Midterm Materials

- Ch.1: Intro
  - 1.3 (packet vs circuit switching), 1.4 (delay, loss, throughput), 1.5(layering)
  - ~~1.1(views), 1.2 (edge), 1.6. (security), 1.7 (history)~~
- Ch.2: Applications
  - 2.1 (principles), 2.2 (web), 2.3 (mail), 2.4 (dns), 2.5 (p2p), 2.6 (video and CDN), ~~2.7 (sockets)~~
- Ch.3: Transport
  - 3.1-3.2 (intro), 3.3 (udp), 3.4 (reliable transport), 3.5 (TCP)
  - ~~3.6 7: TCP Congestion Control~~
- Companion website
  - interactive exercises, self-assessment quizzes
  - http://wps.pearsoned.com/ecs_kurose_compnetw_6/
  - https://gaia.cs.umass.edu/kurose_ross/interactive/

Sample Midterm from S16

- Midterm from Spring 2016: https://canvas.eee.uci.edu/courses/6774/files/folder/slides?preview=2311256
- Solutions for midterm: https://canvas.eee.uci.edu/courses/6774/files/folder/slides?preview=2311259

Review Outline

- Problem 2b(ii): DNS and TCP/HTTP
  - Not enough time to do rest of this problem
- Reliability Problem 3: GBN, SR
- Reliability Problem for TCP

Problem 2(b)(ii) midterm S16

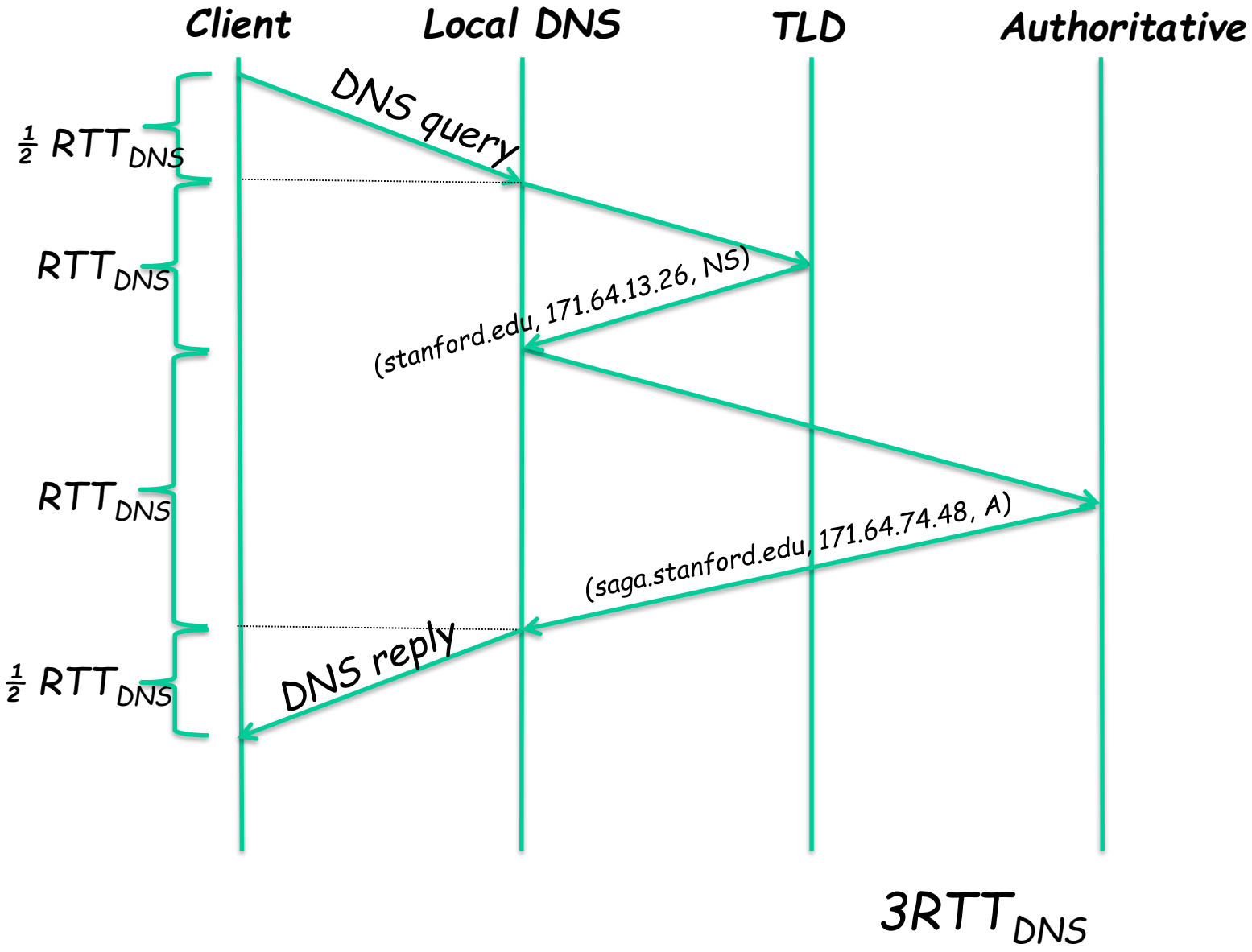
You open your browser and you click on http://www.stanford.edu/.
…

Assume you are the first person at UCI who visits the website www.stanford.edu.
For simplicity, let *RTT_DNS* be the delay for any DNS-query and response made.
State any other assumptions you make regarding DNS. Additional simplifying assumptions: no packet is lost…
….

