PAGE NO. .....

Error detection and correction

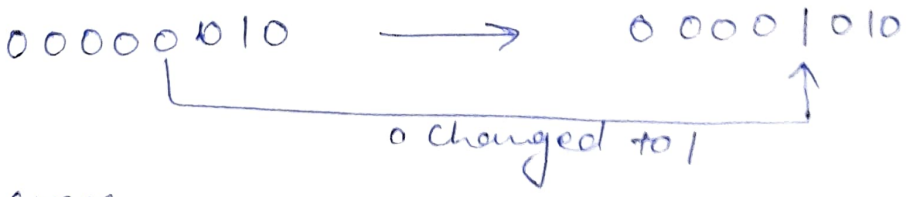
Error

Data are transmitted in the N/w. The data can be corrupted during transmission. known as transmission error.

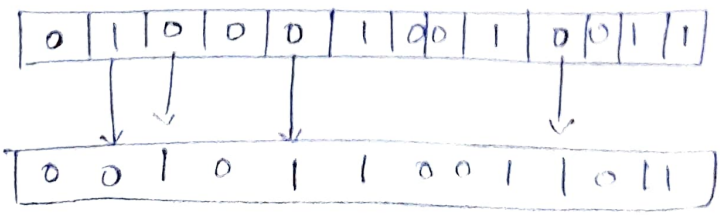
- For reliable comm^n, errors must be detected & corrected.
- Error detection and correction are implemented either at the data link layer or the transport layer of the OSI Model.

Types of Errors

- **Bit Error** - one is going to change



Burst Error - 2 or more bits in data unit have changed.

