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Wisdom & Virtue

MIRPUR UNIVERSITY OF SCIENCE AND TECHNOLOGY (MUST), MIRPUR

DEPARTMENT OF SOFTWARE ENGINEERING

Computer Networks

Lecture [3]: Physical Structures & Network Topologies

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(Lecturer)

Topics discussed in Today's Lectures

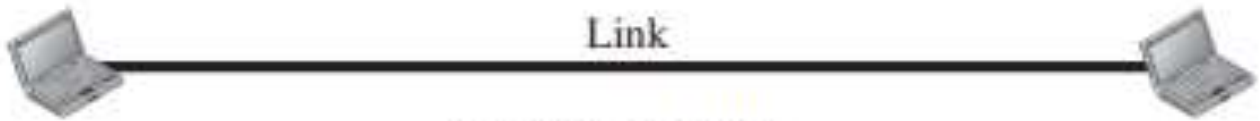
- Type of Network Connections
- Network Topologies

Type of Connection

- 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

Point-to-Point

- A point-to-point connection provides a dedicated link between two devices
- Entire capacity of the link is reserved for transmission b/w those two devices
- Most point-to-point connections use an actual length of wire or cable to connect the two ends
- Example: When we change TV channels by infrared remote control, we are establishing a point-to-point connection b/w remote control and the TV's control system



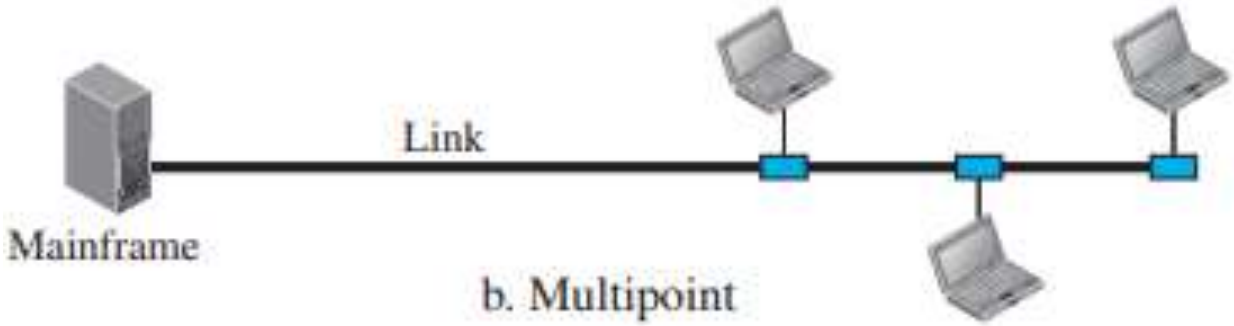
a. Point-to-point

Type of Connection

- There are two possible types of connections: point-to-point and multipoint (Contd…)

Multipoint

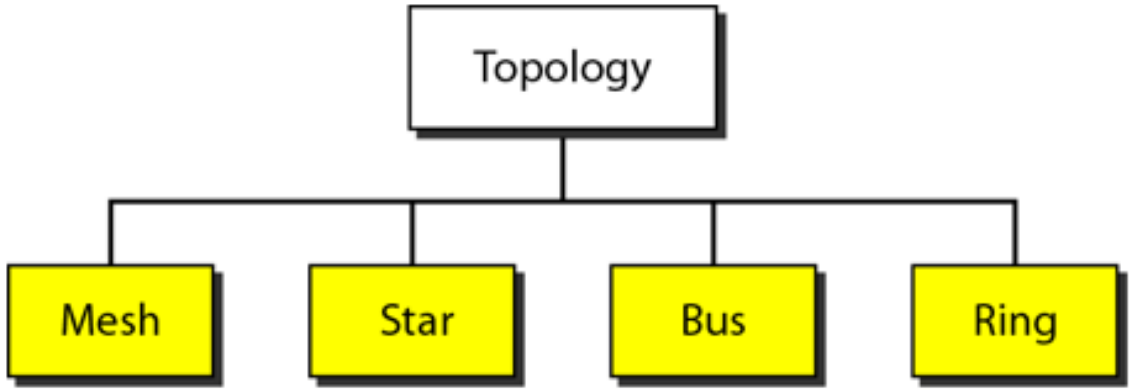
- A multipoint connection is one in which more than two specific devices share a single link
- Capacity of the channel is shared, either spatially or temporally
- If several devices can use the link simultaneously, it is a spatially shared connection
- If users must take turns, it is a timeshared connection



b. Multipoint

Physical Topology

- 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***
- There are four basic topologies possible: mesh, star, bus, and ring

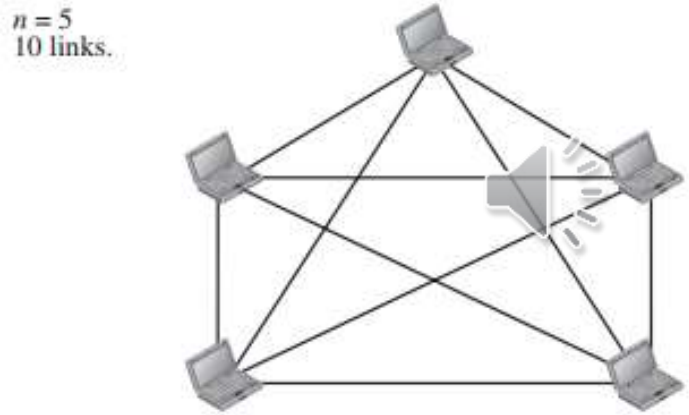


Physical Topology

Mesh Topology

- In a mesh topology, every device has a dedicated point-to-point link to every other device
- Term ***dedicated*** means that the link carries traffic only b/n 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 – 1 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 in Simplex Mode and need n (n – 1) / 2 duplex-mode links

