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15/ENG04/010

EEE 512

DIGITAL COMMUNICATIONS

QUESTION 1

3G architecture

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.

3G wireless networks support the following maximum data transfer rates:

- 2.05 Mbits/second to stationary devices.
- 384 Kbits/second for slowly moving devices, such as a handset carried by a walking user.
- 128 Kbits/second for fast moving devices, such as handsets in moving vehicles.

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.

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:

i. **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.

ii. **Radio Network Controllers (RNC):**

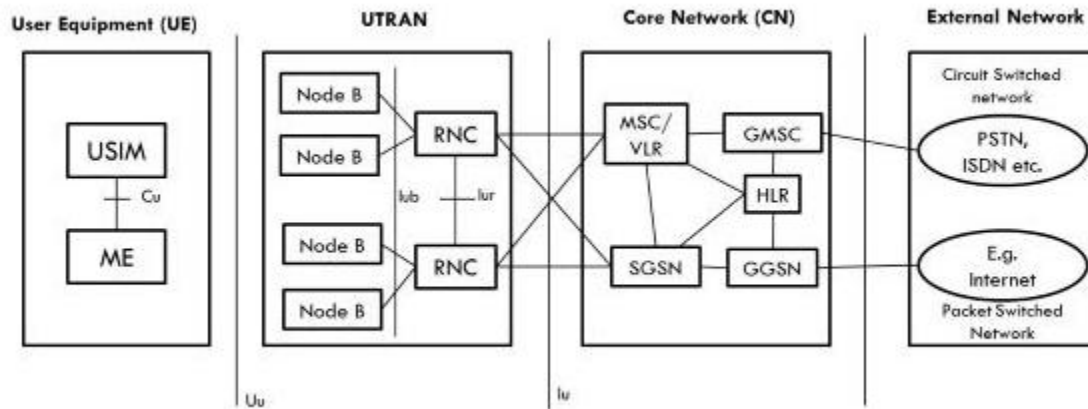
- RNC's controls and manages radio resources to Node B.
- RNC performs the data-link layer processing and participates in handover operations. • RNC is considered a single access point of UTRAN for the core network.
- It's connected to a single MSC/VLR to route circuit-switched traffic and to a single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

- Gateway GPRS Support Node (GGSN): Connects UMTS to external packet switched. (e.g. Internet)



Advantages

- New radio spectrum to relieve overcrowding in existing systems.
- More bandwidth, security, and reliability.
- Interoperability between service providers.
- Fixed and variable data rates.
- Asymmetric data rates.
- Backward compatibility of devices with existing networks.
- Always-online devices. 3G will use IP connectivity, IP is packet based (not circuit based).
- Rich multimedia services.

Disadvantages

- The cost of upgrading base stations and cellular infrastructure to 3G is very high.

- Base stations need to be closer to each other (more cost).
- Tremendous spectrum-license costs, network deployment costs, handset subsidies to subscribers, etc.

4G Architecture

1. 4G stands for fourth generation cellular system.
2. 4G is evolution of 3G to meet the forecasted rising demand.
3. It is an integration of various technologies including GSM, CDMA, GPRS, IMT-2000, Wireless LAN.
4. Data rate in 4G system will range from 20 to 100 Mbps.

Features:

- Fully IP based Mobile System.
- It supports interactive multimedia, voice, streaming video, internet and other broadband service.
- It has better spectrum efficiency.
- It supports Ad-hoc and multi hop network.

Smart Antennas:

- Smart Antennas are Transmitting and receiving antennas.
- It does not require increase power and additional frequency.

IPV6 Technology:

- 4G uses IPV6 Technology in order to support a large number of wireless enable devices.
- It enables a number of application with better multicast, security and route optimization capabilities.

VoIP:

- It stands for Voice over IP.
- It allows only packet to be transferred eliminating complexity of 2 protocols over the same circuit.

OFDM:

- OFDM stands for Orthogonal Frequency Division Multiplexing.
- It is currently used as WiMax and WiFi.

