3.Questions on Delays

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What is the propagation time if the distance between the two points is 12,000 km? Assume the propagation speed to be 2.4 × 10^8 m/s in cable.

Tp = d / s = (12*10^3)/(2.4*10^8) = 50ms

What are the propagation time and the transmission time for a 2500byte message (an e-mail) if the bandwidth of the network is 1 Gbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4 × 10^8 m/s.

Tl = L/B = 2500*8/10^9 = 2*10^-5s

How long does it take to send a file of 640,000 bits from host A to host B over a circuit-switched network?

- All links are 1.536 Mb/s
- Each link uses TDM with 24 slots/sec (TDM = Time Division Multiplexing)
- 500 msec to establish end-to-end circuit

Packet switching	Circuit switching

Circuit-switching:
Total time = Setup delay + Transmission delay + Propagation delay + Termination delay

= 500 + (640000/(1536000/24)) = 10.500s

Calculate the total time required to transfer a 1.5-MB file in the following cases, assuming a RTT of 80 ms, a packet size of 1 KB and an initial 2×RTT of "handshaking" before data is sent.
(a) The bandwidth is 10 Mbps, and data packets can be sent continuously.
(b) The bandwidth is 100 Mbps, but after we finish sending each data packet, we must wait one RTT before sending the next.

Total size = 1.5MB = 1.5 * 2^20 * 8 = 12,582,912 bits

RTT = 80ms
Size of packet = 1KB = 2^10 * 8 = 8,192 bits

a. Packets can be sent continuously

T(total) = 2*RTT + Tt + Tp
= (2*0.080) + (12,582,912/(10^7)) + (0.040) = 1.4583s

In terms of file size/data size

K	2^10
M	2^20
G	2^30

In terms of time

K	10^3
M	10^6
G	10^9

b. Wait 1RTT after sending every packet

Total number of packets = (12582912/8192) = 1536
1535 RTTs required

(b) The bandwidth is 100 Mbps, but after we finish sending each data packet, we must wait one RTT before sending the next.

First, count number of packets needed to send the file:

1.5-MB / 1 KB = 12,582,912 bits / 1024(8) bits
= 12,582,912 bits / 8192 bits
= 1536

Thus, we need (1536-1) RTTs to be added to the total delay time.

Second, we need to calculate the network delay in this case:

Delay = propagation delay + transmission delay
= 40 ms + (1.5-MB / 100 Mbps)
= 40 ms + (1.5*1,048,576 B / 100*1,000,000 bps)
= 40 ms + (1.5*1,048,576*8 b / 100*1,000,000 bps)
= 40 ms + (12,582,912 bits / 100,000,000 bps)
= 40 ms + 0.126 s
= 40 ms + 126 ms
= 166 ms

» **total time = initial handshaking + network delay + 1535 (80 ms)**
= 160 ms + 166 ms + 122800 ms
= 123,126 ms
= 123.26 s

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 and an initial 2 × RTT of "handshaking" before data is sent.
(a) The bandwidth is 1.5 Mbps, and data packets can be sent continuously.
(b) The bandwidth is 1.5 Mbps, but after we finish sending each data packet we must wait one RTT before sending the next