

Telecommunication Engineering

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CT-02

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Ans to the question no- 1(a)

1. (a) what is telephone numbering? Describe the telephone number structure.

Ans: The numbering plan is used to identify the subscribers connected in a telecommunication network. The main objectives of numbering plan by any nation is to standardise the number length wherever practical according to ITU recommendations.

Telephone number structure:

Country code	National number
1-3 digits	9-11 digits max
→ 12 digit maximum →	

Fig - International telephone number

Area or Trunk code	Exchange code	Line number
subscribers numbers		

Fig - National telephone number

A national number consists of three parts. The parts are described below :-

The area code or Trunk code: This code identifies a particular numbering area or the multi-exchange area of the called subscriber.

Exchange code: This code identifies a particular exchange within a numbering plan area. It determines the routing for incoming trunk call from another numbering area.

Subscriber Line number: It is used to select the called subscriber line at the terminating exchange. The combination of the exchange code and the subscriber line number is called the Subscriber line number in CCITT technology.

Ans to the Question no 1(b)

1.(b) Write down the difference between in-channel and common channel signaling.

Ans:

In-channel Signaling: It is also known as Per Trunk Signalling.

This uses the same channel, which carries user voice or data, to pass control signals related to that call or connection. No additional transmission facilities are needed, for In-channel Signaling.

Common channel signaling: Common channel signaling uses a separate common channel for passing control signals for a group of trunks or information paths. This signaling does not use the speech or the data path for signaling.

Ans to the question no - 1(c)

1.(c) Explain the different types of numbering plans.

Ans: The types of numbering plans are described below:

Open numbering plan: This is also called the Non-uniform numbering plan and permits wide variation in the number of digits to be used to identify a subscriber within a multi-exchange area or within a country.

Semi-open numbering plan: This plan permits number lengths to differ almost one or two digits. The semi-open numbering plan is commonly used in a few countries such as India, Sweden, and UK.

Closed numbering plan: This is also called the Uniform

Numbering plan - where the number of digits in a subscriber number are fixed. This is used in a few countries such as France, Belgium, many others.

(a) Ans to the question no + 2(a)

2.0) Define the signaling techniques. Describe signaling techniques involved in telecommunication network.

Ans:

Signalling techniques enable the circuit to function as a whole by interconnecting all varieties of switching systems. There are three forms of signalling involved in a telecommunication network.

- ↳ Subscriber loop signalling.
- ↳ Intraexchange or register signalling.
- ↳ Interexchange or inter-register signalling.

The subscriber loop signaling depends upon the type of telephone instrument used.

The intra-exchange signalling refers to the internal portion of a switching system that is heavily dependent upon the type and design of a switching system, which varies depending upon the model.

The interexchange signalling takes place between exchanges.

This helps in the exchange of address digits, which pass from exchange to exchange on a link by link basis.

Ans to the question no - 2(b)

2. b) What is charging plan? Explain the charging plan.

Ans:

Charging plan: The cost of providing a telecommunication network consists of the capital costs and the current operating expenses.

The calls are charged as accounted by the metering instruments connected to the each subscriber line or as per a metering register that is assigned to each subscriber in case of electronic exchanges. A meter counts the number of charging units, and that count is incremented by sending a pulse to the meter. For the number of units, the reader reads, a bill is raised by assigning a rate to the charging unit.

The individual calls can be charged based on the following categories :

↳ Duration independent charging.

↳ Duration dependent charging.

Ans to the question no - 2(c)

2.c) Explain in details, the topologies of the routing plan.

Ans: Three basic topologies are adopted for interconnecting exchanges. These are:-

- ↳ Mesh-connected network
- ↳ star topology
- ↳ Hierarchical networks.

Mesh-connected networks: Mesh topology as name implies, is a fully connected network. The number of trunk groups in a mesh network is proportional to the square of the exchanges being interconnected. Hence mesh topologies are widely used in metropolitan areas where there is heavy traffic.

