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Semester Final Answer Sheet

Course Code: CSE 209

Course Title: Data Communication

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Answer to the question no 1(a)

Ans: Multiplexing is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link.

- In a multiplexed system, n lines share the bandwidth of one link.
- Multiplexer(MUX) Combines the lines into single stream(many-to-one).
- At the receiving end, that stream is fed into demultiplexer (DEMUX), which separates the stream back into its components transmission (one-to -many).

In frequency division multiplexing (FDM) signals generated by each sending device modulate different carrier frequencies. These modulated signals are then combined into a single composite signal that can be transported by the link. Channels can be separated by guard bands to prevent overlapping.

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The diagram of Multiplexing and Demultiplexing with 1 link and 8 channels is given below:

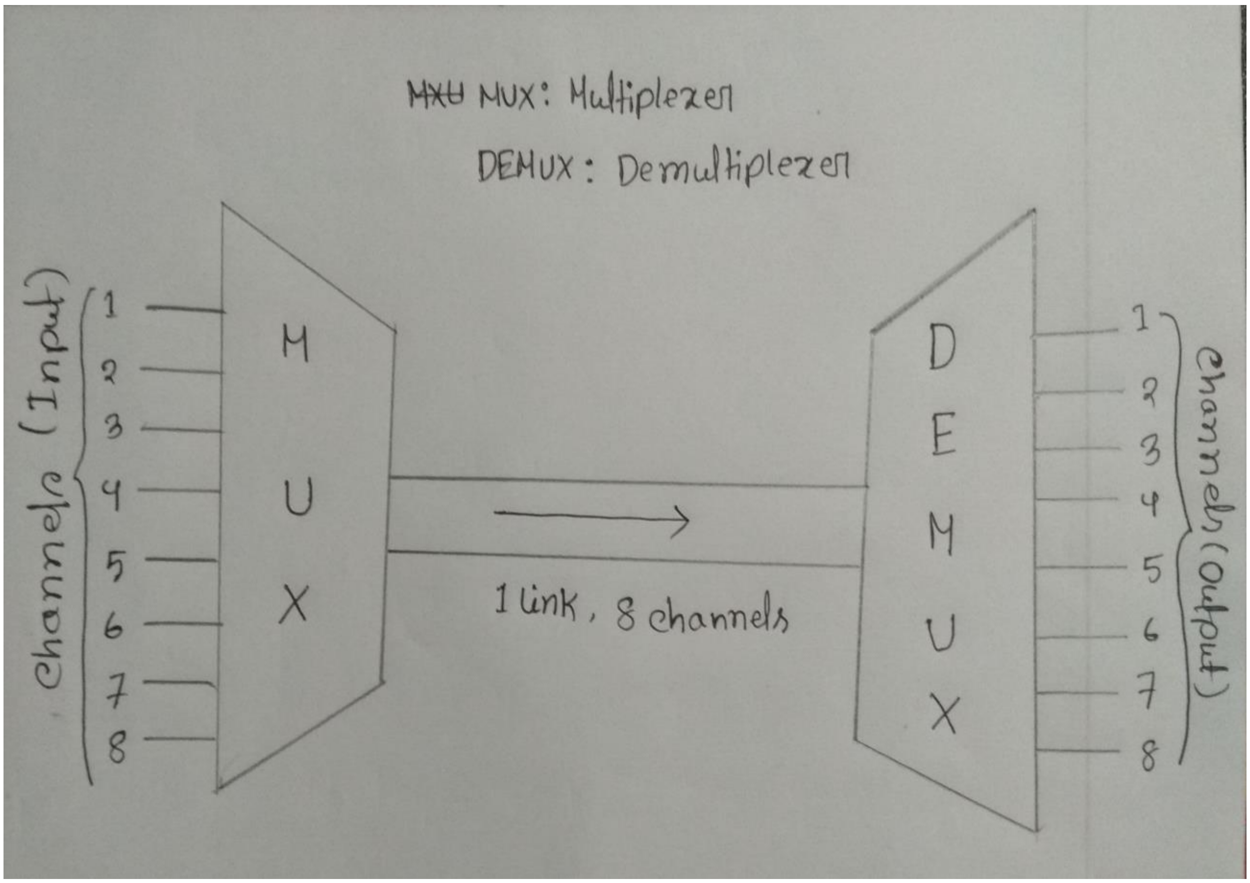

Fig: Multiplexing and Demultiplexing with 1 link and 8 channels

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Answer to the question no 1(b)

Ans: A collective class of signaling techniques are employed before transmitting a signal to provide a secure communication, known as the Spread Spectrum Modulation. The main advantage of spread spectrum communication technique is to prevent "interference" whether it is intentional or unintentional. There are two types of spread spectrum: i) FHSS and ii) DSSS. Both the spectrum FHSS and DSSS are popular for their own characteristics. To have a clear understanding, let discuss the difference between Frequency Hoping Spread Spectrum (FHSS) and Direct Sequence Spread Spectrum (DSSS):

No.	FHSS	DSSS
1	Multiple frequencies are used.	Single frequency is used.
2	Hard to find the user's frequency at any instant of time.	User frequency, once allotted is always the same.
3	Frequency reuse is allowed.	Frequency reuse is not allowed.
4	Sender need not wait.	Sender has to wait if the spectrum is busy.
5	Power strength of the signal is high.	Power strength of the signal is low.
6	Stronger and penetrates through the obstacles.	It is weaker compared to FHSS.
7	It is never affected by interference.	It can be affected by interference.
8	It is cheaper.	It is expensive.
9	This is the commonly used technique.	This technique is not frequently used.

