CT-03

Physical layer and Transport layer

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01.

ⓐ What is physical layer? Give an example of physical layer. 4

Ans :

The physical layer is the first and lowest layer of the Open System Interconnection Model (OSI Model). The physical layer also known as layer 1 deals with bit level transmission between different devices and supports electrical or Mechanical interfaces connecting to the physical medium for synchronized communication. This layer may be implemented by a PHY chip. The physical layer defines the means of transmitting a raw bits over a physical data link connecting network nodes.

Physical layer example:

Devices and network components that are associated with the physical layer, for example, the antenna and the compiler, plug and socket for the network cable, the reapeater, the stroke, the transceiver, the T-bar and the terminator are (Terminator).

(b) What are the services of physical ~~net~~ layer in computer network? 5

Ans:

The physial layer is the lowest layer. This layer provides mechanical, electrical and other functional aids available to enable or disable. they maintains and transmit bits about

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physical connections. This may for example be electrical signals, optical signals, electromagnetic waves. The techniques used are called technical transmission process.

Services of physical layer:

1. Bit-by-bit or Symbol-by-symbol delivery.
2. Modulation.
3. Line coding.
4. Bit synchronization.
5. Start-stop signalling.
6. Circuit switching.
7. Multiplexing.
8. Carrier sense and collition detection.
9. physical network topology, like bus, ring, mesh or star network.

(c) Write down the name of the popular physical layer technologies?

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Ans:

In the seven layer OSI model of computer networking, the physical layer or layer 1 is the first and lowest layer. The implementation of this layer is often termed PHY.

Popular physical layer technologies:

1- Wire

ARINC 818 Avionics Digital Video Bus.

Blutooth Physical layer

CAN bus (controller area network) physical layer

DSL

EIA RS-232 also EIA-422, EIA-423, RS-449, RS-485

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Etherloop

Ethernet physical layer 10BASE-T, 10BASE2, 10BASE-5, 10BASE-TX, 10BASE-FX, 100BAS 1000BASE-T, 1000BASE-SX and others.

GSM ~UM air interface physical

G.hn/G.9960 Physical layer.

I²C, I²S

IEEE 1394 interface

ISDN

IRDA physica layer

ITU

Mobile Industry processor. Interface physical layer.

OTN Optical Transport Network.

SMB

Telephone network modems

USB physical layer.

02.

ⓐ What is Signal and Transmitter? Explain: 4

Ans:

⇒ Signal :

A signal is an electrical current or electromagnetic field used to convey data from one place to another.

⇒ ~~T~~ransmitter :

A transmitter encoded a message into a signal, which is carried to a receiver by the communications channel.

⇒ Signals can be interpreted as either

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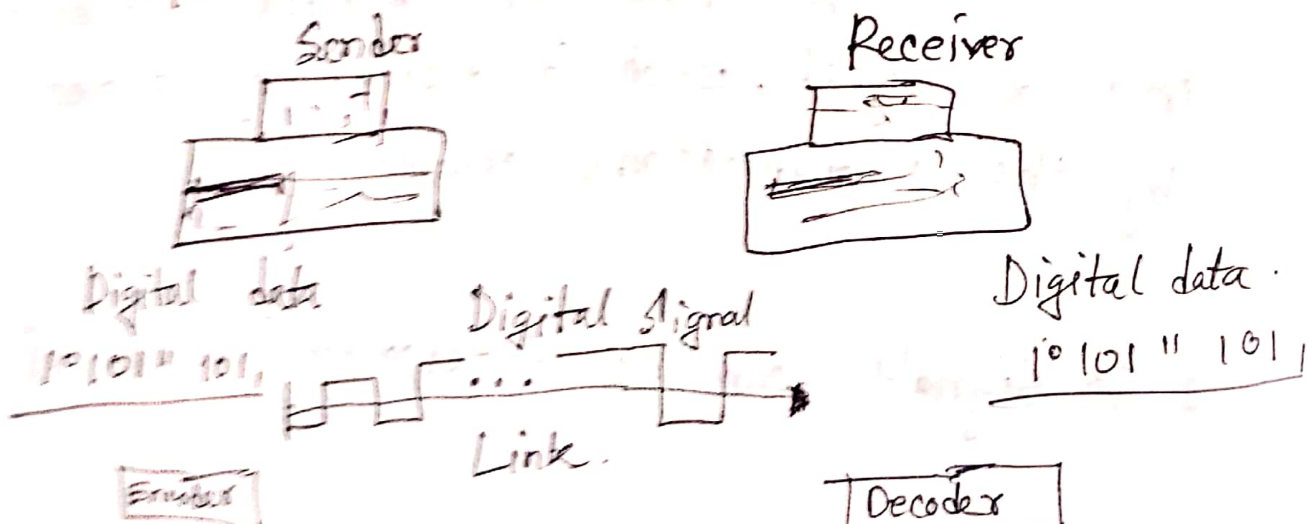
Analogue or Digital.

