Lecture 19 (MAC Protocols)

1 Channel Partition Protocols

1.1 TDMA (Time Division Multiple Access)

Divide access to channel in time slots

1.2 FDMA (Frequency Division Multiple Access)

Divide access to channel in frequency slots

2 Random Access Protocols

Transmits at full channel data rate

2.1 Slotted ALOHA

- 1. Assumes that all frames of same size
- 2. Time divided into equal size slots
- 3. Nodes start to transmit only at slot beginning
- 4. Nodes are synchronized
- 5. If multiple nodes transmit in same slot, all nodes detect collision
- 6. If collision occurs, retransmission happens in subsequent slot with probability p
- 7. It has disadvantage of clock synchronisation and wastage of the time slot in case of collision

2.1.1 Efficiency

$$success = p(1-p)^{N-1}$$

$$success_{any} = Np(1-p)^{N-1}$$

$$max efficiency = \max_{p} Np(1-p)^{N-1}$$

This max efficiency is equal to 1/e

2.2 Pure ALOHA

- 1. Similar to slotted but no synchronisation and time for transmission can differ
- 2. The efficiency is half of the efficiency of pure ALOHA

2.3 CSMA/CD (Carrier Sense Multiple Access/Collision Detection)

- 1. Sense the channel before transmitting, prevents collisions
- 2. More advanced version has CD, and colliding transmission is aborted to reduce channel wastage
- 3. CSMA/CD is difficult to implement in wireless networks

2.3.1 Algorithm

- 1. Receive datagram, create frame(s)
- 2. If channel busy, wait else start frame transmission
- 3. If transmission successful, finish transmission
- 4. Else, abort and send jam signal
- 5. After m^{th} collision, choose K randomly from $\{0, 1, 2, 3, \dots, 2^m 1\}$ and wait for 512K bit times and then reattempt transmission

2.3.2 Efficiency

efficiency =
$$\frac{1}{1 + 5t_{prop}/t_{trans}}$$

Where t_{prop} is max propagation delay and t_{trans} is transmission delay (for max-size frame).

3 "Taking Turns" Protocol

3.1 Polling

- 1. Master node *invites* other nodes to transmit in turn
- 2. Drawbacks are:
- polling overhead
- latency
- single point of failure

3.2 Token Passing

- 1. Control token is passed from one node to the next one sequentially
- 2. Similar drawbacks as previous part (token overhead instead of polling)

4 Wireless Link Characteristics

- 1. Signal strength decreases with increasing distance
- 2. Interference from other sources
- 3. Multipath propagation (same data can arrive multiple times)
- 4. Hidden terminal problem: two nodes may not be able to detect the presence of the other and hence CSMA might not work

4.1 802.11 LAN/WiFi Architecture

- 1. Host communicates with base station
- 2. Base station is the Access Point (AP)
- 3. Basic Service Set (BSS) contains:
- wireless hosts
- AP
- ad hoc mode (hosts only)

4.1.1 CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance)

- 1. Since it is difficult to detect collisions, avoidance is done
- 2. If channel is sensed to be idle for WT1, entire frame is transmitted
- 3. Else, start a random backoff time and transmit when timer expires
- 4. Wait for ACK and if none received, increase random backoff interval and re-wait
- 5. On receiver's end, return ACK after WT2
- 6. Sender reserves channel use for data frames using small reservation packets
- 7. Small request-to-send (RTS) packets are transmitted first to BS
- 8. BS broadcasts clear-to-send (CTS) in response to RTS