Name_____ Student ID_____ Department/Year_____

Midterm Examination

Introduction to Computer Networks
Class#: 901 E31110
Fall 2014

9:10-11:10 Thursday
November 12, 2014

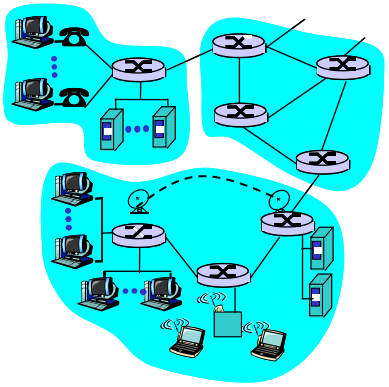
Prohibited

1. You are not allowed to write down the answers using pencils. Use only black- or blue-inked pens.
2. You are not allowed to read books or any references not on the question sheets.
3. You are not allowed to use calculators or electronic devices in any form.
4. You are not allowed to use extra sheets of papers.
5. You are not allowed to have any oral, visual, gesture exchange about the exam questions or answers during the exam.

Cautions

1. Check if you get 12 pages (including this title page), 6 questions.
2. Write your **name in Chinese**, student ID, and department/year down on top of the first page.
3. There are in total 100 points to earn. You have 100 minutes to answer the questions. Skim through all questions and start from the questions you are more confident with.
4. Use only English to answer the questions. Misspelling and grammar errors will be tolerated, but you want to make sure with those errors your answers will still make sense.
5. If you have any extra-exam emergency or problem regarding the exam questions, raise your hand quietly. The exam administrator will approach you and deal with the problem.

1. (Overview) We have seen figures similar to the one on the right. It illustrates a typical composition of a network on the Internet.

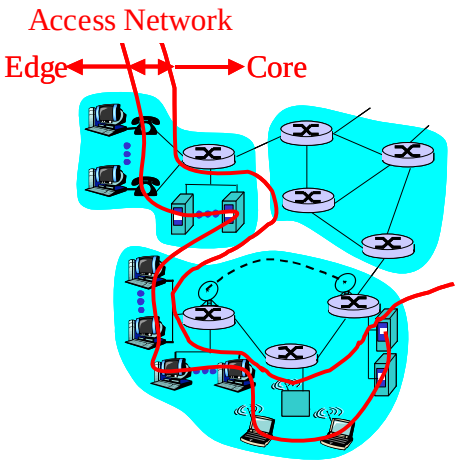


   (1) Based on how you understand what the Internet edge, core, and access network is, circle out the computers belonging to the edge of the network, the computers belonging to the core of the network, and the links belonging to the access network. (4%)

   (2) Name two kinds of Access Network. (4%)

Sample Solution:

(1) As depicted



(2) ADSL, Cable, Ethernet, WiFi, 3G/4G

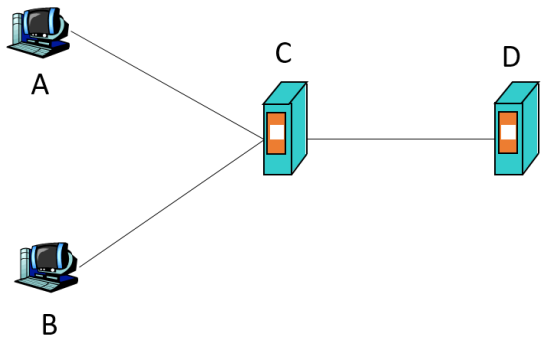
2. (Overview) Compare and contrast circuit switching vs. packet switching.
   (1) Which one needs to set up a connection before transmitting data? (4%)
   (2) Which one allows active data flows to fully utilize the network bandwidth? (4%)
   (3) If you are designing a network that transmits only real-time video calls, which one would you pick? Why? (8%)
   (4) If you are designing a network that transmits only emails, which one would you pick? Why? (8%)

Sample Solution:

   (3) Circuit switching
   (4) Packet switching
   (5) Take your pick and justify.
   (6) Take your pick and justify.

3. (Application) Consider the network depicted below. A and B are Web clients. D is the Web server. The system administrator of A and B's ISP is evaluating whether it is worthwhile setting up a Proxy Server on C to shorten the download delay.

