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Communication and Computer Networks
Class 4 (A/B)
Lesson 6... Network Topology

Abstract

This lesson will mainly focus on the network topology, the map that we use to connect the devices to the network.

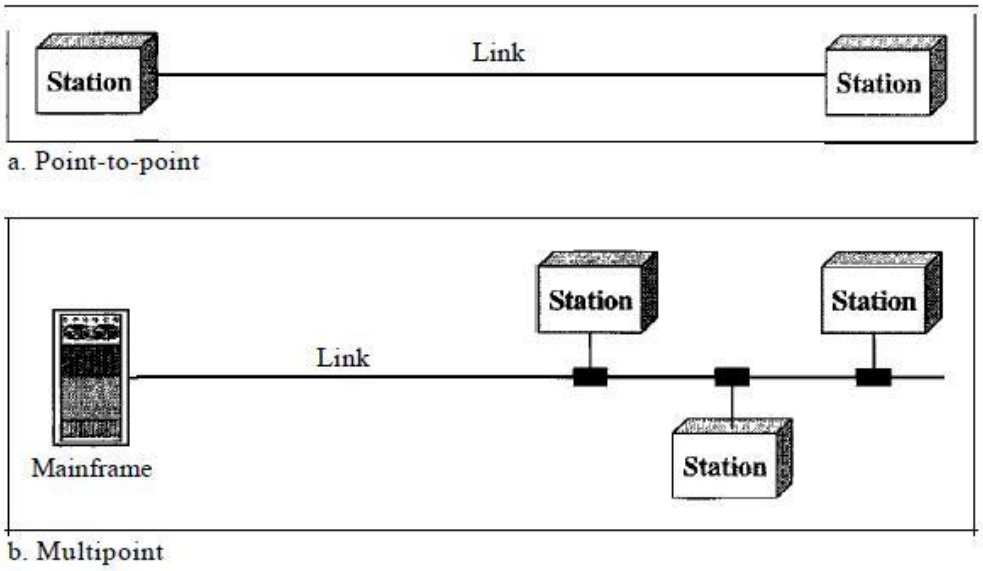
Some previous important concepts

1- **Data communications**; Simply, this represent the transfer of data between two devices that are directly connected.
2- The **electromagnetic signal** (analog or digital) can be described as consisting of a spectrum of components across a range of electromagnetic frequencies.
3- In any communications scheme, there will be a certain **rate of errors** suffered during transmission.
4- A **data link control protocol** provides mechanisms for detecting and recovering from such errors, so that a potentially unreliable transmission path is turned into a reliable data communications link.
5- **Data flow** represents the travel of the information from one device to another. This can be simplex, half-duplex, or full-duplex.
6- If the **capacity** of the link is greater than the requirements for a single transmission, then a variety of **multiplexing techniques** can be used to provide for efficient use of the medium.
7- A **network** is a set of devices (often referred to as nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.
8- For communication to occur, two devices must be connected in some way to the same link at the same time. There are two possible types of connections: **point-to-point** and **multipoint**.

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. 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 (see Figure 1 a). When you change television channels by infrared remote control, you are establishing a point-to-point connection between the remote control and the television's control system.

A **multipoint** (also called multidrop) connection is one in which more than two specific devices share a single link (see Figure 1 b). 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.

Figure 1 *Types of connections: point-to-point and multipoint*



Network Topologies

Network topology is the design model of interconnections of the various elements (links, nodes, etc.) of a computer network. Network topologies may be **physical** or **logical**. **Physical topology** means the physical design of a network consist of the devices, location and cable installation. **Logical topology** show to how data is actually transferred in a network as opposed to its physical design. There are nine basic topologies of network:

1. Fully connected

2. Bus topology
3. Star topology
4. Ring topology
5. Tree topology
6. Mesh topology
7. Hybrid topology
8. Dual Ring topologies
9. Linear-topologies

