CHAPTER 6

Transmission of Digital Data: Interfaces and Modems

6.1 REVIEW QUESTIONS

1. In parallel mode, bits are grouped together and transmitted simultaneously over separate communication lines. In serial mode, all bits are transmitted over only one communication line and one bit follows another.
2. Advantage: increase of transmission speed and therefore efficiency. Disadvantage: cost of multiple communication lines.
3. In asynchronous transmission, there is no timing needed at the byte level, because information is received and translated by agreed-upon patterns. This method is mostly used for low-speed communication. In synchronous transmission, timing is very important. This method is very fast and used for high-speed transmissions.
4. A DTE is any device (e.g., a computer) that is a source or destination for binary digital data. A DCE is any device (e.g., a modem) that transmits or receives data in the form of analog or digital signals through a network.
5. EIA and ITU-T have been involved in developing DTE/DCE interfaces.
6. EIA-232, EIA-442, EIA-449, V and X series
7. DB-25 and DB-9 are implementations of EIA-232. DB-9 has fewer pins and fewer functions and is used in a single asynchronous connection, while DB-25 allows full-duplex transmission.
8. A null modem is used to connect two compatible digital devices directly over a short distance. Signals do not need to be modulated, therefore a null modem is a DTE/DTE interface without DCEs.
9. In a null modem, links must be crossed. Pin 2 is for transmitting data and pin 3 is for receiving data. Therefore pin 2 of the first DTE connects to pin 3 of the second DTE and pin 2 of the second DTE connects to pin 3 of the first DTE.
10. RS-423 is an unbalanced circuit specification and defines only one line for propagating a signal while RS-422, which is used for balanced circuits, defines two lines for propagating a signal: one for the original signal and one for its complement. RS-422 has better performance with respect to noise.

11. X.21 eliminates most of the control circuits by directing their traffic over data circuits.
12. Modem: modulator/demodulator.
13. A modulator converts a digital signal into an analog signal using ASK, FSK, PSK or QAM. A demodulator converts an analog signal into a digital signal; it reverses the process of modulation.
14. The data rate of a link is affected by the type of encoding and the bandwidth of the medium.
15. Every line has an upper and a lower limit of frequencies of the signals it can carry. This limited range of frequencies is the bandwidth. Traditional phone lines have a bandwidth of 3 to 4 KHz.
16. Intelligent modems contain software to support additional functions like automatic answering and dialing.
17. Downloading has a maximum of 56 Kbps and uploading has a maximum of 33.6 Kbps because the process of downloading does not involve quantization using PCM.
18. A cable modem uses a 6-MHz cable TV channel.
19. The primary channel is used to transmit data; the secondary channel is used mostly for flow control in half-duplex mode.
20. The pairs of pins are utilized for a balanced circuit which needs two lines for a signal, one for the original and one for the complement.
21. An unbalanced circuit has one line for signal propagation, while a balanced circuit has two lines.
22. Data rate is inversely proportional to the distance.
23. A user types one character at a time producing unpredictable gaps between characters. Only asynchronous transmission will be effective in this case.
24. The mechanical specification of EIA-232 defines the DTE/DCE interface as a 25-wire cable with a male and a female DB-25 pin connector attached to either end.
25. The electrical specification defines the voltage level and the type of signal transmitted.
26. The functional specification of EIA-232 defines the purpose of each pin.
27. Category I includes those pins whose functions are compatible to those in EIA-232. Category II pins have no equivalent to EIA-232 or have been redefined.
28. Modems transform the digital output of computers into analog form usable by telephone local loops and vice versa.
29. In full-duplex transmission the available bandwidth is divided into two, one for each direction.
30. FSK does not support more than one bit per baud.
31. In a four-wire system, each pair of wires can be used for transmission in each direction. The capacity is therefore twice of that of a two-wire system.
32. In FSK, some of the bandwidth is used to separate the two carrier frequencies.