   Now, suppose the time to transmit an HTTP Request or a Web object between A—C is d, and the same for B—C and C—D. Consider the following scenarios and estimate the total download delay with and without setting up the Proxy Server in terms of d.



   (1) Client A begins by downloading Web object #1 and #2. Client B follows by downloading Web object #3 and #4. (4%)
   (2) Client A begins by downloading Web object #1 and #2. Client B follows by downloading Web object #1 and #2. (4%)
   (3) Client A begins by downloading Web object #1 and #2. Client B follows by downloading Web object #2 and #3. (4%)
   (4) Client A begins by downloading N different Web objects. B follows by downloading N Web objects, of which p% have been downloaded by A before. (8%)

Sample Solution:

   (1) With proxy: 16d, without proxy: 16d
   (2) With proxy: 12d, without proxy: 16d
   (3) With proxy: 14d, without proxy: 16d
   (4) With proxy: 4d*N+2d* N*(p/100)+4d*N*(1-p/100)=8dN-2dN*p/100, without proxy: 4d *N+4d*N=8dN

4. (Application) Suppose you are designing the communication part of a multi-functional teleconferencing app. Your teleconferencing app allows voice talk and text-based messaging among the users. The table below shows the QoS (quality of service) the general users demand for the two functions.

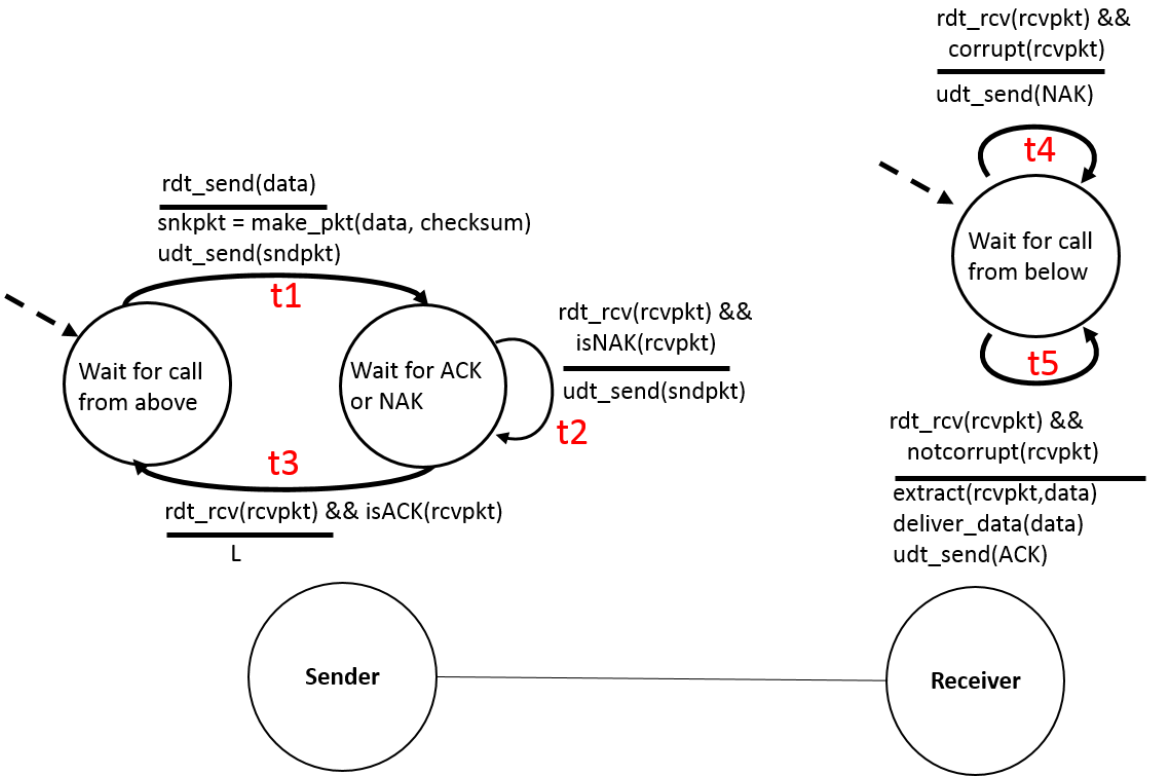
	Loss	Bandwidth	Time Sensitive
Messaging	no loss	elastic	no
Talk	loss tolerant	audio: 5kbps	yes

