

# CN (IT-3001)

## Introduction

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# Content

- Types of connections
  - Point-to-Point
  - Multipoint
  - Broadcast
- Network Topologies:
  - Mesh
  - Star
  - Bus
  - Ring
  - Tree
- Categorization of Network based on Area
  - PAN
  - LAN
  - MAN
  - WAN

# Types of Connections

- There are two possible types of connections: **Point-to-Point** and **Multipoint**.

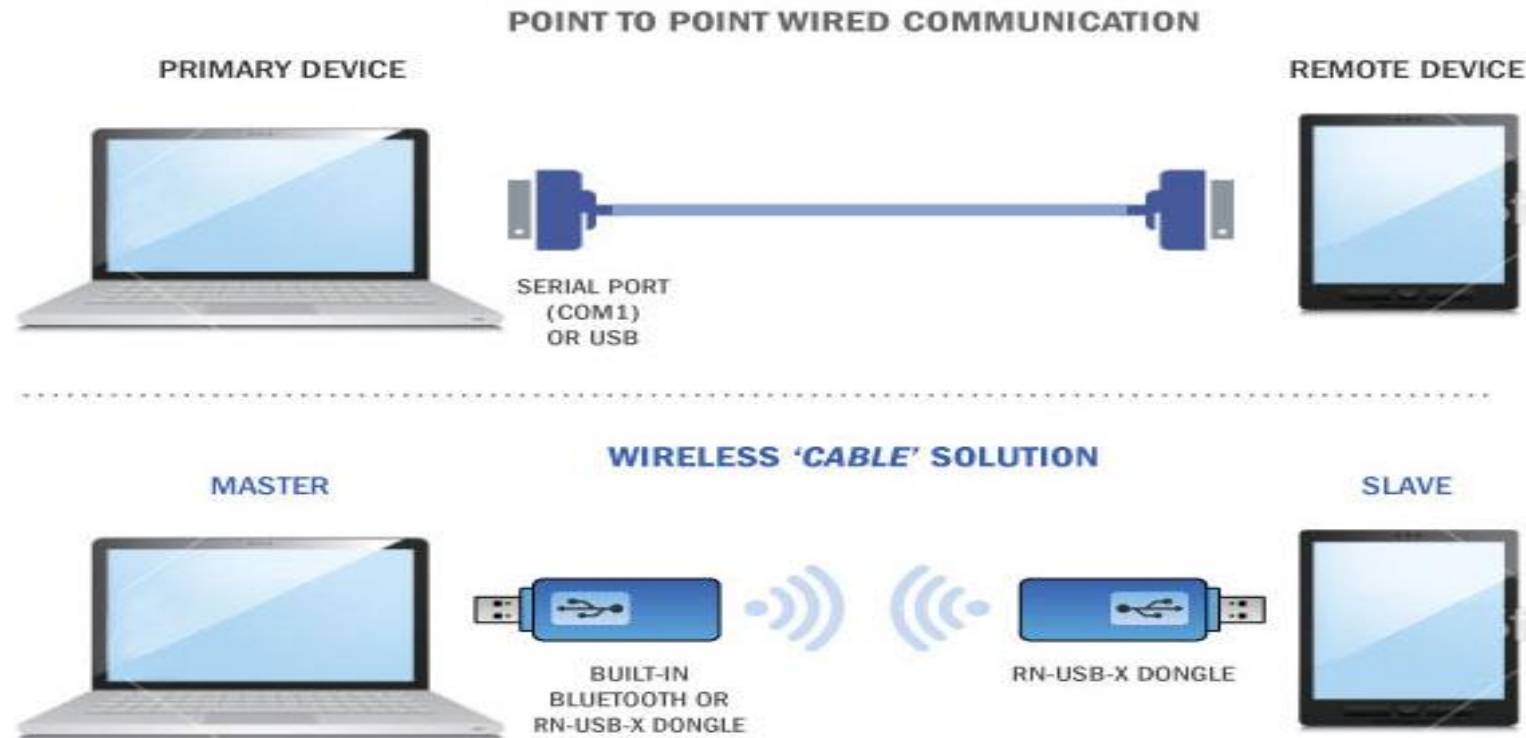
## 1) Point-to-Point:

- A point-to-point connection provides a **dedicated** link between two devices.
- The **entire capacity** of the link is **reserved** for transmission between those two devices.

**Note:** *Most point-to-point connections use an actual length of wire or cable to connect the two ends, but other options, such as **microwave or satellite** links, are **also possible**.*

**Example:** When we change television channels by infrared remote control, we are establishing a point-to-point connection between the **remote control** and the **television's** control system.

