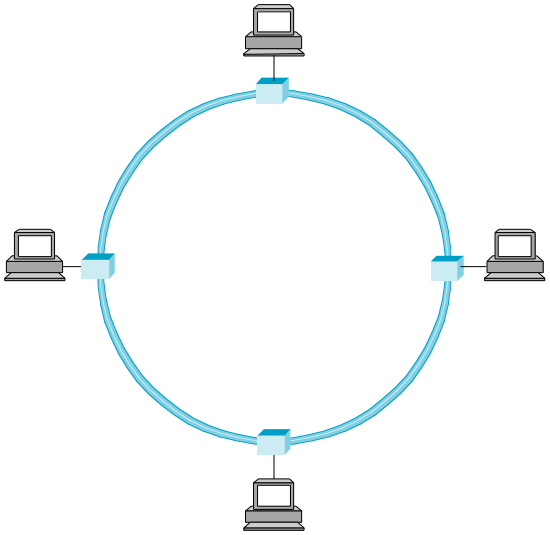

# Shared Access Networks
# ring: Token Ring (FDDI)

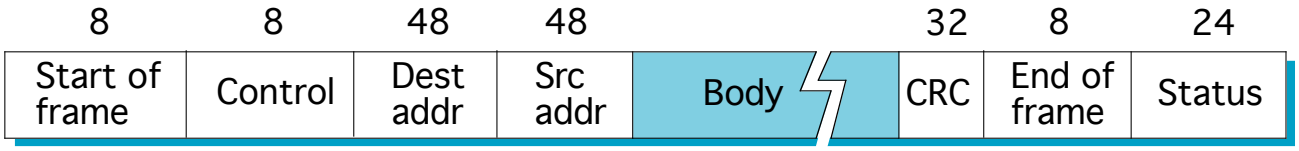
# Token Ring Overview


- 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`** <= **`ActiveNodes`** `X` **`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