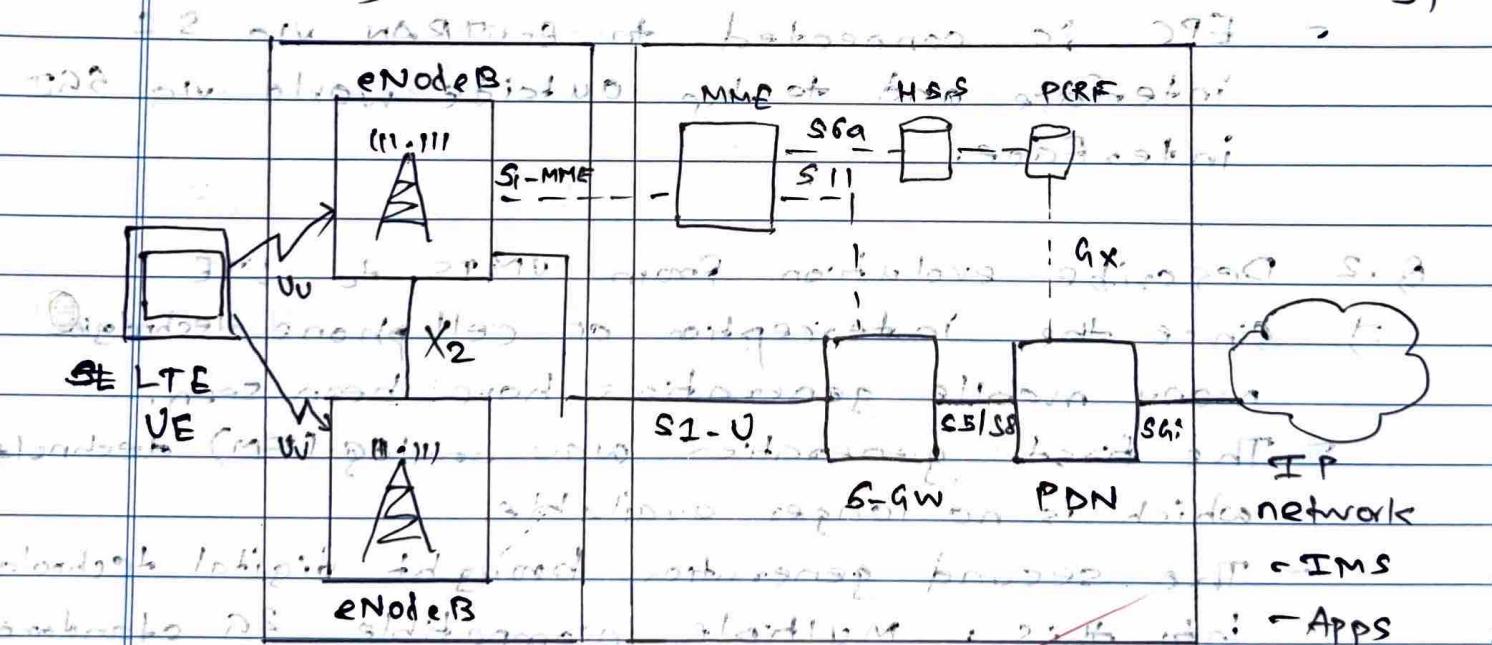


Assignment 2

Q.1 Draw and explain LTE SA Evolution architecture.

- ⇒ System Architecture Evolution (SAE) is a new network architecture designed to simplify LTE networks by removing RNC and SGSN.
- It establishes a flat architecture similar to other IP-based communication protocols.
- SAE uses an eNB and Access Gateway (GW) and removes the RNC and SGSN from equivalent 3G networks/architectures. This allows the network to be built with an 'All-IP' based network architecture.
- SAE also includes entities to allow full interworking with other related wireless technology.



These entities can specifically manage and permit the non-3GPP technologies to interface directly with the network.

- The high-level network architecture of LTE is comprised of following three main components:
 - 1) The User Environment (UE)
 - 2) The Evolved UMTS Terrestrial Radio Access Network (E-UTRAN)
 - 3) The Evolved Packet Core (EPC)
- The evolved packet core provides the means to communicate with packet data networks in the outside world such as internet, private corporate networks or the IP multimedia subsystems.
- Between UE and E-UTRAN there is a UU interface.
- EPC is connected to E-UTRAN via S1 interface and to the outside world via SGi interface.

- Q.2 Describe evolution from UMTS to LTE
- ⇒ Since the inception of cell phone technology many mobile generations have been seen.
 - ⇒ The first generation was analog (FM) technology which is no longer available.
 - ⇒ The second generation brought digital technology into this; multiple incompatible 2G standards were developed. Only two of them, GSM and IS-95A, CDMA have survived.
 - ⇒ Next, the third generation (3G) standards came into market.

