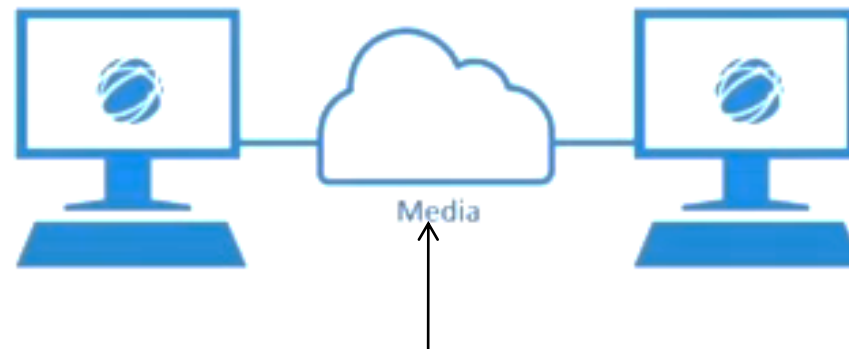


# Cybersecurity and Network Engineering



**A computer network** is a system where multiple computers and devices are connected using wired or wireless communication technologies.

The primary purpose of networking is to enable the **sharing of resources** such as hardware (e.g., printers), software applications, data, and information among connected devices.



**COMMUNICATION MEDIUM**

# Advantages of Networking

- Easy Sharing of Resources
- Better Communication
- Centralized Data Storage
- Improved Security

# Easy Sharing of Resources

When computers are connected in a network, you can easily share things like printers, files, and internet connections. For example, if there is one printer in an office, all computers can use it without needing separate printers for each one.

# Better Communication

Networking helps people communicate quickly and easily. You can send emails, chat, or make video calls within seconds. This is very helpful for offices, schools, and even at home

# Centralized Data Storage

Instead of saving files on each computer separately, you can save them in one main place (called a server). This makes it easier to manage, back up, and protect data.

# Improved Security

In a network, it is easier to control who can access which data. You can set permissions, use passwords, and keep important information safe from unauthorized access.

# Disadvantages of Networking

- Virus and Malware Spread Quickly
- High Setup and Maintenance Cost
- Security Problems
- Server Failure Affects All



# Virus and Malware Spread Quickly

If one computer in the network gets a virus, it can easily spread to other computers. This can damage files and affect all connected systems.

# High Setup and Maintenance Cost

Creating a network needs special devices (like switches, routers, and cables), which can be expensive. Also, you may need to pay for maintenance and repairs

# Security Problems

If security is not strong, hackers can access the network and steal important data. Extra steps like passwords and firewalls are needed to keep it safe.

## Server Failure Affects All

In many networks, there is a main computer (server). If this server fails or stops working, all users connected to it may lose access to files and services



# Types of Networks

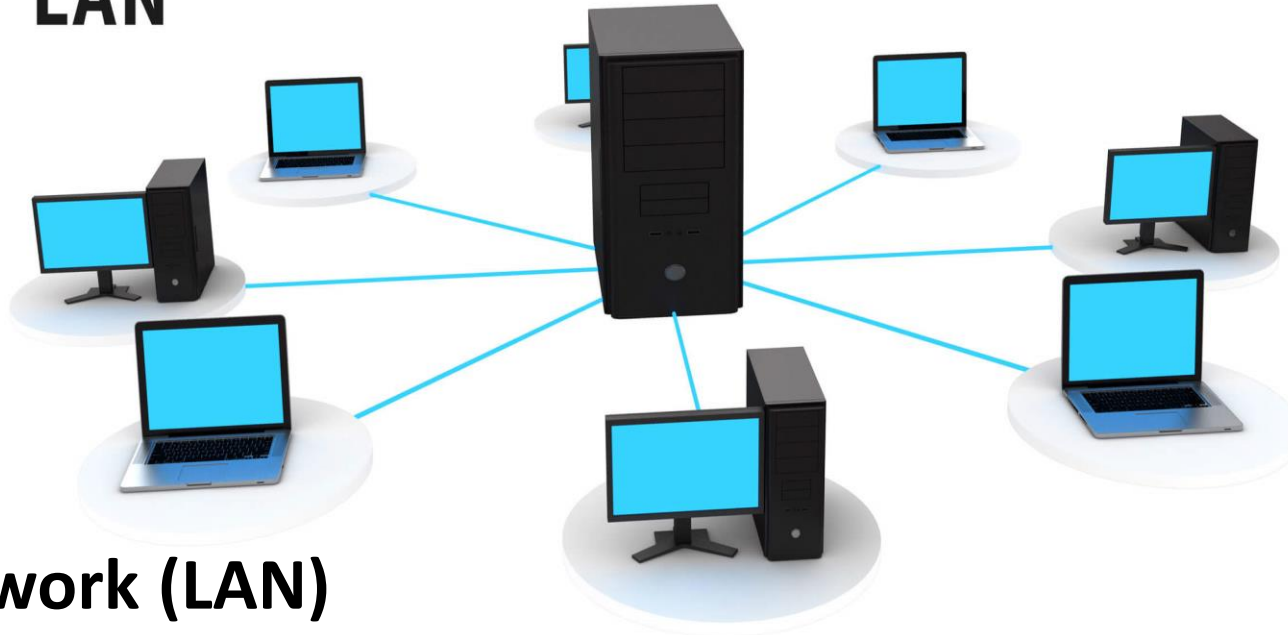
Networks are groups of two or more computers or devices connected to share data and resources. Networks can be classified based on size, distance, or how they are connected.

- Local Area Network (LAN)
- Wide Area Network (WAN)
- Metropolitan Area Network (MAN)
- Personal Area Network (PAN)
- Wireless Networks (WLAN)
- Virtual Private Network (VPN)



# Local Area Network (LAN)

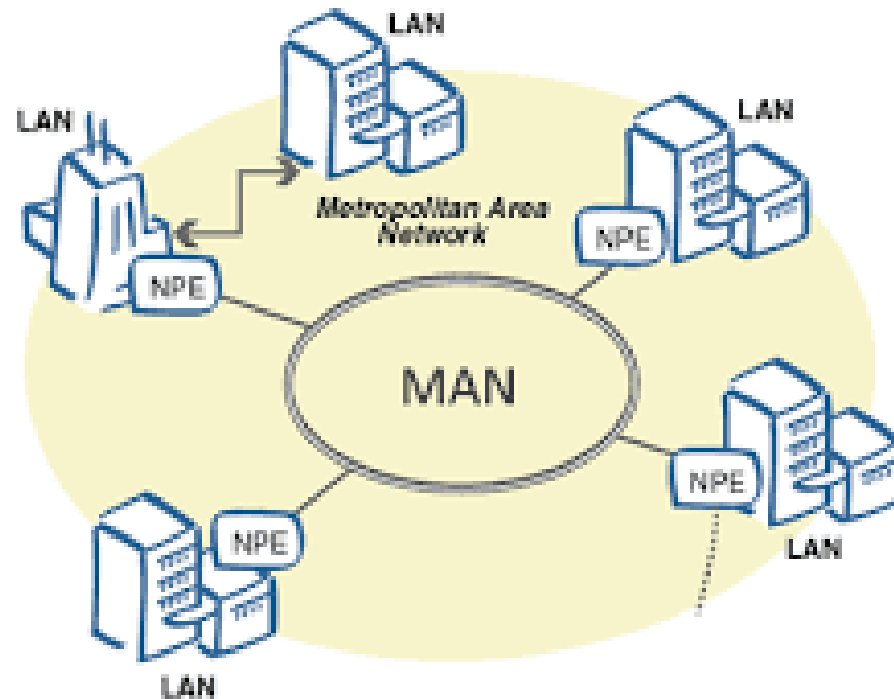
## LAN



## Local Area Network (LAN)

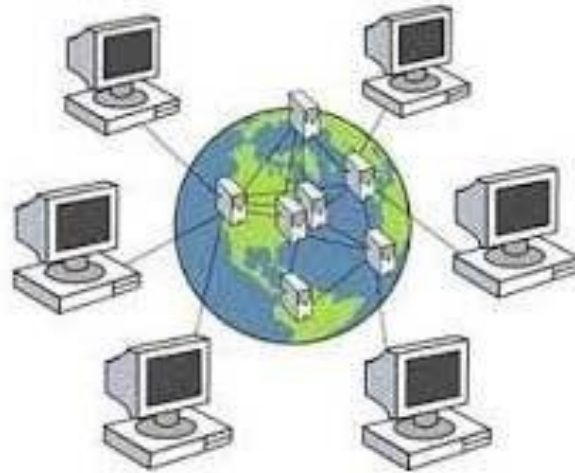
- Covers a small area like a home, office, or school.
- Computers are connected closely, usually within one building.
- Fast connection speed.
- Example: Office computers connected to the same printer.

