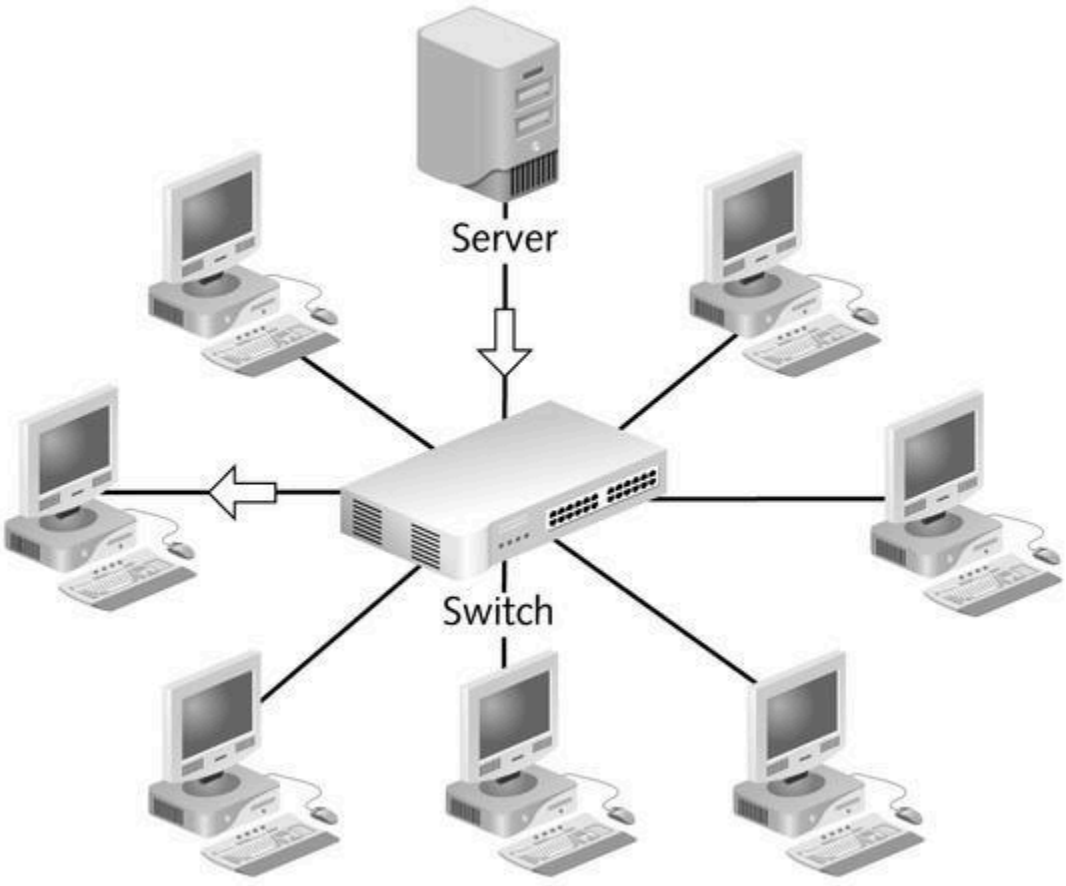
Computer Networks — Module 1 Notes

1. Computer Network

What is a computer network?

A computer network is a group of two or more computers or devices connected together to share information and resources.

Example: In a college computer lab, many computers are connected to the same network. They can share files, printers, and an internet connection.



link-elearning.com

Why do we use computer networks?

- File sharing: Send files from one computer to another.

- Resource sharing: Share printers and storage devices.
- Communication: Send emails, messages, and video calls.
- Information sharing: Access information stored on other computers.
- Cost saving: Multiple users can share one printer or internet connection.
- Centralized management: Store and manage information from a central server.

Advantages

1. Fast communication.
2. Easy sharing of files.
3. Saves money by sharing resources.
4. Provides access to remote information.
5. Makes teamwork easier.

Disadvantages

1. Viruses can spread between connected computers.
2. Hackers may access network resources.
3. If a central server fails, many users may be affected.
4. Setting up and maintaining a network costs money.

Exam-ready answer (2 marks):

A computer network is a collection of interconnected computers and devices that communicate with each other to share data, resources, and services. Examples include a college computer lab network and the Internet.

2. Network Criteria

A computer network is mainly evaluated using three important criteria.



1. Performance

Performance means how fast and efficiently a network transfers data.

It depends on:

- Number of users.
- Type of transmission medium.
- Hardware and software.
- Network traffic.

Example: A fast college Wi-Fi connection has good performance.



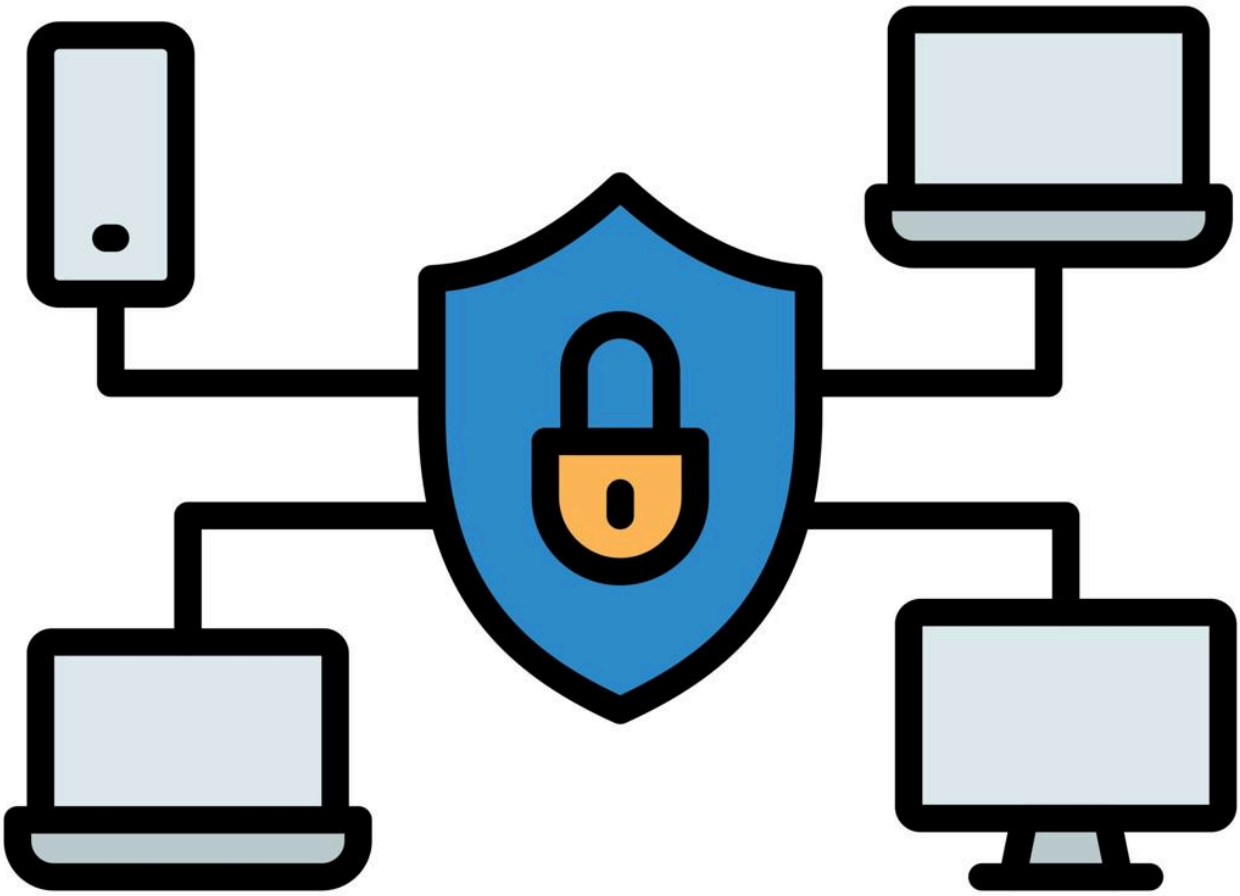
2. Reliability

Reliability means how consistently a network works without failure.

It depends on:

- Frequency of failures.
- Time required to recover.
- Ability to continue working during failures.

Example: A network that continues working even if one connection fails is more reliable.



3. Security

Security means protecting data and network resources from unauthorized access, damage, and theft.

It involves:

- Confidentiality: keeping information private.
- Integrity: keeping information accurate.
- Availability: keeping services accessible when needed.

Example: Passwords and encryption help protect a college network.

Memory trick: P-R-S = Performance, Reliability, Security.

Exam tip: If asked to explain network criteria, write all three headings and give one example for each.

3. Network Topologies

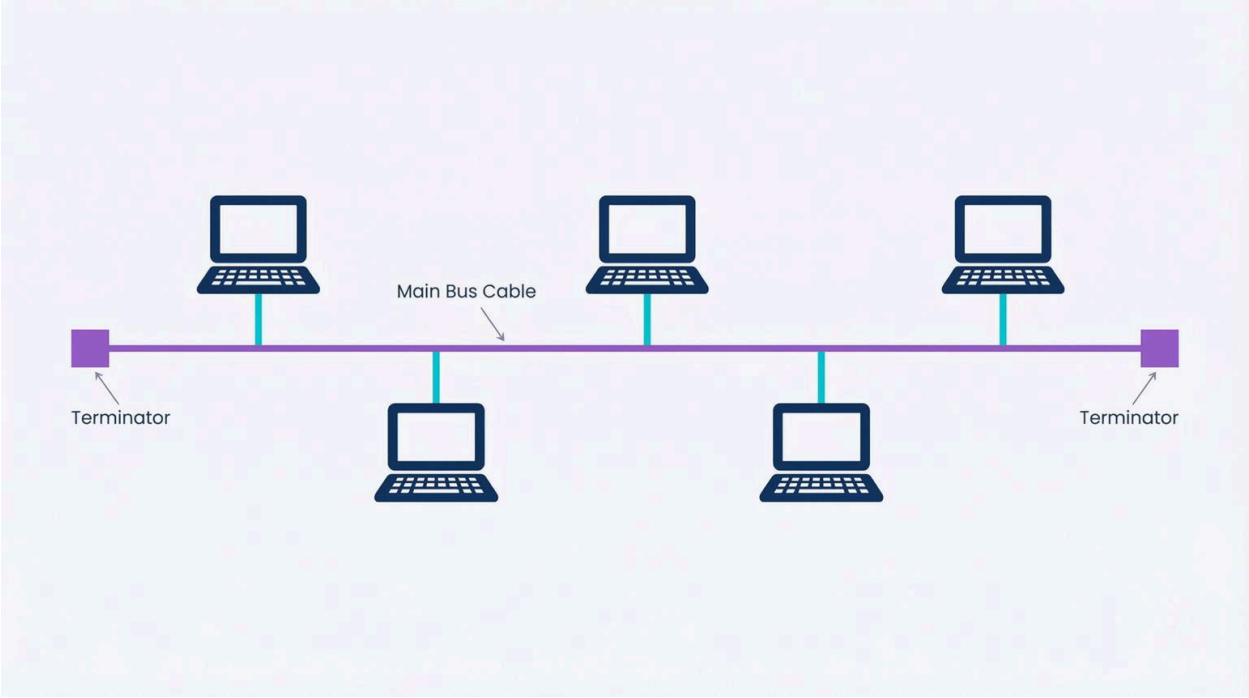
What is network topology?