(b) Digital signals are non-continuous and Anal[illegible] signals are continuous - its it true or false? Write your answer with a proper diagram. 6

Ans:

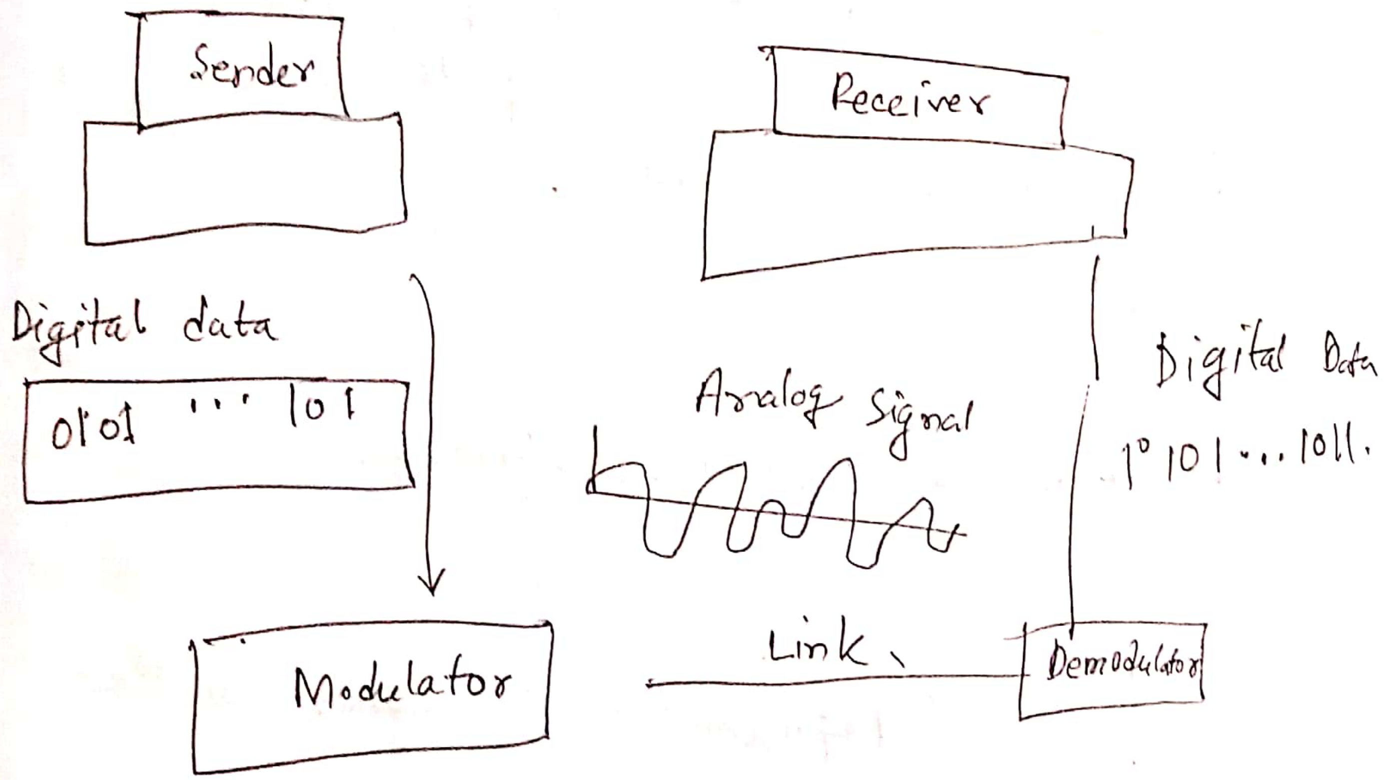
Yes. True.

