Final 20-21 Q.solve

1. [Marks 3]

(a) Data communication refers to exchange data between two or more devices through a transmission medium like wires, fibers, cable ~~etc~~. wireless signal etc.

A data communication has five main components. They are:

1. Message: The actual data to be communicated (like, text, image, voice etc)
2. Sender : The devices that sends the data message. (Phone, computer etc).
3. Receiver: The devices that received the data message. (computer, phone etc).
4. Transmission Media : The physical path by which data travels from sender to receiver. (wires, fiber etc)
5. Protocol : A set of rules that governs data communication

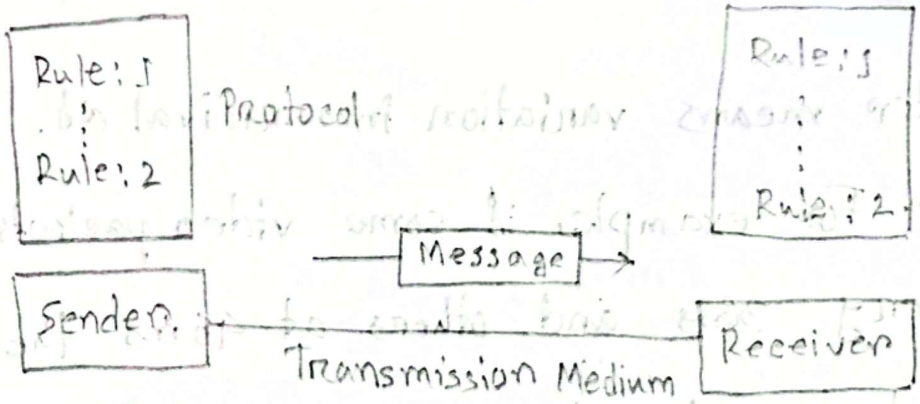


Fig: Components of Data Communication

Extra Note: Characteristics of data ~~Computer~~ Communication

There are four fundamental characteristics of data communication. They are;

1. **Delivery:** The system must deliver data to the correct destination. ~~It should not go to the wrong desti~~ Data must be received by the intended devices or user.

2. **Accuracy:** The data must delivered accurately and without any errors. If the data is changed it becomes useless.

~~3. Timelessness~~

3. **Timeliness:** The system must deliver in timely manner. If it is late, especially in audio or video, it losses its value

This is called real-time transmission.

4. Jitter: Jitter means variation in arrival of data packets. For example, if some video packets arrived every 30ms and others at 45ms the video may lag or break.

Correct Place, Correct Data, On time, Smoothly.

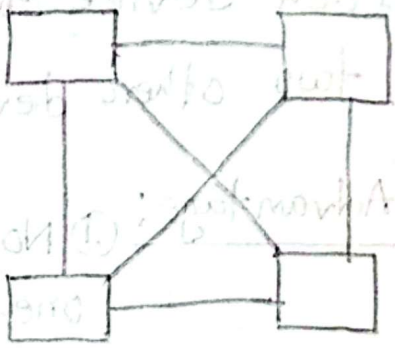
(b) Physical Topology refers to the actual layout of devices and cables in a network. It shows how devices (called nodes), cables, switches, router and others are connected in a network physically.

There are five basic topologies possible such as: Mesh topology, Bus topology, Ring topology Star topology and Tree topology.

Description of those topologies are given below:

1. Mesh Topology:

Every devices connects to every other device directly.



Advantage: (i) very reliable and secure
(ii) Data can take multiple paths

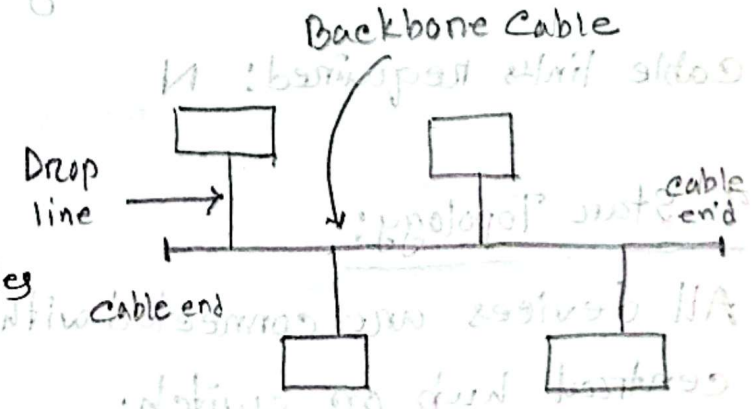
Disadvantage: (i) High cost of cabling
(ii) Complex installation

node = 4
links = $\frac{4(4-1)}{2} = 6$

Cable links required: $\frac{n(n-1)}{2}$

2. Bus Topology:

Devices are connected to a single backbone cable.



