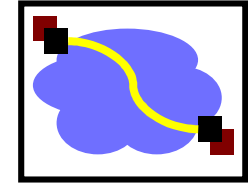


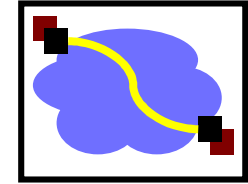
Token Ring

IEEE 802.5 Token Ring



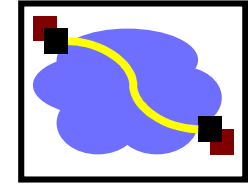
- Consists of a set of nodes connected in a ring.
- Data flows in a particular direction only.
- Data received from upstream neighbour forwarded to downstream neighbour.
- Token – access to the shared ring
 - A special sequence of bits
 - Circulates around the ring.

Token Ring Cont...



- Each node receives and forwards token.
- Frame makes its way back to sender
 - Frame removed by sender
 - Sender reinsert token.
- As token circulates around ring, each station gets a chance to transmit
 - Service round - robin fashion

Token Ring Issues

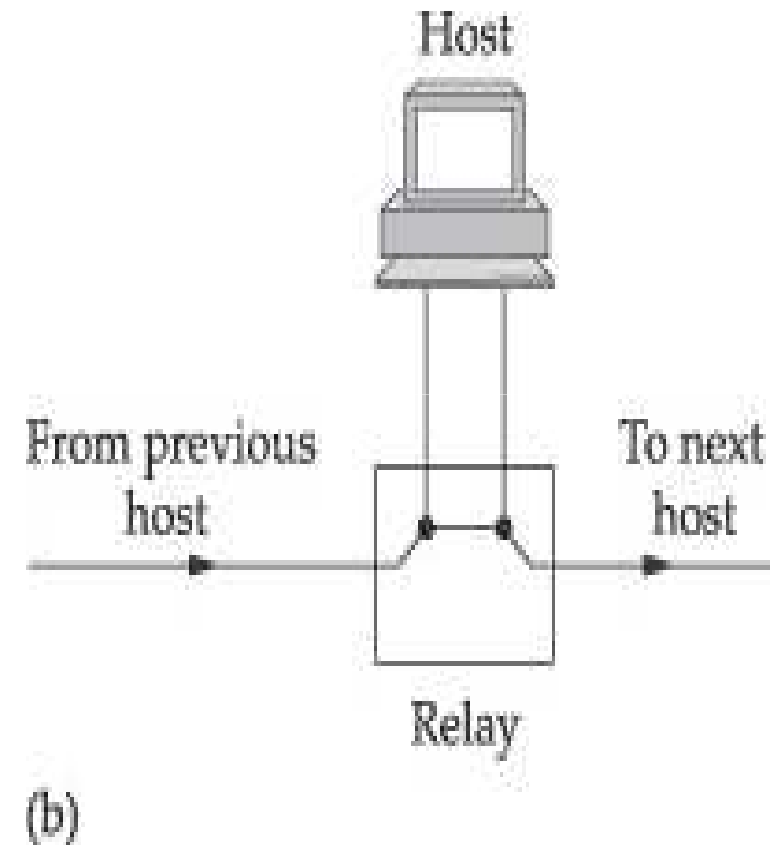
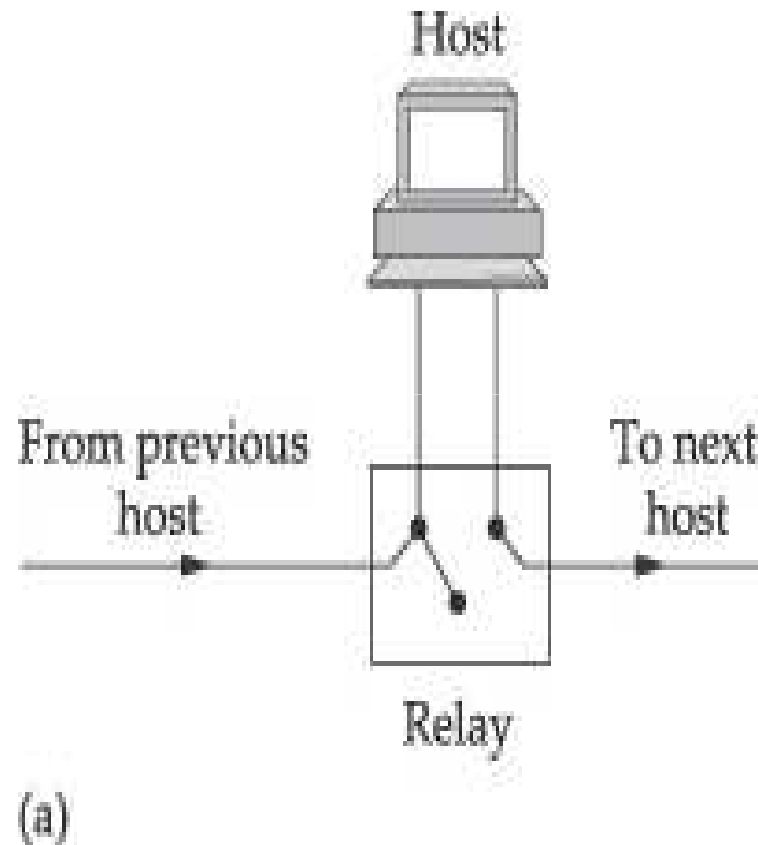
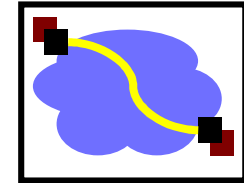


