

# **MOBILE COMPUTING ASSIGNMENT 2**

**Done By**

**Harikrishnan V**

**CS6A**

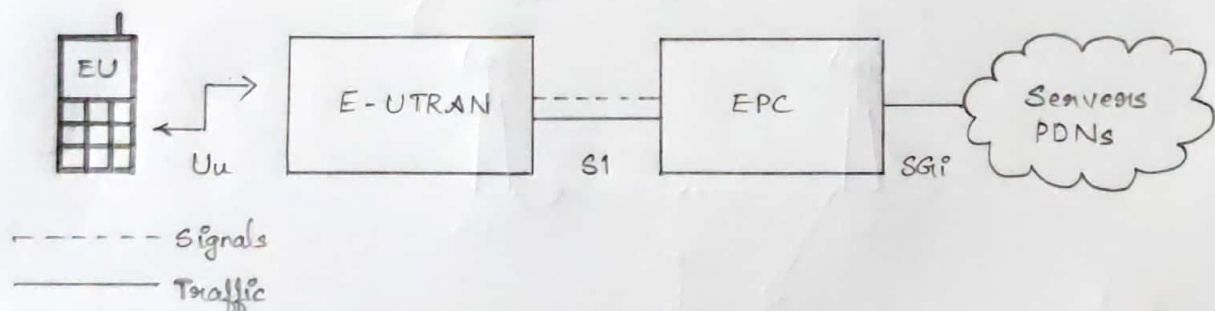
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## LTE ARCHITECTURE & INTERFACE

The high-level network architecture of LTE is composed of following three main components:

- The User Equipment (UE).
- The Evolved UMTS Terrestrial Radio Access Network (E-UTRAN).
- The Evolved Packet Core (EPC).

The evolved packet core communicates with packet data networks in the outside world such as the Internet, private corporate networks or the IP multimedia subsystem. The interfaces between the different parts of the system are denoted Uu, S1 & S-Gi as shown below:



### The User Equipment (UE)

The internal architecture of the user equipment for LTE is identical to the one used by UMTS & GSM which is actually a Mobile Equipment (ME). The mobile equipment comprised of the following important modules:

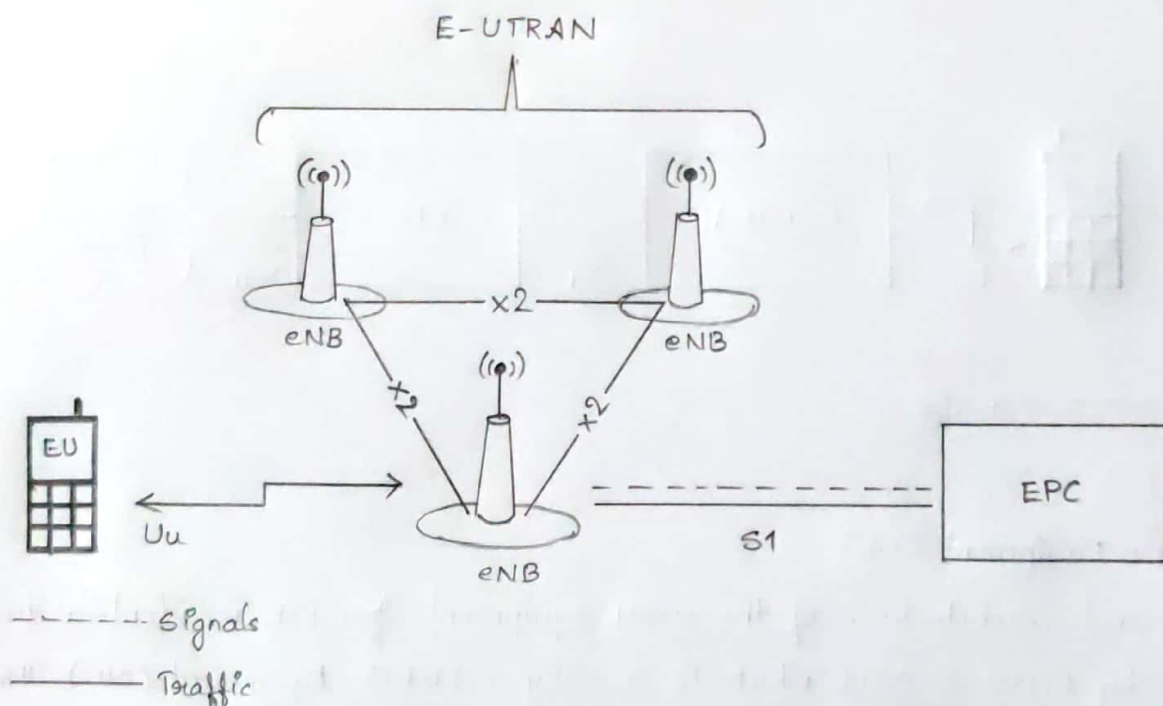
- Mobile Termination (MT): This handles all the communication functions.
- Terminal Equipment (TE): This terminates the data streams.
- Universal Integrated Circuit Card (UICC): This is also known as the SIM card.

