

Exercise series no. 3

Exercise 01

1. The following character encoding is used in a data link protocol:
A: 01000111; B:11100011; FLAG: 01111110; ESC: 11100000.
Show the bit sequence transmitted (in binary) for the four-character frame: A B ESC FLAG when each of the following framing methods are used:
 - a) Character count.
 - b) Flag bytes with byte stuffing.
 - c) Starting and ending flag bytes, with bit stuffing.
2. A bit string, 011110111110111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing?
3. Byte stuff the following data: A ESC ESC FLAG B

Exercise 02

1. The message 11010011 is to be transmitted using the CRC error detection method having the generator polynomial $G(x) = x^5 + x^2 + 1$. Calculate the frame that will be transmitted.
2. Consider the received frame 110110111. Check, if the received frame was transmitted correctly, using the CRC error detection method having the generator polynomial $G(x) = x^3 + x^2 + 1$.

Exercise 03

1. A message of 8 bits payload (10011010) need to be transferred. Calculate the message that will be transmitted using Hamming Code.
2. The following messages have been received. Verify, if they were transmitted correctly, using Hamming Code.
 - a) 00111101
 - b) 101110100010

Exercise 04

In the transmission of frames from a sender A to a receiver B, a protocol is defined as follows:

- a) The sender transmits three frames in succession and then waits for an acknowledgment from B.
- b) When this acknowledgment arrives, the sender transmits the next three frames and waits for a new acknowledgment.
- c) Frames consist of 1024 bits, including 80 service bits.
- d) Acknowledgments consist of 64 bits.
- e) The channel data rate is 2 Mbit/s, and the propagation speed of electromagnetic waves is 3×10^8 m/s over the 10 km link between A and B.

Questions:

1. What is the time required for the confirmed transmission of a frame?
2. What is the channel utilization rate?
3. A 1 MB message is sent from A to B using the above protocol. What is the total transmission time for this message?

Exercise 05

A bus-type 802.3 local network has a 10 Mbit/s data rate and is 800 m long. The signal propagation speed is 200 m/ μ s. The MAC frames contain 256 bits in total. The time interval immediately following a data transmission is reserved for an acknowledgment of 32 bits.

Questions:

1. How many bits are in transit on the bus at a given moment?
2. What is the actual useful throughput of the network, assuming each frame contains 48 service bits (MAC and LLC fields)?

Exercise 06

We recall that the nominal data rate of an Ethernet network is 10 Mbit/s and that frames contain:

- A preamble of 8 bytes.
- Two address fields of 6 bytes each.
- A length field of 2 bytes.
- Data, whose length must be between 46 and 1500 bytes.
- An error control block of 4 bytes.
- Additionally, a silent interval between frames is mandatory, lasting 9.6 μ s.

Questions:

1. Determine the maximum useful throughput on an Ethernet network.
2. What is the degree of the generator polynomial used for error control?