

Ekstraoppgaver 3 - inf3190

1)

An upper-layer packet is split into 10 frames, each of which has an 80 percent chance of arriving undamaged. If no error control is done by the data link protocol, how many times must the message be sent on average to get the entire thing through?

Svar:

Since each frame has a chance of 0.8 of getting through, the chance of the 1 whole message getting through is 0.8^{10} , which is about $1/0.107 = 9.3$

14)

What is the remainder obtained by dividing $x^7 + x^5 + 1$ by the generator polynomial $x^3 + 1$?

Svar:

The remainder is $x^2 + x + 1$.

15)

A bit stream 10011101 is transmitted using the standard CRC method described in the text. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end.

Svar:

The frame is 10011101. The generator is 1001. The message after appending three zeros is 10011101000. The remainder on dividing 10011101000 by 1001 is 100. So, the actual bit string transmitted is 10011101100. The received bit stream with an error in the third bit from the left is 10111101100. Dividing this by 1001 produces a remainder 100, which is different from zero. Thus, the receiver detects the error and can ask for a retransmission.

16)

Data link protocols almost always put the CRC in a trailer rather than in a header. Why?

Svar:

The CRC is computed during transmission and appended to the output stream as soon as the last bit goes out onto the wire. If the CRC were in the header, it would be necessary to make a pass over the frame to compute the CRC before transmitting. This would require each byte to be handled twice—once for checksumming and once for transmitting. Using the trailer cuts the work in half.

17)

A channel has a bit rate of 4 kbps and a propagation delay of 20 msec. For what range of frame sizes does stop-and-wait give an efficiency of at least 50 percent?

Svar:

Efficiency will be 50% when the time to transmit the frame equals the roundtrip propagation delay. At a transmission rate of 4 bits/ms, 160 bits takes 40 ms. For frame sizes above 160 bits, stop-and-wait is reasonably efficient.

18)

A 3000-km-long T1 trunk is used to transmit 64-byte frames using protocol 5. If the propagation speed is 6 $\mu\text{sec}/\text{km}$, how many bits should the sequence numbers be?

Svar:

To operate efficiently, the sequence space (actually, the send window size) must be large enough to allow the transmitter to keep transmitting until the first acknowledgement has been received. The propagation time is 18 ms. At T1 speed, which is 1.536 Mbps (excluding the 1 header bit), a 64-byte frame takes 0.300 msec. Therefore, the first frame fully arrives 18.3 msec after its transmission was started. The acknowledgement takes another 18 msec to get back, plus a small (negligible) time for the acknowledgement to arrive fully. In all, this time is 36.3 msec. The transmitter must have enough window space to keep going for 36.3 msec. A frame takes 0.3 ms, so it takes 121 frames to fill the pipe. Seven-bit sequence numbers are needed.

29)

Frames of 1000 bits are sent over a 1-Mbps channel using a geostationary satellite whose propagation time from the earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three-bit sequence numbers are used. What is the maximum achievable channel utilization for

- a. (a) Stop-and-wait.
- b. (b) Protocol 5.
- c. (c) Protocol 6.

Svar:

Let $t = 0$ denote the start of transmission. At $t = 1$ msec, the first frame has been fully transmitted.

At $t = 271$ msec, the first frame has fully arrived. At $t = 272$ msec, the frame acknowledging the first one has been fully sent. At $t = 542$ msec, the acknowledgement-bearing frame has fully arrived. Thus,

the cycle is 542 msec. A total of k frames are sent in 542 msec, for an efficiency of $k/542$. Hence

(a) $k = 1$, efficiency = $1/542 = 0.18\%$

(b) $k = 7$, efficiency = $7/542 = 1.29\%$

(c) $k = 4$, efficiency = $4/542 = 0.74\%$