Digital signal are non continuous, they change in individual steps. They consist of puls[illegible] or digits with discrete levels or values. [illegible] value of each pulse is constant, but there is an abrupt change from one [illegible] to the next. Digital signals have two amplitude levels.



Yes, Analog signal are continuous, non discrete.

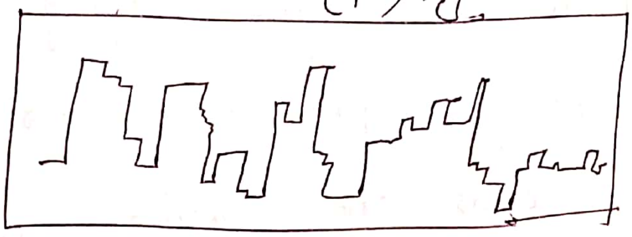
At it's base, an analog signal is a continuous signal in which one-time varying quantity (such as voltage, pressure etc) represents another time-based variable. In other words, one variable is an analog of the other.



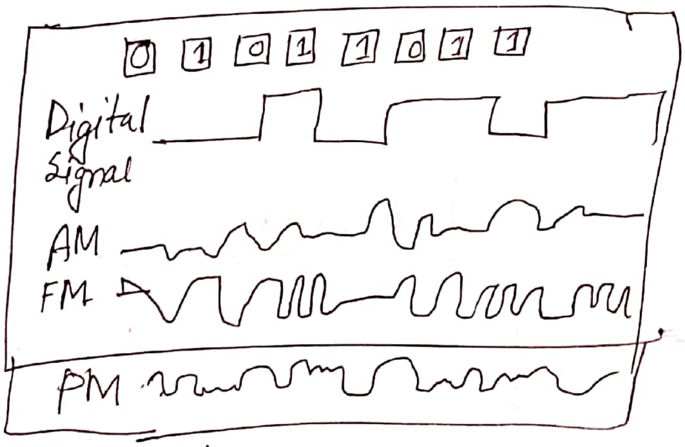
9)

ⓒ Draw the Representation s of Signal on the physical Media. 4

Outbound (Tx) signal



Sample electrical signals transmitted on copper cable.



Respresentative light pulse fiber signals.

Microwave (wireless) signals.

Figure : Representation of signals on the physical Media.

Q3.

(a) How many ways data transfer can be measured? Explain briefly. 7

Ans: Different physical media support the transfer of bits at different speeds. Data transfer can be measured in three ways. These are:

(i) Bandwidth: The capacity of a medium to carry data is described as the raw data bandwidth of the Media. Digital bandwidth measures the amount of information that can flow from one place to anothe is a given amount of time. Bandwidth is typically measured in kilobits per second (Kbps) or Megabits per second (Mbps).

(ii) Throughput: Throughput is the measure of the transfer bits across the media over a given period of time.

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Due to a number of factors, throughput usually does not match the specified bandwidth in Physical layer implementations such as Ethernet.

Goodput :

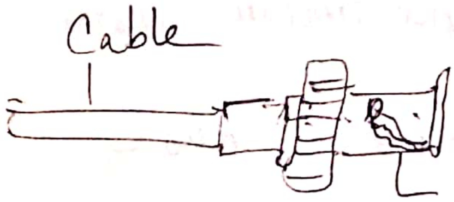
A third measurement has been created to measure the transfer of usable data. Goodput is the measure of usable data transferred over a given period of time. ~~Goodput~~ is therefore the measure that is of most interest to network users.

