CSCI 4171/CSCI 6704
NETWORKS
Assignment No. 1
Date Given: Sunday, September 18, 2016
Due: Monday, October 3, 2016, 11.55 p.m. (5 minutes to midnight)
Submission: On dal.ca/brightspace

1. <Experimental study of traceroute>

The traceroute program (tracert in Windows) allows you to send test packets to a given location and collect statistics on the route and time.

a. Read and understand the documentation of traceroute (you can get the documentation from the web) and answer the following questions:
How does the traceroute program work?
What are the parameters generated by the basic traceroute command?
What are some of the important options in the traceroute command (such as –f, -g, etc.) and how can they be used in network analysis?
Give brief examples wherever appropriate.

b. Run a series of experiments using traceroute (you can use the traceroute or tracert command or get an online traceroute tool) to approximately 25 known web servers and collect the traceroute reports. Based on your experiments,

- Plot a graph showing the one-way transit time over the Internet a function of physical distance between the source and the destination. Here geographical distance refers to nautical distance (also called distance "as the crow flies"). There are many websites such as http://www.infoplease.com/atlas/calculate-distance.html that have geographical distance calculators with an extensive database of main cities.
- Plot another graph showing the number of hops vs. physical distance.
- Report any other interesting observations that you make. (Is the one-way transit time directly proportional to distance? Is the number of hops directly proportional to distance?)

Note 1: If you are unable to connect to some servers because of their rejection of traceoute packets, you can collect the statistics up to the last router that replied to the traceroute message.
Note 2: traceroute gives you the round-trip time. You need to take the average of the three round trip times for the last hop and divide by 2 to get the one-way transit time.

2. <Research question> The Center for Applied Internet Data Analysis (CAIDA) (www.caida.org) conducts a number of research studies and projects in the areas of Internet topology, Internet traffic measurements, security, routing, etc. Visit their website and investigate one research area or project or tool. Summarize its goals, methodology, and some of their results. (Approximately 2 pages typewritten, 11 point font size, single line spacing). You must write in your own words as far as possible. If you use a sentence or a paragraph verbatim from a website, you must enclose it within "" and give the reference. If you paraphrase the content in your own words, you need not enclose it in "". However, you still need to provide the reference. Use proper citation format (IEEE or ACM style).

<Short snappers: Bandwidth delay problems>

3. Consider two hosts, A and B, connected by a single link of bandwidth R bits per sec. Suppose that the two hosts are separated by m meters, and suppose the propagation speed along the link is s meters/sec. Host A is to send a packet of size L bits to Host B. Ignore the processing and queuing delays. Suppose s = 2.5 X 10^8 , L = 100 bits, and R = 28 kbps. Find the distance m so that the propagation delay equals transmission delay.

4. Consider sending a packet of F bits over a path of Q links. Each link transmits at R bps.
   a. Suppose the network is a virtual-circuit packet-switched network. Let the VC set up time be t_s seconds. Suppose that the source adds a total of h bits of header to each packet. How

long does it take to send the packet from source to destination? Ignore queuing, propagation and any other processing delay.

b. Suppose the network is a datagram packet-switched network and connectionless service is used. Each packet has 2h bits of header. How long does it take to send the packet? Ignore queuing, propagation and any other processing delay.

5. Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of R = 2 Mbps. Suppose the propagation speed over the link is $2.5*10^8$ meters/sec. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one big message. How long does it take to send the file?
   Suppose now the file is broken up into 20 packets each with each packet containing 40,000 bits. Suppose the receiver acknowledges each packet and the transmission time of an acknowledgement packet is 100 ms. Finally, assume that the sender cannot send a packet until the preceding one is acknowledged. How long does it take to send the file?