for LTE equipments. It runs an application known as the Universal Subscriber Identity Module (USIM).

A USIM stores user-specific data very similar to 3G SIM card. This keeps information about the user's phone number, home network identity & security keys etc.

### The E-UTRAN (The access network)

The architecture of evolved UMTS Terrestrial Radio Access Network (E-UTRAN) has been illustrated below.



The E-UTRAN handles the radio communications between the mobile & the evolved packet core & just has one component, the evolved base stations, called eNodeB or eNB. Each eNB is a base station that controls the mobiles in one or more cells. The base station that is communicating with a mobile



is known as its serving eNB.

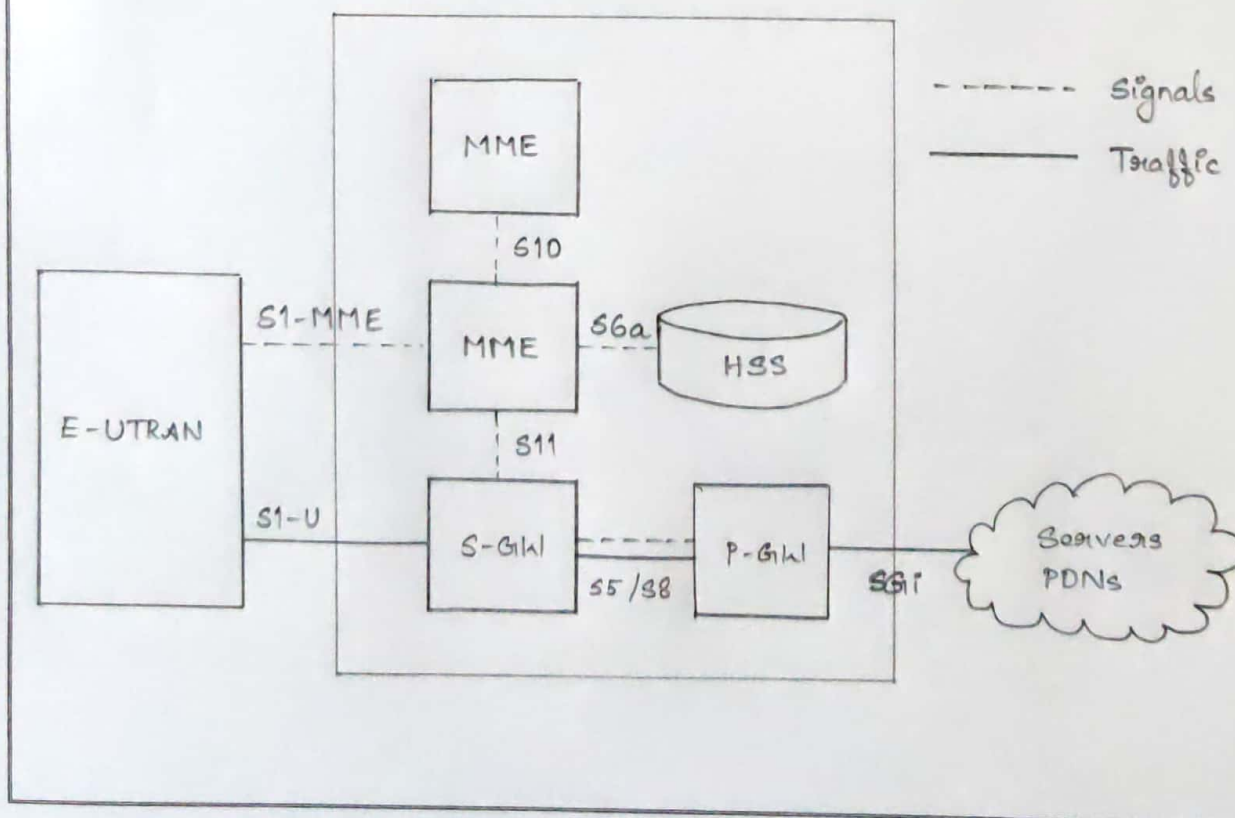
LTE mobile communicates with just one base station & one cell at a time & there are following 2 main functions supported by eNB:

- The eNB sends & receives radio transmissions to all the mobiles using the analogue & digital signal processing functions of the LTE air interface.
- The eNB controls the low-level operation of all its mobiles, by sending them signalling messages such as handover commands.

Each eNB connects with the EPC by means of the S1 interface & it can also be connected to nearby base stations by the X2 interface, which is mainly used for signalling & packet forwarding during handover.

The Evolved Packet Core (EPC) (The core network)

The architecture of Evolved Packet Core (EPC) has been illustrated below.



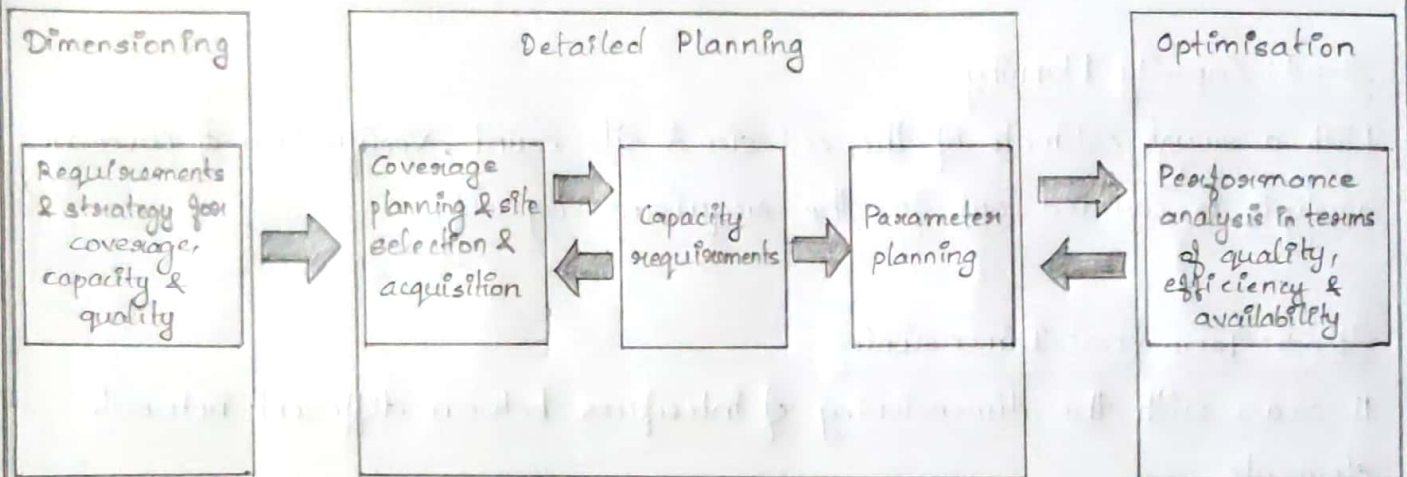
Below is a brief description of each of the components shown in the architecture:

- The Home Subscriber Server (HSS) component has been evolved forward from UMTS & GSM & is a central database that contains information about all the network operator's subscribers.
- The Packet Data Network (PDN) Gateway (P-GW) communicates with the outside world i.e. packet data networks PDN, using S-Gi interface.
- The serving gateway (S-GW) acts as a router, & forwards data between the base station & the PDN gateway.
- The mobility management entity (MME) controls the high-level operation of the mobile by means of signalling messages & Home Subscriber Server (HSS).
- The Policy Control & Charging Rules Function (PCRF) is a component which 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.