(b) Briefly Explain Connectors with appropriate figure ? 7

Ans: To connect coaxial cable to

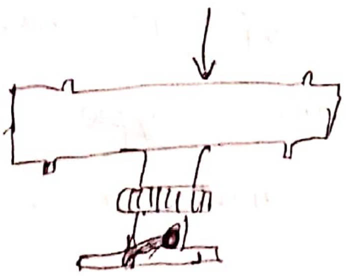
to devices , it is necessary to use coaxial connectors. The most common type of connectors is the Bayone – Neill concelman, or BNC, connectors. BNC connectors are sometimes reffered to as bayonet mount as they can be easily twisted on or off. There are three types: the BNC connector, the BNC T connector, the BNC terminator.

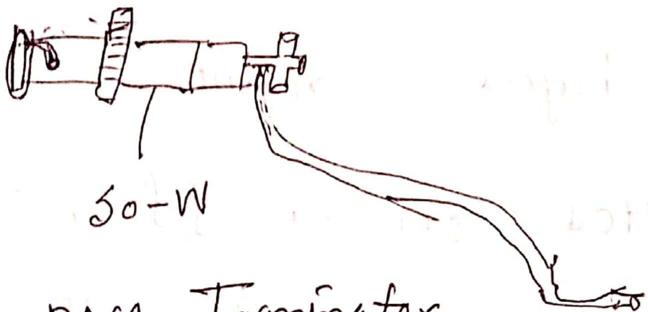
Co axial cable applications include analog and digital telephone networks, cable TV networks, Ethernet LANs and short range connections.



BNC Connector.

BNC T





BNC Terminator Ground ~~wire~~ wire

04.

(a) Explain Nyquist theorem? 3

Ans: Nyquist theorem: To transmit at a ~~transactio~~ transmission rate of f_b Hz requires a minimum bandwidth of of $H_{min} = f_b/2$ Hz.

→ This specifies the maximum data rate for the noiseless case as:

~~fd mc~~

$f_d \, max = 2H \log_2(V)$ bps.

Where V is the number of discrete levels in the signal and H is the maximum bandwith.

(b) Explain shanon's theorem? 3

Ans:

Shanon's theorem:

If information rate does not exeed channel capacity, there exists a coding technique such that information can be transmitted over a noisy channel, error free. The channel capacity provides the maximum possible data rate for the general noisy case as:

$$H \log_2 (1 + S/N) \text{ bps.}$$

(c) Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. ~~The maximu~~ What will be SNR_{dB}. 8

<u>Answer:</u>
Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. The maximum bit rate can be calculated as,

$$\text{Bit Rate} = 2 \times 3000 \times \log_2 2 = 6000 \text{ bps}$$

We can calculate theoritical highest bit rate of a regular telephone line.

A telephone line normally has a bandwidth of 3000. The signal-to-noise ratio is usually 3162. For this ~~cap~~ channal the capacity is calculated as,

$$C = B \log_2 (1 + SNR) = 3000 \log_2 (1 + 3162)$$

$$= 3000 \log_2 3163$$

$$= 3000 \times 11.62$$

$$= 34860 \text{ bps.}$$

The signal-to-noise is often given in decibels. Assume that $SNR_{dB} = 36$. and the channel bandwidth is 2 MHz. The theoritical channel capacity can be calculated as,

$$SNR_{dB} = 10 \log_{10} SNR \longrightarrow SNR = 10^{SNR_{dB}/10}$$

$$\longrightarrow SNR = 10^{3.6} = 3981$$

$$\therefore C = B \log_2 (1 + SNR) = 2 \times 10^6 \times \log_2 3982$$

$$= 24 \text{ Mbps.}$$

05.

(a) Express a period of 100 ms in microseconds, and express the corresponding frequency in kilohertz? 6

Ans:

Given,

$t = 100$ ms.

We know,

$1\ ms = 10^{-3} s.$

$\therefore 100\ ms = 100 \times 10^{-3}\ s$

$= 10^{-1} s$

Again, $1\ s = 10^{6}\ \mu s$

$\therefore 10^{-1} s = 10^{-1} \times 10^{6}\ \mu s$

$= 10^{5}\ \mu s.$

Now we use the inverse relationship to find the frequency changing hertz to kilohertz:

$100\ ms = 100 \times 10^{-3}\ s = 10^{-1} s.$

$$f = \frac{1}{10^{-1}} \text{ Hz}$$

$$= 10 \times 10^{-3} \text{ KHz}$$

$$= 10^{-2} \text{ KHz}.$$

(b) A sine wave is offset one-sixth of a cycle with respect to time zero. What is it's phase in degrees and radians? 5

Ans: We know that one complete cycle is 360 degrees.