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Now justifying their difference with the diagram of FHSS and DSSS:

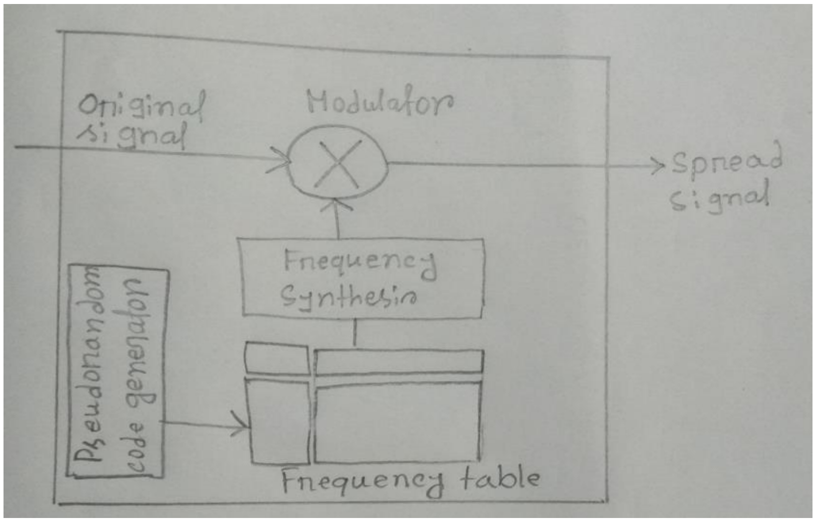

Fig: FHSS Technique

The frequency hopping spread spectrum (FHSS) technique uses a number of different carrier frequencies that are modulated by the source signal. At one moment, the signal modulates one carrier frequency; at the next moment, the signal modulates another carrier frequency.

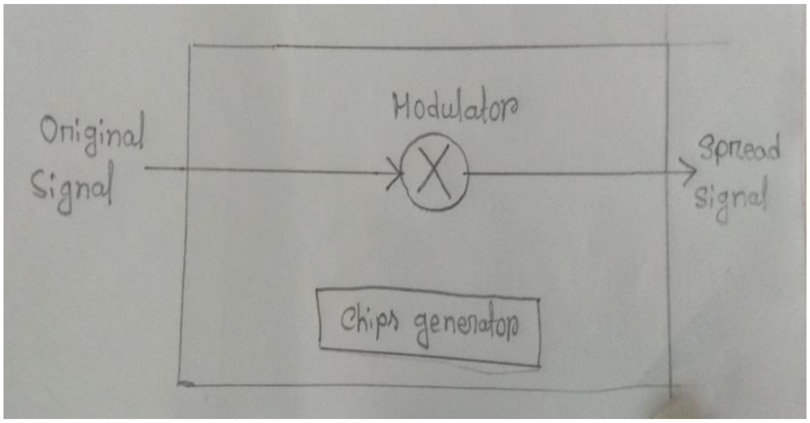

Fig: DSSS Technique

DSSS also expands the bandwidth of the signal in a different process. DSSS represents each data bit with n bits using a spreading code.

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Answer to the question no 2(a)

Ans: Time division multiplexing (FDM) is a technique of multiplexing, where the users are allowed the total available bandwidth on time sharing basis. Here the time domain is divided into several recurrent slots of fixed length. In TDM, the data flow of each input stream is divided into units. One unit may be 1 bit, 1 byte, or a block of few bytes. Each input unit is allotted an input time slot. One input unit corresponds to one output unit and is allotted an output time slot.

Example: Consider a system having four input streams, 1, 2, 3 and 4. Each of the data streams is divided into units which are allocated time slots. Hence, the time slot 1 is allotted to 4, slot 2 is allotted to 3, slot 3 is allotted to 4, slot 4 is allotted to 1, slot 5 is allocated to 4 again, and this goes on till the data in all the streams are transmitted.