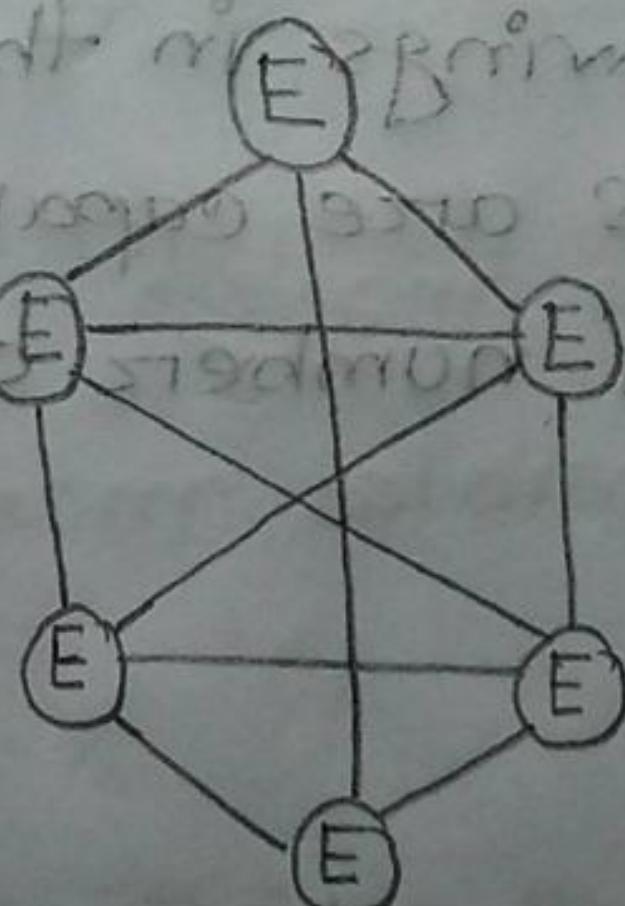


Fig- Mesh topology .

Star topology : Star topology is connected ⁱⁿ to the shape of a star, which utilizes an intermediate exchange called a tandem exchange through which all other exchanges communicate. The star network is used when traffic levels are comparatively low.

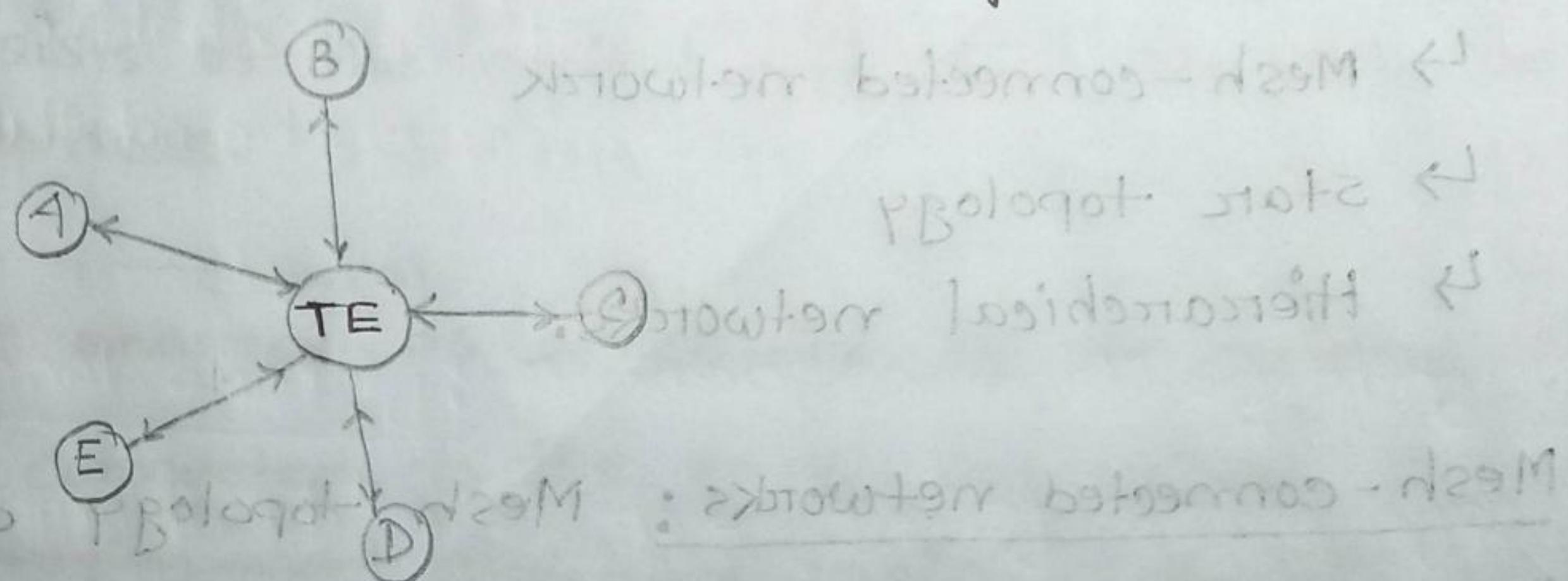


Fig- star network.

