Error Detection and Correction

By

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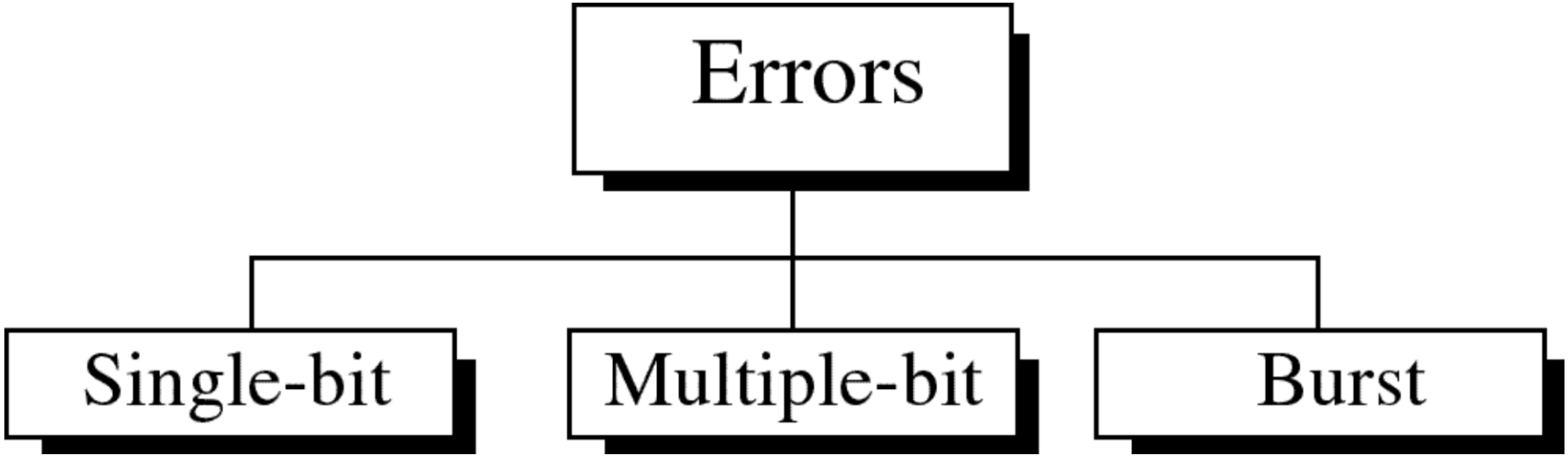
Transmission Media and Impairments

- ✓ Signals/ Bits may be corrupted during Transmission due to
  - ✓ Attenuation
  - ✓ Distortion
  - ✓ Noise
  - ✓ Interferences

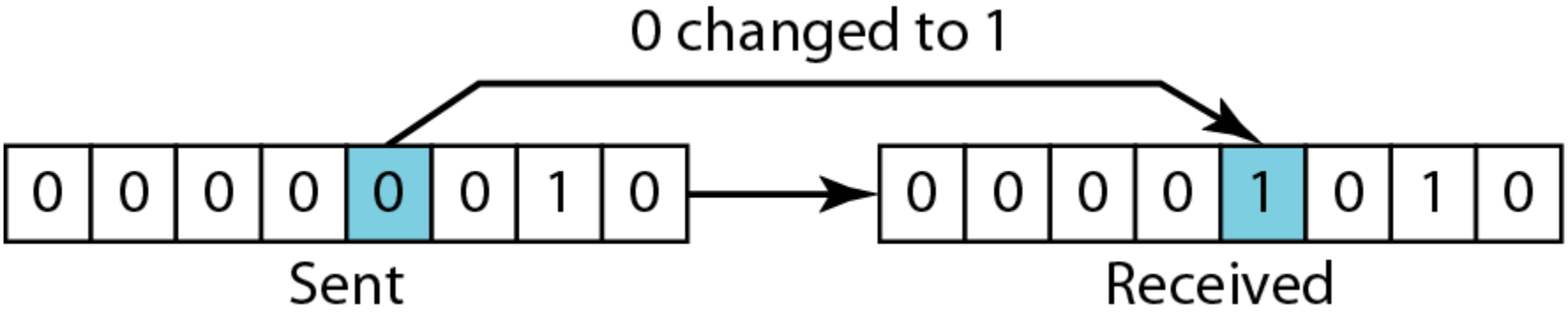
- ✓ Error Detection and Correction mechanisms are required
  - ✓ For Reliable Communication/ Transmission