# Metropolitan Area Network (MAN)



- A city government connecting all its offices in different parts of the city
- University campuses spread across a city
- Cable TV networks in a metropolitan area

# Wide Area Network



A **Wide Area Network (WAN)** is a type of computer network that connects computers and networks **over a large geographical area**, such as **different cities, countries, or even continents**

# Types of networks

(Based on connection)

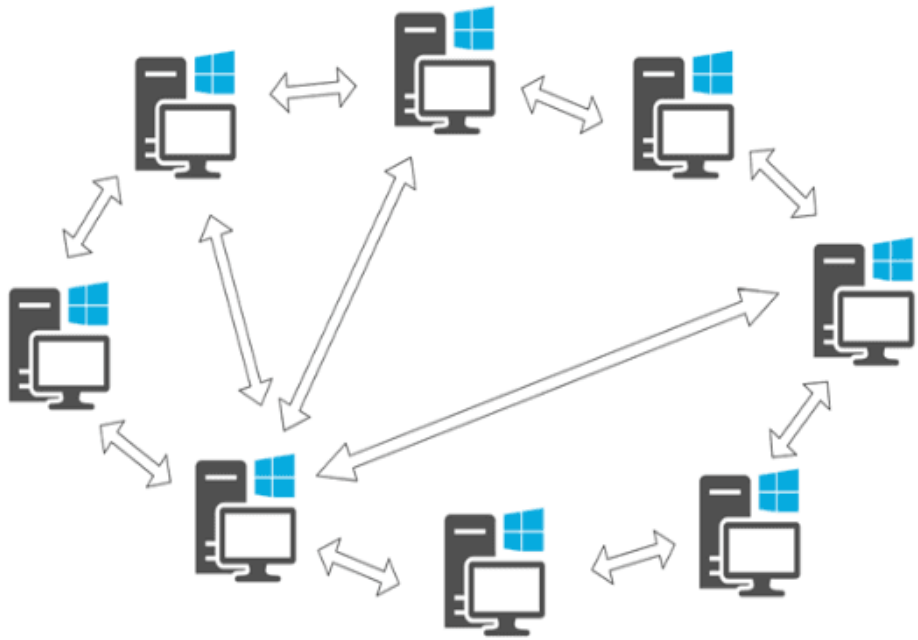
Peer to Peer  
network

Client server  
network

Hybrid  
network



# Peer to Peer network



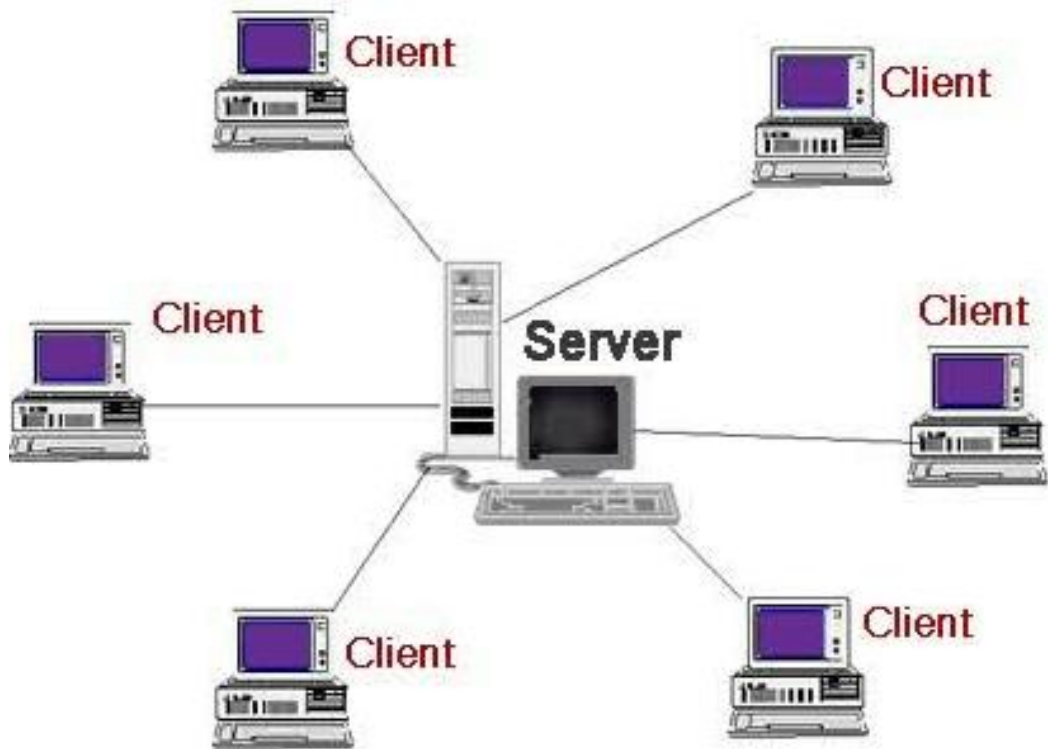
A **Peer-to-Peer network** is a type of computer network where **all computers (peers) are equal**, and **each computer can act as both a client and a server**.

This means every computer can **share files, resources, or data directly with other computers** without needing a central server.

Small networks (2 to 10 computers) work very well and are easy to manage.



# Client Server Network



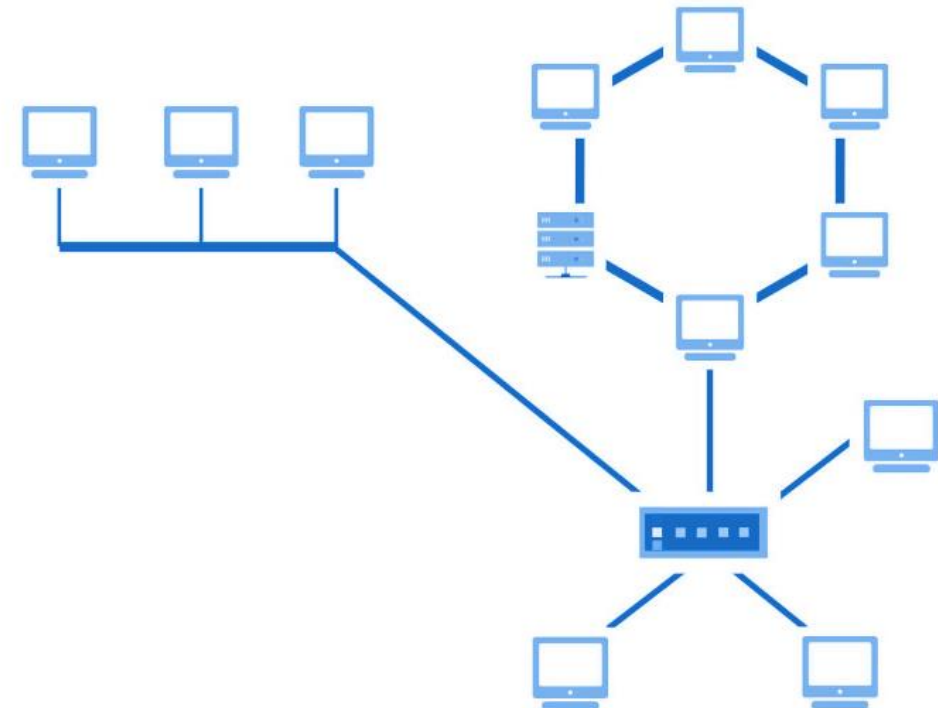
A **Client-Server network** is a type of computer network where there is a **central server** that provides services, data, or resources to **client computers** (users).

In this model:

- The **server** is powerful and stores data, applications, or manages printers, security, etc.
- The **clients** (ordinary computers) request and use these services.

# Hybrid network topology

A hybrid topology **mixes these basic topologies** to create a network that fits specific needs.



