Ministry of Higher Education and Scientific Research

Al-Mustaqbal University

College Of Engineering & Technology

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2023 -2024

Computer Networks Fundamentals

Lecture 3:

1.6.2- Topology

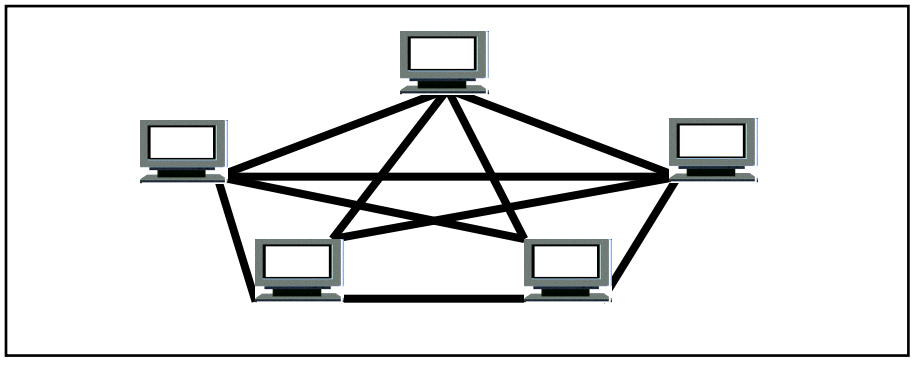
The term topology refers to the way a network is laid out, either physically or logically. Two or more devices connect to a link; two or more links form a topology. ***The topology of a network is the geometric representation of the relationship of all the links and linking devices (nodes) to each other***.

There are five basic topologies possible. These five labels describe how the devices in a network are interconnected rather than their physical arrangement.

Two relationships are possible: ***peer-to-peer***, where the devices, share the link equally, and ***client-server***, where one device controls traffic and the others must transmit through it. Ring and mesh topologies are more convenient for peer-to-peer transmission, while star and tree are more convenient for client-server. A bus topology is equally convenient for either.

❖ ***Mesh***

In a mesh topology, every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects.
A fully connected mesh network therefore has **[n (n-1) / 2**] physical channels to link it devices. (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 where every message sent travels along a dedicated line, only the intended recipient see it.
4. Point-to-point links make fault identification and fault isolation easy.

The main ***disadvantages*** of a mesh topology are:

1. Difficult installation and reconfiguration because every device must be connected to every other device.
2. The bulk of the wiring can be greater than the available space can accommodate.
3. The hardware required to connect each link can be expensive.

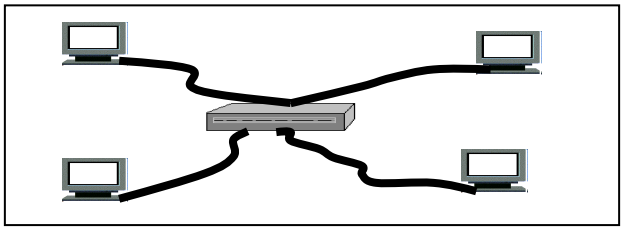
Due to these reasons, a mesh topology is usually of limited use

❖ ***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 relays the data to the other connected devices (see Figure below).

The ***advantages*** of star topology are:

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



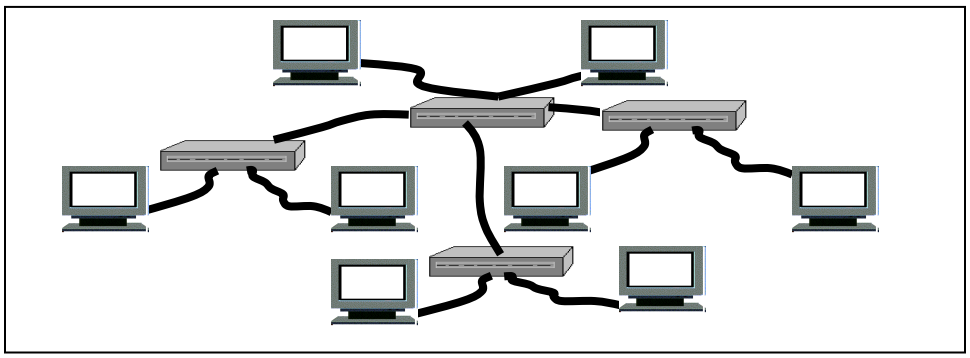
The ***disadvantages*** of the star topology are:

1. Any fault occur to the central controller will drop down the entire network.

2. Although the star needs less cabling than mesh, it still needs more cables than ring and tree topology.

❖ ***Tree***

A tree topology is a variation of a star. However, 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 (see Figure below).

