

Media Access Protocols

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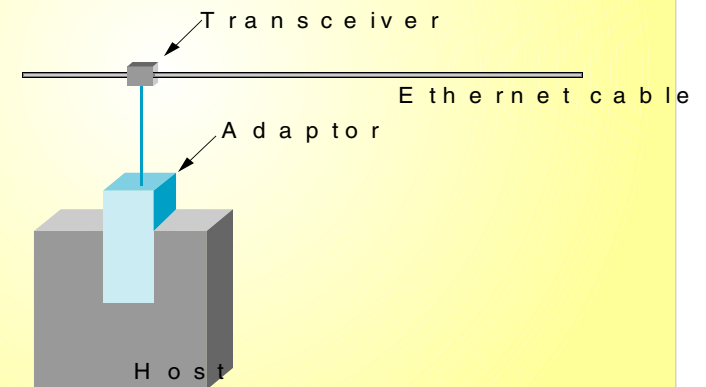
Shared Access Networks

- More than two nodes are attached to the same physical medium
- Normally span a small geographical area
- Referred to as Local Area networks
- Examples: Ethernet, Token Ring, FDDI, 802.11
- Problem: How to resolve contention for the shared channel amongst several nodes?
- Solution: Media Access Protocols

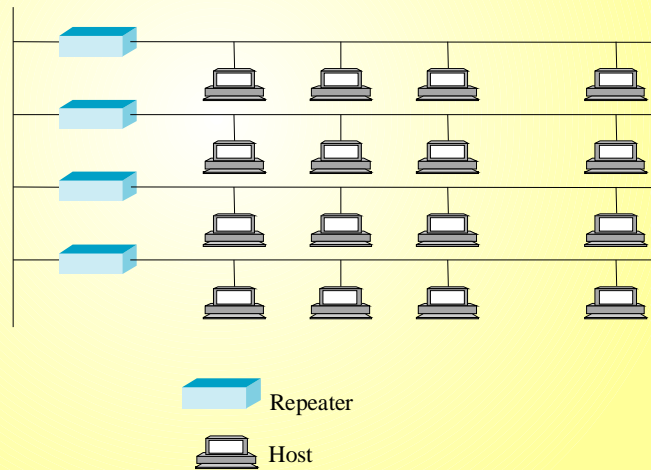
Ethernet (802.3)

- Implemented on a coaxial cable of up to 500m
- Bandwidth: 10Mbps, 100Mbps, 1Gbps
- Host connects to an Ethernet segment by means of a tap
- Tap consists of a transceiver which
 - Detects when the line is idle, drives transmitted signal from host, Receives incoming signals
- Ethernet logic implemented in the adaptor
- Any signal placed on Ethernet is broadcast over the entire network

Ethernet cont....

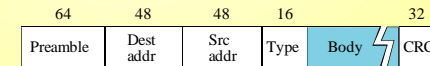


Ethernet Repeater



Frame Format

- Preamble: 64 bit sequence of alternating 0's and 1's
- Destination/Source Address: 48 bit address used to identify hosts
 - Example: 00:0F:1F:D2:00:BB
- Type: Identifies which of the higher layer protocols this frame should be delivered



CSMA/CD Access Protocol

- CSMA/CD: Carrier Sense Multiple Access with Collision Detection
- Carrier Sense means
 - All nodes can distinguish between an idle and busy link
- Collision Detect means
 - A node listens as it transmits
 - It can detect interference from other node transmissions
- Under heavy loads, utilization is only 30%
 - Maximum hosts limited to 1024

Receiver Side Algorithm

- Each frame transmitted on the Ethernet is received by every adaptor connected to it
- An adaptors accepts only those frames
 - addressed to its own address
 - addressed to the broadcast address
 - addressed to multicast address it belongs to
 - all frames, if placed in promiscuous mode (special mode)

