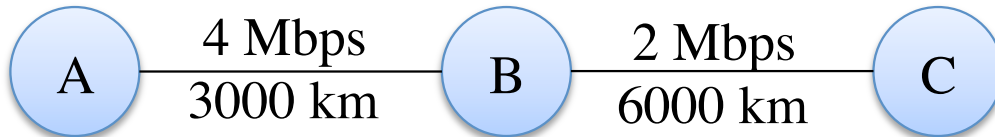# CS168 Fall 2014 Discussion Section 1

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

A — 4 Mbps / 3000 km — B — 2 Mbps / 6000 km — C

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?

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

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

(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?

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

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

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.

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

(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)).

Problem 3: Contention
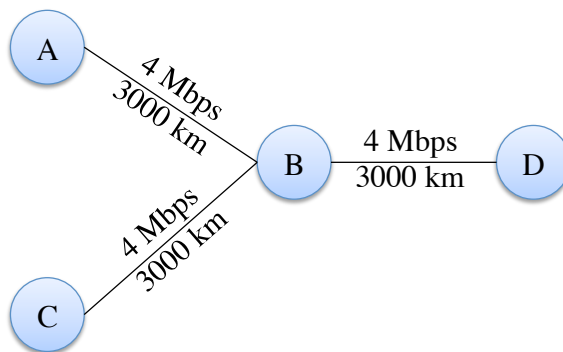
In the above topology, suppose that A sends two 500 byte packets to D at $t = 0$ and that C sends a single 500 byte packet to D 1.5 milliseconds later. What is the end-to-end delay of the first packet from A? What about the packet from C?