Total time: 50 minutes

Name: ______________________

WPI username: ____________________

CS 3516 – Mid-Term Exam- Sample Questions - A Term, 2018

This exam is worth **23 points** points. Please write concisely, using only the space provided below. Extremely long answers to questions will be interpreted as guessing and will be penalized. Please specify the question/sub-question you are answering.

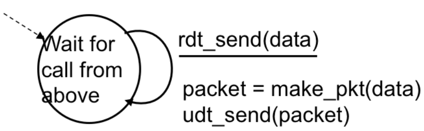
1. (1 point, 2 minutes) **Using one or two sentences, define what is a protocol.**

Protocols define format, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt. **(1 point)**

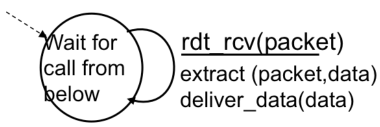
2. (1 point, 2 minutes) **Using one or two sentences, describe what is queuing delay?**

The queuing delay is the time a packet waits in a queue until it can be executed. It is a key component of network delay, which may be caused by delays at the originating switch, intermediate switches, or the call receiver servicing switch **(1 point)**.

3. (2 points, 3 minutes) **Describe the Finite State Machine of RDT 1.0.**



sender



receiver

4. (12 points, 25 minutes) **Jupiter and Saturn are two end hosts on the Internet. Consider the following topology, link capacity and other specifications:**

. Saturn, the destination host, is 5 hops away from Jupiter, the source, i.e., there are 4 intermediate switches: Jupiter – R1 – R2 – R3 – R4 – Saturn.
. The distance between any two adjacent nodes is 300m.
. The signal propagation speed is 3×10^5 meters per second.
. The message size is 1Mbits (1M = 10^6).
. The maximum packet size is 1Kbits (1K = 10^3). The header size is negligible. Note the message should be divided to packets, with the maximum packet size.
. The transmission rate of each link is 1Mbps.
. The queuing delay and the processing time for routing & forwarding decision at each node can be ignored.
. Keeping in mind that each switch uses store-and-forward packet switching. Hence, when message segmentation is used, we safely assume that the time at which the 2nd packet is received at the first switch is equal to the time at which the 1st packet is received at the second switch.

Please answer the following questions. (Note please make sure to illustrate your calculations clearly; you may receive partial credits even if your final answer is incorrect.)

(a) (6 points) The end to end delay in delivering the message (from Jupiter to Saturn) using packet switching with message segmentation.

By message segmentation, the message is divided into 1Mbits/1kbits=1000 packets. Time to send 1st packet from source host to first packet switch includes propagation delay d_p and transmission delay d_t, where d_t =

1kbits/1Mbps = 1ms, and $d_p = 3\times100m/(3\times10^5) = 1ms$. Thus the total delay from source host to first packet switch is $d = d_t + d_p = 2ms$.
Time at which 2nd packet is received at the first switch = time at which 1st packet is received at the second switch = 2 × 2ms = 4ms.
Time at which 1st packet is received at the destination host = 5hops × 2ms = 10ms.
After this, every 2ms one packet will be received at destination host; thus time at which the last (1000th) packet is received = 10ms + 999 × 2ms = 2.008s.

(b) (6 points) Consider sending the message without message segmentation. What is the total time to move the message from source host to destination host? Compare this result with your answer in part (a) and comment.

Time to send message from source host to first packet switch includes propagation delay d_p and transmission delay d_t, where d_t = 1Mbits/1Mbps = 1s, and $d_p = 300m/(3 \times 10^5) = 0.001s$. Thus the total delay from source host to first packet switch is $d = d_t + d_p = 1.001s$. With store-and-forward switching, the total time to move message from source host to destination host dtot = 1.001s × 5hops = 5.005s. It can be seen that delay in using message segmentation is significantly less.

5. **(7 points) DNS and Locality-Aware Load Balancing**

(a) (2 points) Web services such as Google have employed DNS to perform locality-aware load balancing. For example, when you send a search query to www.google.com, Google will use the DNS queries to figure out that you likely reside in Worcester, and respond with an IP address of a (front-end) server that is close to you (say, located in Boston metro area) to handle your search query. Suppose that you access google.com through your local DNS server, describe in your own words how Google can use DNS queries to determine the approximate location of a user.
(Here you can assume that given an IP address, Google can figure out where the machine with that IP address is approximately located (see e.g., www.maxmind.com).)

DNS servers can only see the IP address of the LDNS, instead of the IP of the user. Then, an IP address of a google web server that is geographically closer to the LDNS is returned to the user. (1 point)
Usually, the user is close to its LDNS, thus using the address LDNS, Google can identify the approximate location of the user. (1 point)

(b) (5 points) Given the above assumption that given any IP address, Google can figure out where the machine with that IP address is approximately located, why doesn't Google simply use the IP address of your machine (as opposed to the IP address of your local DNS server) to determine where you are located?

In processing the DNS resolution, the users have to send DNS queries via LDNS servers. Thus, Google can only see the IP address of the LDNS, and the user's IP address is invisible to Google.