Hierarchical networks : An orderly construction of multi-level star networks leads to hierarchical networks. Hierarchical network requires more switching nodes, but achieves significant savings in the numbers of trunks. Hierarchical networks are capable of handling heavy traffic with minimal number of trunk groups.

Ans to the question no - 3(a)

3. a) Categories the signalling Technique.

Ans:

Signalling

In-channel

Out-channel

D.C Low frequency

Associated

Non-associated

In-band

Out-band

Ans to the question no - 3(b)

3. b) Describe the in-channel and out-channel channel

signaling techniques.

Ans:

In-channel signaling: Also known as Per Trunk signalling

This type of signalling is used to carry voice or data and pass control signals related to a call or connection. There are three different types of In-channel signalling. The D.c signalling is simple, cheap and reliable even for

Unamplified audio circuits. However, for unamplified audio circuits, low frequency A.c. signaling may be adopted.

The voice frequency signaling is used when FDM (Frequency Division Multiplexing) transmission systems are used because low frequency signaling and D.c. signaling can't be provided. This frequency signaling may be In-band or out-band.

Common-channel signaling: Common channel signaling uses a separate common channel for passing control signals for a group of trunks or information path as it does not use the speech or the data path for signaling. The common channel signaling consists of two types of nodes such as Signaling Transfer Points (STP) and Signalling Points (SP). This common channel signaling is implemented in two modes:

↳ Channel associated mode.

↳ Channel non-associated mode.

Ans to the question no - 3(c)

3.c) Explain in details fading fading.

Ans: Fading is a phenomenon that occurs due to varying parameters and conditions of the channel during wireless propagation.

