IT 4505
Section 2

Packet Network Architectures

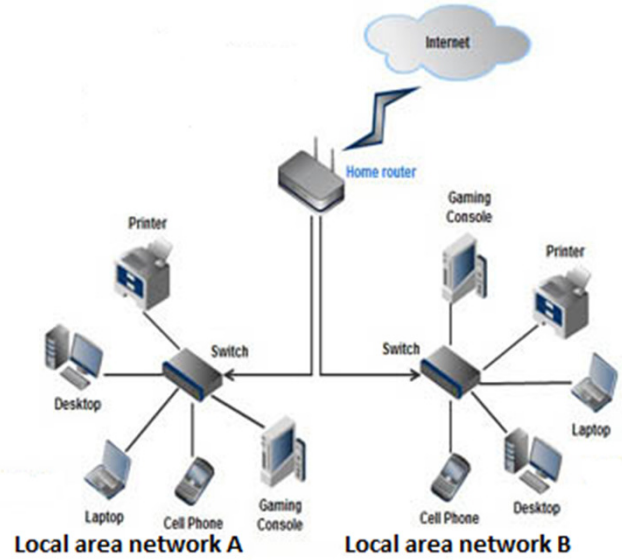
2.2 Network Topologies

- A ***network topology*** is the physical structure or organization of the communication platform, that links between hosts or devices on a network.

- LAN topology

  A LAN is a shared medium that serves many hosts located in close proximity such as in one building.

  Three basis topologies associated with LANs: **bus**, **ring**, and **star**

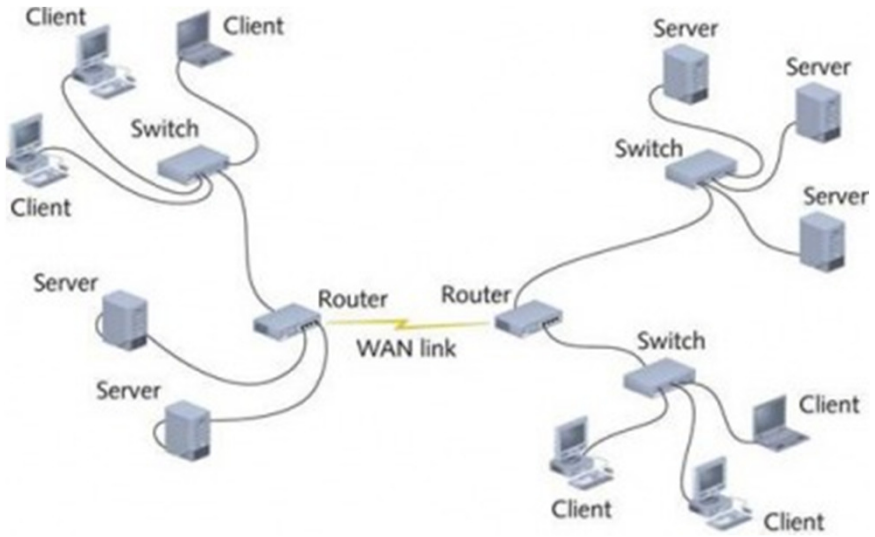


2.2 Network Topologies

- WAN Topology

  A WAN connects networks that are geographically separated by long distance through switches, routers, and/or bridges.

  Two topologies: **mesh** and **tree**



Network Topologies cont.

Why Multiple Topologies?

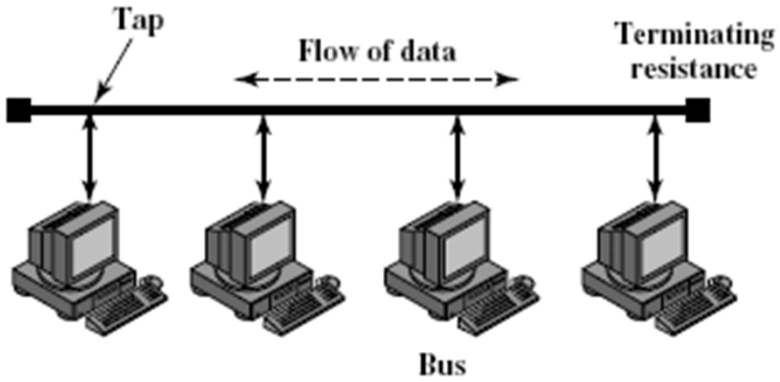
Each has advantages and disadvantages:

Ring – predictable network performance: Unidirectional or bidirectional data flows.