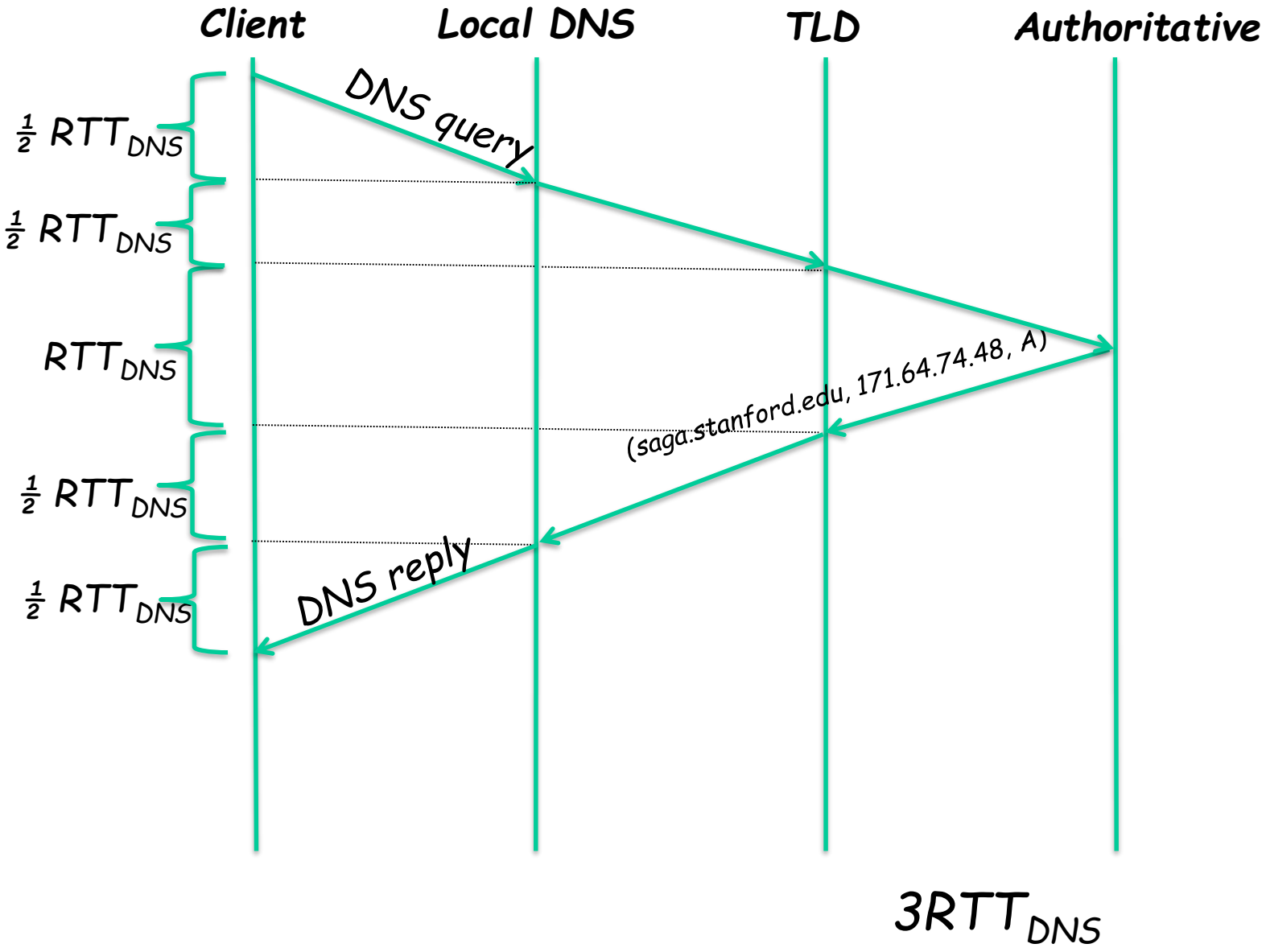
You are interested in the delay from when you enter the URL until the webpage is displayed on your browser.

i. List (or draw) all messages exchanged including application layer messages (e.g., DNS, HTTP) and transport layer segments (e.g., UDP, TCP)
ii. Compute the delay.