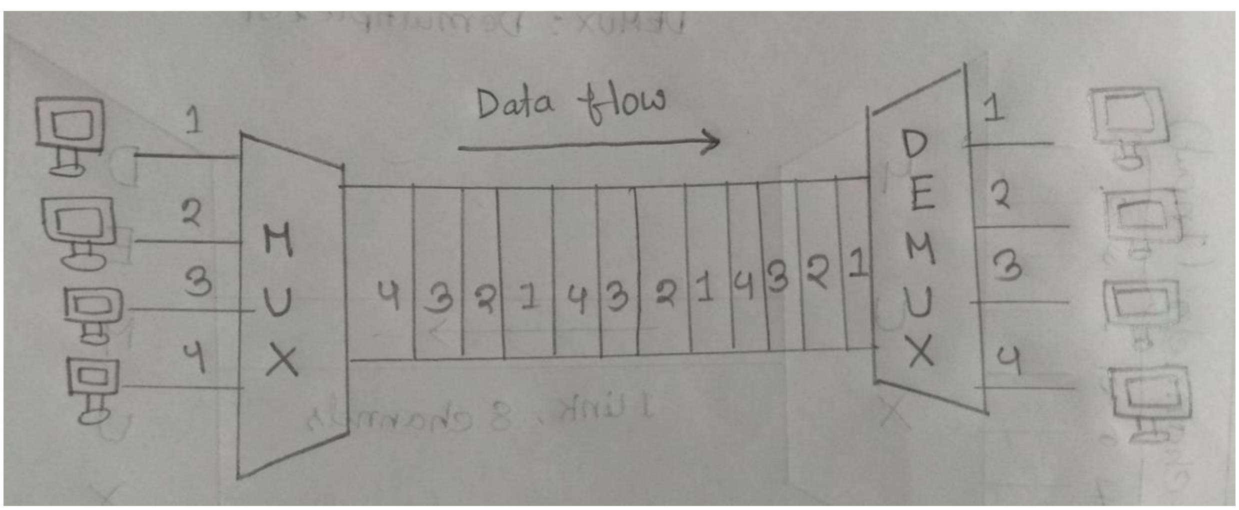

Fig: bandwidth sharing in Time-Division Multiplexing (TDM)

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So, from the figure we can see that in TDM each connection occupies the total bandwidth for a certain amount of time, instead of sharing the total bandwidth.

There are two types of Time-Division Multiplexing:

i) Synchronous and ii) Statistical

In synchronous TDM, the data flow of each input connection is divided into units, where each input occupies one input time slot. A unit can be 1bit, one character or one block of data. Each input unit becomes one output unit and occupies one output time slot. In synchronous TDM, the data rate of the link is n times faster, and the unit duration is n times shorter.

On the other hand, in statistical TDM is a technique in which time slots are not fixed as in the case of synchronous TDM. Time slots are allocated to only those devices which have the data to send. Therefore, we can say that statistical Time-division Multiplexer transmits only the data from an active workstation.

From the above explanation I can say that in TDM we divide the time in time slots or portions. Then we send the data in sequences. And it is true for both type of TDM.

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Answer to the question no 2(b)

Ans: Comparing and contrasting Packet-Switched Network with Circuit-Switched Network with appropriate diagrams in below:

Packet-Switched Network

Packet switching is a connectionless network switching technique. Here, the message is divided and grouped into a number of units called packets that are individually routed from the source to the destination. There is no need to establish a dedicated circuit for communication.

The process of packet switching:

Each packet in a packet switching technique has two parts: a header and a trailer. The header contains the addressing information of the packet and is used by the intermediate routers to direct it towards its destination. The trailer carries the actual data. A packet is transmitted as soon as it is available in a node, based upon its header information. The packets of a message are not routed via the same path. So, the packets in the message arrives in the destination out of order. It is the responsibility of the destination to reorder the packets in order to retrieve the original message.

The process is diagrammatically represented in the following figure. Here the message comprises of four packets, 1, 2, 3 and 4, which may follow different routes from the sender to the receiver.

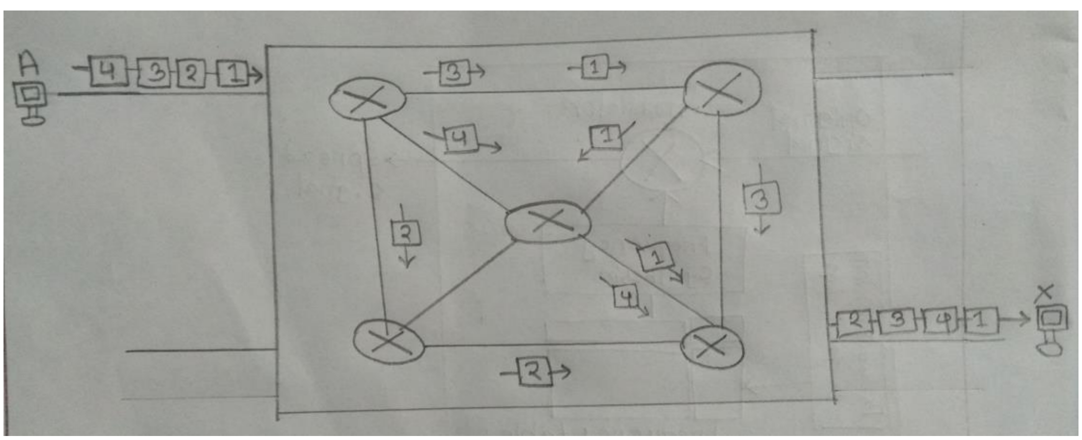

Fig: Packet switched network diagram

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Circuit-Switched Network

Circuit switching is a connection-oriented network switching technique. Here, a dedicated route is established between the source and the destination and the entire message is transferred through it.

