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Data Communication CS601 Lecture No 25

Lecture Prepared By

Muhammad Abid Ali

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CS601 Lecture No 25 Topic 143 to 148

Parity-Check Code

- **Most common error-detecting code**
- **Linear block code (n=k+1)**

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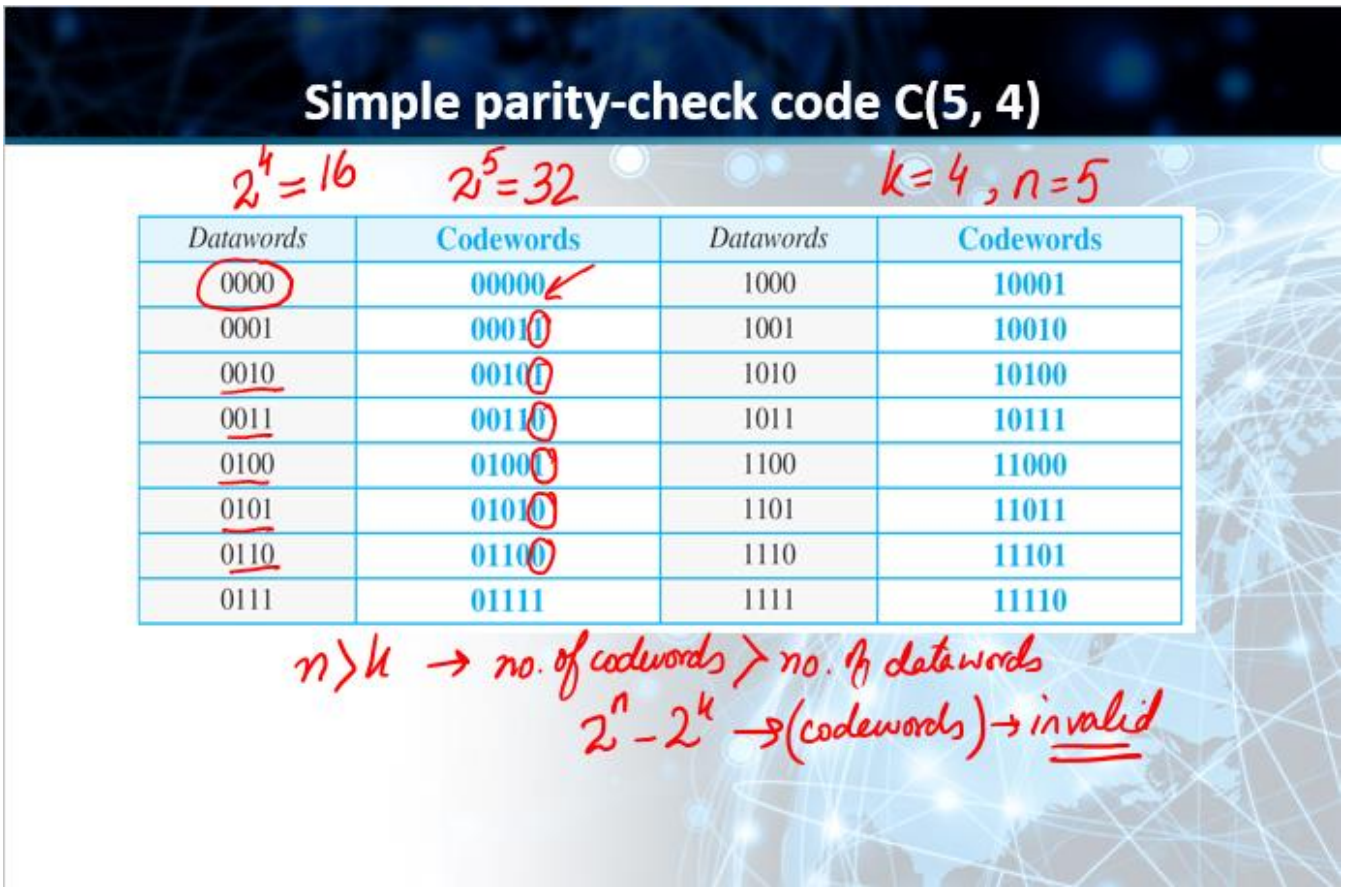
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- **The extra parity bit is selected to make total number of 1s in codeword even**

The simple parity-check code is the most familiar error-detecting code. In this code, **a k-bit data word is changed to an n-bit code word where n = k + 1**. The extra bit, called the parity bit, is selected to make the total number of 1s in the code word even.



