23.4.2 Questions

Q23-1. Assume we have a set of dedicated computers in a system, each designed to perform only a single task. Do we still need host-to-host and process-to-process communication and two levels of addressing?
No, if they run only one process each, no port number is needed. They only need the hosts' addresses

Q23-2. Operating systems assign a process number to every running application program. Can you explain why these process numbers cannot be used instead of port numbers?
Usually the process number is given randomly. Since this number is random, the communication between client and server using this random number can't be known by each other.

Q23-3. Assume you need to write and test a client-server application program on two hosts you have at home.
a. What is the range of port numbers you would choose for the client program?
Dynamic Ports (49152 ~ 65535)
b. What is the range of port numbers you would choose for the server program?
Well-known Ports (0 ~ 1023)
c. Can the two port numbers be the same?
No

Q23-4. Assume a new organization needs to create a new server process and allow its customers to access the organization site using that process. How should the port number for the server process be selected?
Select one of Well-Known Port Number

Q23-5. In a network, the size of the receive window is 1 packet. Which of the following protocols is being used by the network?
a. Stop-and-Wait b. Go-Back-N c. Selective-Repeat

Q23-6. In a network, the size of the send window is 20 packets. Which of the following protocols is being used by the network?
a. Stop-and-Wait b. Go-Back-N c. Selective-Repeat

Q23-7. In a network with fixed value for m > 1, we can either use the Go-Back-N or the Selective-Repeat protocol. Describe the advantage and the disadvantage of using each. What other network criteria should be considered to select either of these protocols?

	GBN Protocol	SR Protocol
Adv.	Receiver입장에서의 패킷을 받는 과정을 간소화 시켜줌	실제로 lost된 패킷만 재송신 함(효율적)
Disadv.	많은 패킷이 Lost 될 경우 매우 비효율적이 됨(전체 재송신)	Receiver쪽에도 저장공간이 필요함

Reliability, lost될 확률에 영향

Q23-8. Since the field that stores the sequence number of a packet is limited in size, the sequence number in a protocol needs to wrap around, which means that two packets may have the same sequence number. In a protocol that uses m bits for the sequence-number field, if a packet has the sequence number x, how many packets need to be sent to see a packet with the same sequence number x, assuming that each packet is assigned one sequence number?
$2^m -1$ packets

Q23-9. Does the wraparound situation we discussed in the previous question create a problem in a network?
No, the sliding window will be designed to prvent problems

Q23-10. Can you explain why some transport-layer packets may be received out of order in the Internet?

Some of the packets may be lost and the packet next that may arrive safely

Q23-11. Can you explain why some transport-layer packets may be lost in the Internet?

Because of the external problems(electricity) or receiver may not be able to receive in the sender's sending speed so discarding it

Q23-12. Can you explain why some transport-layer packets may be duplicated in the Internet?

If there's no flow control of sequence number, ack might not be sent properly bur sender doesn't know so it sends the same packet

Q23-13. In the Go-Back-N protocol, the size of the send window can be 2m − 1, while the size of the receive window is only 1. How can flow control be accomplished when there is a big difference between the size of the send and receive windows?

GBN Protocol sends the entire oustanding packets in case of timeout, and receiver just has to send ACK using cumulative sequence number, which will help sender if the packets are being sent properly

Q23-14. In the Selective-Repeat protocol, the size of the send and receive windows is the same. Does this mean that there are supposed to be no packets in transit?

No, receiver window's size is same as sender to keep track of safely sent packets, and the packets are sent in sequel

23.4.3 Problems

P23-1. Compare the range of 16-bit addresses, 0 to 65,535, with the range of 32-bit IP addresses, 0 to 4,294,967,295 (discussed in Chapter 18). Why do we need such a large range of IP addresses, but only a relatively small range of port numbers?

port numbers are needed to identify the processes of the host, not as many as the number of hosts in whole world. So it doesn't need that big range.

P23-2. Can you explain why ICANN has divided the port numbers into three groups: well-known, registered, and dynamic?

Well-known for servers, registered to prevent duplicates, and dynamic for privat

P23-3. A sender sends a series of packets to the same destination using 5-bit sequence numbers. If the sequence numbers start with 0, what is the sequence number of the 100th packet?

