Chapter 14  LAN Systems

• Ethernet (CSMA/CD)
  ➢ ALOHA
  ➢ Slotted ALOHA
  ➢ CSMA
  ➢ CSMA/CD

• Token Ring /FDDI

Ethernet (CSMA/CD)

• Carriers Sense Multiple Access with Collision Detection
  ➢ Random Access & Contention
    ➢ Stations access medium randomly, content for time on medium
  ➢ ALOHA – Precursor of CSMA/CD: Packet Radio
    ➢ When sender station has frame, it sends
      ➢ Sender station listens (for max round trip time plus small increment)
        ➢ If ACK, fine. If not, retransmit
        ➢ If no ACK after repeated transmissions, give up
  ➢ Receiver station frame check sequence (as in HDLC)
    ➢ If frame OK and address matches receiver, send ACK
      ➢ Frame may be damaged by noise or by another station transmitting at the same time (collision)
        ➢ Any overlap of frames causes collision
    ➢ Max utilization 18%, not desirable -> Slotted ALOHA

From Slotted ALOHA to CSMA

• Slotted ALOHA
  ➢ Time in uniform slots equal to frame transmission time
    ➢ Need central clock (or other sync mechanism)
    ➢ Transmission begins at slot boundary
  ➢ Max utilization 37%

• CSMA: take advantage of small (compare to transmission time) propagation delay
  ➢ All stations know that a transmission has started almost immediately in LAN
    ➢ First listen for clear medium (carrier sense)
    ➢ If medium idle, transmit
    ➢ Collision occurs only if two stations start at the same instant, collision
    ➢ Wait reasonable time (round trip plus ACK contention, No ACK then retransmit
  ➢ Max utilization depends on propagation time (medium length) and frame length
    ➢ Longer frame and shorter propagation gives better utilization

CSMA/CD

• CSMA: collision occupies medium for duration of transmission, waste of capacity
  ➢ If medium is idle, transmit
  ➢ If busy, listen for idle then transmit immediately
  ➢ If two stations are waiting, collision

• CSMA/CD: stations listening whilst transmitting
  ➢ If medium idle, transmit
  ➢ If busy, listen for idle, then transmit
  ➢ If collision detected, jam signal then cease transmission
  ➢ After jam, wait random time then start again
    ➢ Binary exponential back off
Collision Detection

- On baseband bus, collision produces much higher signal voltage than single signal
  - Collision detected if cable signal greater than single station signal
- Signal attenuates over distance
- Limit distance to 500m (10Base5) or 200m (10Base2)
- For twisted pair star-topology activity on more than one port is collision
  - Special collision presence signal generated

Ethernet

- 10Mbps -> 100Mbps -> Gigabit Ethernet
- Gigabit Ethernet
  - Compatible to 10/100
  - Enhancement of CSMA/CD
    - Carrier extension: At least 4096 bit-times long (512 for 10/100)
    - Frame bursting
    - With switching hub, no need for the enhancement

Token Ring

- 802.5 MAC protocol
  - Small frame (token) circulates when idle
  - Station waits for token
  - Changes one bit in token to make it SOF for data frame
  - Append rest of data frame
  - Frame makes round trip and is absorbed by transmitting station
  - Station then inserts new token
    - when transmission has finished and
    - With/without the leading edge of returning frame arrives (delayed release/immediate release)

FDDI: Another Token Ring MAC Protocol

- FDDI: Fiber Distributed Data Interface
- As for 802.5 except:
  - Station seizes token by aborting token transmission
  - Once token captured, one or more data frames transmitted
  - New token released as soon as transmission finished (early token release in 802.5)
  - Refer to the diagram in the previous slide for details