Datawords	Codewords	Datawords	Codewords
0000	00000	1000	10001
0001	00011	1001	10010
0010	00101	1010	10100
0011	00110	1011	10111
0100	01001	1100	11000
0101	01010	1101	11011
0110	01100	1110	11101
0111	01111	1111	11110

CYCLIC CODES

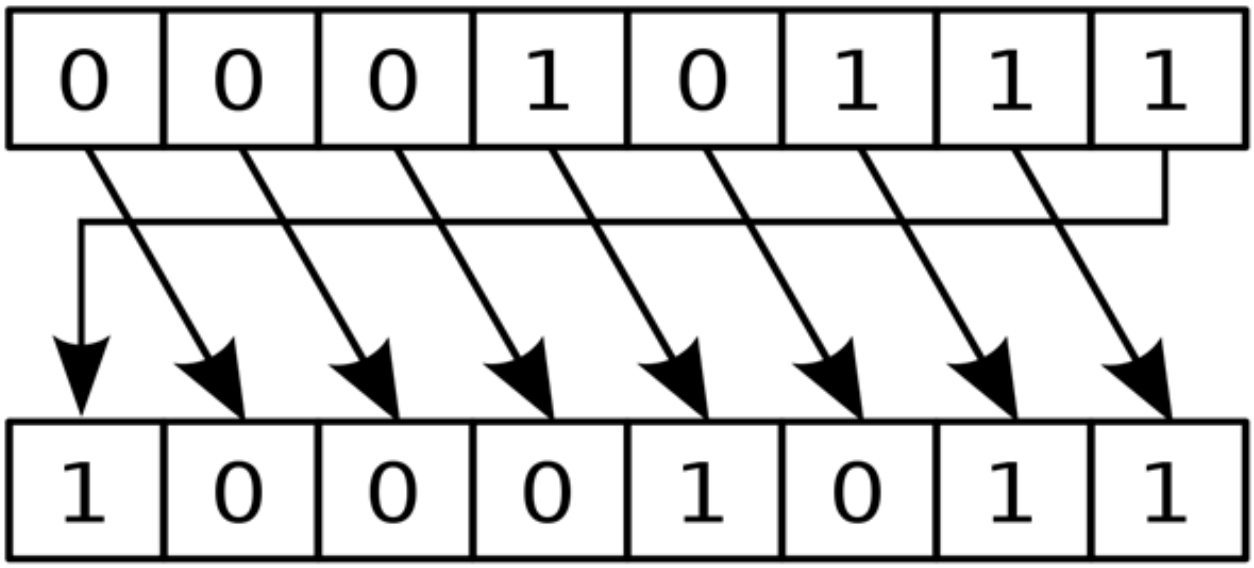
- **Special linear block codes with one extra property**
- **If a codeword is cyclically shifted (rotated), the result is another codeword**
- **If 1011000 is a codeword and we cyclically left-shift, then 0110001 is also a codeword**

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In coding theory, a cyclic code is **a block code, where the circular shifts of each codeword gives another word that belongs to the code**.



Cyclic Redundancy Check (CRC)

- **Subset of Cyclic Codes**
- **Cyclic redundancy check (CRC) is used in networks such as LANs and WANs**