# Point-to-point connection



## 2) Multipoint

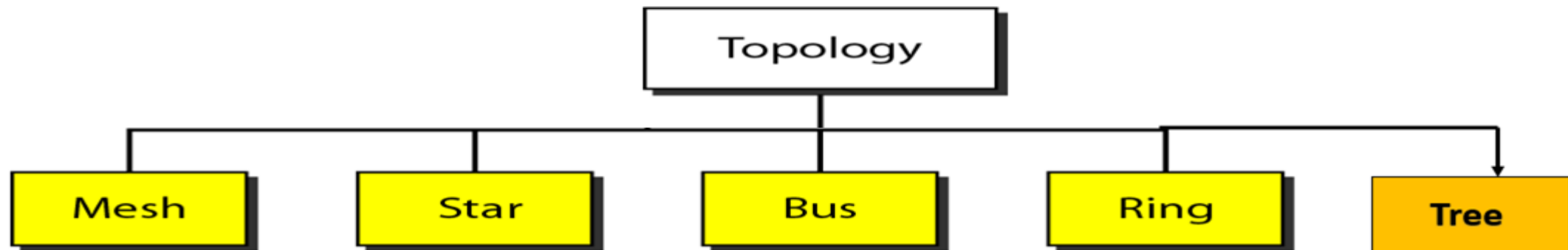
- A multipoint (also called multidrop) connection is one in which more than two specific devices **share a single link**.
- In a multipoint environment, the capacity of the channel is shared, either **spatially or temporally**.
- If several devices can use the link simultaneously, it is a ***spatially shared*** connection.
- If users must take turns, it is a ***timeshared*** connection.



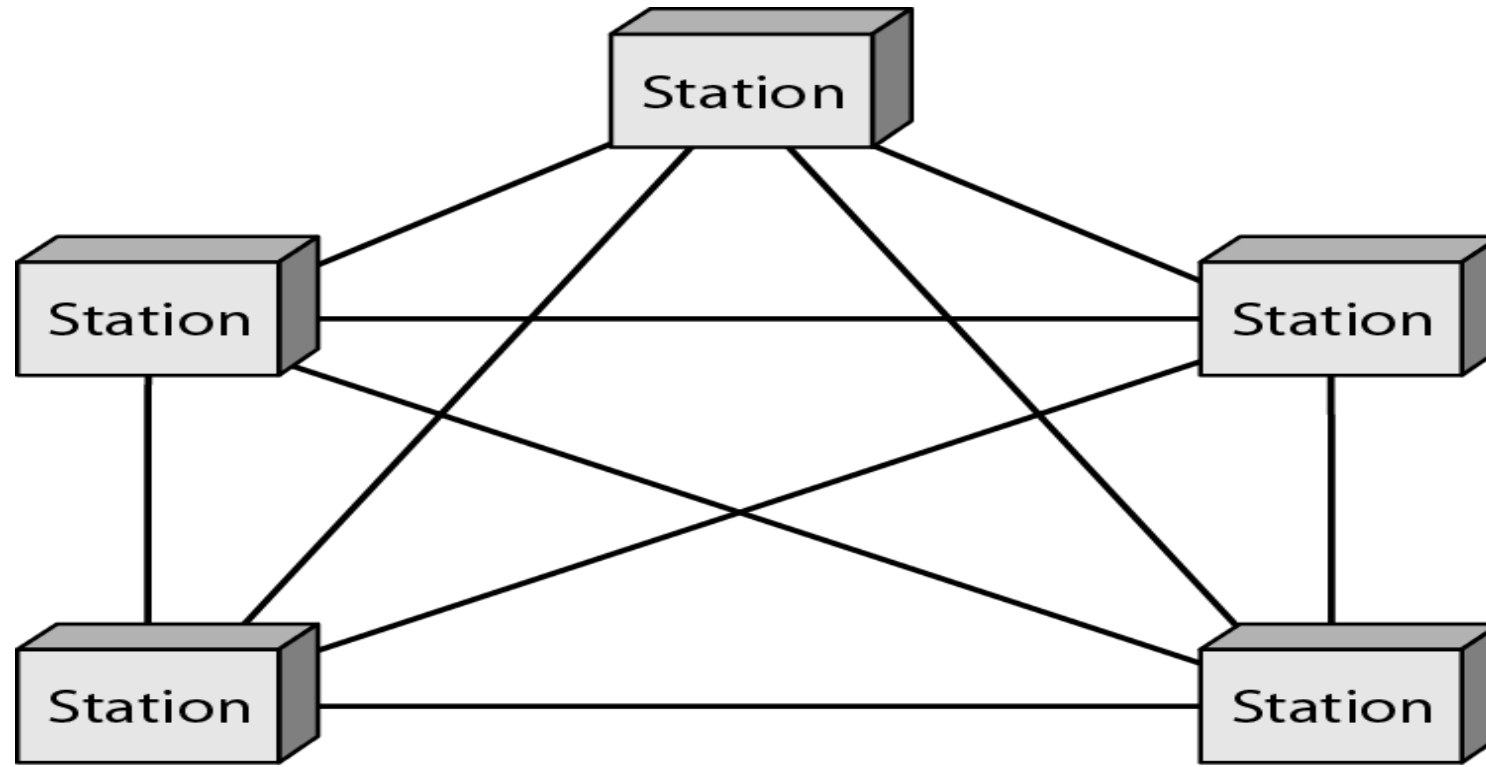
**In what fashion devices should  
be connected to a network ?**

# Network Topology

- A Network Topology is the **arrangement** with which computer systems or network devices are connected to each other.
- Topologies may define both **physical** and **logical aspect** of the **network**. Both logical and physical topologies could be **same or different in a same network**.
- There are **four basic and one hybrid** topologies possible: mesh, star, bus, ring and Tree.



