# CSE and EE 461
# Lecture 17

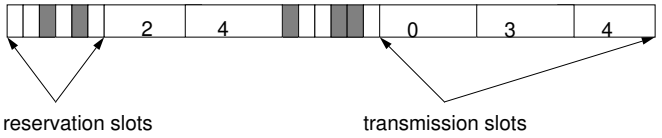
Autumn Quarter 1997



## Collision Free Protocols

**Reservation Protocol**

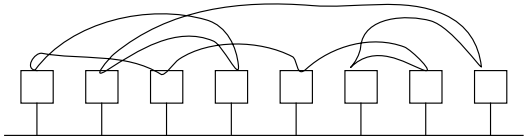
- Can be used when there is no collision detection and frames are fairly long.






## Token Bus

- Uses a broadcast channel, but the stations form a logical ring.



- There is a special packet called the "token".

  - a station that has the token is allowed to transmit for a time, called the "holding time"

  - when the time is up it passes the token to the next station in the ring

  - a station may only transmit what it has when the token arrived. If it has no frames to send then it simply passes the token on.

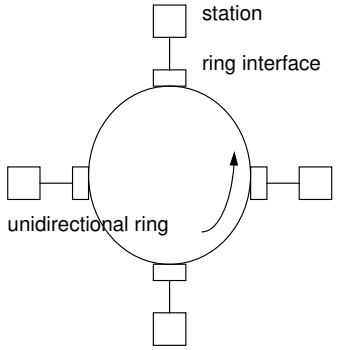


## Properties of the Token Bus

- Useful in real-time application when a guaranteed level of service is required.
- In heavy loads there is very good utilization since token passing is only a small percentage of the traffic and there are no collisions.
- In very light loads there are delays caused by the token passing.
- If a station goes down there is the potential of a token being lost. A lost token can be detected and can be regenerated by the remaining active stations.
- The token bus allows for priorities. For example, high priority can be given to voice packets.
- The token bus can allow for quick turnaround on acknowledgements. The station that has the token allows the recipent to ack before sending the next frame.
- IEEE 802.4 is a standard for token buses running on broadcast channel.

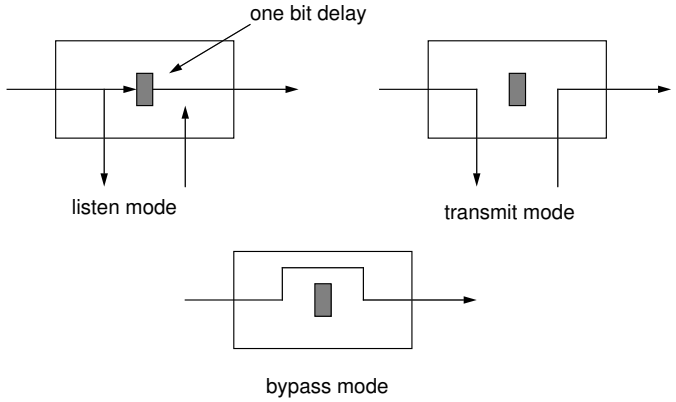
## Token Ring

- Uses token ring hardware and not coax with taps.






## Ring Interface






## Token Ring Protocol

- All frames begin with either 0 or 1.

  - 0 means token is busy and this frame has data. Remain in listen mode.

  - 1 means token is free and grab it if you wish and change to transmit mode. Remain in transmit mode for a short period, transmitting.

- Transmitter absorbs its frame(s) then transmits the token and changes to listen mode.



## Properties of the Token Ring

- Acknowledgement of a frame arrival can be done by destination by changing a bit at the tail of a frame.
- In light loads the token circulates counterclockwise to get to a ready station.
- In heavy loads the token passes from station to station counterclockwise, with stations transmitting.

## Utilization of Token Ring in Heavy Load

- Assume round trip delay is d seconds with d/N from station to next station.
- Assume each station is ready to send a frame with frame time f.
- No acknowledgement case - token is passed as soon as transmission completes, like FDDI*.

$$U = \frac{f}{f + \frac{d}{N}} = \frac{1}{1 + \frac{d}{fN}}$$

- Examples:

  f = d/N implies U = 1/2

  f =d implies U = N/(N+1)

  * In the standard 802.5 a station does not pass the token until the frame has been completely absorbed by the tranmitter and the acknowledgement (last bit of the frame) is read.



## Utilization of Token Ring in Light Load

- Assume one station repeatedly transmits frames with frame time f and passes token to itself.

$$U = \frac{f}{f + d} = \frac{1}{1 + \frac{d}{f}}$$

- Examples:

  f = d/N implies U = 1/(1+N)

  f =d implies U = 1/2



## Comparison of LANs

| | Ethernet | Token Bus | Token Ring |
|---|---|---|---|
| standard | IEEE 802.3 | IEEE 802.4 | IEEE 802.5 |
| technology | partially analog | partially analog | digital |
| interface | passive | passive | active |
| collisions | yes | no, except in recovery | no |
| protocol | exponential backoff | token passing | token passing |
| transmission | 1-persistent | token holding time | token holding time |
| station joining | just add | protocol for joining | make interface active |
| station leaving | just remove | protocol for leaving | make interface bypass |
| recovery | none | token generation | token generation |
| recovery control | none | distributed | centralized monitor |
| priorities | no | yes | yes |
| application | office | manufacturing | office |
| cost | cheap | expensive | expensive |