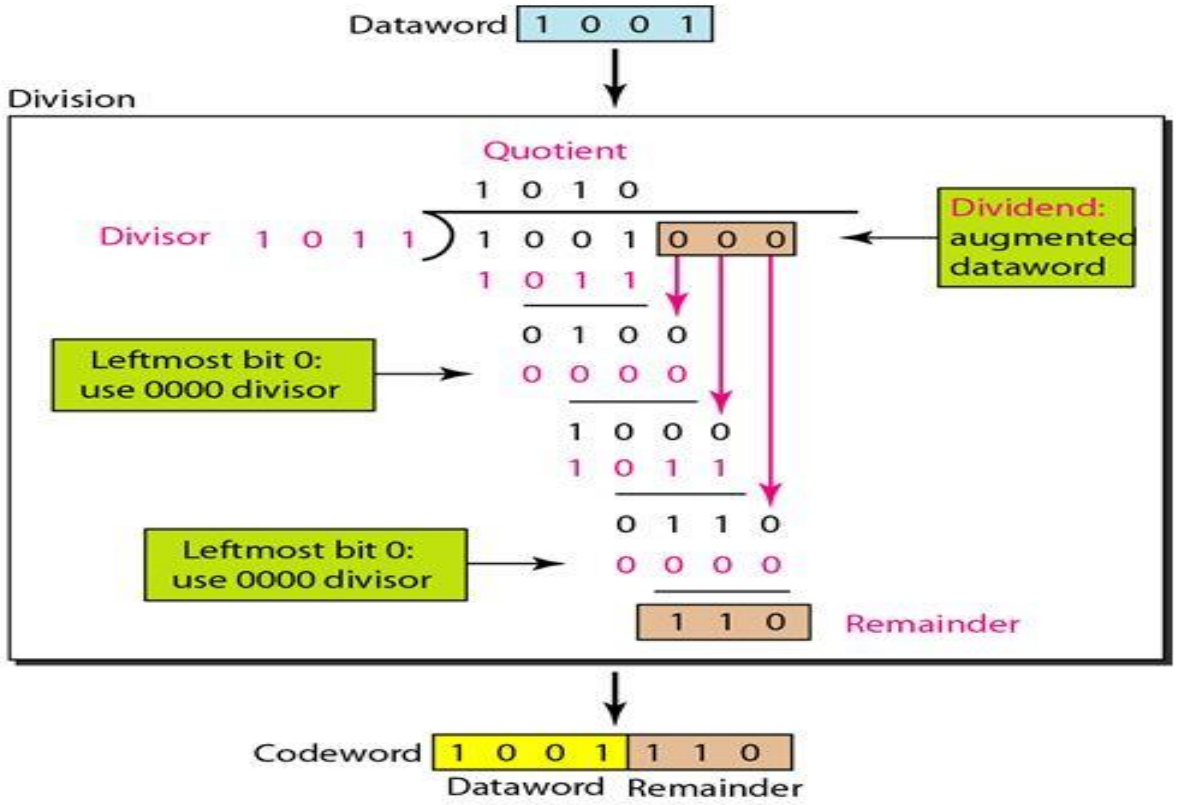
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A CRC code with C(7, 4)

Dataword	*Codeword*	*Dataword*	*Codeword*
0000	0000000	1000	1000101
0001	0001011	1001	1001110
0010	0010110	1010	1010011
0011	0011101	1011	1011000
0100	0100111	1100	1100010
0101	0101100	1101	1101001
0110	0110001	1110	1110100
0111	0111010	1111	1111111