# Network Topology: Mesh



In a mesh topology, every device has a **dedicated** point-to-point link to every other device. In a **fully connected** mesh network, total number of physical links required for  $n$  devices are:

**$n(n-1)$**

And if we assume each link is **duplex** then, total number of physical links required will be

**$n(n-1)/2$ .**



- **Advantage:** A mesh offers several advantages over other network topologies like
  - The use of **dedicated links** guarantees that each connection can carry its own data load, thus eliminating the **traffic problems** that can occur when links must be shared by multiple devices.
  - A mesh topology is **robust**. If one link becomes unusable, it does not incapacitate the **entire system**.
  - There is the advantage of **privacy or security**. When every message travels along a dedicated line, only the intended recipient sees it.
  - Finally, **point-to-point links make fault identification and fault isolation easy**. So, traffic can be routed to avoid links with suspected problems.
- **Disadvantage:** The main reason for disadvantage is **the amount of cabling** and the number of I/O ports required.
  - First, because every device must be connected to every other device, installation and reconnection are difficult.
  - Second, the sheer **bulk of the wiring** can be greater than the available space to accommodate.
  - Finally, the hardware required to connect each link (I/O ports and cable) can be prohibitively **expensive**.
- **Application:** For the reasons of all its disadvantages, a mesh topology is usually implemented in a limited fashion, for example, as a backbone connecting the main computers of a **hybrid network** that can include several other topologies.

One **practical example** of a mesh topology is the connection of **telephone regional offices** in which each regional office needs to be connected to every other regional office.

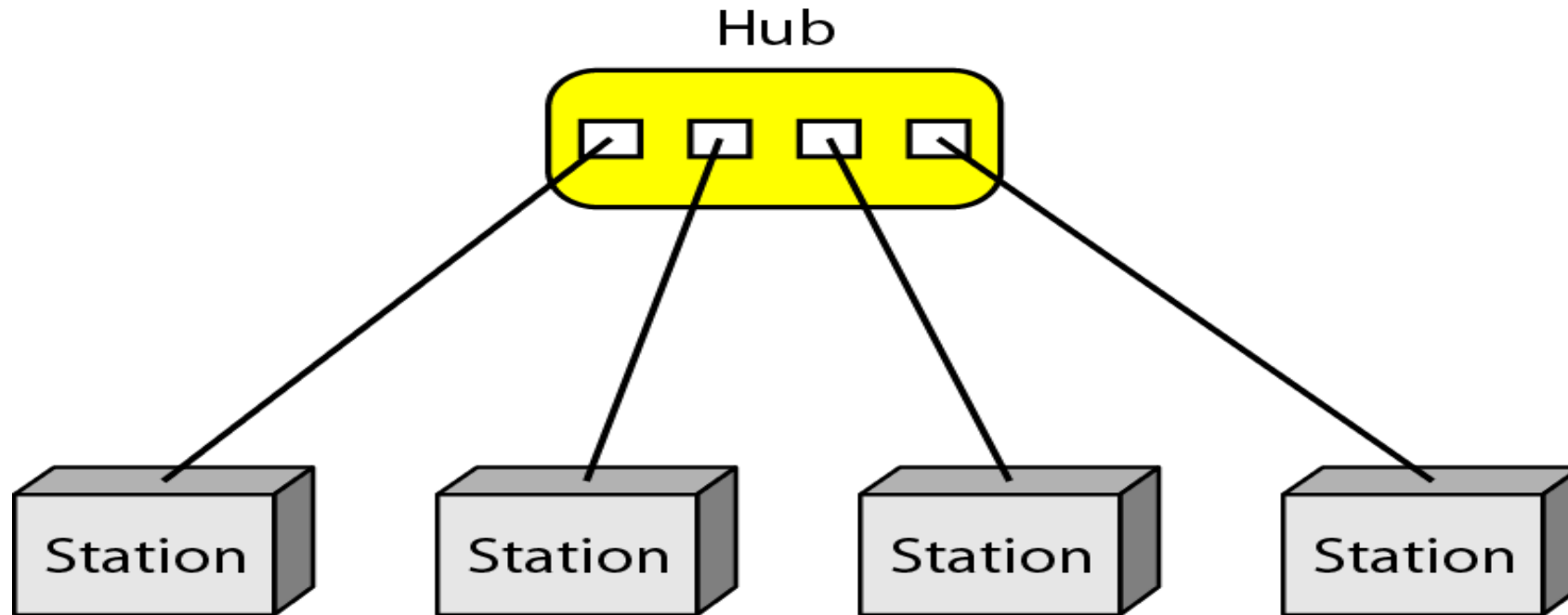
**Can we go for mesh topology for our campus LAN connection?**

# Can we go for mesh topology for our campus LAN connection?

No, otherwise this may be the scenario...



# Network Topology: Star



In a star topology, each device has a **dedicated point-to-point link only to a central controller**, usually called a *hub*.

