ASSIGNMENT-2

Tittle: To demonstrate error detection and correction using Hamming Codes or CRC

Objectives : To implement error detection and correction techniques

Problem Statement: Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.

Outcome : Demonstrate Hamming Codes or CRC with example.

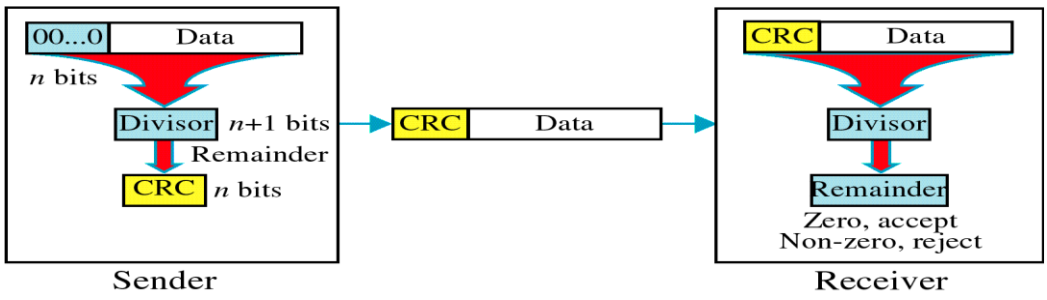
Software Requirements : Jdk and wireshark

Hardware Requirements : Open source linux operating system.

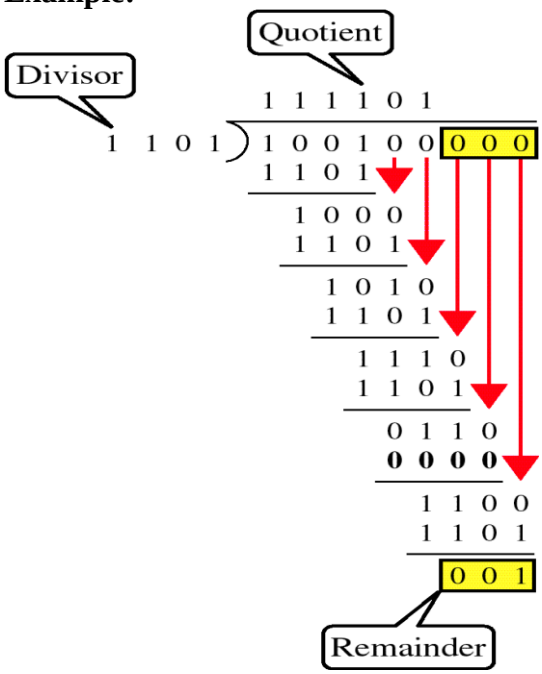
THEORY:

Cyclic Redundancy Check: CRC

- Given a k-bit frame or message, the transmitter generates an n-bit sequence, known as a *frame check sequence (FCS)*, so that the resulting frame, consisting of (k+n) bits, is exactly divisible by some predetermined number.
- The receiver then divides the incoming frame by the same number and, if there is no remainder, assumes that there was no error.



Example:



Hamming code

- **Hamming codes are a family of linear error-correcting codes that generalize the Hamming(7,4)-code**
- **Invented by Richard Hamming in 1950**

Hamming codes can detect up to two-bit errors or correct one-bit errors without detection of uncorrected errors.