   (1) Which transport layer services, TCP or UDP, will you choose to transfer the text messages and why? (8%)
   (2) Which transport layer services, TCP or UDP, will you choose to transfer the talk voices and why? (8%)

Sample Solution:

   (1) TCP. No-loss is the only requirement.
   (2) UDP. Delay is important. Reliability isn't. This way, there is no need to wait for the retransmission that might be too late already

5. (Transport) Provided below are the FSMs of rdt 2.0 sender and receiver. Indicate the order of the transitions (in terms of t1, t2, t3, t4, t5) taking place for the following scenarios.

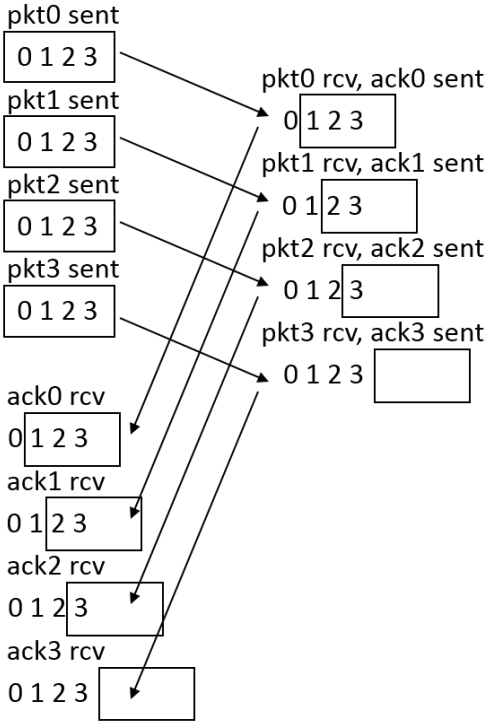


(1) Sender gets a call from above and there is no bit error. (4%)
(2) Sender gets a call from above and there is a bit error in the data packet. (4%).
(3) Sender gets a call from above and there is a bit error in the data packet and the 1st retransmitted data packet. (4%)
(4) Sender gets a call from above and there is a bit error in the ACK packet coming back. (4%)

Sample Solution:

(1) t1, t5, t3
(2) t1, t4, t2, t5, t3
(3) t1, t4, t2, t4, t2, t5, t3
(4) t1, t5, and then the sender hangs. None of the t2 and t3 defines such an event. rdt 2.0 does not handle cases where there are bit errors in the ACK or NAK.

6. (Transport) Recall the mechanism of Go-Back-N and consider a simple case of window size being 4 and a short session of sending 4 data packets. Below is the diagram illustrating how the data packets and the acknowledgement packets are exchanges, as well as how the window at the sender and receiver side are shifted.

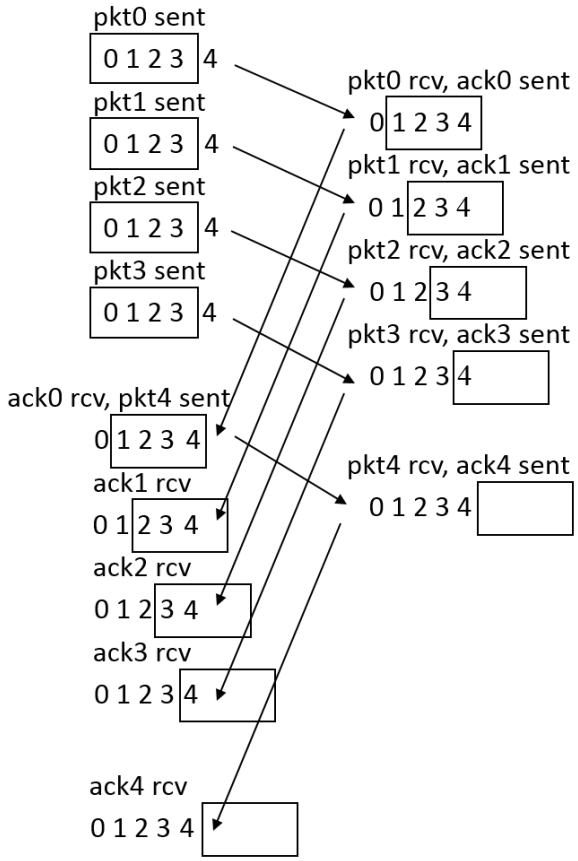


(1) The window size remains 4. Draw the diagram for a session of sending 5 data packets (until acknowledgement packets for all data packets have been received). (8%)