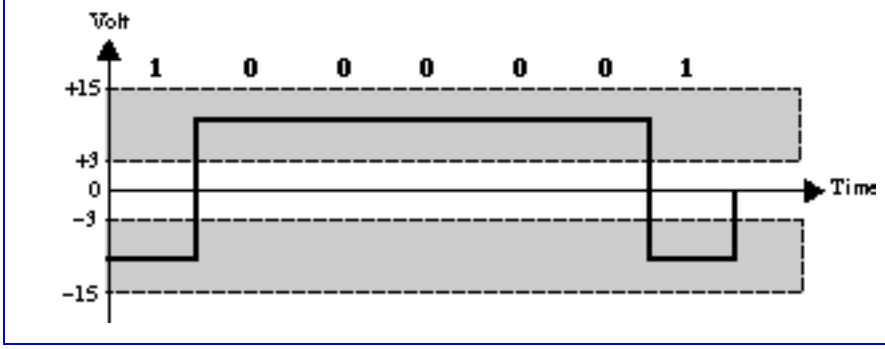
6.2 MULTIPLE CHOICE QUESTIONS

33. c	34. d	35. a	36. b	37. d	38. a	39. b	40. d	41. b	42. d
43. c	44. a	45. a	46. a	47. d	48. d	49. d	50. d	51. d	52. b
53. c	54. c	55. b	56. c	57. c	58. a	59. a	60. b	61. a	62. c
63. c	64. b	65. b	66. b	67. d	68. b	69. a	70. d	71. b	72. d
73. d	74. c	75. a	76. a	77. a	78. d	79. d	80. c	81. d	

6.3 EXERCISES

82. For seven-bit ASCII: 7000 bits for data, 1000 stop bits, 1000 start bits, for a total of 9000 bits. This means 78% of bits transmitted are data (7000/9000). Note that if a parity bit is used to make each character eight bits long, the calculation would be different.
83. See Figure 6.1.

Figur e 6.1 *Exercise 83*



84. See Figure 6.2.
85. See Figure 6.3.

Figure 6.2 *Exercise 84*

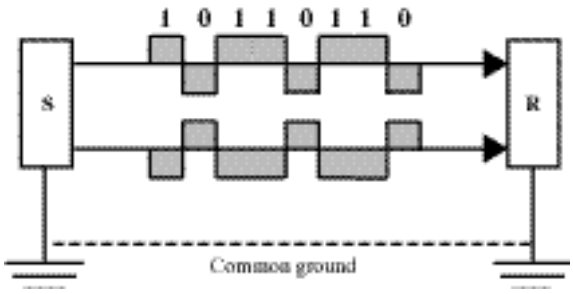
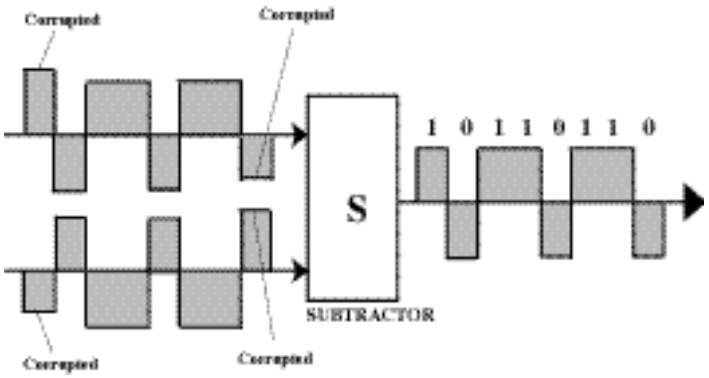


