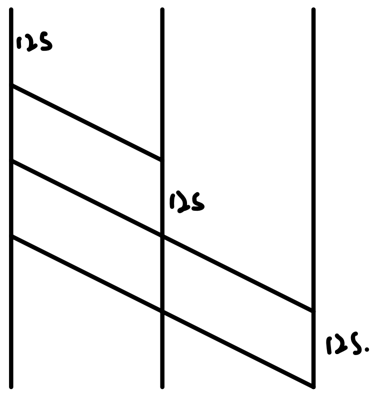
P4 a 16

b 8

c 2 connection can be setted through A-B-C
2 connection can be setted through A-D-C } Yes
B-A-D has 2 connections.
B-C-D has 2 connections

$\frac{120}{3}$

P5 a



175 km / 100 km/h = 1.75 h = 6300 s

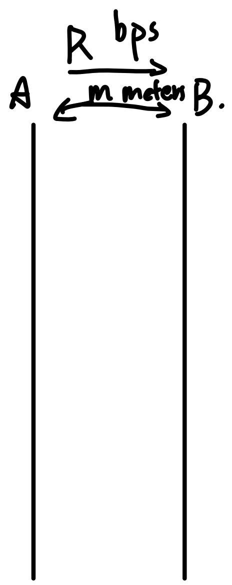
3 × 10×12 = 360 (s)

6300 + 360 = 6660 (s)

b 3 × 8×12s = 3× 96 s = 288 s

288 s + 6300 s = 6588 s

P6



a $d_{prop} = m/s$

b $d_{trans} = L/R$

c $d_{prop} + d_{trans} = m/s + L/R$

d the last bit of packet just left from A.

e the first bit of packet is $d_{trans} \cdot s$ meters away from host A

f the first bit of packet is in host B

g $d_{prop} = m / 2.5\times10^8\ m/s$

d_{trans} = 1500 byte / 10 Mbps

= 12000 bits / 10×10^6 bits/s

= 0.0012 (s)

$d_{trans} = d_{prop}$

$\frac{m}{2.5\times10^8} = 0.0012$ m = 300000 m = 300 km

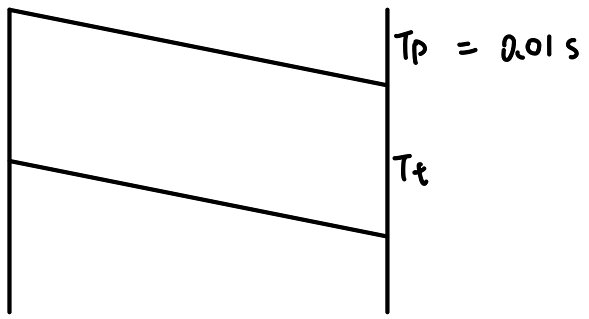
P7 56 byte = 56×8 bit = 448 bits

$T_{decod} = 448 / 64\times10^3$ bit/s

$= 0.007$ s

$T_t = 448 / 10$ Mb/s

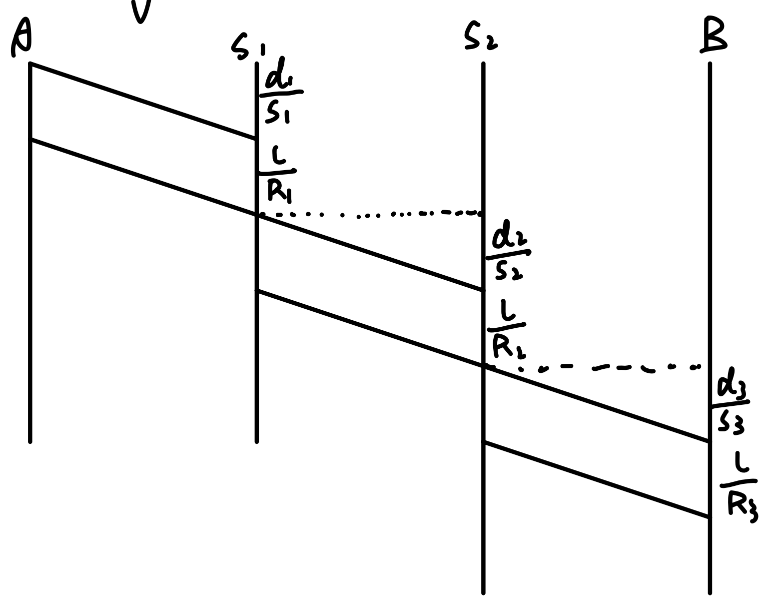
$= 0.0000448$ s



$0.007 + 0.0000448 + 0.01$

$= 0.0170448$ (s)

