S-72.3235 Network Access 3 cr

Exam xx.yy.2008
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.

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

a) Non-pre-emptive and pre-emptive priority (2 p)
b) Generalized TDMA (2 p)
c) MSAP protocol (2 p)
d) Non-persistent and p-persistent CSMA (2 p)
e) Hidden and exposed node problem (2 p)

Problem A.2
Consider the use of slotted ALOHA protocol in wireless channel. Discuss its throughput, stability and effects of capture phenomenon on its performance. Discuss also the practical applications of the protocol. (10 p)

Problem A.3
Will you give course feedback?
(By giving feedback you obtain one additional point)

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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.

Problem B.1
Consider a TDMA system. An user generates messages according to Poission process. The message size is uniformly distributed between 1 and *K* MAC-layer SDUs (packets). The channel is subject to fast fading and noise. A MAC layer packet is lost in the channel with probability *p*. Assume that stop-and-wait ARQ protocol is utilized on the MAC layer for ensuring error free communications. Consider the case, in which the receiver can signal NAK/ACK message before the start of the next frame.

a) Determine the expected transmission time of the message in slots (4 p)
b) Determine the generating function of the service time (4 p)
c) Determine the Laplace-transform of the message delay distribution (2 p)

Hint: $\sum_{k=0}^{\infty} p^k = \frac{1}{1-p}$ $\sum_{k=1}^{\infty} k p^{k-1} = \frac{1}{(1-p)^2}$ $\sum_{k=1}^{K} k = \frac{K(K+1)}{2}$

Problem B.2

Consider a medium access protocol for wireless personal area networks, in which the PAN coordinator transmits periodic beacon messages followed by contention free period of *M* slots. TDMA protocol is utilized during the contention free period wile CSMA is used during the contention period. The beacon period Tc=(*K*+*M*)T where *K* is an integer. Determine the normalized expected delay for a user using a dedicated time slot in the contention free period. Assume that packets of length T arrive according to Poisson process with intensity λ packets/time unit. The frame structure is illustrated in Figure 1.

(10 p)

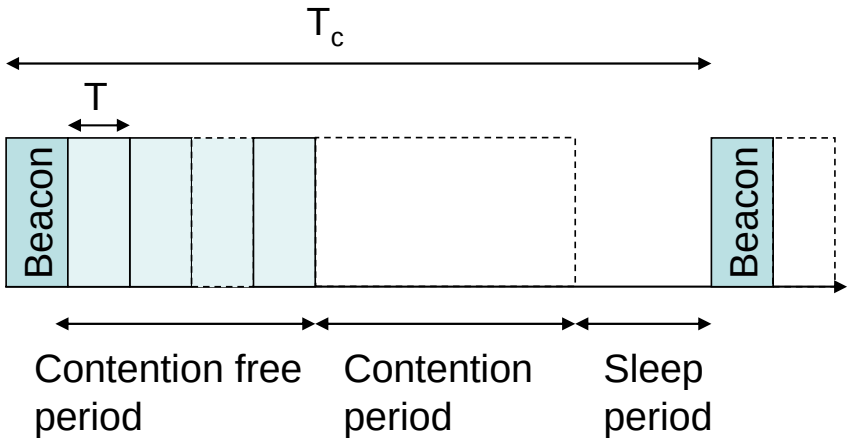

Figure 1. Frame structure

Problem B.3

Consider a slotted non-persistent CSMA protocol with RTS-CTS handshake mechanism. Consider the case in which packets arrive according to Poission process with intensity λ=1000 packets/second. Determine the throughput when T_DIFS= 34 μs, T_SIFS=27 μs, T_RTS=T_CTS=T_ACK=24 μs and T_Payload=157 μs and T_Header=20 μs.

(10 p)

Problem B.4

i)
Consider the IEEE 802.11e EDCF MAC protocol. Discuss its performance as a function of traffic load, fairness among users belonging to the same access category and service differentiation among the access categories. How well it can guarantee quality of service QoS? (7 p)

ii)
How could HCF be utilized to provide absolute guarantees for QoS? What are the drawbacks / difficulties related to HCF? (3 p)