4

P23-4. In each of the following protocols, how many packets can have independent sequence numbers before wraparound occurs (see the previous problems).
a. Stop-and-Wait : 2
b. Go-Back-N with m = 8 : 256
c. Select-Repeat with m = 8 : 256

P23-5. Using 5-bit sequence numbers, what is the maximum size of the send and receive windows for each of the following protocols?
a. Stop-and-Wait : 1, 1
b. Go-Back-N : 31, 1
c. Selective-Repeat : 16, 16

P23-6. Show the FSM for an imaginary machine with three states: A (starting state), B, and C; and four events: events 1, 2, 3, and 4. The following specify the behavior of the machine:

a. When in state A, two events may occur: event 1 and event 2. If event 1 occurs, the machine performs action 1 and moves to state B. If event 2 occurs, the machine moves to state C (no action).

b. When in state B, two events may occur: event 3 and event 4. If event 3 occurs, the machine performs action 2, but remains in state B. If event 4 occurs, the machine just moves to state C.

c. When in state C, the machine remains in this state forever.
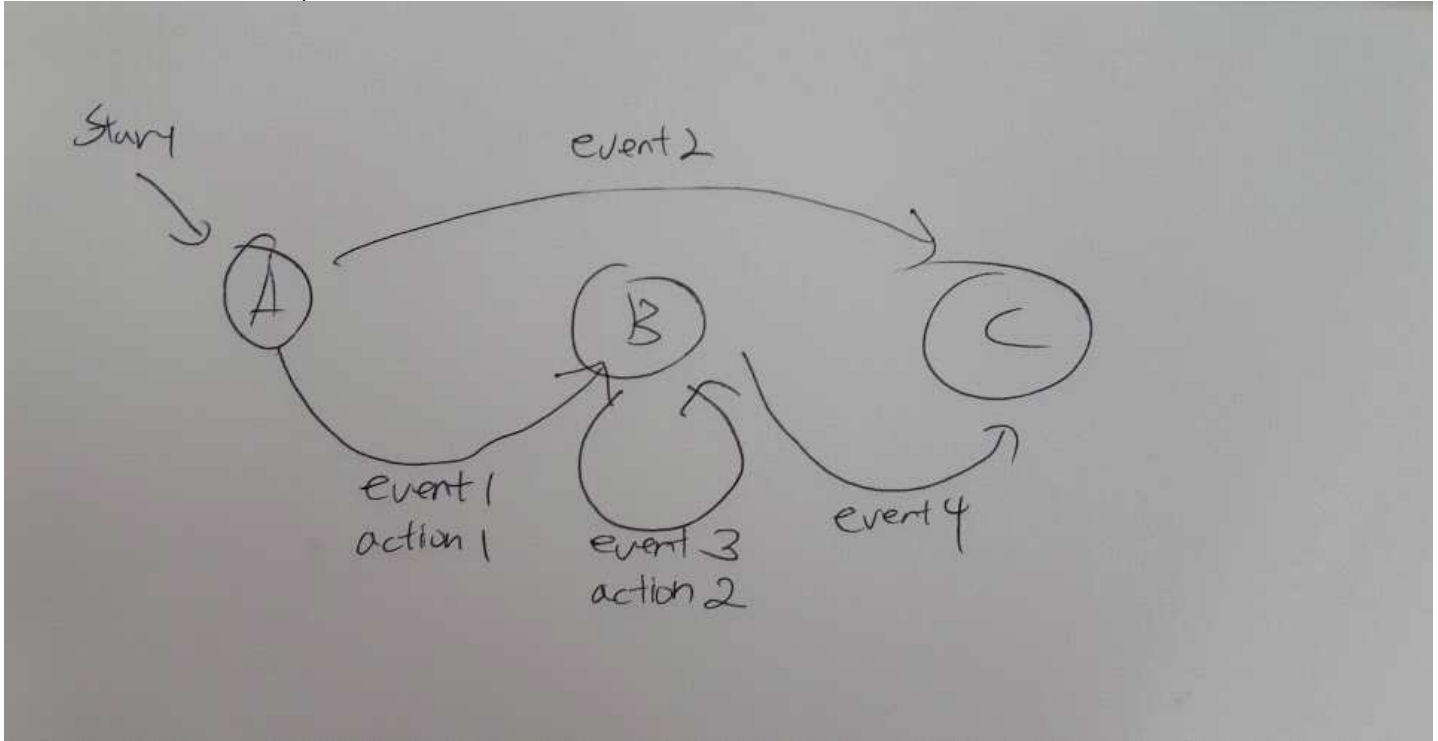
P23-7. Assume that our network never corrupts, loses, or duplicates packets. We are only concerned about flow control. We do not want the sender to overwhelm the receiver with packets. Design an FSM to allow the sender to send a packet to the receiver only when the receiver is ready. If the receiver is ready to receive a packet, it sends an ACK. Lack of getting an ACK for the sender means that the receiver is not ready to receive more packets.
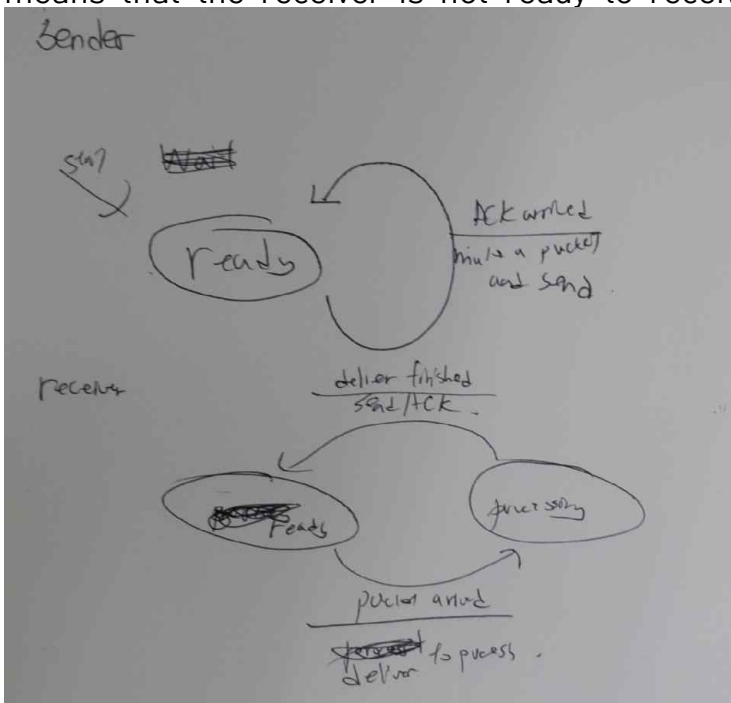
P23-8. Assume that our network may corrupt packets, but it never loses or duplicates a packet. We are also concerned about flow control. We do not want the sender to overwhelm the receiver with packets. Design an FSM of a new protocol to allow these features.
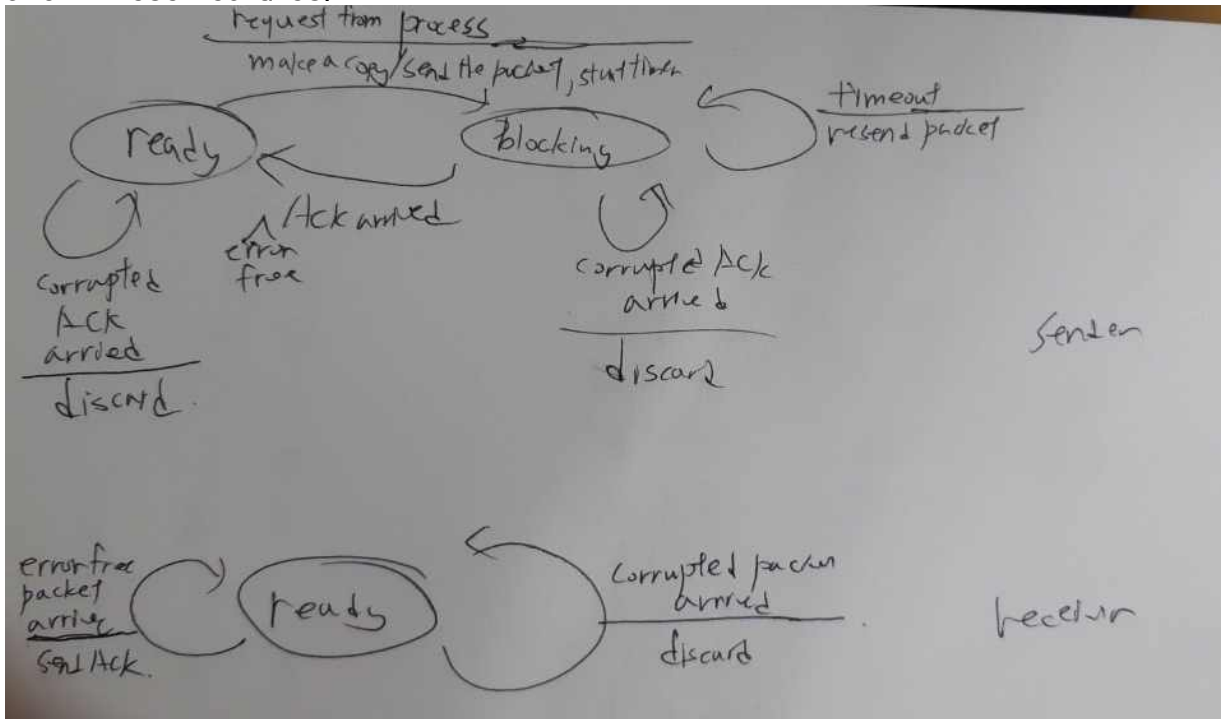