There fore,

$1/6$ cycle is,

$$\left(\frac{1}{6}\right) \times 360 = 60 \text{ degrees} = 60 \times 2\pi/360 \text{ rad}.$$

$$= 1.046 \text{ rad}.$$

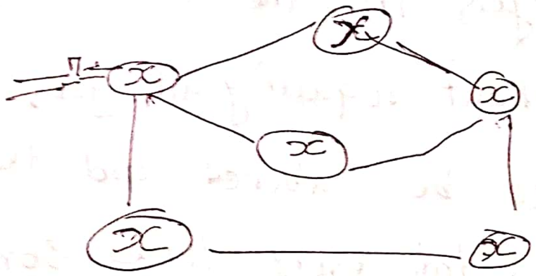
(c) Explain Bandwidth ? 3

Ans: Bandwidth describes the maximum data transfer rate of a network or internet connection. It measures how much data can be sent over a specific connection in a given amount of Time. For example a gigabit Ethernet connection has a bandwidth of 1000 Mbps (125 megabytes per second).

(06) (a) Define Routing Algorithms ? Describe properties of routing algorithm? 7

Answer:

Definition: The routing Algorithm is that part of the network layer software responsible for deciding which output line an incoming packet should be transmitted on.



Properties of routing algorithm:

Correctness, simplicity, robustness, stability, fairness and optimality.

1. Robustness:

Once a major network comes on the air, it may be expected to run continuously for years without system-wide failures. During that period there will be hardware and software failures of all kinds. Hosts, routers, and links will fail repeatedly, and the topology will change many times.

The routing algorithm should be able to cope with changes in the ~~tech~~ topology and traffic without requiring all jobs in all hosts to be aborted and the network to be rebooted every time some router crashes.

3) Stability:

It is also an important goal for the routing algorithm. There exist routing algorithms that never converge to equilibrium, no matter how long they run. A stable algorithm reaches equilibrium and stays there.

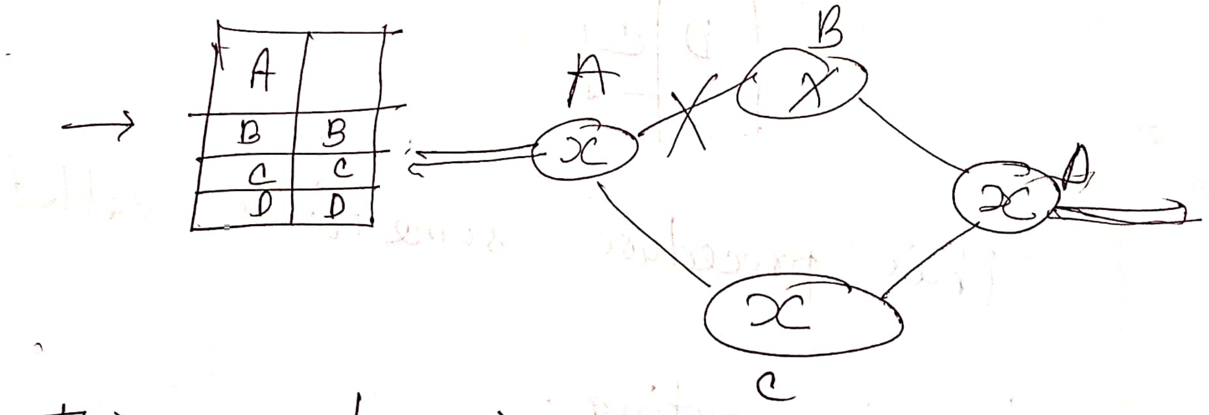
4) Fairness and optimality may sound obvious, but as it turns out, they are often contradictory goals.