SDR:

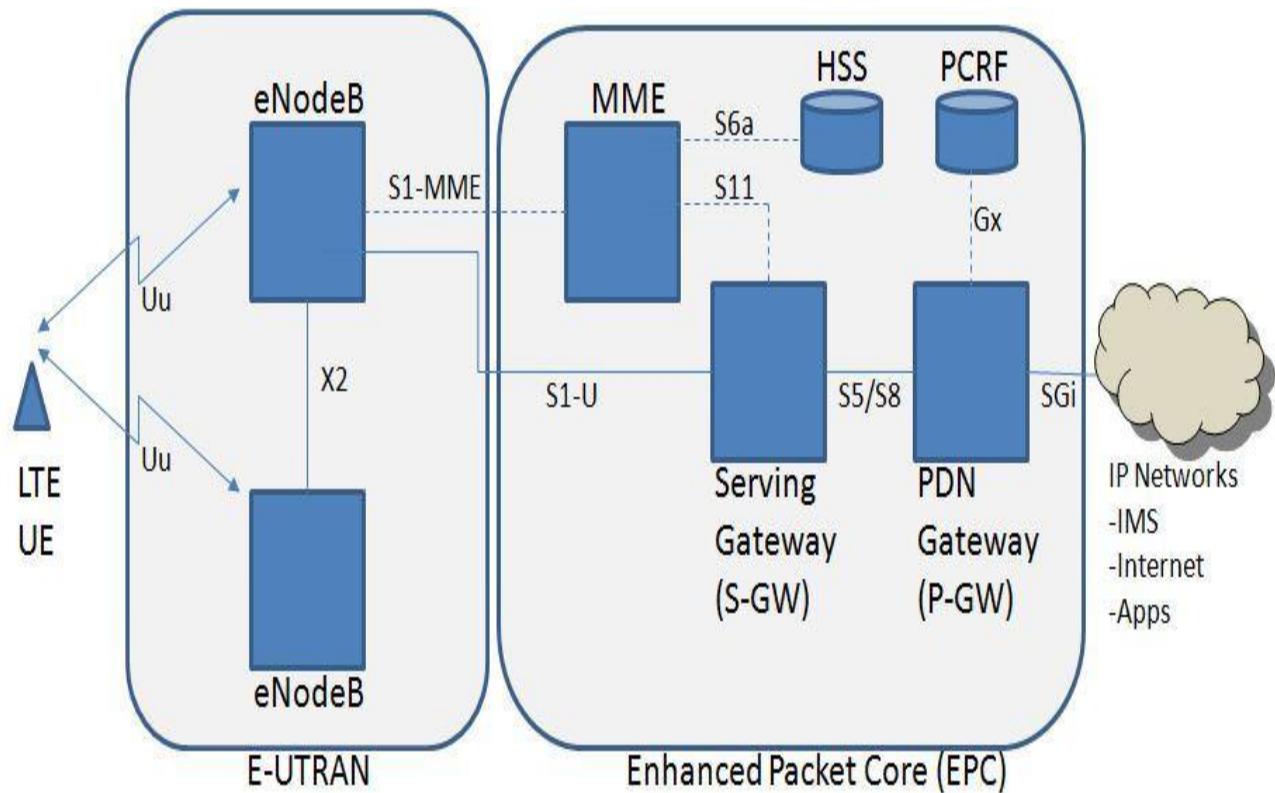
- SDR stands for Software Defined Radio.
- It is the form of open wireless architecture.

Advantages:

- It provides better spectral efficiency.
- It has high speed, high capacity and low cost per bit.

