

Chapter 5: Data Link Layer

Answers to End-of-Chapter Questions

1. What does the data link layer do?
2. What is media access control and why is it important?
3. Under what conditions is media access control unimportant?
4. Compare and contrast roll call polling, hub polling (or token passing), and contention.
5. Which is better, hub polling or contention? Explain.
6. Define two fundamental types of errors.
7. Errors normally appear in _____, which is when more than one data bit is changed by the error-causing condition.
8. Is there any difference in the error rates of lower speed lines and of higher speed lines?
9. Briefly define noise.
10. Describe five types of noise. Which is likely to pose the greatest problem to network managers?
11. How do amplifiers differ from repeaters?
12. What are three ways of reducing errors and the types of noise they affect?
13. Describe three approaches to detecting errors, including how they work, the probability of detecting an error, and any other benefits or limitations.
14. Briefly describe how even parity and odd parity work.
15. Briefly describe how polynomial checking works.
16. How does cyclical redundancy checking work?
17. How does forward error correction work? How is it different from other error correction methods?
18. Under what circumstances is forward error correction desirable?

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19. Compare and contrast stop-and-wait ARQ and continuous ARQ.
20. Which is the simplest (least sophisticated) protocol described in this chapter?
21. How do the various types of XMODEM differ from YMODEM and ZMODEM?
22. Describe the packet layout for SDLC, ethernet, token ring, SLIP and PPP.
23. What is transparency, and why is this a problem with SDLC?
24. How do SDLC and SLIP overcome their transparency problems?
25. Explain why ethernet and token ring do not suffer from transparency problems.
26. What are the major problems with SLIP?
27. How does SLIP differ from CSLIP?
28. Why do SDLC packets need an address and SLIP packets do not?
29. What is transmission efficiency?
30. How do information bits differ from overhead bits?

TRUE/FALSE

The following are possible True/False questions for tests. The statement is given and the answer is provided in square brackets. The level of difficulty (easy, moderate, difficult) is also furnished.

1. The data link layer is the only layer responsible for physical transmission.
Moderate
2. Senders and receivers have to agree on the rules or protocols that govern how they will communicate with one another.
Easy
3. Media access control refers to a function for controlling when computers transmit.
Easy
4. Message delineation refers to the control that is needed when computers transmit.
Moderate

5. Two fundamental approaches to media access control are: controlled access and contention.

Easy

6. Most computer networks managed by a host mainframe computer use contention media access control.

Moderate

7. Polling is the process of sending a signal to a client to give it permission to transmit or to ask it to receive data.

Easy

8. In a mainframe-based network, a front-end processor helps poll terminals more efficiently.

Moderate

9. Token passing is a term that refers to hub polling, in which one computer starts a poll and passes it to the next computer on a multipoint circuit.

Moderate

10. Contention is never used with Ethernet local area networks.

Moderate

11. In a network, many errors caused by humans can be controlled by application programs.

Moderate

12. Two categories of network errors are: corrupted data and delimited data.

Moderate

13. Corrupted data refers to data that has been changed.

Easy

14. In data transmission, data errors appear generally appear in bursts.

Easy

15. Noise, which can be introduced by equipment or natural disturbances, degrades the performance of a communication circuit.

Easy

16. Intermodulation noise is a special type of attenuation.

Moderate

17. Eliminating jitter to generate a pure carrier signal in an analog circuit is impossible.

Moderate

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18. The distance between repeaters or amplifiers on a telephone circuit is determined by the amount of power gained per unit length of the transmission.

Moderate

19. Repeaters are commonly used on analog circuits.

Moderate

20. A conditioned circuit is more expensive than a regular telephone circuit because it has been certified by the carrier to experience fewer errors.

Moderate

21. For effective error detection and correction, extra data must be included with each message.

Moderate

22. In an odd parity checking scheme, the parity bit is set to make the total number of ones in the byte (including the parity bit) an odd number.

Moderate

23. The most commonly used method for error correction is retransmission.

Easy

24. Another term for continuous ARQ is sliding window.

Moderate

25. One type of forward error correction is the Hamming code.

Easy

26. Newer modem standards, such as the V.34 modem standard, include forward error checking.

Moderate

27. The asynchronous file transfer protocol, Kermit, was named after Kermit the Frog.

Easy

28. HDLC is very different to SDLC synchronous data link protocol.

Moderate

29. Serial Line Internet Protocol was designed as an extremely simple protocol for connecting two computers using Internet protocols over a point-to-point telephone line.

