NETWORK TOPOLOGY

Direct Point-to-Point Communication

- A direct point-to-point communication channel (whither it is physical, or wireless, channel) connects exactly two computers
- Advantage
  - Having the ability to do the followings per each single channel at any time without affecting the rest of the network
    - Use the appropriate hardware
    - Set/change connection details (e.g., frame format, and error detection mechanism)
    - Enforce security and privacy
- Disadvantage
  - The number of connections grows quickly as the number of connected computers increases;
    For N computers, the required connections $= \frac{N\times(N-1)}{2}$;
    Adding the N^{th} computer requires $N-1$ new connections

Shared Communication Channels

- Instead of the expensive dedicated point-to-point connections, shared communication channels are used
- In a shared communication channel, more than two specific devices can share a single channel
- Advantage
  - Reduced cost
- Disadvantage
  - Devices should coordinate/compete to use this shared channel, i.e., transmission/computation overhead

Network Topologies

- A computer network consists of two, or more, devices connected somehow to each other using point-to-point/shared channels
- The term *topology* refers to the way a network is laid out, either physically, or logically
- There are four basic network topologies which are commonly used:
  - Mesh topology
  - Star topology
  - Ring topology
  - Bus topology

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
  - No traffic problem that may occur when links are shared by multiple devices
  - Easy to identify and isolate faults
  - If a link is broken, the rest of the network can still work properly (robust)
  - Only the intended recipient can see the sent message (privacy/security)
- A mesh network has $\frac{N\times(N-1)}{2}$ physical channels to link N devices, and consequently, every device must have $N-1$ input/output ports
  - Expensive
  - Installation and reconfiguration are difficult
  - The wiring can be greater than the available space in the walls, ceiling, or floors

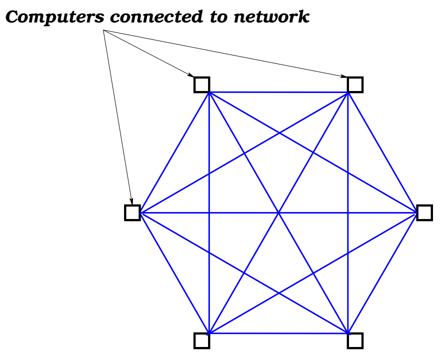

Illustration of mesh topology

Star Topology

- Each device is attached, through a dedicated point-to-point link, to a central controller (called a *hub*)
- Unlike a mesh topology, a star topology does not allow direct traffic between devices
- A typical hub consists of an electronic device that accepts data from a sending computer and delivers it to the appropriate destination
- The hub 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
- Star networks seldom have a symmetric shape in which the hub is located at equal distance from all computers
- If a single cable is damaged, only the device which is connected to this cable will be isolated, since each cable connects only one device to the network
- Less expensive than a mesh network
- Easy to install and reconfigure
- On the other hand, if the hub is broken the entire star network is disabled

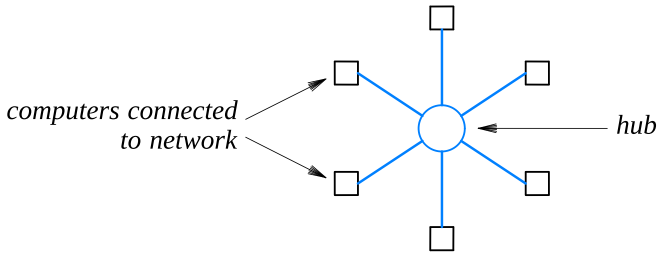

Illustration of star topology

Ring Topology

- Devices are connected in a close loop
- Each device has two dedicated point-to-point links to connect it with the two devices on either side of it
- The name *ring* refers to just the logical connections among devices, not the physical orientation
- A signal is passed along the ring in one direction, from device to device, until it reaches its destination
- A ring topology makes it easy for devices to
  - Coordinate access
  - Detect whether the network operates correctly or not
- Easy to install and reconfigure
- An entire ring network is disabled if one of the cable is cut

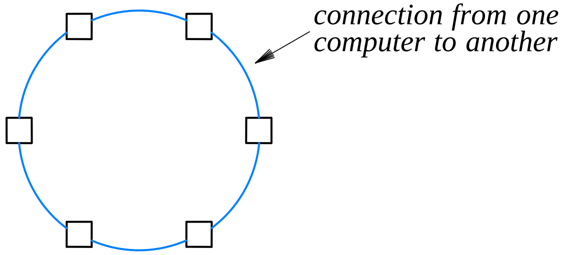

Illustration of ring topology

Bus Topology

- Devices are connected to a single shared cable (this cable acts as a *backbone*)
- Any device attached to a bus can send a signal down the cable in both directions and all devices receive the signal
- Devices attached to a bus network must coordinate to ensure that only one device sends a signal at any time, or chaos will occur
- Easy to install
- A bus topology requires fewer wires (less meters of cables) than a mash, a star, or a ring topology
- Difficult fault isolation
- Difficult to reconfigure
  - Adding new devices may require a modification or a replacement of the backbone to insure a minimum distance between tapes
- An entire bus network is disabled if the backbone cable is cut; this is because the signals are reflected in the direction of origin inside the broken segment; hence creating noise in both directions

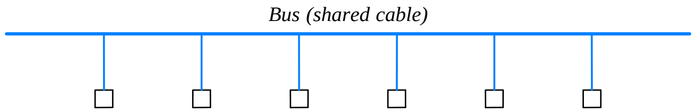

Illustration of bus topology