- **Example:** connection of telephone regional offices in which each regional office needs to be connected to every other regional office



Physical Topology

Mesh Topology Advantages

- Use of dedicated links guarantees that each connection can carry its own data load
  - So eliminating the traffic problems that can occur when links must be shared by multiple devices
- Mesh topology is robust. If one link becomes unusable, it does not disable the entire system
- High privacy or security
  - When every message travels along a dedicated line, only the intended recipient sees it
- Finally, point-to-point links make fault identification and fault isolation easy

Physical Topology

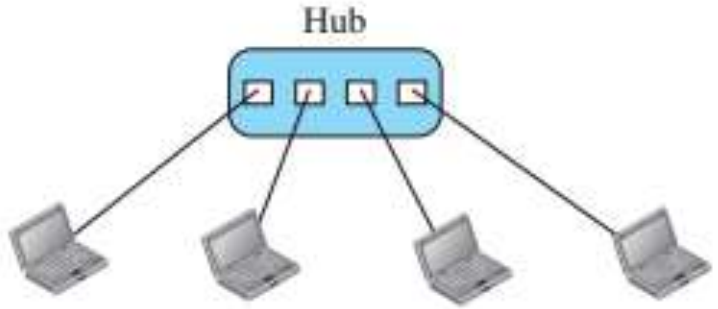
Mesh Topology Disadvantages

- Amount of cabling and the number of I/O ports required
  - Every device must be connected to every other device, installation & reconnection are difficult
  - Bulk of wiring can be greater than available space (in walls, ceilings, or floors) can accommodate
  - Hardware required to connect each link (I/O ports and cable) can be expensive
  - So it is implemented in a limited fashion, i.e, as a backbone connecting the main computers of a hybrid network that can include several other topologies

Physical Topology

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
- 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



Physical Topology

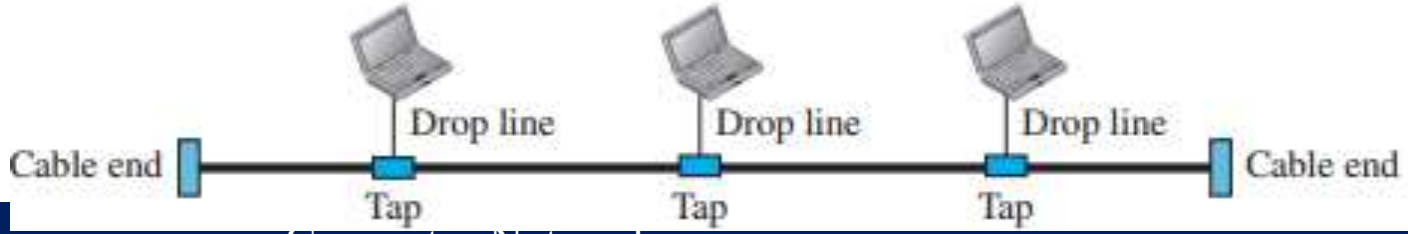
Star Topology (Contd…)

- A star topology is less expensive than a mesh topology
  - Each device needs only one link and one I/O port to connect it to any number of others
  - Therefore it is easy to install and reconfigure
  - Far less cabling needs to be housed, and additions, moves, and deletions involve only one connection: between that device and the hub
- Robustness. If one link fails, only that link is affected
  - All other links remain active. So there is 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
- Disadvantage → Dependency of the whole topology on one single point, the hub
- If the hub goes down, the whole system is dead

Physical Topology

Bus Topology

- A bus topology is multipoint
- One long cable acts as a backbone to link all the devices in a network
- Nodes are connected to the bus cable by drop lines and taps
- A **drop line** is a connection running between the device and the main cable
- A **tap** is a connector that either joints into the main cable
- 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
- So, there is a limit on the No. of taps a bus can support and on distance b/w those taps



Physical Topology

Bus Topology (Advantages)

- **Ease of installation.** Backbone cable can be laid along the most efficient path, then connected to the nodes by drop lines of various lengths
- It uses less cabling than mesh or star topologies
- In a star, for example, four network devices in the same room require four lengths of cable reaching all the way to the hub
- In a bus, this redundancy is eliminated
- Only the backbone cable stretches through the entire facility
- Each drop line has to reach only as far as the nearest point on the backbone

Physical Topology

Bus Topology (Disadvantages)

- Difficult reconnection and fault isolation. A bus is usually designed to be optimally efficient at installation
- It can therefore be difficult to add new devices
- Signal reflection at the taps can cause degradation in quality
- This degradation can be controlled by limiting the number and spacing of devices connected to a given length of cable
- Adding new devices may therefore require modification or replacement of the backbone.
- In addition, 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

References

Chapter 1

Data Communication and Networking (5th Edition)

By Behrouz A. Forouzan

THANKS