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Master Course Computer Networks

Homework 2
(submission until November 19th into INBOX located in front of 03.05.052)

Note: Subproblems marked by * can be solved without preceding results.

Media Access Control (CSMA CD and the Binary Exponential Backoff)

Given a network with n stations attached to hub (see Figure 1). Let's assume time is slotted and each slot lasts for 512 bit, the transmit rate is 100 Mbit/s, and CSMA/CD is being used as MAC protocol, i. e., any node that currently has data to be sent will start sending at the next time slot it detects an idle medium.

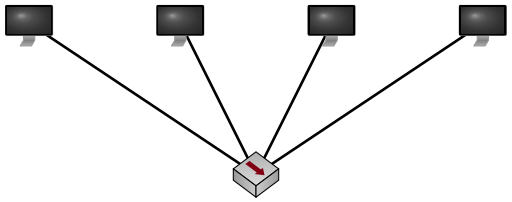

Figure 1: Sample topology

In essence, the situation described above ressembles a simplified variant of FastEthernet.

a)* What is the reasoning that FastEthernet requires a minimum frame length of 64 B?
Hint: Think about serialization delays and signal propagation.

b) Why is it impossible that one node starts transmitting at time slot t and another node still detects an idle medium at $t + 1$?

In case of collisions a binary exponential backoff is being used. After the k-th collision, each node draws uniformly distributed some $x \in \{0, 1, 2, \ldots, 2^k - 1\}$ and waits for x slot times before attempting to transmit again. As a simplification, we assume that any node is notified about a collision and re-draws x even if it was not involved in this collision, i. e., it was waiting due to a previous collision. Furthermore, we assume that all nodes have non-zero backlog, i. e., every node wants to transmit in the next possible time slot.

c)* Let X be the random variable that counts successive retransmits, i. e., $\Pr[X = k]$ is the probability for a successful transmission ~~in the k-th time slot after $k - 1$~~ after k successive collisions. Determine the mass function of X.

d) Use a CAS[1] and visualize the PMF of X in dependency of n and k.

e) What is the expectation of X for $n = 3$ (and $k \to \infty$)?

Classless Inter-Domain Routing **IPv4 Subnetting**

You are given the address blocks 131.159.20.0 / 22 and 131.159.36.0. / 24. Using these blocks, your task is to find a suitable subnet scheme fulfilling the requirements of Table 1.

Subnet	A	B	C	D	E
# IPs	300	300	15	40	4

Table 1: Number of required host addresses (including routers) for each subnet

a)* State the first and last address for each subnet. How many addresses per subnet can be used to address hosts?

b)* Given the two address blocks, why is it not possible to create one single subnet containing all addresses?

[1] TUM students of the faculties for Computer Science and Electrical Engineering have free access to MATLAB (see https://matlab.rbg.tum.de). It is also preinstalled on the "Sunhalle" accounts. But you may use any other CAS of your choice if you wish.