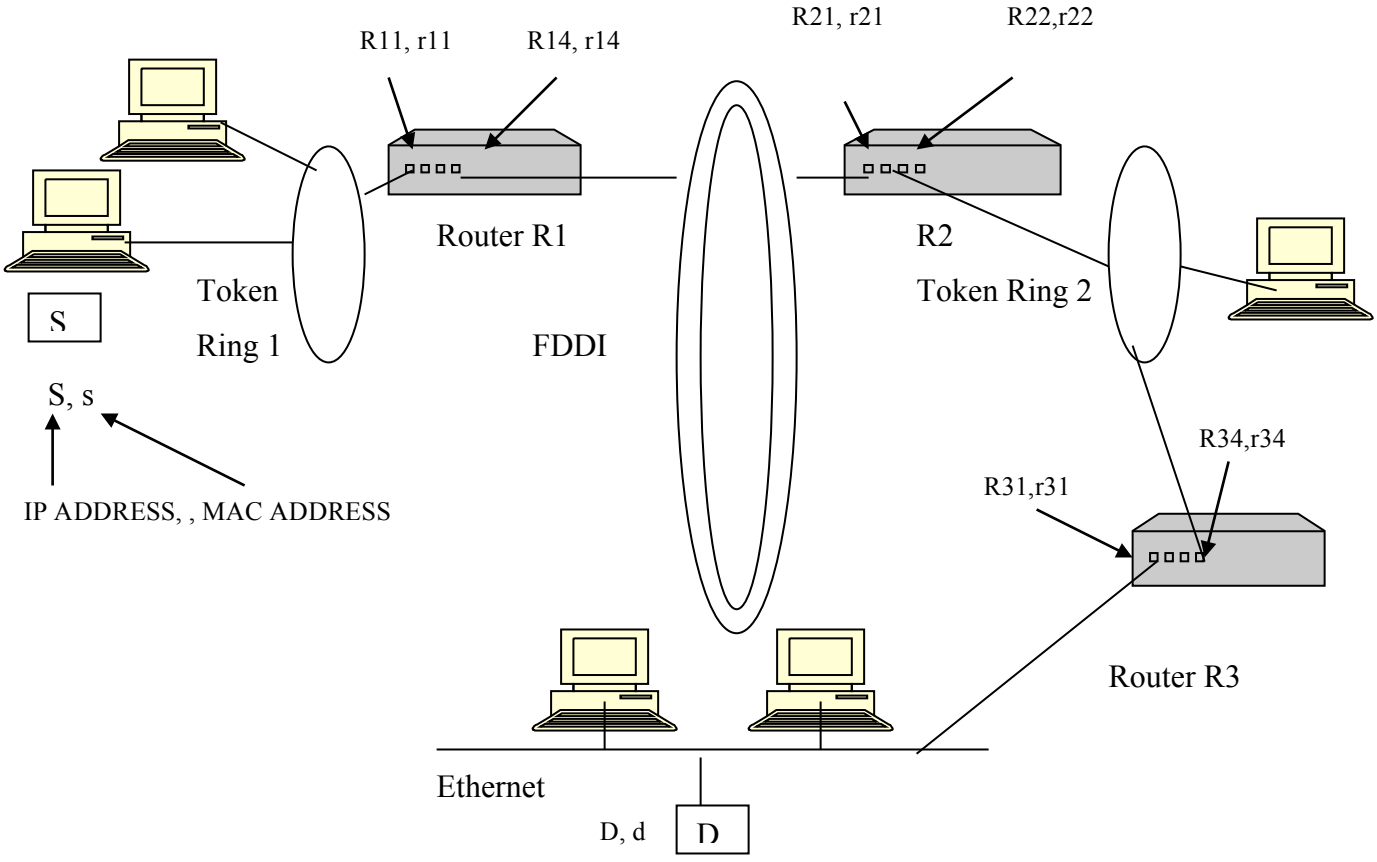
6. Calculate the total time required to transfer a 1.5 MB file in the following cases, assuming RTT of 80ms, a packet size of 1KB and an initial 2XRTT of "handshaking" before it is sent.
   a) The b/w is 10Mbps, and the data packets can be sent continuously.
   b) The b/w is 10Mbps, but after we finish sending each data packet, we must wait one RTT before sending the next.
   c) The link allows infinitely fast transmits, but limits bandwidth such that only 20 packets can be sent per RTT zero transmit time as in (c), but during the first RTT, we can send one packet during the 2nd RTT we can send 2 packets, during the 3rs we can send 4 = 23-1 and so on.

<Short snapper: Addressing problem>

7. The following figure depicts an internetwork. The IP and the MAC addresses of the significant interfaces are shown. An FTP connection is set up from S to D (S is the client and D is the server) and a SSH connection is set up from D to S (D is the client and S is the server). Write the formats of the following message entities, showing the port addresses, IP addresses and MAC addresses using the format:

Source MAC address	Destination MAC address	Source IP address	Destination IP address	Source port address	Destination port address

a. Frame on Token Ring1 – FTP message from S to D.
b. Frame on FDDI – FTP message from S to D.
c. Frame on Token Ring 2 – FTP message from S to D.
d. Frame on Ethernet – FTP message from S to D.
e. Frame on Token Ring 1 – FTP message from D to S.
f. Frame on FDDI – FTP message from D to S.
g. Frame on Token Ring 2 – FTP message from D to S.
h. Frame on FDDI – SSH message from S to D.
i. Frame on Token Ring 2 – SSH message from S to D.
j. Frame on Ethernet – SSH message from S to D.
k. Frame on Token Ring 1 – SSH message from D to S.
l. Frame on FDDI – SSH message from D to S.


R11, r11
R14, r14
R21, r21
R22,r22
Router R1
R2
Token
Ring 1
FDDI
Token Ring 2
S
S, s
IP ADDRESS, , MAC ADDRESS
R34,r34
R31,r31
Router R3
Ethernet
D, d
D