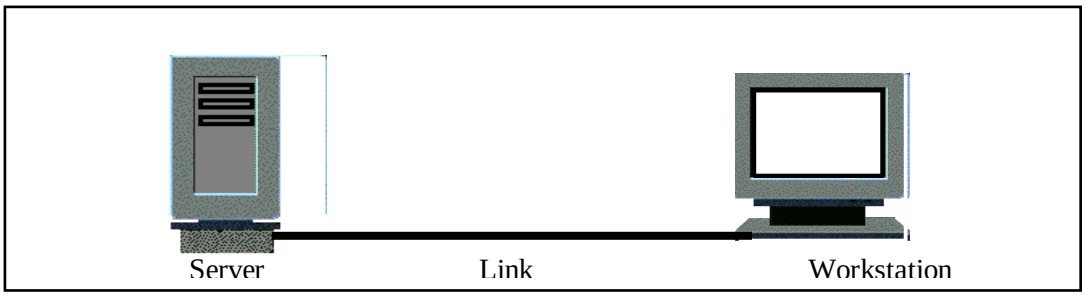
1.6 LINE CONFIGURATION

Line configuration ***refers to the way two or more communication devices attach to a link***. A ***link*** is the physical communication pathway that transfers data from one device to another. Line configuration ***defines the attachment of communication devices to a link***.

Point-to-Point

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

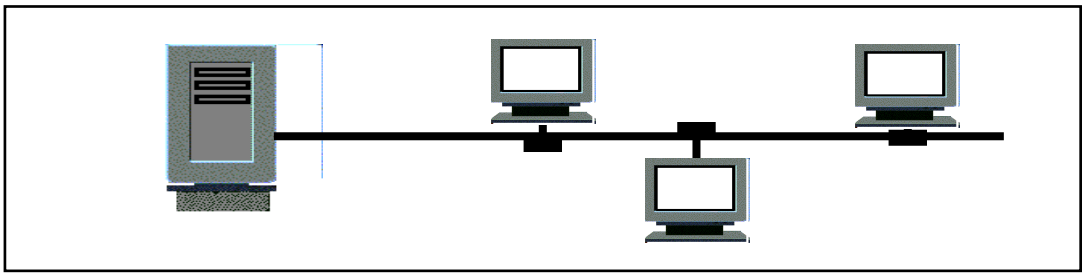
Most point-to-point line configurations use an actual length of wire or cable to connect the two ends but other options, such as microwave or satellite links are also possible (see Figure below



Multipoint

A multipoint (also called multidrop) line configuration is one in which more than two specific devices **share a single link** (see Figure below).

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 line configuration. If users must take turns, it is a time shared line configuration.



1.7 TOPOLOGY

The term topology ***refers to the way a network is laid out, either physically or logically***. Two or more devices connect to a link; two or more links form a topology. The topology of a network is the ***geometric representation of the relationship of all the links (nodes) to each other.***

There are five basic topologies possible:

- **Physical topologies**

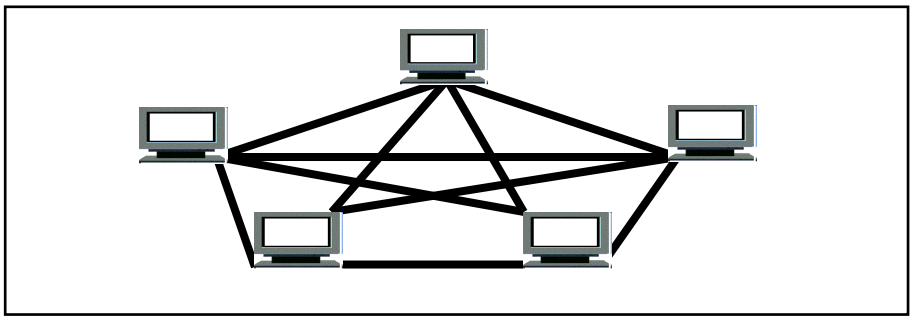
Physical topology is the mapping of the nodes of a network and the physical connections between them, cables.

- **Logical topologies**

Logical topology is the way that the signals act on the network media, or the way that the data passes through the network from one device to the next without regard to the physical interconnection of the devices.

Mesh

In a mesh topology, every device has a ***dedicated point-to-point link*** to every other device.
A fully connected mesh . (See Figure below).



A mesh offers ***several advantages*** over other network topologies:

1. The use of dedicated links ***guarantees that each connection can carry its data load***, thus ***eliminating the traffic problems*** that can occur when links must be shared by multiple devices.
2. A mesh topology is ***robust***. If one link becomes unusable, it does not affect the entire system.
3. security
4. Point-to-point links make ***fault identification and fault isolation easy***.