Unlike a mesh topology, a star topology does not allow direct traffic between devices. The **controller** acts as an exchange: If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device.

- **Advantage:**

- Since, **less # of dedicated links**, it is **less expensive** than a star topology.
- Each device needs **only one link** and **one I/O port** to connect it to any number of others. This factor also makes it **easy to install and reconfigure**.
- Since less cabling, **addition, deletion, movement involve** only one connection: between that device and the hub.
- **Robustness**: i.e. if one link fails, **only** that link is affected. This factor also lends itself to **easy fault identification and isolation**.

- **Disadvantage:** If the hub goes down, the whole system is dead. This is because the whole system depends upon a central controller, called ***Hub***.

- **Application:** High-speed LANs often use a star topology with a central hub.

**Question:** Mesh topology and star topology belong to which one of the following types of connections?

a) Point-to-point

b) Multipoint



**Question:** Mesh topology and star topology belong to which one of the following types of connections?

a) Point-to-point

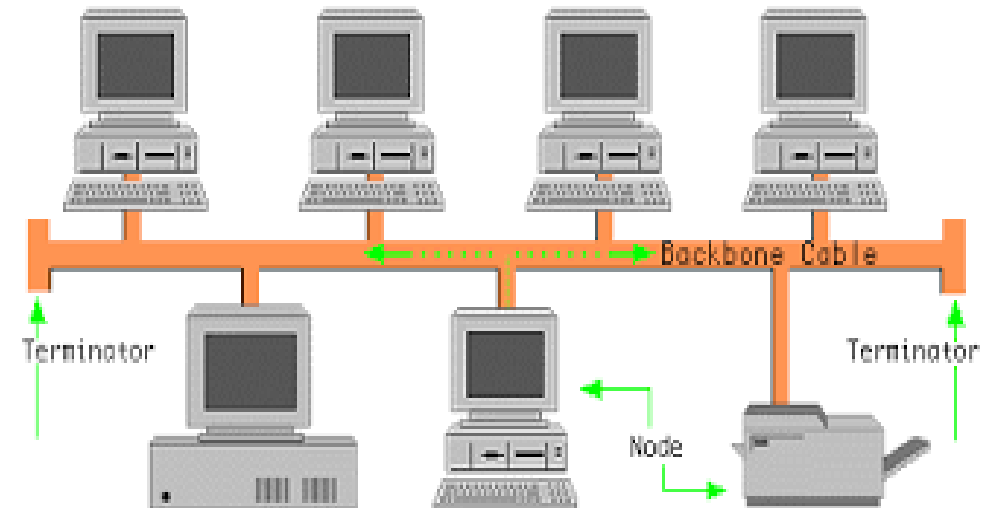
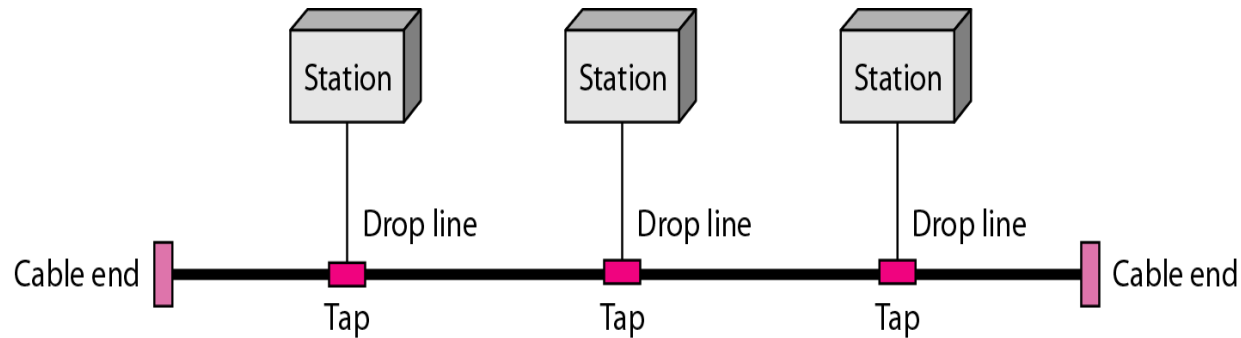
b) Multipoint



Both belongs to point-to-point connection.

# Network Topology: Bus

- A **bus topology** is an example of multipoint connection.



One long cable acts as a **backbone** to link all the devices in a network.  
Nodes are connected to the bus cable by **drop lines** and **taps**.  
A drop line is a connection running between the device and the main cable, whereas tap is a connector.