Types of Errors



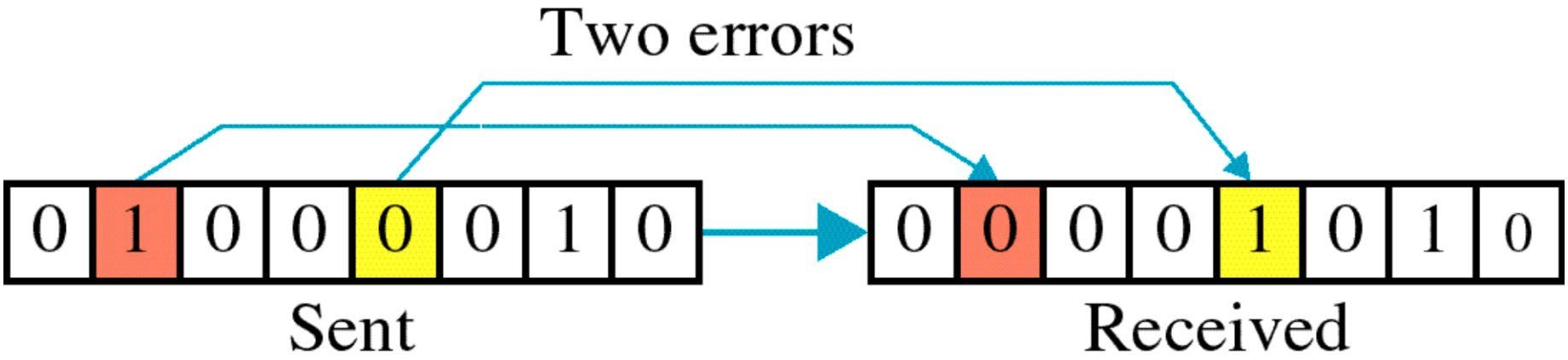
Single Bit Error

- ✓ In a single-bit error, only 1 bit in the data unit has been changed



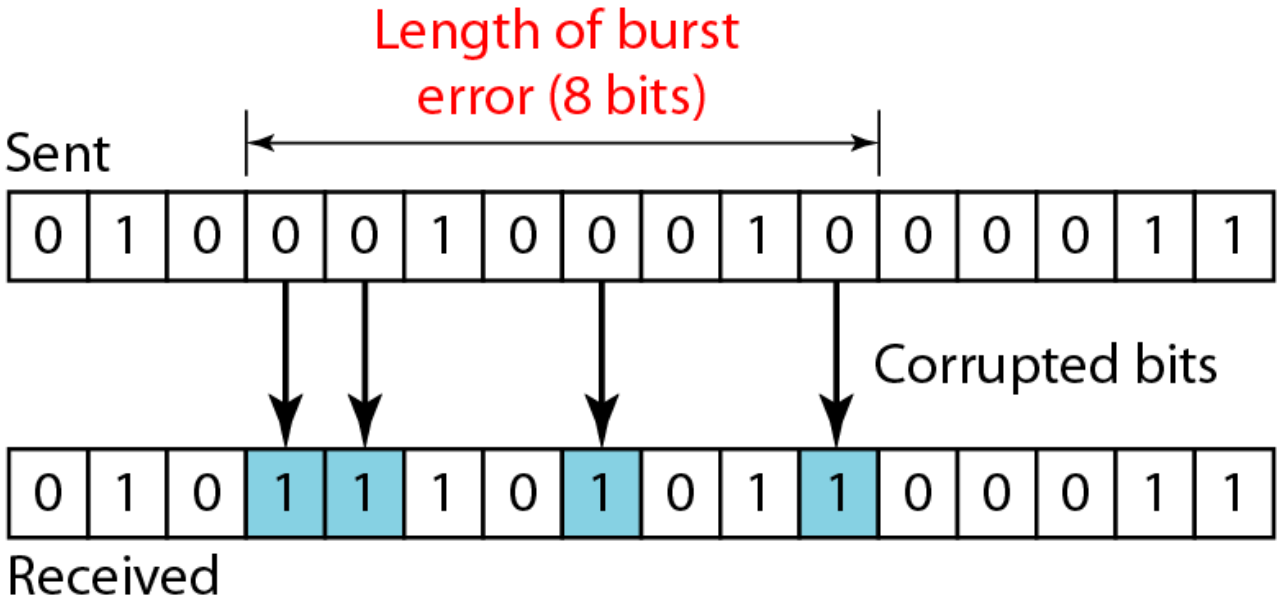
Multiple Bit Errors

- ✓ In a multiple-bit errors, multiple bits in the data unit have been changed



Multiple Bit Errors - Burst Error

- ✓ A burst error means that 2 or more bits in the data unit have been changed



Impact of Single Bit Error

SEND	0000 0010	-	Start of TeXt	-	ASCII STX
RECEIVE	0000 1010	-	Line Feed	-	ASCII LF