## LTE RADIO PLANNING & TOOLS

Dimensioning is the initial phase of network planning. It provides the first estimate of the network element count as well as the capacity of those elements. The purpose of dimensioning is to estimate the required number of radio base stations needed to support a specified traffic load in an area.



Wireless cellular network dimensioning follows these basic steps:

- Data/Traffic Analysis
- Coverage estimation
- Capacity evaluation
- Transport dimensioning

LTE dimensioning process includes the following steps:

### Step 1: Data & Traffic Analysis

This is the 1st step in LTE dimensioning. It involves gathering of required inputs & their analysis to prepare them for use in LTE dimensioning process.

### Step 2: Traffic Analysis

Traffic demand is analyzed to get the best possible network configuration

with minimum supplies.

### Step 3: Coverage Planning

Coverage analysis fundamentally remains the most critical step in the design of LTE network as with 3G systems.

### Step 4: Capacity Planning

With a rough estimate of the cell size & site count, verification of coverage analysis is carried out for the required capacity.

### Step 5: Transport Dimensioning

It deals with the dimensioning of interfaces between different network elements.

### Tools for LTE Dimensioning

LTE dimensioning tool is excel-based software developed to carry out dimensioning of LTE networks. It consists of 8 sheets:

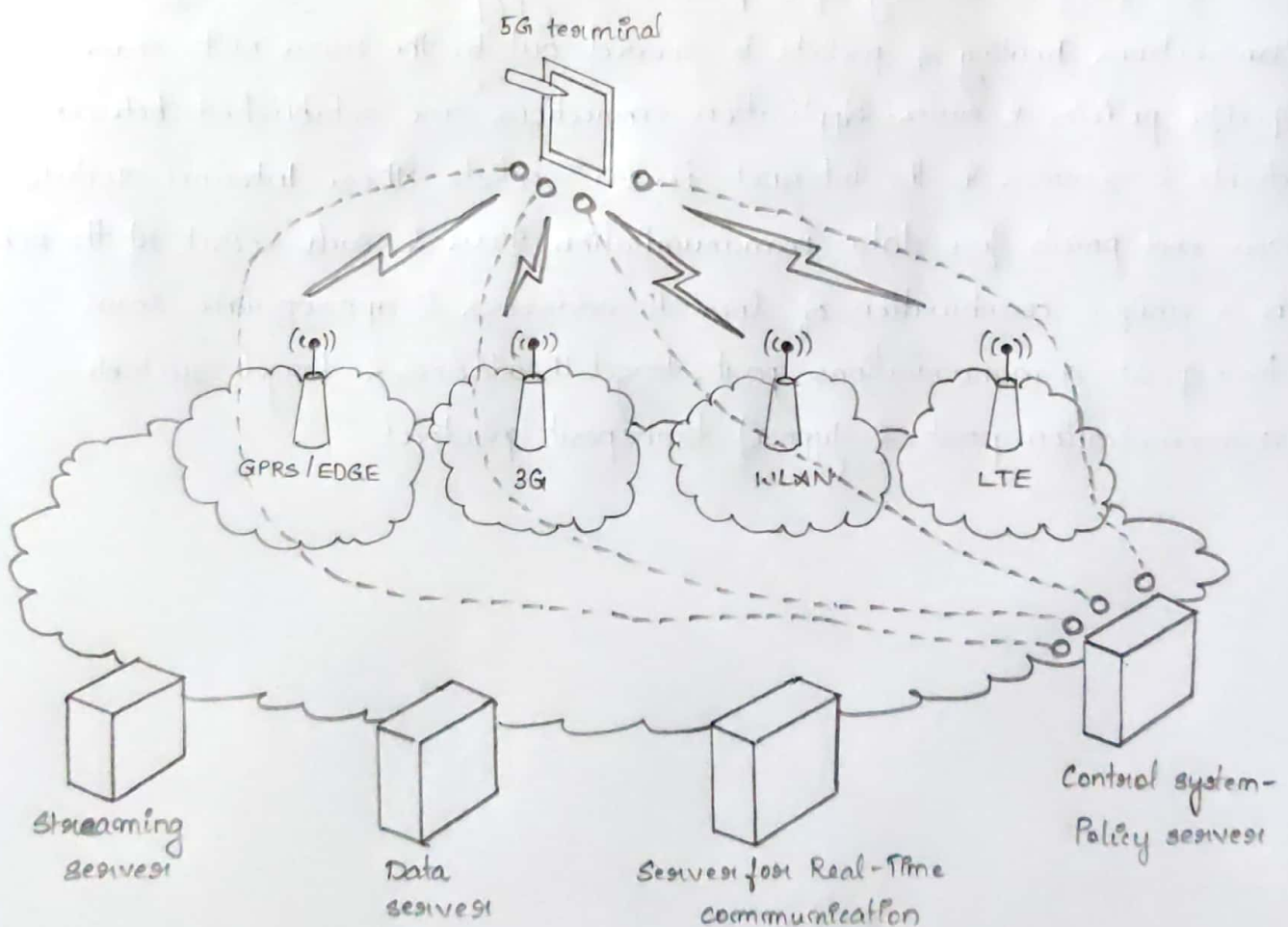
- Inputs
- Tables
- Radio Link Budget (RLB)
- Capacity Evaluation
- Traffic Forecast
- Dimensioning Output
- Version & history of change