Star – easier to manage and more robust, but requires more links.

Bus – requires fewer links; both directional data flows.

Bus Topology



- In a classic bus topology, the medium consists of a ***single wire*** or cable (backbone) to which other nodes are ***attached via*** connectors and drop cables.
  - Disadvantages include the potential for loose connections or breaks in the bus to ***disrupt the entire network***
- Early Ethernet LAN implementations were typically physical bus architectures; today, most Ethernet implementations are physical stars. (However, an Ethernet ***shared media hub*** is sometimes called a "bus in a box")

Bus Topology cont.

❑ Both IEEE 802.3 standard and IEEE 802.4 standards and their protocols address communication over LANs with bus topologies.

❑ **Advantages & Disadvantages**

Advantages of bus topologies:

- Inexpensive to install (uses less cable)
- Easy to add new devices onto the bus or onto the network

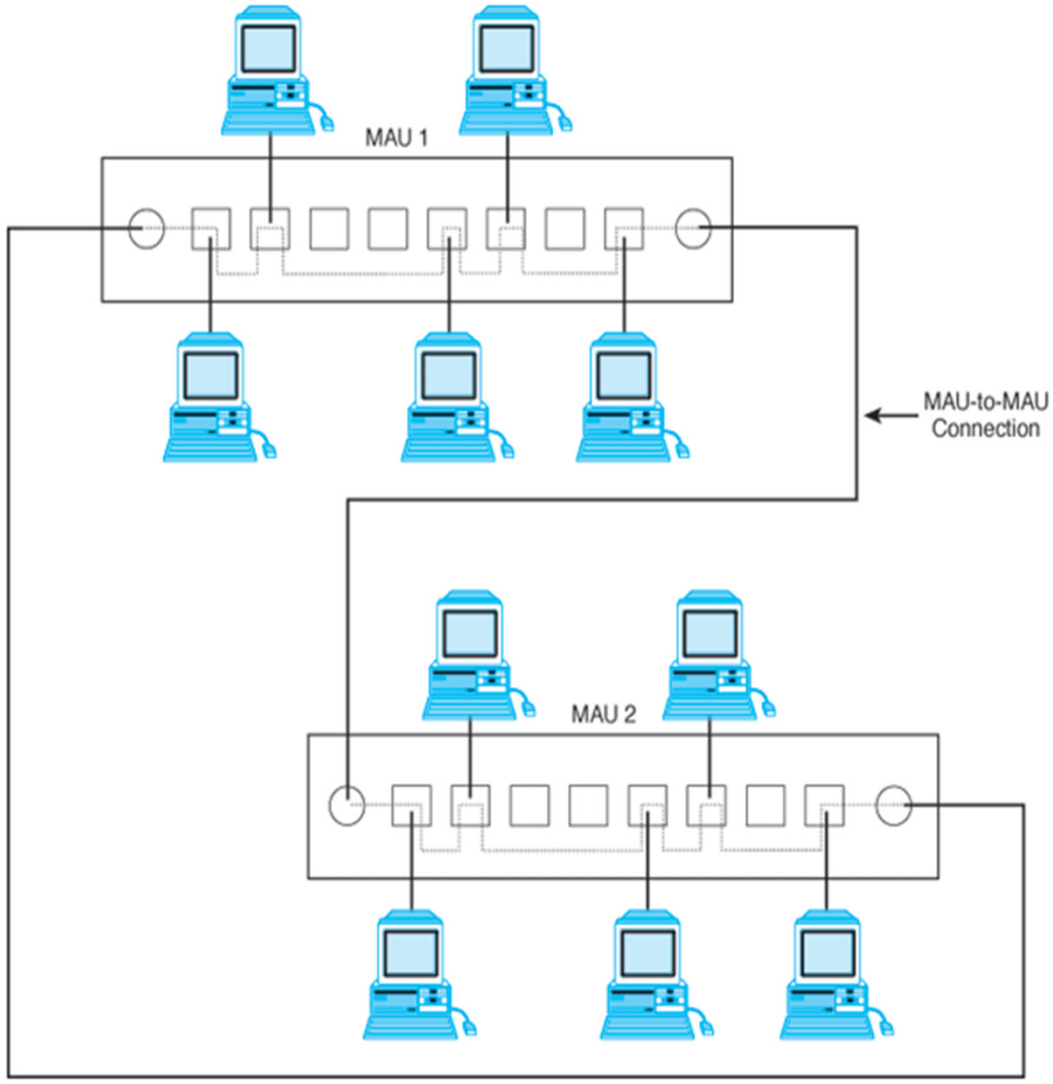
Disadvantages of bus topologies:

- Can be expensive to maintain and troubleshoot
- A naive user can easily "bring down" the entire bus
- Overall maximum length of the bus is limited (10-Base-2)

Ring Topology

- In a physical ring topology, the communication medium forms a ***closed loop*** (ring) and all stations are connected to the loop
  - Data is transmitted node-to-node in ***one direction*** on the ring
  - Similar to a physical bus, the entire network could be disrupted if one of the connectors or links in the ring is failed
- Physical ring topologies are ***less common*** than bus or star topologies
- ***Token ring*** and ***FDDI (Fiber Distributed Data Interface)*** LANs have physical ring topologies
- The most widely used microcomputer ring network is the token passing ring. It conforms to the IEEE 802.5 standard. IEEE 802.6 addresses ***dual-ring*** metropolitan area network (MAN) architecture.

Ring Topology cont.



Ring Topology cont.

Token ring network:

- The nodes attach to Multi-station Access Units (MAUs)
- MAUs can be described as “a ring in a box”, because nodes attach to the physical ring by connecting to the MAU
- MAUs can be interconnected to form larger rings

Ring Topology cont.

Advantages of ring topologies:

- Very predictable network performance
- May be slightly more secure than other topologies

Disadvantages of ring topologies:

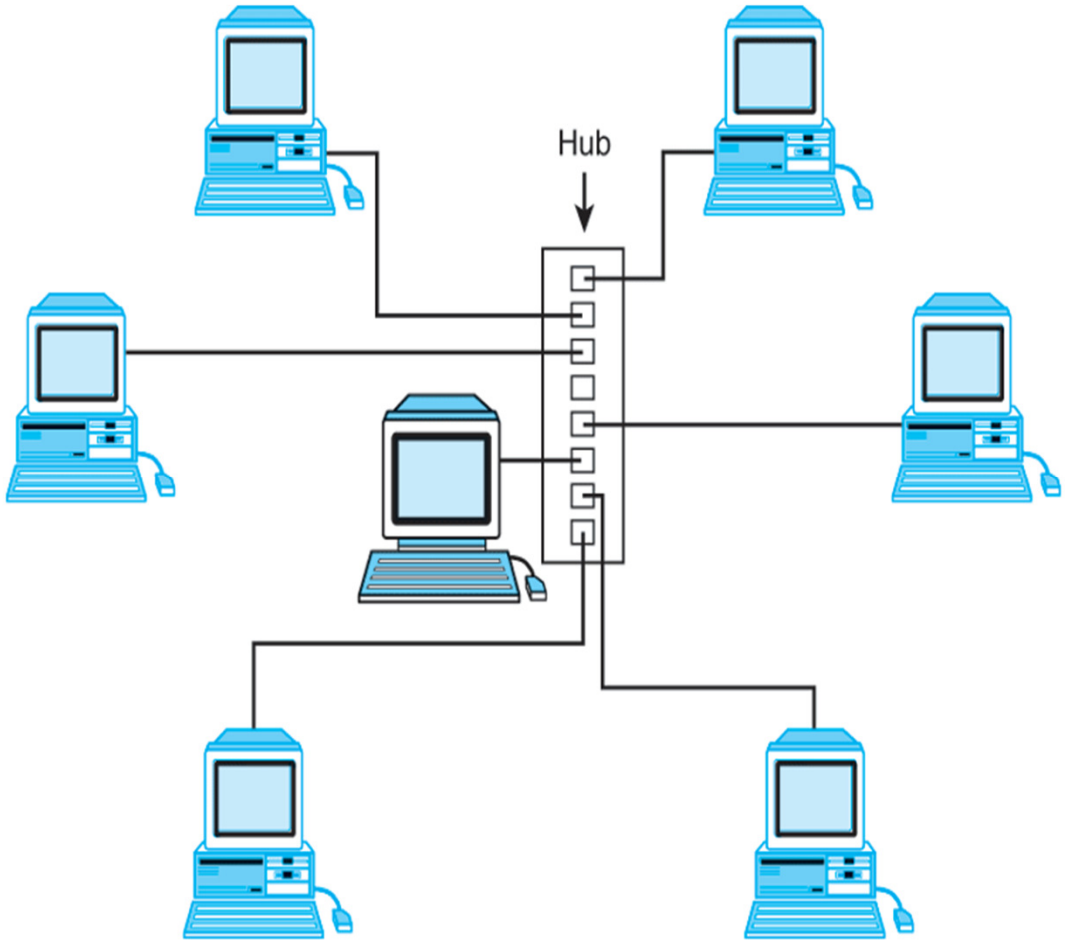
- Expensive as compared to bus/star topologies
- Hardware for ring topologies is less available and therefore more expensive
- Many systems lack good support for networking in ring environments
- Unique wiring requirements
- More complex networking and operational protocol