- Any link or node failure
 - Network rendered useless

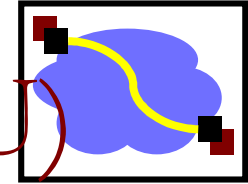
Solution –

- Electromechanical relay
- Station active relay is open and station included

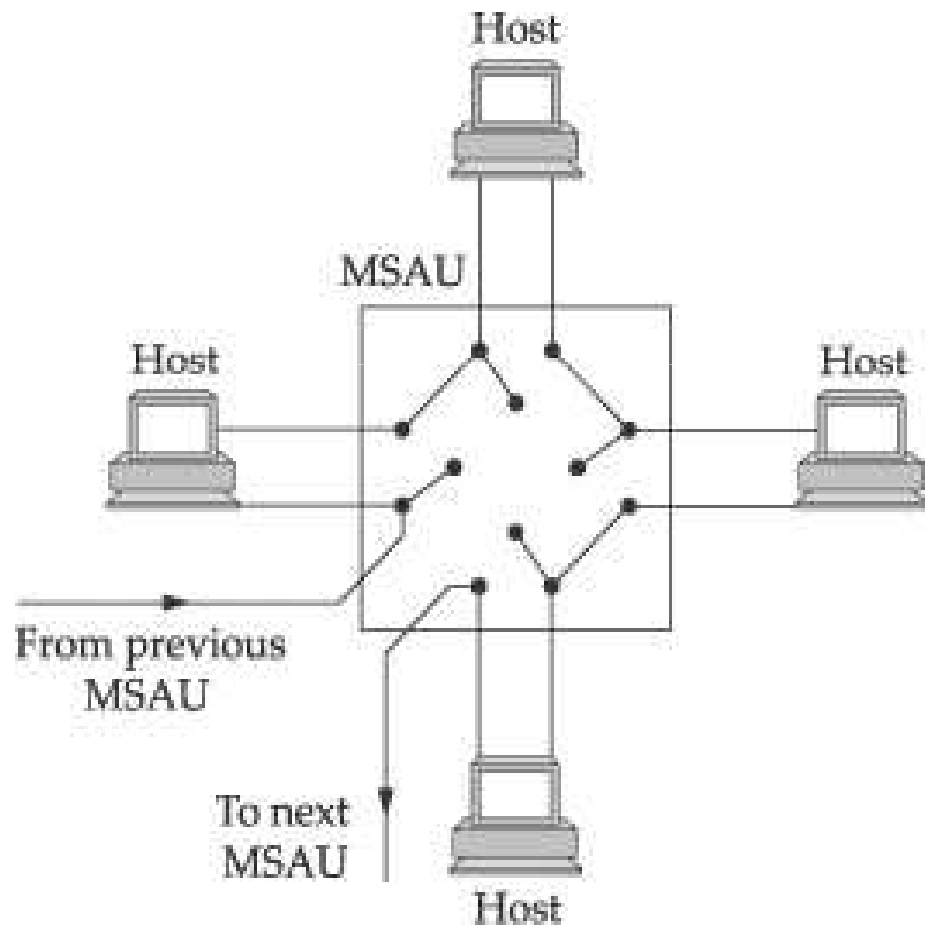
Token Ring Issues



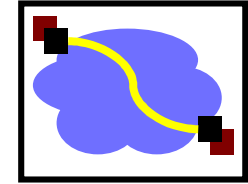
Multistation Access Unit (MSAU)



