Polytechnic University of Puerto Rico
Electrical and Computer Engineering & Computer Science Department
COE 4330, Section 81 – Computer Networks

Activity 1.2

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Completely answer all of the following questions.

1. Suppose there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the switch and between the switch and the receiving host are R1 and R2, respectively. If the switch uses store-and-forward packet switching, what is the total end-to-end delay to send a packet of length L? (Ignore queuing, propagation delay, and processing delay.) *2 points*

Because the switch uses store-and-foward packet switching, the packet must be fully received before being fowarded to the receiving host. This means that the end-to-end delay equals the sum of the transmission delays for both segments.

Transmission delay for the first segment (host to switch)

$$d_{trans,1} = \frac{L}{R_1}$$

Transmission delay for the second segment (switch to receiving host)

$$d_{trans,2} = \frac{L}{R_2}$$

$$d_{total} = d_{trans,1} + d_{trans,2} = \frac{L}{R_1} + \frac{L}{R_2}$$

2. A 3,000-byte packet is to be sent through a 3,000 km link. The link's propagation speed is 3×10^8 m/s, and the bandwidth is 3 Mbps.

   a. What is the propagation delay, **in milliseconds**? You must show all your work. *2 points*

$d_{prop} = \frac{d}{s} \rightarrow$ d = distance (3,000 km = $3 * 10^6$ m)
s = propagation speed ($3 * 10^8$ m/s)

$\frac{3 * 10^6 \text{ m}}{3 * 10^8 \text{ m/s}} = 10^{-2} \text{ s} =$ **10 ms**

   b. What is the transmission delay, **in milliseconds**? You must show all your work. *2 points*

$d_{trans} = \frac{L}{R}$ L = packet length in bits (1 byte = 8 bits, L = 3,000 * 8 = 24,000 bits)
R = bandwidth (3 Mbps = $3 * 10^6$ bps)

$\frac{24{,}000 \text{ bits}}{3 * 10^6 \text{ bps}} = 0.008 \text{ s} =$ **8 ms**

3. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 1,500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.

   a. Assuming no other traffic in the network, what is the throughput for the file transfer? You must show all your work. *2 points*

The throughput is determined by the link with the lowest bandwidth.

$R_1 = 1,500$ kbps

$R_2 = 2,000$ kbps (2 Mbps)

$R_3 = 1,000$ kbps (1 Mbps)

   b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B? You must show all your work. *2 points*

4 million bytes $= 4 * 10^6 * 8 = 32 * 10^6$ bits

$$\text{Time} = \frac{\text{File size}}{\text{Throughput}}$$

$$\frac{32 * 10^6 \text{ bits}}{1,000 * 10^3 \text{ bps}} = 32 \text{ seconds}$$