- **Advantages:**

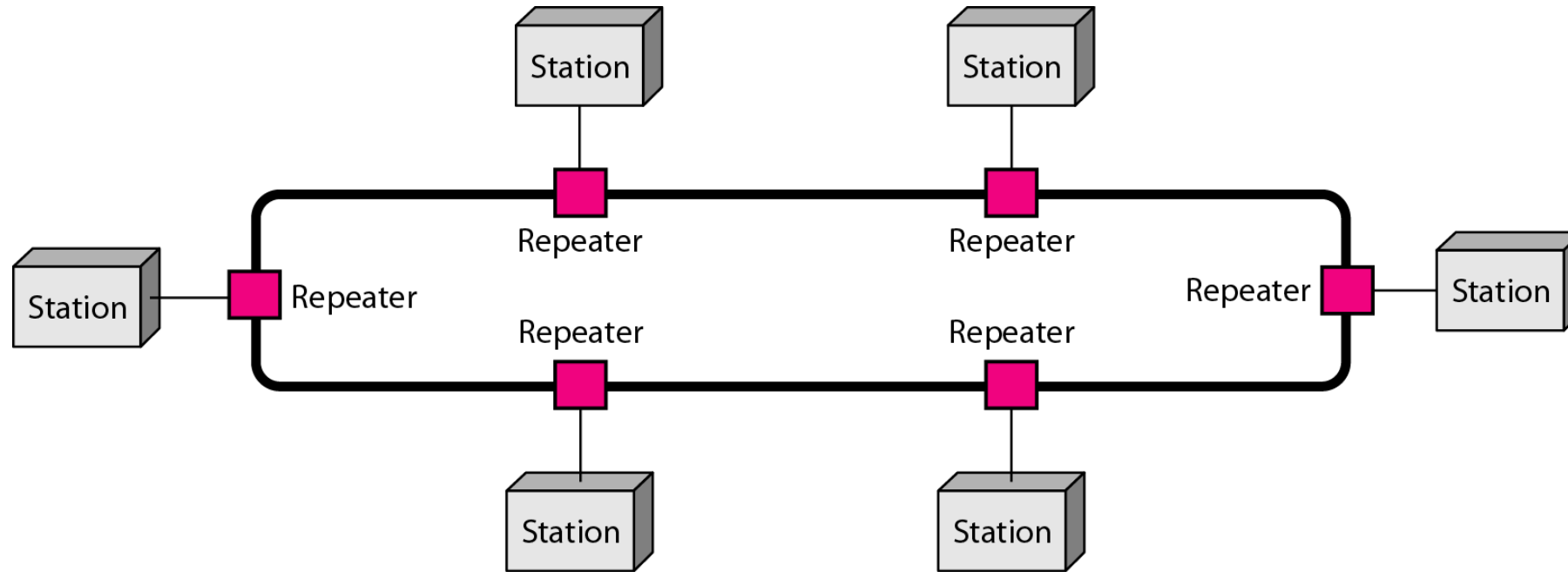
- Easy installation.
- A bus uses **less cabling** than mesh or star topologies.
- For e.g., in a star topology with 100 devices, we need 100 cable, on the other hand, in case of bus topology we need **only one backbone** cable to which 100 devices are connected by **small length drop line**.

- **Disadvantage:**

- Reconnection and fault isolation are difficult.
- **Adding new device is difficult**. This is because of a **bus is usually designed to be optimally efficient at installation**.
- The **signal reflection at tap** degrades the quality of the signal, thus backbone is designed by limiting the number and spacing of devices connected to it.
- A fault or break in the bus cable stops all transmission.

- **Application:** Ethernet LANs

# Network Topology: Ring



- In a ring topology, each device has a **dedicated point-to-point** connection with only the **two devices on either side of it**.
- A signal is passed along the ring in **one direction**, from device to device, until it reaches its destination.
- Each device in the ring incorporates a **repeater**. When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.

- **Advantage:**

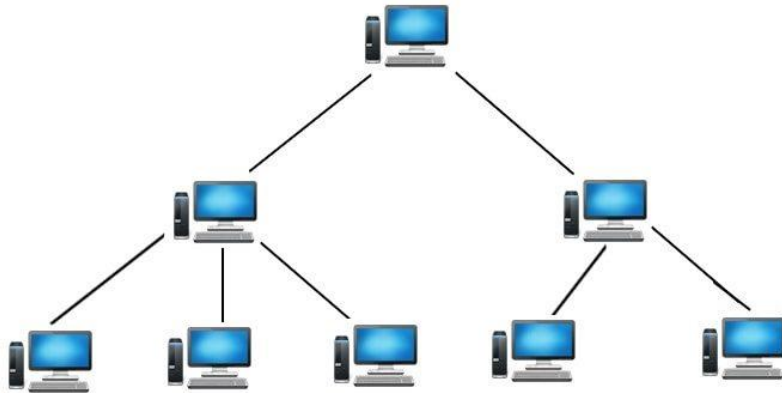
- A ring is relatively easy to install and reconfigure.
- Since, each device is **linked to only its immediate neighbours**. To **add or delete** a device requires **changing only two connections**.
- **Easily problem identification and solution**, this is because: Generally in a ring, a **signal is circulating at all times**. If one device does not receive a signal within a specified period, it can issue an **alarm**. The alarm alerts the network operator to the problem and its location.

