Explain TCP/IP reference model in brief.

The four layers in the TCP/IP protocol suite are −

- **Host-to- Network Layer −**It is the lowest layer that is concerned with the physical transmission of data. TCP/IP does not specifically define any protocol here but supports all the standard protocols.
- **Internet Layer −**It defines the protocols for logical transmission of data over the network. The main protocol in this layer is Internet Protocol (IP) and it is supported by the protocols ICMP, IGMP, RARP, and ARP.
- **Transport Layer −** It is responsible for error-free end-to-end delivery of data. The protocols defined here are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).
- **Application Layer −** This is the topmost layer and defines the interface of host programs with the transport layer services. This layer includes all high-level protocols like Telnet, DNS, HTTP, FTP, SMTP, etc.

A digital signalling system is required to operate at 9600 bps. If a signal element encodes a 4-bit word, determine the minimum required bandwidth of the channel.

Using Nyquist's equation: $C = 2B \log_2 M$

We have C = 9600 bps

$\log_2 M = 4$, because a signal element encodes a 4-bit word

Therefore, C = 9600 = 2B x 4, and

B = 1200 Hz

A channel has a data rate of 4 kbps and a propagation delay of 20ms. For what range of frame sizes does stop and wait protocol give an efficiency of at least 50%?

$$a = \frac{Propagation\ Delay}{Transmission\ Time} = \frac{20 \times 10^{-3}}{\frac{L}{4 \times 10^3}}$$

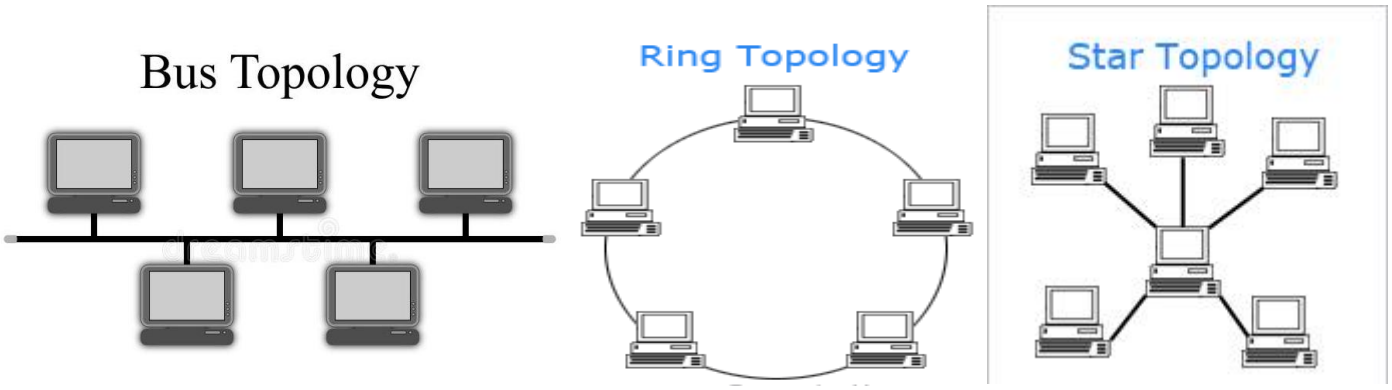
Using the maximum possible utilization expression:

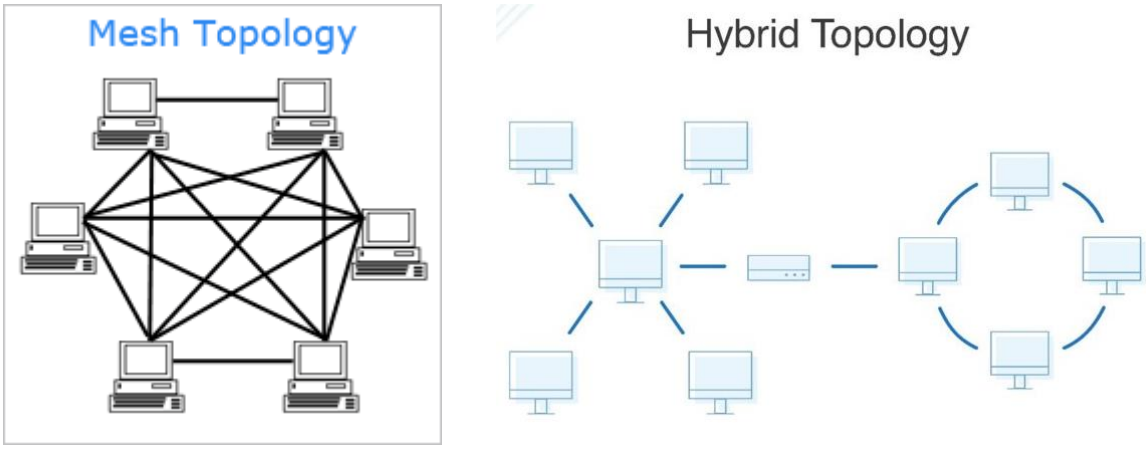
$$U = \frac{1}{1+2a} = \frac{1}{1+\frac{160}{L}} \geq 0.5$$