## 5G ARCHITECTURE

Architecture of 5G is highly advanced, its network elements & various terminals are characteristically upgraded to afford a new situation. Likewise, service providers can implement the advanced technology to adopt the value-added services easily.

As shown in the following figure, the system model of 5G is entirely IP based model designed for the wireless & mobile networks.



Radio Access Technology (RAT) means a physical connection method for a radio based communication network. It is shown in the figure that, within each of the terminals each RATs are the IP link to the outside world & also in mobile

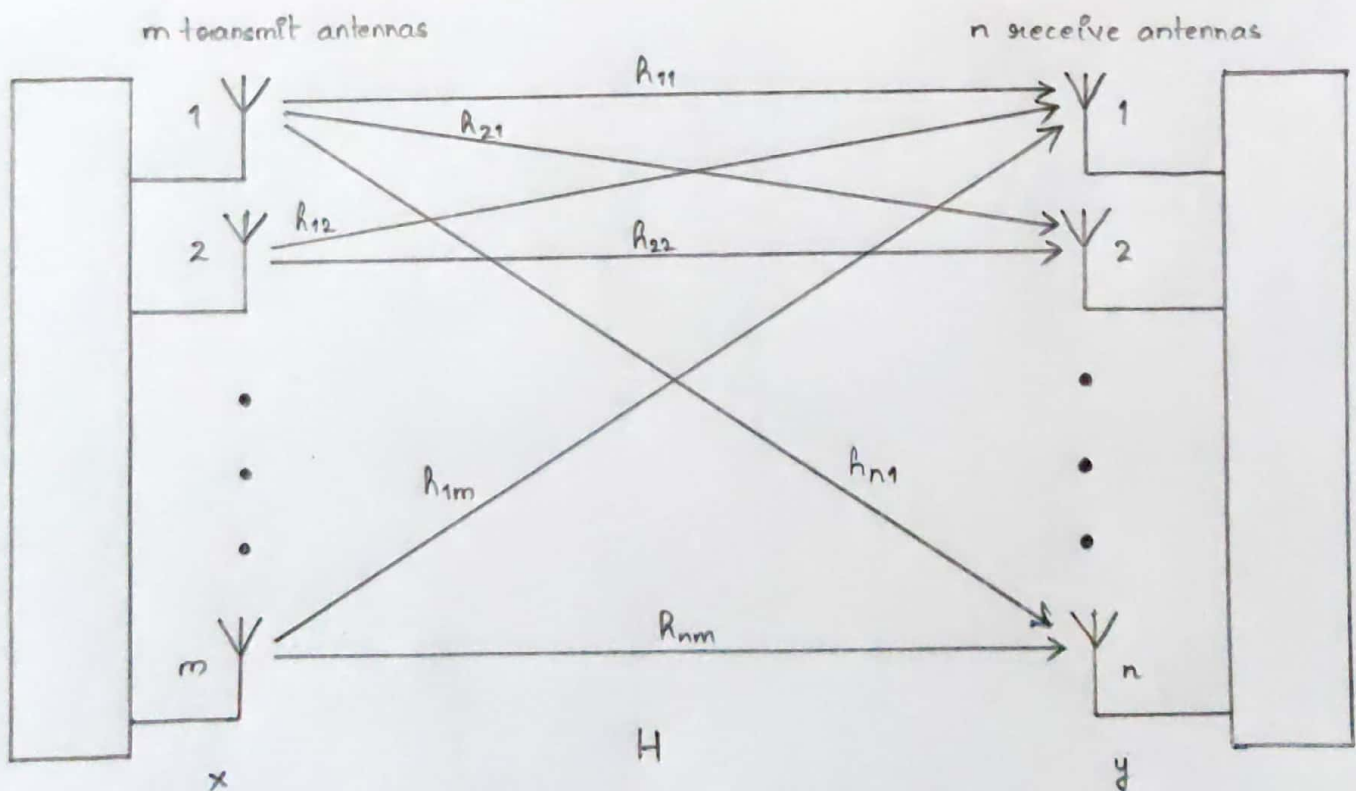


terminal there should be different radio interface for each RATs. If someone wants to access 4 different radio access technologies then 4 different accesses specific interfaces should be there in the mobile terminal & all of them should be activated at the same time in order to function the architecture.

It is called as the IP based model & the main purpose is to ensure control data for proper routing of IP packets belonging to a certain application connections. Routing of packets is carried out by the users with some specific policies & rules. Application connections are established between clients & servers in the internet i.e. via sockets. These Internet sockets are end points for data communication flows & each socket of the web is a unique combination of local IP addresses & appropriate local transport communications port, target IP address & target suitable communication port, & type of transport protocol.

# MIMO

MIMO stands for Multiple Input & Multiple Output. In wireless communication system this method is used to increase the capacity of channel in radio link by using multiple transmit & receive antennas. MIMO has become an important element of wireless communication system standards including IEEE 802.11ac (Wi-Fi), 4G-LTE (4G) etc. MIMO system consists of multiple antennas at both the transmitter & receiver. 1 of the big advantage of this system is more data can be added to the wireless channels. So by using this method the energy efficiency, spectral efficiency & reliability can be improved. In MIMO system the transmitter & receiver pair contains large number of antennas. At 1 time the term "MIMO" referred mainly to the theoretical use of multiple antennas at both transmitter & receiver. In modern technical world, "MIMO" refers to a practical technique for sending & receiving more than 1 data signal on the same radio channel at the same time via multipath propagation.





Also, MIMO is applied to Power line communication for 3-wire installations as part of ITU G.hn standard & Home Plug AV2 specification. In MIMO system the transmit antennas are distributed to various applications & also the receive antennas are distributed to many devices. By using this massive MIMO system, the energy efficiency & spectral efficiency can be increased dramatically. 1 of the biggest advantages of MIMO technology is intercell interference & noise can be minimized.

So due to these advantages, MIMO system is 1 of the key concepts of wireless communication system.