# Hybrid network topology

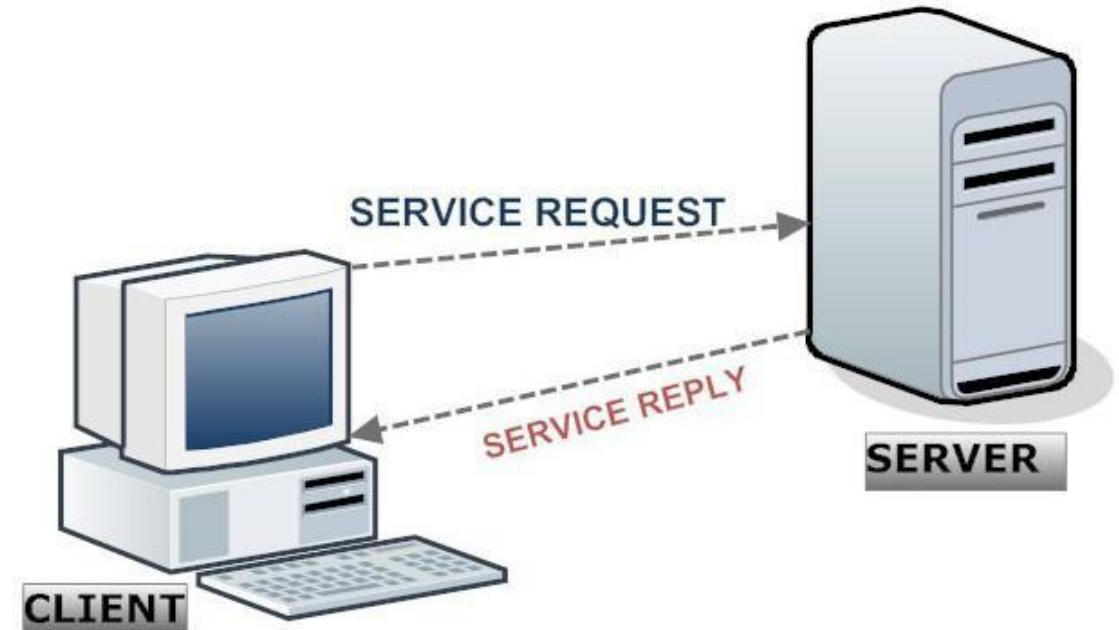
For example:

A large company might use a **star topology** inside each department (central switch in each department), and then connect these stars using a **bus topology** (backbone cable).

A university might use a **ring topology** to connect different buildings, and **star topology** inside each building.

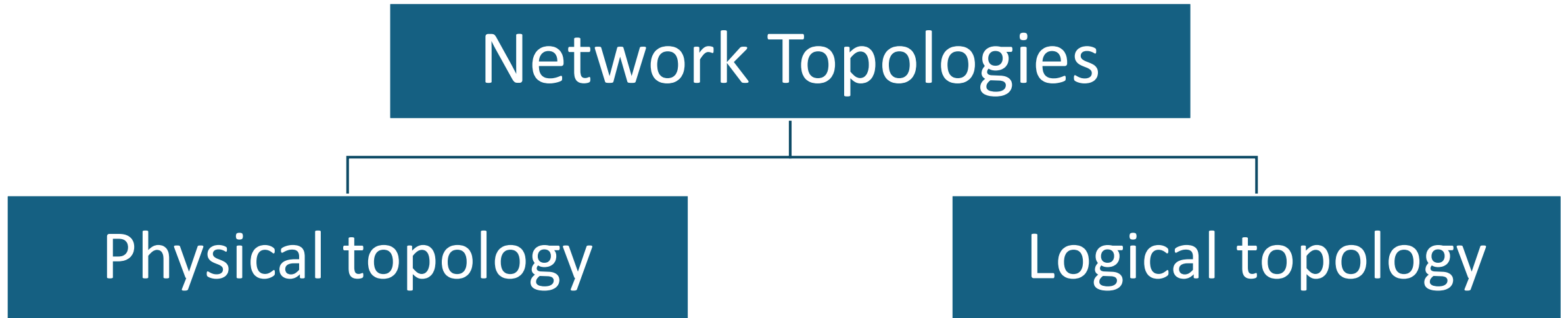
# Server Computer

- A **server computer** is the **main service provider** in a network
- It **stores data**, manages resources, and provides services (like files, websites, printing, applications) to other computers.



# Network Topologies

A **network topology** is the **arrangement or layout of computers and devices** in a network how they are connected to each other





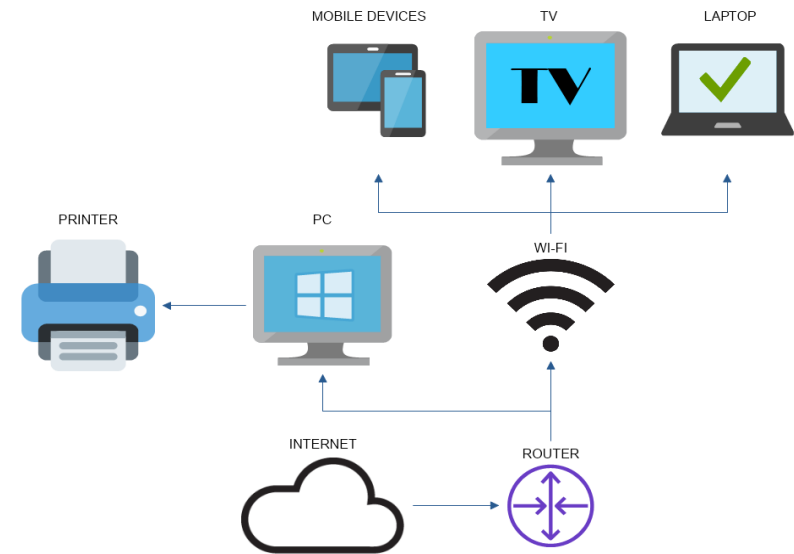
# Physical topology

This refers to the actual physical layout of cables, devices, and how they are physically connected.

Example: Where cables run in the office, how switches and computers are placed.

Examples of physical topologies:

- Bus
- Star
- Ring
- Mesh
- Tree





# Logical topology

Physical topology should not be confused with logical topology **which is the method used to pass information between workstations.**

- Ethernet
- Local Talk
- Token Ring
- FDDI- Fiber distributed Data interface
- ATM-Asynchronous Transfer Mode

# Physical topology

- Star topology
- Ring topology
- Bus topology
- Tree topology

# Star topology

A network setup where all devices are connected to a central hub or switch

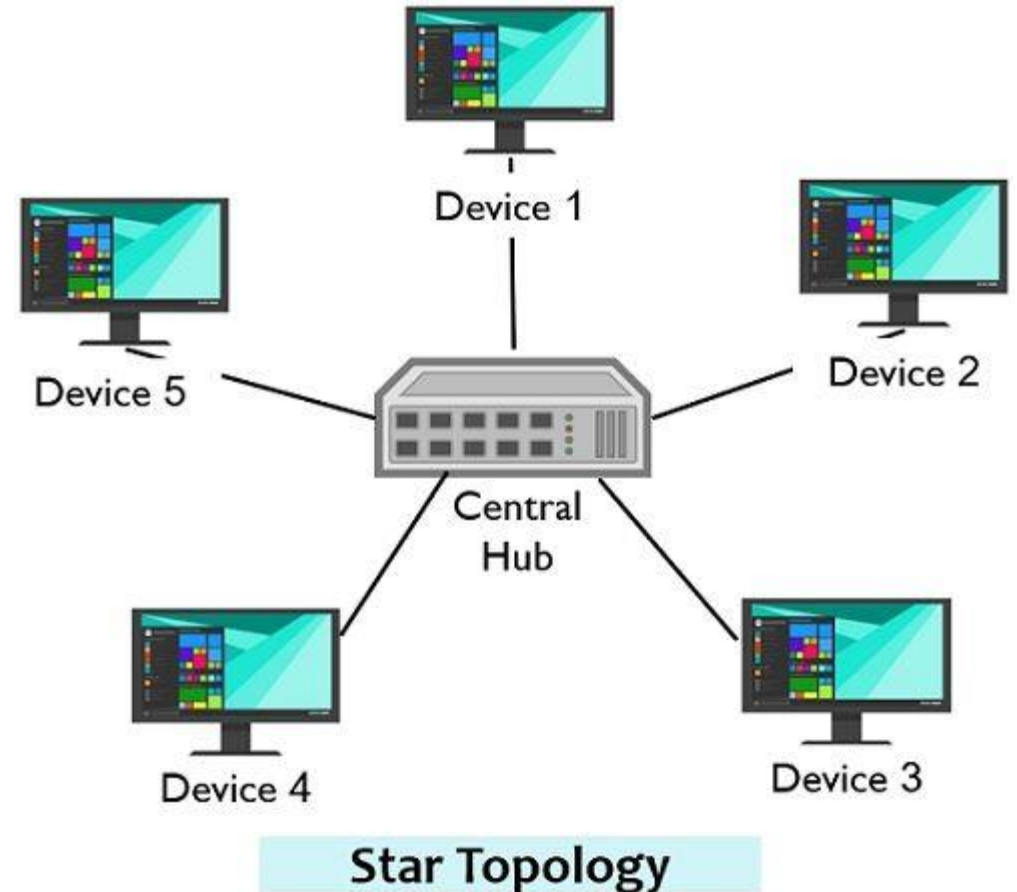
## Advantages:

- Easy to install and manage
- If one device fails, others are not affected
- Easy to detect faults

## Disadvantages:

If the central hub fails, the whole network goes down

More cables needed (higher cost)



# Ring Topology

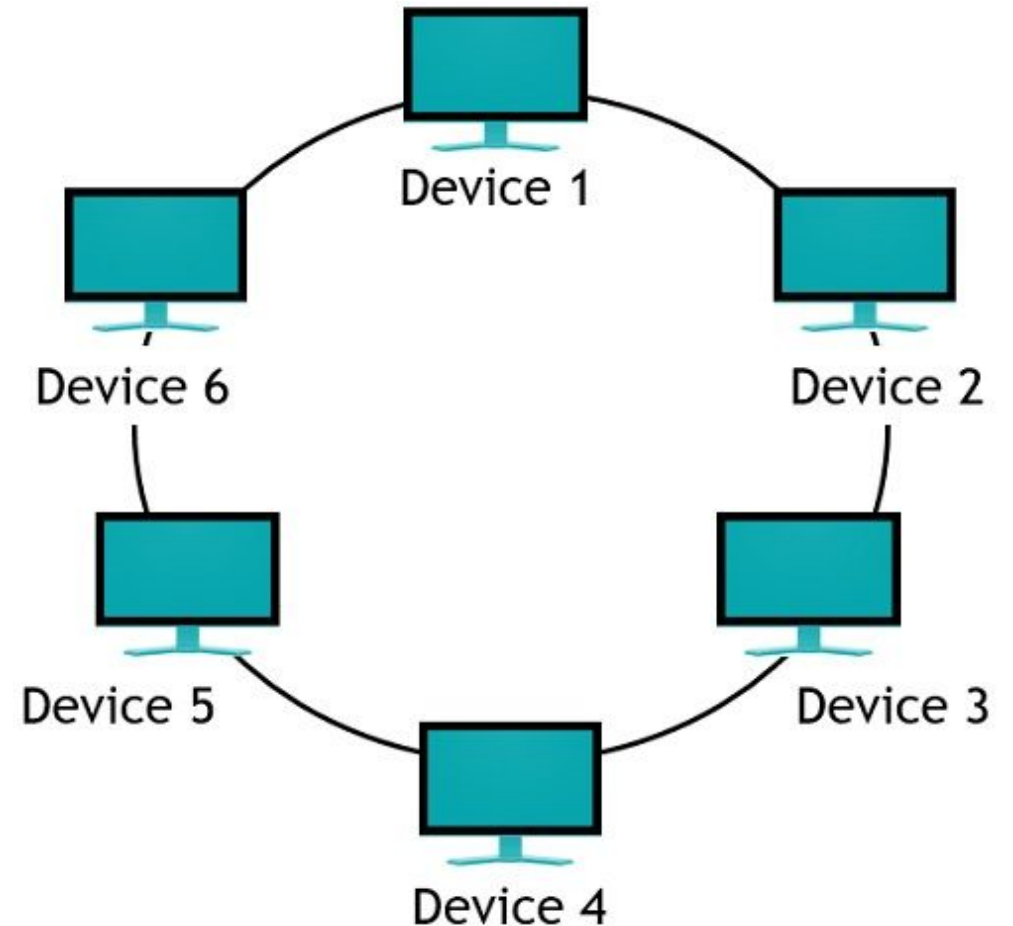
A network setup where each device is connected to exactly two other devices, forming a circular data path

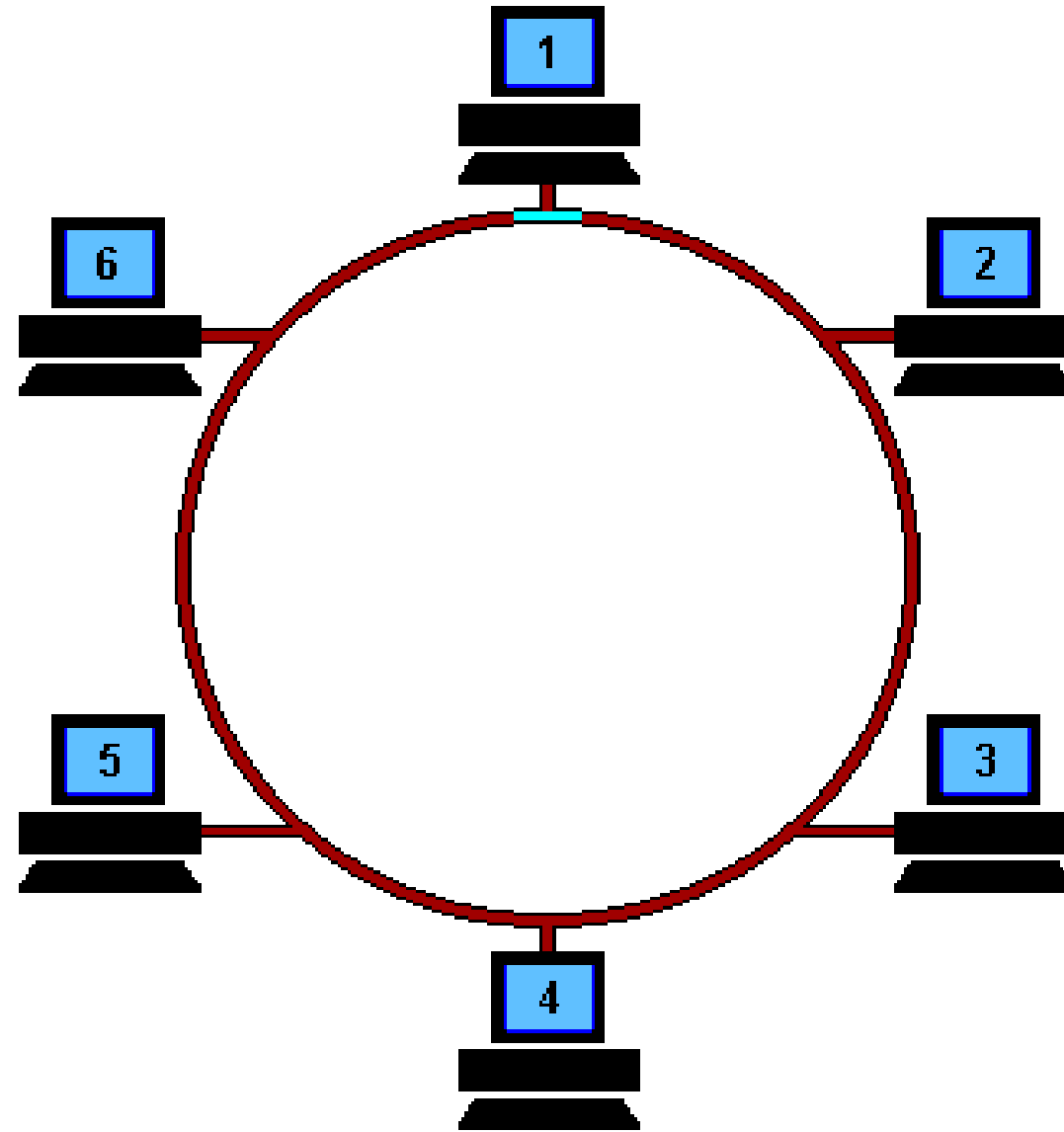
## Advantages:

- Easy to install and manage
- Data flows in one direction, reducing collisions

## Disadvantages:

- Failure in one device affects the whole network
- Troubleshooting is difficult





# Bus Topology

A network setup where all devices are connected to a single central cable (called a **bus**).

