CSE310 Written Homework #1

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1a) Time spent to get to first router: $t = \frac{8\ Mb}{2\ Mb/s} = \boxed{4s}$
Time spent in total: $4s \cdot 3\ links = \boxed{12s}$

1b) $\frac{1 \cdot 10^4\ bits}{2 \cdot 10^6\ bits/s} = \frac{1}{2 \cdot 10^2} s = \boxed{0.005s}$
The second packet will be fully received at the first switch at time $t = \boxed{0.01s}$

1c)

$$
\begin{aligned}
t &= \frac{(n+p+1)L}{R} \\
t &= \frac{(3+800+1) \cdot 10^4\ bits}{2 \cdot 10^6\ bits/s} \\
t &= \frac{8.04 \cdot 10^6\ bits}{2 \cdot 10^6\ bits/s} \\
t &= \boxed{4.02s}
\end{aligned}
$$

By utilizing message segmentation, the time taken to transmit the message is lowered by a factor of 3. This is because we are fully utilizing all links in the network as much as possible, instead of using one link at a time.

2a) $R = 2 \cdot 10^6\ bits/s$
$d_{prop} = \frac{link\ length}{propagation\ speed} = \frac{2 \cdot 10^7\ m}{2.5 \cdot 10^8\ m/s} = \frac{2}{25}\ s = \boxed{0.08\ s}$

$R \cdot d_{prop} = 0.08 \cdot 2 \cdot 10^6 = 0.16 \cdot 10^6 = \boxed{1.6 \cdot 10^5}$

2b) When the first packet is sent through the link, it spends 0.08 seconds in the link. During this 0.08 seconds, the link continues to accept bits at a rate equal to the bandwidth (2Mbps). So the total number of bits in the link is $0.08s \cdot 2 \cdot 10^6 b/s = \boxed{1.6 \cdot 10^5\ bits}$.

2c) The bandwidth-delay product is the maximum number of bits that can be in the link at any given time.

2d)$w_{bit} = \frac{m}{R \cdot d_{prop}} = \frac{2 \cdot 10^7\ m}{1.6 \cdot 10^5\ m/b} = \frac{200}{1.6} = \boxed{125\ m}$
If a bit is 125m wide, then a bit is a little more than twice as wide as a football field.

2e) $w_{bit} = \frac{m}{R \cdot d_{prop}} = \boxed{\frac{m}{R \cdot \frac{m}{s}}}$

3)

$$F = 1.5 \cdot 10^{10}\ bits$$
$$u_s = 3.0 \cdot 10^7\ bits/s$$
$$d_i = 2.0 \cdot 10^6\ bits/s$$

For client-server scenario: $D_{cs} = max\left(\frac{N \cdot F}{u_s}, \frac{F}{d_i}\right)$

N, the number of users, is represented on the left hand side, has values of 10, 100, and 1000. u, the upload speed, has values of $3 \cdot 10^5$, $7 \cdot 10^5$, and $2 \cdot 10^6$ and is represented on the bottom. All units in the table are seconds.

10	7500	7500	7500
100	50000	50000	50000
1000	500000	500000	500000
	$3 \cdot 10^5$	$7 \cdot 10^5$	$2 \cdot 10^6$

For peer-to-peer scenario: $D_{p2p} = max\left(\frac{F}{u_s}, \frac{F}{d_i}, \frac{N \cdot F}{\sum u_i}\right)$
Again, N is represented on the left and u at the bottom.

10	500000	214285.71	75000
100	5000000	2142857.14	750000
1000	50000000	21428571.43	7500000
	$3 \cdot 10^5$	$7 \cdot 10^5$	$2 \cdot 10^6$