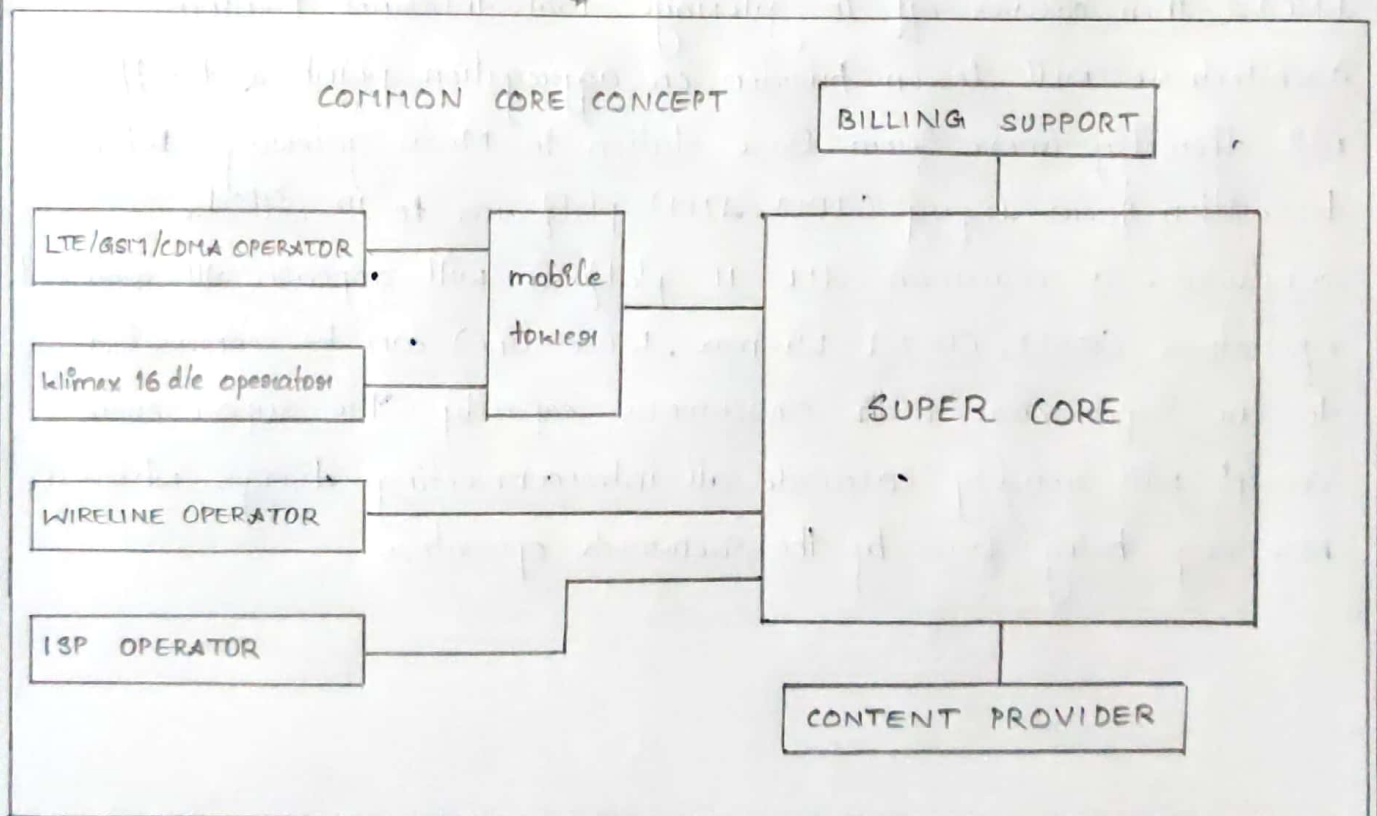