P23-9. In the Stop-and-Wait protocol, show the case in which the receiver receives a duplicate packet (which is also out of order).
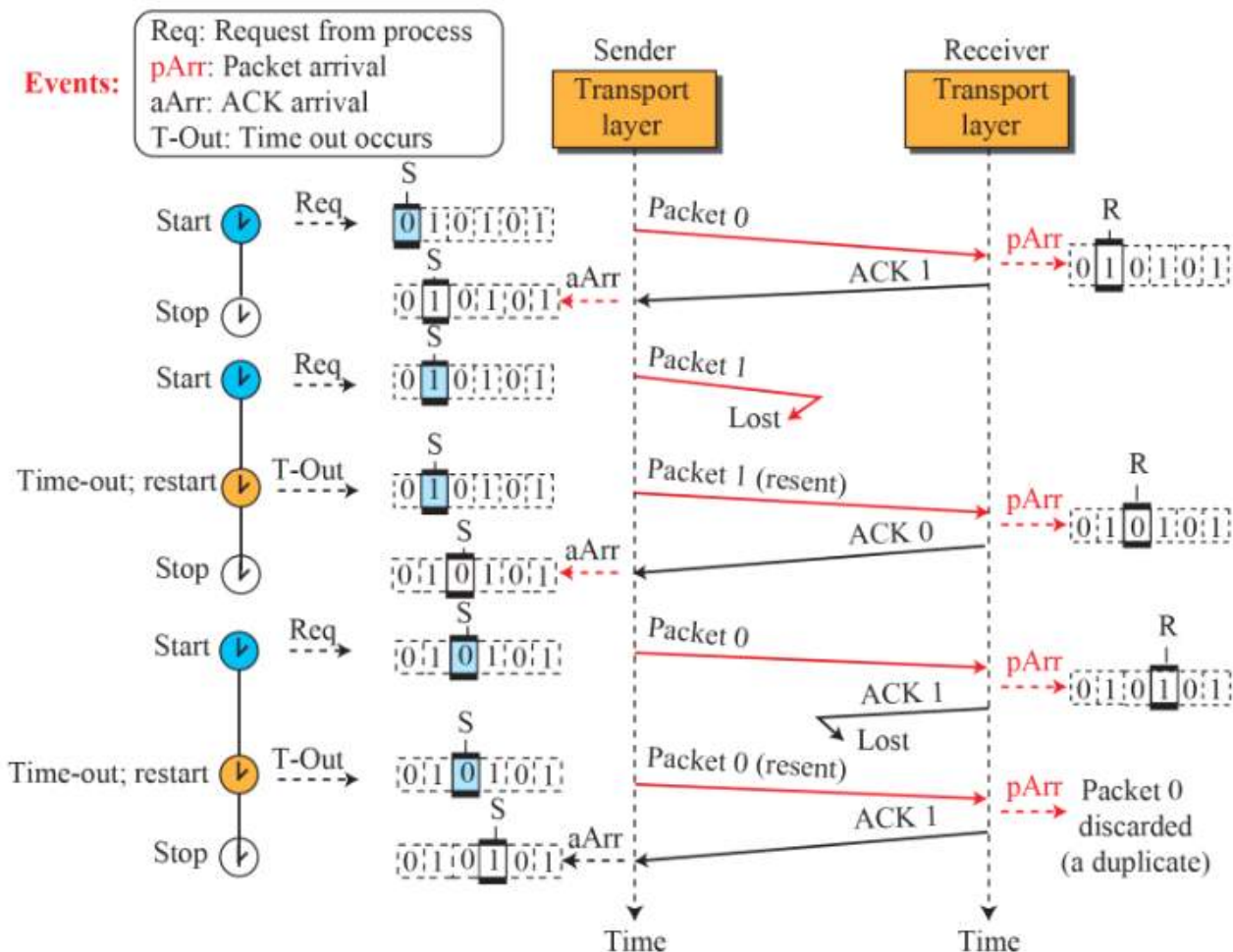
P23-10. Assume we want to change the Stop-and-Wait protocol and add the NAK (negative ACK) packet to the system. When a corrupted packet arrives at the receiver, the receiver discards the packet, but sends a NAK with a nakNo defining the seqNo of the corrupted packet. In this way, the sender can resend the corrupted packet without waiting for the time-out. Explain what changes need to be made in the FSM of Figure 23.21 and show an example of the operation of the new protocol with a time-line diagram.

