WN Sheet 3 Sol.

Medium Access Control

1) Compare between Contention-Based and Contention-Free multiple access.

Solution

Contention-based	Contention-free
Allows collisions (with recovering)	Avoids collisions
Typically, distributed	Typically, decentralized
Aloha, Slotted Aloha, CSMA	Binary Countdown, Bitmap

2) Compare between Unslotted Aloha and Slotted Aloha multiple access?

Solution

Unslotted Aloha	Slotted Aloha
Any station sends at any time	Any station sends at any beginning of slot
Vulnerable time is $2t$	Vulnerable time is t
Continuous Time	Discrete Time
No synchronization	Requires synchronization in time

- Recall that unlike $CSMA$ nodes don't listen on the channel before deciding to send

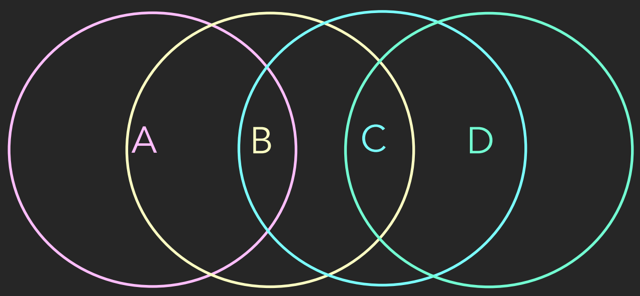
3) What is the disadvantage of the Back-off algorithm?

Solution

- Although the probability of collision decreases exponentially; the back off increases exponentially in return
- As the probability of success for a station increases exponentially with successive successes, it decreases exponentially for the other station (unfairness)
- Only works for two stations

4) Describe the hidden terminal problem? How can it be solved?

Solution



- Stations out of range of each other transmit to a common station
- Consider the topology above
  - Suppose Station A transmits to station B
  - Signal from A does not reach C so C senses the channel as idle
  - C starts transmitting to B as well yielding a collision (failed carrier sense)

- To solve, use RTS/CTS
  - Let the sender node A send an RTS before transmission
  - Once it reaches B it sends back a CTS
    - Also heard by C as it's in range
    - C checks the duration in the header and stays silent for that time
  - In general, any node in the range of the transmitter or the receiver (hearing RTS or CTS respectively) stays silent for the duration

5) Describe the exposed terminal problem?

Solution

- Transmissions that would not interfere with each other are blocked because a node was exposed to another transmitting node

- Consider the topology above
  - Suppose Station A transmits to station B
    - B gets RTS from A
    - A, C get CTS from B
  - C will keep quiet for the duration even if it has data to send to D
    - Such transmission would have not caused any problem as D is not in the field of B

  - Alternatively, consider if B transmits to A and D wants to transmit to C

- Has no universal solution

6) A and B are the only two stations on a shared medium

- Each has a steady queue of frames to send
- Both A and B attempts to transmit a frame, collide and A wins first back off race
- At the end of this successful transmission by A (first back off race)
  - Both A and B attempt to transmit and collide
  - What is the probability that A wins the second back off race?

Solution

- The fact that B lost in the first race implies that in the second race it will have to wait $t \in [0, 2^2 - 1] = [0,3]$ (i.e., $n = 2$)
  - Meanwhile, A is transmitting a new packet so $n = 1$ for it as usual (i.e., will wait $t \in [0,1]$)
- So, for the second race there are 4×2 possibilities (0 to 3 for B and 0 to 1 for A) for the number of slots k waited by each station:

K_A	K_B	$Remarks$
0	0	$Collision$
0	1	$A\ Wins$
0	2	$A\ Wins$
0	3	$A\ Wins$
1	0	$B\ Wins$
1	1	$Collision$
1	2	$A\ Wins$
1	3	$A\ Wins$

- Clearly, $P(A\ Wins) = 5/8$ and $P(B\ Wins) = 1/8$ and $P(Colision) = 2/8$
- Recall from the lecture (or logic), station that waits less wins