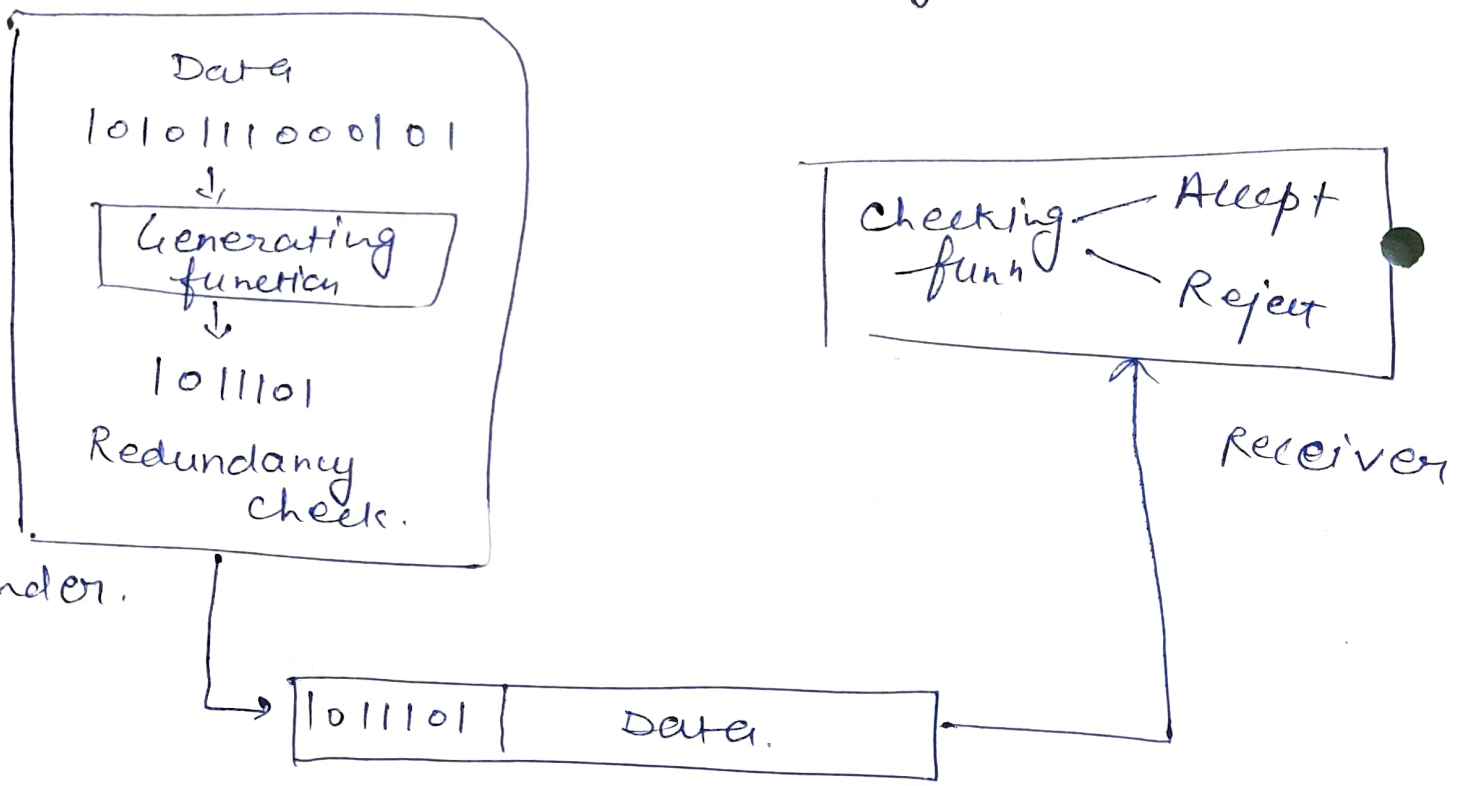


How to detect an error

- Error detection means to decide whether the received data is correct or not without having a copy of the original msg.

- To detect or correct errors, we need to send some ~~data~~ Extra bits with data.

- Known as redundancy bits.



Error Correction

It can be handled in two ways.

- Receiver can have the sender ~~to~~ retransmit the entire data unit
- The receiver can use an error correcting code which automatically corrects certain error

Both error detection & correction need redundancy

PAGE NO. .....

Msg → Generator → Msg + redund ⟶ Received → Msg → Checker → correct or discard.

4 types of Error detection techniques

1) Vertical Redundancy check (VRC)
2) Longitudinal Redundancy check (LRC)
3) Checksum
4) Cyclic Redundancy check (CRC)

1) VRC (Vertical Redundancy check)
- It is also called as parity check.

VRC = 1 ; if odd No. of 1's
VRC = 0 ; if even No. of 1's

1100001 → Even parity generator → Redundant bit → 1 → append with data → 1 1100001 → Data transmitted ⟶ 11100001 → Receiver

Performance – 9+ can detect single bit error

- 9+ can detect burst Error only if the No. of Error is odd.

11100001 → 10100001 → Receiver rejects this data

one bit changed.

11100001 → 10100101 → Receiver accepts this data.

- Misunderstand the data in burst error

Q- Append the parity bit after each block shown below using VRC

1110110 110 1111 1110010

PAGE NO. .....

LRC Longitudinal Redundancy Check.

- In LRC, a block of bits is organized in rows and columns.
- also known as 2-D parity
- The parity bit is calculated for each column and sent along with the data.
- The block of parity acts as the redundant bits.

Ex Find LRC

11100111 11011101 00111001 10100101

Determine the data that is transmitted.

```
11100111
11011101
00111001
10100101
--------
10101010
```

10101010	10100101	00111001	11011101	11100111

Performance of LRC

- LRC increases the likelihood of detecting burst errors.

- If two bits in one data units are damaged and two bits in exactly the same positions in another data unit are also damaged, the LRC checker will not detect an error.

