Shared Access Networks
ring: Token Ring (FDDI)
Token Ring Overview

• Examples
  – 16Mbps IEEE 802.5 (based on earlier IBM ring network)
  – 100Mbps Fiber Distributed Data Interface (FDDI)
Token Ring (cont)

• Idea
  – Frames flow in one direction: upstream to downstream
  – special bit pattern (token) rotates around ring
  – must capture token before transmitting
  – release token after done transmitting
    • immediate release – as soon as sent
    • delayed release – wait until message returns
  – remove your frame when it comes back around
  – stations get round-robin service

• Frame Format
Timed Token Algorithm

- **Token Holding Time (THT)**
  - upper limit on how long a station can hold the token

- **Token Rotation Time (TRT)**
  - how long it takes the token to traverse the ring
  - \[ TRT \leq ActiveNodes \times THT + RingLatency \]

- **Target Token Rotation Time (TTRT)**
  - agreed-upon upper bound on TRT
    - Key for performance and for determining if token broken
Algorithm (cont)

• Each node measures TRT between successive tokens
  – if measured-TRT > TTRT: token is late so don’t send
    • Can’t send because some other node held token too long
  – if measured-TRT < TTRT: token is early so OK to send

• Two classes of traffic
  – synchronous: can always send
    • There are cases where can ignore TTRT
  – asynchronous: can send only if token is early

• Worse case: 2xTTRT between seeing token
• Back-to-back 2xTTRT rotations not possible
Token Maintenance

- **Lost Token**
  - no token when initializing ring
  - bit error corrupts token pattern
  - node holding token crashes

- **Generating a Token (and agreeing on TTRT)**
  - execute when node joins ring or suspect a failure
  - send a *claim frame* that includes the node’s TTRT *bid*
  - When node receives claim frame, update the bid and forward
  - if your claim frame makes it all the way around the ring:
    - your bid was the lowest
    - everyone knows TTRT
    - you insert new token
Maintenance (cont)

• Monitoring for a Valid Token
  – should periodically see valid transmission (frame or token)
  – maximum gap = ring latency + max frame ≤ 2.5ms
  – set timer at 2.5ms and send claim frame if it fires
Token Ring Summary

• Too complicated
• Large networks, large TTRT
• Issues with coming and going nodes