Midterm -16 question2 part(b)(i) iterative



Midterm -16 question2 part(b)(i) recursive



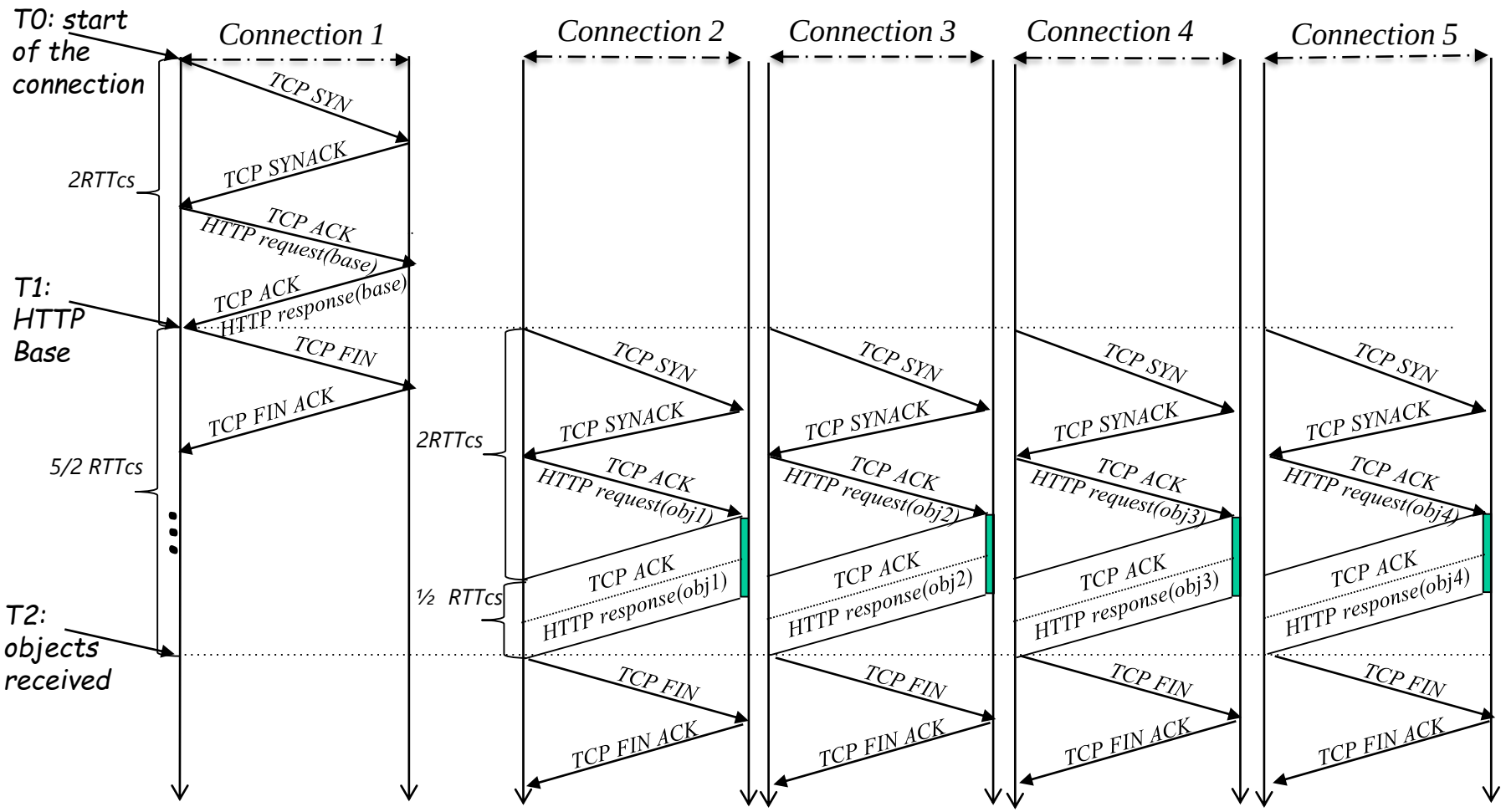
Problem 2(b)(ii) midterm S16

…
Assume that the Stanford webpage consists of an HTML file and 4 images. Let *RTTcs* be the RTT between your laptop and the Stanford webserver. The HTML file is small, thus its transmission delay is negligible. However, the images are large: (an HTTP response for) each image fits in exactly two TCP segments, each with the maximum segment size (MSS Bytes) and transmission delay 1/4 · *RTTcs*. The transmission delays of all other messages are negligible.

…
Additional simplifying assumptions: no packet is lost; ignore the TCP window effect; ignore any processing delays; all TCP segments have either negligible or maximum (MSS) size, as specified above.

Consider that your browser uses **non-persistent HTTP with up to 5 parallel connections.** You are interested in the delay from when you enter the URL until the webpage is displayed on your browser.

Midterm -16 question2 part(b)(i): Getting the web page



Getting IP: 3 RTTdns
Getting page + objects: 2 RTTcs + (5/2) RTTcs = (9/2) RTTcs

Total: 3 RTTdns + (9/2) RTTcs

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- Problem 1

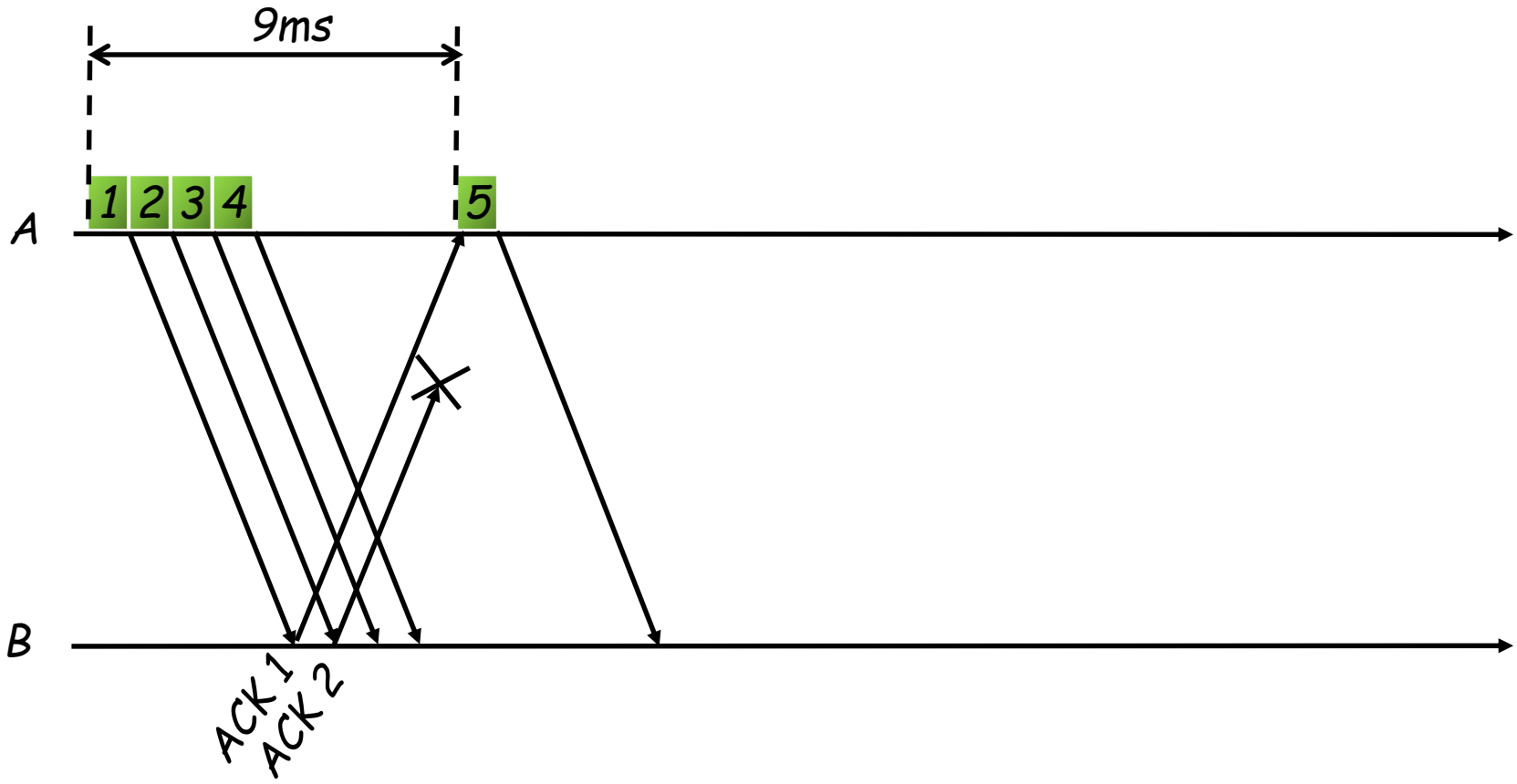
Midterm S16 – Problem 3 (Summarized)

- Suppose that host A sends N = 6 data packets to host B using one of the idealized pipelined protocols we learnt in class
- All protocols have (sender and/or receiver if applicable) window size equal to 4 packets
- Timeout value = 10 ms (assume that the timeout starts after the packet is sent).
- The one-way propagation delay between host A and B = 4 ms
- Transmission time of each data packet = 1ms
- Transmission time of each ACK packet = 0 ms
- Suppose that ACK No. 2 is lost on the way from host B to host A and no other packet gets lost.

