CSC 41200 | Homework 1 Solutions | Spring 2005

CSC Dept. CCNY | Instructor: T. Rahman

*Review Question 9:*

At time $t_0$ the sending host begins to transmit. At time $t_1 = L/R_1$, the sending host completes transmission and the entire packet is received at the router (no propagation delay). Because the router has the entire packet at time t1, it can begin to transmit the packet to the receiving host at time t1. At time $t_2 = t_1 + L/R_2$, the router completes transmission and the entire packet is received at the receiving host (again, no propagation delay). Thus, the end-to-end delay is $L/R_1 + L/R_2$.

*Review Question 10:*

In a VC network, each packet switch in the network core maintains connection state information for each VC passing through it. Some of this connection state information is maintained to a VC-number translation table. (See page 25)

*Review Question 13:*

A tier-1 ISP connects to all other tier-1 ISPs; a tier-2 ISP connects to only a few of the tier-1 ISPs. Also, a tier-2 ISP is a customer of one or more tier-1.

*Review Question 14:*

A POP is a group of one or more routers in an ISPs network at which routers in other ISPs can connect. NAPs are localized networks at which many ISPs (tier-1, tier-2 and lower-tier ISPs) can interconnect.

*Problem 5:*

(a) The time to transmit one packet onto a link is $(L + h)/R$. The time to deliver the packet over Q links is $Q(L + h)/R$. Thus the total latency is $t + Q(L + h)/R$.

(b) $Q(L + 2h)/R$

(c) Because there is no store-and-forward delays at the links, the total delay is $t + (L + h)/R$.

*Problem 6:*

(a) $d_{prop} = m/s$ sec.

(b) $d_{trans} = L/R$ sec.

(c) $d_{end-to-end} = (m/s + L/R)$ sec.

(d) The bit is just leaving Host A.

(e) The first bit is in the link and has not reached Host B.

(f) The first bit has reached Host B.

(g) $m = \frac{L}{R}S = \frac{100}{28\times10^3}(2.5 \times 10^8) = 893$ km

*Problem 20:*

(a) Time to send message from source host to first packet switch $\frac{7.5\times10^6}{1.5\times10^6} = 5sec$. With store-and-forward switching, the total time to move message from source to destination is $5sec \times 3hops = 15sec$.

(b)Time to send $1^{st}$ packet from source to first packet switch $\frac{7.5\times10^3}{1.5\times10^6} = 1msec$. Time at which $2^{nd}$ packet is received at the first switch = time at which $1^{st}$ packet is received at the second switch = $2 \times 1msec = 2msec$.

(c) Time at which $1^{st}$ packet is received at the destination host $1msec \times 3hops = 3msec$. After this, every $1msec$ one packet will be received; thus time at which last ($5000^{th}$) packet is received: $3msec + 4999 \times 1msec = 5.002sec$. It can be seen that delay in using message segmentation is significantly less (almost 1/3).

(d) Drawbacks:

(i) Packets have to be put in sequence at the destination.

(ii) Message segmentation results in many smaller packets. Since header size is usually the same for all packets regardless of their size, with message segmentation the total amount of header bytes explodes.

*Problem 22:*
Time at which the $1^{st}$ packet is received at the destination $\frac{S+40}{R} \times 2sec$. After this, one packet is received at destination every $\frac{S+40}{R}sec$. Thus, delay in sending the whole file:

$$delay = \frac{S+40}{R} \times 2 + (\frac{F}{S} - 1) \times (\frac{S+40}{R}) = \frac{S+40}{R} \times (\frac{F}{S} + 1)$$

To calculate the value of $S$ which leads to the minimum delay,

$$\frac{d}{dS} delay = 0$$

$$\frac{F}{R}(\frac{1}{S} - \frac{40+S}{S^2}) + \frac{1}{R} = 0$$

So, $S = \sqrt{40F}$