Figure 6.3 *Exercise 85*



86. See Table 6.1

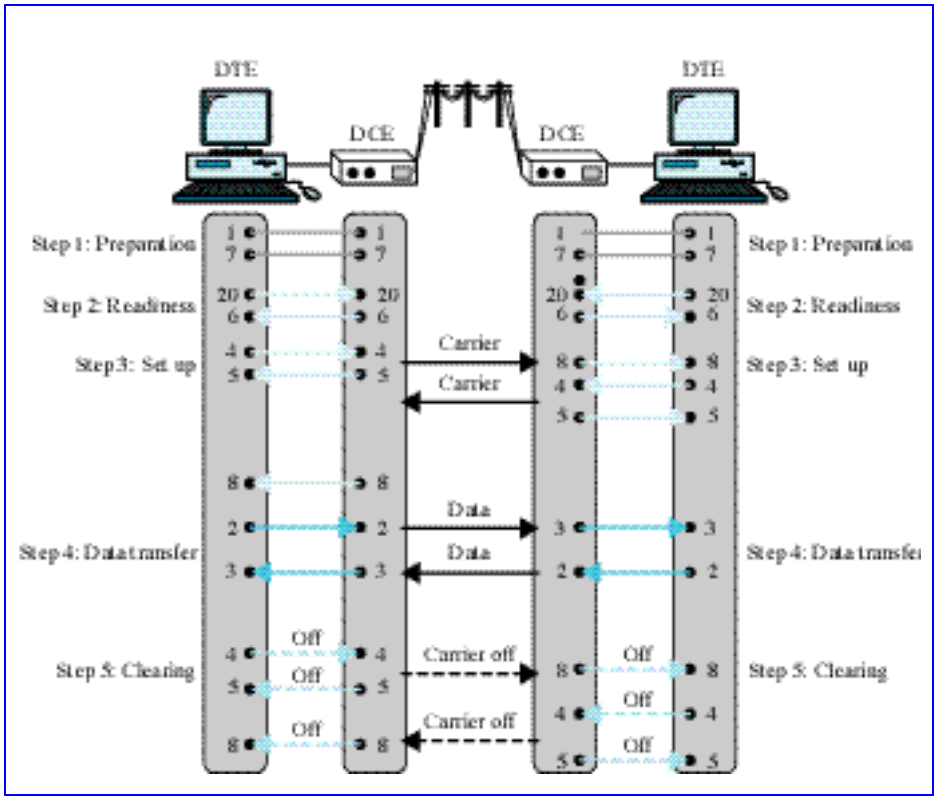
Table 6.1 *Exercise 86*

DB-9	*Function*	*DB-25*
1	*Carrier detect*	1
2	*Transmit data*	2
3	*Receive data*	3
4	*DTE ready*	20
5	*Signal ground*	7
6	*DCE ready*	6
7	*Request to send*	4
8	*Clear to send*	5
9	*Ring indicator*	22

87. Downloading: 6 × 7 = 42 Mbps Uploading: 6 × 3 = 18 Mbps

88. ATTD4088648902L10
89. ATTD4088648902E0
90. ATTD4088648902E1
91. 9 pins (DB-9)
92. 11 pins.
93. 5 pins
94. See Figure 6.4.