- ✓ Fill out the rest of the diagrams until all 6 packets are sent and acknowledged. Show all packets (transmissions, retransmissions and acknowledgements), their sequence numbers and the times they were sent/received.
- ✓ For each scenario, write down the total time, i.e., when the all 6 packets are successfully acknowledged at the server.

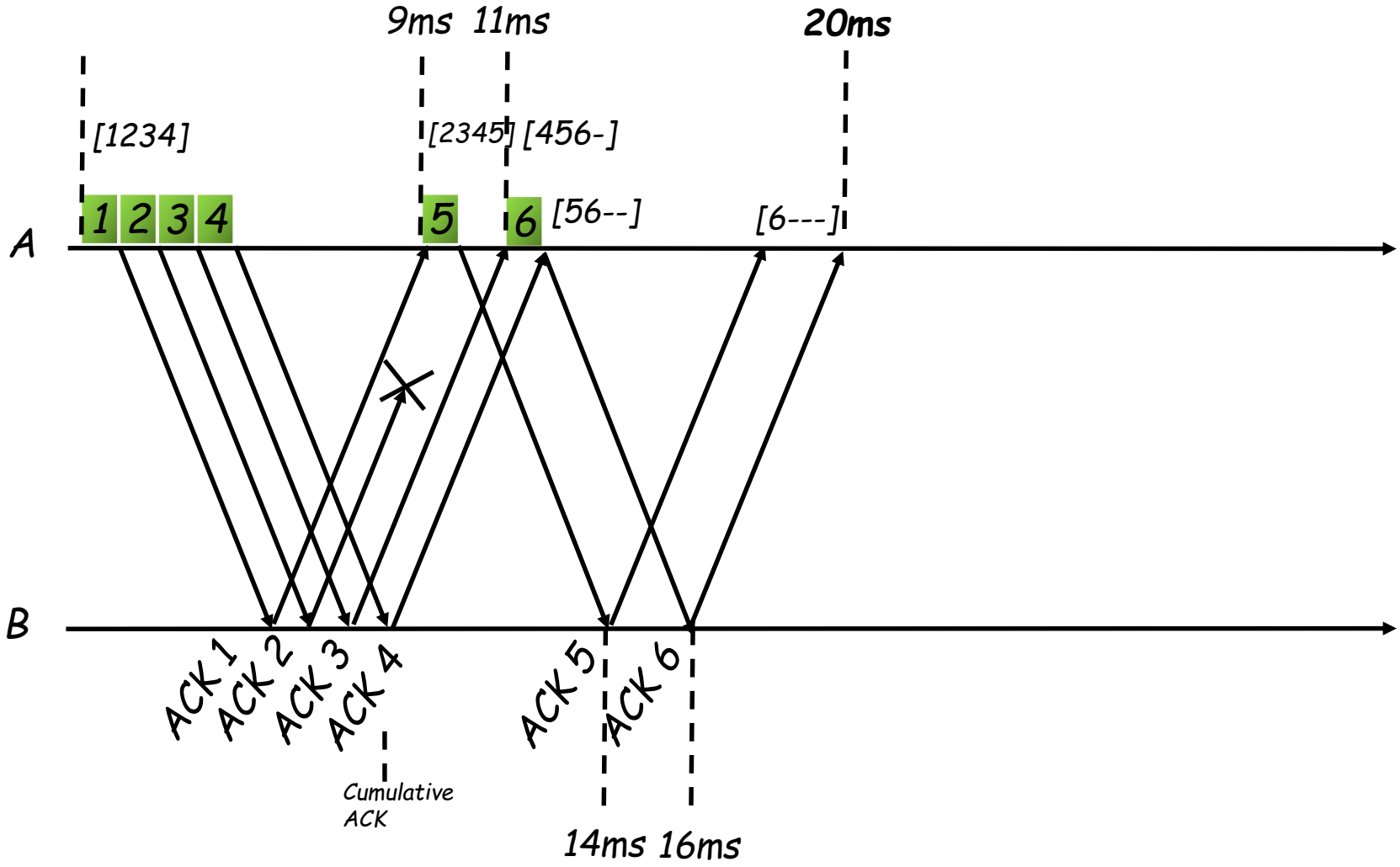
GBN: Q

a) GBN with ACK 2 lost - fill out the rest of the diagrams until all 6 packets are sent and acknowledged