(b) Described adaptive and nonadaptive algorithm? 7

Ans:

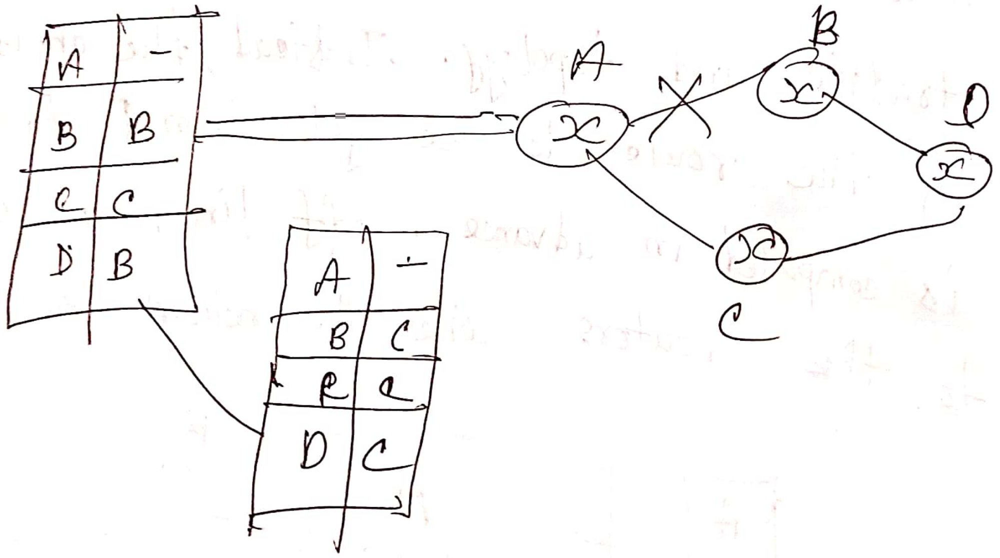
Nonadaptive algorithms:

Non adaptive algorithms do not base their routing decisions on measurements or estimates of the current traffic and topology. Instead, the choice of the route to use get from I to J is computed in advance, off line, and downloaded to the routers when the network is booted.



This procedure is sometimes called static routing.

Adaptive algorithms; in contrast, change their routing decisions to reflect changes in the topology and usually the traffic as well.



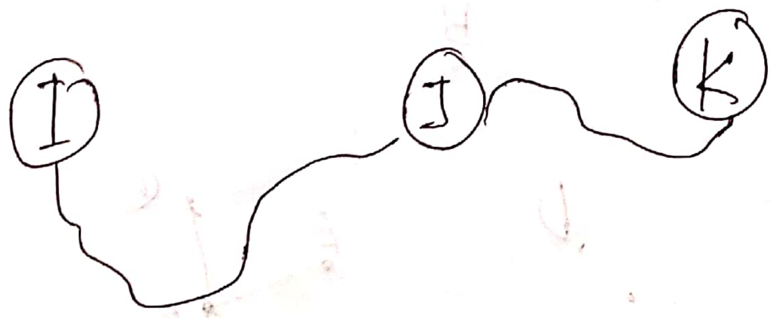
This procedure sometimes called dynamic routing.

07.

(a) Describe the Optimality Principle routing algorithm ? 7

Ans :

The Optimality Principle : If router J is on the optimal path from router I to router K, then the optimal path from J to K also falls along the same route,



The set of optimal routes from all sources to a given destination form a tree rooted at the destination. Such a tree is called a sink tree.