The process of circuit switching:

- Circuit Establishment**:** In this phase, a dedicated circuit is established from the source to the destination through a number of intermediate switching centers. The sender and receiver transmits communication signals to request and acknowledge establishment of circuits.
- Data Transfer**:** Once the circuit has been established, data and voice are transferred from the source to the destination. The dedicated connection remains as long as the end parties communicate.
- Circuit Disconnection**:** When data transfer is complete, the connection is relinquished. The disconnection is initiated by any one of the user. Disconnection involves removal of all intermediate links from the sender to the receiver.

The following diagram represents circuit established between two telephones connected by circuit switched connection.

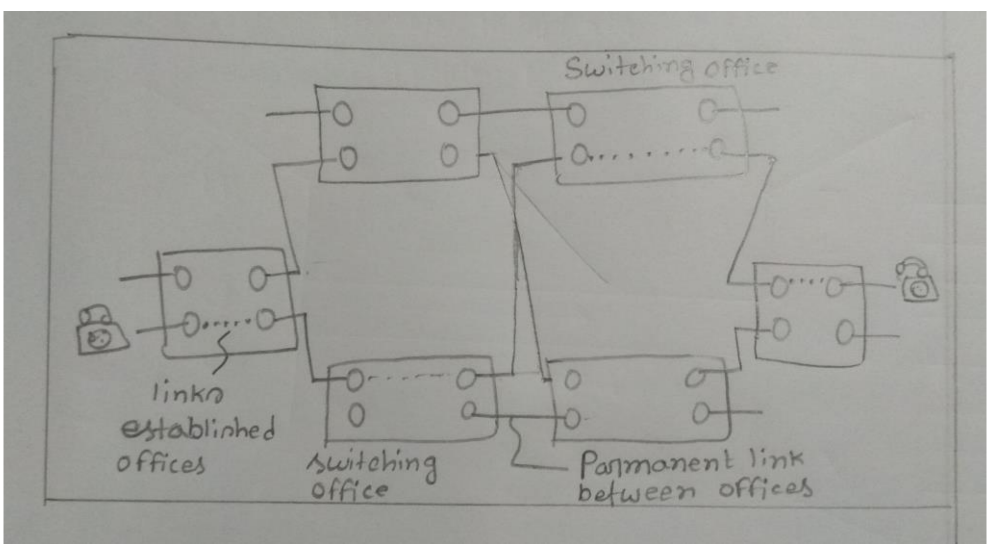

Fig: circuit switched network diagram

From the discussion above comparing and contrasting pocket and circuit switching, we can say the process of this two switching are different from one another.

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Answer to the question no 3(a)

Ans: Discussing the Best Effort performance and congestion in a datagram packet-switching network in below:

Best Effort performance:

Packet switching is similar to message switching using short messages. Any message exceeding a network-defined maximum length is broken up into shorter units, known as packets, for transmission. The packets, each with an associated header, are then transmitted individually through the network. The performance of Packet Switching is called Best Effort performance. If we transmit from sender to receiver, all the network will do its best to get the packet to the other end as fast as possible, but there are no guarantees on how fast that packet will arrive. In datagram packet switching:

- Each packet is routed independently through network.
- It is also called connectionless packet-switching.
- Routers in the internet are packet switches that operate in datagram mode.

Congestion:

Congestion relates to the general problem of traffic management for packet switched networks. Congestion means a situation in which the number of transmission requests at a specific time exceeds the transmission capacity at a certain network point (called a bottleneck resource). Congestion usually results in overload conditions. As a result, the buffers overflow, for instance, so that packets are retransmitted either by the network or by the subscriber. In general, congestion arises when the incoming traffic to a specific link is more than the outgoing link capacity. The primary function of congestion control is to ensure good throughput and delay performance while maintaining a fair allocation of network resources to users.

