

Network Topologies

Physical Categories

- Three general categories describe the physical layout of networks according to “shape”
- Bus
- Ring
- Star

Physical Topology - Bus

Bus

- Single cable connecting all nodes on a network without addition of connectivity devices
- Every node shares total capacity of bus
- Must be terminated at each end
- Difficult to troubleshoot
- Not fault-tolerant
- Do not scale
 - More nodes sharing same capacity

Physical Topology - Ring

- Forms circle
- Each node connected to two adjacent nodes
- Transmitted clockwise – one direction
- Typically uses “token” to ensure that only one node is transmitting at a time
- Not fault tolerant (one node down and the network is down)
- Not scalable

Physical Topology - Star

- All nodes on network connected through a central device
- More fault tolerant – each node connected to central device
 - If central device fails – then segment using central device fails
- Scalable

Implementation of Network Topologies

- Local Area Network environments
- Enterprise Network environments
- Wide Area Network environments

Typical Local Area Network Topologies

- Pure physical topologies not suitable for deployment in industry
- Combination of features of the three basic physical topologies
 - Referred to as hybrid topologies

Typical Hybrid Physical Topologies in LANs

- Star Wired Ring
- Star Wired Bus
- Daisy Chained
- Hierarchical

Star Wired Ring

- Star Wired Ring
 - IEEE 802.5 – token ring
 - Physical layout of star with token passing data transmission
 - Each node connected to central device such as hub
 - Data flows through each node via hub

Token Ring Implementation

- Star wired ring
- High Speed Token Ring standard
 - 100 Mbps
 - Use either TP or Fiber
 - Costly
- Token passing
 - Determines which node (active monitor) can transmit

Token Ring Implementation continued

- Active Monitor
 - 3 byte token
 - Picks up token and adds to it to become frame for transmission adding header, data, trailer
 - Circular in that token passed back to active monitor (originated transmission)
 - Either continues to transmit or issues free token

IEEE 802.5

- No collisions
- Transmit
 - 4, 16 or 100 Mbps

- 255 addressable stations on STP
- 72 addressable stations on UTP
- Connects via NIC to MAU (multistation access unit) – think hub
- Highly fault tolerant – unused ports internally close loop

Token Ring Frames

- IEEE 802.5
 - Token fields – 3 bytes
 - Start Delimiter
 - Access Control
 - End Delimiter
 - Destination address
 - Source address
 - Data
 - Frame Check Sequence
 - Frame Status

IBM's modification

- Adds routing information used only by IBM applications

Star Wired Bus

- Ethernet and Fast Ethernet networks
- IEEE 802.3
- Nodes star connected to hubs
- Hubs on single bus

Ethernet Implementation: CSMA/CD

- Carrier Sense Multiple Access with Collision Detection
- Access method of Ethernet
- NICs listen on the network – when time passes and no signal then NIC determines can transmit as multiple nodes could make this assumption have Multiple Access – transmissions may interfere with each other – collisions possible

Collision Handling

- Jamming signal
- Collision domain

- Mechanisms for ensuring that resending doesn't generate another collision
 - Statistical algorithms
 - Time based algorithms
- Switched Ethernet model employing logical network segments so can support more transmission without collisions

Daisy Chained

- Daisy chain
 - Linked series of devices
 - Modular additions – connect hubs
 - Maximum number of hubs for transmission integrity

Device Definitions: Hub, Router, Bridge, Gateway

- Hub: multiport repeater, regenerate digital signals, uplink port to connect to network backbone, used to connect multiple devices, operates at Physical Layer
- Router: multiport device, can connect dissimilar LANs and WANs running at different transmission speeds with different protocols, determines best path for data transmission, operates at Network Layer

Definitions continued

- Bridge: intelligent repeater, single input and single output, interpret data it retransmits; operates at Data Link Layer
- Gateway: combination of networking hardware and software; connects two different types of networks; operates at several OSI model layers

Physical Topologies : Enterprise Wide Networks

- Backbone networks
 - Serial
 - Distributed
 - Collapsed
 - parallel