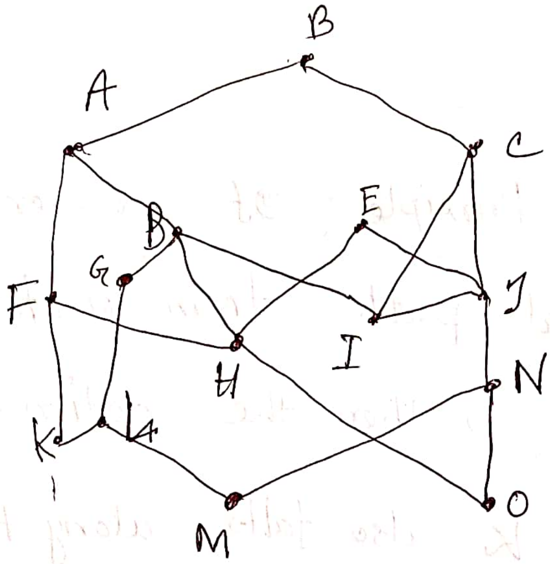


Figure → a subnet

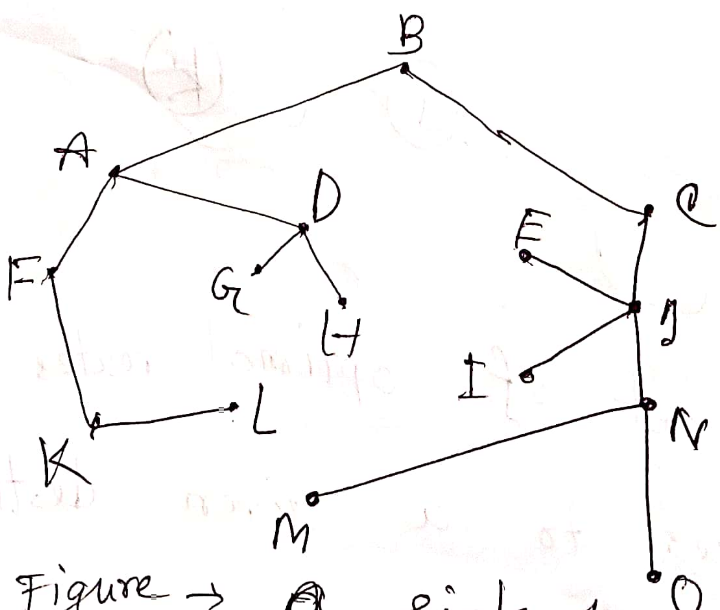


Figure → A sink tree

(b) Describe Flooding Algorithm? Write down its applications? 7

Ans:

- Flooding algorithm: Every incoming packet is sent out on every outgoing line except that one it arrived on.

- Flooding obviously generates vast numbers of duplicate packets, in fact, an infinite number unless some measures are taken to damp the process.

- One such measure is to have a hop counter contained in the header of each packet, which is decremented at each hop, with packet being discarded when the

the counter reaches zero.

An alternative technique for damming the flood is to keep track of which packets have been flooded, to avoid sending them out a second time.

A variation of flooding that is slightly more practical is selective flooding.

Applications of flooding algorithm:

1. Military applications.
2. Distributed database applications.
3. Wireless network.
4. As a metric against which

other routing algorithms cam be compared.

08.

(a) Define Network layer? What happens at the Network layer? 6

Ans:

Network Layer:

In the seven-layers OSI model of computer networking is responsible for packet forwarding including routing through intermediate routers.

Anything that has to do with inter-network connections takes place at the network layer. This includes setting up the routes for data packets to take, checking to see if a server in another network is up and running, and addressing and receiving IP packets from other networks. This last process is perhaps the most important, as the vast majority of internet traffic is sent over IP.

(b) What is a Packet? What is the difference between the network layer and the internet layer? 6

Ans:

All data sent over the internet is broken down into smaller chunks called "packets". When Bob sends Alice a message, for instance, his message is broken down into smaller pieces and then reassembled on Alice's computer. A packet has two parts: the header, which contains information about the packet itself and the body, which is the actual data being sent.

At the network layer, networking software attaches a header to each packet when the packet is sent out over the internet, and on the other end, networking software can use the header to understand how to handle the packet.

A header contains information about the content source, and destination of each packets.

In the TCP/IP model, there is no "network" layer. The OSI model network layer roughly corresponds to the TCP/IP model Internet layer. In the OSI model the network layer is layer 3, in TCP/IP model the internet layer is layer 2.

In other words, the network layer and the internet layers are basically the same thing, but the come from different models of how the internet works.

ⓒ What is the process to achive network layer goals? 2

Ans: To achieve it's goals, the network layer must know about the topology of the communication subnet and choose appropriate paths through it. It also must take care to choose routers to avoid overloading some of the communication lines and routers while leaving others idle.