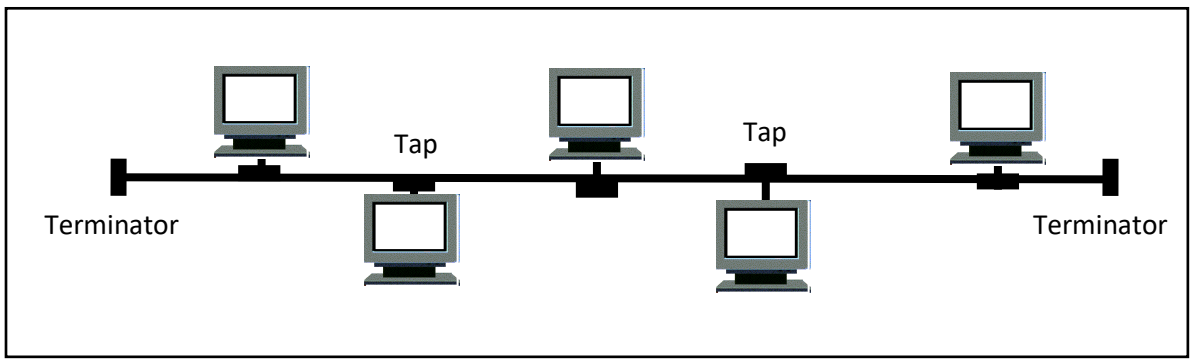


The central hub in the tree is an active hub. An ***active hub*** contains a repeater, which is a hardware device that regenerates the received bit patterns before sending them out. Repeating strengthens transmissions and increases the distance a signal can travel between sender and receiver.
The secondary hubs may be active or ***passive hubs***. A passive hub provides a simple physical connection between the attached devices. Internally, each passive hub contains a set of resistors to balance the circuit linking the connected 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 prioritize communications from different computers.

❖ ***Bus***

The preceding examples all describe point-to-point configurations A bus topology on the other hand, is multipoint. One long cable acts as a backbone to link all the devices in the network (see Figure below).



Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection that running between the device and the main cable, a tap is a connector that splices into the main. As a signal travels along the backbone, some of its energy is transformed into heat. Therefore, it becomes weaker and weaker the farther it has to travel. For this reason, there is a limit on the number of taps a bus can support and on the distance between those taps.

The ***advantages*** of a bus topology are:

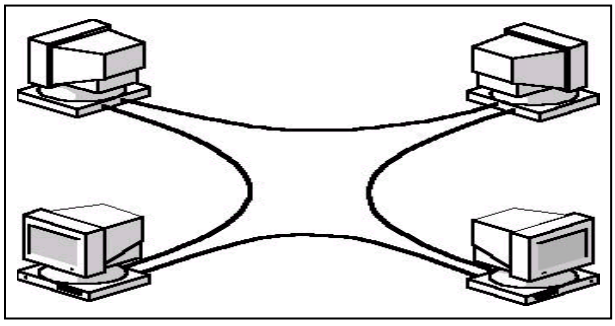
1. Ease of installation.
2. Backbone cable can be laid along the most efficient path, then connected to the nodes by drop lines of various lengths.
3. Use less cabling than mesh, star, and tree topologies.

While the ***disadvantages*** are:

1. Difficult reconfiguration and fault isolation.
2. A fault or break in the bus cable stops all transmission, even between devices on the same side of the problem. The damaged area reflects signals back in the direction of origin, creating noise in both directions.
3. Adding new devices may therefore require modification or replacement of the backbone.

❖ ***Ring***

In a ring topology, each device has a dedicated point-to-point line configuration only with 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 (see, Figure below).



The ***advantages*** of ring topology are:

1. Relatively easy to install and reconfigure.
2. Addition or deletion of a device requires moving only two connections.
3. Fault isolation is simplified.

The ***disadvantage*** of the ring topology is that a break in the ring (such as a disabled station) can disable the entire network, and it is one way data flow.

- ***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 (see Figure below).