- Again, multiple standards were developed mainly WCDMA by the 3GPP and CDMA 2000 by Qualcomm. Both have survived and still used today.
- The 3G standards were continually updated into what is known as 3.5G where WCDMA was updated to HSPA and CDMA 2000 was expanded with 1xRTT EV-DO release A and B. Both are still widely deployed
- The third generation partnership Project developed widely used UMTS WCDMA/HSPA 3G standards.
- As a 3G successor, WCDMA/3GPP developed Long-Term Evolution (LTE).
- Thus, LTE was created an upgrade to the 3G standards.
- Release 7.8 of LTE was completed in 2010 followed by release 9. Now, release 10 is also available which defines.
- ~~LTE-advanced~~ is also under development.

Q.3 Compare mobile generations briefly				
→ 1G: Analog from 1973 to 1985				
2G: digital standard 1992 - 2001				
Technology	1G	2G	3G	4G
Features	Analogue transmission, no security, no roaming, no soft handover.	Digital transmission, security, roaming, soft handover.	High speed data, packet switching, QoS, IP.	Very high speed data, IP, QoS.
Evolution	1973 AT&T	1980s, NTT, Bell, 1990s, 2000s	2000s	2010s
Deployment	1984	1992, 1998	2002	2010, 2015
Speed rate	2 kbps	14.4 - 64 kbps	2 Mbps	1 Gbps to 10 Gbps
Famous standards	AMPS, TDMA	2G: GSM, WCDMA, UMTS, CDMA-2000	Not yet defined.	WiMAX
Technology behind cellular technology	Analog cellular	Digital cellular	Broadband bandwidth	Undefined IP and seamless combination of broadband.
Service	Voice	Digital voice, SMS	Integrated high quality info access, audio, video, wearable and data devices	Dynamic info access, wearable device with AI capabilities

Q.4 What are self-organizing networks?

- ⇒ SON stands for the Self Organizing Network.
- It means that just add an eNB wherever you want to put and just connect power and switch on, it would configure all of its configuration by itself and makes itself ready for the service.
 - SON is like a 'Plug-and-Play' functionality.
 - Normally when a system operator constructs a network, they go through following steps :-

- i) Network Planning
- ii) Bringing the hardware to the location determined at Network Planning Process
- iii) Hardware installation
- iv) Basic Configuration
- v) Optimizing parameters.

- The main goal of SON is to automate large portions of human efforts involved in above mentioned process.
- In a more general way of SON frame works can be illustrated in following figure :-

enB power on

→ download configuration file and load it up

1. download configuration file with 3G interface file

download configuration file with 3G interface file

Basic setup

Configuration of IP address

base station IP address

→ 3G IP address association

3G IP address association

Self-

Association with a QRN

Configuration

Authentication

download configuration file with 3G interface file

download configuration file with 3G interface file

Initial radio configuration

Neighbor list configuration

neighbor list configuration

Convergence parameters configuration

Self - optimization

Optimization

neighbor list configuration (ii)

Neighbor list configuration

neighbor list configuration

Convergence parameters configuration

Self - healing

Self - healing

Failure detection & localization

Healing schemes..

- Q5 Explain VOLTE in detail
- VOLTE stands for Voice over Long Term Evolution.
 - It is a digital packet voice service that is delivered over IP via an LTE access network.
 - When 3GPP started designing the LTE system, prime focus was to create a system which can achieve high data throughput with low latency.
 - LTE is an all IP network and the ability to carry voice was not given much importance.
 - Therefore, for LTE networks to carry traditional circuit switched voice calls, a different solution was required.
 - This solution to carry voice over IP in LTE networks is commonly known as "VOLTE".
 - Basically VOLTE systems convert voice into data stream, which is then transmitted using the data connection.
 - VOLTE is based on the IMS
 - IMS is an architectural framework for delivering multimedia communications services such as voice, video and text messaging over IP networks.
 - Benefits of VOLTE :-
The implementation of VOLTE offers many benefits, both in terms of cost and operation.

- VoLTE provide following benefits

- 1) Provides a more efficient use of spectrum than traditional voice; it is 3 times more efficient.
- 2) Meets the rising demand for richer, more reliable services.
- 3) Eliminates the need to have voice on one network and data on another.
- 4) Can be developed simultaneously with video calls over LTE and multimedia services, including video share, multimedia messaging.
- 5) Ensures that video services are fully interoperable across the operator community, just as voice services are.
- 6) Increases handset battery life by 40%.
- 7) Provides rapid call establishment time.

~~Point X~~