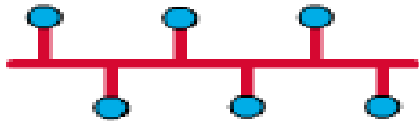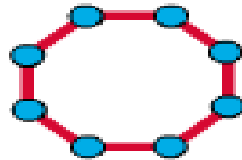# Network Topologies

Network Topology

- The network topology defines the way in which computers, printers, and other devices are connected. A network topology describes the layout of the wire and devices as well as the paths used by data transmissions.

- **Physical topology** refers to arrangement of cabling

- **Logical topology** refers to how data travels between computers on the network.
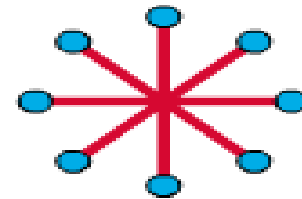
Network topology (cont.)

- Bus (can be both logical and physical)
- Star (physical only)
- Ring (can be both logical and physical)
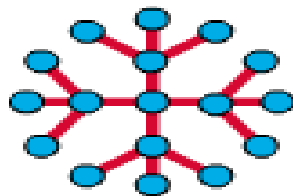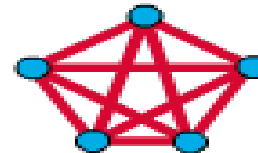- Mesh (can be both logical and physical)

Bus Topology   Ring Topology   Star Topology

Extended Star Topology   Mesh Topology

Network topology (cont.)

Bus

- A bus is the simplest physical topology. It consists of a single cable that runs to every workstation

- This topology uses the least amount of cabling, but also covers the shortest amount of distance.

- Each computer shares the same data and address path. With a logical bus topology, messages pass through the trunk, and each workstation checks to see if the message is addressed to itself. If the address of the message matches the workstation's address, the network adapter copies the message to the card's on-board memory.

Network topology (cont.)

- it is difficult to add a workstation

- have to completely reroute the cable and possibly run two additional lengths of it.

- if any one of the cables breaks, the entire network is disrupted. Therefore, it is very expensive to maintain.

Network topology (cont.)

- Bus topology
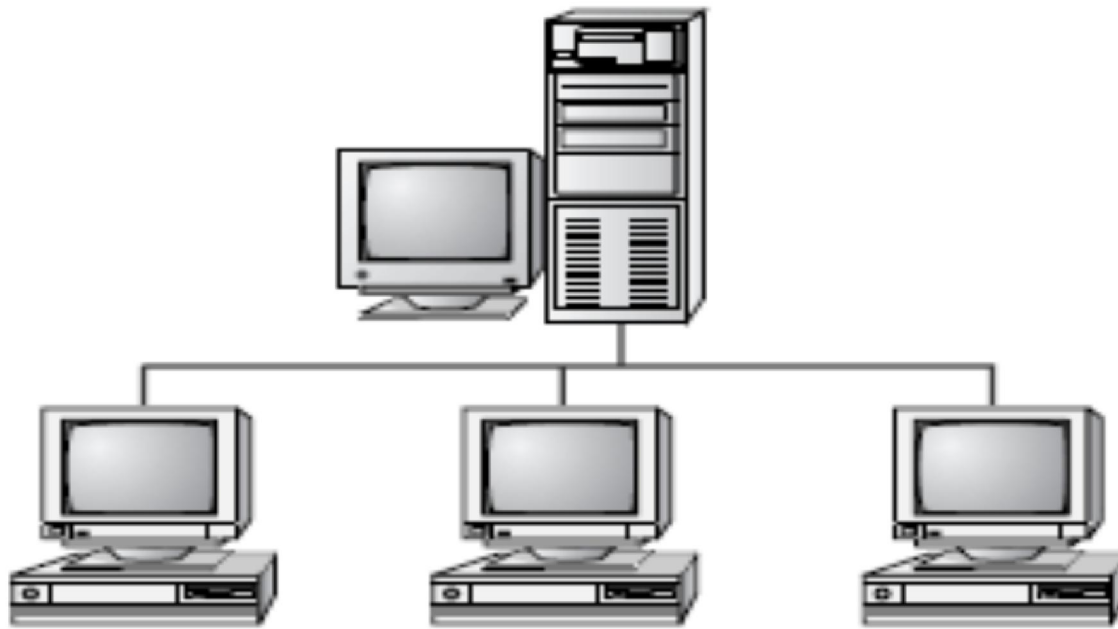
Network topology (cont.)