Fading Types

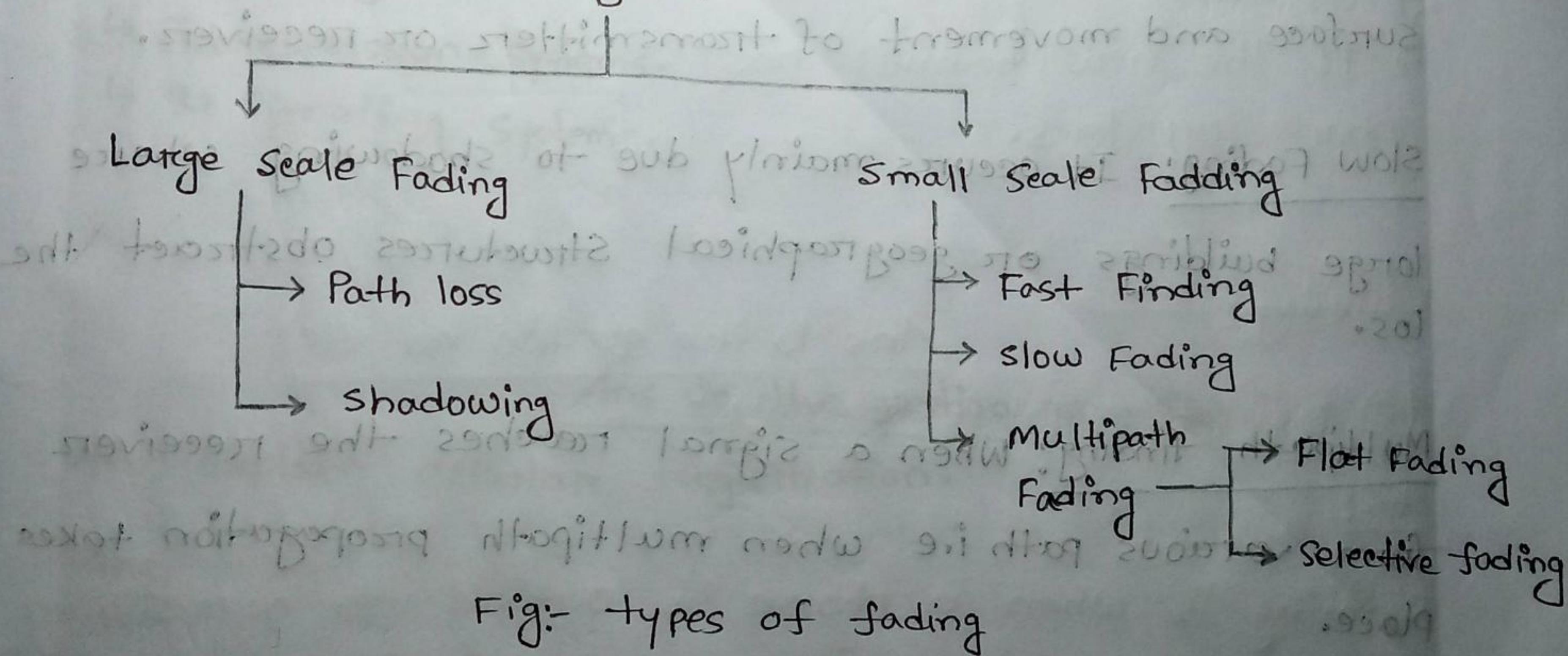


Fig:- types of fading

Large Scale Fading: This refers to the attenuation of signal power due to obstacles between the transmitter and receiver. It also converts the attenuation and fluctuations of signals when the signal is transmitted over a long distance.

Path loss: It refers to the attenuation when a signal is transmitted over large distance.

Shadowing: This refers to the loss in signal power due to the obstructions in the path of propagation.

Small scale fading: This refers to the fluctuations in signal strength and phase over short distance and small duration of time.

Fast Fading: It occurs mainly due to the reflections from surface and movement of transmitter or receiver.

Slow Fading: It occurs mainly due to shadowing where large buildings or geographical structures obstruct the los.

Multipath fading: When a signal reaches the receiver from various path i.e. when multipath propagation takes place.

Flat fading: In flat fading, all frequency components get affected almost equally.

Selective fading: Refers to the multipath fading when the selected frequency component of the signal is affected.

Ans to the question no - 4(a)

4.(a) Write down the system that telecommunication network consists of.

Ans: Any telecommunication network may be viewed as consisting of the following major systems;

- ↳ Subscriber end instruments or equipments
- ↳ Subscriber loop systems.
- ↳ Switching systems.
- ↳ Transmission systems.
- ↳ Signaling systems.

(b) P-on make up of 20A

Ans to the question no - 4(b)

4.(b) Explain cellular registration.

Ans:

Registration: is the process of notifying the network that a phone is active on the system. When phone is switched on, it registers by signalling to the MSC via the base station on a set up or control channel.

Periodic registration: Periodic registration is when the phone announces itself on a regular basis.

Forced registration: is when the phone monitors a control channel which provides information including the cell identification.

- ↳ If the channel strength fades below a threshold, the phone selects another channel.
- ↳ If the new channel has a new call ID, then the phone registers.

Roaming:

Ans to the question no- 4(c)

4.(c) Explain cellular roaming.

Ans:

Roaming is when a phone is outside its home area or local region.

→ If the phone registers outside its home area, the MSC contracts the phone's home area and confirms that the phone is OK.

→ MSC then notifies home area of the phone's current location and provides instructions for routing incoming calls to the phone.

(a) Ans to the question no - 5(a)

5.a) What is sampling ? why Sampling is necessary ?
What are problems in sampling ?

Ans:

Sampling : Sampling is the process of measuring the amplitude of a continuous time signal at discrete instants, converting the continuous signal into a discrete signal.

Importance of sampling :

- ↳ Sampling plays an important role in converting analog signal to digital signal
- ↳ Can't convert a analog signal to digital signals without sampling.

Problems in sampling :

- ↳ Sampling errors
- ↳ amplitude accuracy

(Q) Ans to the question no. 5(b)

5. b) What is Nyquist theorem? Write the applications of Nyquist sampling?

Ans: The Nyquist Sampling theorem states that:

A bandlimited continuous-time signal can be sampled and perfectly reconstructed from its samples if the waveform is sampled over time twice as fast as it's highest frequency components.

$$f_{\max} \leq f_s / 2$$

Applications:

If we sample an analog signal at a frequency that is lower than the Nyquist rate, we will not be able to perfectly reconstruct the original signal. We can find the nyquist rate from the Nyquist Sampling theorem.

Nyquist Sampling
Nyquist Rate

Ans to the question no-5(c)

5.(c) Draw the block diagram of PCM system and describe the operations of different blocks.