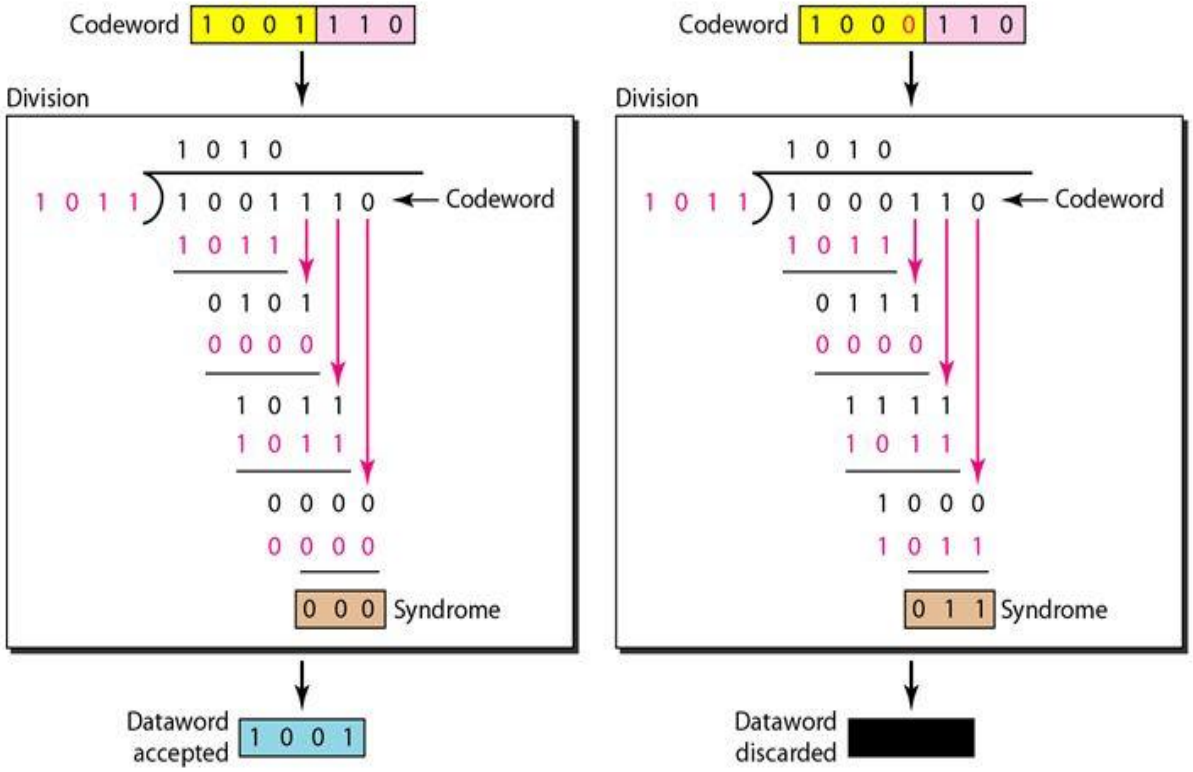


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Decoder:



Advantages of Cyclic Codes

- **Good performance in detection:**
  - **Single-bit errors**
  - **Double errors**
  - **Odd number of errors**
  - **Burst errors**
- **Easy Implementation**
- **Fast Implementation**

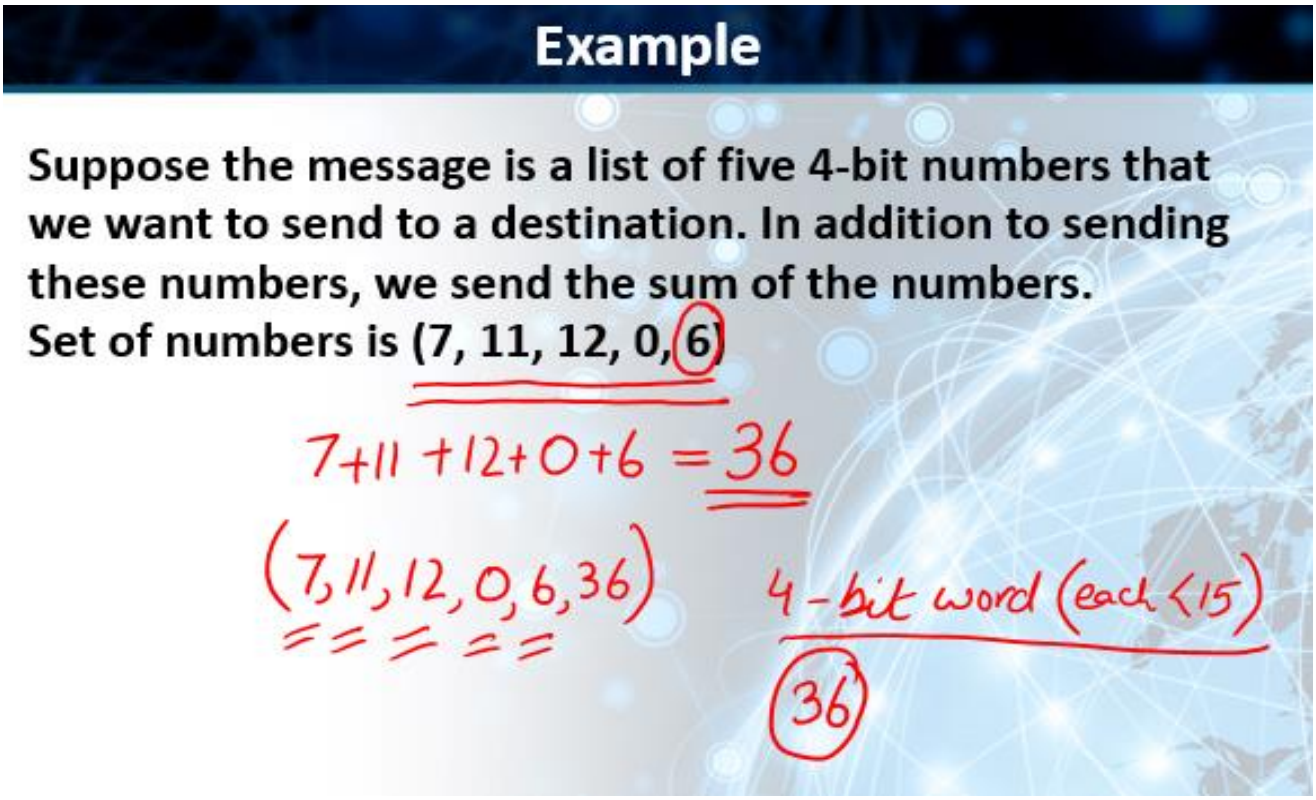
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CHECKSUM