Star Topology

- In LANs with star topologies, all nodes are connected to some kind of wiring center such as a ***hub or switch***
- Each ***node is isolated*** on its own network segment in a physical star topology, which minimizes the possibility of total network disruption by a malfunctioning connector, NIC, or link

  However, the network is vulnerable to wiring center failure
- The use of central connection points also facilitates network ***traffic monitoring*** and ***network management***, including network security management
- ARCnet (2.5Mbps) was one of the first (1970) LAN architectures with a star topology

Star Topology cont.



Star Topology Cont.

Advantages of star topologies:

- Each node has a dedicated connection to the network – disconnecting a single node does not bring down the rest of the nodes on the network
- Network and cable administration are centralized

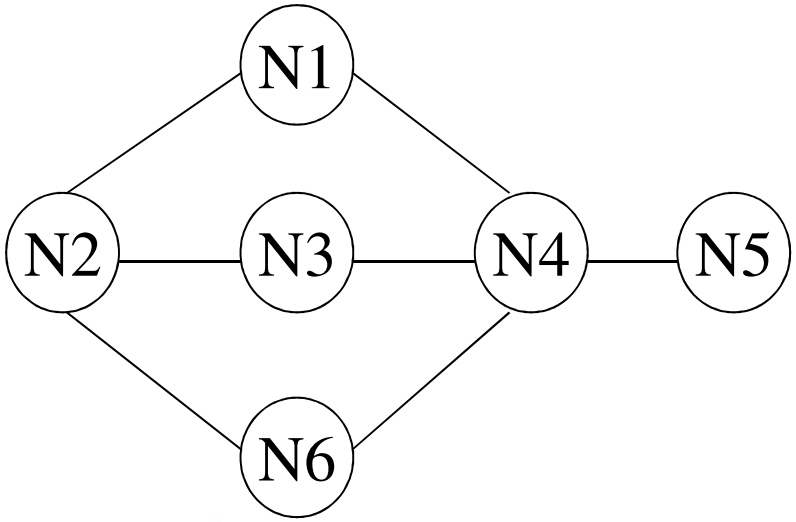
Disadvantages of star topologies:

- More expensive to install – require more cable and the additional cost of a hub
- Maximum length of each spoke of the hub is limited to the allowed maximum length of the medium (for example, on a 10-Base-T network using UTP cable, the maximum distance from the hub to a host is 100m)
- Breakdown of the hub causes breakdown of the entire system (also the Hub can become the bottleneck)

WAN Topologies – Mesh & Tree

Mesh/Network Topology:

provides ***multiple*** paths between nodes or networks (N) usually implemented with switches and routers



Tree/Hub Topology:

A ***hierarchical architecture*** starts with ***header node*** and branches out to other nodes. Simpler to implement than mesh topology