Star Topology

- A physical star topology branches each network device off a central device called a *hub*, making it very easy to add a new workstation.

- Also, if any workstation goes down it does not affect the entire network. (But, as you might expect, if the central device goes down, the entire network goes down.)

- Some types of Ethernet and ARCNet use a physical star topology. Figure below gives an example of the organization of the star network.

Network topology (cont.)

- Star topologies are easy to install. A cable is run from each workstation to the hub. The hub is placed in a central location in the office.
- Star topologies are more expensive to install than bus networks, because there are several more cables that need to be installed, plus the cost of the hubs that are needed.

Network topology (cont.)

- Star Topology
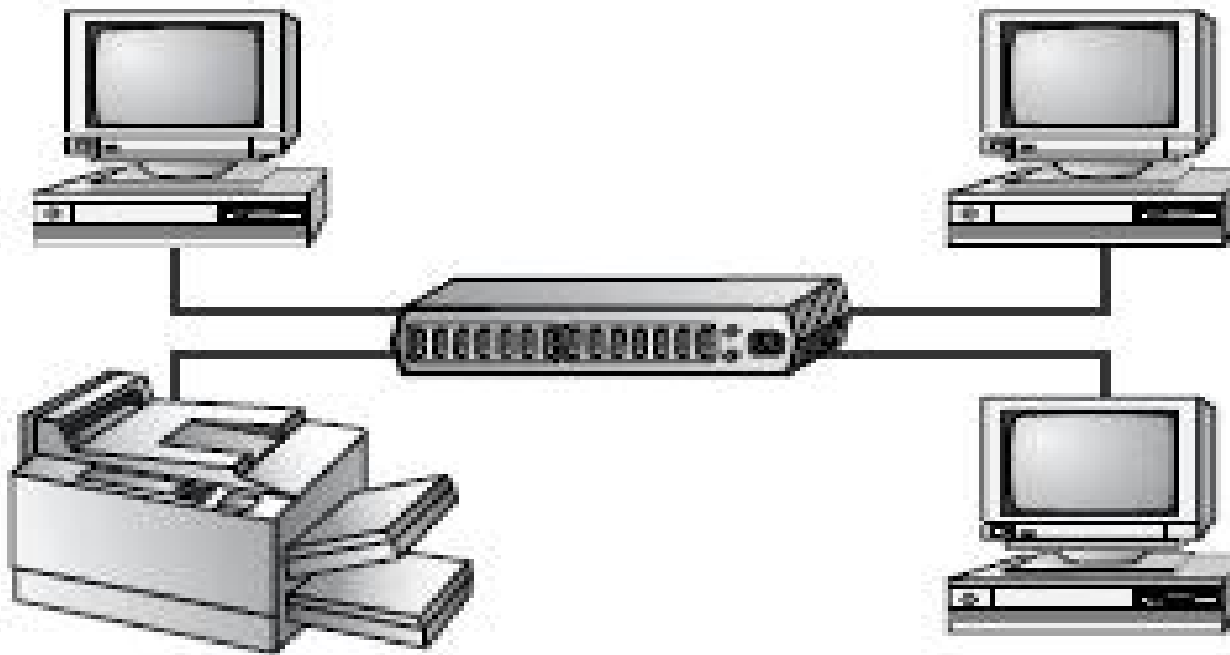
Network topology (cont.)

Ring

- Each computer connects to two other computers, joining them in a circle creating a unidirectional path where messages move from workstation to workstation.

- Each entity participating in the ring reads a message, then regenerates it and hands it to its neighbor on a different network cable.

Network topology (cont.)

- The ring makes it difficult to add new computers.

- Unlike a star topology network, the ring topology network will go down if one entity is removed from the ring.

- Physical ring topology systems don't exist much anymore, mainly because the hardware involved was fairly expensive and the fault tolerance was very low.

Network topology (cont.)