Change the timeout to the receive NAK
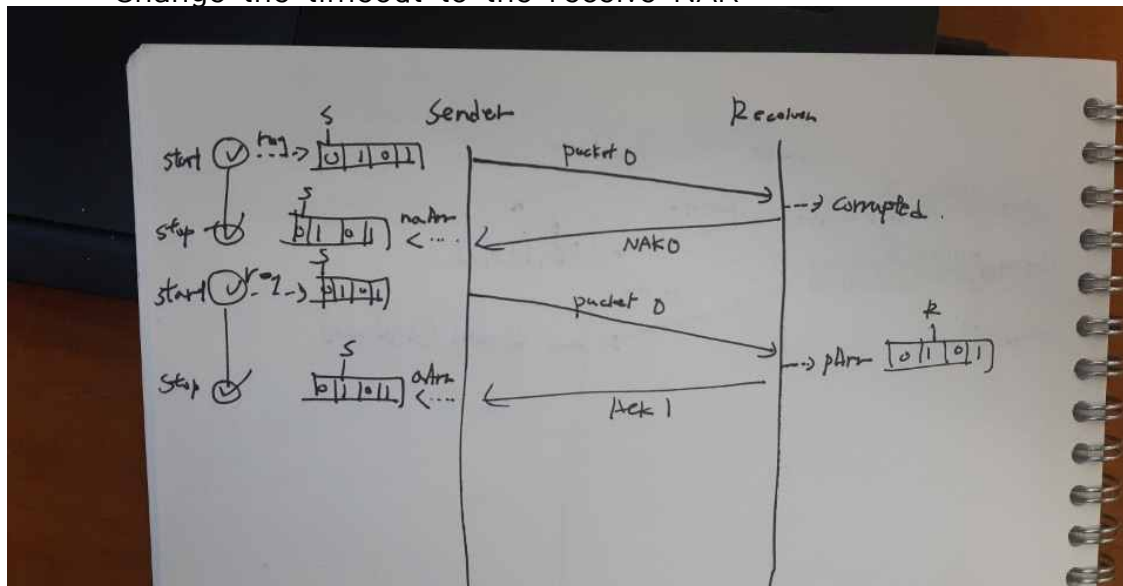
P23-11. Redraw Figure 23.19 with 5 packets exchanged (0, 1, 2, 3, 4). Assume packet 2 is lost and packet 3 arrives after packet 4.
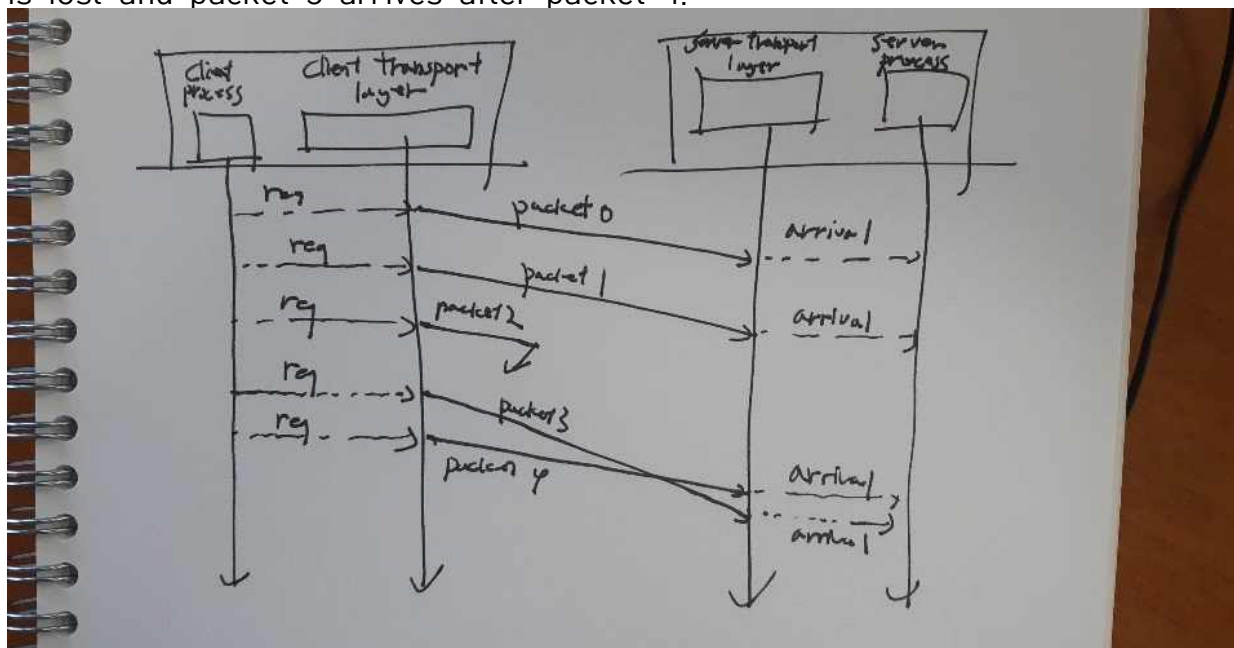
P23-12. Create a scenario similar to Figure 23.22 in which the sender sends three packets. The first and second packets arrive and are acknowledged. The third packet is delayed and resent. The duplicate packet is received after the acknowledgment for the original is sent.
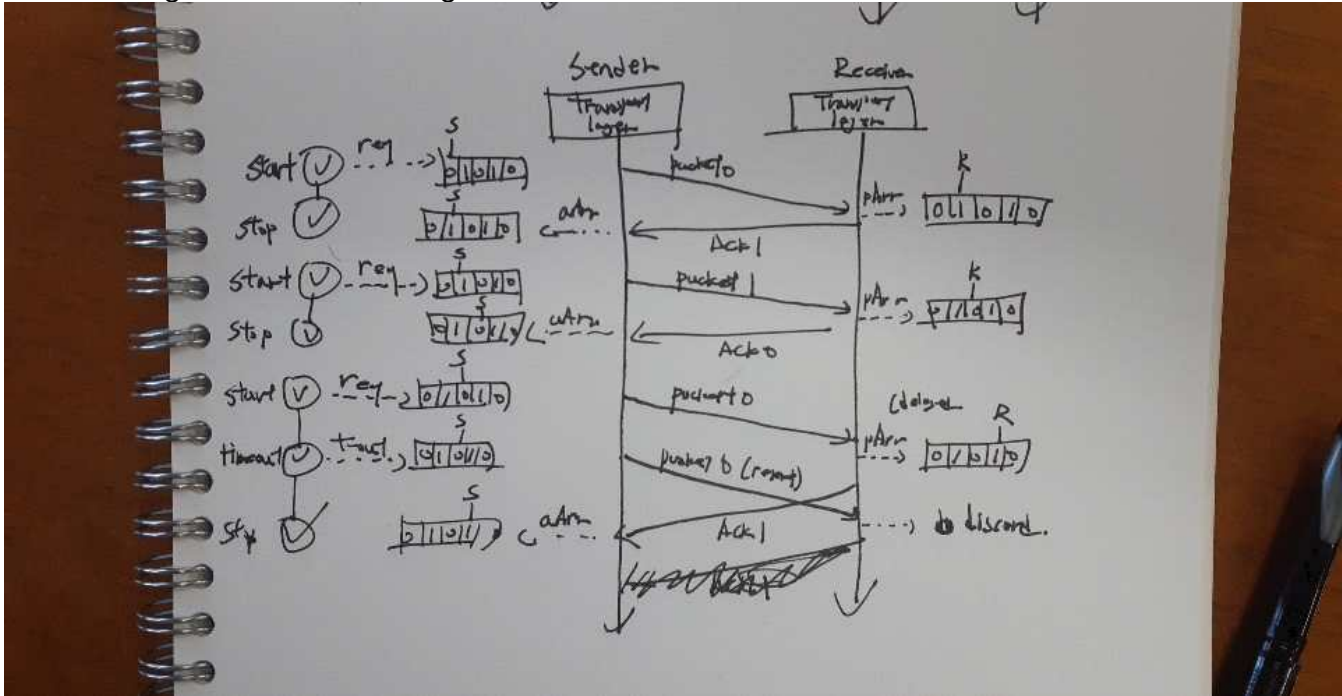
