16.36: Comm. Sys. Engineering   Date Issued: May 6
Problem Set No. 10   Date Due: Never

You may assume for all of these problems that packet arrivals are Poisson distributed and packet
lengths are fixed.

1) A group of N stations share a 56 kbps pure (unslotted) aloha channel. Each station has
one (NEW) packet arriving every 100 seconds and packets are 1000 bits long. What is
the maximum value of N that the channel can accommodate?

2) A slotted aloha system has packets (both new and retransmissions) arriving at a rate
of 50 per second. Packets take 40 ms to transmit.

a) What is G (packets per slot)?
b) What is the probability of success of during a slot?
c) What is the average number of slots per successful transmission?

3) Suppose you measure a slotted aloha channel and determine that 10% of the slots are idle.

a) What is the channel load G?
b) What is the system throughput in packets/slot?
c) Is the channel overloaded or underloaded?

4) You are to design a slotted ALOHA system with N users. Each user has a packet arriving
during a slot with some probability p. The probability that i users have a packet to send during a
slot is given by the Binomial distribution as,

$$P(i) = \binom{N}{i} p^i (1-p)^{N-i}$$

a) What is the probability that a collision occurs?
b) What is the Efficiency of the system (successful packets per slot)?
c) For what value of p is efficiency maximized?
d) For a system with 4 users, what is the value of p that maximizes efficiency and what is the
maximum efficiency?

5) 1000 nodes are connected to a 2000 meter long cable. Each node has to send an average of 30
new packets of 1000 bits each per second. The transmission rate is 100 Mbps. Which of the
following MAC protocols can be used: pure aloha, slotted aloha, CSMA/CD?

6) You build a 100 Mbps CSMA/CD network over a 3 km cable. The packets are 1000
bits long including 100 bits of overhead. What is the throughput of the system in information
bits per second?