COMP3234 Computer and Communication Networks / ELEC3443 Computer Networks
First Semester, 2023-2024
Mid-term Exam
24 Oct 2023 (Tuesday)
12:30 – 13:15pm (45 mins)

This mid-term exam has 45 mins. The total mark is 40. Answer all questions in this paper. Please write your answers directly.

Question 1 [14pts]
  (a) Name three services that TCP provides, but UDP does not provide. [6 pts]
  (b) Give the ***transport layer*** protocol and ***application layer*** protocol for the following applications. [8 pts]
    - E-mail
    - Web browsing
    - Video streaming
    - Domain name system

Answer (some examples):
  (a) Flow control, congestion control, reliable data transfer

  (b)

	Transport layer	Application layer
E-mail	TCP	SMTP/IMAP
Web browsing	TCP	HTTP
Video streaming	UDP/TCP	SIP/RTSP
Domain name system	UDP	DNS

Question 2 [14pts]

This question is related to reliable data transmission.

    (a) In reliable data transmission, why do we need timer? [2pts]

    (b) Why do we use sequence number? [2pts]

    (c) Consider a sender who wants to send **six** packets (from *pkt0* to *pkt5*) to the receiver using **Selective Repeat**. The sender winder size is **three**. Could you please complete the following transmission diagram until all the six packets are sent from the sender to the receiver? You may assume no further packet loss except *pkt2* in the following transmissions. Please write down the *sender window position*, *packet ID*, and *ack ID* for the transmissions. The sender window position [0:2] shows you that the window position starts at 0 and ends at 2 at the beginning of the transmissions. [10pts]
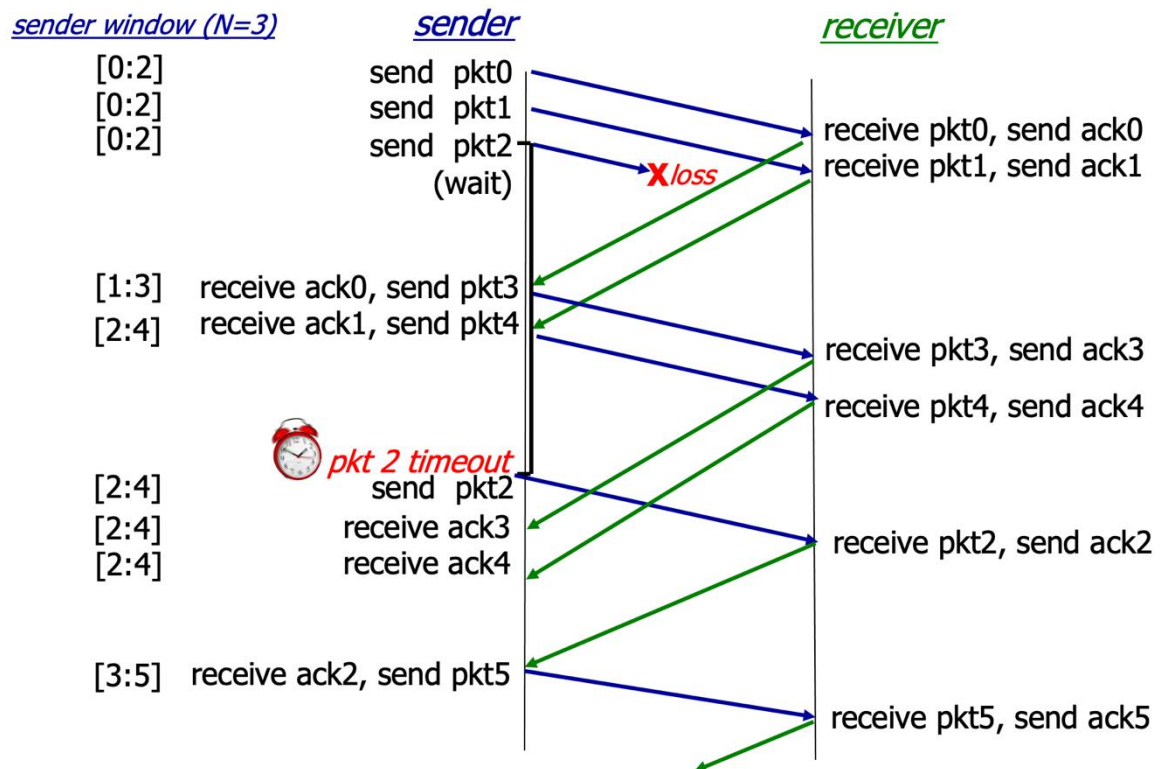
Answer:

  (a) Timer is used for retransmission; because packets may get lost.

  (b) Sequence number is used to handle/avoid duplication.

  (c)

sender window (N=3)	sender	receiver
[0:2]	send pkt0	
[0:2]	send pkt1	receive pkt0, send ack0
[0:2]	send pkt2	receive pkt1, send ack1
	(wait)	
[1:3]	receive ack0, send pkt3	
[2:4]	receive ack1, send pkt4	receive pkt3, send ack3
		receive pkt4, send ack4
[2:4]	pkt 2 timeout / send pkt2	
[2:4]	receive ack3	receive pkt2, send ack2
[2:4]	receive ack4	
[3:5]	receive ack2, send pkt5	receive pkt5, send ack5

X loss

Question 3 [12pts]:
Suppose users share a 3Mbps link. Also, suppose each user required 200 kbps when transmitting, but each user transmits only 10 percent of the time.
  (a) When circuit switching is used, how many users can be supported? [4pts]
  (b) For the remainder of this problem, suppose packet switching is used. Suppose there are 20 users. Find the probability that there are more than 15 users transmitting simultaneously. You can use the expression, *C(n,r)*, to represent the combinations formula. [8pts]

$$C(n,r) = \frac{n!}{r!\,(n-r)!}$$

Answer:
  (a) 3×10^6 / $200*10^3$ = 3000000/200000 = 15 users
  (b) P(user >15) = sum_{k=16, 17, 18, 19, 20} C(20,k) (0.1)^k (0.9)^(20-k)
      = C(20,16) (0.1)^16 (0.9)^4 + C(20,17) (0.1)^17 (0.9)^3 + C(20,18) (0.1)^18 (0.9)^2
      + C(20,19) (0.1)^19 (0.9) + (0.1)^20