EE 450 HW #2

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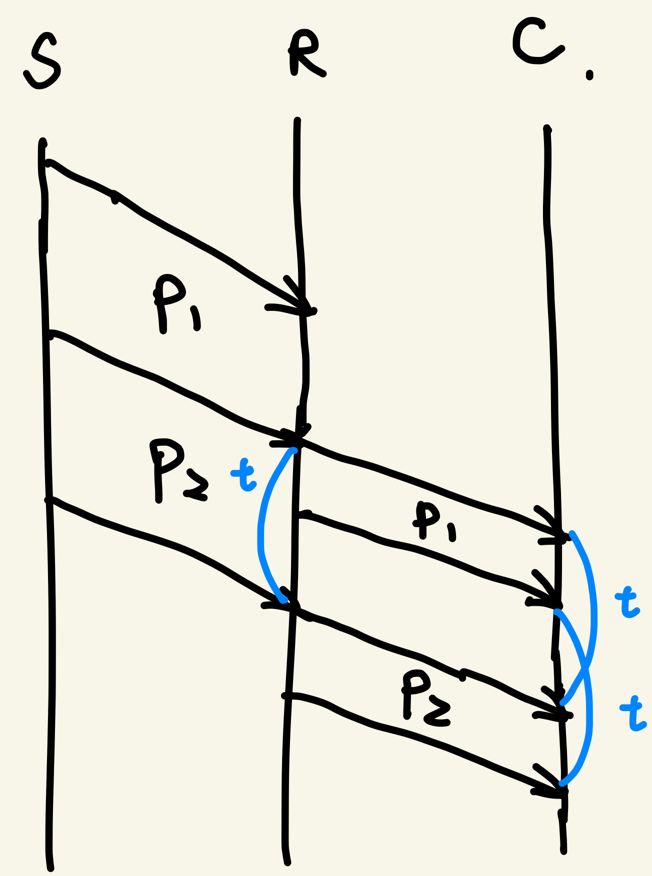
Ch1. P23

a.

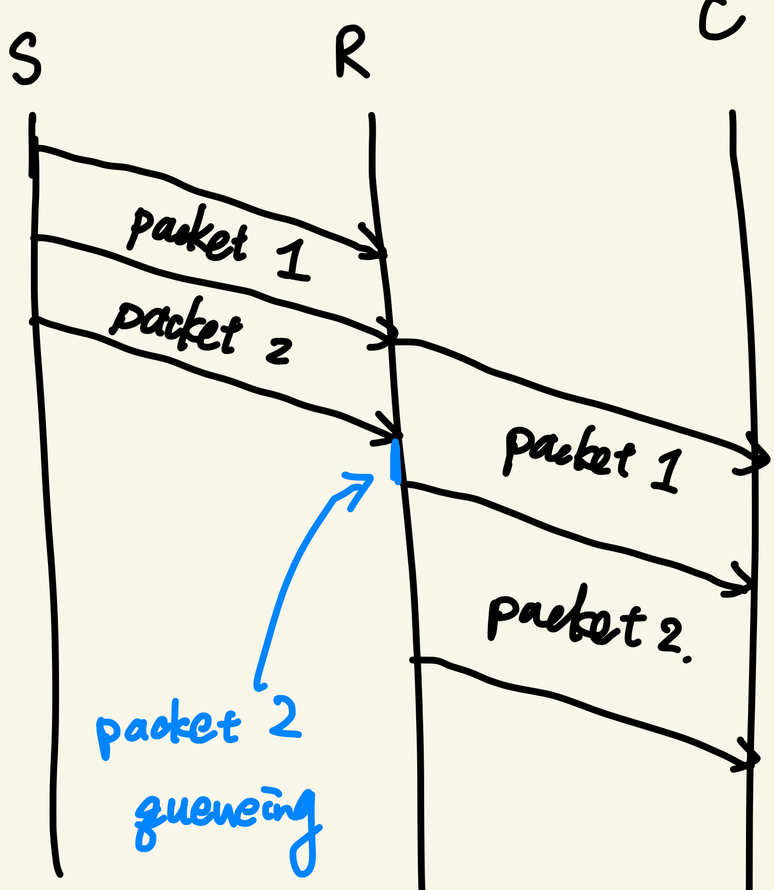


From the diagram above, I can see that the inter-arrival time = $t = \frac{L}{R_s}$ #

Ch 1 P23 (cont.)

b.