Network topology is the arrangement of computers and connections in a network.

Think of it as the shape or layout of a network.

There are five common topologies you should know.

A. Bus topology

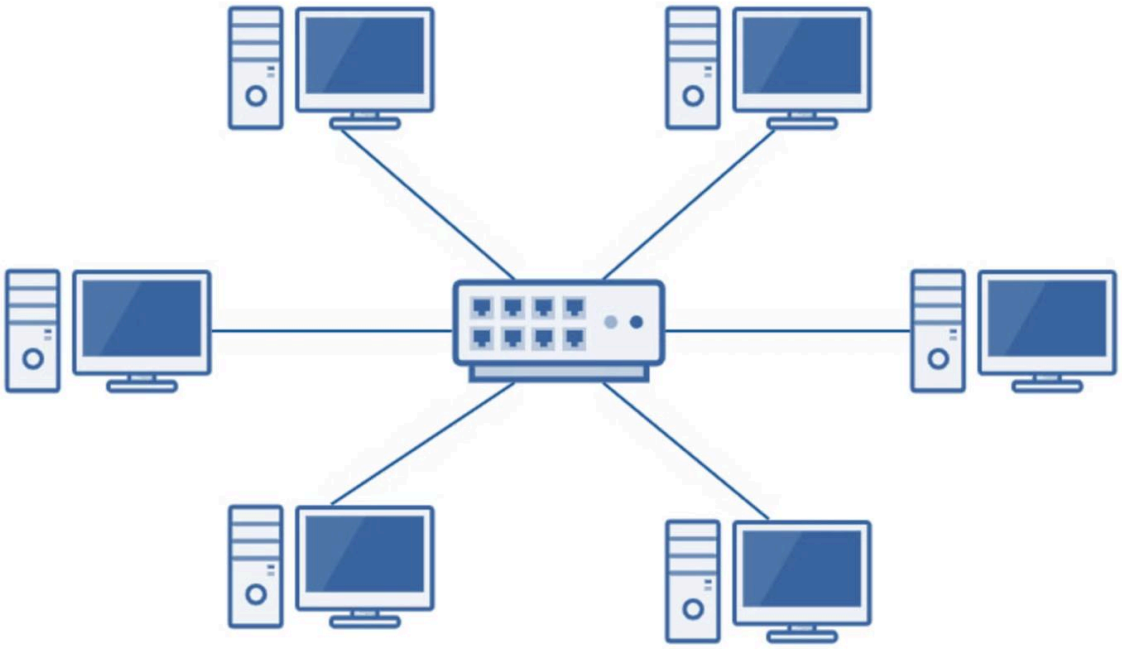


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All computers are connected to one main cable called the backbone cable.

- Advantages: Cheap, uses less cable, easy to install in small networks.
- Disadvantages: If the backbone cable fails, the entire network can stop. Fault detection can be difficult.
- Example: Older small computer networks.

B. Star topology

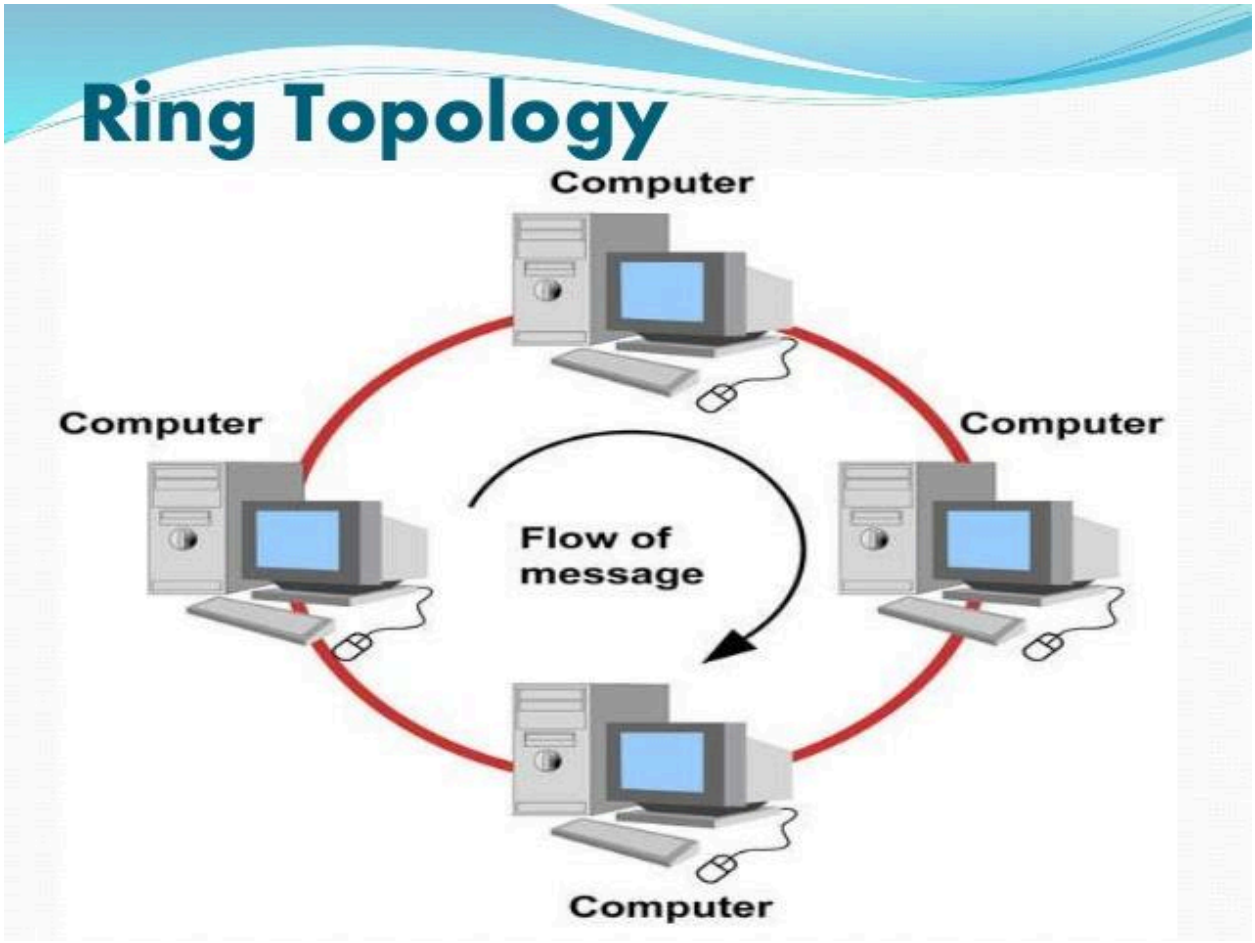


gliffy.com

All computers connect to a central device, usually a switch.

- Advantages: Easy to install, manage, and troubleshoot. Failure of one computer's cable usually affects only that computer.
- Disadvantages: If the central switch fails, the connected network stops working. It requires more cable than bus topology.
- Example: Modern office and computer lab networks.

C. Ring topology

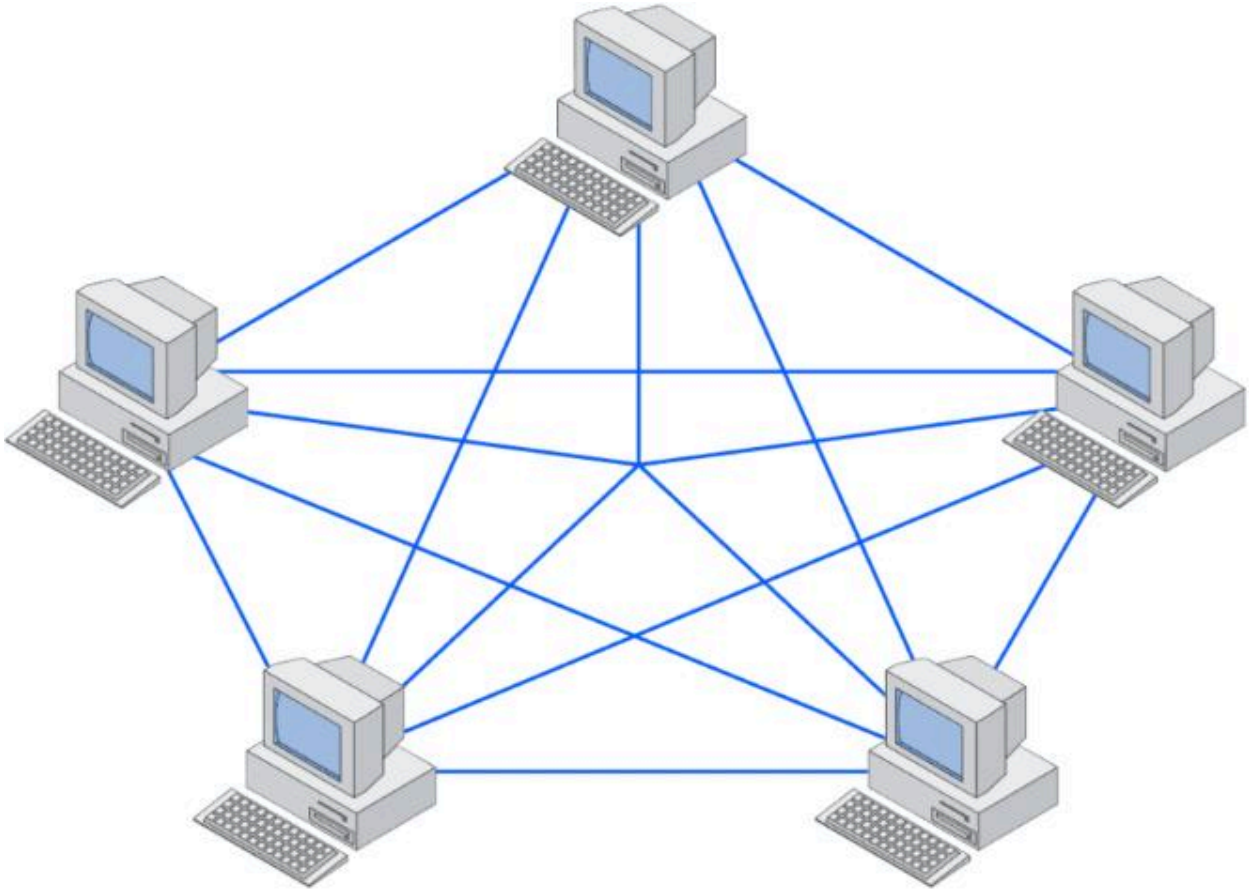


infotechcomputers.org

Each computer connects to two neighboring computers, forming a closed loop.

- Advantages: Data can travel in an orderly manner; access can be predictable in some ring protocols.
- Disadvantages: A break in a basic ring can disrupt the network. Troubleshooting can be difficult.
- Example: Some older token-ring networks.