P23-13. Create a scenario similar to Figure 23.22 in which the sender sends two packets.
The first packet is received and acknowledged, but the acknowledgment is lost. The sender resends the packet after time-out. The second packet is lost and resent.
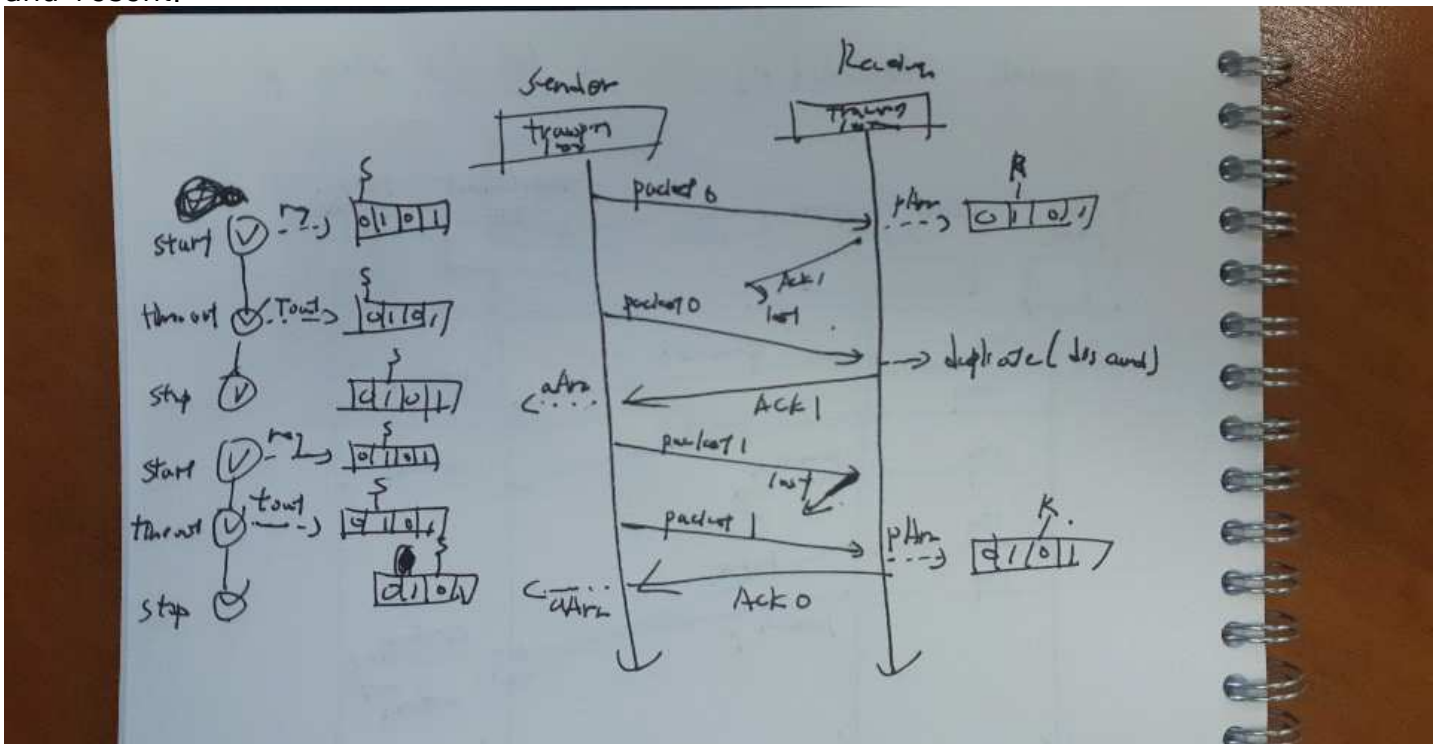
P23-14. Redraw Figure 23.29 when the sender sends 5 packets (0, 1, 2, 3, and 4). Packets
0, 1, and 2 are sent and acknowledged in a single ACK, which arrives at the
sender site after all packets have been sent. Packet 3 is received and acknowledged
in a single ACK. Packet 4 is lost and resent.