General algorithm

- **The following general algorithm generates a single-error correcting (SEC) code for any number of bits.**
- **Number the bits starting from 1: bit 1, 2, 3, 4, 5, etc.**
- **Write the bit numbers in binary: 1, 10, 11, 100, 101, etc.**
- **All bit positions that are powers of two (have only one 1 bit in the binary form of their position) are parity bits: 1, 2, 4, 8, etc. (1, 10, 100, 1000)**
- **All other bit positions, with two or more 1 bits in the binary form of their position, are data bits.**
- **Each data bit is included in a unique set of 2 or more parity bits, as determined by the binary form of its bit position.**
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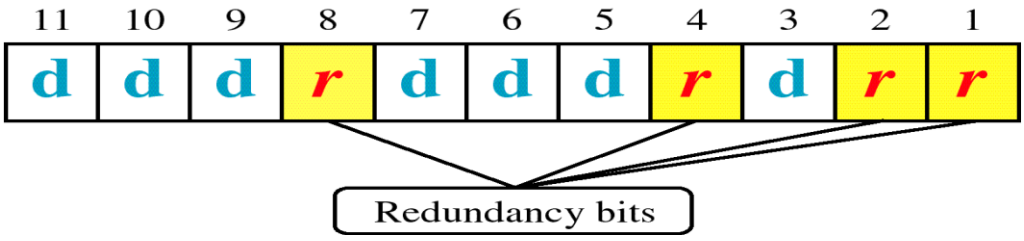
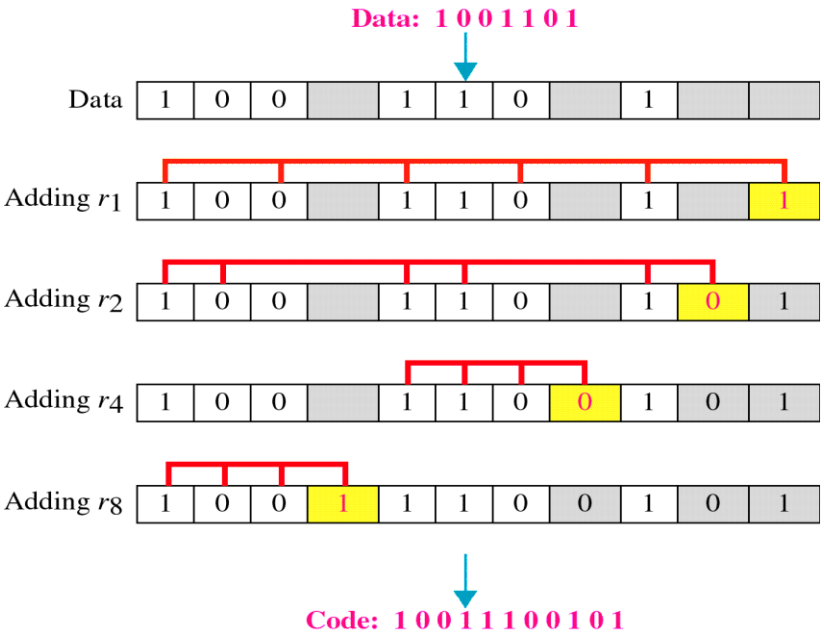
- **Parity bit 1 covers all bit positions which have the least significant bit set: bit 1 (the parity bit itself), 3, 5, 7, 9, etc.**
- **Parity bit 2 covers all bit positions which have the second least significant bit set: bit 2 (the parity bit itself), 3, 6, 7, 10, 11, etc.**
- **Parity bit 4 covers all bit positions which have the third least significant bit set: bits 4–7, 12–15, 20–23, etc.**
- **Parity bit 8 covers all bit positions which have the fourth least significant bit set: bits 8–15, 24–31, 40–47, etc.**
- **In general each parity bit covers all bits where the bitwise AND of the parity position and the bit position is non-zero.**

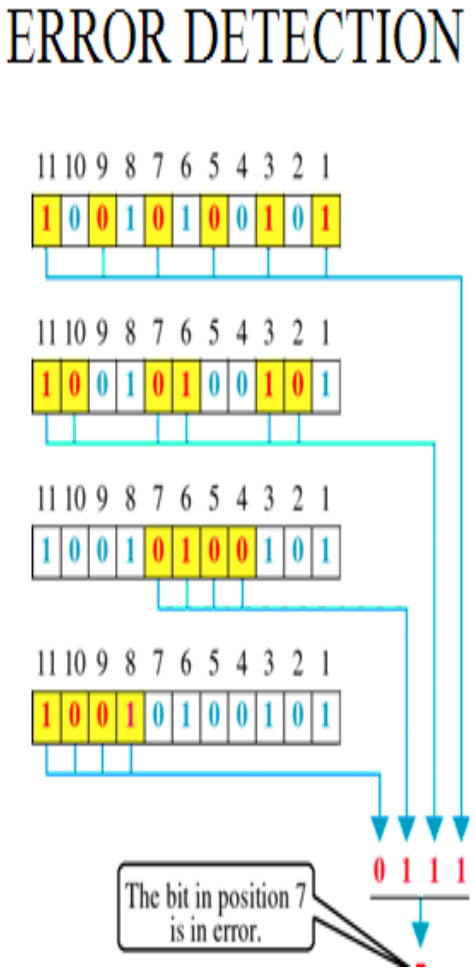


Example

Error detection



Error correction



Conclusion: Hence we have implemented CRC and Hamming code.

Assignment Questions:

1. **Solve Data word to be sent – 100100 Key – 1101**