Advantage: (i) Requires less cables
(ii) Easy to set up

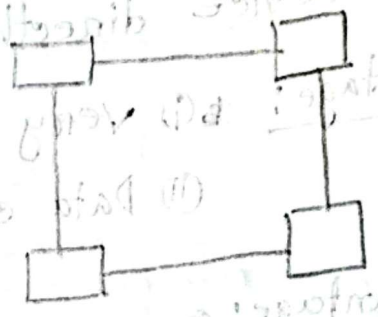
Disadvantage:
(i) Backbone cable fault, ~~distroy~~ breaks the whole network.
(ii) Difficult to troubleshoot

node = 4
links = 4+1 = 5

Cable links required: n+1 (1 backbone cable + n drop lines ~~devices cable~~)

3. Ring Topology:

Each device connects to exactly two other devices in a circle.



node = 4
links = 4

Advantage:

① No collision due to one-way data flow

② Equal access for all devices.

Disadvantage:

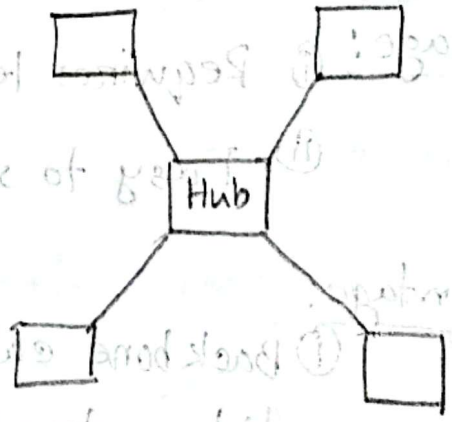
① Faults in one device, can break the whole network

② Slow, if many devices are connected.

Cable links required: N

4. Star Topology:

All devices are connected with central hub or switch.



node = 4
links = 4

Advantage:

① Easy to add new devices.

② Failure in one device don't affect others.

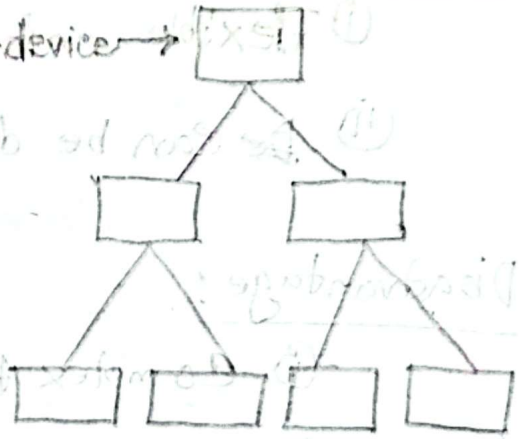
Disadvantage: ① Hub failure crash the whole network

② performance depends on central hub.

Cable links required: N

5. Tree Topology :

~~Tree topo~~ It is a hierarchical network where devices are ~~connected~~ arranged in parent-child structure.



node = 7

links = 7-1 = 6

Advantage: ⓘ Scalable and easy to expand.

ⓘⓘ Good for large network.

Disadvantage: ⓘ If ~~root device or~~ parent device fail, affects all its child devices.