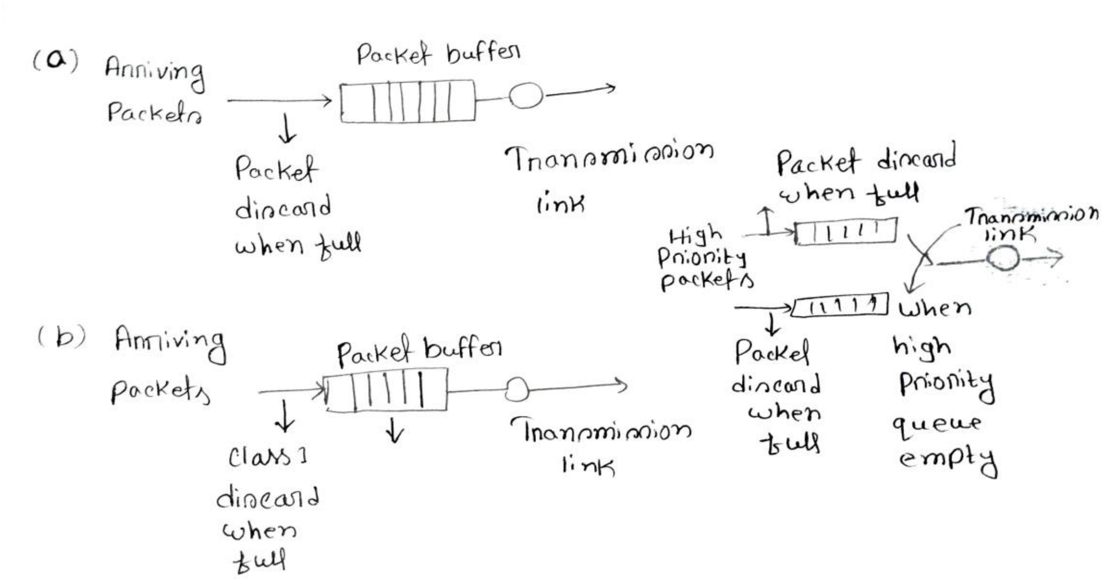

Fig: congestion in a datagram packet-switching network

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Answer to the question no 3(b)

Given, P = T/3, and there are 5 routers from source to destination.

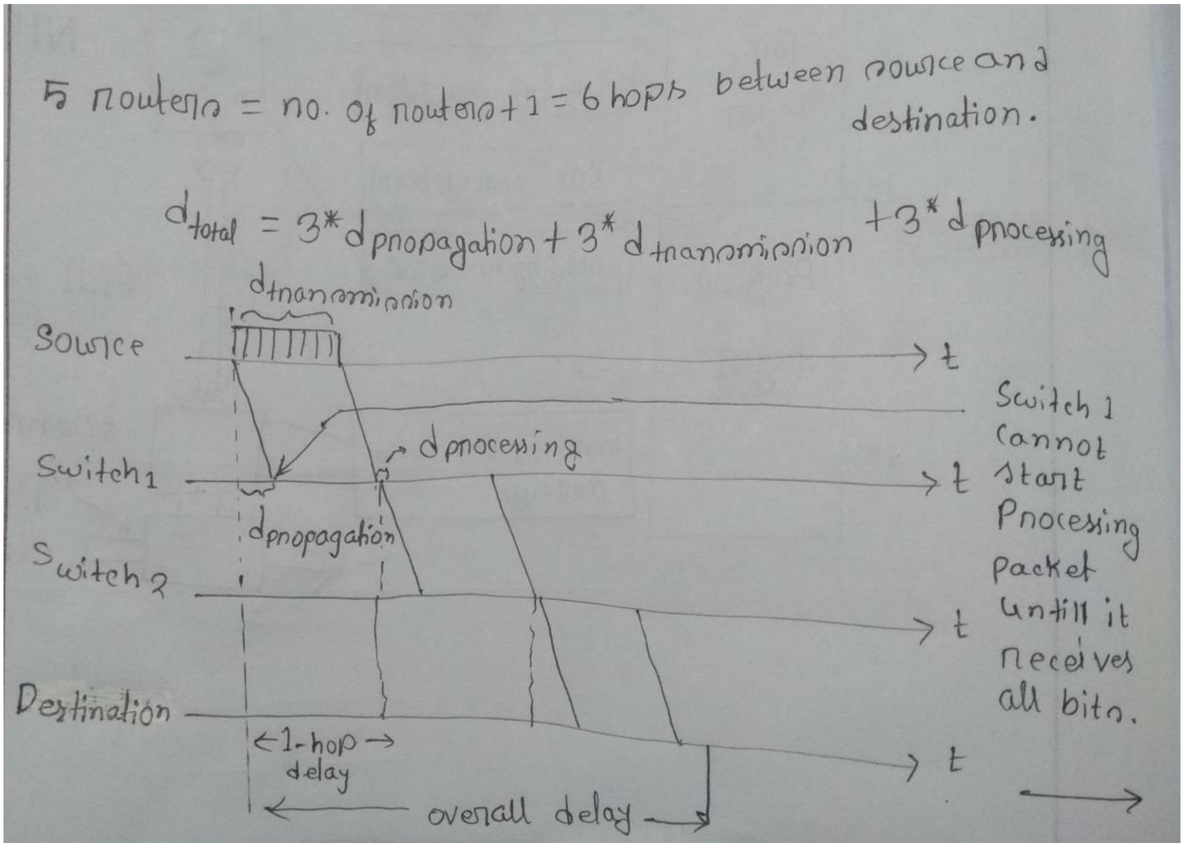

Fig: delay in case of datagram packet switching

Now, calculating delay in datagram packet switching with an appropriate diagram below:

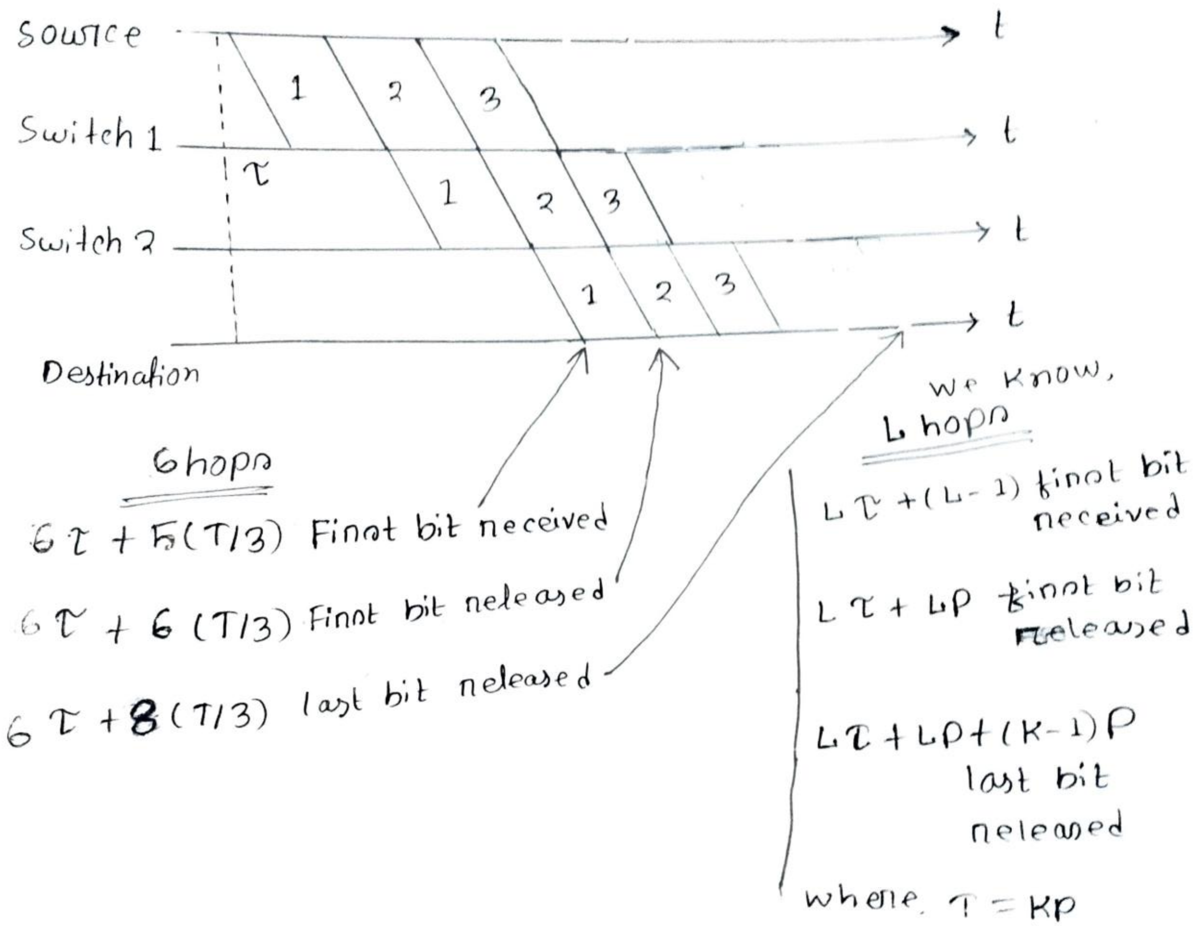

Fig: calculated delay diagram

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<u>Answer to the question no 4(a)</u>

<u>Part-1</u>

<u>Ans:</u> The refraction in Fiber optic transmission media with appropriate diagrams is given below:

A fiber-optic cable is made of glass or plastic and transmits signals in the form of light. To understand optical fiber, we first need to explore several aspects of the nature of light. Light travels in a straight line as long as it is moving through a single uniform substance. If a ray of light traveling through one substance suddenly enters another substance (of a different density), the ray changes direction.

