Ch1 P10. Find end-to-end delay:

Link1:

D1, s1, R1

Link3:

D3, s3, R3

Link2:

D2, s2, R2

Destination

Src: A

End to end delay = processing + queueing + transmission + propagation

* Processing delay = 2.dproc (one at each packet switch)
* Queueing delay = 0
* Transmission delay: time to transmit packet onto link

= =

* Propagation delay: time needed to send the packet through the link

= =

.˙. End to end delay = 2\*dproc

Substituting values for Part 2:

Converting time to milliseconds, bytes to bits, distances to km

End to end delay =

Ch1 P13. Queueing delay:

1. For the first packet, the queueing delay is 0. The 2nd packet has to wait for L/R time units while the 1st packet is being served, the 3rd packet has to wait for 2\*L/R time units for packets 1 and 2 to be served. In general, a packet waits for (N-1)\*L/R time units. Adding them up and taking the average over N, we get:

Average Queueing delay

… using

The transmission time is for N packets. So when the next batch of N packets arrive, they see an empty buffer. .˙. the average delay is effectively the average delay within the first set of N packets, which is calculated to be above

Ch1 P21. Throughput:

If the server can use only one path to send data to the client:

* Path1 throughput = min(R11, R21, R31… RN1)
* Path2 throughput = min(R12, R22, R32… RN2)

.˙. Max throughput = max (min(R11, R21, R31… RN1), ….. min(R1M, R2M, R3M… RNM))

But the performance would be better if the server can use all M paths:

Throughput = (R1k, R2k, R3k… RNk)

Ch1 P23. Bottlenecks:

1. If the 1st link is the bottleneck:

The second packet waits for the transmission of the first packet at the first link for time units, which is the inter-arrival time at the destination

1. If the 2nd link is the bottleneck:

We need to consider 2 time delays

1. T2 = 2nd packet arriving at the 2nd link
2. T1 = 1st packet completely placed on the 2nd link

Since Rc < Rs, T1 > T2 i.e., the second packet gets queued at link 2.

Now if the 2nd packet is sent after T secs, to ensure no queueing, we need:

T2 + T >= T1

i.e.,

.˙. min

Ch1 P29. Delays:

… (data from <http://searchmobilecomputing.techtarget.com/definition/geostationary-satellite)>

1. Propagation delay = 149 msec
2. BW-delay product bits
3. For continuous transmission, we must have the traffic intensity = 1

i.e.,

.˙.

On verifying, we see that x/R (=60 secs) > d/s (0.149 secs), so the deciding factor is x/R.