Ans:

PCM (Pulse code Modulation) :

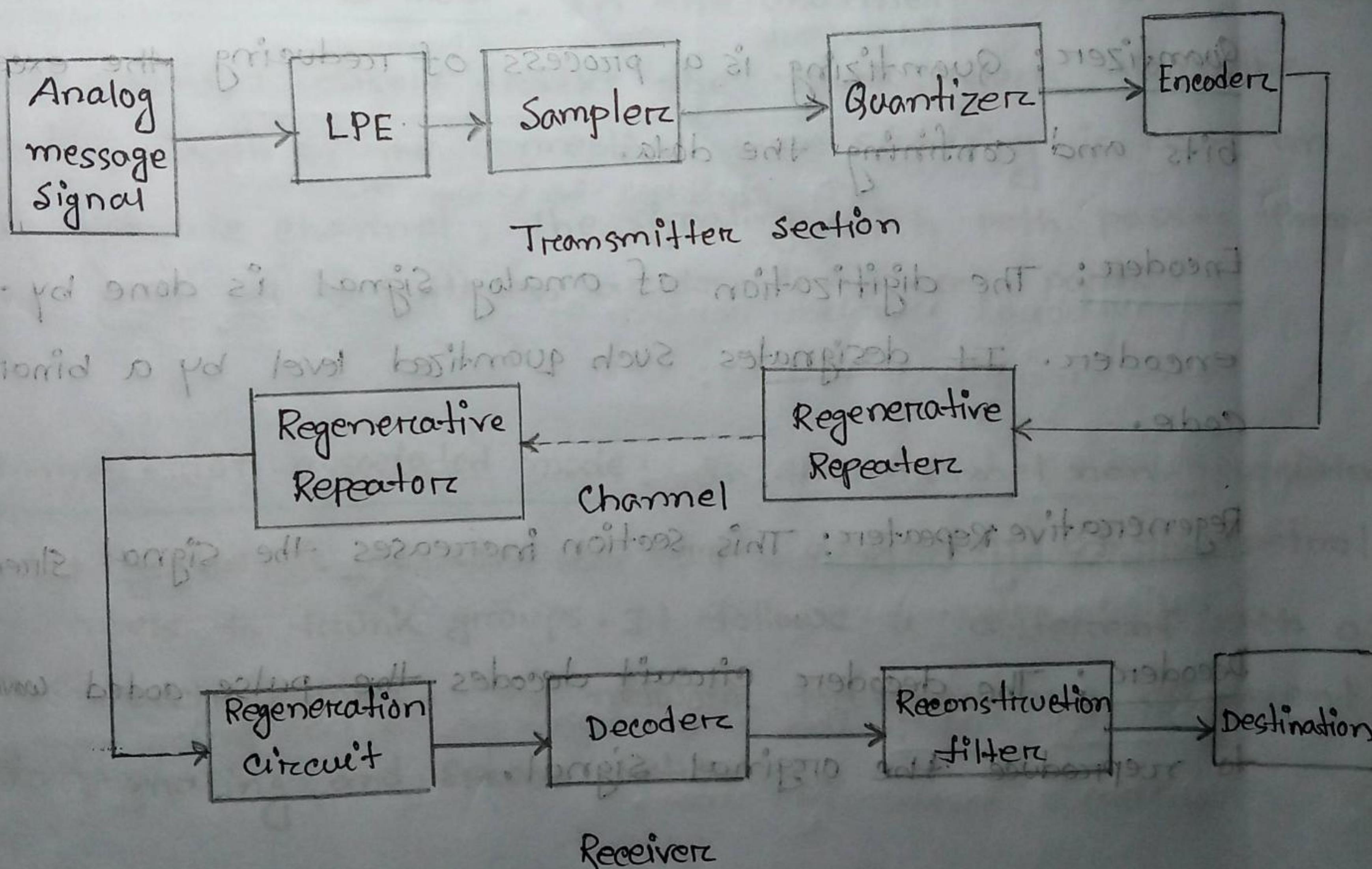


Fig- PCM block diagram .

Low pass filter: This filter eliminates the high frequency components present in the input analog signal which is greater than the highest frequency of message signal to avoid aliasing of the message signal.

Sampler: This is the technique which helps to collect the sample data at instantaneous values of message signal, so as to reconstruct the original signal.

Quantizer: Quantizing is a process of reducing the excessives bits and confining the data.

Encoder: The digitization of analog signal is done by the encoder. It designates such quantized level by a binary code.

Regenerative Repeaters: This section increases the signal strength.