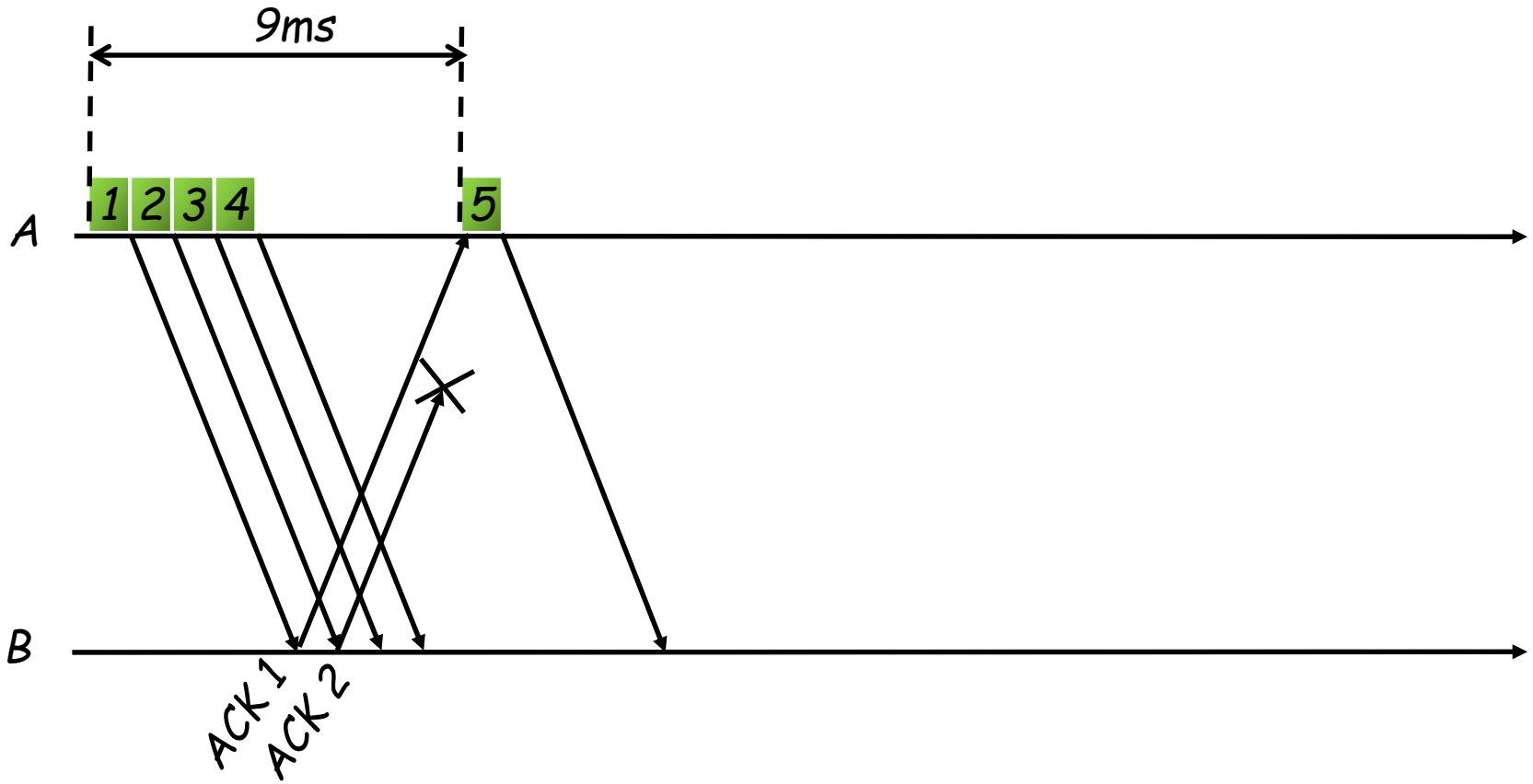
GBN: A

a) GBN with ACK 2 lost - answer



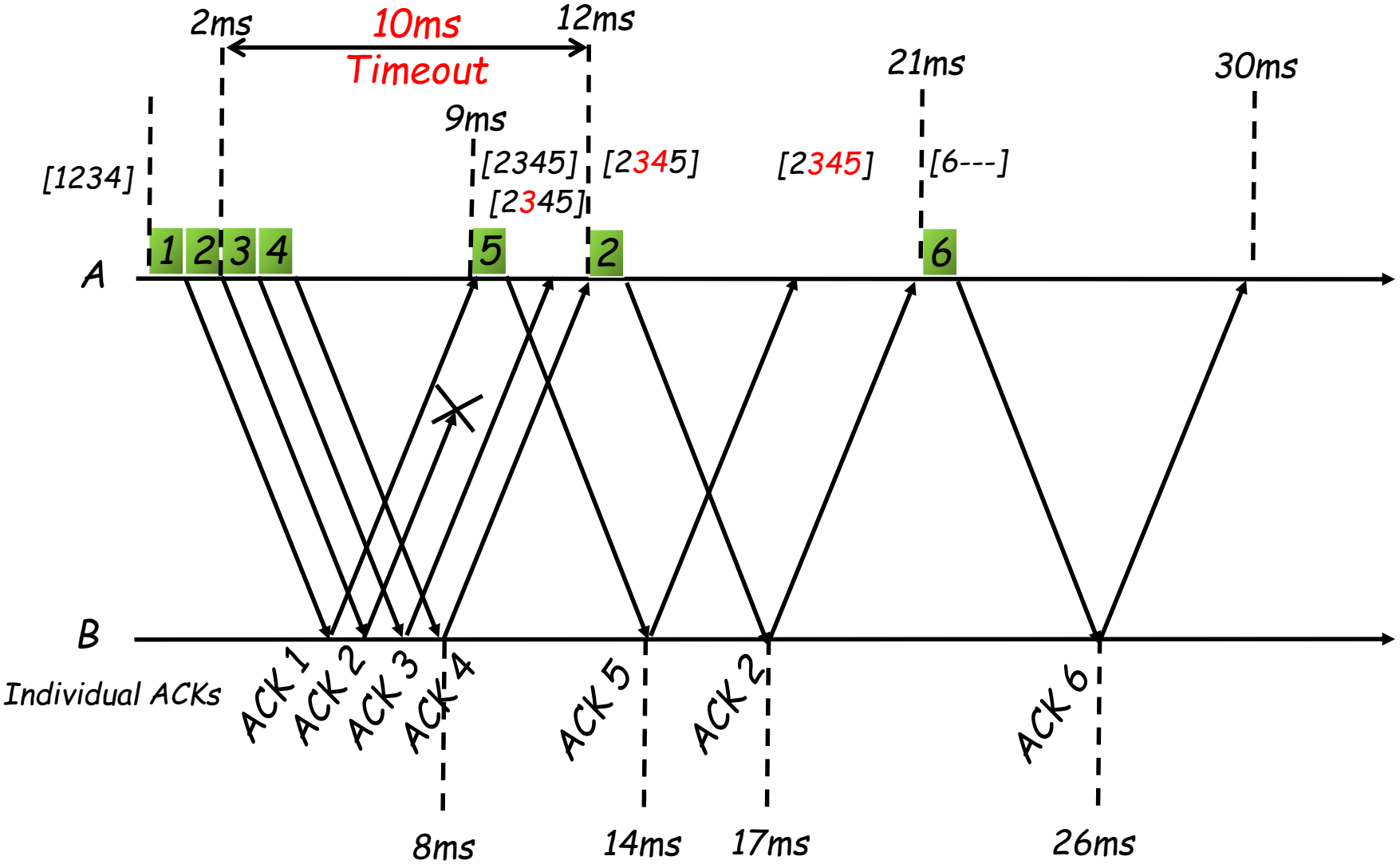
Selective Repeat: Q

b) Selective Repeat with ACK 2 lost - fill out the rest of the diagrams until all 6 packets are sent and acknowledged