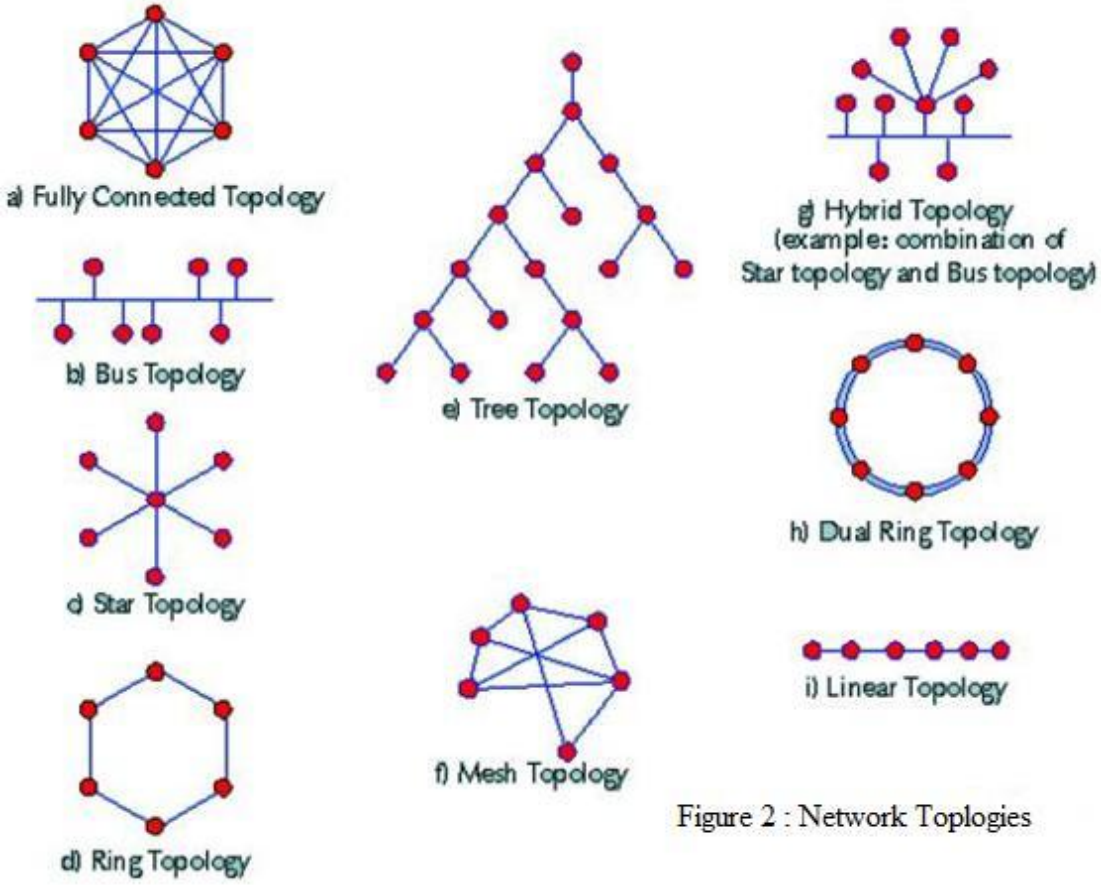


Figure 2 : Network Toplogies

Logical topologies

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

Physical Topology

The term physical topology refers to the way in which a network is laid out physically. 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 (usually called nodes) to one another.

In this section, we will talk about four basic topologies, these are: **mesh, star, bus**, and **ring.** We also will show that the **hybrid** topology is actually a combination of two or more types of network topology.

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.

To find the number of physical links in a fully connected mesh network with n nodes, we first consider that each node must be connected to every other node. Node 1 must be connected to n - I nodes, node 2 must be connected to n – 1 nodes, and finally node n must be connected to n - 1 nodes. We need n(n - 1) physical links. However, if each physical link allows communication in both directions (duplex mode), we can divide the number of links by 2. In other words, we can say that in a mesh topology, we need :

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

duplex-mode links.

advantages over other network topologies. First, 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. Second, a mesh topology is robust.

The main disadvantages of a mesh are related to the amount of cabling and the number of I/O ports required., because every device must be connected to every other device, installation and reconnection are difficult.