$$L \geq 160$$

Therefore, an efficiency of at least 50% requires a frame size of at least 160 bits.

Draw the schematic diagrams showing different topologies of local area networks





Explain the difference between a store and forward switch and a cut through switch.

Store-and-Forward Switching	Cut-through Switching
The switching device waits to receive the entire frame before forwarding the data packet.	The switching device forwards the data packet as soon as the destination address is received and doesn't wait for the entire frame to be received.
It is not further classified into different types.	Cut through switching is further classified as Rapid frame forwarding and Fragment free.
It has high latency rate	It has low latency rate
It is more secure	It is less secure

Store-and-Forward Switching	Cut-through Switching
It has a high waiting time	It has a low waiting time
It does not limit routing or arbitration decisions in switches.	It puts a limit on routing or arbitration decisions in switches between source and destination.
It has networks with more storage requirements.	It has less storage requirement.
Example: Telecommunication networks or transmission across networks requiring high mobility.	Example: Communication via fiber channel and low latency transmission for SCSI transmission.

What is multicasting? Mention its important applications?

Multicasting is a group communication technology that allows a single source to send data to multiple receivers simultaneously. This can save bandwidth and improve performance, especially for applications such as live streaming and content distribution. However, multicasting can also be a security risk and can be difficult to manage.

- **Live streaming:** Multicasting is used to send a single stream of data to a large number of receivers simultaneously, saving bandwidth and improving performance.
- **Content distribution:** Multicasting is used to send a single copy of content to a large number of receivers, saving bandwidth and improving performance.
- **Network gaming:** Multicasting is used to send a single stream of data to all players in a multiplayer online game, improving performance and reducing latency.
- **VoIP**: Multicasting is used to transmit VoIP traffic, improving the quality of the voice calls and reducing the latency.
- **Broadcasting:** Multicasting is used to broadcast content to a large number of receivers, such as news broadcasts and weather alerts.
- **Education:** Multicasting is used to deliver educational content to a large number of students, such as online courses and webinars.
- **Simulation:** Multicasting is used to simulate the behavior of a large number of entities, such as traffic simulation and military simulations.

Discuss ISO-OSI reference model in detail.

The OSI model divides the process of data communication into seven layers:

- **Physical layer:** This layer is responsible for the physical transmission of data over the network. It defines the electrical, mechanical, and procedural specifications for how data is transmitted over the physical medium, such as a copper cable or a wireless signal.

- **Data link layer:** This layer is responsible for error detection and correction. It ensures that data is transmitted reliably over the physical layer by adding error-checking bits to the data stream.
- **Network layer:** This layer is responsible for routing data between different networks. It determines the best path for data to travel from one network to another.
- **Transport layer:** This layer is responsible for providing a reliable connection between two hosts. It ensures that data is delivered in the correct order and that no data is lost.
- **Session layer:** This layer is responsible for managing the dialogue between two hosts. It establishes, maintains, and terminates sessions between hosts.
- **Presentation layer:** This layer is responsible for formatting data for presentation to the user. It ensures that data is presented in a way that is understandable by the user's application.
- **Application layer:** This layer is responsible for providing services to the user. It provides a variety of services, such as file transfer, email, and web browsing.

What is the relationship between data rate and bandwidth?

Data rate is the speed at which data is transferred between two points. It is measured in bits per second (bps).

Bandwidth is the maximum amount of data that can be transferred between two points in a given period of time. It is measured in hertz (Hz).

The relationship between data rate and bandwidth is that data rate is a function of bandwidth i.e. the data rate cannot exceed the bandwidth of the network.

What are impairments in wireless communication? Describe those

Impairments in wireless communication are any factors that degrade the quality of the signal as it travels from the transmitter to the receiver.