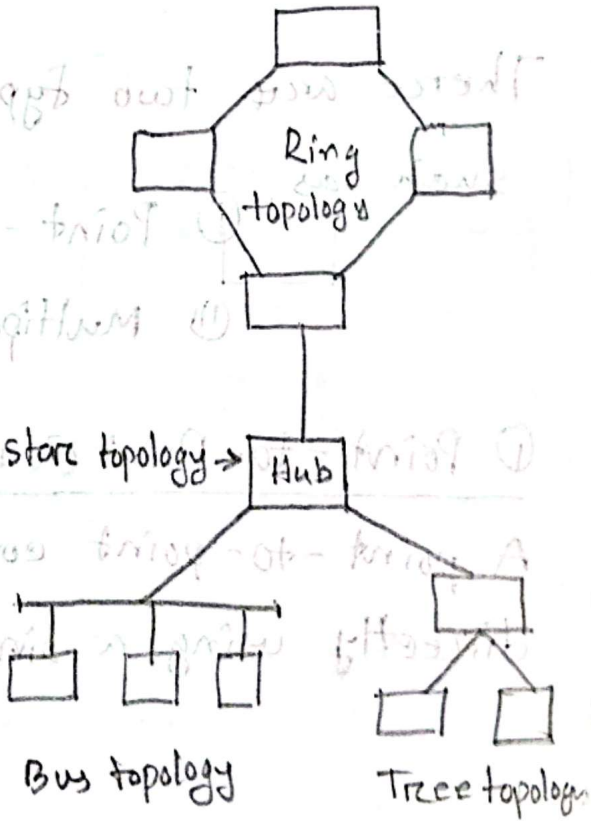
ⓘⓘ Difficult to main-tain

Cable links Required: N-1

Extra Note:

Hybrib Topology :

A network where two or more topologies ~~are combined~~ (star, bus, Ring etc) are combined.



Advantage:

(i) Flexible and scalable

(ii) Can be designed based on specific needs.

Disadvantage:

(i) Complex to design and maintain.

(ii) Very expensive compare to others.

Cable links required: Depends on design, combination and structure used. (not fixed).

Line configuration

There are two types of line configurations such as

(i) Point-to-Point

(ii) Multipoint

(i) Point-to-Point Configuration:

A point-to-point configuration connects two devices directly using a single communication link.

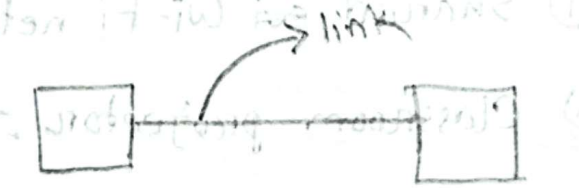
Advantage:

① Full bandwidth used by only two devices.

② Simple design and reliable communication.

Disadvantage:

1. Can't connect more than two devices.
2. Not suitable for large network.



Example / Application:

Computer-to-printer via USB cable

TV remote and TV (via infrared)

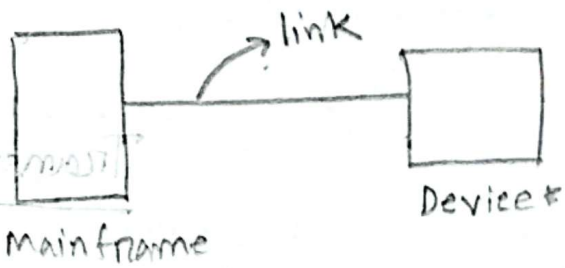
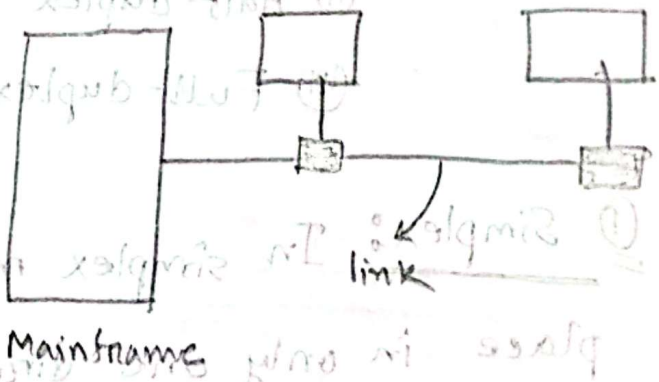


Fig: Point-to-point

② Multipoint Configuration:

In a multipoint configuration two or more devices share a single communication link.



Advantage:

① Cost-effective, as the cable is shared

② Easy to add more devices.

Disadvantage:

~~Bandwidth divided~~ :

(i) Devices must share bandwidth

(ii) Performance drops as more devices connect.

Example:

(i) Shared Wi-Fi network in our CSE department.

(ii) Classroom projector system where multiple computers share one display cable.

Transmission Mode

There are three types of transmission mode. they are,

(i) Simplex

(ii) Half-duplex

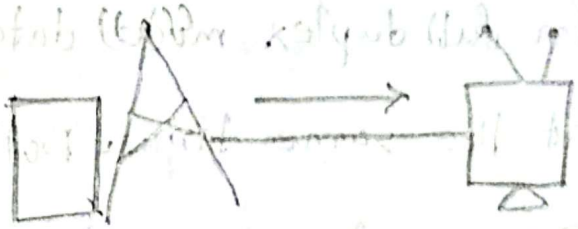
(iii) Full-duplex.