D. Mesh topology



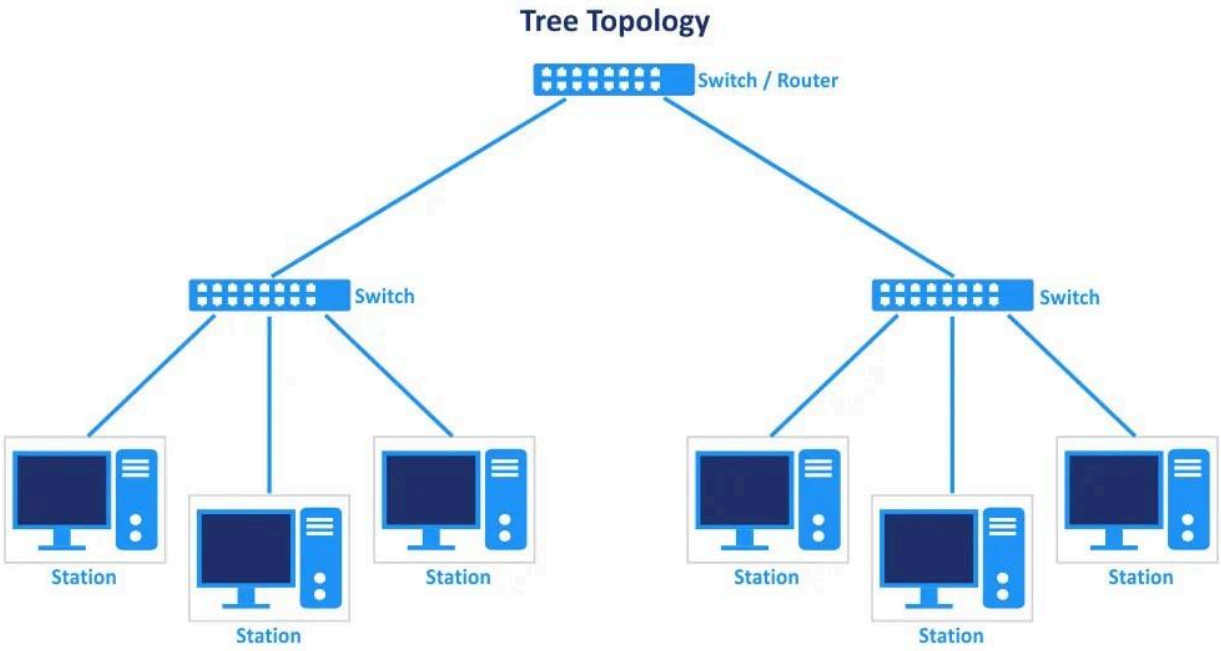
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Computers or network devices have multiple connections to other devices.

In a full mesh, every device connects directly to every other device.

- Advantages: Highly reliable, multiple paths are available, and one link failure may not stop communication.
- Disadvantages: Expensive, requires many cables and ports, and is complex to install.
- Example: Some backbone and wireless mesh networks.

E. Tree topology



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Devices are arranged in a hierarchy, like a tree with branches.

- Advantages: Easy to expand and manage large networks in sections.
- Disadvantages: Failure of an important backbone or upper-level device can affect an entire branch.
- Example: Networks organized by departments in a large organization.

Comparison of network topologies

Topology	Structure	Main advantage	Main disadvantage
Bus	One main cable	Low cost	Backbone failure affects network
Star	Central switch	Easy troubleshooting	Central switch failure
Ring	Circular loop	Orderly access in some protocols	A break may disrupt communication

Mesh	Multiple interconnections	High reliability	Expensive
Tree	Hierarchical branches	Easy expansion	Upper-level failure affects branches

Quick memory trick: Bus = line, Star = center, Ring = circle, Mesh = many links, Tree = branches.

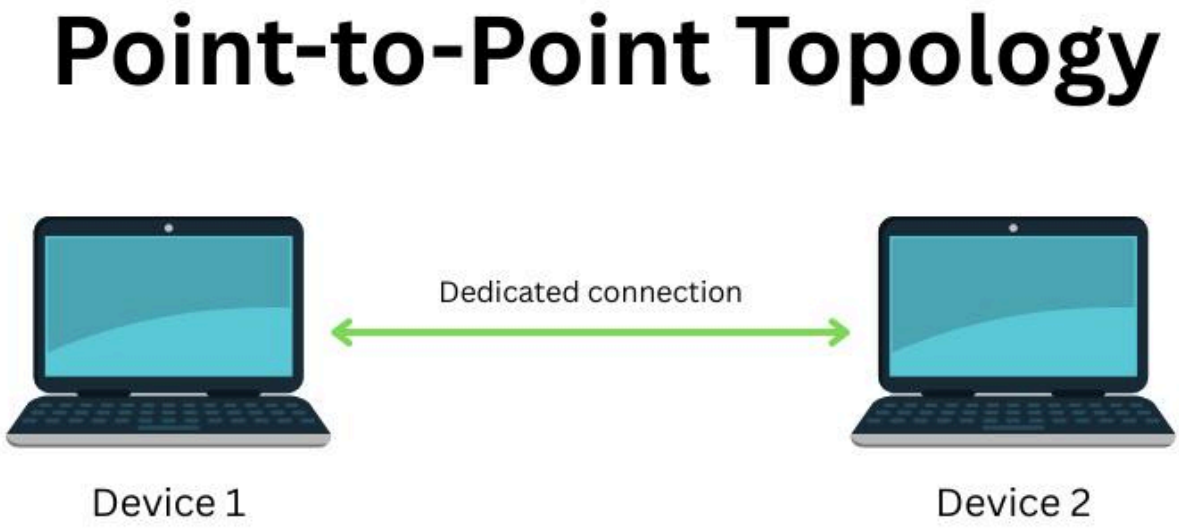
4. Types of Connection

A network connection describes how devices are connected to communicate.

There are two basic types.

A. Point-to-point connection

A point-to-point connection is a direct connection between two devices.



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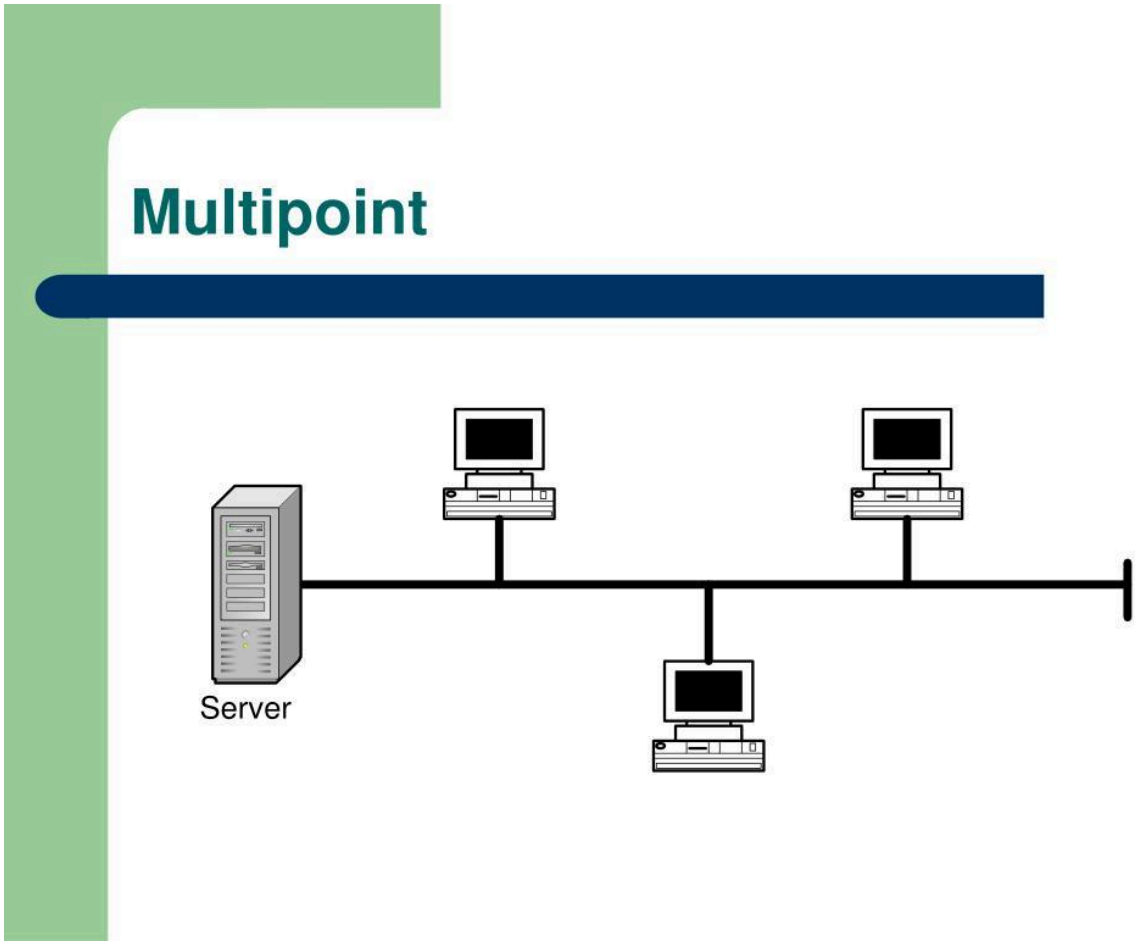
Example: A direct cable connection between two computers.

- Only two devices use that link.
- The entire link capacity is available for communication between them.

- It is usually simple to manage.

B. Multipoint connection

A multipoint connection is a connection in which multiple devices share a single communication link.



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Example: Multiple devices sharing a common communication channel.

There are two common ways to share the link:

- Spatial sharing: Devices use different portions of the link.
- Time sharing: Devices take turns using the link.

Difference between point-to-point and multipoint

Point-to-point	Multipoint

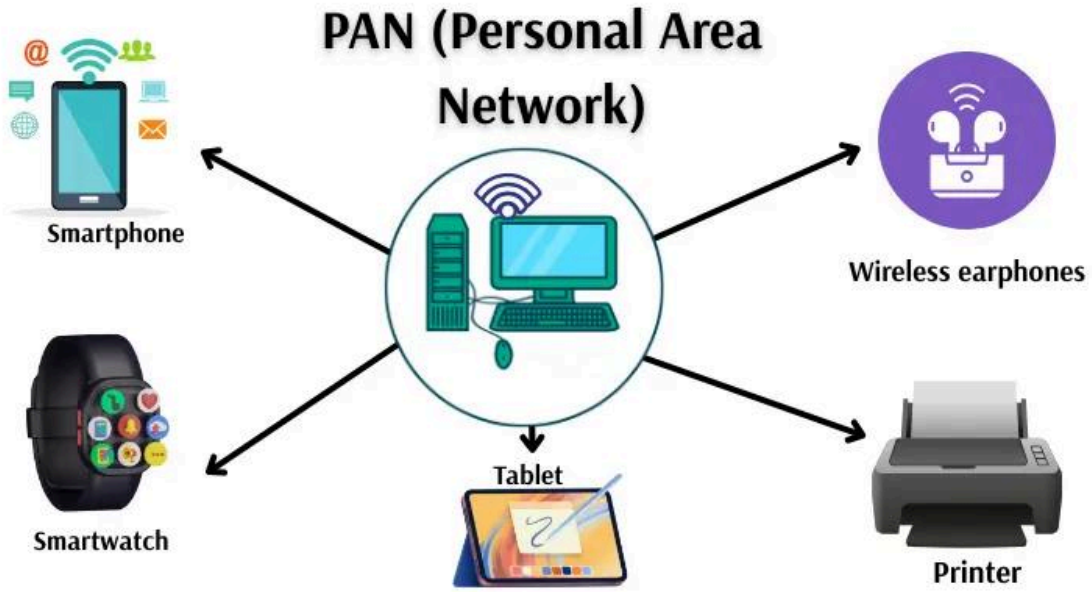
Connects two devices	Connects multiple devices
Link is dedicated to two endpoints	Link capacity is shared
Usually simpler	Sharing may need coordination
Example: direct cable link	Example: shared communication channel

Exam-ready definition: Point-to-point connects two devices through a dedicated link, whereas multipoint allows multiple devices to share one communication link.