Decoder: The decoder circuit decodes the pulse coded waveform to reproduce the original signal.

Ans to the question no - 6(a)

6.a) Explain the mode of operation of CCS.

Ans: CCS stands for common channel signaling. This common channel signaling is implemented in two modes:

1. Channel associated mode.
2. Channel non-associated mode.

Channel associated mode: In the channel associated mode, the channel closely tracks the trunk groups along the entire length of the connection. Hence, signaling is done on a separate channel; the signaling path passes through the same set of switches, as does the speech path.

Channel - non - associated mode: In the channel non-associated mode, there is no close or simple assignment of the control channels to trunk groups. It follows a different path of the speech signal. The network topologies are different for signaling and speech networks.

Ans to the question no- 6(b)

6.b) Explain the national telephone numbering system.

Ans: The national telephone numbering systems are giving below :-

Subscriber number		
Area or Trunk code	Exchange code	Line Number
91 91 91	91 91 91	91 91 91

Fig: National telephone Number

A national number consists of three parts. The parts are described below:-

Area or Trunk code: This code identifies a particular numbering area or the multi-exchange area of the called subscriber.

Exchange code: This code identifies a particular exchange within a numbering area.

Subscriber line number: It is used to select the called subscriber line at the terminating exchange.

(c) Ans to the question no - 6(c)

6.c) Describe briefly PBX.

Ans to the question no - 6(c)

Ans: PBX or private Branch Exchange can be understood as a local exchange within an office or a building, in order to communicate within themselves. As the name implies, it is a private exchange, which is a branch to the main exchange. Similar to a local loop connected to the main loop as a branch.

Private Branch Exchange is a telephone system within a local area that switches calls between these users on local lines while allowing all users to share a certain number of external phone lines.

The main purpose of PBX is to save the cost of the requirement for a line to each user to the central exchange office.

(2) Ans to the question no-7(a)

7.a) Describe PSTN.

Ans: The PSTN or Public Switched Telephone Network is understood as an aggregate of world's circuit switched telephone networks, used for providing public telecommunication. The PSTN network are called POTS (Plain old Telephone System). These networks are operated regionally, locally, nationally and internationally using telephone lines, fiber optics cables, microwave transmission links or cellular communications.

PSTN consists of switches at centralized points on the network, which act as nodes for communication between any point and any other point on the network.

All the types of switching such as circuit switching, packet switching and message switching are different modes of using PSTN.

Ans to the question no-7(b) part 4

7.b) Explain C/I ratio.

Ans: The carrier to interface ratio, C/I, one of the signal at the mobile from the transmitter in a given cell, can be found in an approximate manner by summation of interference from all base station using the same frequency. usually expressed in dB.

$$\frac{C}{I} = \frac{R^{-n}}{\sum_{i=1}^M D_i^{-n}}$$

Ans to the question no-7(c)

7.c) What do you mean by Multi-access (MA) method.

Explain MA types.

Ans:

Multi-access (MA) method : The manner in which radio resources are allocated into voice channels.

↳ FDMA (frequency division) - each voice channel is assigned a separate frequency.

Q2

↳ TDMA (Time division) - each voice channel is assigned segments of time slots. Mobiles are commonly served in a round robin fashion.

Ans to Q. no. 1(d) :
↳ CDMA (Code division) - each voice channel is assigned a specific code.

Ans to the Q. no. 7(d)

7. d) classify the long distance radio communication.

Ans:

$$\frac{D}{n} = \frac{C}{I}$$

1. Sky wave or ionospheric communication.

2. Line of sight (LOS) microwave communication limited by horizon.

3. Tropospheric Scatter communication.

4. Satellite communication.

Ans to Q. no. 7(d) : bottom (AM) - I.I.U.M

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(d) 2 or Ans to the question no - 8(a)

8.a) Define Omni-directional. Explain the open process of call initiated from mobile.

Ans: Omni-directional antenna that transmits in all directions serving the whole cell.