Selective Repeat: A

b) Selective Repeat with ACK 2 lost - answer



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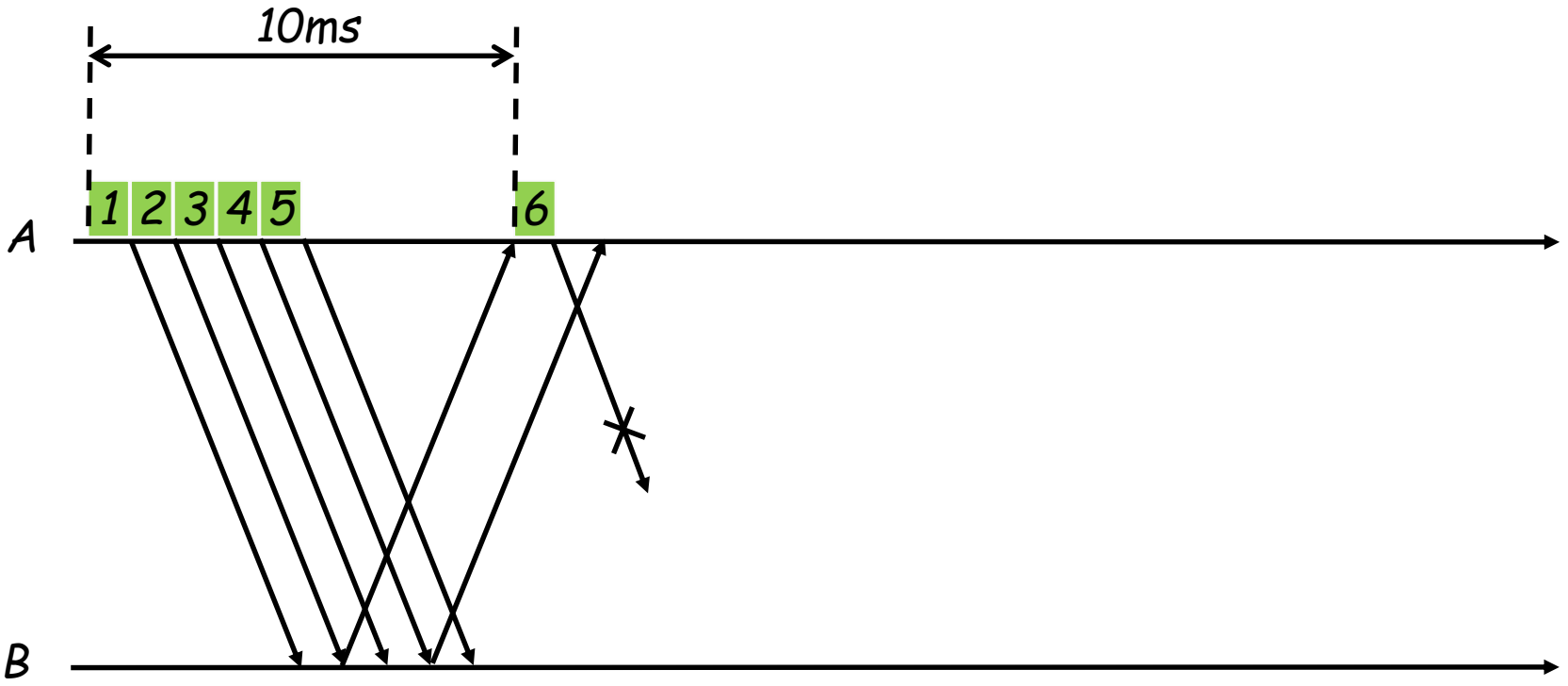
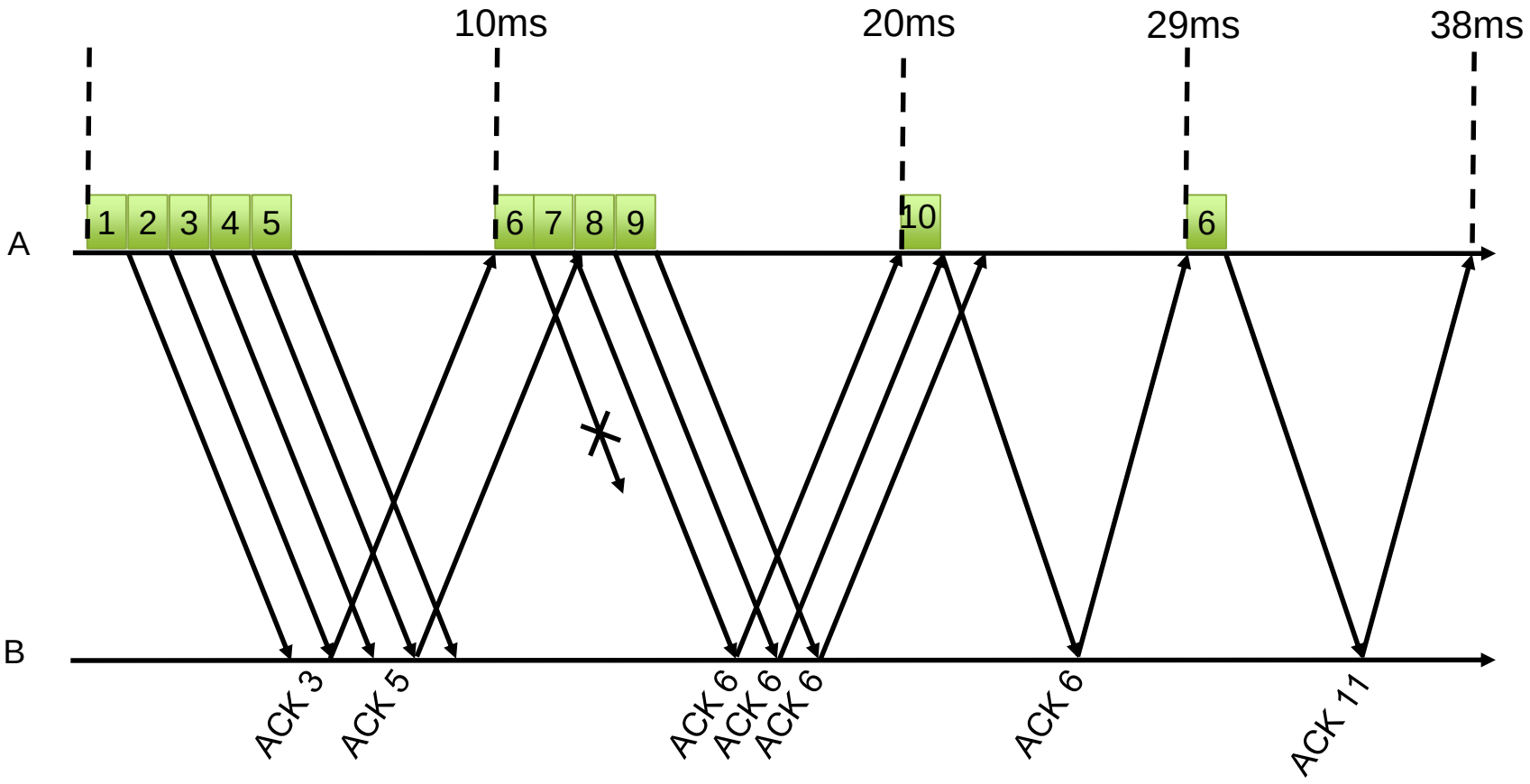
TCP: Q