5. Categories of Networks

Networks can be categorized according to the geographical area they cover.

A. PAN — Personal Area Network



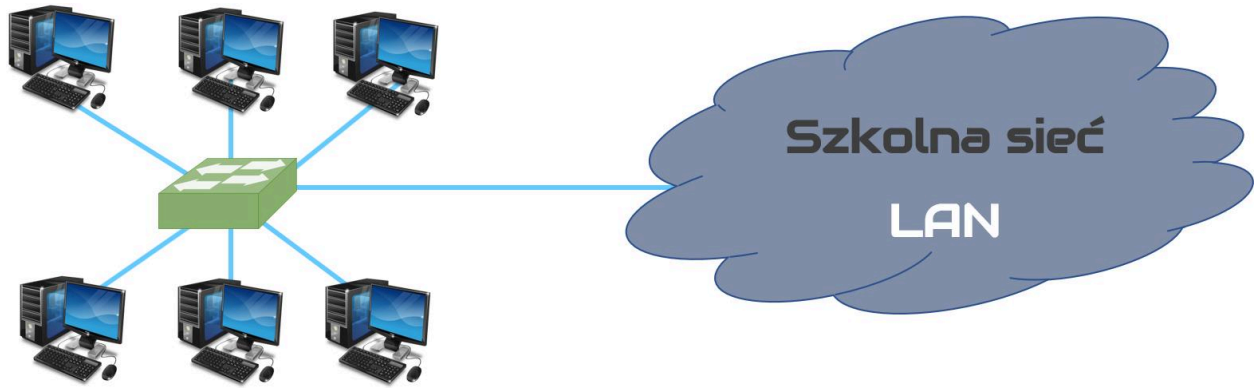
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A PAN connects personal devices over a very short distance.

- Coverage: Usually a few metres.

- Example: A mobile phone connected to Bluetooth earbuds or a smartwatch.

B. LAN — Local Area Network

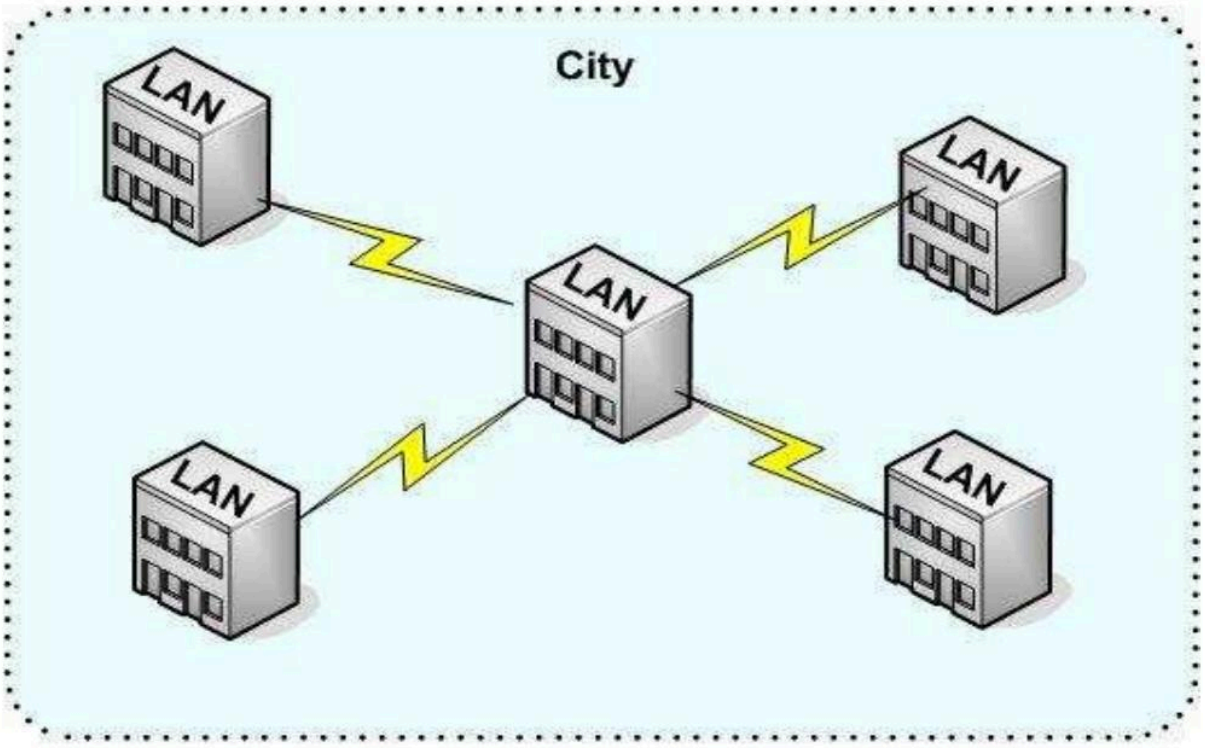


zpe.gov.pl

A LAN connects devices within a small area, such as a room, home, office, or college building.

- Usually managed by one person or organization.
- Often provides high-speed communication.
- Example: A college computer lab.

C. MAN — Metropolitan Area Network



Metropolitan Area Network (MAN)

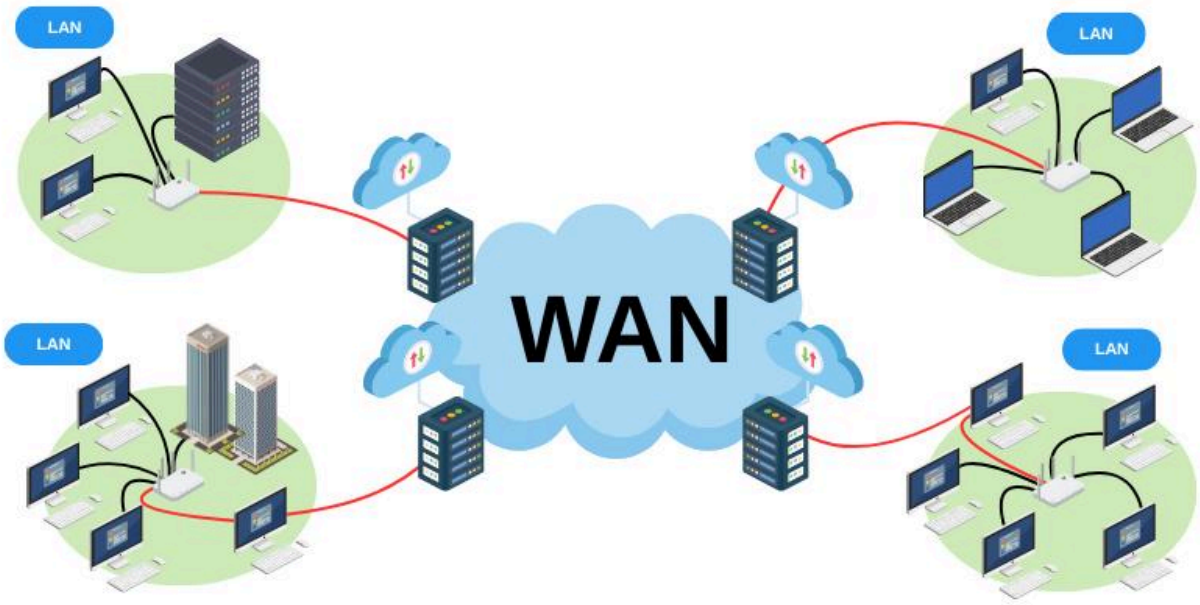
Fig 7: Metropolitan Area Network (MAN)

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A MAN connects networks across a city or metropolitan area.

- Covers a larger area than a LAN.
- Can connect networks in different buildings.
- Example: A network connecting several branches of an organization across a city.

D. WAN — Wide Area Network



worachot-kl.blogspot.com

A WAN connects networks across large geographical areas, including countries and continents.

- Uses communication links over long distances.
- Can connect multiple LANs and MANs.
- Example: The Internet is the best-known example of a global internetwork.

Comparison

Network	Full form	Coverage	Example
PAN	Personal Area Network	Around a person	Bluetooth devices
LAN	Local Area Network	Room/building/site	College lab
MAN	Metropolitan Area Network	City	City-wide network
WAN	Wide Area Network	Countries/continents	Internet

Memory trick: PAN → LAN → MAN → WAN means the coverage generally gets larger.

6. Internet

What is the Internet?

The Internet is a global network of interconnected computer networks that communicate using common protocols, especially TCP/IP.

In simple words, it connects billions of devices around the world so they can exchange information.



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How does the Internet work?

Imagine you open a website on your phone.

1. You enter the website address.
2. The DNS system helps find the server's IP address.
3. Your device sends a request through the network.
4. Routers forward the data toward the destination.
5. The server sends the requested information back.
6. Your browser displays the website.

Data is commonly divided into smaller units called packets for transmission across networks.

Important Internet services

- World Wide Web (WWW): Websites and webpages accessed through browsers.
- Email: Sending and receiving electronic messages.
- File transfer: Moving files between computers.
- VoIP: Voice calls over the Internet.
- Video conferencing: Online meetings and classes.
- Cloud services: Storing and accessing files and applications online.

Internet vs. World Wide Web

Internet	World Wide Web (WWW)
Global network infrastructure	A service that runs over the Internet
Connects devices and networks	Provides linked webpages and websites
Supports many services	Mainly uses web technologies such as HTTP/HTTPS
Example: network carrying email	Example: a website opened in a browser

Important: The Internet and the Web are not the same thing. The Web is one service that uses the Internet.

Exam-ready answer (2 marks): The Internet is a worldwide system of interconnected networks that enables computers and other devices to exchange data using standardized communication protocols.

7. Reference Models

What is a reference model?

A reference model is a conceptual framework that divides network communication into separate layers, with each layer having specific responsibilities.

Why do we need it?

Imagine building a house. One person handles the foundation, another handles the walls, and another handles the roof. Dividing the work makes the process easier to understand and manage.

Networking layers work in a similar way.

The two important reference models are:

1. OSI Reference Model.
2. TCP/IP Reference Model.

8. OSI Reference Model

OSI stands for Open Systems Interconnection.

It is a reference model developed by ISO that divides network communication into seven layers.

The 7 OSI Layers

7

Application Layer

Services used by applications

6

Presentation Layer

Translation, encryption, compression

5

Session Layer

Manages communication sessions

4

Transport Layer

End-to-end delivery and reliability

3

Network Layer

Logical addressing and routing

2

Data Link Layer

Frames and local-link delivery

1

Physical Layer

Bits and physical signals

Let's understand each layer from the bottom to the top.

Layer 1: Physical Layer

Job: Transmits raw bits (0s and 1s) through a physical medium or wireless signal.

It deals with cables, connectors, electrical signals, optical signals, and radio signals.

Example: Sending bits through a fibre-optic cable.

Data unit: Bits.

Layer 2: Data Link Layer

Job: Transfers data between devices on the same link and handles framing.

It deals with:

- Frames.
- MAC addresses.
- Error detection.
- Media access control.

Example: An Ethernet network interface sending a frame to another device on the local network.

