been a huge amount of essentially unused higher frequencies available, so carriers could easily construct wide roads for high speeds.

The goal of 5G is to have far higher speeds available, and far higher capacity per sector, at far lower latency than 4G.

ii. Advantages of 3G

- Faster data rate.
- It supports multimedia applications such as video and photography.
- High speed mobile internet access.
- Increased capacity.
- High Bandwidth.

Disadvantages of 3G

- It requires 3G compatible handsets.
- Power consumption is high.
- It requires closer base stations which is expensive.

Advantages of 4G

- High spectral efficiency
- Faster data transfer speed due to increased bandwidth
- High voice quality.
- Easy internet access, streaming media, video calling etc.
- Very low latency.
- Simple protocol architecture.
- Efficient multicast/broadcast.

Disadvantages of 4G

- Higher data prices for consumers.
- Complex hardware.
- Power usage is more than 3g.
- Increased invasion of privacy.
- It requires expensive infrastructure for operation.

Advantages of 5G

- Extremely increased bandwidth
- The fifth-generation cellular Technology has a higher speed than previous generations(1G, 2G, 3G, 4G)
- It provides high-resolution and bi-directional large bandwidth shaping.
- Ability to provide a uniform, consistent and uninterrupted, connectivity across the world.
- It offers 10x decrease in latency, 100x traffic capacity 10x connection density, 3x spectrum efficiency, and 100x network efficiency.

Disdvantages of 5G

- Increased cost of service because of construction of more towers.
- Congestion of the spectrum due to the addition of more cells.
- Equipment of 5G are costly and require skilled engineers to install and maintain.
- Devices running on 5G experience huge battery drain and give off a lot of heat.

- Lack of widespread coverage

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

Generation	**2G**	**3G**	**4G**	**5G**
Technology	GSM	WCDMA	LTE,WiMAX	MIMI,mm Waves
Switching type	Circuit switching for voice and packet switching for data.	Packet switching except for air interface.	Packet switching.	Packet switching.
Access system	TDMA,CDMA	CDMA	CDMA	OFDM,BDMA
Core Network	PSTN	Packet Network	Internet	Internet
Data rate	14.4-64 kbps	2Mbps	2000 Mbps -1Gbps	1 Gbps and higher
Internet service	Narrowband	Broadband	Ultra broadband	WirelessWorld Wide Web
Frequency	850-1900MHz	1.6-2GHz	2-8GHz	3-30GHz
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. There is no correlation between 5G and Corona virus`
   II. The reasons are:

   - There is no scientific evidence that 5G towers are causing COVID-19 symptoms or that 5G radiation is making people more susceptible to SARS-CoV2 infections. COVID-19 has a clear cause, a new corona virus. It is a biological virus and not an electronic one. This virus can spread via person-to-person contact and respiratory droplets.
   - South Korea was the first country to launch 5G in April 2019 and they didn't have their first Covid case until January 2020 as well as USA but China (Wuhan) where the virus originated (Nov 2019) launched 5G in October 2019.If 5G was related to Corona virus the Covid cases would have started in South Korea or USA.
   - The Corona virus does not affect only countries because there are only about 34 countries with 5G and the virus has spread to more than 210 countries. For example Iran does not have 5G but has recorded one of the highest number of cases.

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