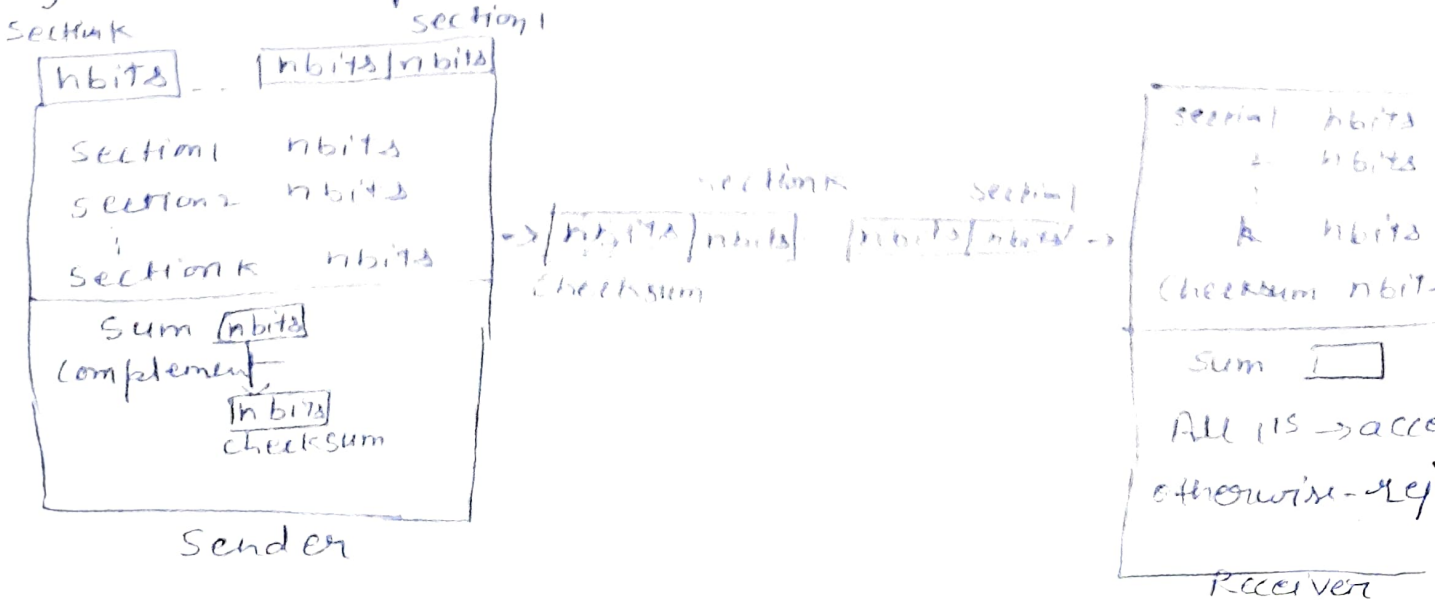
Assignmt Find the LRC for the data blocks
01110111 , 10101001, 01101001, 10101010
determine the data that is transmitted.

3) Checksum - check + sum

Sender - Checksum creation
Receiver side - Checksum validation

operation at sender side

1) Break the original msg in a K No. of blocks with n bits in each block.
2) Sum all the 'K' data blocks
3) Add the carry to the sum, if any
4) Do 1's complement to the sum = checksum.



Examples (sender)

10011001 11100010 00100100 10000100

```
  1 1 1 1 1
  1 0 0 1 1 0 0 1
  1 1 1 0 0 0 1 0
  0 0 1 0 0 1 0 0
  1 0 0 0 0 1 0 0
-------------------
1 0 0 0 1 0 0 0 1 1
+               1
-------------------
  0 0 1 0 0 0 1 0 0
```

1's complement.

1 1 0 1 1 0 1 0 checksum value appended with msg.

Receiver → collect all the data blocks including the checksum
→ Sum all the data blocks & checksum
→ If the result is all 1's → Accept
Else → Reject.

11011010 10011001 11100010 00100100 10000100

```
  1 1 0 1 1 0 1 0
  1 0 0 1 1 0 0 1
  1 1 1 0 0 0 1 0
  0 0 1 0 0 1 0 0
  1 0 0 0 0 1 0 0
-------------------
1 1 1 1 1 1 1 0 0
+               1
-------------------
  1 1 1 1 1 1 1 1
```

Accepts

Performance

- The Checksum detects all errors involving an odd number of bits
- It detects most errors involving an even No. of bits
- If one or more bits of a segment are damaged and the corresponding bit or bits of opposite value in a second segment are also damaged, the sum of those columns will not change and the receiver will not detect the errors.