S-72.3235 Network Access 3 cr

Exam 25.10.2010
Part A: Closed book tasks (3 tasks)

The examination consists of two parts. When you have done the tasks in Part A (closed book) you should give the answers to the exam supervisor, and then you will get Part B (open book) including 4 problems, out of which 3 best will be graded. You are allowed to use any literature that you feel useful in part B.

You can decide yourself the time you spend with each part, but the total exam duration is 3 h. You can leave the exam room 1 hour after the exam start.

You can answer in Finnish, Swedish or English.

Which homework problems (if any) you have submitted?

Problem A.1
Describe briefly the following concepts/abbreviations/standards

a) Truncking loss (2 p)
b) Generalized TDMA (2 p)
c) ETSI HIPERLAN EY-NPA (2 p)
d) Collision resolution (2 p)
e) Hidden and exposed node problem (2 p)

Problem A.2

a) Compare conflict free MAC with fixed and dynamic resource allocation to contention based MAC. How do the protocols perform as function of load (offered traffic)? (5 p)
b) Mention at least two real-life applications of the ALOHA protocol. (2 p)
c) The ALOHA protocol is known to be unstable. What methods can be utilized to improve its performance in high load conditions and what are their limitations? (3 p)

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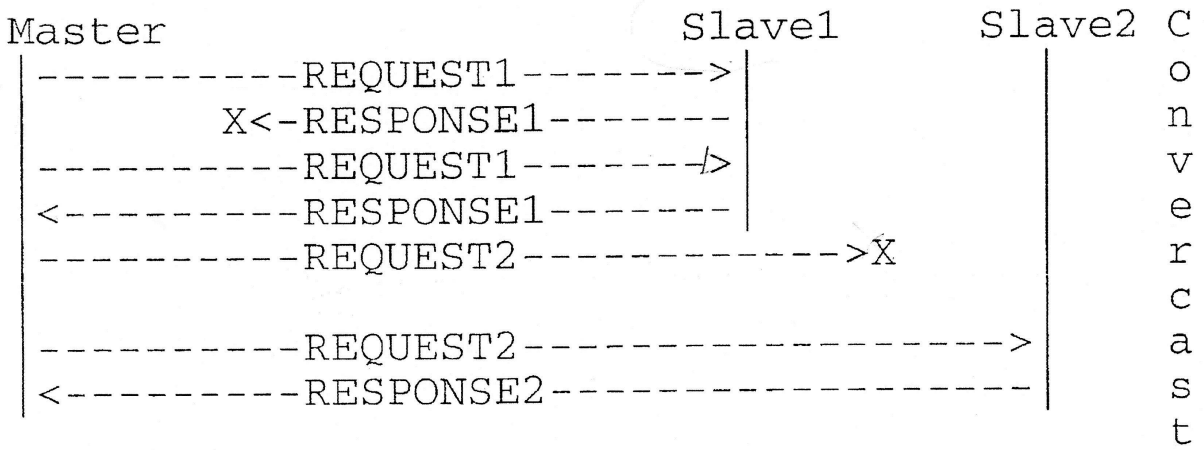
Exam 25.10.2010
Part B: Open book tasks (4 tasks)

There are four problems in this part, out of which three best are taken into consideration in the grading.

You are allowed to use any literature that you feel useful.

You can answer in Finnish, Swedish or English.

Problem B.1
Consider Master-Slave Polling protocol, in which a master node polls sequentially N slave nodes. The protocol operates such that the master sends a request packet of length T and the slave replies with response packet of length T. Master keeps polling a particular slave until it receives the response packet successfully. Example signal flow is shown below:



The wireless channel is prone to errors. Let $\tilde{a}_n$ denote the number of attempts needed to poll a given slave n. Hence one round of polling all the N nodes takes

$$\tilde{d} = 2T\sum_{n=1}^{N}\tilde{a}_n$$

seconds. The probability generating function of $\tilde{a}_n$ is $A(z)$ and the first moment is $\bar{a}$.

a) Determine the Laplace-transform of the probability density (pdf) of the convergast time $D(s)=\mathrm{E}\{e^{-sd}\}$. (5 p)

b) Determine the throughput S of the protocol (5 p)

Problem B.2

Consider non-persistent slotted CSMA protocol. The sensing slot equal to the propagation time τ. Packets of length T arrive according to Poisson process with intensity g packets per time unit. Consider the case of imperfect carrier sensing procedure that has miss probability p_m and false alarm probability p_f. That is, the carrier sensing fails to detect ongoing transmissions with probability p_m and detects non-existing transmission with probability p_f. Determine the throughput S of the protocol.

(10 p)

Problem B.3

Consider the IEEE 802.11 DCF CSMA/CA protocol with binary exponential backoff (BEB) and RTS-CTS handshake.

a) What are the merits and shortcomings of the BEB? How does the performance relate to protocol that would use optimal back-off window size? (4 p)

b) What are the merits and shortcomings of the RTS-CTS handshake procedure? For what applications it would be suited for? (3 p)

c) Assume that the protocol is used in radio environment that has high packet error probability. How do the packet errors affect the MAC protocol performance? (3 p)

Problem B.4

Consider a system with C orthogonal frequency channels. The transmitter can transmit using only one channel at the time and the receiver needs to select which channel to listen prior to the actual packet transmission. Suggest a contention based MAC protocol that is able to utilize all the C channels and discuss its performance. You can assume Poisson arrivals with intensity g packet per time unit.

(10 p)