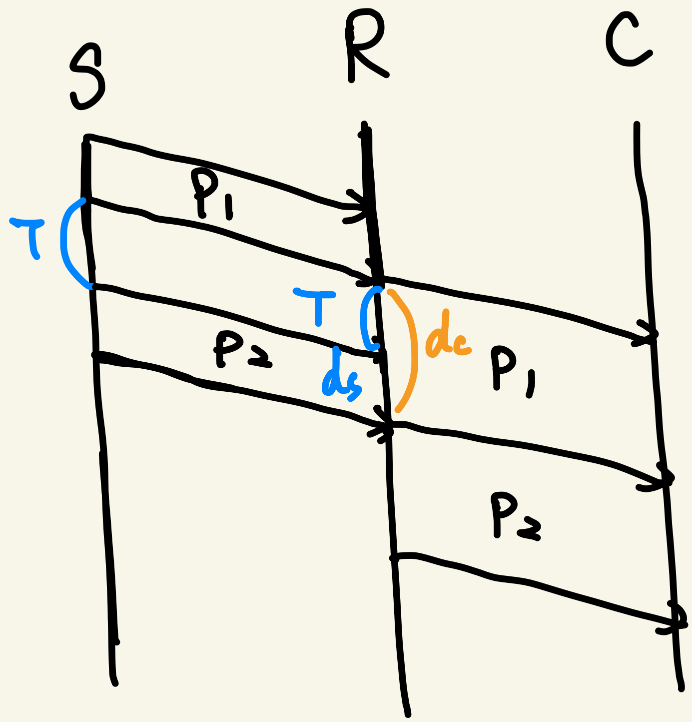
(1) Yes, it is possible. Since the packets are sent back-to-back and $R_c < R_s$, packet 2 will arrive link 2 while link 2 is still transmitting packet 1.



Ch1 P23 (cont.)

b.

(2) If we send packet 2 T second later, the time it arrives link 2 should be equal to or later than the time when the last bit of packet 1 is leaving and transmitting on link 2.



$$d_s = \frac{L}{R_s}$$

$$d_c = \frac{L}{R_c}$$

Based on the diagram above, we can find out

$$T + d_s \geq d_c \Rightarrow T \geq d_c - d_s$$

$$\Rightarrow T \geq \frac{L}{R_c} - \frac{L}{R_s}$$

#

Ch1. P31

a. transmission rate $= 5\times10^{6}$ bps

(1)

$$T = \frac{10^6}{5\times10^6} = \underline{0.2\ \text{sec}} ※$$

(2)

3 hops

$$\text{total time} = \frac{10^6}{5\times10^6} \times 3 = \underline{0.6\ \text{sec}} ※$$

b.

(1)

$$T = \frac{10^4}{5\times10^6} = \underline{2\times10^{-3}\ \text{sec}} ※$$

(2)

second packet will be received at

$$2\times10^{-3} + 2\times10^{-3} = \underline{4\times10^{-3}\ \text{sec}} ※$$

Ch1. P31 (cont.)

c.

(1) the first packet will arrive the destination at $2 \times 10^{-3} \times 3 = 6 \times 10^{-3}$ sec

the second packet will be 2×10^{-3} sec late, which is $6 \times 10^{-3} + (2-1) \times 2 \times 10^{-3}$

so on and so forth. the 100th packet will arrive at

$$6 \times 10^{-3} + (100-1) \times 2 \times 10^{-3}$$

$$= \underline{0.204 \text{ sec}} \; \#$$

(2) $0.204 < 0.6$

$\Rightarrow$ segmentation is more time-efficient #

d.

① When one smaller packet gets lost or has errors, the sender should only resend that packet instead of the whole message.

② The segmented packets can be transmitted through different routes to the destination. It can decrease the load of one router.

e.

① Since the message is separated into several segments, they need to be rearranged at the destination.

