

## ET4254 Communications and Networking 1 – Tutorial Sheet 6

### **Short Questions:**

1. What is a major disadvantage of asynchronous transmission?
2. What is a parity bit?
3. What is the CRC?
4. Why would you expect a CRC to detect more errors than a parity bit?
5. List three different ways in which the CRC algorithm can be described.

### **Problems:**

1. Suppose a file of 10,000 bytes is to be sent over a line at 2400bps.
  - a. Calculate the overhead in bits and time in using asynchronous communication. Assume one start bit and a stop element of length one bit, and 8 bits to send the byte itself for each character. The 8-bit character consists of all data bits with no parity bits.
  - b. Calculate the overhead in bits and time using synchronous communication. Assume that the data are sent in frames. Each frame consists of 1000 characters = 8000 bits and an overhead of 48 control bits per frame.
  - c. What would the answers to parts (a) and (b) be for a file of 100,000 characters?
  - d. What would the answers to parts (a) and (b) be for the original file of 10,000 characters except at a data rate of 9600bps?
2. Suppose that a sender and receiver use asynchronous transmission and agree not to use any stop elements. Could this work? If so explain any necessary conditions.
3. Would you expect that the inclusion of a parity bit with each character would change the probability of receiving a correct message?
4. Two communicating devices are using a single-bit even parity check for error detection. The transmitter sends the byte 10011010. Will the receiver detect the error? Why or Why not?
5. For  $P = 110011$  and  $M = 11100011$  find the CRC.

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### Answers:

### Short Questions

1. Asynchronous transmission requires an overhead of two or three bits per character, and is, therefore, significantly less efficient than synchronous transmission.
2. A check bit appended to an array of binary digits to make the sum of all the binary digits, including the check bit, always odd (odd parity) or always even (even parity).
3. An error detecting code in which the code is the remainder resulting from dividing the bits to be checked by a predetermined binary number.
4. The CRC has more bits and therefore provides more redundancy. That is, it provides more information that can be used to detect errors.
5. Modulo 2 arithmetic, polynomials, and digital logic.

### Problems

1.
  - a. Each character has 25% overhead. For 10,000 characters, there are 20,000 extra bits. This would take an extra  $20,000/2400 = 8.33$  seconds.
  - b. The file takes 10 frames or 480 additional bits. The transmission time for the additional bits is  $480/2400 = 0.2$  seconds.
  - c. Ten times as many extra bits and ten times as long for both.
  - d. The number of overhead bits would be the same, and the time would be decreased by a factor of 4 =  $9600/2400$ .
2. Not for asynchronous transmission. The stop bit is needed so that the start bit can be recognized as such. The start bit is the synchronization event, but it must be recognizable. The start bit is always a 0, and the stop bit is always a 1, which is also the idle state of the line. When a start bit occurs, it is guaranteed to be different from the current state of the line.
3. The inclusion of a parity bit extends the message length. There are more bits that can be in error since the parity bit is now included. The parity bit may be in error when there are

no errors in the corresponding data bits. Therefore, the inclusion of a parity bit with each character would change the probability of receiving a correct message.

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                                10110110
110011 / 11100011000000
          110011
          -----
            101111
            110011
            -----
              111000
              110011
              -----
                101100
                110011
                -----
                  111110
                  110011
                  -----
                    CRC = 11010

```