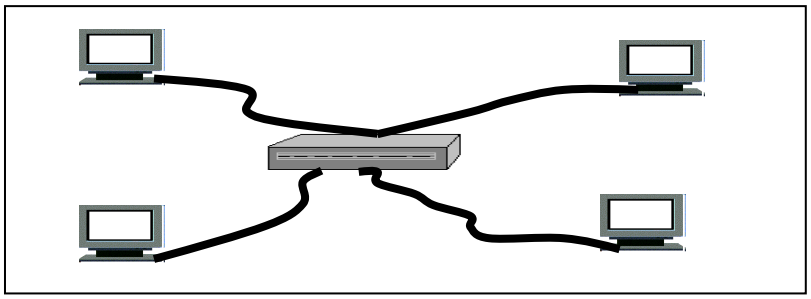
The main ***disadvantages*** of a mesh are related to the amount of cabling and the number of I/0 ports required.

Star

- In a star topology, each device has a dedicated ***point-to-point link*** only to a central controller, usually called a ***hub***.
- The devices are not linked to each other. 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 to the controller, which then send the data to the other connected devices

.***A star topology is:***

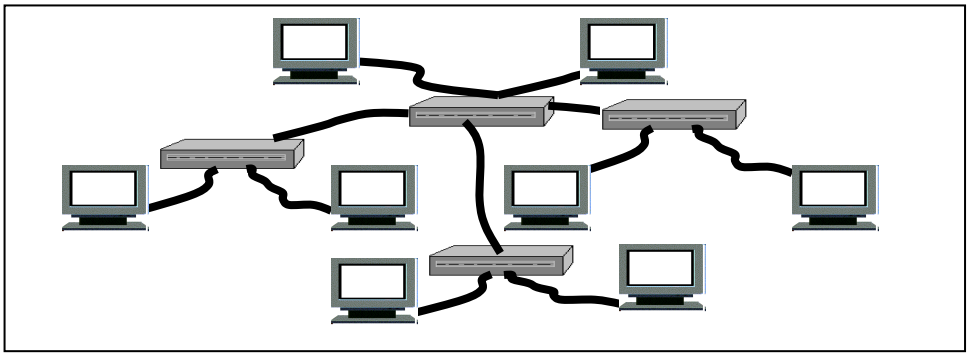
- Less expensive than a mesh topology.
- Easy to install.
- Robustness. If one link fails, only that link is affected.
-easy fault identification and fault isolation. As long as the hub is working, it can be used to monitor link problems and by pass defective links.



Tree

- A tree topology is a **variation of a star** but, not every device plugs directly into the central hub.
- The majority of devices connect to a **secondary hub** that in turn is connected to the central hub
- The central hub in the tree is an **active hub**. An active hub contains a repeater, which is a hardware device that **regenerates** the received bit patterns before sending them out.(**Repeating strengthens transmissions and increases the distance a signal can travel between sender and receiver).**
- **The secondary hubs** may be active or passive hubs. **A passive hub** provides a simple physical connection between the attached devices.

The advantages and disadvantages of a tree topology are generally the same as those of a star. The addition of secondary hubs however, brings two ***further advantages.***
First, it allows more devices to be attached to a single central hub and can therefore ***increase the distance a signal can travel between devices.***
Second, it allows the network to ***isolate and prioritise communications from different computers.***



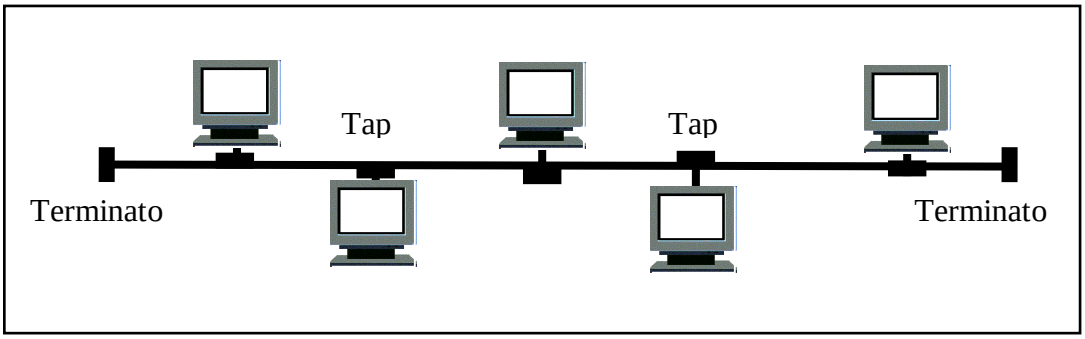
Bus

- **multipoint configurations**.
- One long cable acts as a backbone to link all the devices in the network

Advantages of a bus topology include:

- Ease of installation.
- Backbone cable can be laid along the most efficient path.