P10 a packet length L.



end to end delay $= \frac{d_1}{S_1} + \frac{L}{R_1} + \frac{d_2}{S_2} + \frac{L}{R_2} + \frac{d_3}{S_3} + \frac{L}{R_3} + 2\,d_{proc}$

$= \frac{(5000 + 4000 + 1000)\text{ km}}{2.5\times10^8\text{ m/s}} + \frac{1500\text{ bytes}}{2.5\text{ Mb/s}} \times 3 + 2\times 0.003\text{ s}$

$= \frac{1\cancel{0\,000\,000}\text{ m}}{25\,\cancel{000\,0000}\text{ m/s}} + \frac{12000\text{ bits}}{2500\,000\text{ bits/s}} \times 3 + 0.006\text{ s}$

$= \frac{1}{25}\text{ s} + \frac{36}{2500}\text{ s} + 0.006\text{ s} = \frac{136}{2500}\text{ s} + 0.006(s) = 0.0544(s) + 0.006(s)$

$= 0.0604$ (s)

P_{12}

$L = 1500$ bytes

$R = 2.5$ Mbps $= 2500000$ bits/s

$$T_Q = \left(4+\frac{1}{2}\right) \times \frac{1500 \text{ bytes}}{2500000 \text{ bits/s}}$$

$$= \frac{9}{2} \times \frac{\overset{6}{\cancel{12000}} \text{ bits}}{2500\cancel{000} \text{ bits/s}}$$

$$= \frac{54}{2500} \text{ s} \approx 0.0216 \text{ (s)}$$

$$T_Q = \frac{(L-x) + L \cdot n}{R}$$

P_{20} $\quad \text{Min}\left\{R_s, R_c, \frac{R}{M}\right\}$

P_{21} $\quad \text{Max}\left\{\text{Min}\left\{R_1^1, R_2^1, R_3^1, \cdots, R_N^1\right\}, \text{Min}\left\{R_1^2, R_2^2, \cdots R_N^2\right\} \cdots\cdots\right\}$

$\text{Sum}\left\{\text{Min}\left\{R_1^1, R_2^1, R_3^1, \cdots, R_N^1\right\}, \text{Min}\left\{R_1^2, R_2^2, \cdots R_N^2\right\} \cdots\cdots\right\}$

P_{25}

a $\quad R \cdot d_{prop} = 5$ Mbits/s $\cdot$ 20000 km $/ 2.5 \times 10^8$ m/s

$= 5000000$ bit/s $2\cancel{0000\ 000}$ m $/ 25\cancel{0000000}$ m/s

$= \overset{2}{\cancel{5}}000000$ bit/s $\cdot \dfrac{2\text{m}}{\underset{5}{\cancel{25}} \text{ m/s}}$

$= 400000$ bits

b. $\quad$ 4 00 000 bits.

c $\quad$ The maximum data present on the line.

d. $\quad 2\cancel{0000}$ km $/ 4\cancel{00000} = \dfrac{2009 \text{ m}}{4 \text{ bits}} = 50\text{m} < 109.728 \text{m} \approx 120$ yard.

No, it is not longer than a football field.

e $\quad R \cdot \frac{m}{s}$ $\quad$ width of bit $= m / (R \cdot \frac{m}{s}) = s/R$

P28

a $\frac{8\cancel{00\,000}\text{ bits}}{5\,\cancel{000000}\text{ bits/s}} + \frac{20000\text{ km}}{2.5\times10^8\text{ m/s}}$

$= \frac{8}{50}\text{ s} + \frac{2\cancel{0000}\ \cancel{000}\text{ m}}{25\ \cancel{0000000}\text{ m/s}}$

$= \frac{4}{25} + \frac{2}{25} = \frac{6}{25}\text{ (s)}$

b $20 \times \left(\frac{4\cancel{0000}\text{ bits}}{5\,\cancel{000}\ \cancel{000}\text{ bits/s}} + \frac{2\cancel{0000}\ \cancel{000}\text{ m}}{25\ \cancel{000}\ \cancel{000}\ \cancel{0}\text{ m/s}} \times 2 \right)$

$= 20 \times \left(\frac{\cancel{4}\,2}{\cancel{500}\ 250}\text{ s} + \frac{40}{250} \right)$

$= 2\cancel{0} \times \frac{42}{25\cancel{0}}$

$= \frac{84}{25}\text{ (s)} > \frac{6}{25}\text{ (s)}$

c "a" spends less time than "b"