(i) **Simplex:** In simplex mode, communication takes place in only one direction. One device is always the sender and another one is always the receiver. Receivers never send any data back.

Advantage:

(i) very simple and easy design.

(ii) Only need when data is to send one direction.



Unidirectional.

Example:

TV station broadcast news via TV to the user. But user never resend any data back.

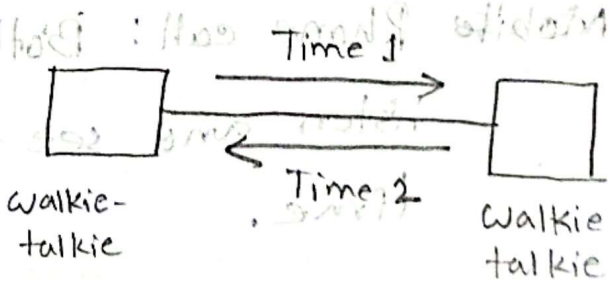
Half-duplex:

In half-duplex allows data transmisson in both directions but only one devices can send data at a time. When one device sends data, another must wait.

Advantage:

(i) Enables two-way communication with fewer resources.

(ii) Less wiring needed compare to full-duplex.



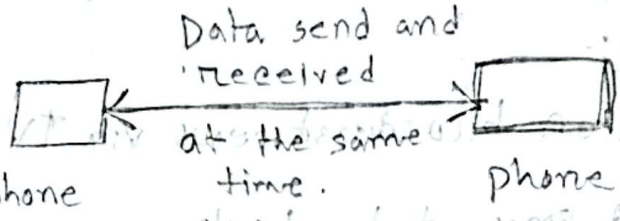
Bi-directional

Example:

Walkie-talkie: When one person talks, the other must wait to reply.

③ Full duplex:

In full duplex mode data transmission in both direction at the same time. Both devices can send and receive data simultaneously.



Advantage:

(i) No waiting, communication is continuous

(ii) faster, effierent and gives real time experience.

Example:

Google Meet Classroom: In google meet, class teachers and students can se/share data at the same time.

Phone call: Both people can talk, and listen and see each other at the same time.

Difference:

Aspects	Simplex	Half-duplex	Full-duplex
Direction of Data	Unidirectional	Bi-Directional (one at a time)	Bi-Directional (Both at the same time)
Communication type	Only sender to receiver	Alternating turns	Simultaneous transfer
Design	simple	Moderate	Complex
Speed	Slow	Medium	Fast
Example	Radio to user	Walkie-talkie	Mobile phone call.

Networks

There are three types of basic networks. such as.

(i) Local Area Network (LAN)

(ii) Metropolitan Area Network (MAN)

(iii) Wide Area Network (WAN)

And Internet is the combination of LANs, MANs and WANs.

1. Local Area Network (LAN):

(i) Covers a small graphical area, like a room, building or campus.

(ii) High data transfer speed and low latency.

(iii) Usually privately owned and managed.

Exaple: Computers connected ~~with~~ within a ~~campus~~ campus or department.

