Computer Networks

Homework 5

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# Problem 1:

N stations share a 10Mbps pure ALOHA channel. Each station outputs on average one new 20000b frame every 20s. In case of maximum utilization by pure ALOHA:

1. What is the maximum N such that the real data rate is sufficient for all the stations?
2. What is the vulnerable time?
3. What is the average total number G of all generated frames per frame transmission time? Which frames, apart from the new ones, are included in this number?
4. What would the vulnerable time be if slotted ALOHA was used?

data rate = 10 \* 106 bps

data F­ = 20 \* 103 b

N nfps = 1/20s

G ­max = ½

S max = 0.184

1. d. r. ALOHA = S max \* data rate = 0.184 \* 10 \* 106 bps = 1 840 000 bps

req. d. r. = d. r. ALOHA = data F \* NS \* N nfps

Ns = d. r. ALOHA / (data F \* N nfps) = 1 840 000 bps / (20 \* 103 b \* 1/20s) = 1 840

**Answer**: The maximum number of stations such that the data rate is sufficient is 1 840.

1. TFr = data F / data rate = 20 \* 103 b / (10 \* 106 bps) = 2 ms

TV­ = 2 \* T Fr = 2 \* 2 ms = 4 ms

**Answer**: The vulnerable time is 4 ms.

1. **Answer**: Because we assume a case of maximum utilization the average total number G is 1/2. The retransmission frames are also included in this number.
2. TV = TFr = 2 ms

**Answer**: The vulnerable time would be 2 ms if slotted ALOHA was used.

# Problem 2:

Protocol families such as ALOHA, CSMA, etc. allow multiple devices to access a shared  
communication channel. Which of the following data-link protocol families require such access:

1. Wi-Fi,
2. “Classic” Ethernet,
3. “Switched” Ethernet with full duplex transmission?

Shortly justify the answer for each point (descriptions of the two Ethernets can be found in “Computer Networks (5th Edition)” by Tanenbaum).

a) Wi-Fi requires multiple devices to access a shared communication channel. It uses the CSMA/CA protocol, which allows devices to sense the channel and avoid collisions by using a contention-based access method. Devices wait for a clear channel before transmitting data, and collisions are minimized using virtual carrier sensing and acknowledgement mechanisms.

b) "Classic" Ethernet also requires multiple devices to access a shared communication channel. It uses the CSMA/CD protocol. Devices listen to the channel before transmitting, and if a collision is detected, they wait for a random backoff period before retransmitting. CSMA/CD allows devices to contend for access to the channel, ensuring fairness among multiple devices.

c) "Switched" Ethernet with full duplex transmission does not require devices to access a shared communication channel. In full-duplex mode, each device has a dedicated and separate transmit and receive path, allowing simultaneous bi-directional communication. Collisions are eliminated, as each device can transmit and receive data independently.