- **Disadvantage:**

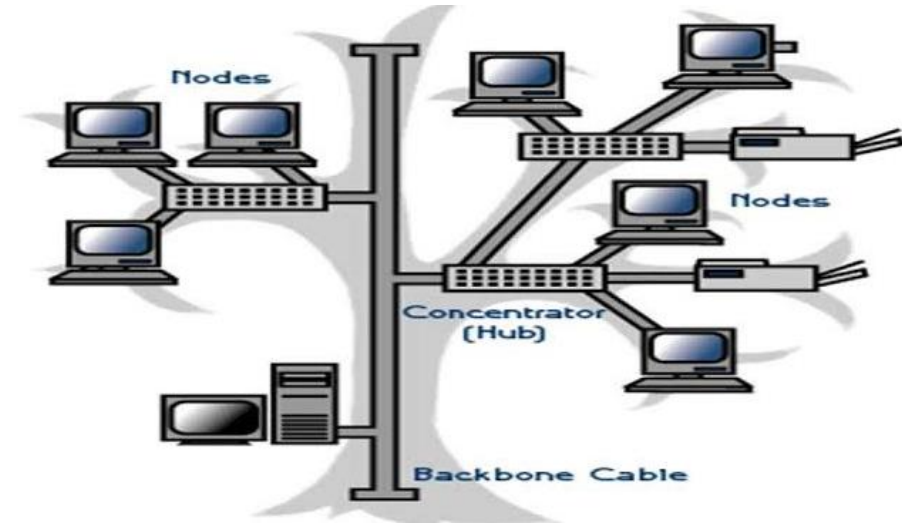
- Since traffic is **unidirectional**, In a simple ring, a break in the ring (such as a disabled station) can disable the entire network. This weakness can be solved by using a **dual ring** or a **switch** capable of closing off the break.
- **Application:** **Used in LAN introduced by IBM**, but now its less popular because of the need of high-speed LAN.

# Network Topology: Tree

- A **tree topology** is a special type of structure in which many connected elements are arranged like the branches of a tree.
- Tree topologies form a natural parent and child hierarchy as shown in Fig.1
- In computer networks, a tree topology is also known as a **star bus topology**. It incorporates elements of both a bus topology and a star topology.



**Fig 1:** Tree Topology, In general



**Fig:** Tree Topology, as star-Bus topology

**Advantages of tree topology:**

- Scalable as leaf nodes can accommodate more nodes in the hierarchical chain.
- A point to point wiring to the central hub at each intermediate node of a tree topology represents a node in the bus topology
- Other hierarchical networks are not affected if one of them gets damaged
- Easier maintenance and fault finding

**Disadvantages of tree topology:**

- Huge cabling is needed
- A lot of maintenance is needed
- backbone forms the point of failure.

# What network topologies to choose and when to choose



What network topologies to choose and when to choose



For point-to-point connection star topology is better  
And in case of multipoint connection bus topology is better.

But, there are some more conditions for choosing the **best** topology.

# Try by yourself

Consider you want to start your own small company consisting of you as owner, a business manager, an administrator, and four agents. Assume that your company will grow and after two years, you have to hire two new agents for the same.

Everyone in the company has a computer, but the business manager has the only printer. These computers are not connected by any form of networking. When agents need to print a document, they must first copy the file to a USB, then carry it to the business manager's computer, where they are finally able to print it. Similarly, when staff members want to share data, the only means available is to copy the data on one computer to a USB and insert it in another computer.

Recently, problems have arisen. The business manager is spending too much time printing other people's documents; and it is frequently unclear which copy of a given document is the current and authoritative version.

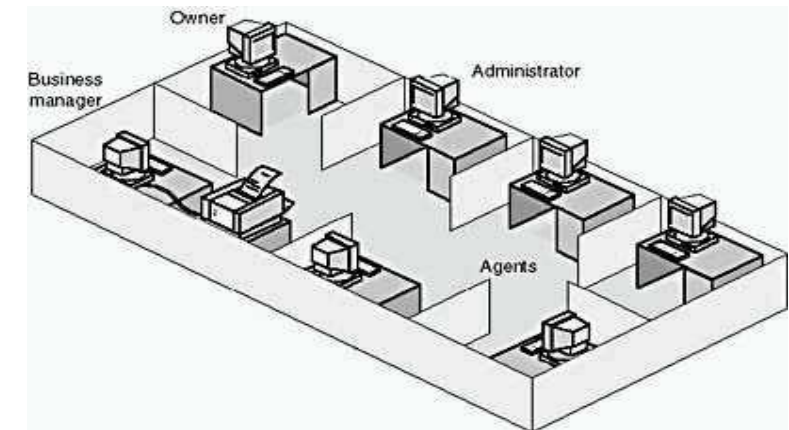
Your task is to design a network for this company by answering following questions.