- ✓ Parallel transmission – Clubbing of wires – ex: CPU and RAM

Impact of Burst Errors

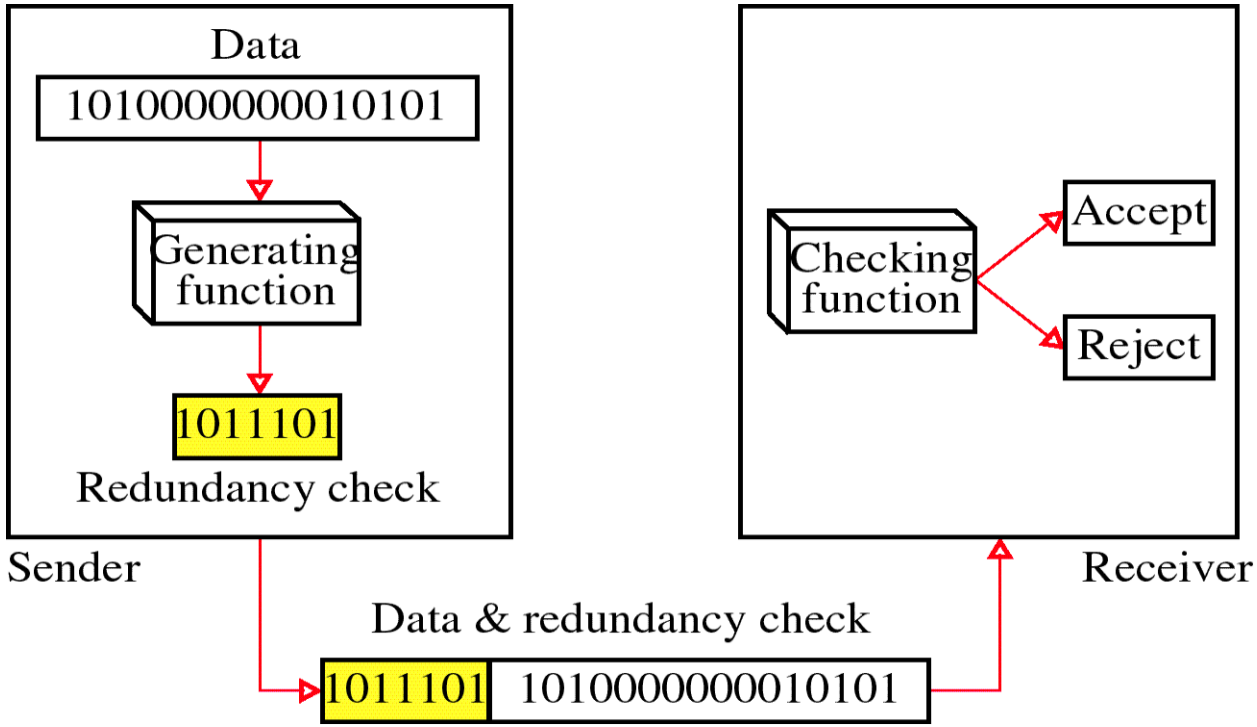
SEND 0100 0100 0100 0011

RECEIVE 0101 1101 0100 0011

BURST LENGTH = 5

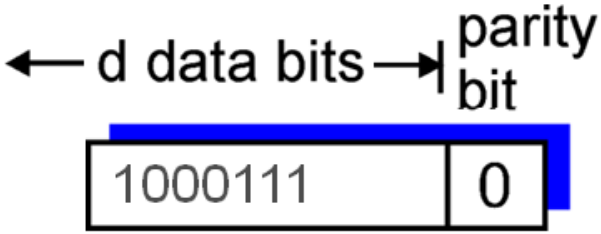
If we send 1 Kpbs, noise of 1/100 s can affect 10 bits

Redundancy Check



Parity Bits – Redundant Bit