② We need additional headers for each packet, so the total amount of transmitted bytes is more than not using segmentation.

Ch 2. P7.

Required time for obtaining IP address is

$$RTT_1 + RTT_2 + \cdots + RTT_n$$

$$\text{total time} = \underline{2RTT_0 + (RTT_1 + \cdots + RTT_n)} \ \#$$

one for establishing connection

the other for transmission of data

Ch 2 P8.

a. time for obtaining IP address of the server is $RTT_1 + RTT_2 + \cdots + RTT_n$

Since it's non-persistent HTTP, it requires to establish a connection before requesting objects

Connection + HTML file ↘   connection + objects ↓   ← query DNS

$$\Rightarrow 2RTT_0 + 8(2RTT_0) + (RTT_0 + \cdots + RTT_n)$$

$$= \underline{18\,RTT_0 + RTT_1 + RTT_2 + \cdots + RTT_n} \#.$$

b. 6 parallel connections for 8 objects requires 2 rounds of transmission

$$\Rightarrow 2RTT_0 + 2(2RTT_0) + RTT_1 + \cdots + RTT_n$$

$$= \underline{6\,RTT_0 + RTT_1 + RTT_2 + \cdots + RTT_n} \#$$

c.

① with pipeling:

setup connection

HTML file + objects

$$\Rightarrow RTT_0 + 2RTT_0 + RTT_1 + \cdots + RTT_n$$

$$= \underline{3RTT_0 + RTT_1 + RTT_2 + \cdots + RTT_n} \#$$

② without pipeling:

setup connection

HTML file

objects

$$\Rightarrow \overset{\text{setup connection}}{RTT_0} + \overset{\text{HTML file}}{RTT_0} + \overset{\text{objects}}{8RTT_0} + RTT_1 + \cdots + RTT_n$$

$$= \underline{10RTT_0 + (RTT_1 + RTT_2 + \cdots + RTT_n)} \#$$

Ch 2 P10

one object can be put into one packet

① non-persistent HTTP + parallel

Let $N = 10 \Rightarrow$ each get $\frac{1}{10} \times 150 = 15$ bits/sec

establish connection   initial object

$$3 \times \left(\frac{200}{150} + d_{prop}\right) + \frac{10^5}{150} + d_{prop} +$$
$$3 \times \left(\frac{200}{15} + d_{prop}\right) + \frac{10^5}{15} + d_{prop}$$

$$\doteq \underline{7377.3 + 8\, d_{prop}}\ \#$$

② persistent HTTP

$$3 \times \left(\frac{200}{150} + d_{prop}\right) + \frac{10^5}{150} + d_{prop} +$$

request file

$$10 \times \left(\frac{200}{150} + d_{prop} + \frac{10^5}{150} + d_{prop}\right)$$

$$\doteq \underline{7350.67 + 24\, d_{prop}}\ \#$$

$$d_{prop} = \frac{10}{3 \times 10^8} = 3 \times 10^{-7}\ \text{sec}\ \text{(negligible)}$$

(1) Yes. Parallel downloads make sense in this case.

(2) NO. Persistent HTTP is not signficant faster than non-persistent HTTP with parallel #

Ch6 P27

$r = 128 \times 10^3$ bps

a. $\text{packetization delay} = \dfrac{L \times 8}{128 \times 10^3} \times 10^3$

$= \dfrac{L}{16}$ (msec) #

b.

① L = 1500 bytes

$\Rightarrow \text{delay} = \dfrac{1500}{16} = 93.75$ (msec) > 20 #

② L = 50 bytes

$\Rightarrow \text{delay} = \dfrac{50}{16} = 3.125$ (msec) < 20 #

c.

① L = 1500 bytes

$\Rightarrow \text{delay} = \dfrac{1500 \times 8}{622 \times 10^6} \approx 1.93 \times 10^{-5}$ (sec)

② L = 50 bytes

$\Rightarrow \text{delay} = \dfrac{50 \times 8}{622 \times 10^6} \approx 6.43 \times 10^{-7}$ (sec)

Ch 6 P27 (cont.)

d. For store-and-forward delay, both small packet size and large packet size are small. However, for packetization delay, large packet size can be too large (noticeable). #