Easy

30. Point-to-point Protocol, designed as a replacement for SLIP, has the advantage of error control.

Moderate

MULTIPLE CHOICE

The following are possible multiple choice questions for tests. The question is posed and the answer is provided under the choices. The level of difficulty (easy, moderate, difficult) is also furnished.

1. Which of the following is **not** a responsibility of a data link protocol?
 - a. determining when a computer can transmit
 - b. determining where a message begins
 - c. determining the voltage to use when transmitting a message
 - d. determining where a message ends
 - e. determining how a receiver recognizes a transmission error
2. As part of the simplified four-layer network model, the data link layer sits directly between:
 - a. the physical and the application layers
 - b. the network and the application layers
 - c. the physical and the network layers
 - d. the network and transport layers
 - e. the physical and the presentation layers
3. Which of the following is **not** true with respect to the data link layer?
 - a. It accepts streams of bits from the physical layer.
 - b. It is responsible for getting a message from one computer to another (one node to another) without errors.
 - c. It accepts messages from the network layer.
 - d. It performs routing functions.
 - e. It organizes data from the physical layer and passes these coherent messages to the network layer.
4. _____ is **not** a function of a data link protocol.
 - a. Error control
 - b. Message delineation
 - c. Media access control
 - d. Amplitude shift keying
 - e. Indicating when a message starts and stops
5. Media access control:
 - a. is not very important in local area networks
 - b. is not very important in a point-to-point with a half duplex configuration
 - c. is not very important in a multipoint configuration
 - d. is not very important in point-to-point with full duplex configuration
 - e. does not control when computers transmit

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6. Which of the following is **not** a controlled access method of media access control?
 - a. polling
 - b. X-ON/X-OFF
 - c. CSMA/CD
 - d. hub polling
 - e. roll call polling
7. Roll call polling:
 - a. is often used in a LAN multipoint configuration that does not have a central host computer
 - b. is also called token passing
 - c. can not be modified to increase priority of clients or terminals
 - d. typically involves some waiting because the front-end processor has to wait for a response from the polled client or terminal
 - e. is a type of contention approach to media access control
8. With contention:
 - a. the front end processor works consecutively through a list of clients to determine who should have access to the media
 - b. one computer starts the poll and passes it to the next computer on the multipoint circuit
 - c. the front end processor must wait for a response from the polled client or terminal
 - d. computers wait until the circuit is free before they send data
 - e. there is never a chance for “collision,” or two computers trying to send data at the same time
9. Contention is the opposite of:
 - a. retention processing
 - b. distraction processing
 - c. controlled access
 - d. indirect access
 - e. media access
10. In general, contention approaches:
 - a. work better than controlled approaches for small networks that have low usage
 - b. work better than controlled approaches for large networks that have high usage
 - c. work better than controlled approaches for high volume networks
 - d. require a host or central control computer to assign media access control
 - e. require a front end processor to control the circuit
11. Which of the following is **not** an appropriate choice in this sentence, “Networks should be designed to _____ both corrupted and lost data.”
 - a. aggravate
 - b. prevent

- c. detect
 - d. correct
 - e. none of the above are appropriate choices
12. In a _____, more than one data bit is changed by the error-causing condition.
- a. uniform distribution
 - b. burst error
 - c. data rate shift
 - d. amplitude key shift
 - e. Trellis-coded modulation
13. Errors on a network can occur:
- a. only on poorly maintained and conditioned networks
 - b. only on dial-up type of circuits
 - c. extremely rarely, so it is not worth studying
 - d. only due to lightning strikes
 - e. because of noise on the line
14. In a dial-up network:
- a. users might try to transmit the data at a higher speed to decrease the error rate
 - b. the network is less prone to errors than private dedicated lines
 - c. the error rate will vary because the circuits will change with each dial-up
 - d. constant transmission conditions will always create a constant error rate
 - e. users might try to transmit the data at a lower speed to speed up the data transmission
15. Which of the following lines are more prone to errors?
- a. dial-up switched lines
 - b. private dedicated lines for LANs
 - c. leased lines
 - d. private dedicated lines for WANs
 - e. private dedicated lines for BNs
16. Which of the following media is less susceptible to noise?
- a. coaxial cable
 - b. twisted pair
 - c. fiber optic
 - d. unshielded twisted pair
 - e. shielded twisted pair
17. Electrical media is:
- a. less likely to suffer from noise than optical media
 - b. more likely to suffer from noise than optical media
 - c. has about the same likelihood of suffering from noise as optical media