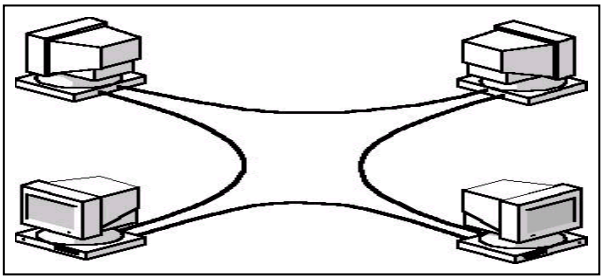
Disadvantages include:
Difficult reconfiguration and fault isolation.
A fault or break in the bus cable stops all transmission.



Ring

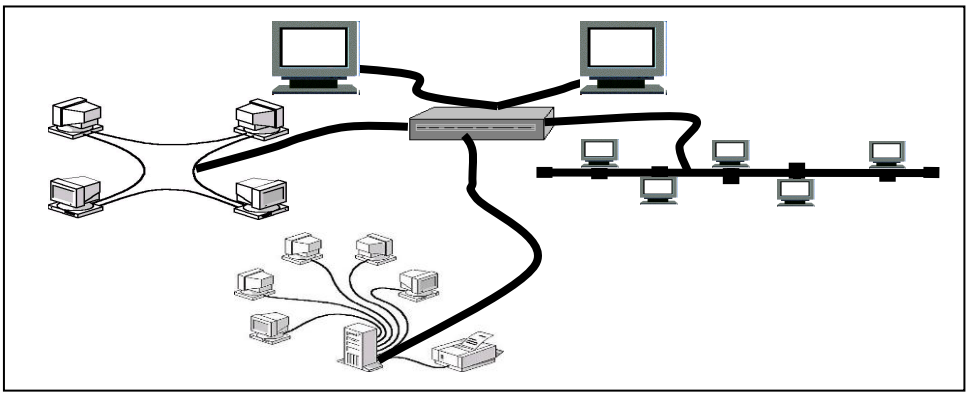
In a ring topology:

- Each device has a dedicated point-to-point line configuration.
- A signal is passed along the ring in one direction.
- Each device in the ring incorporates a repeater.
- easy to install and reconfigure.
- Fault isolation is simplified.
- In a simple ring, a ***break in the ring*** (such as a disabled station) can disable the entire network.



Hybrid Topologies

Often a network combines **several topologies** as sub-networks linked together in a larger topology. For instance, one department of a business may have decided to use a bus topology while another department has a ring. The two can be connected to each other via a central controller in a star topology .



Classification of networks According to the size:

We are generally referring to three primary categories:
Local area networks (LANs).
Metropolitan area networks (MANs).
Wide area networks (WANs).

Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

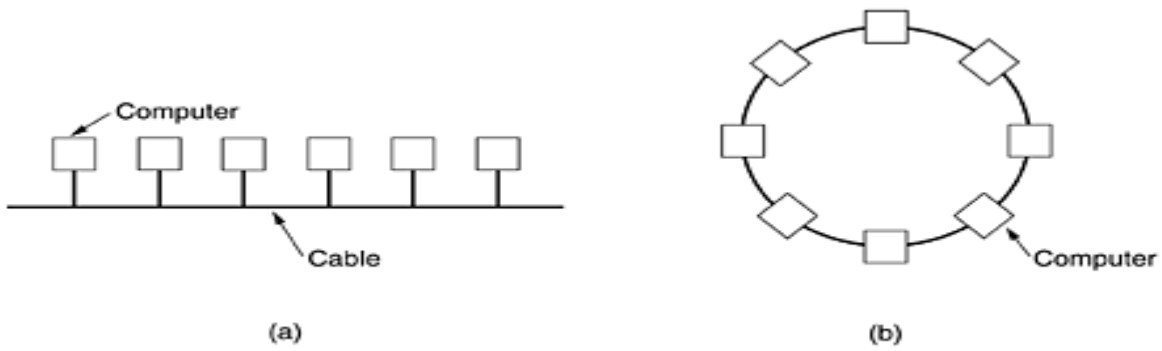
Local Area Network (LAN)

- A local area network is usually privately owned and links the devices in a single office building, or size ***is limited to a few Kilometers.***

- LANs are designed to ***allow resources to be shared between personal computers or workstations***. The resources to be shared can include hardware (e.g., a printer), software (e.g., an application program), or data.
- In addition to size, LANs are distinguished from other types of networks by their ***transmission media and topology***. In general, a given LAN will use only **one type** of transmission medium.
- Traditionally, LANs have data rates in the 4 to 16 Mbps range. Today, however, speeds are increasing and can reach ***100 Mbps*** with gigabit systems in development.

