COE 431

Computer Networks

Spring 2013

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Assignment I

# Problem I

1. Consider two hosts, A and B, connected by a single link of rate 40 Mbps. Suppose that the two hosts are separated by 2000 Km, and that the propagation speed across that link is 2x108 meters/s. Each data packet transmitted from the sender A to the receiver B is assumed to be 1000 bytes long. Suppose further that the acknowledgment sent by B to A for each correctly received packet is 10 bytes long. The sender A introduces 100 µs of processing delay per transmitted packet, while the receiver introduces 10 µs of processing delay per ACK. What is the round trip delay of this link?

1. Host A and Host B are participating in a VoIP session. Host A converts voice data from analog to digital at a rate of 64000 bps. As soon as A has converted 56 bytes, it sends the 56-byte long VoIP packet to Host B, where host B converts the data back to analog and plays it. The hosts are connected by a single 2 Mbps link with a propagation delay of 10 ms. How much time elapses between the time a bit is created (from the original analog signal on A) until the time it is decoded (as part of the analog signal on B)?

**Problem II**

Consider sending a large file of F bits from Host A to Host B. There are two links between A and B, and the links are uncongested (that is, no queueing delay). Host A segments the file into segments of S bits each and then adds 40 bits of header to each segment, forming packets of length L=40+S bits. Each link has a transmission rate of R bps. Find the value of S that minimizes the delay of moving the file from Host A to Host B. Disregard the propagation delay and assume that F is divisible by S. (Hint: express the end to end delay experienced by the file as a function of S, take its derivative, and then find the value of S that causes the derivative to be zero).

**Time at which the 1st packet is received at destination = . After this, one packet is received at destination every sec. Thus, the delay in sending the whole file is =**

**To calculate the value of S that leads to minimum delay:**

# Problem III

Suppose users share a 1 Gbps link. Also, suppose each user requires 10 Mbps when transmitting, but each user is idle 60% of the time.

1. When circuit switching is used, how many simultaneous users can be supported?

**1Gbps/10Mbps = 100 users**

1. For the remainder of the problem, suppose packet switching is used. Find the probability that a given user is transmitting?

**Prob = 1 – 0.6 = 0.4**

1. Suppose that there are 400 users. Find the probability that at any given time, there would be n simultaneously active users.

1. Find the probability that there are 3 or less users transmitting at the same time.

**Problem IV**

Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.

1. Assuming no other traffic in the network, what is the throughput for the file transfer?

**Throughput = 500 kbps**

1. Suppose the file is 4 million bytes long. Roughly, how long will it take to transfer the file to Host B?

**Delay = (4x8x106)/(500x103)=64s**

1. Assuming now that 5 simultaneous downloads are traversing the second link, namely the one with rate R2, what is the throughput in this case for the file-transfer from Host A to Host B? How long will it take to transfer the file to Host B under this condition?

**Throughput = 400 kbps. Delay = (4x8x106)/(400x103) = 80 s**