- **Noise:** Noise is any unwanted signal that is added to the transmitted signal. Noise can be caused by a variety of factors, such as thermal noise, interference from other signals, and environmental noise.
- **Attenuation:** Attenuation is the loss of signal strength as it travels through the transmission medium. Attenuation can be caused by a variety of factors, such as the distance between the transmitter and the receiver, the frequency of the signal, and the properties of the transmission medium.
- **Distortion:** Distortion is any change in the shape of the signal as it travels through the transmission medium. Distortion can be caused by a variety of factors, such as non-linearities in the transmission medium, multipath propagation, and Doppler shift.

Illustrate the difference between guided media and unguided media.

S.No.	Guided Media	Unguided Media
1.	In guided media, the signal energy communicates via wires.	In unguided media, the signal energy communicates through the air.
2.	Guided media is generally preferred when we want to execute direct communication.	Unguided media is generally preferred for radio broadcasting in all directions.
3.	The guided media formed the different network topologies.	The unguided media formed the continuous network topologies.
4.	Here, the signals are in the state of current and voltage.	Here, the signals are in the state of electromagnetic waves.
5.	In the case of guided media, the transmission capacity can be boosted by counting more wires.	In the case of unguided media, it is not feasible to acquire more capacity.
6.	Open Wire, Twisted Pair, Coaxial Cable, and Optical Fibre are the different kinds of guided media.	Microwave Transmission, Radio Transmission, and Infrared Transmission are the types of unguided media.

A typical channel has 300 Hz bandwidth and signal to noise ratio of 3 db. Assuming white thermal noise, determine the capacity of the channel.

The channel capacity for a teleprinter is 600 bps.

Given:

Bandwidth (**B**) = 300 Hz

Signal to Noise Ratio (**SNR**) = 3 dB

To Find:

The Channel Capacity of a Teleprinter.

Solution:

Channel capacity is the maximum rate at which the information can be transmitted through a channel. Its measuring unit is bits per second.

For Finding the Channel Capacity,

Channel capacity can easily be calculated by Shannon's equation.

The Equation is,

$$Channel\ Capacity = B\ *\ log(1 + SNR)$$

Now by inserting the given values,

$$Channel\ Capacity = 300\ *\ log(1 + 3)$$
$$Channel\ Capacity = 300\ *\ log(4)$$
$$Channel\ Capacity = 300\ *\ 2$$
$$Channel\ Capacity = 600\ bps$$

The **capacity of the channel comes to be 600 bits per second**.

Discuss different design issues of data link layer.

- **Frame synchronization:** The data link layer must ensure that the sender and receiver are synchronized on the data frames being transmitted. This is necessary because the data frames may be corrupted or lost during transmission, and the receiver must be able to resynchronize with the sender in order to recover the data.
- **Error detection and correction:** The data link layer must detect and correct errors that occur during transmission. This is necessary because the physical layer is not always reliable, and errors can occur due to noise, interference, or other factors.
- **Flow control:** The data link layer must control the flow of data between the sender and receiver. This is necessary because the sender may be sending data faster than the receiver can receive it, and the data link layer must prevent the sender from overwhelming the receiver.
- **Media access control:** The data link layer must control access to the shared medium. This is necessary in networks where multiple nodes share the same physical medium, such as a bus or a wireless network.

Describe one Bit sliding window protocol.

- The sender can only send one frame at a time.
- The sender maintains a "window" of frames that have been sent but not yet acknowledged.
- The window size is one frame.
- When the sender sends a frame, it sets a bit in the window to indicate that the frame has been sent.
- If the receiver receives the frame correctly, it sends an acknowledgement back to the sender.
- The sender then clears the bit in the window to indicate that the frame has been acknowledged.
- If the receiver does not receive the frame correctly, it does not send an acknowledgement.
- The sender will then retransmit the frame.

Explain the use of Binary exponential back off algorithm in case of collision.

1. **Collision Detection:** Devices detect collisions during transmission and send a jam signal.
2. **Backoff Time Calculation:** Devices calculate a random wait time using the binary exponential backoff algorithm.
3. **Exponential Increase:** The backoff time increases exponentially after each collision.

4. **Random Selection:** Devices randomly choose a time slot within the calculated range to retransmit data.
5. **Retransmission:** Devices attempt to transmit data after the selected backoff time elapses.
6. **Maximum Retransmission Attempts:** A limit is set to prevent indefinite retransmissions.

Discuss high speed LANS in detail.

High-speed LANs are local area networks (LANs) that offer data transfer rates of 100 Mbps or more.