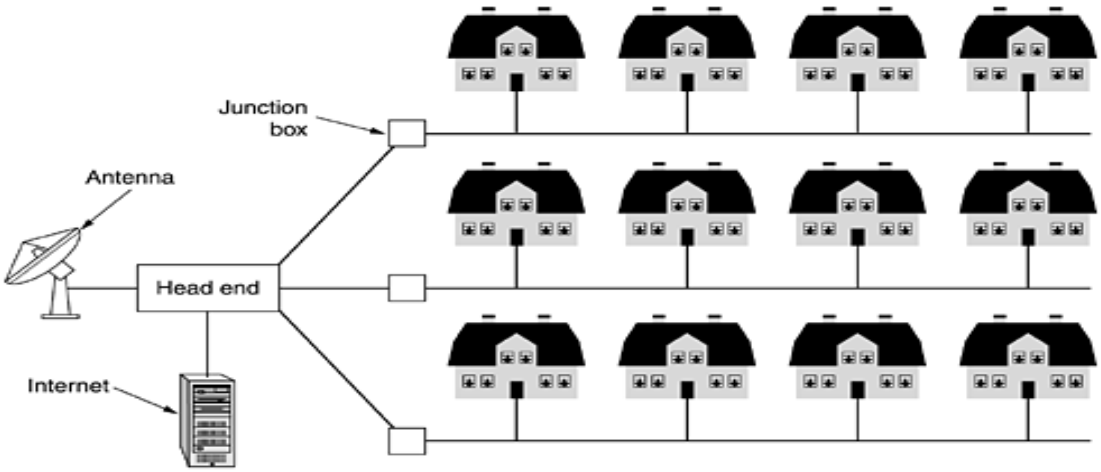
- low delay (microseconds or nanoseconds)

- Very few errors.



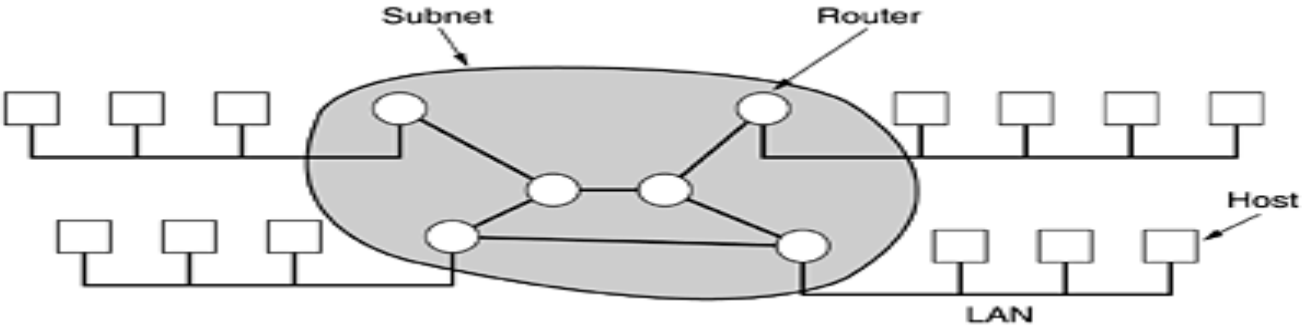
Metropolitan Area Network (MAN)

- is designed to ***extend over*** an entire city.
- It may be a **single network** such as a cable television network or it may be a means of **connecting a number of LANs into a larger network** so that resources may be shared LAN-to-LAN.
- is of size between LAN & WAN. It is **larger** than LAN but **smaller** than WA.
- A MAN may be wholly owned and operated by a **private company**, or it may be a service provided by a **public company**, such as a local telephone company.



Wide Area Network (WAN)

- A wide area network provides ***long-distance*** transmission of data ***over large geographical*** areas that may comprise a country, a continent, or even the whole world.
- WANs may ***utilize public, leased, or private communication devices*** an unlimited number of miles.
- A WAN that is wholly ***owned and used by a single company is often referred to as an enterprise network.***
- The job of the subnet is to carry messages from host to host, just as the telephone system carries words from speaker to listener.
- In most wide area networks, the subnet consists of two distinct components: **transmission lines** and **switching elements**.



