

CSE 160 : HW 1-1

1.4: Calculate the total time required to transfer a 1000-kB file in the following cases, assuming an RTT of 100 ms, a packet size of 1 kB data, and an initial $2 \times \text{RTT}$ of "handshaking" before data are sent.

a) The bandwidth is 1.5 Mbps, and data packets can be sent continuously.

$$\text{Transmit delay} = \frac{1000 \text{ kB}}{1.5 \text{ Mbps}} \Rightarrow \frac{8000 \text{ Kb}}{1500 \text{ Kbps}} = 5.33 \text{ s}$$

$1 \text{ Mbps} = 1000 \text{ Kbps}$

$$\text{RTT (round trip time)} = 50 \text{ ms} / 2 = 25 \text{ ms}$$

$$\begin{aligned} \text{Total} &= \text{handshaking delay} + \text{transmit delay} + \text{propagation delay} \\ &= 100 \text{ ms} + 5.33 \text{ s} + 25 \text{ ms} \Rightarrow 0.100 \text{ s} + 5.33 \text{ s} + 0.025 \text{ s} \end{aligned}$$

$$1 \text{ ms} = 0.001 \text{ s} \quad = 5.465$$

b) The bandwidth is 1.5 Mbps, but after we finish sending each data packet, we must wait one RTT before sending the next.

$$\text{number of packets} = 1000 \text{ kB} / 1 \text{ kB} = 1000 \text{ packets}$$

*We have to add the additional RTT's to the total time calculated in Part (a)

$$\begin{aligned} \text{Total} &= 5.465 + (999 \cdot 50) \text{ ms} \\ &= 5.465 + 49,950 \text{ ms} \\ &= 5.465 + 49.95 \text{ s} = 55.41 \text{ s} \end{aligned}$$

has to be ~~aaa~~
due to waiting
one RTT after
transmitting

c) The bandwidth is "infinite" meaning that we take transmit time to be zero, and up to 20 packets can be sent per RTT.

$$\text{RTT} = 20 \quad \text{for required} = 1000 / 20 = 50$$

$$\text{Total time} = \text{initial } 2 \text{ RTT} + \text{required RTT}$$

$$= 2 \cdot \text{RTT} + 50 \cdot \text{RTT}$$

$$= 52 \cdot \text{RTT}$$

$$= 52 \cdot 0.05 = 2.6 \text{ s}$$

$$\text{RTT} = 0.05 \text{ s}$$