*Which type of network would you suggest for this company?*

Peer-to-peer or Server-based

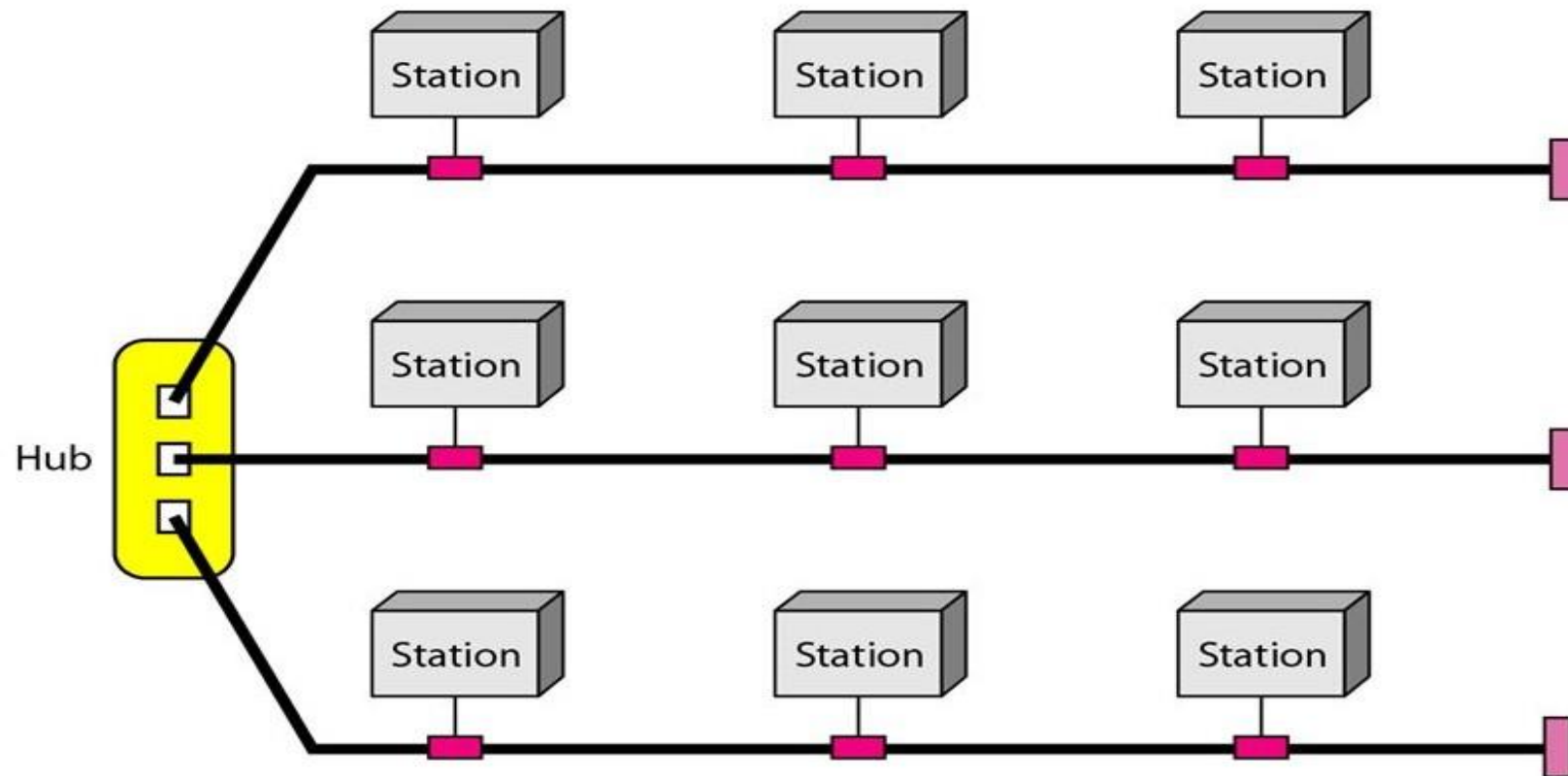
*Which network topology would be most appropriate in this situation?*

Bus,	Ring	Star
Mesh	Star bus	Star ring





- **Hybrid Topology:** A network can be hybrid. *For example, we can have a main star topology with each branch connecting several stations in a bus topology as shown below.*
- **Note:** *star-bus topology is also known as tree topology.*



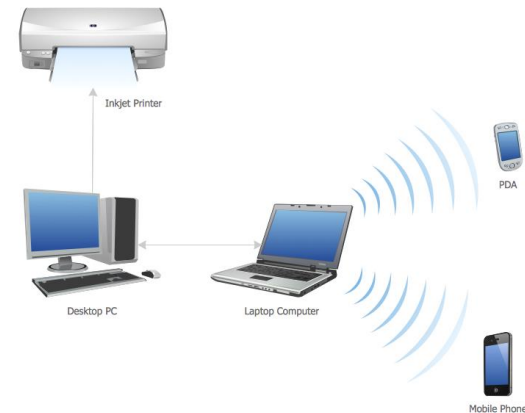
# Categories of Networks

- It is of three types based on geographical area:
  1. PAN
  2. LAN
  3. MAN
  4. WAN