- Several relays in a box
- Looks like a star topology
- Add or delete a station
 - Plug into or plug out of MSAU

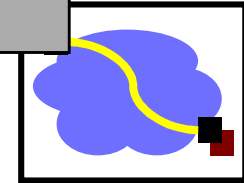


Characteristics



- Data rate: 4 Mbps or 16 Mbps
- Encoding: differential manchester
- 802.5 upto 250 station

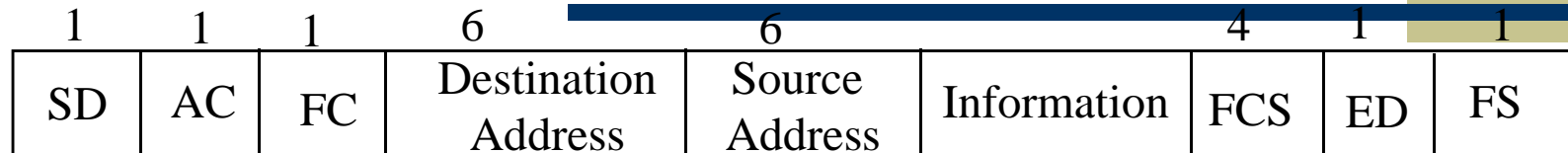
IEEE 802.5 Token and data frame structure



Token Frame Format



Data Frame Format

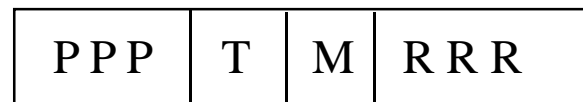


Starting
delimiter



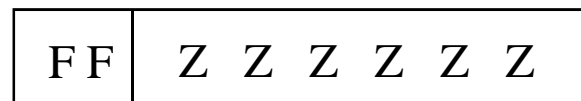
J, K non-data symbols (line code)

Access
control



PPP Priority; T Token bit --0 token 1 frame
M Monitor bit; RRR Reservation

Frame
control



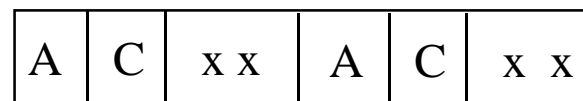
FF frame type
ZZZZZZ control bit

Ending
delimiter



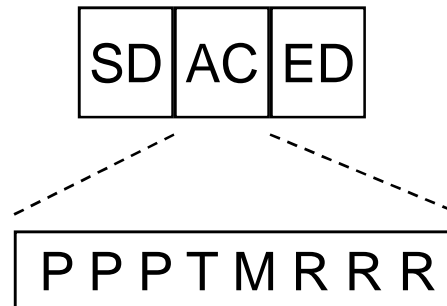
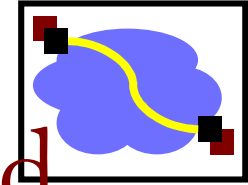
I intermediate-frame bit
E error-detection bit

Frame
status



A address-recognized bit
xx undefined
C frame-copied bit

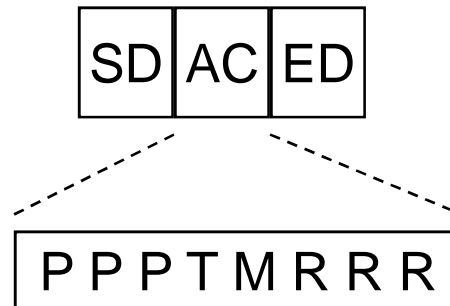
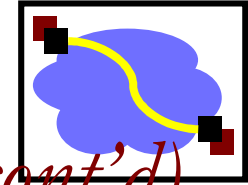
Token Ring Access Control Field



(Note: The AC field is also used in frames)

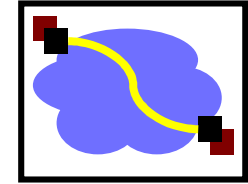
- P = Priority bits
 - Provides up to 8 levels of priority when accessing the ring
- T = Token bit
 - T=0: Token
 - T=1: Frame

Token Ring Access Control Field *(cont'd)*



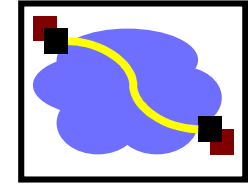
- M = Monitor Bit
 - All frames and tokens are issued with M=0
 - On passing through the “monitor station,” M is set to 1
 - All other stations repeat this bit as set
 - Prevents tokens and frames from circulating indefinitely

