###### *CSE 473 – Introduction to Computer Networks John DeHart*

Lab 4 Report

##### *Your name. Due 11/9/2015 1*

*Part A*. (20 points)Paste a copy of the completed source code for *Rdt* below. Highlight your changes by making them **bold**(you may omit sections of the original program that contain no added code). Remember to also place a complete copy in the repository before you make your final commit.

paste your code here

*Part B.* (10 points) Use the provided *script0* to test your client and server on a single computer. You may do this testing on any Unix (including MacOS) or Linux computer (shell.cec.wustl.edu or onl.wustl.edu). All you need to do is type

./script0

in the folder that contains all your Java code. Paste a copy of the output below.

your output here

1. Based on the report output, how many of the packets sent by the client were retransmissions? How many of these were caused by the discarding of the data packets and how many were caused by the discarding of acknowledgments?
2. What was the specified run length for this test? How does that compare to the actual time it took to transfer all the packets?

*Part C*. (5 points) Use the provided *script1* to test your client and server on two computers in ONL, using the provided ONL configuration. To run the script, just type

./script1

in the folder that holds your Java classes and the scripts. Paste a copy of the output below.

your output here

*Part D*. (15 points) Use the provided *script2* to run this next test. Paste a copy of the output below. Also, paste a screen capture showing the two monitoring windows labeled “from/to hosts” and “inter-router traffic”. Make sure your screenshot shows the curves for the entire duration of the script run, and that the text labels are large enough to read on a printed copy. You will find it easier to do the screen capture if you first “stop” the chart by using the “Stop” menu item in the Options menu (to restart the chart, select this item again).

your output here

screenshot here

Answer the following questions, based on your the results of this test.

1. What was the specified run length for this script? What was the specified packet sending rate for the client and server? (You will need to examine the script in order to answer this question.)
2. How long did it take to deliver all the packets? What was the effective packet delivery rate from the client to the module at the server?
3. How many packets did the *Rdt* module at the client send (including retransmissions but excluding acks)? How many of these were retransmissions? What was the average sending rate for the client, including both retransmissions and acks?

*Part E.* (20 points) In this part you will be using the provided *script3* to answer some questions about the performance of your protocol when run from a client at *h4x2* to a server at *h7x1* (in this script, the server does not send any data packets). The script takes several arguments, whose values you will need to specify, when running the experiments needed to answer the questions below.

1. Determine the round-trip delay (rounded to the nearest ms) between *h4x2* and *h7x1* using *ping* (make sure you are using the correct addresses, so that your packets go through your experimental network, and not the ONL control network). What value did you get? Based on this, if your protocol is configured with a window size of 1 packet, what is the maximum rate at which it can send packets? What is the smallest window size that would allow it to send 1000 packets per second? Note that later answers in this section depend on your ability to answer this part correctly, so make sure you understand this.
2. In this part, you will run *script3* with a timeout value of 0.6 seconds, a drop probability of 0 and a delta value of .004. What sending rate does this correspond to? Choose the smallest window size that is consistent with this sending rate and paste a copy of the output of your run below. Were the packets actually delivered to the destination at the specified sending rate?
3. In this part, you are to determine the maximum rate at which you can send traffic between the two routers. Determine the maximum sending rate by decreasing the delta value, while increasing the window size to match (keep the timeout value at 0.6 and the discard probability at 0). Observe the packet rate on the inter-router link using the monitoring window and stop decreasing delta when you no longer get any increase in the peak transfer rate observed. At this point, your sending rate is being constrained by the link’s ability to forward packets. Paste a copy of the script output from the run that achieves this maximum packet rate. Also, paste a screen shot showing all three of the monitoring windows from this run.

your output here

screenshot here

What was the maximum packet sending rate you were able to achieve? What was the specified sending rate? Did you observe any queueing at the inter-router link?

1. Run *script3* with a windows size of 300, timeout of 0.6, discard probability of 0 and a delta of .00015. Now run it again with window sizes of 400, 450 and 500. For each of these runs note the maximum length of the queues at the inter-router link. What are these maximum queue lengths?

How does the throughput compare for these four cases?

Explain the observed results as best you can. Hint: you may want to examine the queue table at port 1 of router 1.