CHAPTER 10

Data Link Control

10.1 REVIEW QUESTIONS

1. Transmission means to put a signal on a line. Communication is a meaningful and orderly relationship between devices that send and receive data.
3. The purpose of line discipline is to determine which device should send data at a given time and to make sure the receiver is ready to receive the data. The line discipline functions of the data link layer oversee the establishment of links and the right of a particular device to transmit data at a given time.
5. The initiator of the transmission first transmits an ENQ frame asking the receiver if it is ready to receive data. The receiver then answers either with an ACK frame if it is ready or with a NAK frame otherwise.
7. In ENQ/ACK, no addressing is needed because it is a point-to-point connection, which means that any transmission put on the link by one device must be intended for only the other device it is connected to. In poll/select on the other hand, there are several secondary devices and in order to identify and communicate with a specific secondary device, addressing is needed.
9. Flow control prevents the receiving device from being overwhelmed with data.
11. Stop-and-wait and sliding-window.
13. In sliding-window flow control, the sender may transmit several frames before needing an acknowledgment. The receiver can send a single ACK frame to confirm multiple data frames.
15. Stop-and wait ARQ and sliding window ARQ.
17. The sender waits until it receives an acknowledgment for the last frame sent before sending another frame. The sending device keeps a copy of the frame sent until it receives an ACK. The ACK frames are numbered 0 and 1 alternately to identify the frame. If an error is detected at the receiver it will transmit a NAK frame to request the retransmission of the last frame sent. The sending device has a timer so when time runs out it assumes the frame got lost and resends the last frame.

19. Parameters to be considered are the speed at which the receiver can process data and the size of the buffer to store incoming data at the receiver.

21. If a NAK gets lost, the sender timer expires. The sender automatically retransmits the last frame sent. The NAK frames are not numbered because the sender waits for an acknowledgment after each frame is sent. If the sender receives a NAK frame it automatically knows that the last frame sent was damaged and retransmits that frame.

23. In the ARQ method frames are discarded when the receiver receives duplicates of already sent frames. This can happen in the case of lost acknowledgment frames, or in go-back-n when a damaged frame is received or a data frame gets lost. In this case all frames sent after that damaged or lost frame will be discarded until the receiver receives an undamaged copy of the damaged or lost frame.

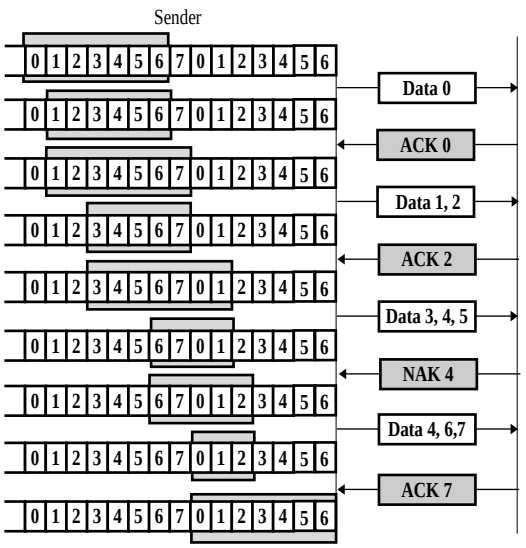
10.2 MULTIPLE CHOICE QUESTIONS

25. a 27. b 29. a 31. b 33. c 35. b 37. d 39. c 41. d 43. a 45. a

10.3 EXERCISES

47. See Figure 10.1

Figure 10.1 *Exercise 47*



49.

a. No number

b. The number refers to the damaged frame; all frames sent since that last frame acknowledged should be resent.

c. The number refers to the damaged frame; only that frame should be resent.

51.

a. Frames 7 and 0 received; next frame expected is frame 1

b. Frames 7, 0, 1, 2, and 3 received; next frame expected is frame 4

c. Frames 7, 0, 1, 2 received; the next frame expected is frame 3

d. Frames 7 and 0 received; frame 1 was damaged or lost. Frames 1, 2, and 3 should be resent.

e. Frames 7, 0, 1, and 2 received; frame 3 damaged or lost. Frame 3 should be resent.

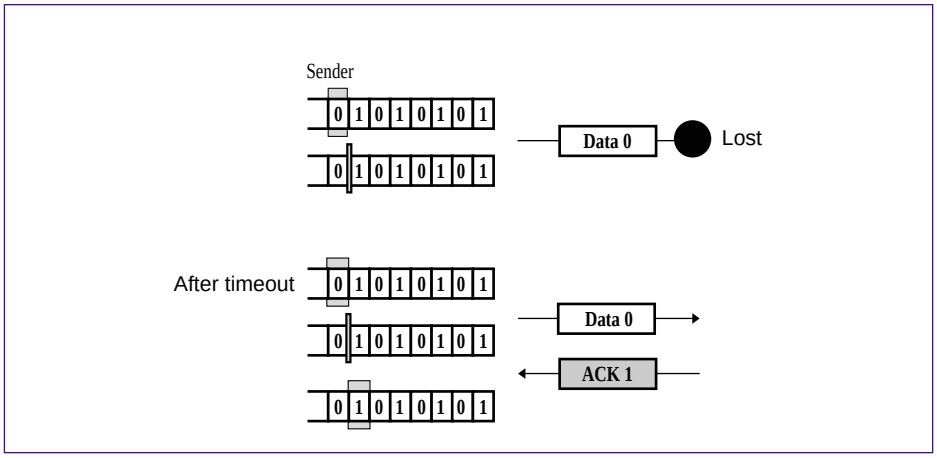
f. Frame 7 damaged or lost. Frames 7, 0, 1, 2, and 3 should be resent.