P23-15. Redraw Figure 23.35 if the sender sends 5 packets (0, 1, 2, 3, and 4). Packets
0, 1, and 2 are received in order and acknowledged, one by one. Packet 3 is
delayed and received after packet 4.

P23-16. Answer the following questions related to the FSMs for the Stop-and-Wait
protocol (Figure 23.21):
a. The sending machine is in the ready state and S = 0. What is the sequence
number of the next packet to send?
    0
b. The sending machine is in the blocking state and S = 1. What is the
sequence number of the next packet to send if a time-out occurs?
    1
c. The receiving machine is in the ready state and R = 1. A packet with the
sequence number 1 arrives. What is the action in response to this event?
    Deliver the message to application, slide the window forward and send ACK with
    ackNo = R
d. The receiving machine is in the ready state and R = 1. A packet with the
sequence number 0 arrives. What is the action in response to this event?
    Discard the packet, send ACK with ackNo = R

P23-17. Answer the following questions related to the FSMs for the Go-back-N
protocol with m = 6 bits. Assume the window size is 63. (Figure 23.27):
a. The sending machine is in the ready state with Sf = 10 and Sn = 15. What is
the sequence number of the next packet to send?
    15
b. The sending machine is in the ready state with Sf = 10 and Sn = 15. A time-out
occurs. How many packets are to be resent? What are their sequence numbers?
    5 (10,11,12,13,14)
c. The sending machine is in the ready state with Sf = 10 and Sn = 15. An
ACK with ackNo = 13 arrives. What are the next values of Sf and Sn?
    Sf = 13, Sn = 15
d. The sending machine is in the blocking state with Sf = 14 and Sn = 21.
What is the size of the window?
    7
e. The sending machine is in the blocking state with Sf = 14 and Sn = 21. An
ACK with ackNo = 18 arrives. What are the next values of Sf and Sn? What
is the state of the sending machine?
    Sf = 18, Sn = 21, ready
f. The receiving machine is in the ready state with Rn = 16. A packet with
sequence number 16 arrives. What is the next value of Rn? What is the
response of the machine to this event?
    17, Deliver message, slide window and send ACK

