Section 1

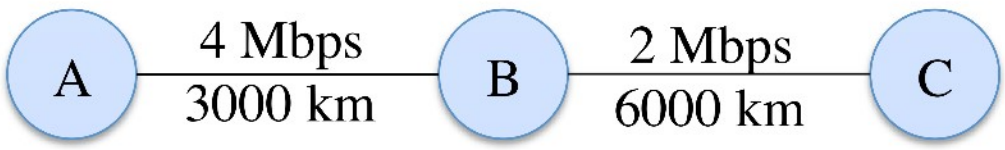
Tuesday, June 11, 2019 4:06 PM

section1

CS168 Fall 2015 Discussion Section 1

Packet Delay Constants

1 Mbps = 10^6 bits per second
1 ms = 10^{-3} seconds
Speed of light (c) = $3 \cdot 10^5$ km/second



Problem 1: Delays in Packet Switching

For this problem, assume all packets are sent using packet switching, and intermediate nodes use store-and-forward when forwarding packets.

(a) What is the transmission delay if A sends a 500 byte packet to B?

D_t = 500*8 * (1/4E6) = 0.001

(b) What is the propagation delay if A sends a 500 byte packet to B?

D_p = (3000E3) / (3E5*1E3) = 0.01

(c) What is the end-to-end delay if A sends a 500 byte packet to B?

0.01+0.001 = 0.011

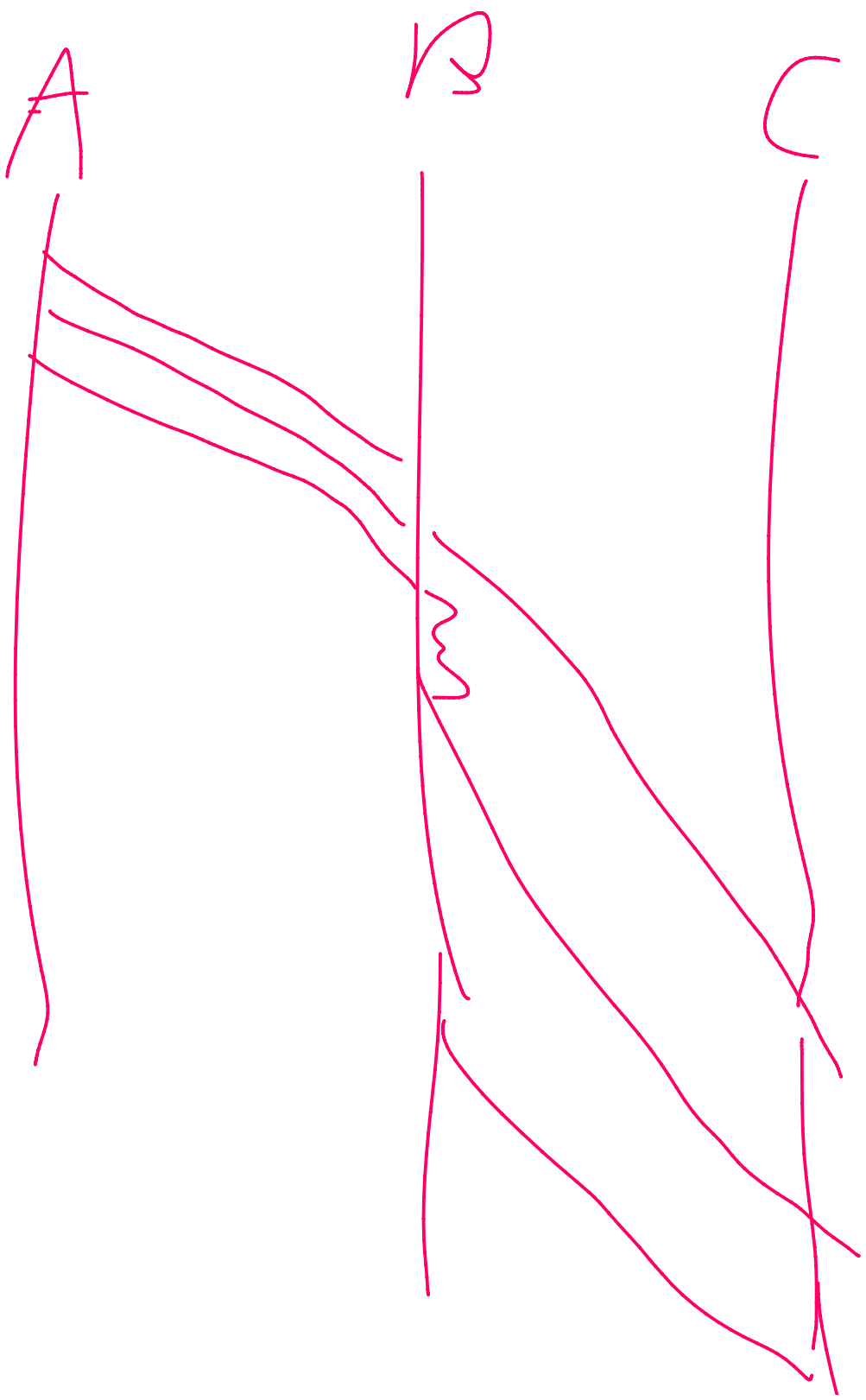
(d) What is the end-to-end delay if A sends a 1000 byte packet to B? Which component of delay is affected by packet size?