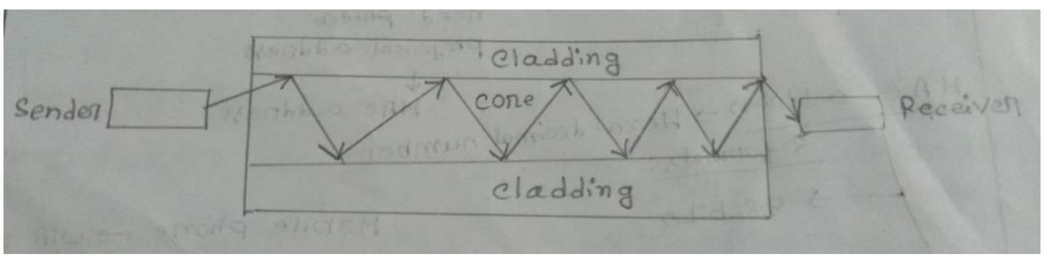

Fig1: Optical fiber refraction on transmission media

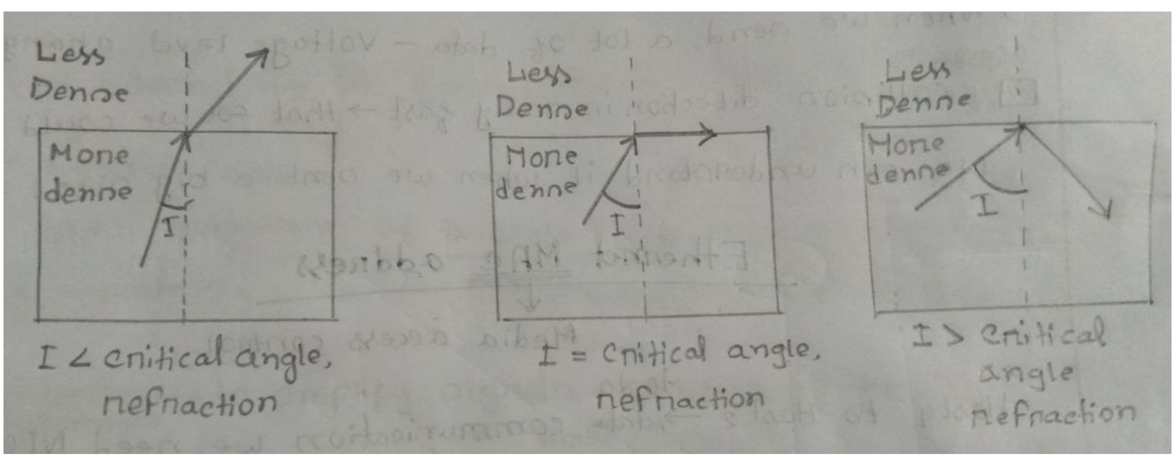

Fig2: how refraction happens

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Figure2 shows how a ray of light changes direction when going from a denser to a less dense substance. As the figure shows, if the angle of incidence I (the angle the ray makes with the line perpendicular to the interface between the two substances) is less than the critical angle, the ray refracts and moves closer to the surface. That's how refraction happens in Fiber optic transmission media. Here critical angle for refraction is 44.35 ° or 45 °.

<u>Part-2</u>

2.4 GHz and 5GHz These numbers refer to two different radio wavelengths (often called "bands" or "frequencies") currently used by most routers to transmit wireless internet connections. The two big differences between the 2.4 GHz and 5 GHz frequencies are speed and range. Major differences between 2.4GHz and 5GHz Wi-Fi networks are given below:

No	2.4 GHz	5 GHz
1.	Lower data rate	Higher data rate;
2.	more prone to interference; usually more devices using this frequency	less prone to interference; usually fewer devices using this frequency
3.	Larger coverage area;	Smaller coverage area;
4.	3 non-overlapping channels.	24 non-overlapping channels.
5.	better at penetrating solid objects	less successful at penetrating solid objects
6.	Universal Compatibility.	Limited Compatibility.
7.	Max connection speed: ~150 Mbps	Max connection speed: ~1 Gbps
8.	WIFI standards IEEE 802.11b operating frequency.	WIFI standards IEEE 802.11a operating frequency.
9.	More devices are designed to use this band.	Less devices are designed to use this band.

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Answer to the question no 4(b)

Part-1

Ans: Ethernet was the first Local Area Network (LAN) technology and remains the most important one. It was developed during the early 1970s by Xerox PARC. The original Ethernet enabled computers located within a few hundred yards of one another to exchange messages. By adding repeaters and bridges between multiple LANs, that distance has been extended to a few thousand yards. Thus, it is suitable for connecting the computers in a building or campus. Ethernet architecture is based on the concept of connecting multiple computers to a long cable, sometimes called the ether, thereby forming a bus structure. Each computer is fitted with an Ethernet adapter that includes a unique 48-bit address for that computer.

