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CS 118 – Lab 1A

Homework 1

1. How long does it take a packet of length L bytes to propagate over a distance of 200 km? Does the delay depend upon the packet length and transmission rate?

$$distance = d = 200\ km = 200{,}000\ m$$
$$propagation\ speed = s = 2 * 10^8 \frac{m}{s}$$
$$transmission\ rate = R = 3\ Mbps = 3{,}000{,}000\ bps$$

$$transmission\ delay = \ t_{delay} = \frac{L}{R} = \frac{L * 8\ bits}{3{,}000{,}000\ bps} = 0.00266\ ms$$
$$propagation\ delay = s_{delay} = \frac{d}{s} = \frac{200{,}000\ m}{2 * 10^8 \frac{m}{s}} = 0.001\ s = 1\ ms$$
$$total\ time = t_{total} = t_{delay} + s_{delay} = 0.00266 + 0.01 = 1.00266\ ms$$

Delay does depend on packet length and transmission rate.

2. How long will it take to send 5 packets from A to B?

$$L = 1500\ bytes = 12{,}000\ bits$$
$$R = \ 10\ Mbps = 10{,}000{,}000\ bps$$
$$propagation\ delay = \ d_{prop} = 10\ ms$$

A	Node-1	Node-2	B	Time
5 4 3 2 1				0
5 4 3 2	1			L/R
5 4 3	2	1		2L/R
5 4	3	2	1	3L/R
5	4	3	2	4L/R
	5	4	3	5L/R
		5	4	6L/R
			5	7L/R

$$Delay_{A-B} = \frac{7L}{R} + 7d_{prop} = 7\left(\frac{L}{R} + d_{prop}\right) = 7\left(\frac{12{,}000\ bits}{10{,}000{,}000\ bps} + 10\ ms\right) = 7(1.2\ ms + 10\ ms)$$
$$= \ 7(11.2\ ms) = \ 78.4\ ms$$

3. Consider two hosts, A and B, connected by a direct link of rate $R = 4$ Mbps. Suppose that the two hosts are separated by 25,000 km, and suppose the propagation speed along the link is 2.5×10^8 m/s.

a. Calculate the bandwidth-delay product, $R \times d_{prop}$.

$$d_{prop} = \frac{25{,}000\ km}{2.5{\times}10^8 \frac{m}{s}} = \frac{25{,}000{,}000\ m}{2.5{\times}10^8 \frac{m}{s}} = 0.1\ s$$
$$R \times d_{prop} = 4\ Mbps * 0.1\ s = 400{,}000\ bits$$

b. Suppose we can modify the value of R, for what value of R is the width of a bit as long as the length of the link.

$$width\ of\ bit = \frac{25{,}000{,}000\ m}{400{,}000\ bits} = 62.5 \frac{m}{bits}$$
$$\frac{25{,}000{,}000\ m}{R \times d_{prop}} = 25{,}000{,}000\ m$$

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$$R = \frac{1}{d_{prop}} = \frac{1}{0.1} = 10\ Mbps$$

c. Derive the general expression of the width of a bit in terms of propagation speed s, the transmission rate R, and the length of the link m.

$$width\ of\ bit = \frac{m}{R \times \frac{m}{s}} = \frac{s}{R}$$

4. In this problem, we consider spending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64 kbps bit stream on the fly and then groups the bits into 48-byte packets. There is one link between Host A and B; its transmission rate is 3 Mbps and its propagation delay is 5 msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packets bits to an analog signal. How much time elapses form the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

$$time_{total} = time_{create} + time_{transmit} + time_{propagate} = \left(\frac{48 * 8\ bits}{64{,}000\ bps}\right) + \left(\frac{48 * 8\ bits}{3{,}000{,}000\ bps}\right) + 0.005\ s$$
$$= 0.011128\ s = 11.128\ ms$$

5. Consider the following string of ASCII characters that were captured by *Wireshark* when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message). The characters <CR><LF> are carriage return and the line-feed characters (that is, the italicized character string <CR> in the text below represents the single carriage-return character that was contained at that point in the HTTP header). Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /cs118/index.html HTTP/1.1<CR><LF>Host: gaia.cs.ucla.edu<CR><LF>User-Agent: Mozilla/5.0
(Windows;U; Windows NT 5.1; en-US; rv:1.7.2) Gecko/20040804 Netscape/7.2
(ax)<CR><LF>Accept:ext/xml, application/xml, application/xhtml+xml, text/html;q=0.9,
text/plain;q=0.8,image/png,*/*;q=0.5<CR><LF>Accept-Language: en-us,en; q=0.5<CR><LF>Accept-
Encoding: zip,deflate<CR><LF>Accept-Charset: ISO-8859-1, utf-8;q=0.7,*;q=0.7<CR><LF>Keep-Alive:
300<CR><LF>Connection:keep-alive<CR><LF><CR><LF>
```

a. What is the URL of the document required by the browser?

Host: gaia.cs.ucla.edu
Absolute path: /cs118/index.html
URL of document: http://gaia.cs.ucla.edu/cs118/index.html

b. Does the browser request a non-persistent or persistent connection?

Keep-Alive:300
Persistent.

c. What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

User-Agent: Mozilla/5.0
The browser type is needed in order for the server send the correct objects to clients based on the client's browser and version.

d. What is the IP Address of the host on which the browser is running?

The IP address of the host is not obtainable from the HTTP GET message.