Data unit: Frame.

Layer 3: Network Layer

Job: Determines how packets travel between different networks.

It deals with:

- IP addresses.
- Routing.
- Packet forwarding.

Example: A router forwards an IP packet toward a server in another country.

Data unit: Packet.

Layer 4: Transport Layer

Job: Provides communication between processes running on different devices.

It can provide:

- Segmentation and reassembly.
- Port numbers.
- Reliability and retransmission (TCP).
- Faster, connectionless transport (UDP).

Example: TCP helps reliably deliver data for a file download.

Data unit: Segment for TCP; UDP uses datagrams.

Layer 5: Session Layer

Job: Manages communication sessions between applications.

It can establish, maintain, and terminate sessions.

Example: Managing the stages of a continuing communication session.

Exam keyword: Session management.

Layer 6: Presentation Layer

Job: Deals with how data is represented.

Its commonly described functions include:

- Data translation and format conversion.
- Encryption and decryption.

- Compression and decompression.

Example: Converting data between different formats so the receiving system can interpret it.

Exam keyword: Data representation.

Layer 7: Application Layer

Job: Provides network services to user applications.

Examples of application-layer protocols include:

- HTTP/HTTPS — web communication.
- SMTP — sending email.
- DNS — resolving domain names.
- FTP — file transfer.

Example: Your browser requesting a webpage.

Important: The application layer is not the browser itself; it provides the network protocols that applications use.

OSI layer memory trick

Remember from Layer 7 down to Layer 1:

All People Seem To Need Data Processing.

- A — Application
- P — Presentation
- S — Session
- T — Transport
- N — Network
- D — Data Link
- P — Physical

OSI data units

Layer	Data unit
Application	Data

Presentation	Data
Session	Data
Transport	Segment / datagram
Network	Packet
Data Link	Frame
Physical	Bits

The names above are the standard teaching convention; exact terminology can vary by protocol.

What happens when data is sent?

Suppose you send a message through a network application.

1. Application layer creates the message.
2. Presentation and Session layers handle their respective functions.
3. Transport layer divides the data as needed and adds transport information.
4. Network layer adds IP addressing information.
5. Data Link layer adds frame information for the next link.
6. Physical layer transmits the bits.

At the receiving device, the process is reversed. This is called decapsulation as the receiving layers remove their corresponding protocol information.

Exam-ready answer (5 marks):

The OSI Reference Model is a seven-layer conceptual model developed by ISO to standardize and explain network communication. Its layers are Physical, Data Link, Network, Transport, Session, Presentation, and Application. Each layer performs specific functions and communicates with the layers above and below it. The model helps explain network design, troubleshooting, and interoperability.

9. TCP/IP Reference Model

TCP/IP stands for Transmission Control Protocol / Internet Protocol.

It is the protocol suite used for communication over the Internet. The TCP/IP reference model is commonly taught using four layers.

4

Application Layer

Web, email, DNS and application services

3

Transport Layer

TCP and UDP; process-to-process communication

2

Internet Layer

IP addressing and packet routing

1

Network Access Layer

Local-link transmission and physical media

Layer 1: Network Access Layer

Also called the Link Layer in many TCP/IP descriptions.

- Sends data over the local network connection.
- Handles link-level framing and access to the transmission medium.
- Works with Ethernet, Wi-Fi, and other link technologies.

Example: Sending a frame over Wi-Fi.

Layer 2: Internet Layer

- Handles logical IP addressing.
- Moves packets between networks.
- Supports routing through IP and related protocols.

Example: IP helps a packet travel from your phone toward a website server.

Layer 3: Transport Layer

- Provides communication between processes.
- Uses port numbers to identify applications.
- TCP provides reliable, ordered delivery.
- UDP provides datagram delivery without TCP's built-in reliability guarantees.

Example: TCP is commonly used for reliable web data delivery.

Layer 4: Application Layer

- Provides network communication services to applications.
- Includes protocols such as HTTP, HTTPS, DNS, SMTP, and FTP.

Example: Your browser uses HTTP or HTTPS to request a webpage.

Difference between OSI and TCP/IP models

OSI Model	TCP/IP Model
7 layers	Commonly 4 layers
Developed as a reference model by ISO	Built around the Internet protocol suite
Separates Session and Presentation layers	Includes their functions in Application-layer protocols or libraries
Separates Physical and Data Link layers	Combines them in Network Access / Link layer

Mainly used for learning and conceptual understanding	Used as the practical basis of Internet communication

Mapping OSI to TCP/IP

OSI layers	TCP/IP layer
Application, Presentation, Session	Application
Transport	Transport
Network	Internet
Data Link, Physical	Network Access

Important exam point: OSI has seven layers, whereas the commonly taught TCP/IP model has four layers. Some textbooks describe TCP/IP using five layers by separating Physical and Data Link functions.

10. Physical Layer

The Physical Layer is the lowest layer of the OSI model.

It is responsible for transmitting raw bits through a communication medium.

Main functions

1. Defines the physical characteristics of the medium and interface.
2. Transmits bits as electrical, optical, or radio signals.
3. Specifies data transmission rates.
4. Defines aspects of bit timing and signal synchronization.
5. Specifies physical connectors and transmission arrangements.

There are two broad types of transmission media:

- Guided transmission media: Signals travel along a physical path, such as a cable.
- Unguided transmission media: Signals travel through free space, typically using wireless electromagnetic waves.

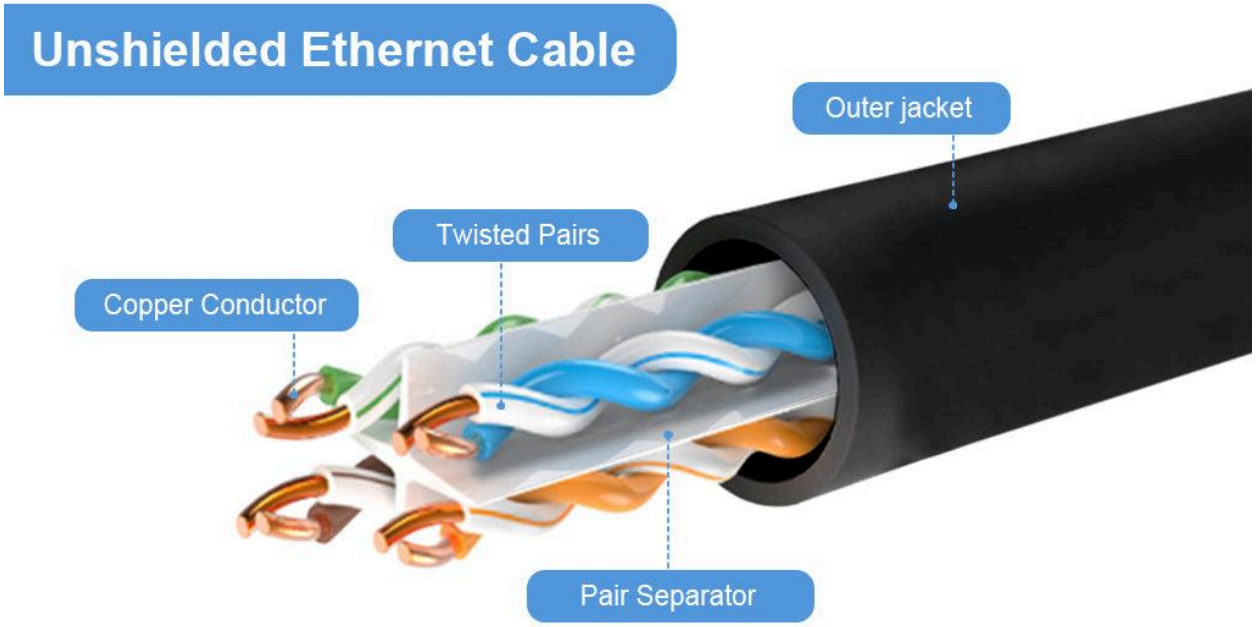
11. Guided Transmission Media

Guided media are transmission media in which signals follow a physical path.

There are three major types:

1. Twisted-pair cable.
2. Coaxial cable.
3. Optical fibre.

A. Twisted-pair cable



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It contains pairs of insulated copper wires twisted around each other.

Why are the wires twisted? Twisting helps reduce electromagnetic interference and crosstalk.

Types:

- UTP — Unshielded Twisted Pair.
- STP — Shielded Twisted Pair.

Advantages

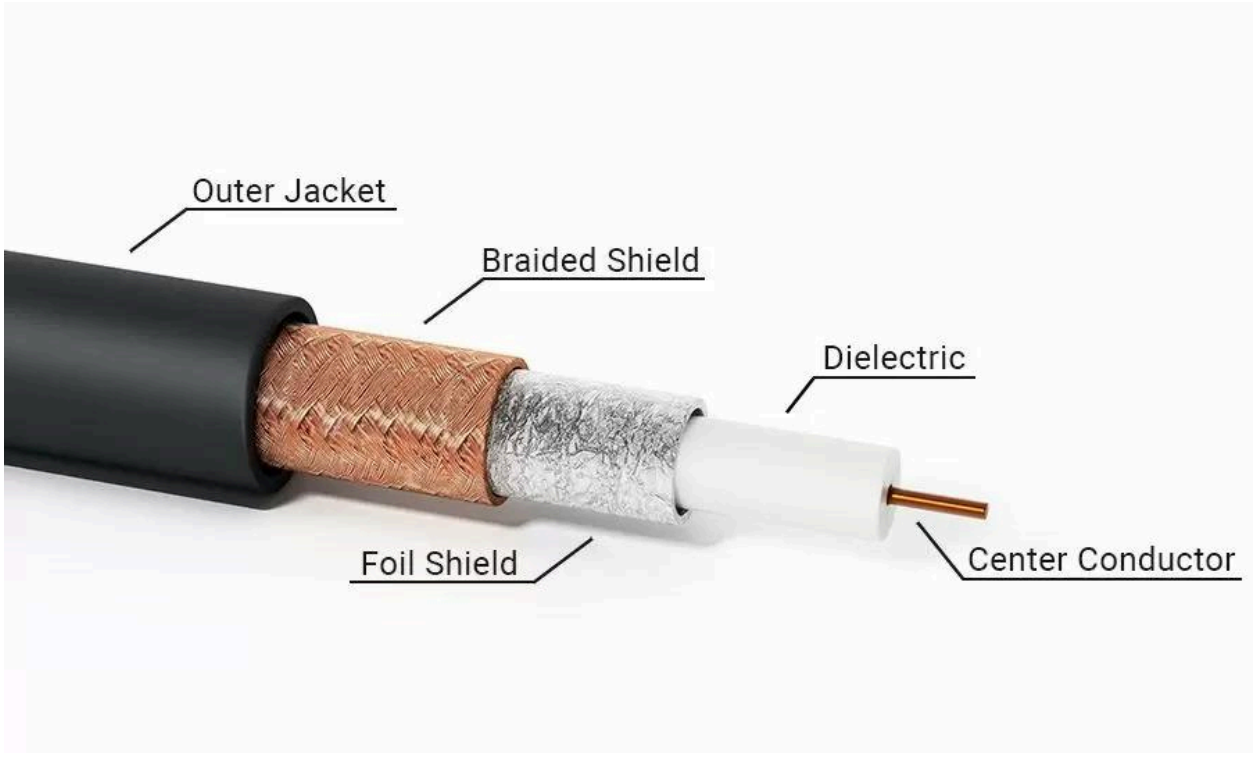
- Low cost.
- Easy to install.
- Widely used in Ethernet networks.