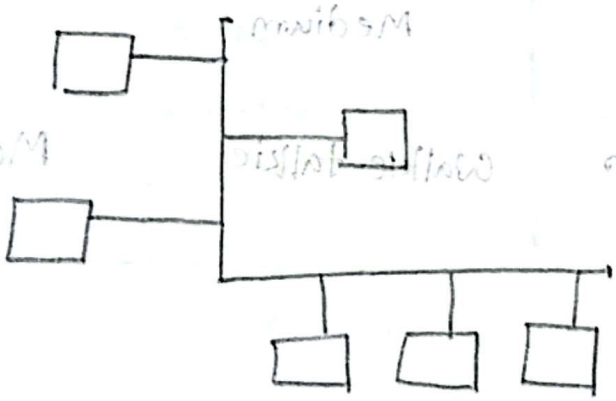


Fig: Single Building LAN

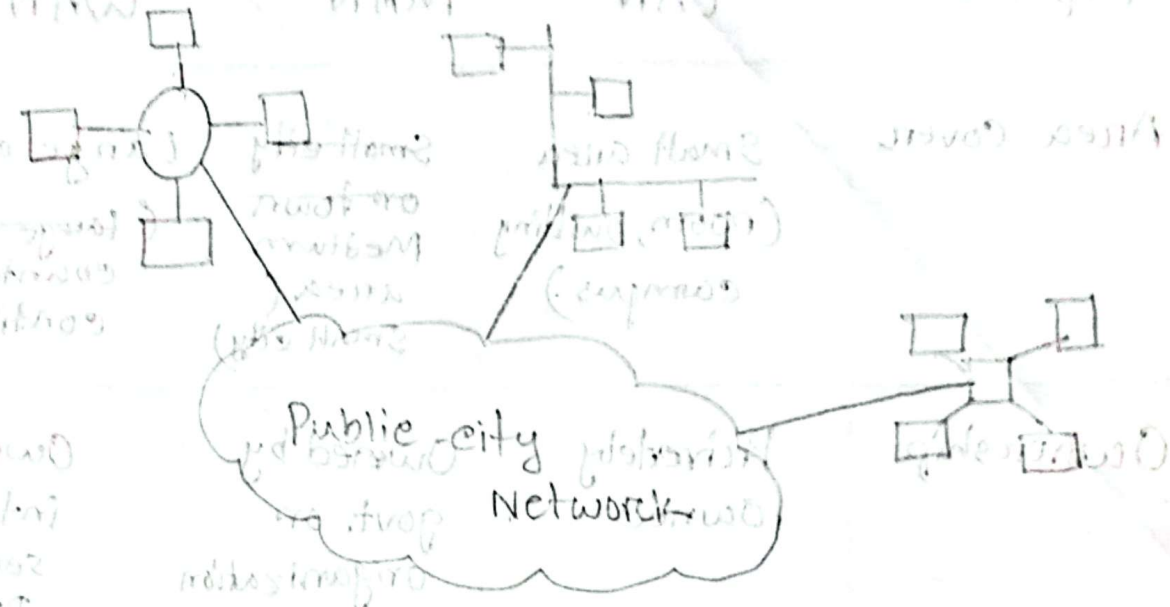
2. Metropolitan Area Network (MAN):

(i) Covers a city or large ~~town~~ town, larger than LAN but smaller than WAN.

(ii) Connects multiple LANs together

(iii) Owned by government or service provider.

Example: Cable TV network in a city, city-wide security system (CCTV) etc.



3. Wide Area Network (WAN):

(i) Covers a very large area, like ~~con~~ country or continents

(ii) Connects multiples LANs and MANs.

(iii) Lower speed and higher cost..

Example: satellite and ~~internet~~.