- Ring Topology
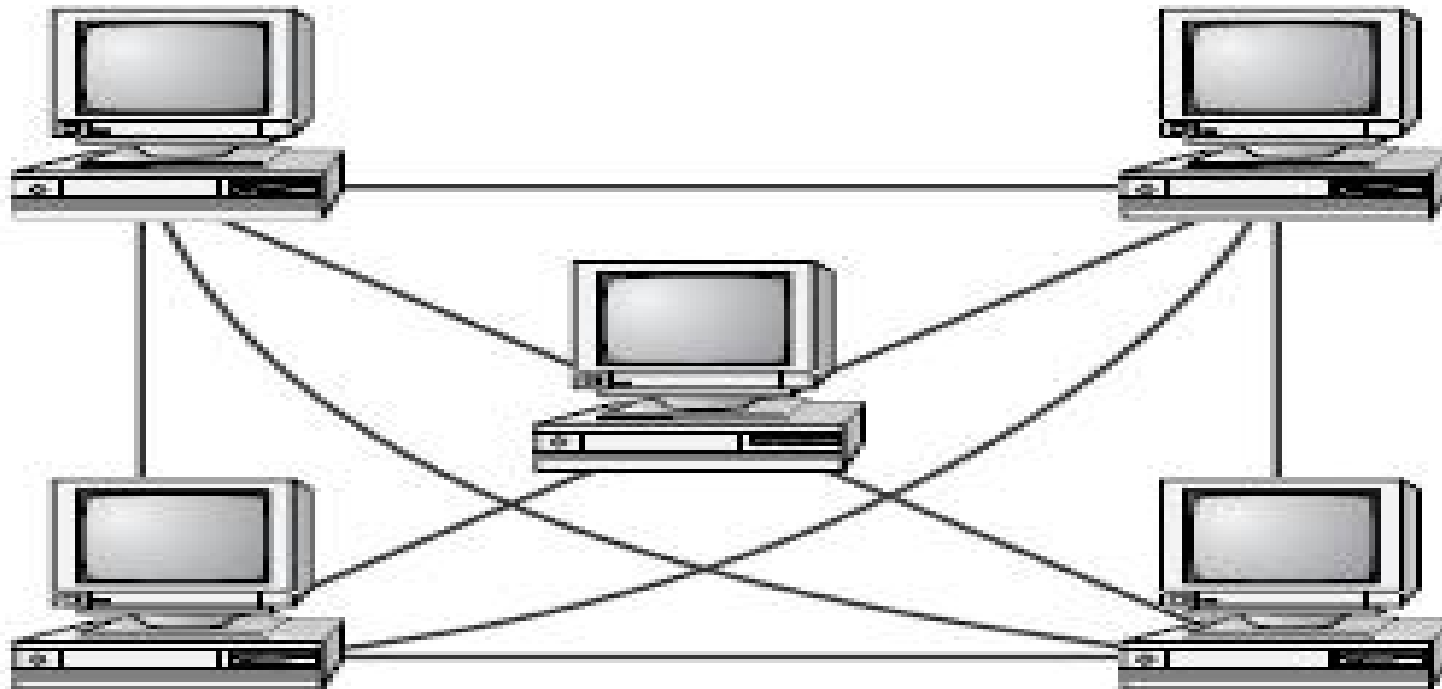
Network topology (cont.)

Mesh

- The *mesh topology* is the simplest logical topology in terms of data flow, but it is the most complex in terms of physical design.
- In this physical topology, each device is connected to every other device
- This topology is rarely found in LANs, mainly because of the complexity of the cabling.
- If there are x computers, there will be $(x \times (x-1)) \div 2$ cables in the network. For example, if you have five computers in a mesh network, it will use $5 \times (5 - 1) \div 2$, which equals 10 cables. This complexity is compounded when you add another workstation.
- For example, your five-computer, 10-cable network will jump to 15 cables just by adding one more computer. Imagine how the person doing the cabling would feel if you told them you had to cable 50 computers in a mesh network—they'd have to come up with $50 \times (50 - 1) \div 2 = 1225$ cables!

Network topology (cont.)

- Because of its design, the physical mesh topology is very expensive to install and maintain.

- Cables must be run from each device to every other device. The advantage you gain from it is its high fault tolerance.

- With a logical mesh topology, however, there will always be a way of getting the data from source to destination.

- It may not be able to take the direct route, but it can take an alternate, indirect route. It is for this reason that the mesh topology is still found in WANs to connect multiple sites across WAN links. It uses devices called *routers* to search multiple routes through the mesh and determine the best path.

- However, the mesh topology does become inefficient with five or more entities.

Network topology (cont.)

- Mesh Topology

Network topology (cont.)

- Advantages and Disadvantages of Network Topologies

Topology	Advantages	Disadvantages
Bus	Cheap. Easy to install.	Difficult to reconfigure. Break in bus disables entire network.
Star	Cheap. Easy to install. Easy to reconfigure. Fault tolerant.	More expensive than bus.
Ring	Efficient. Easy to install.	Reconfiguration difficult. Very expensive.
Mesh	Simplest. Most fault tolerant.	Reconfiguration extremely difficult. Extremely expensive. Very complex.