- ✓ To detect or correct errors, we need to send extra (redundant) bits with data



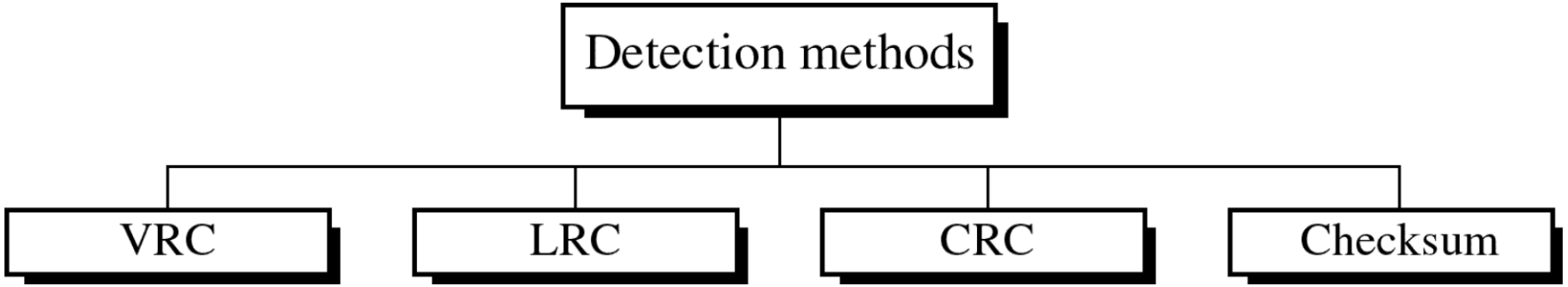
- ✓ Parity Bit
- ✓ One additional bit per character
- ✓ *Even parity*
- ✓ *Odd Parity*

Parity Bit Checking

Sender	Maintain Even Ones	Receiver	Check for Even Parity
1000111	0	1010111	0 => Error
1000111	0	1010011	0 => Errors are not detected