**What is PAN, LAN, MAN & WAN ?**

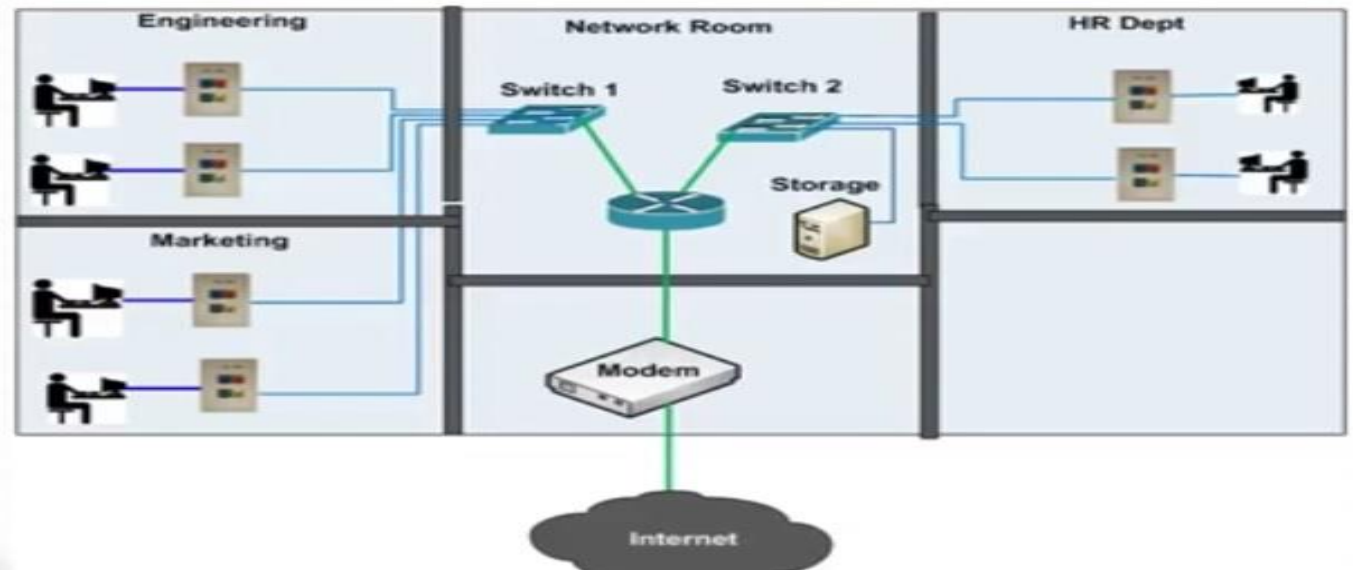
- **Personal Area Network (PAN):**

- It is a network with a size covering **few meters** of area.
- It normally covers the area inside a room.
- It is designed to communicate the devices nearby a person.
- PAN can be wired, such as USB or FireWire, or it can be wireless- such as infrared, Bluetooth, ZigBee, Hotspot, etc.
- Examples: FireStick, Hotspot, wireless mouse, wireless keyboard, gaming consoles, etc.



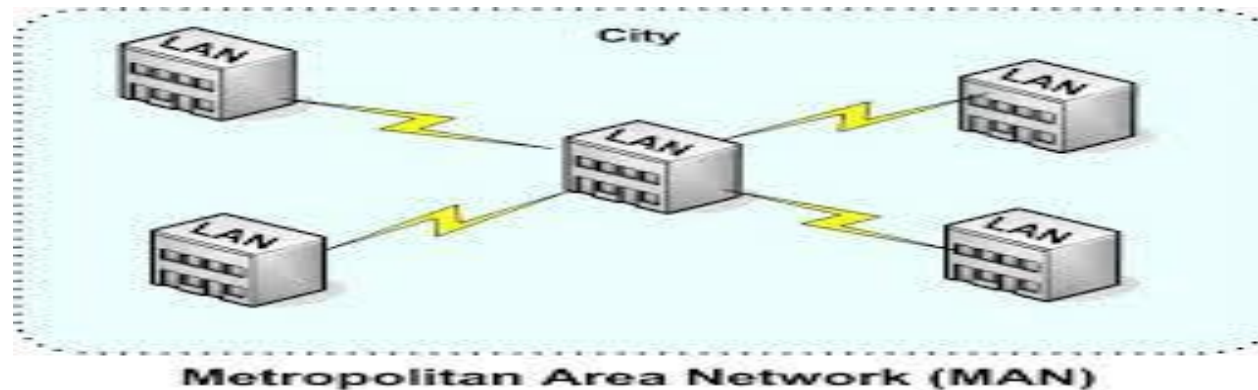
- **Local Area Network (LAN):**

- Generally covers **few kilometres**.
- A local area network (LAN) is usually privately owned and links the devices in a single office, building, or campus.
- Early LANs had data rates in the 4 to 16 megabits per second (Mbps) range. Today, however, speeds are normally 100 or 1000 Mbps.
- It may be wired or wireless.



- **Metropolitan Area Network (MAN):**

- It is a network with a size between a LAN and a WAN.
- It normally covers the area inside a town or a city.
- It is designed for customers who need a high-speed connectivity, normally to the Internet, and have endpoints spread over a city or part of city.
- A good example of a MAN is the part of the telephone company network that can provide a high-speed DSL line to the customer.
- Another example is the cable TV network that originally was designed for cable TV, but today can also be used for high-speed data connection to the Internet.



- **Wide Area Network (WAN):**

- A wide area network (WAN) provides long-distance transmission of data, image, audio, and video information over large geographic areas.
- Area may comprise a country, a continent, or even the whole world.
- A good example of WAN is the asynchronous transfer mode (ATM) network.