0.002+0.01 = 0.012

Transmission delay is affected by packet size.

(e) What is the end-to-end delay if A sends a 500 byte packet to C?

Dp = 0.03 + 500*8*(1/4E6+1/2E6) = 0.033


A
B
C

(f) What is the end-to-end delay if A sends two 500 byte packets, one afer the other, to C?

0.03+ 500*8*(1/4E6+1/2E6) + 500*8/2E6 = 0.035

Problem 2: Delays in Circuit Switching

Now, suppose all packets are sent using circuit switching. Assume we're using virtual circuit switching, where we set up a circuit on a packet-switched network by first using a setup packet.

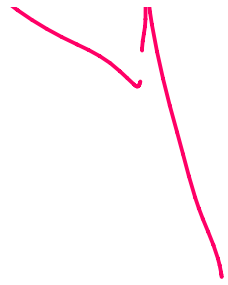
(a) How long does it take to establish a circuit from A to C? Assume intermediate nodes can process the setup message instantaneously, and that the setup and confirmation messages are 100 bytes.

Lets use state to aid our transport.

VCS gives us the illusion of dedicated circuits and allow us to bypass store + forward routing for cut-through switching.

Set up send time: 0.03 + 100*8*(1/4E6+1/2E6) = 0.0306
Ack message send + receive: 0.03+ 100*8*(1/2E6) = 0.0304

Circuit set up time = 0.0306+0.0304 = 0.061



2e delay is when the LAST packet is fully received by the reciever

he packet incurs ALL propagation delays.
ue to stor eand forward processing, it incurs ALL transmission delay time (assuming 0 rocessing time)
stly, the packet will spend time in a queue before it can get stu ffed in a pipe to move n

ueueing can occur at switch B
nce first packet has been received, unfortunatel,y second packet is right behind it.
ueue timer starts now.

Vell, switch B is going to immediately grab paccket 1 and transmit it. This takes 500* /2E6 = 0.002 seconds.

herefore, the total delay is
045 + 0.003 + 0.002 = 0.05

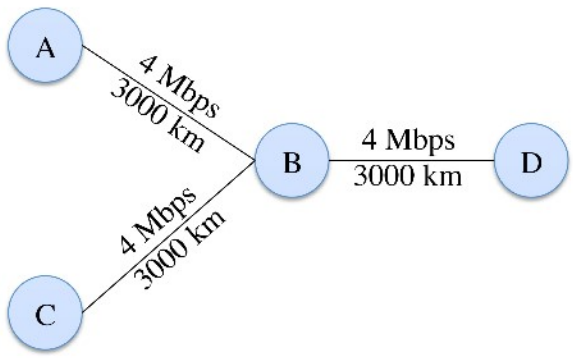
(b) Once the circuit is set up, what is the end-to-end delay if A sends a 500 byte packet to C?

0.03 + 500*8 / (2E6) = 0.032

(c) Now, suppose that A needs to send a 1MB (megabyte) packet to C. What is the total delay with circuit switching, including the time to set up the circuit (under the same assumptions as in (a)).

0.061 + 0.03 + 1E6 * 8 / (2E6) = 4.091

Problem 3: Contention



In the above topology, suppose that A sends two 500 byte packets to D at $t = 0$ and that C sends a single 500 byte packet to D 1.5 milliseconds later. What is the end-to-end delay of the first packet from A? What about the packet from C?

A incurs the propagation and transmit delays, no queuing delays for switch contention

6000E3 / (3E5*1E3) + 500*8*(1/4E6+1/4E6) = 0.022

The packet from C incurs all the same delays, but an additional queuing delay

Specifically, it arrives at switch B at 0.0015 + 500*8/4E6 + 3000E3/(3E5*1E3) = 0.0125

Router B is able to process this packet at 3000E3/(3E5*1E3) + 2*500*8/4E6 + 500*8/4E6 = 0.013

This precedes the arrival time of packet 3, therefore packet 3's delay is standard

6000E3/(3E5*1E3) + 500*8*(1/4E6+1/4E6) + (0.013-0.0125) = 0.0225