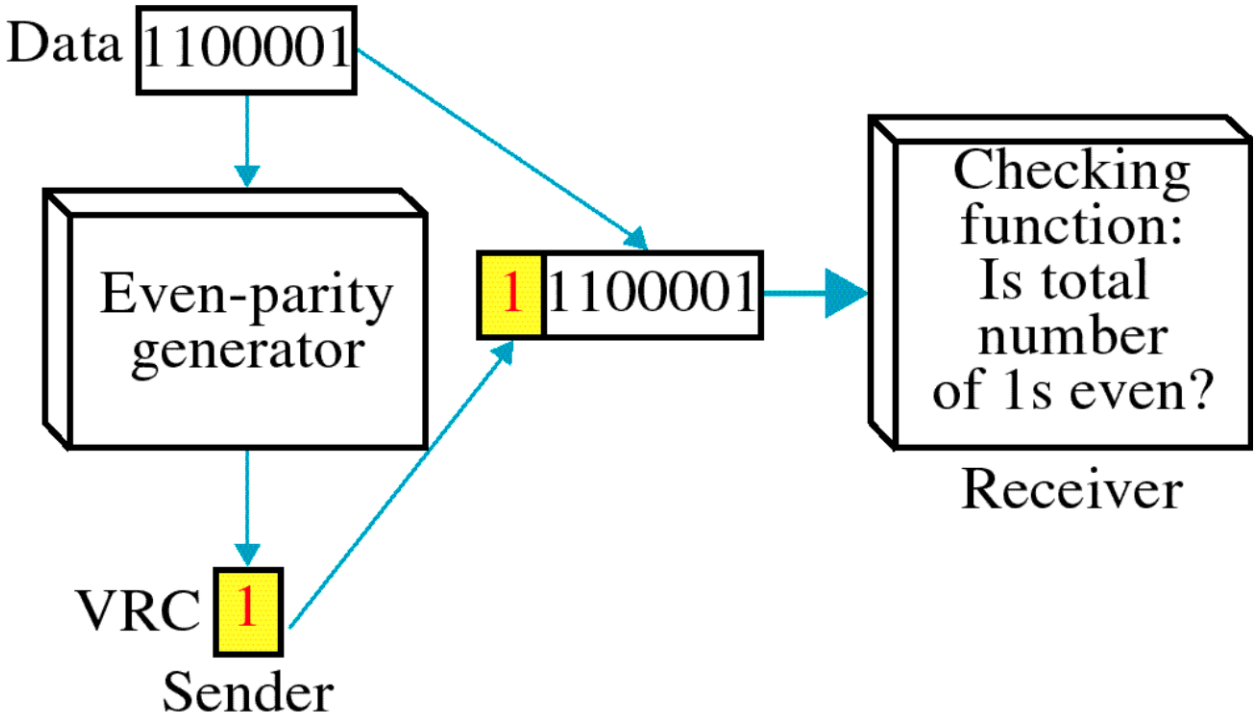
Only odd number of Errors are detected

Error Detection Methods

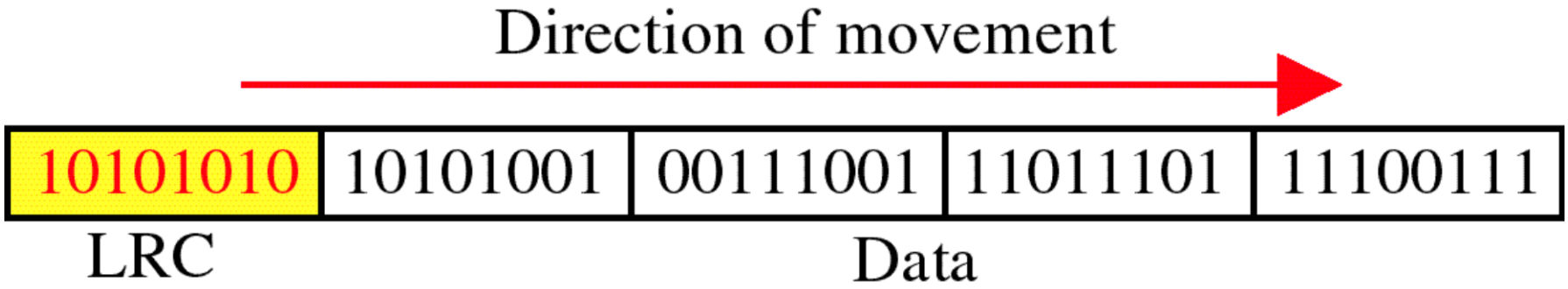


Error Detection Methods - VRC

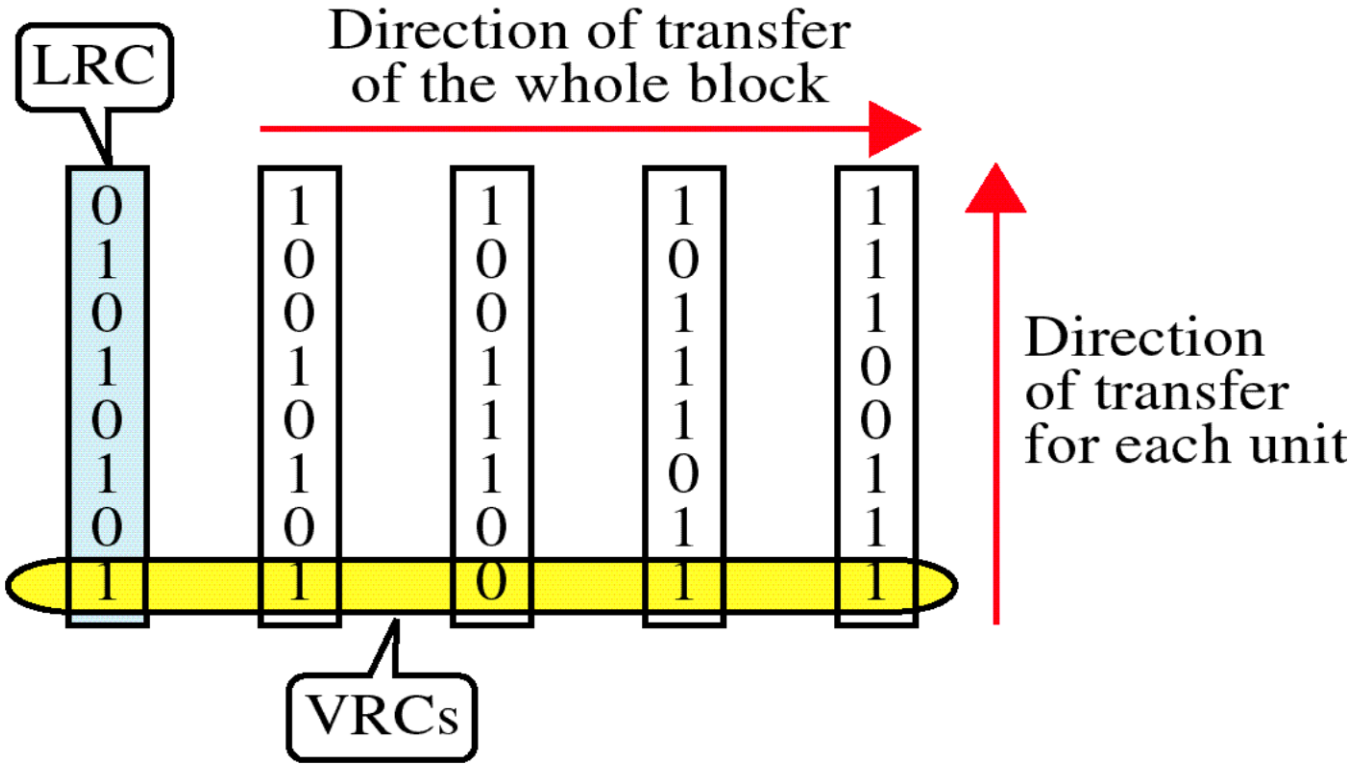
Only odd number of Errors are detected



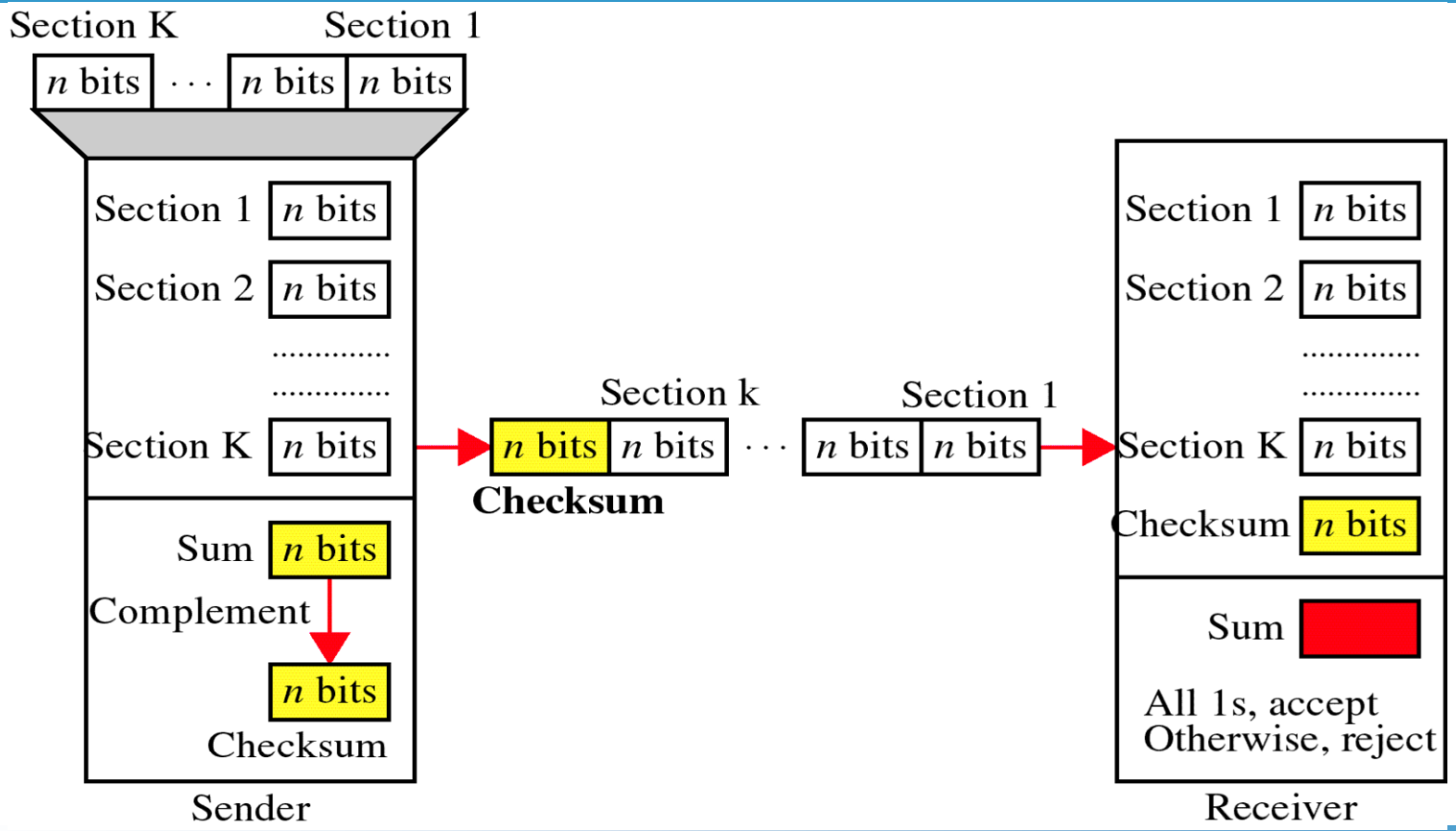
Error Detection Methods - LRC



