CISC7002 Computer Networks
Homework 1 Solutions

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Question 1 (a)

$$\frac{1Mbps}{100kbps} = \frac{10^3 kbps}{100kbps} = 10$$

So, 10 hosts can be admitted by this access link.

(b) "cannot obtain the required bandwidth" means the number of hosts>10. Then:

$$\sum_{n=11}^{25} \binom{25}{11} (0.2^n)(0.8^{25-n}) \approx 0.005$$

The probability is about 0.5%

Question 2 For the first packet:

$$t_1 = (1+1)\frac{L}{R}$$

For the rest of packets:

$$t_2 = 2\frac{L}{R}$$

The overall latency:

$$d = t_1 + t_2 = 4\frac{L}{R}$$

Question 3

$$\begin{aligned} d &= d_{proc} + d_{queue} + d_{trans} + d_{prop} \\ &= 2T + 3\frac{L}{R} + 3\frac{d}{v} \end{aligned}$$

Question 4 (a)

$$t = \max\{\frac{NF}{u_s}, \frac{F}{\min(d_i)}\}$$

$$t_{N=5} = \max\{\frac{5\times 20}{40}, \frac{20}{10}\} = 2.5$$

$$t_{N=10} = \max\{\frac{10\times 20}{40}, \frac{20}{10}\} = 5$$

$$t_{N=20} = \max\{\frac{20\times 20}{40}, \frac{20}{10}\} = 10$$

$$t_{N=40} = \max\{\frac{40\times 20}{40}, \frac{20}{10}\} = 20$$

$$t_{N=60} = \max\{\frac{60\times 20}{40}, \frac{20}{10}\} = 30$$

(b)

$$t = \max\{\frac{F}{u_s}, \frac{F}{\min(d_i)}, \frac{NF}{u_s + \sum u_i}\}$$

$$t_{N=5} = \max\{\frac{20}{40}, \frac{20}{10}, \frac{5 \times 20}{40 + 5 \times 5}\} = 2$$

$$t_{N=10} = \max\{\frac{20}{40}, \frac{20}{10}, \frac{10 \times 20}{40 + 10 \times 5}\} = \frac{20}{9} = 2.2$$

$$t_{N=20} = \max\{\frac{20}{40}, \frac{20}{10}, \frac{20 \times 20}{40 + 20 \times 5}\} = \frac{20}{7} = 2.857$$

$$t_{N=40} = \max\{\frac{20}{40}, \frac{20}{10}, \frac{40 \times 20}{40 + 40 \times 5}\} = \frac{20}{6} = 3.3$$

$$t_{N=60} = \max\{\frac{20}{40}, \frac{20}{10}, \frac{60 \times 20}{40 + 60 \times 5}\} = \frac{60}{17} = 3.529$$

(c) As N increases, the distribution time and the growth rate of distribution time of the P2P service model are much smaller than that of the Client/Server service model.

(d) For Client/Server model, the distribution time increases linearly in N, so:

$$\lim_{N \to \infty} d_{CS} = max\{\frac{NF}{u_s}, \frac{F}{\min(d_i)}\} = \frac{NF}{u_s} \to \infty$$

As $N \to \infty$, the distribution time of Client/Server model tends to the infinity.

For P2P model:

$$\begin{aligned} \lim_{N \to \infty} d_{P2P} &= max\{\frac{F}{u_s}, \frac{F}{\min(d_i)}, \frac{NF}{(u_s + \sum u_i)}\} \\ &= \frac{NF}{u_s + Nu_i} \\ &= \frac{F}{\frac{u_s}{N} + u_i} \\ &= \frac{F}{u_i} \end{aligned}$$

As $N \to \infty$, the distribution time of P2P model tends to a constant.