Token Ring Access Control



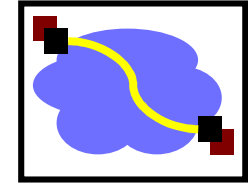
- Network adapter: receiver, and transmitter, and one or more bits of data storage between them.
- When no stations have anything to transmit token circulates
- Ring has enough storage capacity to hold an entire token.
 - 1 bit/station

Token Ring Access Control



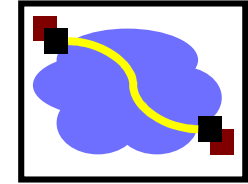
- Token Size: 24 bits
 - Minimum number of stations is 24
 - Overcome this by including a monitor which adds the extra bits of delay
- Token operation
 - Token circulates
 - Station seizes a token

Token operation Cont...



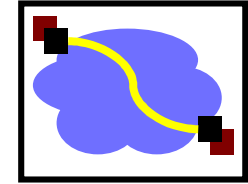
- Station that has token transmits data
- Station drains token out of the ring
- Station sends data
- All stations downhill check destination address
- Destination copies packet
- Packet finds its way back to sending station
- Sending station removes packet from ring
- Station reinserts token into the ring

Issues



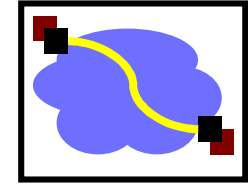
- Size of data that a given node is allowed to transmit
or
- How long a given node is allowed to hold the token
 - Token holding time (THT) = ∞ ?
 - Utilization is 100%
- Unfair to stations to other than the station holding the token
- THT affects ring performance

Cont...



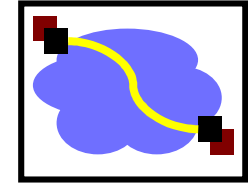
- Token Rotation Time (TRT):
 - $TRT \leq \text{Active nodes} * THT + \text{Ring Latency}$
- Ring Latency – token circulation time (total propagation delay)

Reliable Transmission



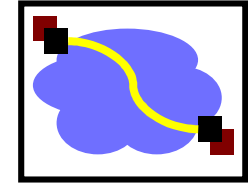
- Use 2 bits in the frame trailer say, A and C bits
- Initially A and C are zero.
- Receiver sets A bit after seeing that it is the intended recipient
- Receiver sets C bit after copying frame
- On receiving the frame back the sender checks for A and C bits.
- If both A and C are not set – retransmit

Priorities in IEEE 802.5



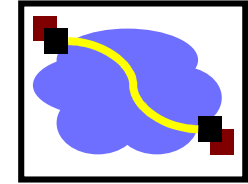
- Supports different levels of priority
 - 3 bits
 - Each station waiting to send, sets priority for packet
 - Then token can be seized
 - Lower priority packets circulate for long in ring

Token Release



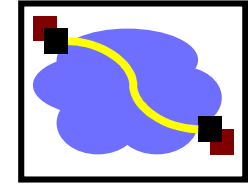
- Early release
 - After transmitting packet
- Delayed release
 - After removing packet when it returns to the sender

Designated monitor



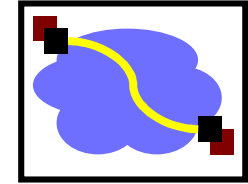
- Makes sure that the token is not lost
- Any station can become a monitor
- Defined procedures for becoming a monitor when the ring is connected or on the failure
- Healthy monitor announces that it is a monitor at periodic interval
- Any station can send a “claim token”
- If claim token comes back to station then it is monitor

Role of monitor



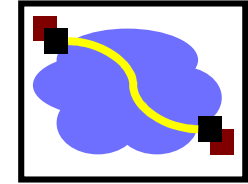
- Insert additional delay in ring
- Ensure always that there is a token somewhere in the ring
- Regenerate a vanished token
- No token seen for TRT \rightarrow regenerate

Token Ring Maintenance



- Orphaned / corrupted packets – drain them if orphaned
 - A and C bits set \rightarrow parent dies
 - A bit set C bit not set \rightarrow parent dies
- Monitor bit is initially set to 1
 - Monitor notices back when packet passes by monitor a second time

Detection of dead stations



- Some problem un detected
- Suspecting station sends a beacon frame –
- How far beacon goes decide which stations must be bypassed.