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- d. not susceptible to noise
 - e. less prone to noise than fiber optic media
18. _____ refers to bits that have been changed, in error, from 1 to 0, or vice versa, in a data transmission.
- a. Flipped bits
 - b. Polled bits
 - c. Inverse multiplexed bits
 - d. Bit delineation
 - e. Contracted bits
19. In a data communication network, noise manifests itself as:
- a. extra bits in an message
 - b. missing bits in a message
 - c. flipped bits in a message
 - d. lost bits in a message
 - e. all of the above
20. _____ is **not** a major type of data transmission error.
- a. White noise
 - b. Line outages
 - c. Impulse noise
 - d. Conditioning noise
 - e. Cross-talk
21. Another term for impulse noise is:
- a. cross-talk
 - b. gaussian noise
 - c. echoes
 - d. intermodulation noise
 - e. spikes
22. The familiar background static on radios and telephones is called:
- a. intermodulation noise
 - b. cross-talk
 - c. echoes
 - d. white noise
 - e. line outages
23. The primary source of error in data communications is:
- a. intermodulation noise
 - b. spikes
 - c. cross-talk

- d. echoes
 - e. jitter
24. Cross-talk:
- a. decreases during wet or damp weather
 - b. decreases with increased proximity of two wires
 - c. is always bothersome because it has a high signal strength
 - d. occurs when one circuit picks up signals in another
 - e. increases with lower frequency signals
25. The loss of power a signal suffers as it travels from the transmitting computer to a receiving computer is:
- a. jitter
 - b. echo
 - c. spiking
 - d. intermodulation
 - e. attenuation
26. A phase hit is likely to be:
- a. white noise
 - b. impulse noise
 - c. a short term shift
 - d. intermodulation noise
 - e. gaussian noise
27. _____ is an effective way to prevent impulse noise, cross-talk, and intermodulation noise.
- a. Adding repeaters to a circuit
 - b. Adding amplifiers to a circuit
 - c. Shielding wires
 - d. Shorting a circuit
 - e. Adding fluorescent lights
28. Which of the following is **not** an error detection method used in the data link layer?
- a. parity checking
 - b. pulse code checking
 - c. longitudinal redundancy checking
 - d. polynomial checking
 - e. cyclic redundancy checking
29. The probability of detecting an error, given that one has occurred, using parity checking is about:
- a. 0
 - b. 100%
 - c. 75%

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- d. 50%
 - e. 98%
30. With even parity and a 7-bit ASCII code, which of the following is incorrect?
- a. 01101010
 - b. 00011011
 - c. 00100101
 - d. 10110111
 - e. 11111111
31. Using parity, the probability for detecting an error, given that one has occurred, is:
- a. about 30% for even parity and 70% for odd parity
 - b. about 50% for either even or odd parity
 - c. about 70% for even parity and 30% for odd parity
 - d. about 100% for either even or odd parity
 - e. about 0% for either even or odd parity
32. Longitudinal redundancy checking adds one additional character, called the _____, to the end of the data packet or frame.
- a. parity byte
 - b. block check character
 - c. checksum character
 - d. cyclic redundancy character
 - e. polynomial check character
33. The probability of detecting an error, provided that one has occurred, using cyclic redundancy checking is about:
- a. 0
 - b. exactly 100%
 - c. 75%
 - d. 50%
 - e. > 99%
34. ARQ means that:
- a. the common carrier Automatically Returns Queries to the subscriber upon receipt of such queries
 - b. a receiver that detects an error in a message simply asks the sender to retransmit the message until it is received without error
 - c. a fiber optic cable meets the American Registered Quality, a certification standard for use in high-quality data communication transmission lines
 - d. a sender is using a data link protocol called Asynchronous Repeating reQuest
 - e. a sender is using a parity scheme called Array Resource Quality

35. In ARQ, a NAK:

- a. is sent by the sender at the same time as it sends a data packet
- b. is sent by the recipient if the message contains an error
- c. is sent by the recipient if the message was received without error
- d. refers to non-asynchronous kermit technique
- e. means that the sender should continue with sending the next message

36. By definition, stop-and-wait ARQ uses _____ type of data flow.

- a. full simplex
- b. full complex
- c. half complex
- d. full duplex
- e. half duplex

37. With _____ ARQ, the sender pauses for a response from the receiver to alter each message or packet of data.

- a. halt and be recognized (HBR)
- b. open windows
- c. stop and wait
- d. slow
- e. continuous

38. With _____ ARQ, the sender immediately sends the next message or packet of data.

- a. immediate
- b. open windows
- c. continuous
- d. stop-and-wait
- e. fast

39. _____ prevents errors by detecting and correcting them at the receiving end without retransmission of the original message.