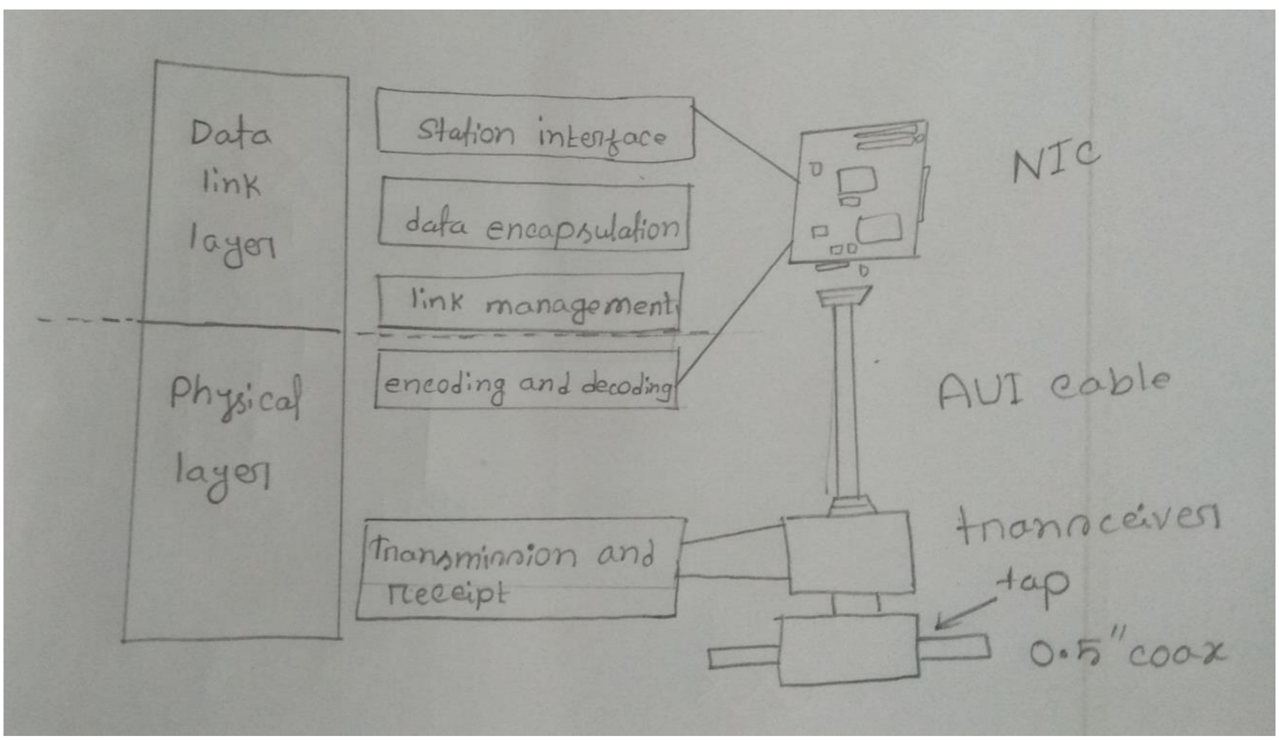

Fig: Ethernet Architecture

Here, NIC go into data link layer. We called it station interface card or network interface card. Work of this card is data encapsulation, link management, encoding and decoding. The port or wire connection that we use as plug is called trasmission and receiptor. It was called transceiver before. And it is connector of actual physical layer.

Part-2

Comparing 10Base2, 10Base5 and 10BaseT Ethernet standards in below:

10Base2:

10Base2 uses coaxial cable which is usually black, sometimes also called "Thinwire coax" "Thin Ethernet," or "RJ-58" cable. 10Base-2 uses BNC connectors which, depending on the configuration, require special terminators.10Base2 networks are wired together in a bus topology, in which individual stations (computers) are connected directly to one long cable. The maximum length of any particular segment of a 10Base2 network is 185 meters. If distances longer than this are required, two or more segments must be connected using repeaters. Altogether, there can be a total of five segments connected using four repeaters, as long as only three of the segments have stations attached to them.

10Base5:

10Base5 is sometimes referred to as “thicknet” because it uses thick coaxial cabling for connecting stations to form a network. The cable is usually yellow color. The maximum length is 500 meters. Also, special connectors are used to interface to the network card. A 10Base5 segment should have no more than 100 stations wired to it. These stations are not connected directly to the thicknet cable as in 10Base2 networks. Instead, a transceiver is attached to the thicknet cable, usually using a cable-piercing connector. From the transceiver, a drop cable is attached, which then connects to the NIC in the computer. The minimum distance between transceivers attached to the thicknet cable is 2.5 meters, and the maximum length for a drop cable is 50 meters.

10BaseT:

10BaseT is the most popular form of 10-Mbps Ethernet, using unshielded twisted-pair (UTP) cabling for connecting stations, and using hubs to form a network. It is more segmented then 10 Base 2 and 10 Base 5. 10BaseT supports a maximum bandwidth of 10 Mbps. 10BaseT networks are wired together in a star topology to a central hub. The UTP cabling used for wiring should be category 3 cabling, category 4 cabling, or category 5 cabling, terminated with RJ-45 connectors. Patch panels can be used to organize wiring and provide termination points for cables running to wall plates in work areas. Patch cables then connect each port on the patch panel to the hub. Usually, most of the wiring is hidden in a wiring cabinet and arranged on a rack for easy access. The maximum length of any particular segment of a 10BaseT network is 100 meters. If distances longer than this are required, two or more segments must be connected using repeaters.