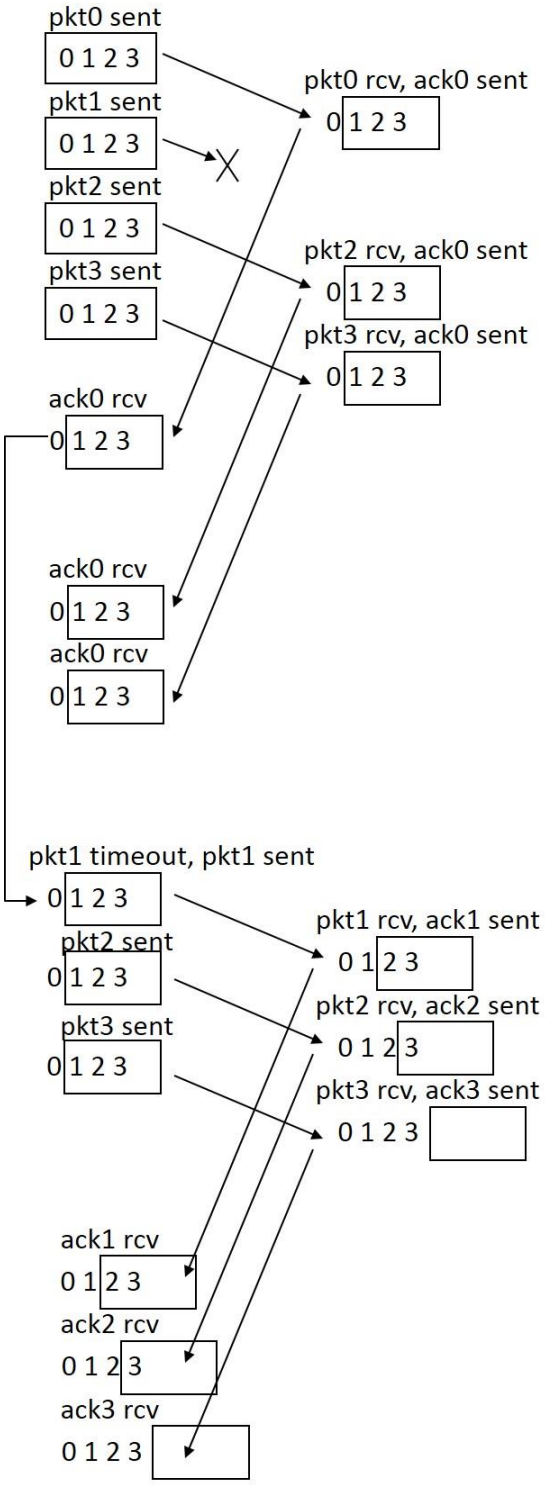
(2) The window size remains 4. Draw the diagram for a session of sending 4 data packets but the 1st transmission of pkt1 is lost (until acknowledgement packets for all data packets have been received). Indicate the starting time of the timer if a retransmission is due to a timer timeout. (8%)

Sample Solution:

(1)



(2)


pkt0 sent
0 1 2 3
pkt1 sent
0 1 2 3
pkt2 sent
0 1 2 3
pkt3 sent
0 1 2 3
pkt0 rcv, ack0 sent
0 1 2 3
pkt2 rcv, ack0 sent
0 1 2 3
pkt3 rcv, ack0 sent
0 1 2 3
ack0 rcv
0 1 2 3
ack0 rcv
0 1 2 3
ack0 rcv
0 1 2 3
pkt1 timeout, pkt1 sent
0 1 2 3
pkt2 sent
0 1 2 3
pkt3 sent
0 1 2 3
pkt1 rcv, ack1 sent
0 1 2 3
pkt2 rcv, ack2 sent
0 1 2 3
pkt3 rcv, ack3 sent
0 1 2 3
ack1 rcv
0 1 2 3
ack2 rcv
0 1 2 3
ack3 rcv
0 1 2 3