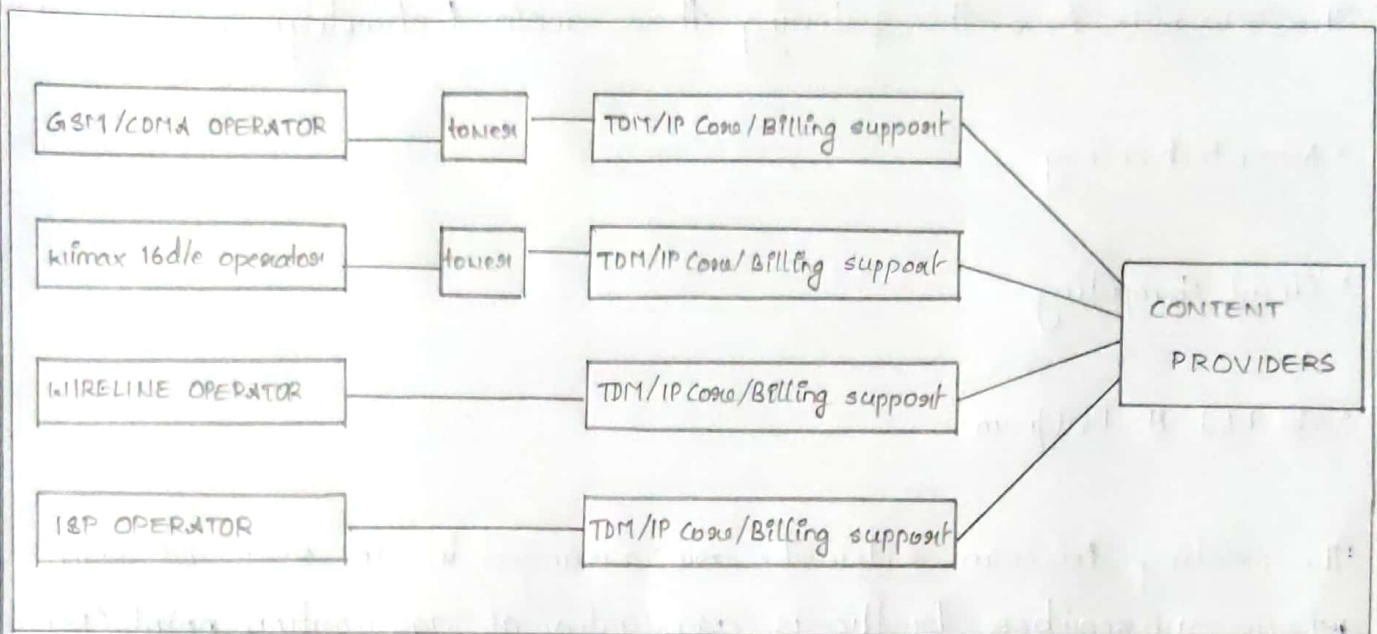
## SUPER CORE CONCEPT