- **Fast Ethernet:** Fast Ethernet is a 100 Mbps version of Ethernet. It is backward compatible with 10 Mbps Ethernet, so it can be used to upgrade existing networks.
- **Gigabit Ethernet:** Gigabit Ethernet is a 1 Gbps version of Ethernet. It is much faster than Fast Ethernet, and it is becoming increasingly popular for high-bandwidth applications.
- **10 Gigabit Ethernet:** 10 Gigabit Ethernet is a 10 Gbps version of Ethernet. It is the fastest version of Ethernet available, and it is used for applications that require the highest possible bandwidth, such as high-definition video streaming.
- **Fiber Distributed Data Interface (FDDI):** FDDI is a high-speed token ring LAN that offers data transfer rates of up to 100 Mbps. It is a reliable and scalable technology, and it is often used as a backbone for high-speed networks.
- **Asynchronous Transfer Mode (ATM):** ATM is a high-speed networking technology that is designed to support a variety of traffic types. It offers data transfer rates of up to 10 Gbps, and it is often used for high-performance applications.

Advantages of High Speed LAN: High bandwidth, Better scalability and Improved reliability

Disadvantages of High Speed LAN: Higher cost, More complex installation and Equipment compatibility

Mention the functions performed by the following: (a) Repeater (b)Switch (c) Bridge

Device	Function	Layer
Repeater	Amplifies and retransmits signals	Physical
Switch	Connects multiple devices on a network	Data Link
Bridge	Connects two separate networks	Data Link

Explain the concept of routing with virtual circuit subnet

Routing with virtual circuit subnet is a method of routing data packets through a network that uses virtual circuits. A virtual circuit is a logical connection between two devices on a network.

There are three phases of transmission by virtual circuits, set up, data transfer and teardown.

- **Set up Phase** − In this phase, a virtual circuit or a route is established from the source to the destination through number of switches. The source and destination use global addresses using which the switches make routing table entries.
- **Data Transfer** − Once the virtual circuit is set up, all packets follow the route established during the set up phase adhering to the routing tables.
- **Teardown Phase** − When data transfer is complete, the source sends a teardown request. The destination responds using a teardown confirmation. The switches flush their routing table entries, thus relinquishing the circuit.

What is link state routing? How does router learn about its neighbours?

Link state routing is a dynamic routing protocol in which each router in the network shares information about its neighbors with every other router in the network. This information includes the cost of the links to each neighbor, as well as the state of the links (whether they are up or down).

Routers learn about their neighbors in two ways:

- **Active learning:** Routers actively send link-state advertisements (LSAs) to their neighbors. These LSAs contain information about the router's neighbors and the cost of the links to each neighbor.
- **Passive learning:** Routers can also learn about their neighbors by listening to LSAs that are sent by other routers.

What is congestion? Also mention congestion prevention policies.

Congestion is a situation in which the demand for network resources exceeds the available capacity. This can lead to delays, packet loss, and other performance problems.

There are two main types of congestion:

- **Link congestion:** This occurs when the capacity of a link is exceeded. This can happen when there is too much traffic on the link, or when the link is experiencing a failure.
- **Node congestion:** This occurs when the processing capacity of a node is exceeded. This can happen when there are too many packets arriving at the node, or when the node is experiencing a failure

The congestion control policies can be divided into two categories:

- **Open loop congestion control:** These policies are used to prevent congestion before it happens. They are implemented by the sender or receiver of packets.
- **Closed loop congestion control:** These policies are used to remove congestion after it has happened. They are implemented by the routers in the network.

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Some congestion prevention policies are:

- **Slow start:** This is an open loop congestion control policy that is used by TCP. It starts with a small window size and gradually increases the window size as packets are acknowledged.
- **Fast retransmit:** This is a closed loop congestion control policy that is used by TCP. It retransmits packets that are not acknowledged after a certain number of retransmissions.
- **Weighted fair queuing:** This is a closed loop congestion control policy that is used by routers. It assigns different weights to different flows of traffic, so that each flow gets a fair share of the available bandwidth.

Write a note on Internet work protocols.

Internetwork protocols are the rules that govern how computers communicate with each other over the internet. They define how data is packaged, addressed, routed, and delivered. They allow computers to communicate with each other and share data. Without internetwork protocols, the internet would not be possible.

Some important Internetwork protocols are:

Protocol	Function
IP	Provides addressing and routing for datagrams over the internet.
TCP	Provides reliable delivery of data over the internet.
UDP	A connectionless protocol that is used for applications that do not require reliable delivery of data.
ICMP	Used for error reporting and control messages.
RIP	A dynamic routing protocol that is used to exchange routing information between routers.