- Host A sends N = 10 data packets to host B using TCP, complete the following figure:
  - Timeout value 30 ms
  - One-way propagation delay 4 ms
  - Packet transmission time 1ms
  - Ack transmission time 0 ms.

  - *ignore congestion and flow control*
  - *each TCP packet is 1Byte*
  - *initial TCP sequence # is 1*
  - *Delayed-Ack (2 ACKs)*
  - *Fast-retransmit (3 duplicate ACKs)*



TCP: Q


10ms
20ms
29ms
38ms
A
B
1
2
3
4
5
6
7
8
9
10
6
ACK 3
ACK 5
ACK 6
ACK 6
ACK 6
ACK 6
ACK 11

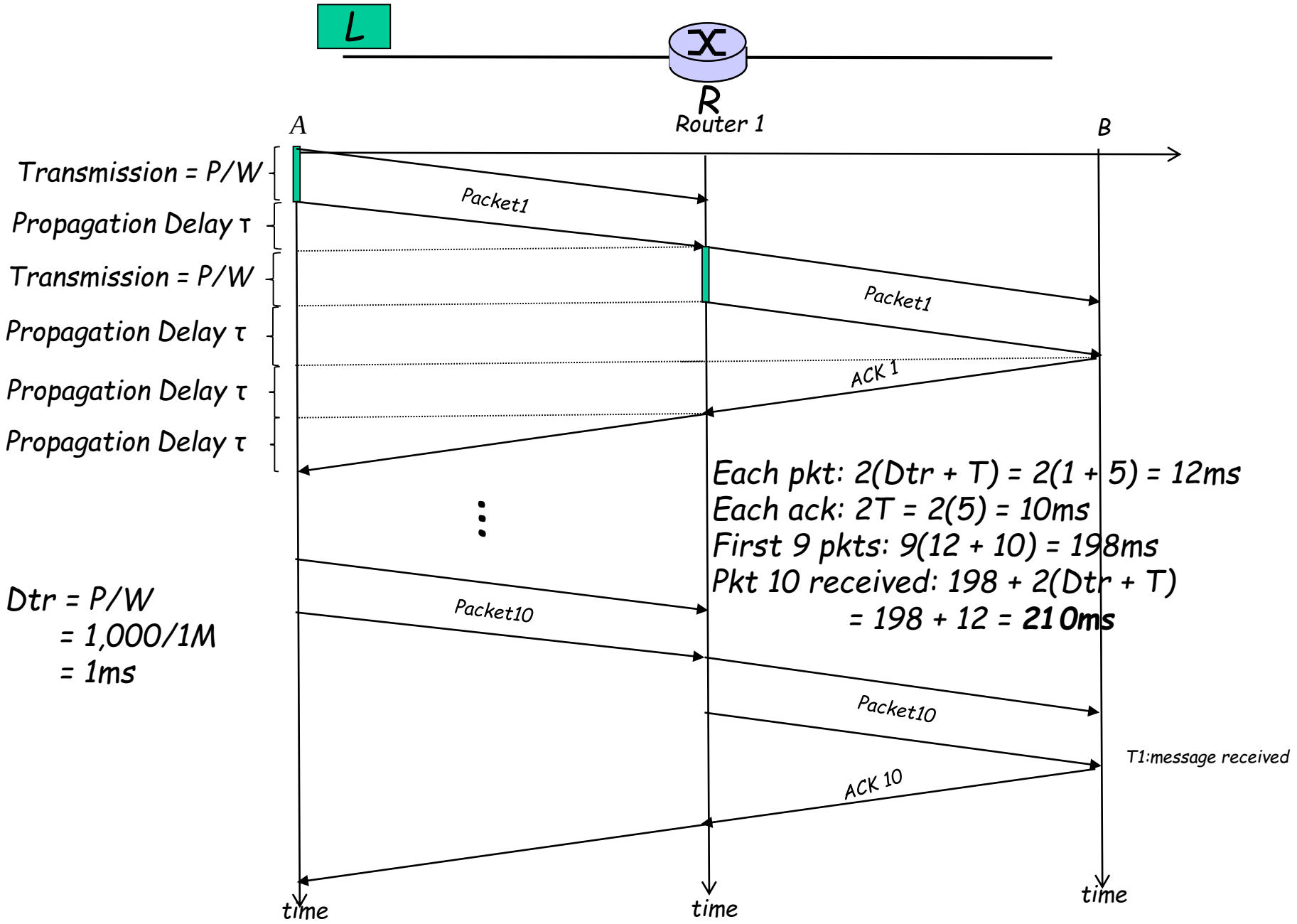
Problem 1 of sample midterm

- Host *A* wants to send to Host B a file of L = 10,000 b
- There are two links and one router (R) on the path from *A* to B
- Packet switching is used for all transmissions in both directions. Each of the two links (*A*-R, R-B) has the same transmission bandwidth W = 1*M bps* and the same propagation delay τ = 5*ms*, in both directions.
- Host *A* breaks the file of L bits into packets of equal size, each consisting of data (D = 1000 bits) and a negligible header (of $H \ll D$ bits) added to it.
- Furthermore, the end-points *A* and B use the stop-and-wait protocol to reliably transmit the file. Host *B* sends back an acknowledgment packet *ACK*, of size H, bits for each packet received. Host *A* waits for a timeout T = 30*ms* to receive the *ACK*.