Disadvantages

- More susceptible to interference than well-shielded alternatives.
- Has distance limitations.
- Generally lower capacity over long distances than fibre.

Applications: Ethernet LANs and telephone lines.

B. Coaxial cable



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A coaxial cable has a central conductor, insulation, a metallic shield, and an outer protective covering.

Advantages

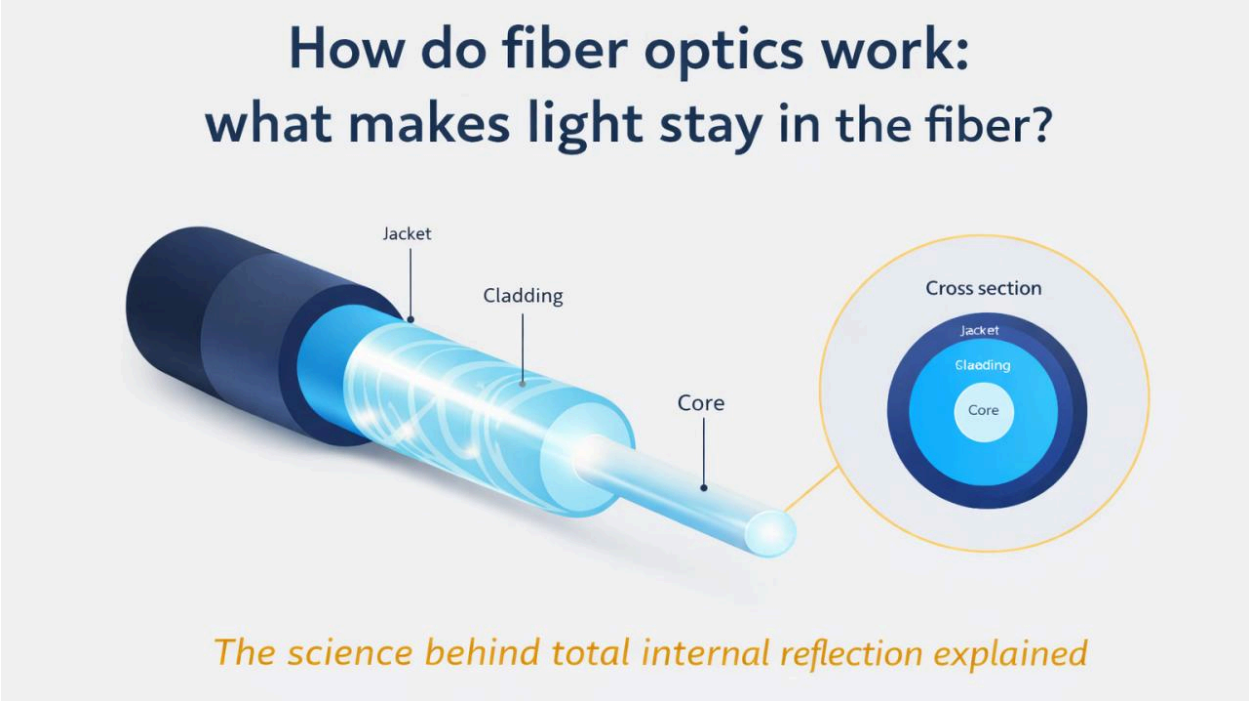
- Better shielding against interference than ordinary unshielded twisted-pair cable.
- Can carry signals over useful distances.
- Durable.

Disadvantages

- Bulkier than twisted-pair cable.
- Can be harder to install.
- Often less suitable than fibre for modern high-capacity backbone links.

Applications: Cable television, broadband connections, and some radio-frequency systems.

C. Optical fibre



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Optical fibre carries information using light signals through thin glass or plastic fibres.

It has three important parts:

- Core: The central region that guides light.
- Cladding: Surrounds the core and helps keep light confined.
- Protective jacket: Protects the fibre from damage.

Advantages

- Very high bandwidth.
- Low signal loss over long distances.
- Immune to electromagnetic interference.
- Difficult to tap without detection compared with ordinary copper links.

Disadvantages

- Installation and repair can require specialized skills.
- Fragile compared with some copper cables.
- Optical equipment can be costly.

Applications: High-speed Internet, submarine cables, and telecommunications.

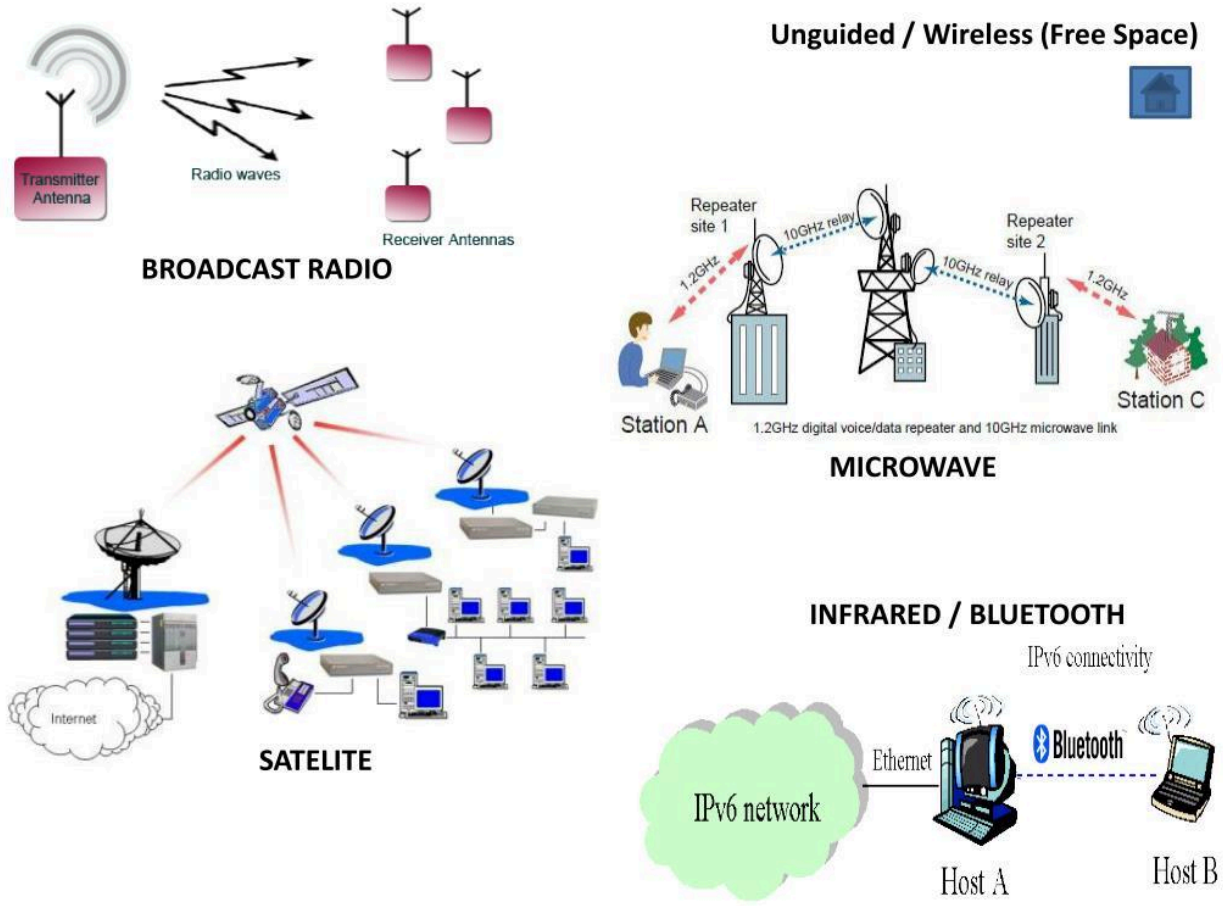
Comparison of guided media

Feature	Twisted pair	Coaxial cable	Optical fibre
Signal	Electrical	Electrical	Light
Medium	Copper wire pairs	Central conductor with shielding	Glass/plastic fibre
Cost	Usually low	Moderate	Installation may cost more
Interference	More susceptible, especially UTP	Better shielding	Immune to electromagnetic interference
Bandwidth	Good for many LAN uses	Good for many RF uses	Very high
Common use	Ethernet LAN	Cable TV/broadband	Backbone Internet links

Memory trick: Twisted pair = twisted copper, Coaxial = shielded copper, Fibre = light.

12. Wireless Transmission

Wireless transmission sends information without a physical cable between the communicating devices. It commonly uses electromagnetic waves.



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A. Radio waves

Radio waves can travel over wide areas and may penetrate walls, depending on their frequency and the environment.

Characteristics

- Can support omnidirectional transmission.
- Useful for mobile communication.
- May experience interference.

Applications: Radio broadcasting, Wi-Fi, Bluetooth, and mobile networks.

B. Microwaves

Microwaves are high-frequency radio waves often used for directional communication.

Characteristics

- Often use directional antennas.
- Terrestrial links commonly need a clear line of sight.
- Can carry large amounts of data.
- Buildings, terrain, and weather can affect some microwave links.

Applications: Point-to-point communication, cellular backhaul, and satellite links.

C. Infrared waves

Infrared communication uses electromagnetic waves beyond the red end of visible light.

Characteristics

- Usually suited to short-range communication.
- Commonly does not pass through walls.
- Can have low interference between separate rooms.

Applications: Television remote controls and some short-range device links.

Comparison

Radio waves	Microwaves	Infrared
Can cover large areas	Often directional	Usually short-range
May pass through walls, depending on frequency	Often needs line of sight	Usually does not pass through walls
Radio and mobile communication	Satellite and point-to-point links	Remote controls
Can be omnidirectional	Commonly directional	Commonly short-range

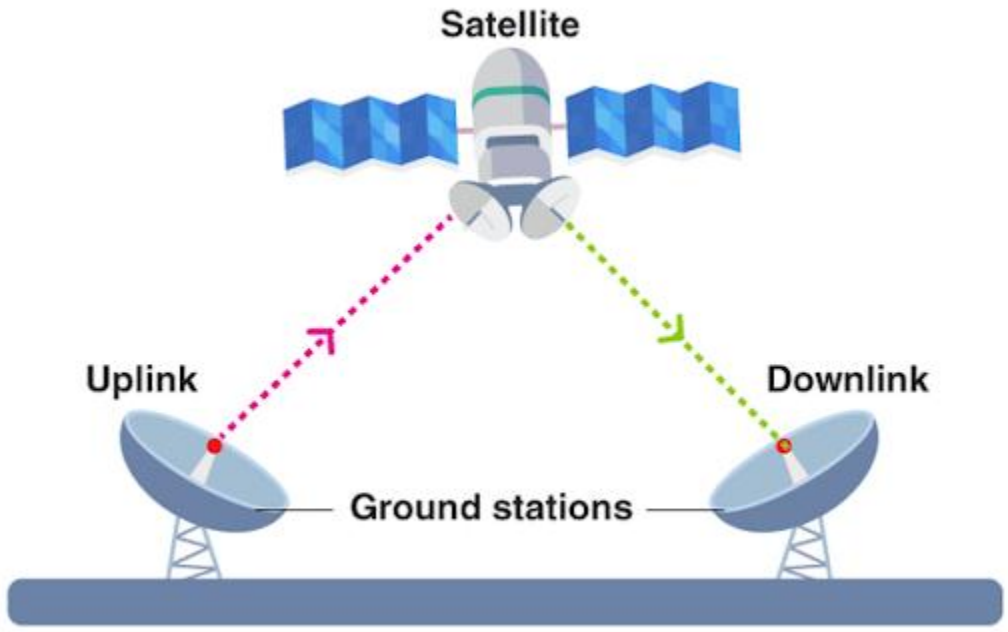
Exam tip: If asked about wireless transmission, explain radio waves, microwaves, and infrared with one characteristic and one application each.