Call initiated from mobile:

- ↳ mobile Sends MIN and ESN.
- ↳ BS passes to MSC; MSC verifies ESN and MIN pair.
- ↳ MSC tells BS to select used voice channel pair.
- ↳ BS selects voice channel pair; pages mobile and informs to move to those channels.
- ↳ Mobile receives page, verifies MIN, and moves to specific
- ↳ MSC connects PSTN with mobile (through BS)

(Q) Ans to the question no 8(b)

8.b) Explain subscriber loop systems

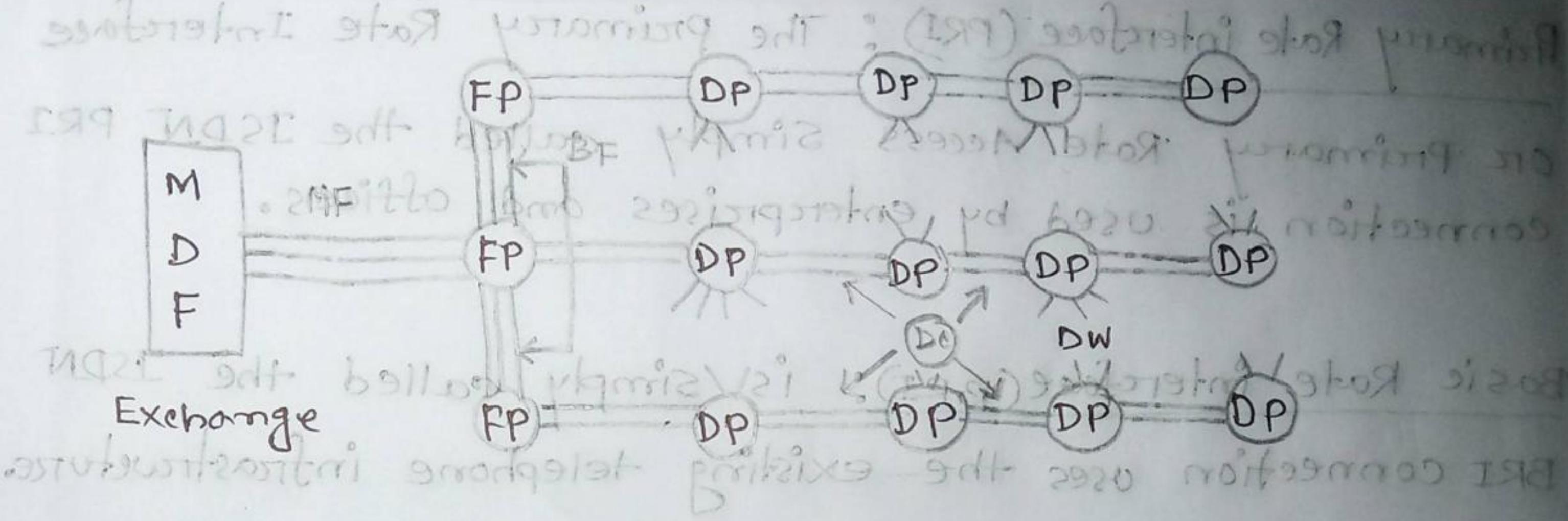
Ans:

Subscriber loop - The physical and/or electronically derived two wire circuit used to connect a local telephone exchange.

Switch to subscriber.

Traditionally subscriber loops have consisted primarily of a pairs of conducting wires within a cable containing many such pairs.

In a general telephone network, every subscriber has two dedicated lines connecting to the nearest switching exchange, which are called the loop lines of that subscriber. The laying of lines to the subscriber premises from the exchange office is called cabling. As it difficult to run cables from each subscriber's premises to the exchange, large cables are used through which the drop wires (subscriber lines) are taken to a distribution point. The drop wires are connected to wire pairs at the distribution point in the cables.



MDF = Main Distribution Frame

DP = Distribution point

DC = Distribution cable

MF = Main Feeder

BF = Branch Feeder

DW = drop wires

Ans to the question no - 8(e)

8.(e) Describe the access interfaces of ISDN.

Ans: ISDN has several kinds of access interfaces such

as :

- ↳ Basic Rate interface (BRI)
- ↳ Primary Rate interface (PRI)
- ↳ Narrowband ISDN
- ↳ Broadband ISDN.

Primary Rate interface (PRI): The Primary Rate Interface

or Primary Rate Access simply called the ISDN PRI connection is used by enterprises and offices.

Basic Rate interface (BRI): is simply called the ISDN BRI connection uses the existing telephone infrastructure.

Narrowband ISDN: The narrowband integrated Services digital network is called N-ISDN. It is implemented to carry voice data.

Broadband ISDN: It is called B-ISDN. This integrates the digital networking services and provides digital transmission over ordinary telephone wires.

(BRI) basic rate interface

(PRI) primary rate interface

ISDN BRI

ISDN PRI

broadband