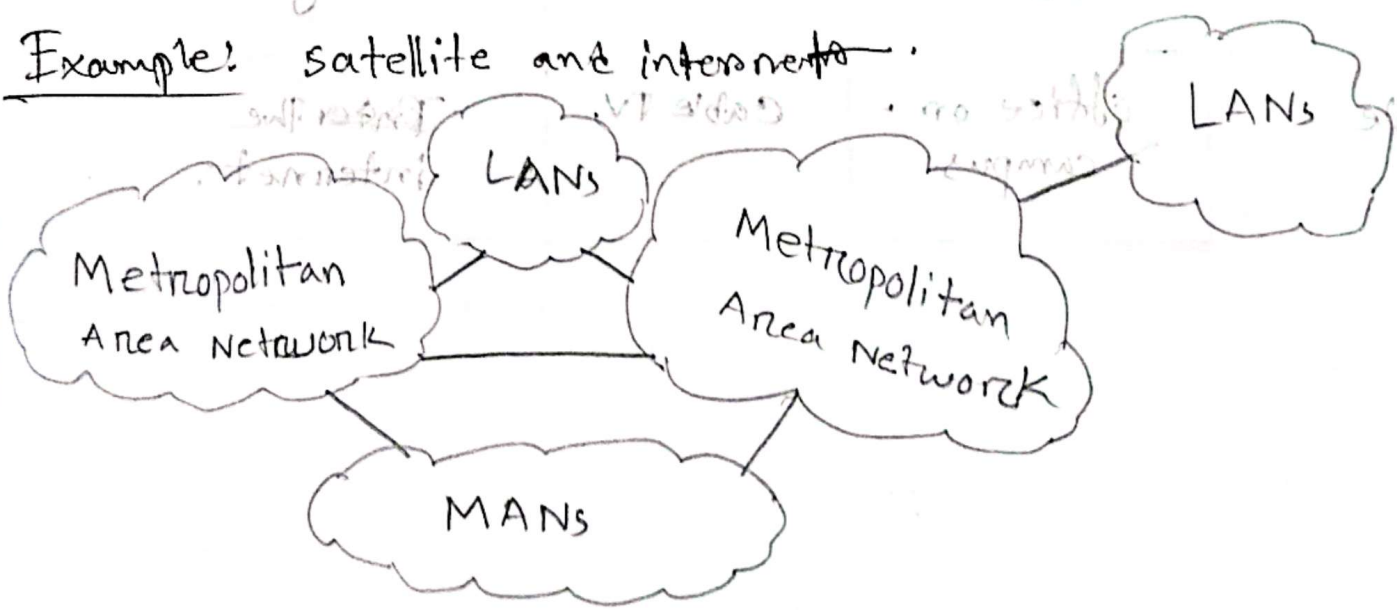


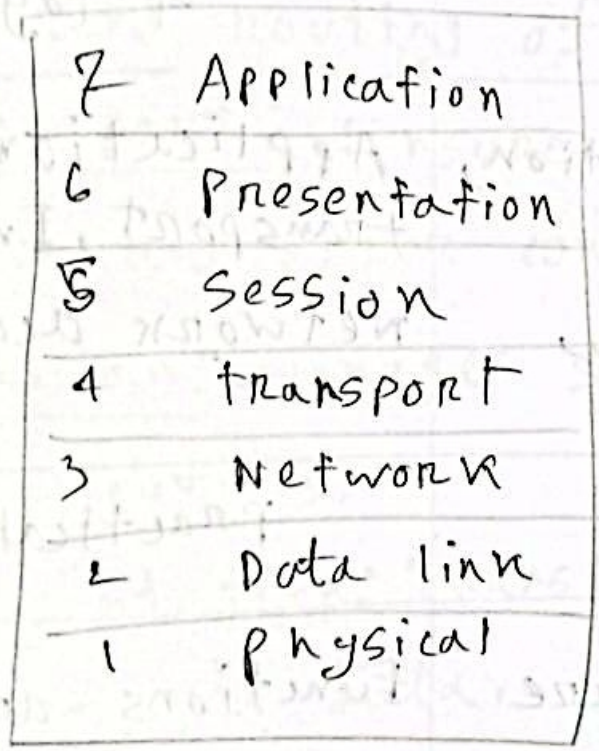
Fig: Wide - Area Network.

Differences:

Aspects	LAN	MAN	WAN
Area Cover	Small area (room, building campus)	~~Small city or town~~ Medium area (small city)	Large area (~~large city or~~ countries or continents)
Ownership	Privately owned	Owned by govt. or organization	Owned by international service provider.
Transmission Medium	WiFi, Ethernet	Cable, fiber	~~Satellite~~ Satellite ~~Submarine~~ cable.
speed	very high	Medium	low
Cost	Low	Medium	high.
Example	office or campus	Cable TV,	~~Internet~~ the internet.

OSI Model (Open Systems Interconnection)

It is a conceptual framework used to understand how data moves through a network. It divides the communication process into 7 separate layers, where each layer performs a specific function.



OSI Model

OSI vs TCP/IP

OSI	TCP/IP
Full form is open systems interconnection.	Transmission control protocol / Internet protocol
developed by international standards organization.	U.S dept of defense
7 layers	4 layers
Application, presentation, session, transport, network, data link, physical.	Application, transport, Internet, network access
Theoretical Model	practical Model
layer functions are seperated (each layer has specific tasks)	Functions are combined (some OSI layers are merged)

Function of each layer

1] physical layer: Transmits raw bits (0s and 1s) using cables, electrical signals etc.

2] Data link layer: Breaks data into frames, adds MAC addresses, handles error detection.

3] Network layer: Handles logical addressing (IP) and routing of data.

4] Transport: Ensures reliable delivery, flow and error control.

5] Session: Manages sessions between applications.

6] presentation: Translates, encrypts and compresses data.

7] Application: Interface for end-users and applications to use the network.

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Virus	Worm
A virus is a malicious program that attaches itself to other files and spreads when the file is run.	A worm is a self-replicating program that spreads through networks without attaching to files.
Needs human action.	Spreads automatically.
Depends on host files to execute and spread.	does not need a host file
Slower spread	Spreads quickly over networks.
Melissa virus	Mydoom