CS 3873: Net-Centric Computing

Assignment 1: Network Overview

Student Name: __Adrian Freeman_ Student Number: _3661616_

[Mandatory] Declaration: “I warrant that this is my own work.”

Signed by _Adrian Freeman___

(You can type in your name as your signature.)

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1) What are the five layers in the Internet protocol stack? Which layers does a router process?

The five layers in the Internet protocol stack are as follows:

1. Application Layer
2. Transport Layer
3. Network Layer
4. Data Link Layer
5. Physical Layer

The router processes layers 3, 4, and 5.

2) How long does it take a packet of length 2300 bytes to be sent over a link of distance 2500 km, propagation speed 2.5x10^8 m/s, and transmission rate 100Mbps? Consider the total of the propagation delay dprop and the transmission delay dtrans. More generally, how long does it take a packet of length L to be sent over a link of distance d, propagation speed s, and transmission rate R bps?

Dtrans = L/R = 2300bytes*8bits / 100Mbps*10^6 bits = 18400bits/10^8bits/s = 0.000184 seconds

Dprop = m/s = 2500km * 1000m / 2.5*10^8 m/s = 2500000m / 2.5*10^8 m/s

= 0.01 seconds

Dtrans + Dprop = 0.000184s + 0.01s = 0.010184s

It would take a packet of length 2300 bytes 0.010184 seconds to travel over a link 2500 kilometers long with a propagation speed of 2.5x10^8 and a transmission rate of 100Mbps

3) Suppose end system A wants to send a large file to end system B. The path from host A to Host B has three links, of rates R1=10 Mbps, R2=25 Mbps, and R3=20 Mbps.

   a) Assuming no further traffic in the network, what is the throughput for the file transfer?

      The throughput would be 10Mbps as it is the slowest speed

   b) Suppose the file is 200 MB. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?

      200MB*8bits = 1600Mbits

      1600Mbits/10Mbps = 160 seconds

      it would take the file 160 seconds to transfer to Host B through the throughput.

   c) Repeat (a) and (b), but now with R1 reduced to 5 Mbps.

      a) Assuming no further traffic in the network, what is the throughput for the file transfer?

         The throughput would be 5Mbps as it is the slowest speed

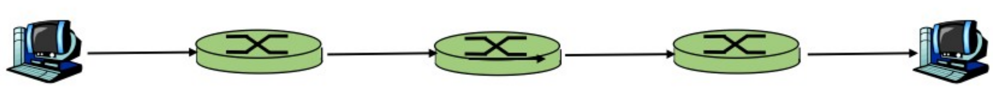
      b) Suppose the file is 200 MB. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?

         200MB*8bits = 1600Mbits

         1600Mbits/5Mbps = 320 seconds

         It would take the file 320 seconds to transfer to Host B through the throughput

4) Assume processing delay and propagation delay are very small and negligible. An end-to-end path in the following figure are only used by a pair of hosts A and B. Suppose A is sending 100 packets to B over this path. Each packet contains 2000 bytes. Suppose the data rate of each link is R = 100 Mbps. Calculate the total end-to-end delay (de2e) for sending all the packets from Host A to Host B.



Dtrans = L/R = 2000bytes*8bits / 100Mbps * 10^6bps = 16000bits / 10^8bps = 0.00016 seconds

De2e = (N + M – 1) * de2e = (4links + 100packets – 1packet) * 0.00016 = 103 * 0.00016 = 0.01648 seconds

The total end-to-end delay for sending 100 packets of size 2000 bytes each is 0.01648 seconds

5) Consider 2 hosts, A and B, connected by a single link of R bps. Suppose that the two hosts are separated by m meters, and the propagation speed along the link is s meters/sec. Host A is sending a number of packets sequentially to Host B. Each packet contains L bits. Consider only the transmission delay dtrans and the propagation delay dprop.

   a) Suppose host A begins to transmit the first packet at time t = 0. At time t = dtrans, where is the last bit of the packet: still at host A (including just sent out); in the middle of the link between A and B; or have arrived at host B?

      The last bit of the packet would be just transmitted onto the link, so it is still technically at host A.

   b) Suppose that dprop is greater than dtrans. At time t = dtrans, where is first bit of the first packet: still at host A (including just sent out); in the middle of the link between A and B; or have arrived at host B?

      Since dprop is the time to reach host b, at time dtrans, since dtrans is less than dprop, the first bit of the packet would still be propogating in the middle of the link between host A and B

   c) Suppose s = 2.5 x 10^8 m/s, m = 500 meters, L = 2 kB, and R = 10 Mbps. When will the first bit of the second packet arrive at Host B? (Hint: Host A only begins to send the second packet after the first packet has been transmitted onto the link.)
      dtrans = 2*8*10^3 / 10*10^6 = 16000bits / 10000000bits/s = 0.0016s

      dtrans for 1 bit = 1bit/10000000bits/s = 0.0000001s

      dprop = 500m / 2.5*10^8m/s = 500m / 250000000m/s = 0.000002s

so it takes dtrans time to transmit the entire packet onto the link, so 1.6ms then the next packet begins to transfer, which takes 0.0001ms. We can omit the dprop for the first packet since that will be transferred ahead of this one, so the total should be 1.6ms + 0.0001ms + 0.002ms = 1.6021ms

It will take 1.6021ms for the first bit of the second packet to arrive at Host B

Unit	Abbreviation	Value
Kilobyte	kB	10^3 bytes
Megabyte	MB	10^6 bytes
Gigabyte	GB	10^9 bytes
Terabyte	TB	10^12 bytes

Unit	Abbreviation	Value
Kilobits/s	kbps, kbit/s	10^3 bits/s
Megabits/s	Mbps, Mbit/s	10^6 bits/s
Gigabits/s	Gbps, Gbit/s	10^9 bits/s