Star Topology ; 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 directly linked to one another. 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.
A star topology is less expensive than a mesh topology. In a star, 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. The star topology is used in local-area networks (LANs).

Bus Topology The preceding examples all describe point-to-point connections. A bus topology, on the other hand, is **multipoint**. One long cable acts as a backbone to link all the devices in a network.
As a signal travels along the backbone, some of its energy is transformed into heat. Therefore, it becomes weaker and weaker as it travels farther and farther. For this reason there is a limit on the number of taps a bus can support and on the distance between those taps.
Advantages of a bus topology include ease of installation. Disadvantages include difficult reconnection and fault isolation.

Ring Topology 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 .

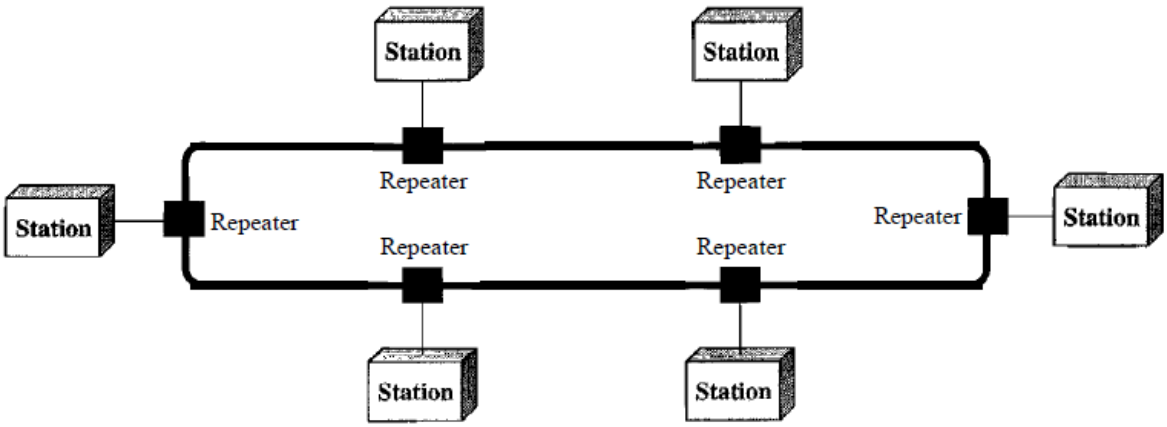


Figure 3 *A ring topology connecting six stations*

A ring is relatively easy to install and reconfigure. Each device is linked to only its immediate neighbors. 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.

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 in Figure 4.

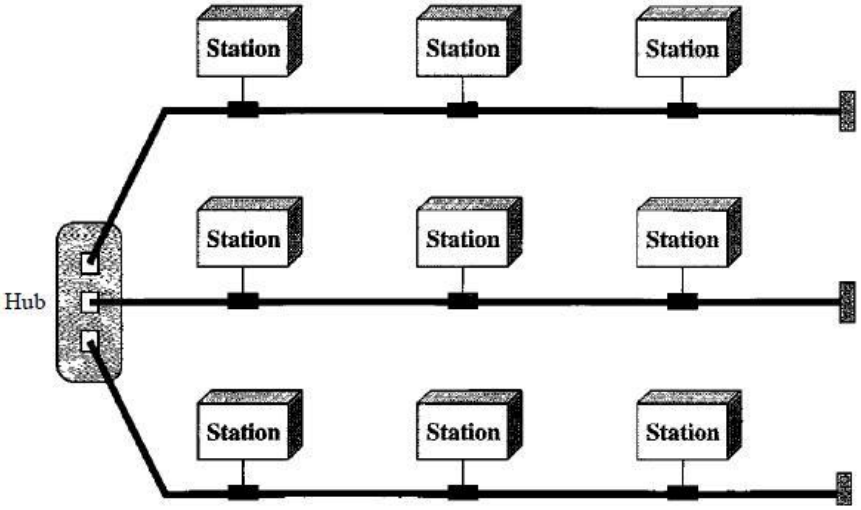


Figure 4 A *hybrid topology: a star backbone with three bus networks*