FDDI (Fiber Distributed Data Interface)

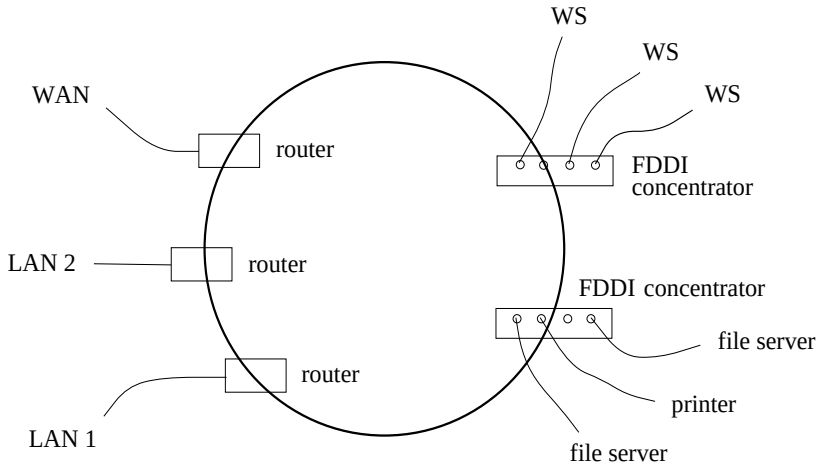
$\longrightarrow$ token ring architecture

High-bandwidth extension of IBM 4 Mbps and 16 Mbps IEEE 802.5 token ring standard.

$\longrightarrow$ 100 Mbps bandwidth

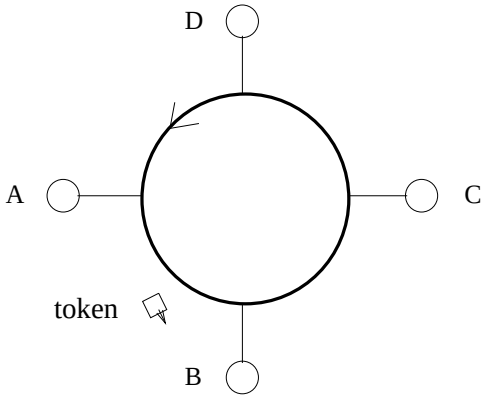
Used as high-bandwidth campus/city backbone.

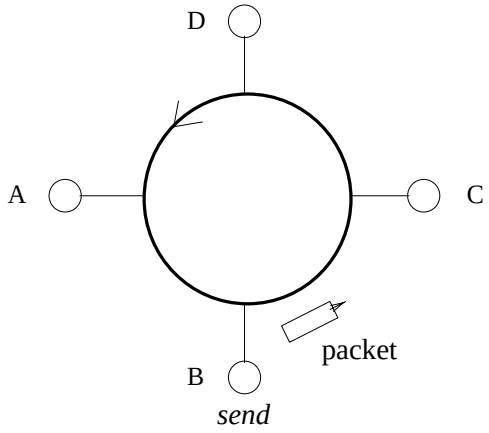
$\longrightarrow$ metropolitan/campus distance: MAN

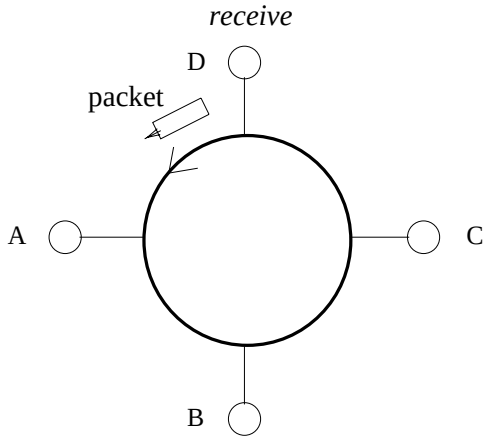


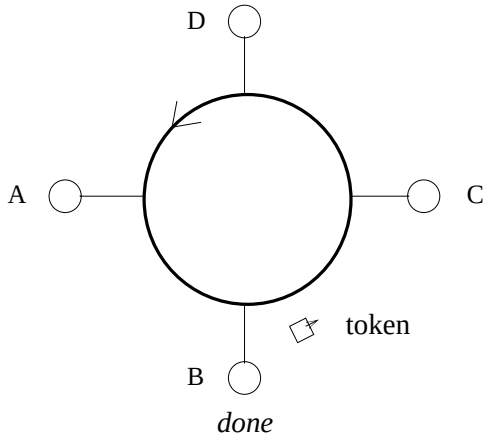
Basic operation:

$\longrightarrow$ B wants to send to D

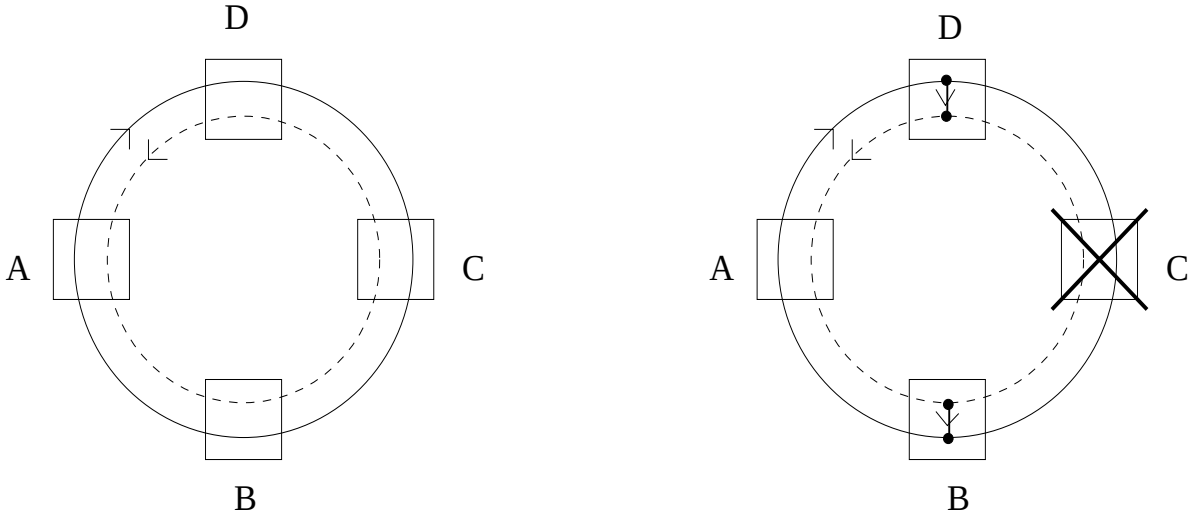




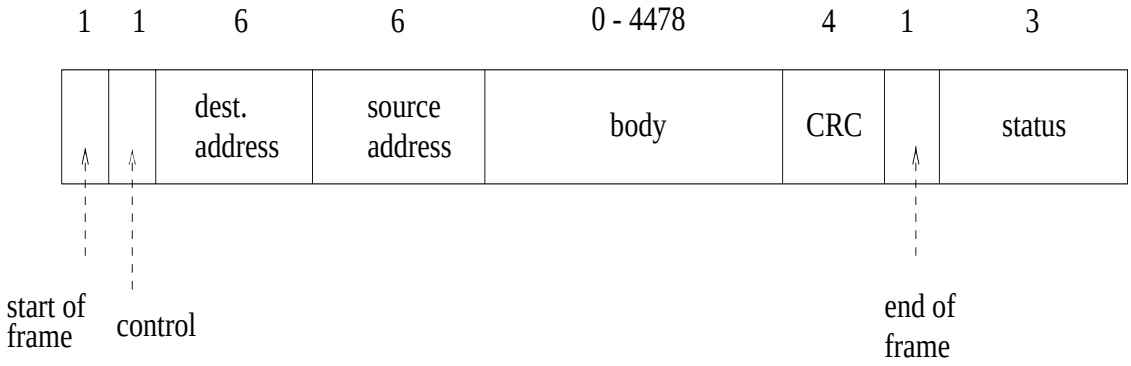




Fault-tolerance:



- DAS (dual attachment station)
- SAS (single attachment station)



- frame size < 4500 B
- 4B/5B encoding
- synchronous/asynchronous data
- 2 km inter-station distance
- 200 km diameter (multimode fiber); 100 km circumference

Performance issues: fairness and efficiency

- TRT (token rotation time)
- THT (token holding time)

$$\text{TRT} = \text{no. of nodes} \times (\text{THT} + \text{link latency})$$

To increase efficiency: increase THT

$\longrightarrow$ let station send as much as it needs

$\longrightarrow$ same as frame size $\uparrow$

$\longrightarrow$ THT $\uparrow$ $\Longrightarrow$ utilization $\rho \uparrow$

To increase fairness: limit THT

$\longrightarrow$ limit station's one-time sending of data

To facilitate fairness: introduce TTRT (target token rotation time).

THT determining factor (assume TTRT is given):

- prioritized frames: synchronous/asynchronous
- synchronous frames always get sent
- if TRT $>$ TTRT, then late; don't send asynchronous data
- if TRT $\leq$ TTRT, then early; send asynchronous data for max $\{$ TTRT $-$ TRT, single frame time $\}$ duration

How to set TTRT?

$\longrightarrow$ token claim process

$\longrightarrow$ initiate when needed (e.g., start-up)

- Each station submits claim frame containing TTRT bid.
- Smaller TTRT bid overrides higher TTRT bids.
  - Compare claim frame bid against own desired TTRT.
  - If less, then reset own TTRT to lower value.
  - If larger, then put lower bid on claim frame and forward.
- Winner: same bid value when claim frame makes full circle.

  $\longrightarrow$ leader election

At the end of the day, consistent TTRT value among all stations.

$\longrightarrow$ consensus problem

Compare against Ethernet's CSMA/CD.

- $\longrightarrow$ round-robin reservation
- $\longrightarrow$ absence of MA and collision
- $\longrightarrow$ determinism vs. indeterminism
- $\longrightarrow$ imperfect QoS assurance
- $\longrightarrow$ performance vis-à-vis CSMA/CD?

Cooperative vs. noncooperative protocols

- $\longrightarrow$ robust if some users use selfish MAC
- $\longrightarrow$ could be malicious