- a. Huffman encoding
- b. Forward error correction
- c. Wave division multiplexing
- d. Front end processing
- e. Hub polling

40. One of the characteristics of many forward error correcting codes is that there must be a minimum:

- a. number of error-free bits between burst of errors
- b. line speed of 4,800 bits per second
- c. of 48 parity bits per byte
- d. all of the above
- e. b and c only

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41. Asynchronous transmission:

- a. is used to transmit each character simultaneously with all other characters
- b. is also known as start-stop transmission
- c. is typically used on multipoint half duplex circuits
- d. uses a continuous series of start bits as an idle signal
- e. has a pre-determined, fixed time between sending characters

42. Which of the following is **not** a type of asynchronous file transfer protocol?

- a. YMODEM
- b. XMODEM-CRC
- c. OSCAR
- d. KERMIT
- e. XMODEM-1K

43. Synchronous transmission:

- a. uses start bits before each character to be sent
- b. is used to send one character at a time
- c. is used to transmit a group or block of data at a time
- d. uses stop bits after each character to be sent
- e. cannot be used on multipoint circuits

44. Which of the following is **not** true about the data link protocol, SDLC:

- a. It uses a special bit pattern called a flag
- b. It is a mainframe protocol developed by IBM in 1972
- c. It is a bit-oriented protocol
- d. It uses a controlled access media access control protocol
- e. It does not have a problem with transparency

45. Which of the following is **not** a type of synchronous data link protocol?

- a. start-stop protocol
- b. SDLC
- c. HDLC
- d. token ring
- e. Ethernet

46. _____ is **not** true about token ring.

- a. It is a byte-oriented protocol.
- b. It uses a controlled access media access protocol.
- c. It is a popular local area network protocol.
- d. Each token ring frame starts and ends with a special delimiter, a special type of electrical signal.
- e. It suffers from the same type of transparency problem as SDLC.

47. In communication protocols, _____ are used for purposes such as error checking.
- information bits
 - overhead bits
 - stop bits
 - start bits
 - flag bits
48. _____ is defined as the total number of information bits divided by the total bits in transmission.
- Asynchronous rate
 - Protocol percentage
 - Transmission efficiency
 - Throughput
 - Transmission Rate of Information Bits
49. Throughput of a data communication network is affected by:
- packet size of the message
 - error rate on the communication circuit
 - propagation time
 - all of the above
 - a and b only
50. Throughput of _____ circuits is especially affected by propagation delay.
- fiber optic
 - coaxial cable
 - satellite
 - twisted pair
 - infrared
51. Calculating the actual throughput of a data communication network is:
- complex because many factors affect throughput
 - simple because packet size is the primary factor affecting throughput
 - not normally required for synchronous networks because they are so fast
 - far less complicated if the system operates on a contention basis
 - not needed for satellite-based networks

Short Answer Questions

1. Compare and contrast hub polling and contention-based approaches to media access control.

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2. Under what conditions do contention-based media access control techniques outperform controlled-access techniques (i.e., have lower response time)? Explain.
3. What are two major sources of error and how can you prevent them?
4. How would a message of THE be sent using even LRC if the ASCII codes for the letters are: T 0010011 H 0001111 E 0000101
5. How would the bit pattern 0110110 be sent using even parity?
6. Which is better, CRC-16 or LRC? Explain.
7. Suppose two computers transferred a series of two messages using Stop and Wait ARQ. Suppose the first message is initially received with an error, and the second message initially not received at all. Draw the pattern of messages, ACKs, etc. that would flow between the two to ensure successful transfer of both messages..
8. Describe how ethernet and SDLC mark the end of a message. Which is "better?"
9. Explain bit stuffing and why it is needed in the SDLC protocol.
10. Which is better for file transfer, large packet sizes or small packet sizes? Justify your answer.
11. Thought question: It is sometimes said that statistical time division multiplexing increases efficiency and at the same time decreases efficiency. Explain.
12. Thought question: Could 10-bit asynchronous transmission protocols be used on a multipoint circuit? Explain.