## **Advantages:**

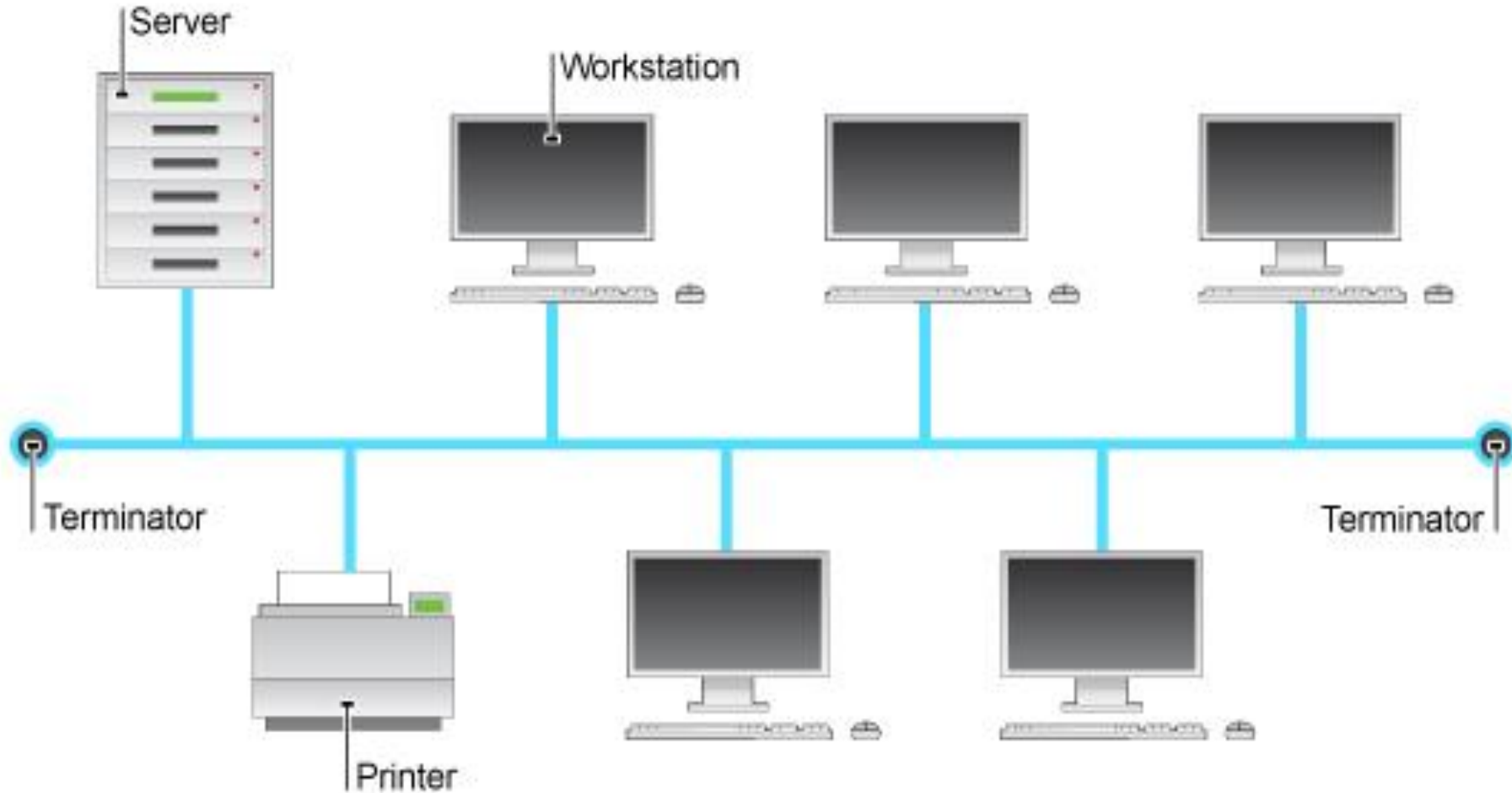
- Easy to set up
- Cost-effective for small networks

## **Disadvantages:**

- If the main cable fails, the whole network goes down
- Slower performance with many devices



# Bus topology



# Tree Topology

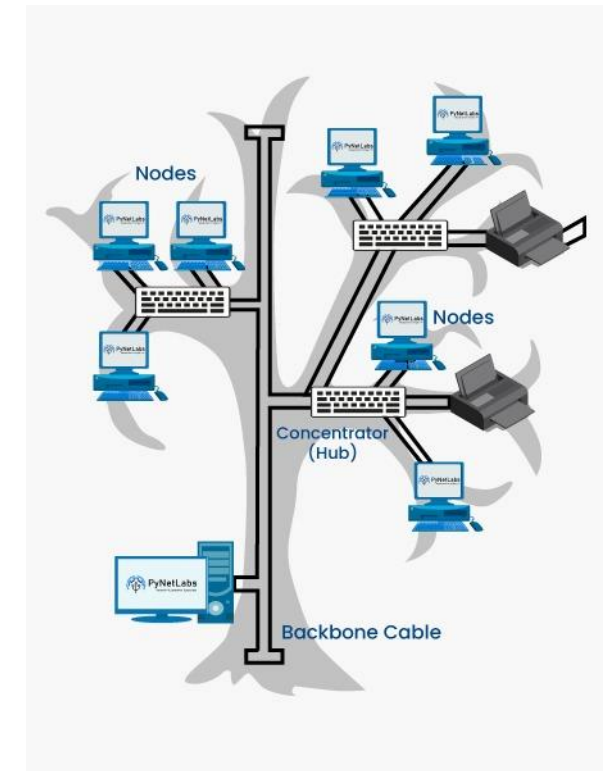
A tree topology is a combination of bus and star topologies. It has a root node connected to one or more levels of branches (nodes), forming a hierarchical structure

## Advantages:

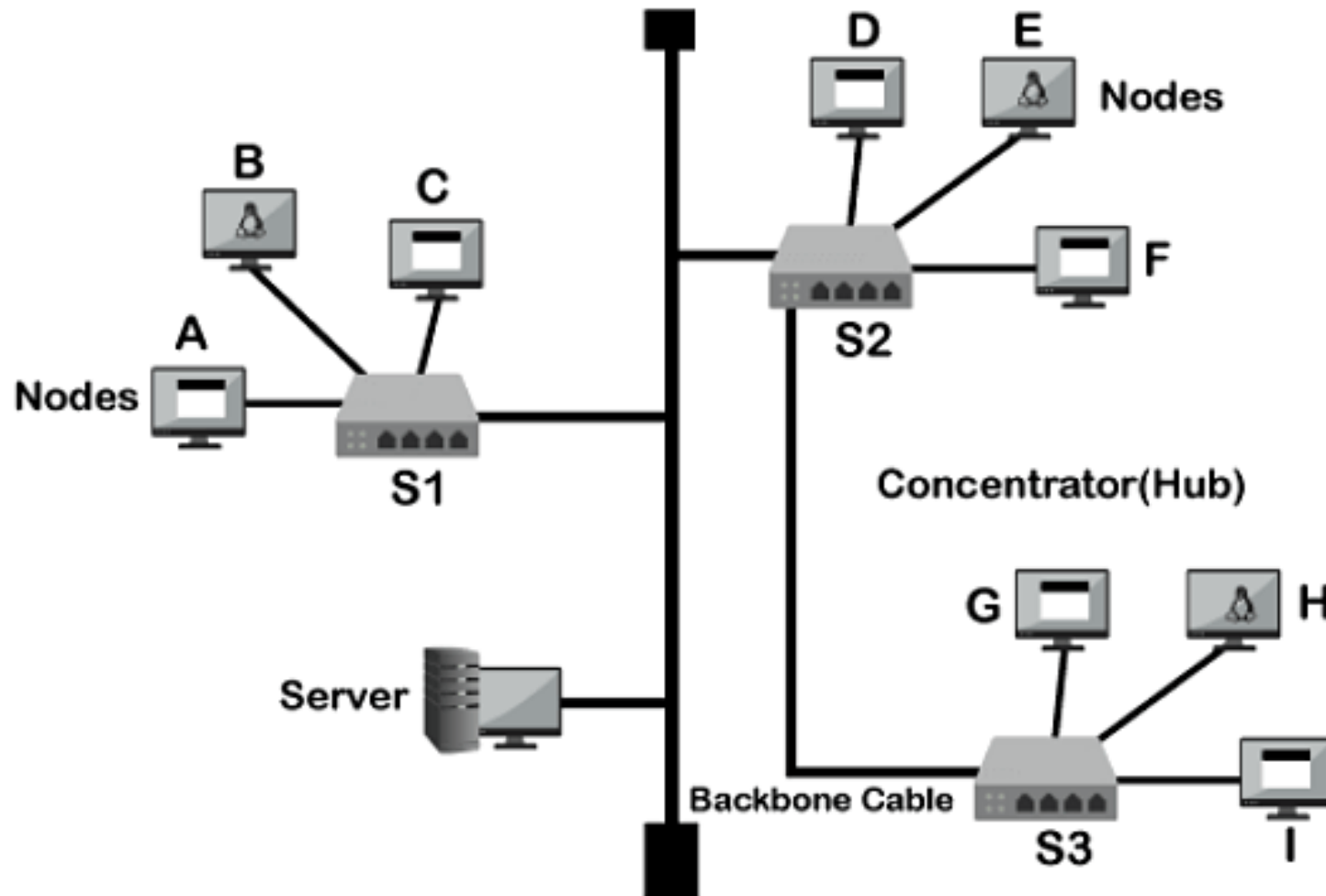
- Easy to expand by adding new nodes.
- Fault isolation is easier.
- Suitable for large networks.

