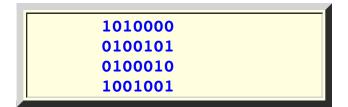
# **CS455 - Intro to Computer Networks**

# Homework 2

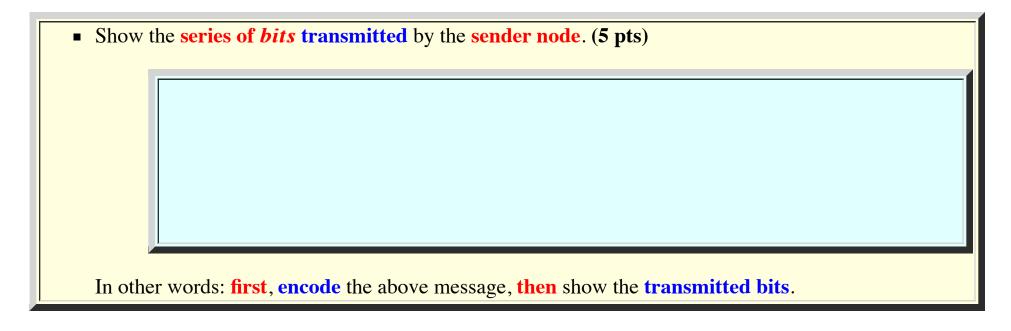
- **Question 1 (20 pts)** 
  - A channel has a total bandwidth of 1 Gbps is shared using the synchronous time division technique
  - A **period** is divided into **640 time slots**.
  - Question:

■ What is the <b>smallest unit</b> of <b>bandwidth reservation</b> that you can make on this system ? (10 pts)
<ul> <li>A user wants to reserve 50 Mbps transmission capacity on this channel</li> <li>How many time slots must we reserve to provide this amount of bandwidth reservation ? (10 pts)</li> </ul>
How many time slots must we reserve to provide this amount of bandwidth reservation? (10 pts)

- **Question 2 (20 pts)** 
  - A sender node uses a 2 dimensional parity scheme to transmit the following 4 ASCII characters:



The sender uses *even* parity in rows and in columns and transmits the bits in a row-wise fashion (including the parity bit in each row).



• A receiving data link layer uses the 2 dimensional parity scheme with even parity for both columns and rows.

Suppose the **receiver** receives the following **message**:

11110000 01010101 10101010 00001111

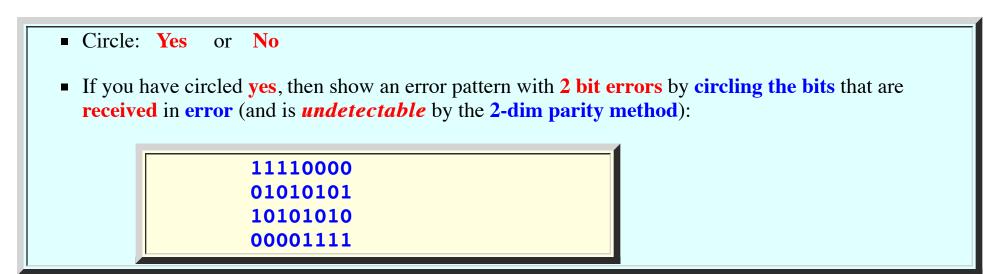
As you can see, all rows and columns have even parity. So the receiver will accept this message without errors.

Suppose the messages above that was received in error

## **Questions:**

■ Is it possible that the **received message** has 2 bits that were **received** in **error** that the receiver **cannot** detect ? (5 pts)

### **Answer:**



■ Is it possible that the received message has 3 bits that were received in error that the receiver cannot detect ? (5 pts)

#### **Answer:**

- Circle: Yes or No

   If you have circled yes, then show an error pattern with 2 bit errors by circling the bits that are received in error (and is undetectable by the 2-dim parity method):

  11110000
  01010101
  10101010
  00001111
- Is it possible that the received message has 4 bits that were received in error that the receiver cannot detect ? (5 pts)

## **Answer:**

■ If you have circled **yes**, then show an error pattern with **2 bit errors** by **circling the bits** that are **received** in **error** (and is *undetectable* by the **2-dim parity method**):

11110000 01010101 10101010 00001111

- **Question 3 (10 pts)** 
  - A sender transmits the following bit pattern using the Hammings code:

```
1111111
Bit position: 6543210987654321
-----
Bit pattern: 0100000010000001
```

I put the pattern under a lot of numbers to show the bit positions. You should read the numbers above the bit pattern as:

```
bit position 1, 2, 3, 4, 5, 6, 7,8, 9, 10 , 11, 12, 13, 14, 15, 16
```

from **right** to left. (The bit positions are written as 16, 15, 14, ..., 4,3,2,1 from **left** to right.)

• **Show** the **bit pattern** that will be **transmitted**:

```
22222222211111111111

Bit position: 9876543210987654321

Answer: (line up bit position !)
```

I.e.: **encode** the above message.

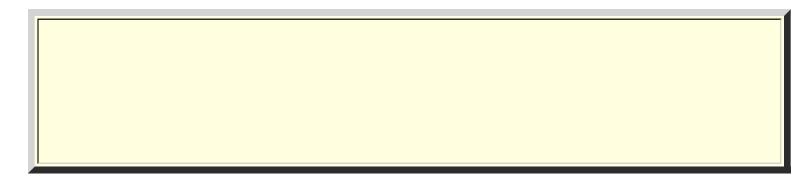
NOTE: You must line up your answer with the bit position as I have done above to receive credit!

- **Question 4 (20 pts)** 
  - Note:
- This question is **not** related to **question 3** above!
- A receiver received the following bit pattern that is encoded using Hamming code:

```
Bit position: 6543210987654321
-----
0100000010000001
```

**Questions:** 

• Which **one** bit will the receiver assume to be in error ? (5 pts)



• What was the **original data** that was transmitted ? (5 pts)

## **Further clarification:**

■ I am asking what is the original data before the Hamming code was applied.

You must use the **corrected Hamming code word** to answer this (the corrected Hamming code word is obtained from the previous question: Which one bit will the receiver assume to be in error? - correct that bit and use the corrected Hamming code to obtain the original data).

**NOTE:** You **MUST** number your answer with the bit position as I have done above to receive credit!

• Show a **Hamming code word** in which **two bit errors** were made in the transmission that **results** in the **following bit pattern**: (10 pts)

```
Bit position: 6543210987654321
-----
0100000010000001
```

Circle in the above figure the 2 bits that are in error.

### **Further clarification:**

• You must find an **Hamming code** word **yyyyyyyyyyyyyyyy** such that:

The **difficulty** of this question lies in the fact that a **Hamming code** word **must** pass the **Hamming code test** (see: **click here** ).

- Question 5 (20 pts)
  - A sender wants to send the following message protected by the CRC polynomial 101:

```
1000001
```

What is the **bit pattern** that the **sender** will **transmit** ? (10 pts)

Will the rece	iver decide that the message was correct or in error? Explain to get full credit. (10 pts)
estion 6 (10 pts)	
• Show the shi	ft-register circuit used to compute the CRC code using the CRC polynomial 1100101 (10 pts)