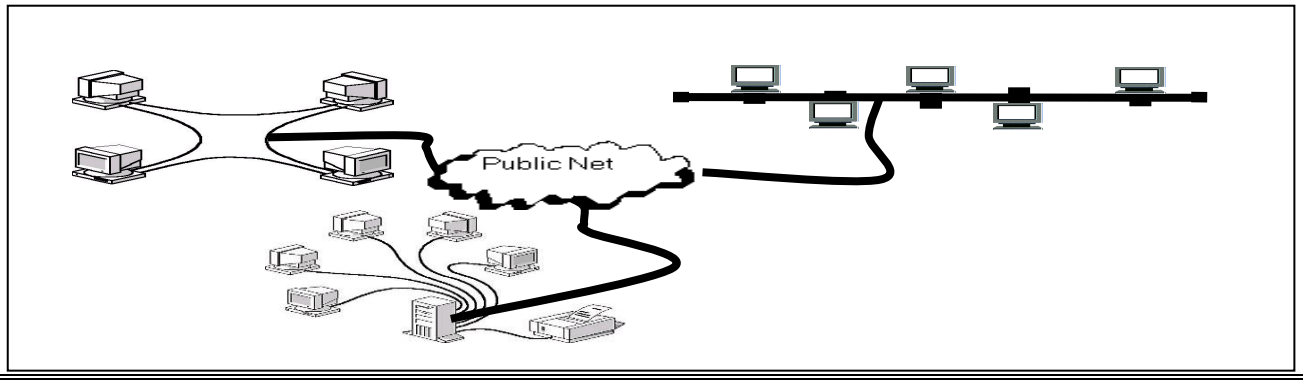
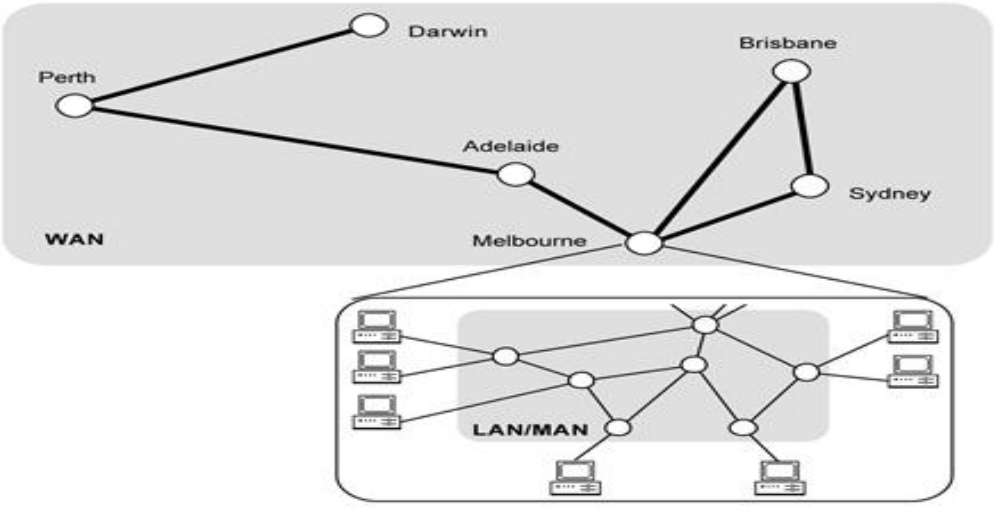


Figure 1.2 Example of a WAN between LANs.



THE OSI MODEL

The International Standards Organization **(ISO)** is a multinational body dedicated to worldwide agreement on international standards (Established in 1947). An ISO standard that covers all aspects of network communications is the Open Systems Interconnection **(OSI)** model. An ***open system*** is a ***set of protocols that allows any two different systems to communicate regardless of their underlying architecture.*** The **purpose of** the OSI model is to open communication between ***different systems without requiring, changes to the logic of the underlying hardware and software.***

Peer-to-Peer Processes

Within a single machine, each layer **calls** upon the services of the layer just below it. Layer 3, for example, uses the services provided by layer 2 and provides services for layer 4. Between machines, layer *x* on one machine communicates with layer *x* on another machine. This communication is governed by an agreed-upon series of rules and conventions called ***protocol.*** The processes on each machine that communicate at a given layer are called ***peer-to-peer processes***. Each layer in the sending machine **adds** its own information to the message it receives from the layer just above it, and **passes** the whole package to the layer just below it. This information is added in the **form of** headers or trailers (control data appended to the beginning or end of a data parcel). Headers are added to the message at layers 6, 5, 4, 3, and 2. A trailer is added at layer 2.