## Disadvantages:

- If the root node fails, the whole network is affected.
- Requires more cables than bus topology.
- Maintenance is complex.



# Tree topology



# Transmission Media

We connect a computer to another through transmission media.

When choosing the transmission media , consider the following ;

- Transmission rate
- Distances
- Cost and ease of installation
- Resistance to environmental conditions

# Types of Communication Medium

## Wired (Guided)

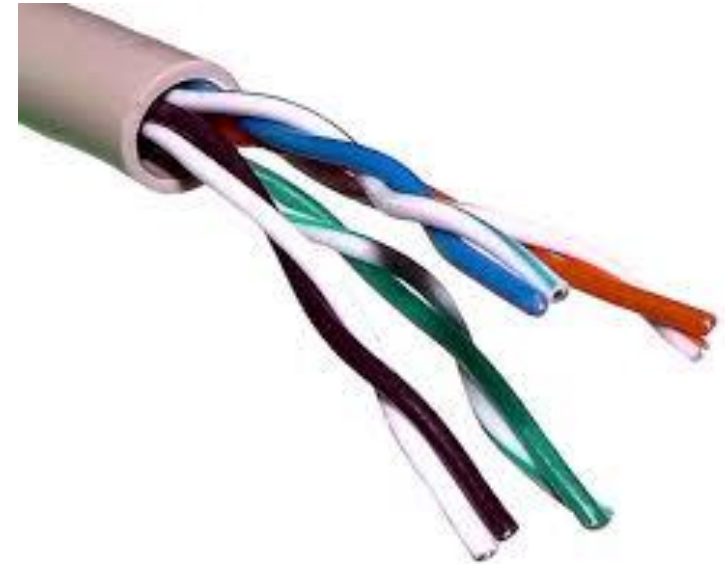
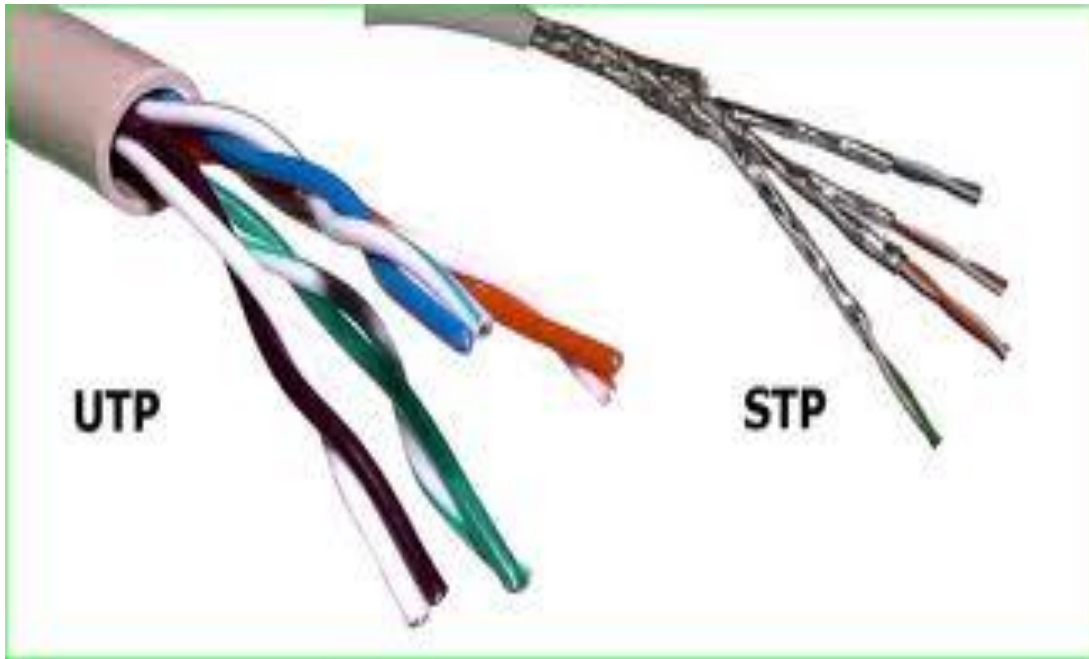
- Twisted Pair Cable
- Coaxial Cable
- Fiber Optic Cable

## Wireless (Unguided)

- Radio Waves
- Microwaves
- Infrared



# Twisted Pair Cable





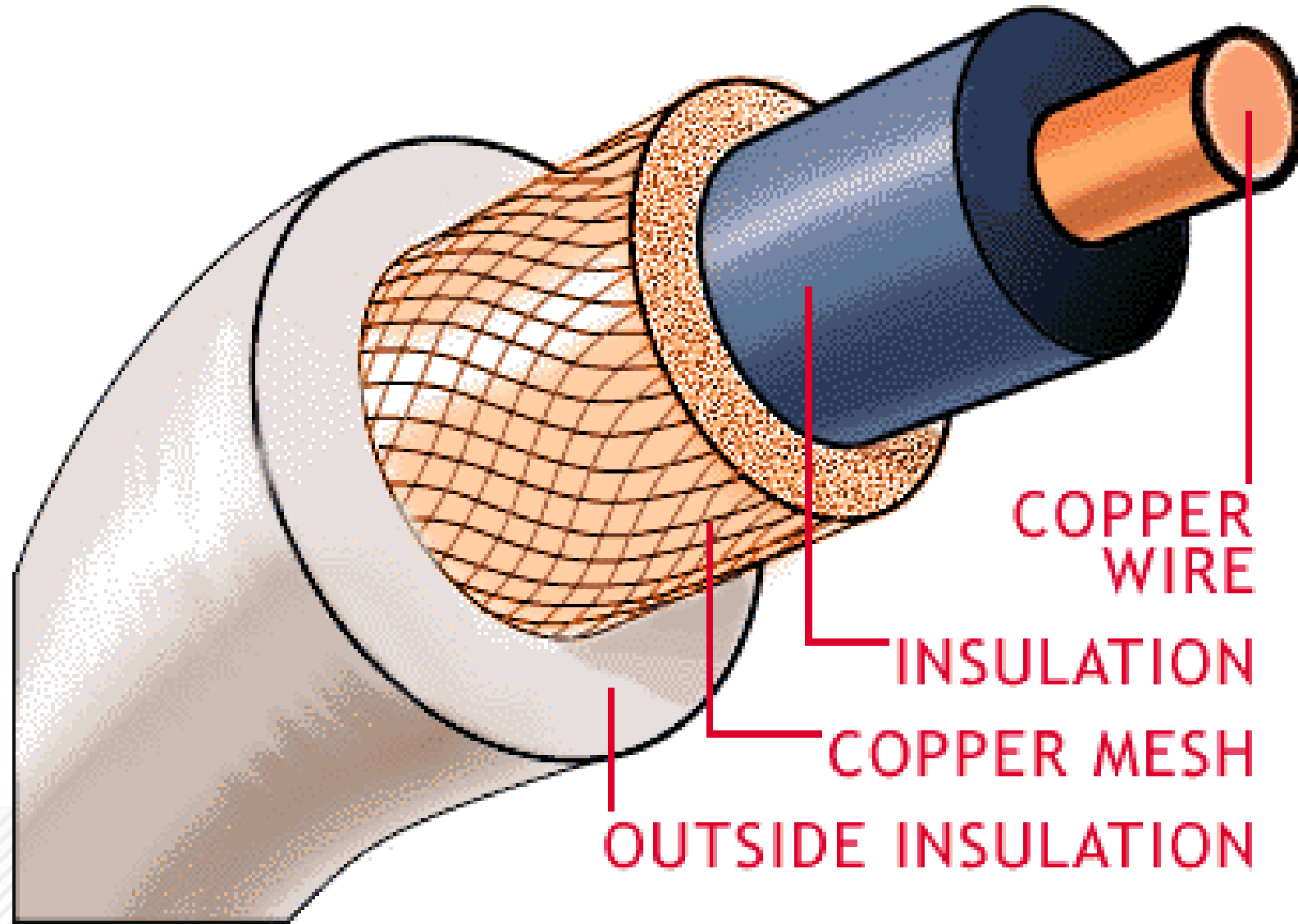
# Advantages

- It is a low cost cable
- Easy to install

# Disadvantages

- Data transmission speed is low
- Only suitable for small distance network
- Low resistance to environmental changes