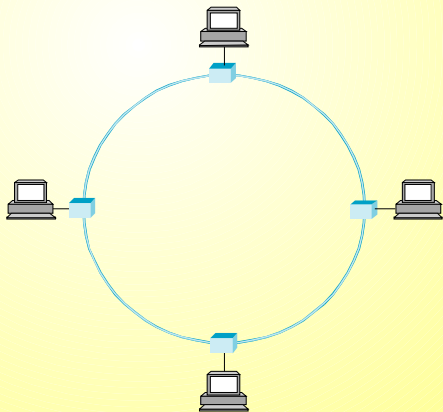
Transmitter Side

- If the line is idle, send immediately
- If the line is busy, wait for it to become idle and transmit immediately (1-persistent protocol)
- If collision
 - Jam for 32 bits and stop transmission
 - To detect collisions, minimum frame size is set to 512 bits
 - Wait some time and try again (exponential back off)
 - 1st time: 0, 51.2 us
 - 2nd time: 0, 51.2, 102.4 or 153.6 us
 - nth time: waits $k * 51.2\text{us}$, k random between 0 and $2^n - 1$
 - Report a transmission error after 16 attempts

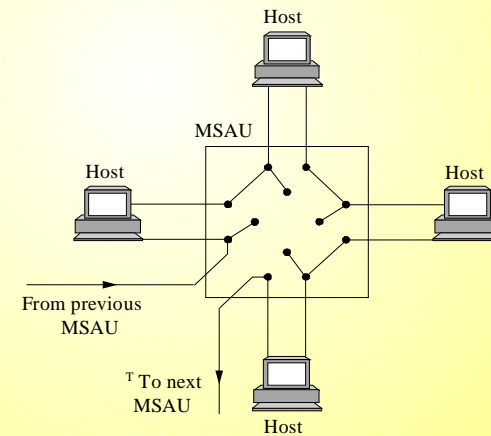
Token Rings (802.5, FDDI)

- A set of hosts connected in a ring
- Data flows in a particular direction around the ring
 - Each node receives from upstream neighbor and forward to downstream neighbor
- Like in Ethernet, the ring is viewed as a single shared medium
- Bandwidths: 4Mbps, 16Mbps or 100Mbps
- 250 stations per Ring

Token Ring Network



Multistation Access Units

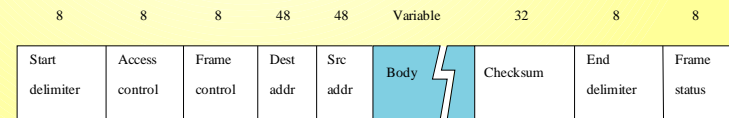


Basic Idea

- A special bit pattern (24 bit token) rotates round the ring
- A host must capture token before transmitting a packet
- As the packet flows past each node on the ring
 - Only the intended receiver copies the packet into its buffer
 - Only the sending host can remove the packet from the ring
- After finishing transmission, sending host release token
 - Immediate release
 - Delayed release
- Hosts get a Round-Robin service

Frame Format

- Access control: Includes frame priority
- Frame Control: Identifies higher layer protocol
- Address fields: Similar to Ethernet, 48 bits long
- Frame Status Byte: Provides reliability info.
 - “A” bit is set if the intended recipient sees the frame
 - “C” bit is set if the intended recipient copies the frame into its buffer successfully



Token Ring Maintenance

- A host acts as a “Monitor” to ensure the health of the ring
- A Monitor periodically transmits a special control message
- A Monitor is elected by transmitting a “claim” token
 - Contention is broken by some well defined rule like “highest address wins”

Role of the Monitor

- Ensures that there is always a token in the ring
 - A token can vanish due to bit errors, crash of a machine holding the token
 - Monitor employs a Timer and watches for a passing token
 - If timer expires before the token is seen, it creates a new one
 - Timer: $\text{NumStations} * \text{TokenHoldingTime} + \text{RingLatency}$
- Checks for corrupted or orphaned frames
 - They are detected using the “monitor” bit in the header
 - At transmission, this bit is set to 0, first time monitor sees the packet, this bit is set to 1
 - Monitor drains off the ring any packet with monitor bit set to 1

Summary

- Looked at how to mediate access to a shared link
- Two different protocols: Ethernet CSMA/CD and token ring
 - Protocols are distributed in nature
- Moving on to “How to make two hosts talk when they are not directly connected?”