The 5G will have the following three main technologies:

- Nanotechnology
- Cloud Computing
- All Flat IP Platform

The existing telecom networks are arranged in an ordered way, where subscriber traffic is aggregated at aggregation point (BSC/RNC) & then drives off to gateways. Flat Internet Protocol architecture will lessen burden on aggregation point & traffic will directly move from Base station to Media gateways. When transition from legacy (TDM, ATM) platforms to IP will be concluded, a common ALL IP platform will appear. All network operators (GSM, CDMA, Wi-max, wire line) can be connected to one Super core with enormous capacity. The super core concept will roughly calculate all interconnecting charges, which is nowadays being faced by the network operators.





## FEATURES & APPLICATIONS

### Features

5G technology would offer high resolution for wireless gadget users & bi-directional large bandwidth sharing.

- The advanced billing interfaces of 5G technology makes it more attractive & effective.
- The high quality services of 5G technology is based on policy to avoid errors. 5G technology would provide large broadcasting of data in Gigabytes.
- The 5G technology network offers enhanced & available connectivity just about the world.
- The traffic statistics by 5G technology makes it more accurate. Through remote management offered by 5G technology a user can get better & fast solutions.
- The remote diagnostics is also a great feature of 5G technology.
- The 5G technology also supports virtual private network.

### Applications

1. One can be able to feel her/his kid's stroke when he/she is in her mother's womb.
2. One can be able to perceive his/her sugar level with his/her mobile.
3. One can be able to charge his/her mobile with his/her own heartbeat.
4. One can be able to view his/her residence in his/her mobile when someone enters.
5. The mobile will ring according to our mood.
6. One can be able to pay all bills in a single payment with his/her mobile.



7. One can get the live share value.
8. One can be able to navigate the train for which he/she might be waiting.
9. One can be able to vote from his/her mobile
10. One can be able to know the exact time of his/her child's birth that too in nanoseconds.
11. One can be able to sense tsunami/earthquake before it occurs.
12. Our mobile can share our work load.
13. One can get an alert in his/her mobile when someone opens his/her intelligent car.
14. One can be able to lock his/her car or bike with his/her mobile when he/she forgets to do so.
15. We can be able to expand our coverage using our mobile phone.
16. Our mobile can perform radio resource management.