# Coaxial cable



## COAXIAL CABLE



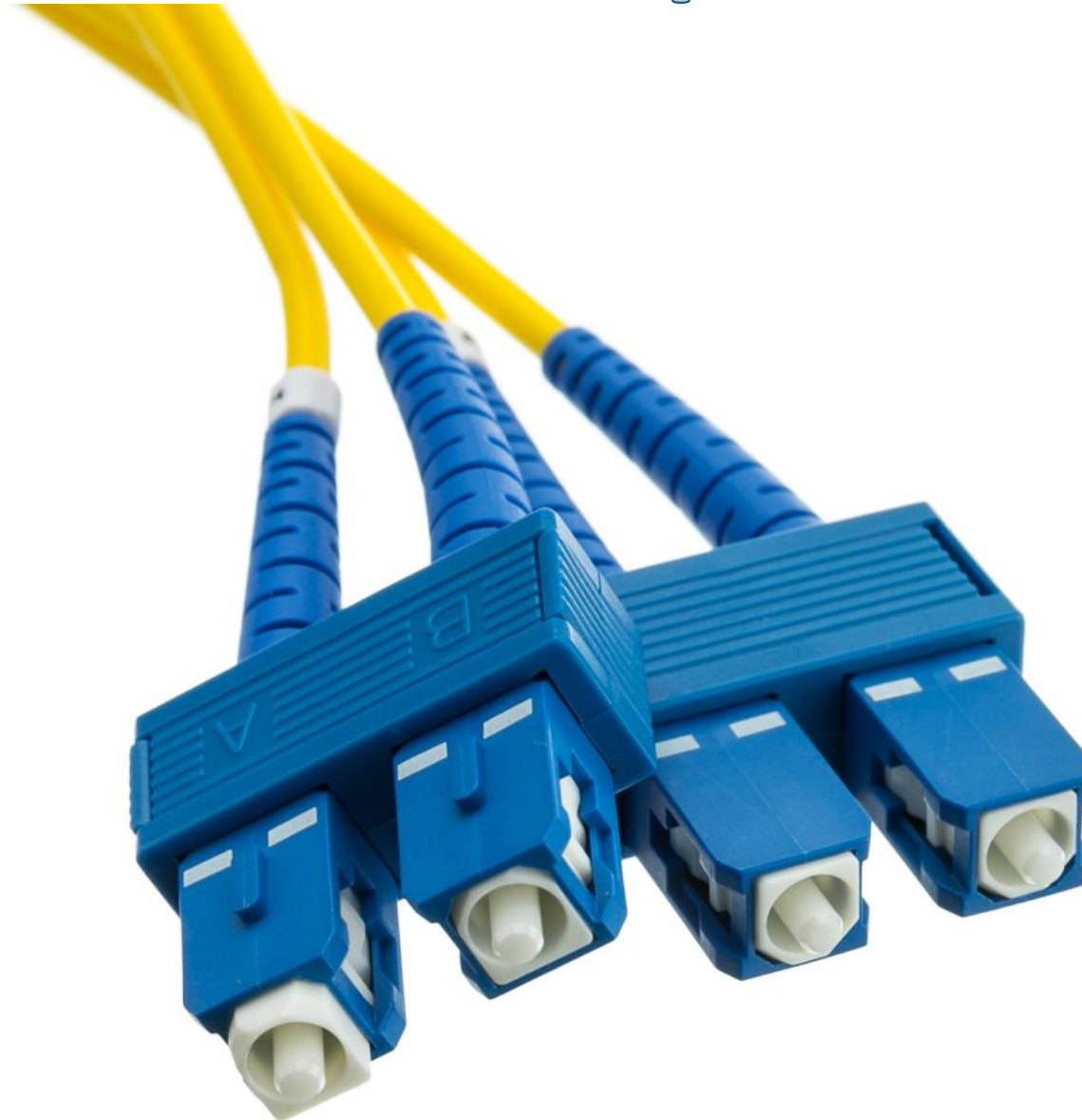
# Advantages

- It is suitable for large and long length networks
- It is highly resistant to signal interference
- It is a high speed cable

# Disadvantages

- Installation is difficult
- Cost of the cable is high

# Fiber Optic



# Advantages

- It is suitable for very large networks
- Resistance to environmental interference is very high
- Fastest cable
- Can apply a security to data on flow

# Disadvantages

- Cost is very high
- Difficult to install
- Need special knowledge to maintain network



# Network Devices

## Network interface Card ( NIC)

A NIC is a printed circuit board that fits into the expansion slots of motherboard. It is an interface between network cable and computer

# Hub / Switch

Both devices are used to connect computers in star topology network.

Both devices are functionally and physically similar to each other.

# Differences

Switch is an intelligent device than hub.

Because switch retransmit data only to the required computer.

But hub retransmits to whole network.

Therefore cost of switch also higher than hub.