P23-18. Answer the following questions related to the FSMs for the Selective-Repeat
protocol with m = 7 bits. Assume the window size is 64. (Figure 23.34):
a. The sending machine is in the ready state with Sf = 10 and Sn = 15. What is
the sequence number of the next packet to send?
    15
b. The sending machine is in the ready state with Sf = 10 and Sn = 15. The
timer for packet 10 times out. How many packets are to be resent? What are
their sequence numbers?
    1, 10
c. The sending machine is in the ready state with Sf = 10 and Sn = 15. An
ACK with ackNo = 13 arrives. What are the next values of Sf and Sn? What
is the action in response to this event?
    Sf = 10, Sn = 15, Mark the corresponding packet(13)

d. The sending machine is in the blocking state with Sf = 14 and Sn = 21.
What is the size of the window?
	7
e. The sending machine is in the blocking state with Sf = 14 and Sn = 21. An
ACK with ackNo = 14 arrives. Packets 15 and 16 have already been
acknowledged. What are the next values of Sf and Sn? What is the state of
the sending machine?
	Sf = 17, Sn = 21, Ready
f. The receiving machine is in the ready state with Rn = 16. The size of the
window is 8. A packet with sequence number 16 arrives. What is the next
value of Rn? What is the response of the machine to this event?
	Rn = 24, deliver the packet and all consecutive previously arrived and stored
	packets to application, and slide window

P23-19. We can define the bandwidth-delay product in a network as the number of
packets that can be in the pipe during the round-trip time (RTT). What is the
bandwidth-delay product in each of the following situations?
a. Bandwidth: 1 Mbps, RTT: 20 ms, packet size: 1000 bits
	20
b. Bandwidth: 10 Mbps, RTT: 20 ms, packet size: 2000 bits
	100
c. Bandwidth: 1 Gbps, RTT: 4 ms, packet size: 10,000 bits
	400

P23-20. Assume we need to design a Go-Back-N sliding-window protocol for a network
in which the bandwidth is 100 Mbps and the average distance between
the sender and receiver is 10,000 km. Assume the average packet size is
100,000 bits and the propagation speed in the media is 2 × 108 m/s. Find the
maximum size of the send and receive windows, the number of bits in the
sequence number field (m), and an appropriate time-out value for the timer.
	sender window = 100, receiver window = 1, m = 7

P23-21. Assume we need to design a Selective-Repeat sliding-window protocol for a
network in which the bandwidth is 1 Gbps and the average distance between
the sender and receiver is 5,000 km. Assume the average packet size is 50,000
bits and the propagation speed in the media is 2 × 108 m. Find the maximum
size of the send and receive windows, the number of bits in the sequence number
field (m), and an appropriate time-out value for the timer.
	sender window = 500, receiver window = 500, m = 10

P23-22. An acknowledgment number in the Go-Back-N protocol defines the next
packet expected, but an acknowledgment number in the Selective-Repeat protocol
defines the sequence number of the packet to be acknowledged. Can you
explain the reason?
	GBN goes back to the Sf when timeout occurs and sends the whole message
	again, which means it doesn't have to mark the received numbers. On the other
	hand SR marks all the ack it received so it sends the received number

P23-23. In a network using the Go-Back-N protocol with m = 3 and the sending window
of size 7, the values of variables are Sf = 62, Sn = 66, and Rn = 64.
Assume that the network does not duplicate or reorder the packets.
a. What are the sequence numbers of data packets in transit?
	0, 1
b. What are the acknowledgment numbers of ACK packets in transit?
	6, 7

P23-24. In a network using the Selective-Repeat protocol with m = 4 and the sending window of size 8, the value of variables are Sf = 62, Sn = 67, and Rn = 64. Packet 65 has already been acknowledged at the sender site; packets 65 and 66 are received out-of-order at the receiver site. Assume that the network does not duplicate the packets.

a. What are the sequence numbers of pending data packets (in transit, corrupted, or lost)?

     0, 3

b. What are the acknowledgment numbers of pending ACK packets (in transit, corrupted, or lost)?

     14, 15, 2