13. Communication Satellites

What is a communication satellite?

A communication satellite is a satellite used to receive signals from one location and retransmit them to another location.

It acts like a relay station in space.



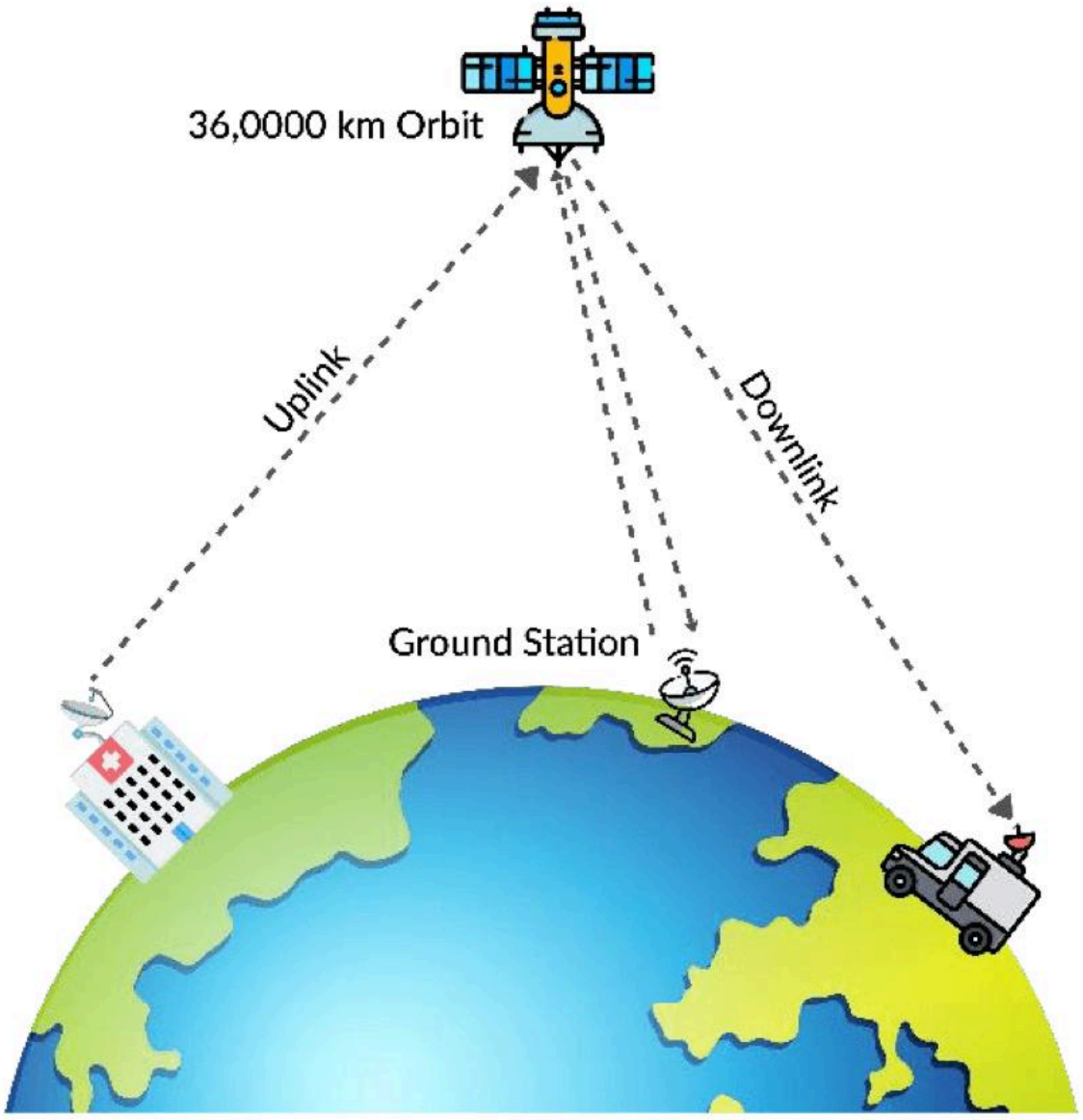
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How does it work?

Imagine a person in India wants to send a signal to a distant location.

1. An Earth station sends the signal toward the satellite. This is the uplink.
2. The satellite receives the signal.
3. The satellite's communication equipment processes or retransmits the signal.
4. The satellite sends the signal back to an Earth station. This is the downlink.
5. The receiving station delivers the information to its destination.

Types of communication satellites



1. GEO — Geostationary Earth Orbit

- Approximately 35,786 km above the equator.
- Appears stationary relative to a point on Earth.
- Covers a very large area.
- Has relatively high communication delay.

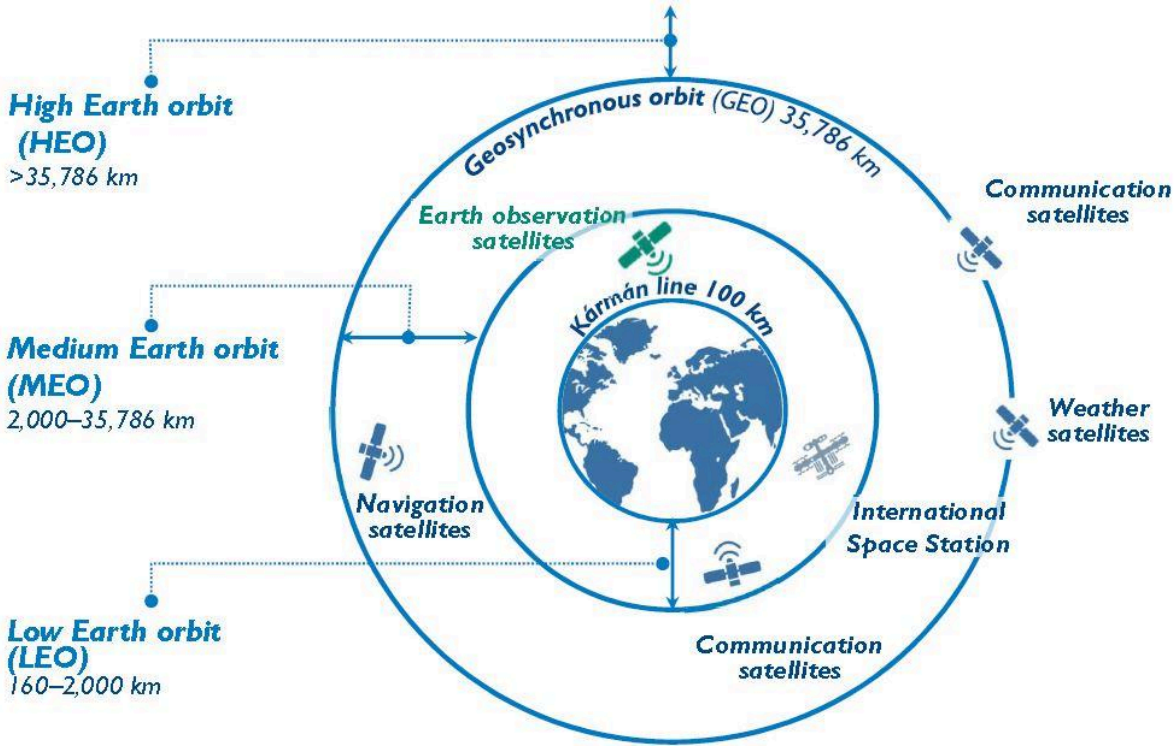
Example: Some television broadcasting and satellite communication systems.



2. LEO — Low Earth Orbit

- Usually a few hundred to around 2,000 km above Earth.
- Lower communication delay than GEO in many systems.
- Satellites move rapidly relative to the ground.
- Many satellites may be needed for continuous global coverage.

Example: Low-orbit broadband satellite constellations.



3. MEO — Medium Earth Orbit

- Between LEO and GEO in altitude.
- Offers a middle ground in coverage and orbital period.
- Used in navigation systems and some communication systems.

Example: Navigation satellite constellations such as GPS.

Advantages

- Covers large geographical areas.
- Can connect distant or remote locations.
- Useful for broadcasting to many receivers.
- Supports communication where terrestrial infrastructure is limited.

Disadvantages

- Satellite equipment and launches can be expensive.
- GEO links have noticeable propagation delay.
- Signals may be affected by weather, especially at some higher frequencies.
- Satellites have limited lifetimes and need replacement.

Important terms:

- Uplink: Earth station to satellite.
- Downlink: Satellite to Earth station.
- Transponder: Equipment on a communication satellite that receives and retransmits signals, often after frequency conversion and amplification.

14. Multiplexing

This is an important topic for your examination, bro. Understand the basic idea first, and FDM, TDM, and WDM become much easier.

What is multiplexing?

Multiplexing is a technique that combines multiple signals and sends them through a single communication channel.

Imagine three students want to send messages through one communication cable. Instead of giving each student a separate cable, multiplexing allows them to share the same channel.

At the receiving end, a process called demultiplexing separates the combined signals.

Multiple input signals

Signal A
Signal B
Signal C

Multiplexer (MUX)

Combines the signals

One shared communication channel

Demultiplexer (DEMUX)

Separates the signals

Separate output signals

Signal A
Signal B
Signal C

Why do we use multiplexing?

- To use communication channels efficiently.
- To reduce the need for separate physical links.
- To allow multiple users or signals to share transmission infrastructure.
- To reduce communication costs.

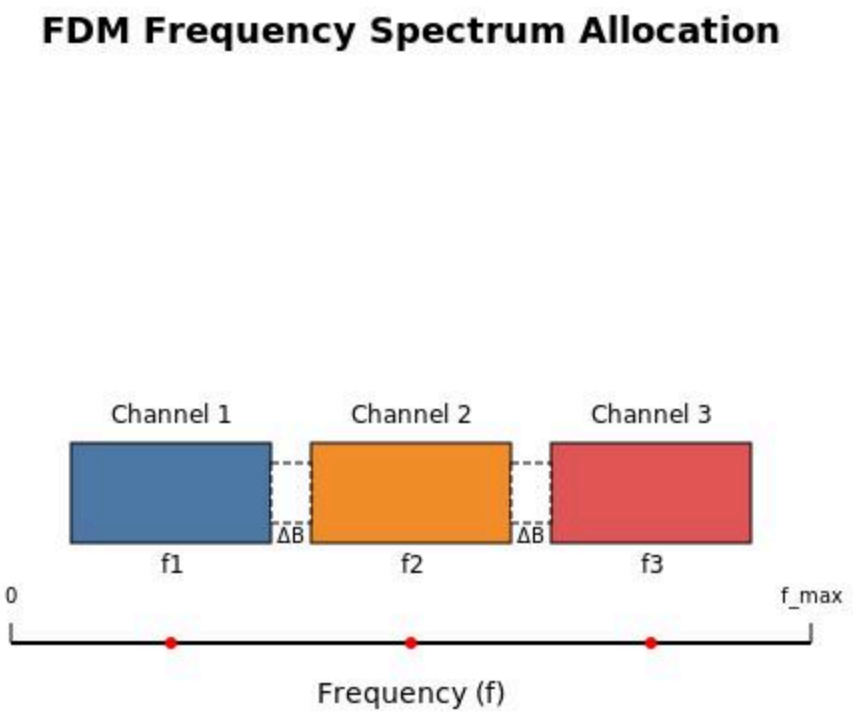
There are three types in your syllabus:

1. FDM — Frequency Division Multiplexing.
2. TDM — Time Division Multiplexing.
3. WDM — Wavelength Division Multiplexing.