Figur e 6.4 *Exercise 94*

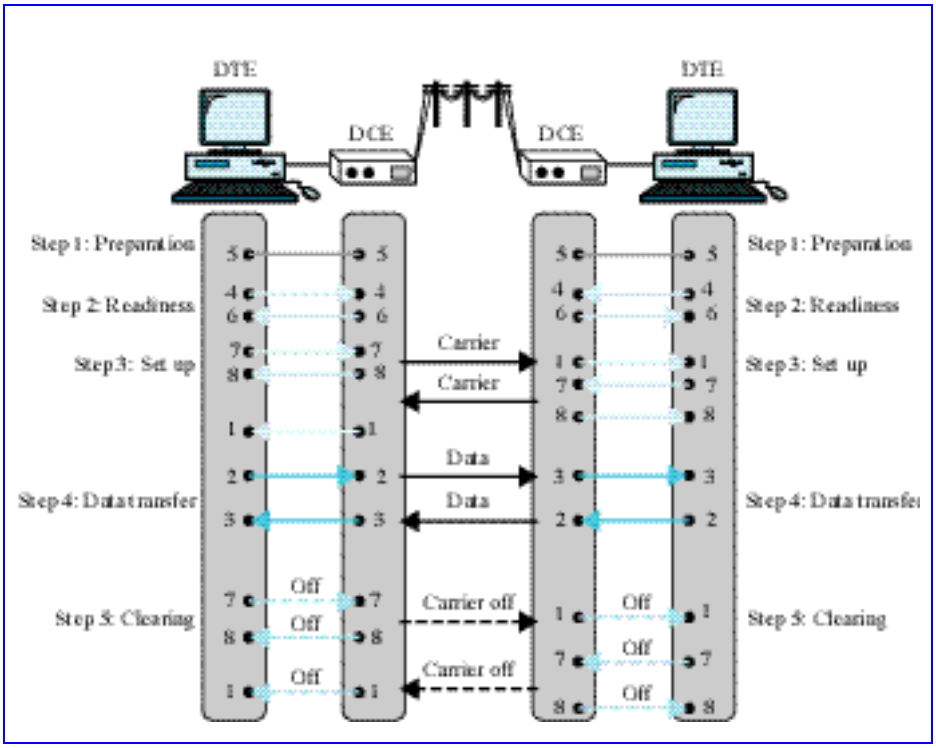


95. See Figure 6.5.
96. If we assume a linear relationship, we will get approximately 76 Kbps.
97. If we assume a linear relationship, we will get approximately 7.6 Mbps.
98. 100 times
99. We use seven-bit ASCII without parity, with a 0 start bit and a 1 stop bit. If data is sent with the most significant bit first, we have the following:

010010001	011001011	011011001	011011001	011011111
H	e	l	l	o

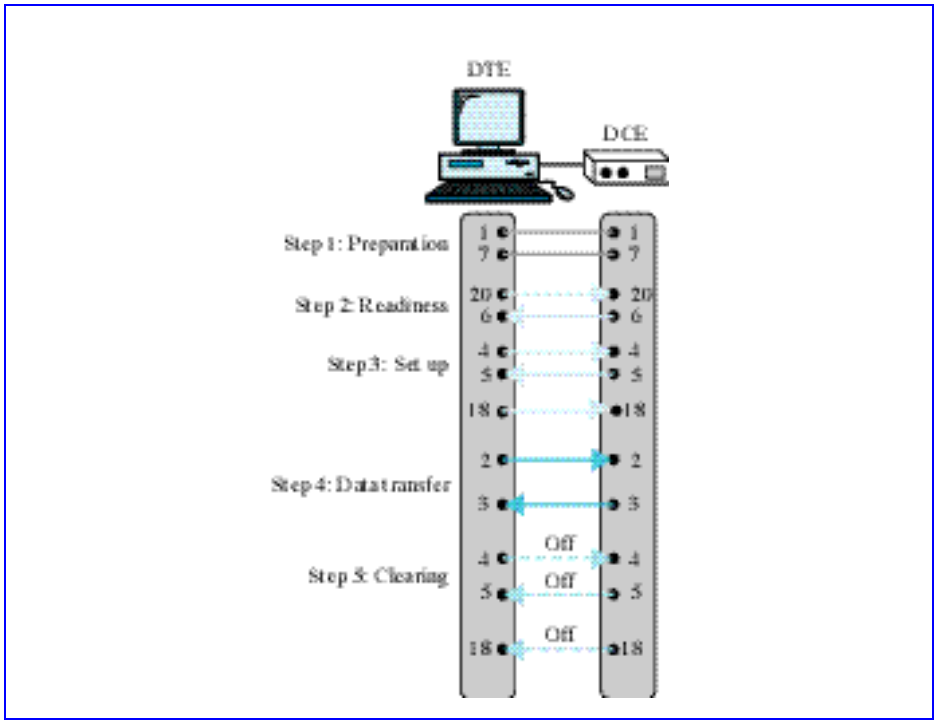
100. These modems send only the four rightmost bits (0000 to 1001).

Figur e 6.5 *Exercise 95*



101. See Figure 6.6.
102. See Figure 6.7.

Figur e 6.6 *Exercise 101*



Figur e 6.7 *Exercise 102*