CHAPTER-8   Error detection and correction

- Network must transfer the data from one device to another device with complete accuracy.

- Data can be corrupted due to some factors like noise signals, interference, attenuation

- For reliable communication, errors must be detected and corrected.

Error detection and correction

- The first approach involves the detection of errors and if an error is being detected it automatically requests for retransmission. (ARQ)

- The second approach ,forward error correction(FEC) involves the detection of errors that is followed by further processing to correct errors in the information.

Error detection methods

- Parity check

- Two dimensional parity check

- Checksum

- Cyclic Redundancy Check method(CRC)

Types of errors

- Whenever an electromagnetic signals flows from one point to another, it is subject to unpredictable interference from heat , magnetism and other forms of electricity.

- This interference can alter the meaning of data ,changing 0 to 1 and 1 to 0.

Three types of errors

- Single-bit error

- Multiple-bit error

- Burst error

Single bit error

- Only one bit of given data unit is changed from 1 to 0 and 0 to 1.

- 0000 0010

- 0000 1010

Multi-bit error

- Two or more non-consecutive bits in the data unit have changed from 1 to 0 and 0 to 1.

- 0000 0001 – Sending data
- 1001 1001 – Receiving data

Burst error

- Two or more consecutive bits in the data unit have changed from 1 to 0 and 0 to 1.

- 1000 0000 – Data to be sent

- 1111 0000 – Received data

Parity check

- To detect and correct the errors, additional bits are added to the data bits at the time of transmission.

- The additional bits are called **parity bits**. They allow detection or correction of the errors.

- The data bits along with the parity bits form a **code word**.

- The parity of 8-bits transmitted word can be either even parity or odd parity.

MSB							LSB
P	d6	d5	d4	d3	d2	d1	d0

Parity bit
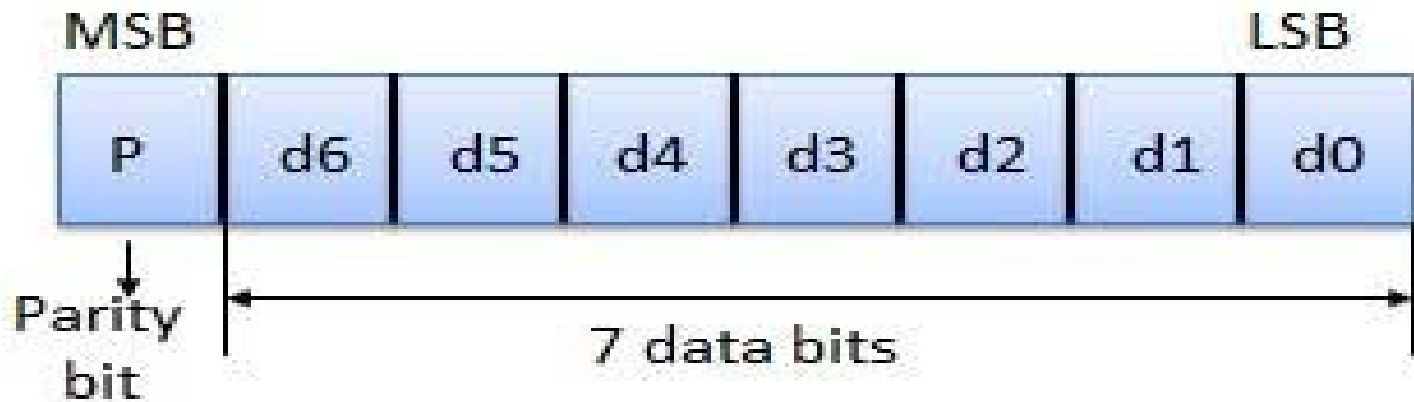
7 data bits

- **Even parity** -- Even parity means the number of 1's in the given word including the parity bit should be even.

- **Odd parity** -- Odd parity means the number of 1's in the given word including the parity bit should be odd .

Data bits	Parity bit for odd parity
0101	1
1101	0
1111	1
01110110	0

Data bits	Parity bit for even parity
0101	0
1101	1
1111	0
01110110	1

Two dimensional parity check

- When a large amount of data is to be transmitted , two dimensional parity checks can be employed.

- The data words are arranged in the form of a two dimensional binary matrix.

- For each row and column of the matrix ,a parity bit is calculated.

- A whole matrix is sent to the receiver.

Checksum

- All the words that are transmitted are added up and then the result of that sum is transmitted. The result is checksum.

- The receiver performs the same calculation on the received data and compares the result with the received checksum.

- If both the calculations are same ,then no error.

Cyclic Redundancy Check

- CRC is an intelligent error detection and correction.

- It is calculated by dividing the bit string of the block by a generator polynomial .This value is also sometimes referred as the frame check sequence (FCS).

- When applying the CRC method ,both sender and receiver must agree upon a generator polynomial g(x).

- The checksum is appended at the end of

Hamming Code

- It is an error detection and correction mechanism that can be used to detect and correct the bit errors when the data is moved from source to destination.

- Hamming code makes use of the concept of parity bits, which are the bits are added to the data, so that the validity of data can be checked.