53. 127.

55. Window size is 15.

57. See Figure 10.2

Figure 10.2 *Exercise 57*



59. See Figure 10.3

61. See Figure 10.4.

63. 80 µs

65. less than 6 ms

67. See Figure 10.5.

69. See Figure 10.6.

Figure 10.3 *Exercise 59*

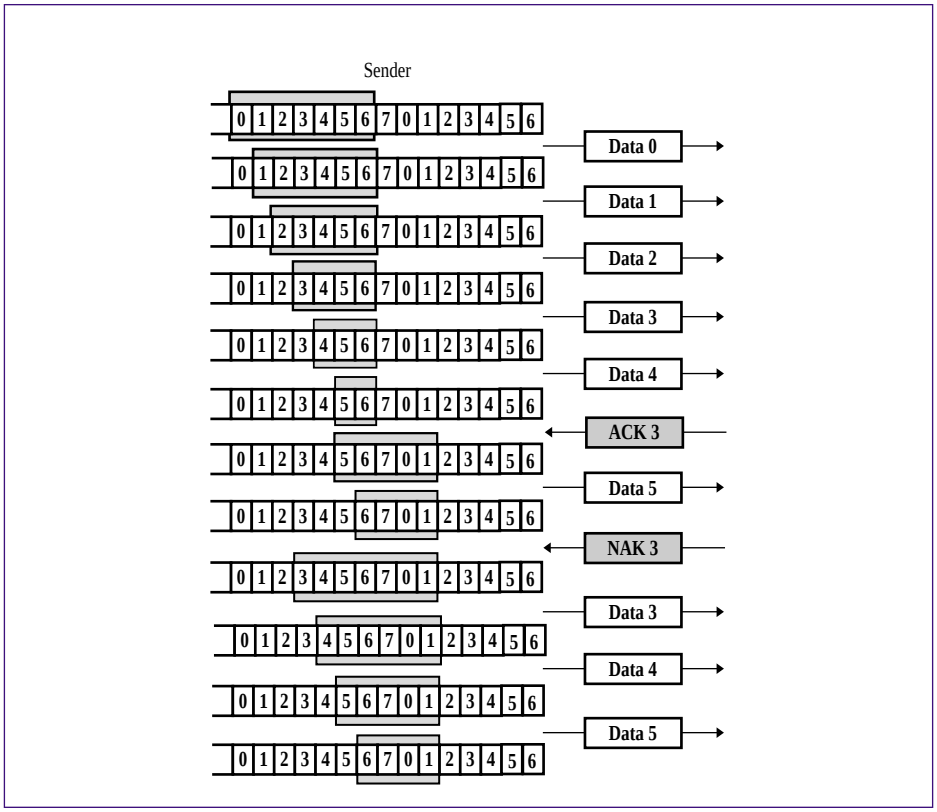


Figure 10.4 *Exercise 61*

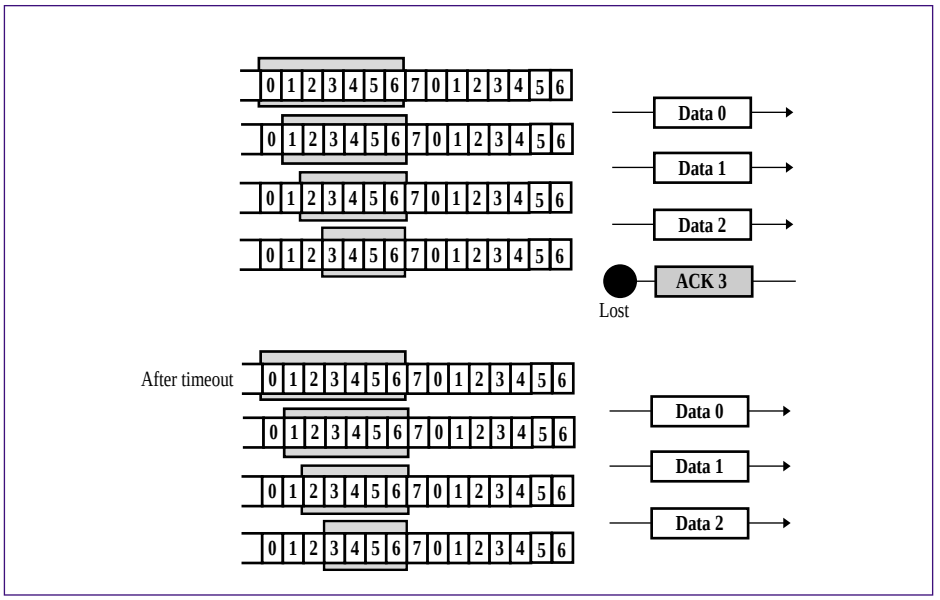


Figure 10.5 *Exercise 67*

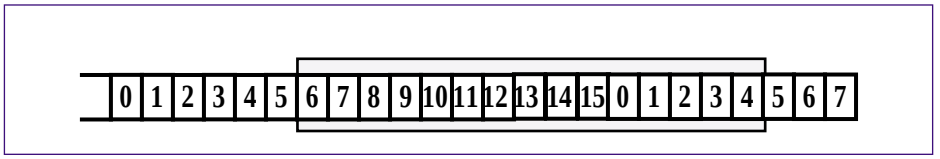


Figure 10.6 *Exercise 69*