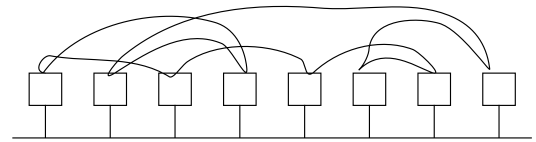
CprE 489
Lecture 28

Fall Semester 1997

Token Bus

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



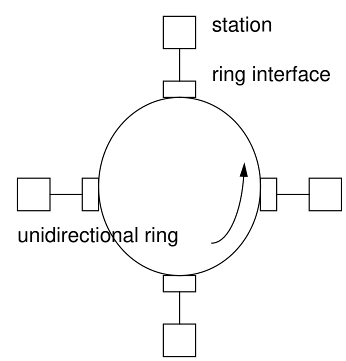
- There is a special packet called the "token".
  - a station that has the token is allowed to transmit for a time
  - when the time is up it passes the token to the next station in the ring
  - a station may only transmit what it has when the token arrived. If it has no frames to send then it simply passes the token on.

Properties of the Token Bus

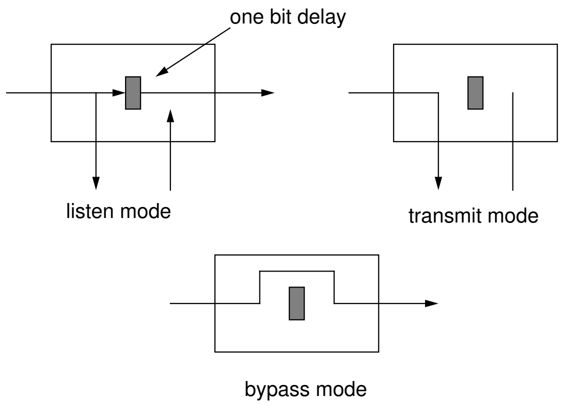
- Useful in real-time application when a guaranteed level of service is required.
- In heavy loads there is very good utilization since token passing is only a small percentage of the traffic and there are no collisions.
- In very light loads there are delays caused by the token passing.
- If a station 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 and Its Properties

- 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.
- 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 and Light 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.

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

- Examples:

  f = d/N implies U = 1/2

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

- Assume one station repeated 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