Error Detection Methods – LRC and VRC

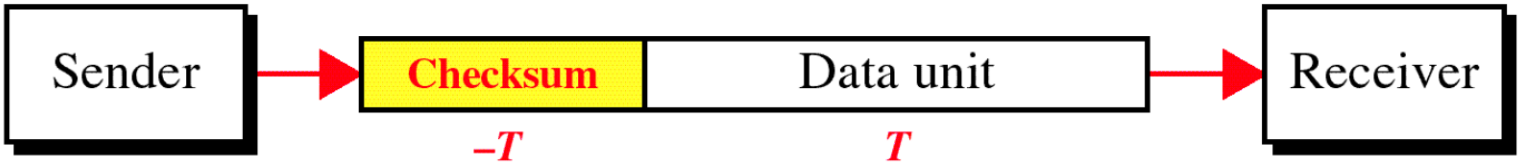


Error Detection - Check Sum Computation



Error Detection - Check Sum Computation

The receiver adds the data unit and the checksum field. If the result is all 1s, the data unit is accepted; otherwise it is discarded.



Hamming Distance

- ✓ The Hamming distance between two words is the number of differences between corresponding bits

- ✓ d(01011, 11110) = 3
- ✓ d(00000,11110) = 4
- ✓ d(01011,10101) = 4

References

- ✓ Book: Data communication and Networking
  Fourth edition
  By : BEHROUZ A FOROUZAN

- ✓ various relevant websites

Thank you