A. FDM — Frequency Division Multiplexing

Definition: FDM divides the available channel bandwidth into different frequency bands so that multiple signals can be transmitted simultaneously.

Think of a radio: different radio stations use different frequencies, allowing several stations to broadcast at the same time.



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How does FDM work?

1. Multiple signals are received.
2. Each signal is assigned a different frequency band.
3. The signals are combined into one channel.
4. They travel simultaneously through the medium.
5. The receiver separates them using their frequency bands.

Guard bands may be placed between frequency bands to reduce interference.

Example: Traditional radio broadcasting, where different stations operate on different assigned frequencies.

Advantages

- Multiple signals can be transmitted simultaneously.
- Does not require each signal to wait for its turn.

- Suitable for continuous signals.

Disadvantages

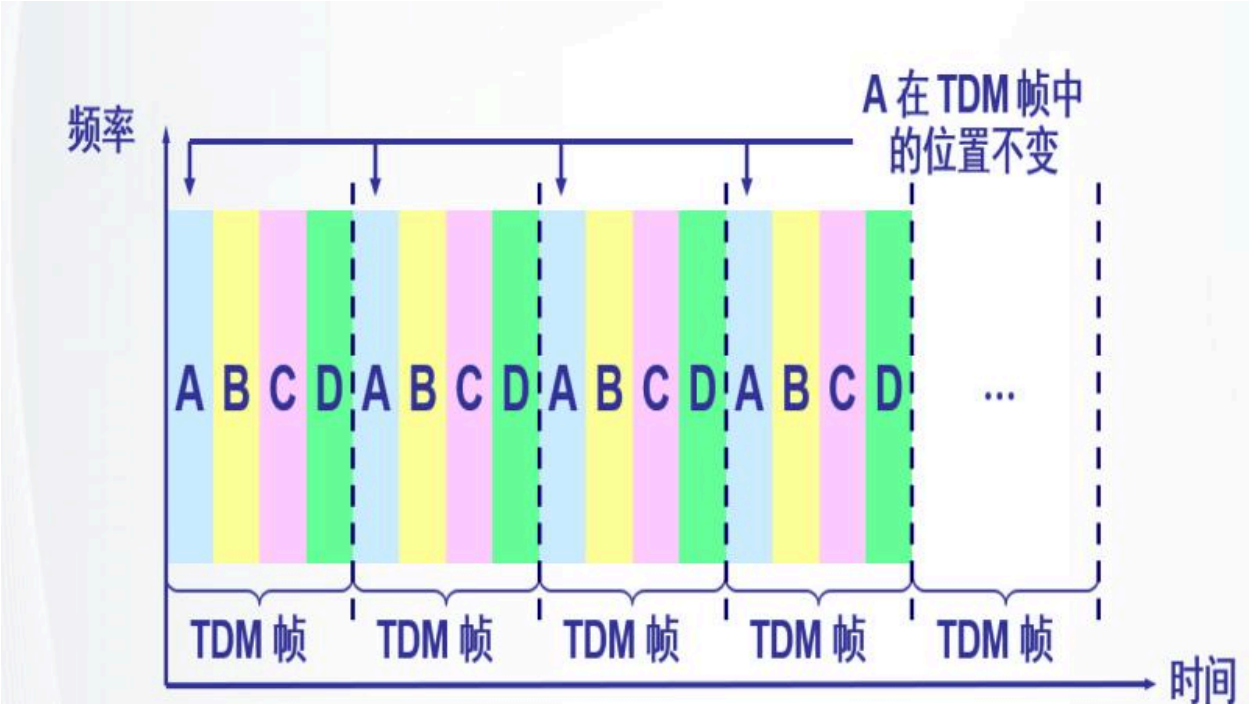
- Requires sufficient bandwidth.
- Signals can interfere if frequency bands are not properly separated.
- Guard bands may waste some available bandwidth.

Memory trick: FDM = Different Frequencies at the same time.

B. TDM — Time Division Multiplexing

Definition: TDM allows multiple signals to share the same communication channel by assigning each signal a different time slot.

Imagine three students sharing one microphone. Student A speaks first, Student B speaks next, and Student C speaks after that. They share the microphone by taking turns.



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How does TDM work?

1. Multiple signals are received.
2. Each signal is assigned a time slot.
3. The signals are transmitted in their allocated slots.
4. The receiver uses timing information to separate the signals.

Types of TDM

- Synchronous TDM: Each input is assigned a fixed time slot in every frame, even if it has no data to send.
- Statistical (asynchronous) TDM: Time slots are assigned dynamically to inputs that have data to send, improving utilization when traffic is uneven.

Example: Digital communication systems that combine several data streams onto one link.

Advantages

- Efficiently shares a communication channel.
- Does not require a separate frequency band for every input.
- Statistical TDM can make better use of capacity when inputs are idle.

Disadvantages

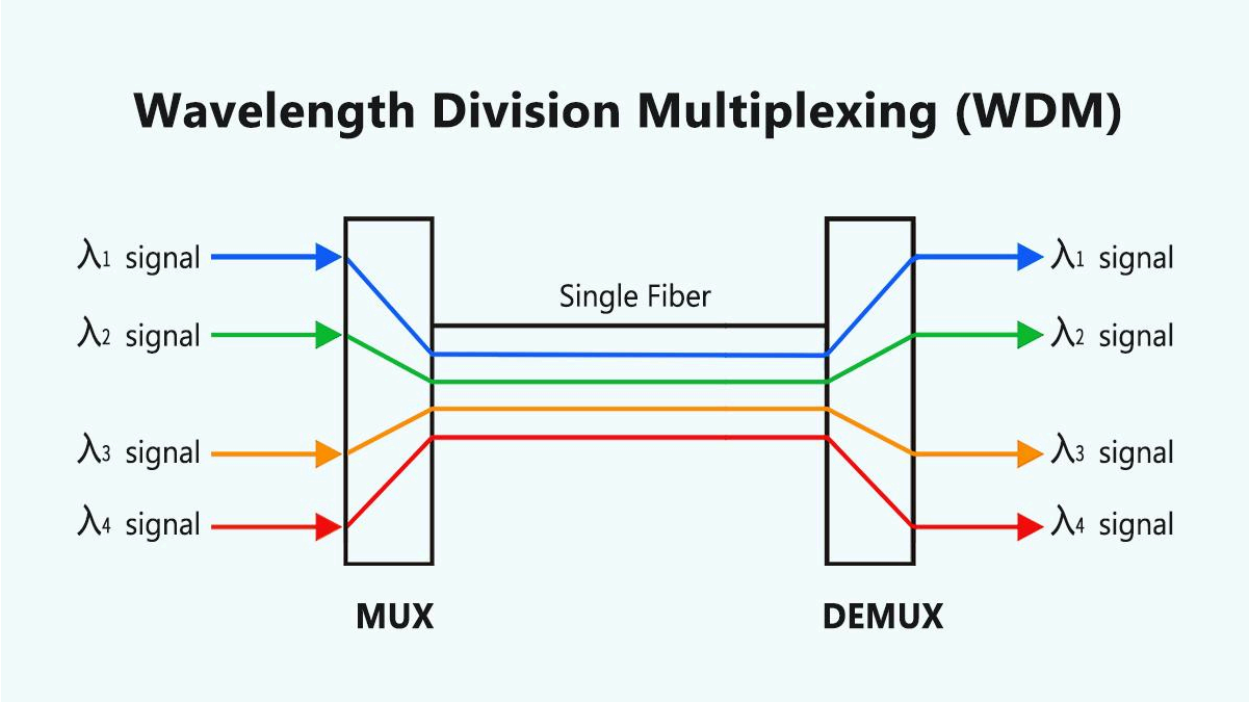
- Requires accurate timing and synchronization.
- Fixed slots may be wasted when a source has no data.
- Delays can occur while waiting for an allocated slot.

Memory trick: TDM = Different Times.

C. WDM — Wavelength Division Multiplexing

Definition: WDM combines multiple optical signals of different wavelengths and transmits them simultaneously through a single optical fibre.

In simple words, different light wavelengths carry separate data streams through the same fibre.



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How does WDM work?

1. Multiple data streams are converted into optical signals.
2. Each signal uses a different wavelength of light.
3. An optical multiplexer combines them into one fibre.
4. The signals travel simultaneously through that fibre.
5. An optical demultiplexer separates the wavelengths at the receiving end.

Example: High-capacity fibre-optic links used by telecommunications providers.

Advantages

- Greatly increases the capacity of optical fibre.
- Allows multiple data streams to share one fibre.
- Can expand capacity without installing additional fibre.

Disadvantages

- Optical multiplexers and demultiplexers can be expensive.
- Requires accurate wavelength management.
- The equipment and system design can be complex.

Memory trick: WDM = Different Wavelengths of light.

FDM vs. TDM vs. WDM

Feature	FDM	TDM	WDM
Full form	Frequency Division Multiplexing	Time Division Multiplexing	Wavelength Division Multiplexing
Separation method	Frequency bands	Time slots	Light wavelengths
Transmission	Simultaneous	Usually takes turns in allocated slots	Simultaneous
Common medium	Radio and other communication channels	Digital communication links	Optical fibre
Example	Radio broadcasting	Digital multiplexed data streams	Fibre-optic backbone

Exam-ready answer (5 marks):

Multiplexing is a technique used to combine multiple signals for transmission through a shared communication channel. FDM assigns different frequency bands to signals, TDM assigns different time slots, and WDM assigns different optical wavelengths. At the receiving end, a demultiplexer separates the signals. Multiplexing improves channel utilization and reduces the need for separate transmission links.

Module 1 — Final revision sheet

Use this section for quick revision before entering the examination hall.

Topic	Remember this

Computer network	Connected devices sharing data and resources
Network criteria	Performance, Reliability, Security
Bus topology	One backbone cable
Star topology	Central switch or hub
Ring topology	Circular connection
Mesh topology	Multiple interconnections
Tree topology	Hierarchical branches
Point-to-point	Two devices share a dedicated link
Multipoint	Multiple devices share a link
PAN	Personal devices
LAN	Small local area
MAN	City-wide network
WAN	Large geographical area

Internet	Global network of interconnected networks
OSI model	Seven layers
TCP/IP model	Commonly four layers
Physical layer	Transmits bits
Twisted pair	Twisted copper wires
Coaxial cable	Shielded central conductor
Optical fibre	Transmits light
Radio waves	Wireless communication over a range of distances
Microwaves	Often directional, line-of-sight links
Infrared	Commonly short-range
Uplink	Earth station → satellite
Downlink	Satellite → Earth station
FDM	Different frequencies

TDM	Different time slots
WDM	Different light wavelength