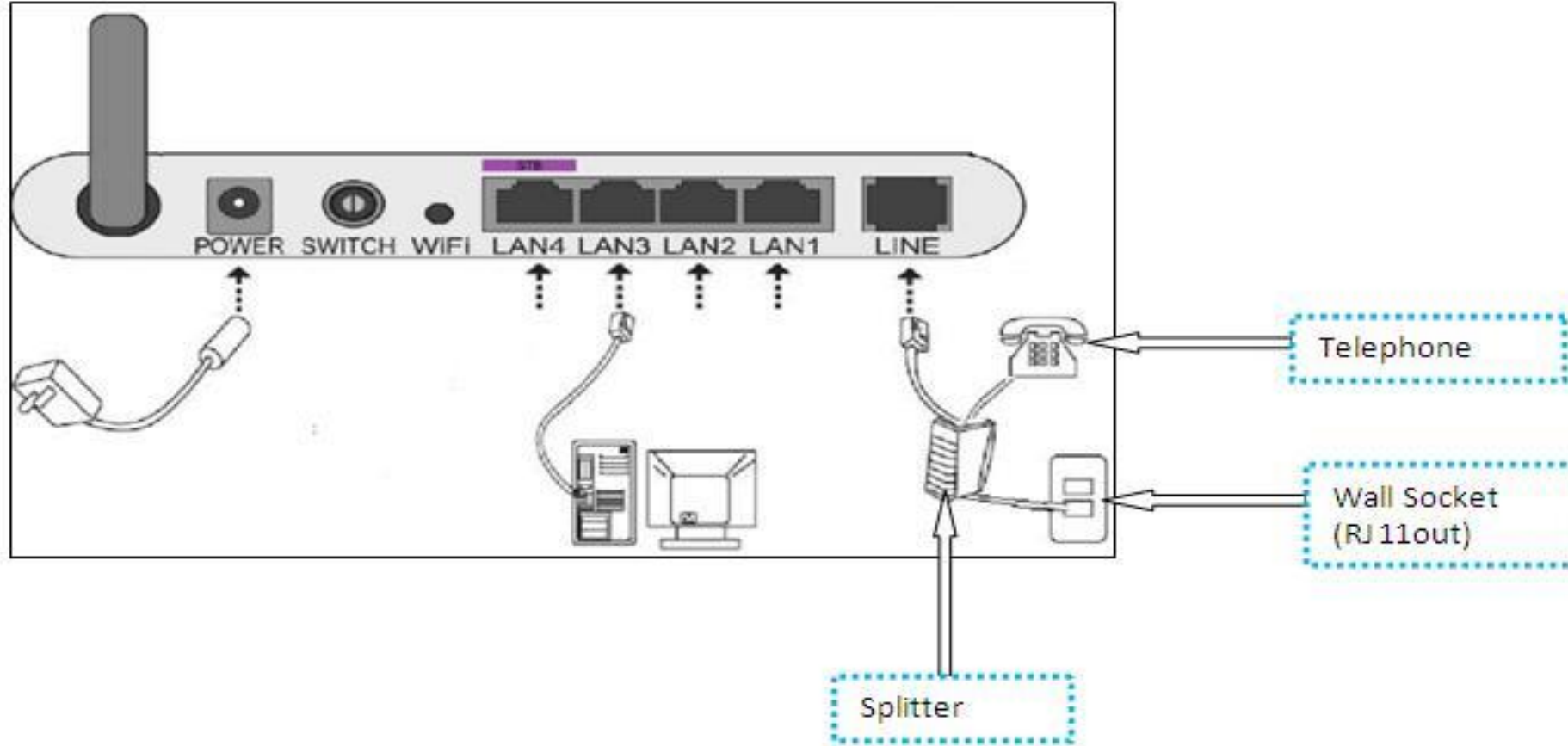
# Routers

Router is a special network device to connect one computer network to another computer network.

Routers select the best path to route a message, based on the destination address and origin.

# Routers

Rear view of ADSL router



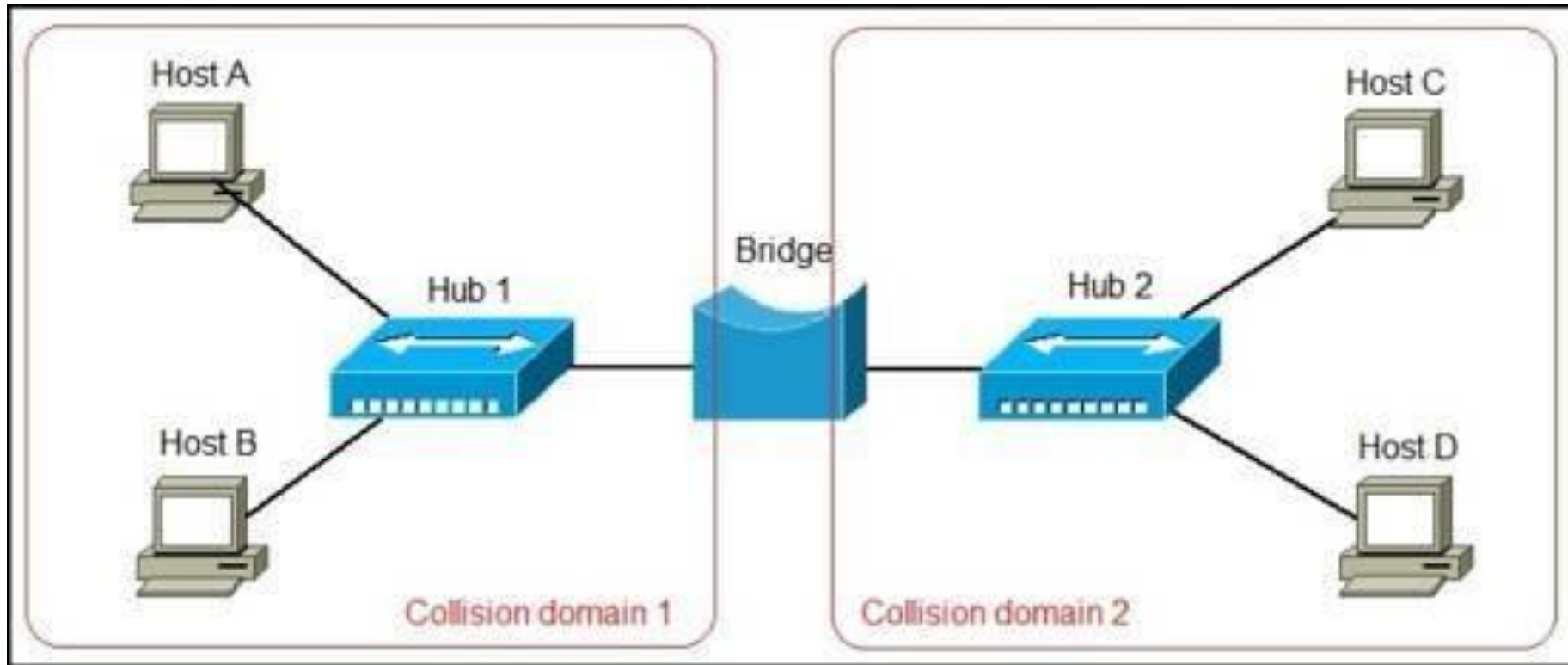
# Bridge

A network bridge joins two otherwise separate computer networks to enable communication between them and allow them to work as a single network.

Bridges are used with local area networks (LANs) to extend their reach to cover larger physical areas than the LAN can otherwise reach. Bridges are similar to—but more intelligent than—simple repeaters, which also extend signal range

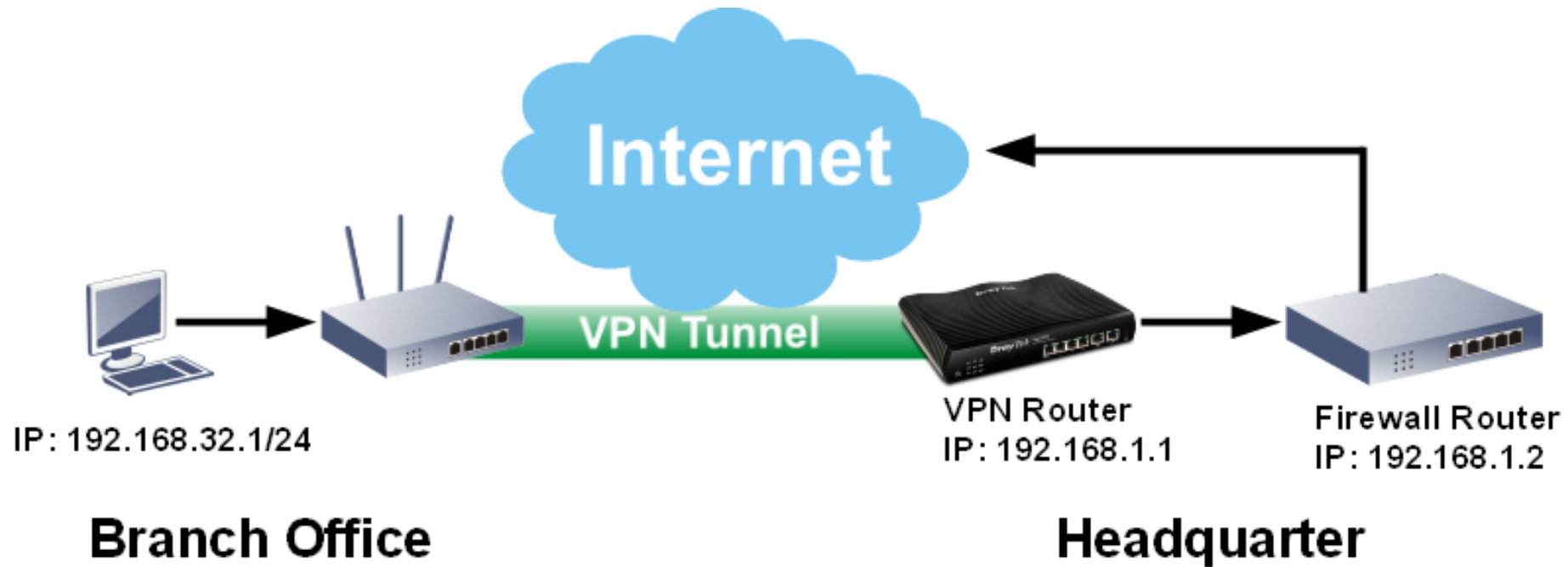


# Bridge



# Gateway

The link between two computers to connect to internet or another network is called gateway



# Access Point

An access point is a device that creates a wireless local area network, or WLAN, usually in an office or large building.

An access point connects to a wired router, switch, or hub via an Ethernet cable, and projects a Wi-Fi signal to a designated area

# Access Point



# Network layer

## Open Systems Interconnection (OSI)

The model uses layers to help give a visual description of what is going on with a particular networking system



# Network layer