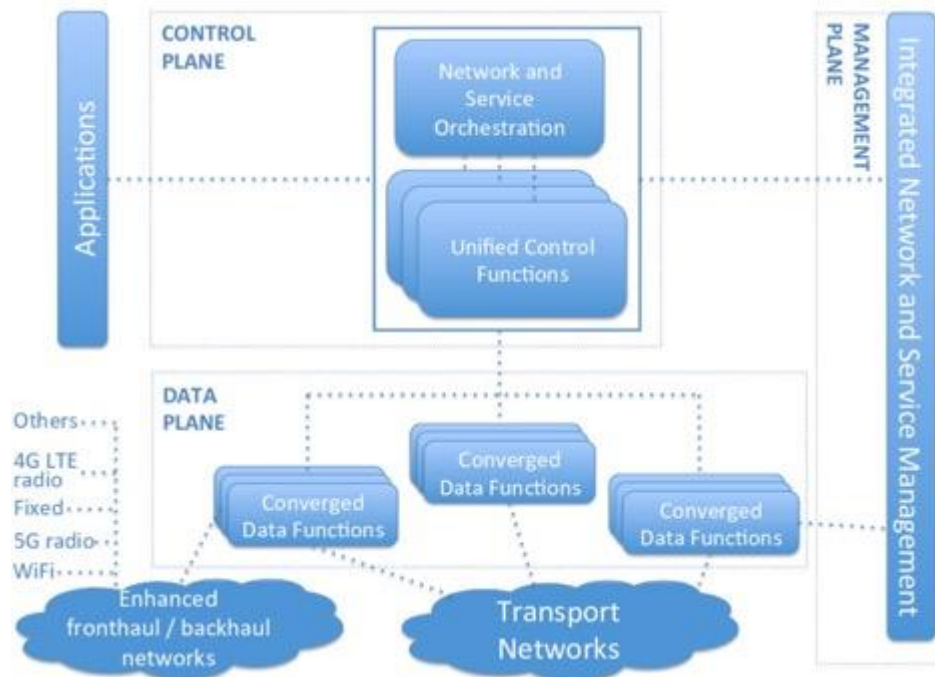
Disadvantages

- Battery usage is more.
- Hard to implement.



5G architecture

That 5G architecture will have a significant impact on today's mobile networks, physical networking, computing facilities, hosting and deployment systems, and service and infrastructure orchestration. Standards reports are coming from the Third Generation Partnership Project (3GPP), the International Telecommunication Union (ITU), and the 5G Infrastructure Public Private Partnership (5GPPP). The 5GPPP report draws on research from the other two standards as well as the European Telecommunications Standards Institute (ETSI). The networks will require a sophisticated integration of massive computing and storage infrastructures. In the new 5G architecture, mobile operators will need to plan for the necessities of higher network capacities, denser cell-site grids, small-cell deployments at the street level, virtualized network functions (VNF), and evolving roles of mission-critical applications.



Advantages

- 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.
- Most likely, will provide a huge broadcasting data (in Gigabit), which will support more than 60,000 connections.
- Easily manageable with the previous generations.
- Technological sound to support heterogeneous services (including private network).
- Possible to provide uniform, uninterrupted, and consistent connectivity across the world.

Disadvantages

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

QUESTION 2

Features	1G	2G	3G	4G	5G
Start/Development	1970/1984	1980/1999	1990/2002	2000/2010	2010/2015
Technology	AMPS, NMT, TACS	GSM	WCDMA	LTE, WiMax	MIMO, mm Waves
Frequency	30 KHz	1.8 Ghz	1.6 - 2 GHz	2 - 8 GHz	3 - 30 Ghz
Bandwidth	2 kbps	14.4 - 64 kbps	2 Mbps	2000 Mbps to 1 Gbps	1 Gbps and higher
AccessSystem	FDMA	TDMA/CDMA	CDMA	CDMA	OFDM/BDMA
Core Network	PSTN	PSTN	Packet Network	Internet	Internet

QUESTION 3

No, there is no correlation between coronavirus and 5G.

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it's important that you also practice respiratory etiquette (for example, by coughing into a flexed elbow).

5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 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.

Therefore there is no correlation between the coronavirus and 5G because 5G cell towers are structures made completely of inorganic materials so they cannot propagate the virus

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