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| Chapter: | 4 |
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# Computer Networks
## Assignment Chapter №4

**Task 1.** *1. Consider building a CSMA/CD network running at 1 Gbps over a 1-km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. What is the minimum frame size?*

*Solution.* $T_{prop} = \frac{len}{signalspeed} = \frac{1000}{200000000} = 0.5 \cdot 10^{-5}$ seconds
$t_{frametransmission} = 2 \cdot T_{prop} = 10^{-5}$ seconds
$minframesize = speed \cdot t_{frametransmission} = 10^9 \cdot 10^{-5} = 10^4$ bits = 1250 bytes

□

**Task 2.** *Let A and B be two stations attempting to transmit on an Ethernet. Each has a steady queue of frames ready to send; A's frames will be numbered A1, A2, and so on, and B's similarly. Let T = 51.2 μs be the exponential backoff base unit. Suppose A and B simultaneously attempt to send frame 1, collide, and happen to choose backoff times of 0 × T and 1 × T , respectively, meaning A wins the race and transmits A1 while B waits. At the end of this transmission, B will attempt to retransmit B1 while A will attempt to transmit A2. These first attempts will collide, but now A backs off for either 0 × T or 1 × T , while B backs off for time equal to one of 0 × T, ..., 3 × T . (a) Give the probability that A wins this second backoff race immediately after this first collision; that is, A's first choice of backoff time k × 51.2 is less than B's. (b) Suppose A wins this second backoff race. A transmits A3, and when it is finished, A and B collide again as A tries to transmit A4 and B tries once more to transmit B1. Give the probability that A wins this third backoff race immediately after the first collision.*

*Solution.* Assume that immediately does mean that A just wins (not in 0 seconds): a) $\frac{1}{2} \cdot \frac{3}{4} + \frac{1}{2} \cdot \frac{2}{4} = \frac{5}{8}$
b) $\frac{1}{2} \cdot \frac{7}{8} + \frac{1}{2} \cdot \frac{6}{8} = \frac{13}{16}$

□

**Task 3.** *Consider the extended LAN connected using bridges B1 and B2 in Fig. 4-1 . Suppose the MAC tables in the two bridges are empty. Give the MAC tables for each of the bridges after the following transmissions:*

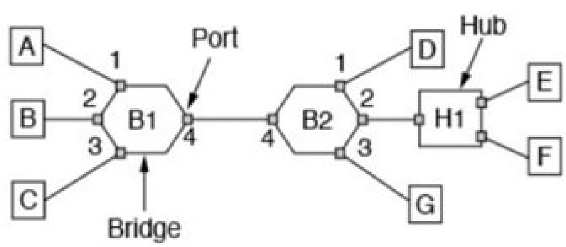


Fig. 4-1 - (Task 3)

*(a) A sends to C. (b) E sends to F. (c) F sends to E. (d) G sends to E. (e) D sends to A. (f) B sends to F*

*Solution.* a) A sends a frame to C:
- B1 receives the frame from A.

- B1 notes that A is connected to port 1 in its hash table.
- B1 forwards the frame to all the ports except port 1.

Because initially, B1 does not have an entry for C in the hash table.
- B2 also forwards the frame to all the ports except port 4 and updates its hashtable for A.

C accepts the frame, while other devices reject it.

b) E sends a frame to F
- HI receives the frame and forwards it to all the ports except the port to which E is connected.
- F receives the frame.
- B2 forwards the frame to all the ports except port 2.
- B1 receives the frame on port 4 and forwards the frame to ports 1, 2, and 3.

All other devices reject the frame.

c) F sends a frame to E
- HI forwards the frame to E and port 2 of B2.
- E accepts the frames.
- B2 knows that the port for the destination E is the same as the source port. So, it discards the frame.

d) G sends a frame to E
- B2 receives the frame from G and identifies the destination E can be reached via port 2.
- B2 forwards the frame to its port 2.
- HI relays the frame to E and F.
- E accepts the frame, while F rejects it.

e) D sends a frame to A
- B2 receives the frame through port 1 and forwards it to port 4
- B1 receives the frame on its port 4.

B1 forwards the frame to port 1, where A is connected.

f) B sends a frame to F
- B1 receives the frame on its port 2 and forwards it to all other ports.
- B2 receives the frame on its port 4.
- B2 forwards the frame to its port 2.
- HI receives the frame and forwards it to E and F.

F receives the frame, but E discards it.

| | B1 Hash Table | | B2 Hash Table | |
|---|---|---|---|---|
| step | port | device | port | device |
| a | 1 | A | 4 | A |
| b | 4 | E | 2 | E |
| c | | | 2 | F |
| d | | | 3 | G |
| e | 4 | D | 1 | D |
| f | 2 | B | 4 | B |

Fig. 4-2 (Task 3)

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**Task 4.** *Why is collision detection more complex in wireless networks than in wired networks such as Ethernet and How can hidden terminals be detected in 802.11 networks*

*Solution.* Collision detection in wireless networks, such as those using the 802.11 protocol, is more complex than in wired networks like Ethernet due to two fundamental factors.

Firstly, radios in wireless networks are typically half duplex, meaning they cannot transmit and listen for noise bursts simultaneously on a single frequency. This limitation prevents devices from employing the same collision detection mechanism as Ethernet, where stations wait for the medium to go silent before transmitting. Additionally, the significant difference in signal strength between transmitted and received signals in wireless networks makes simultaneous transmission and reception impossible. Therefore, collision detection mechanisms like CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) are used, where devices sense the channel before sending and employ exponential backoff after collisions.

Secondly, the transmission ranges of stations in wireless networks may differ, leading to situations like the hidden terminal problem, where stations cannot directly detect each other's transmissions due to obstacles or distance. This problem arises because not all stations are within radio range of each other. As a result, collisions may occur when stations mistakenly assume the channel is idle and start transmitting, unaware of ongoing transmissions elsewhere in the same cell.

To address these challenges, 802.11 networks use a combination of physical and virtual channel sensing mechanisms. Physical sensing checks for valid signals on the medium, while virtual sensing involves maintaining a logical record of channel activity using the Network Allocation Vector (NAV).

Hidden terminals in 802.11 networks can be detected using mechanisms such as Request to Send/Clear to Send (RTS/CTS) and Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). RTS/CTS allows devices to reserve the channel before transmitting, preventing collisions caused by hidden terminals. CSMA/CA helps avoid collisions by having devices listen to the channel before transmitting, ensuring they do not interfere with ongoing transmissions. Additionally, Received Signal Strength Indicator (RSSI) can be used to estimate the signal strength of nearby devices, helping identify potential hidden terminals based on their proximity.

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