- If the timeout expires before receiving the *ACK*, *A* retransmits the same packet
- If it receives an *ACK* before the timeout, *A* transmits the next packet.
- Assume zero processing delay at the nodes, infinite supply of packets at host *A*, no delays in sending the *ACK*s. No other traffic flows on that path.

Problem 1 of sample midterm: Part (b)

- First, assume that no packet gets lost or corrupted.
- What is the message delay (i.e., from the time that A starts transmitting until the time B receives the entire file)?
- What is the throughput as seen by A (i.e. the useful bits/sec)?

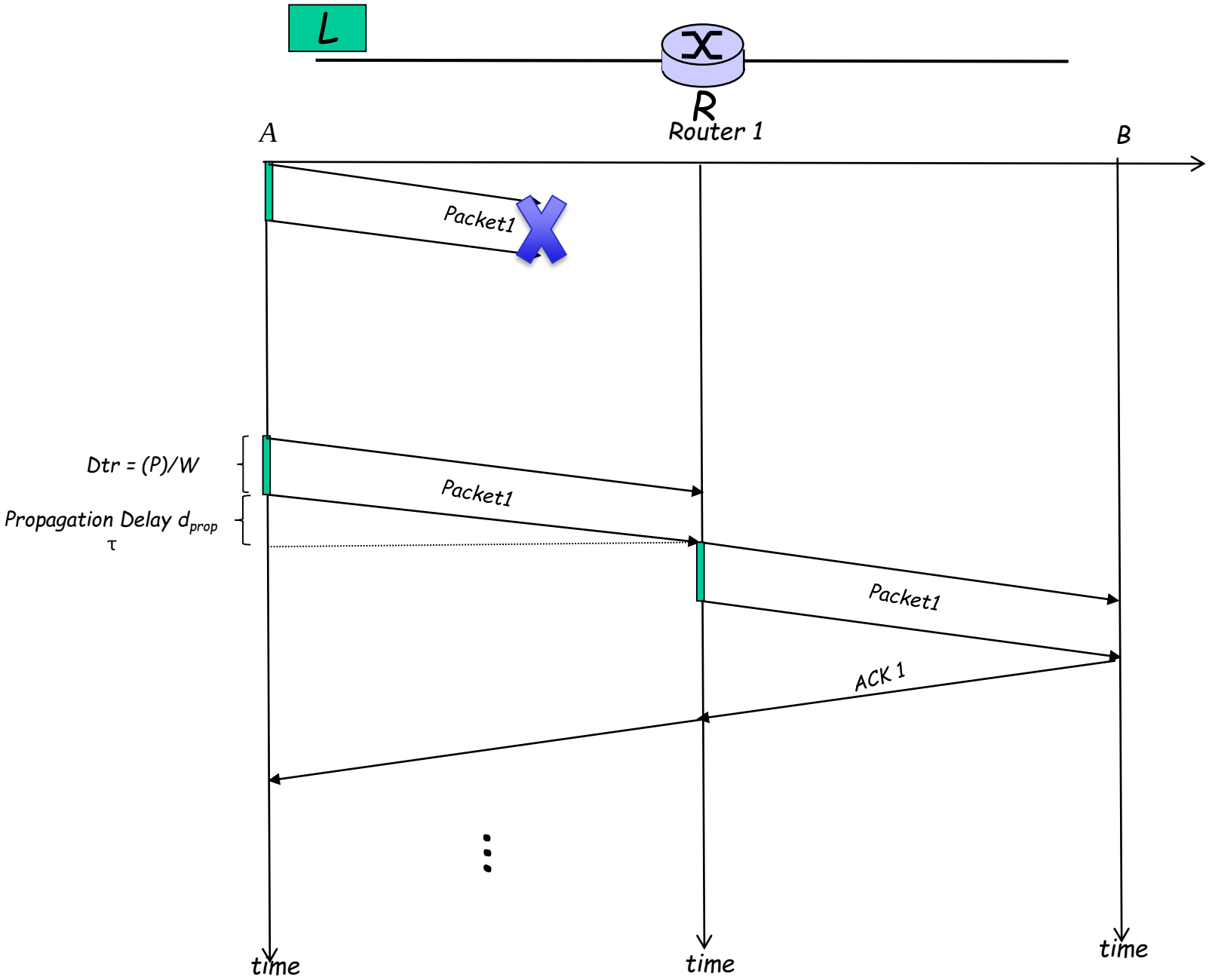
Midterm-16 question1 part(b)



Problem 1 of sample midterm: Part (b)

- First, assume that no packet gets lost or corrupted.
- What is the message delay (i.e., from the time that A starts transmitting until the time B receives the entire file)?
- What is the throughput as seen by A (i.e. the useful bits/sec)?
- Useful bits sent: L
- Time (t) until all of L was acked:
  - Pkt 10 received: 198 + 2(Dtr + T) = 198 + 12 = 210ms
  - Pkt 10 acked: 210 + 2(T) = 210 + 2(5) = 220ms
- Throughput: L/t = 10,000b/220ms = **45.45bpms**

Midterm 16, Question 1, Part (c)



Questions?