- **Error-detection technique that can be applied to a message of any length**
- **Checksum mostly used at the network and transport layer rather than the data-link layer**

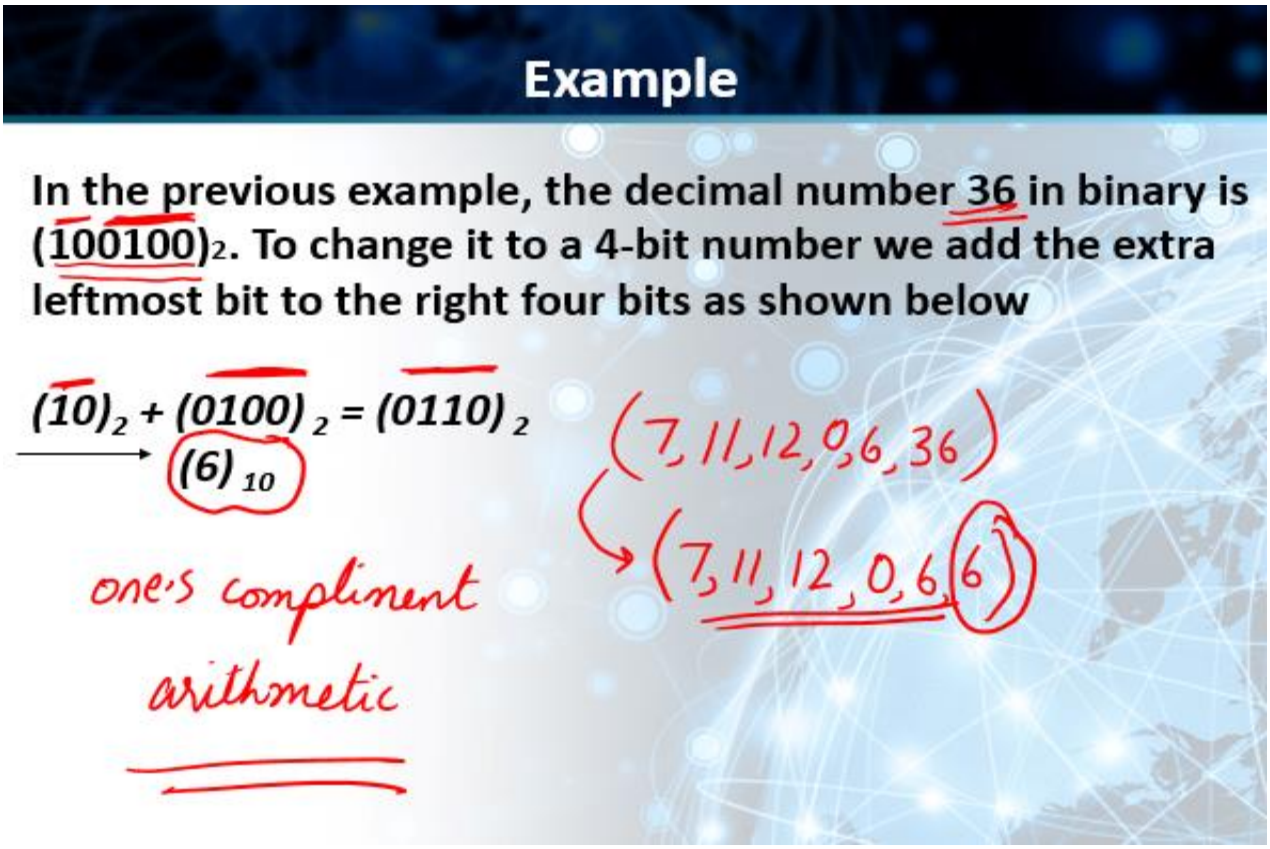


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Forward Error Correction

- **Retransmission of corrupted and lost packets is not useful for real-time multimedia transmission**
- **We need to correct the error or reproduce the packet immediately**
- **Several techniques developed and are commonly called Forward Error Correction techniques**

Using Hamming Distance

- **For error detection, we definitely need more distance**
- **It can be shown that to correct 't' errors, we need to have:**

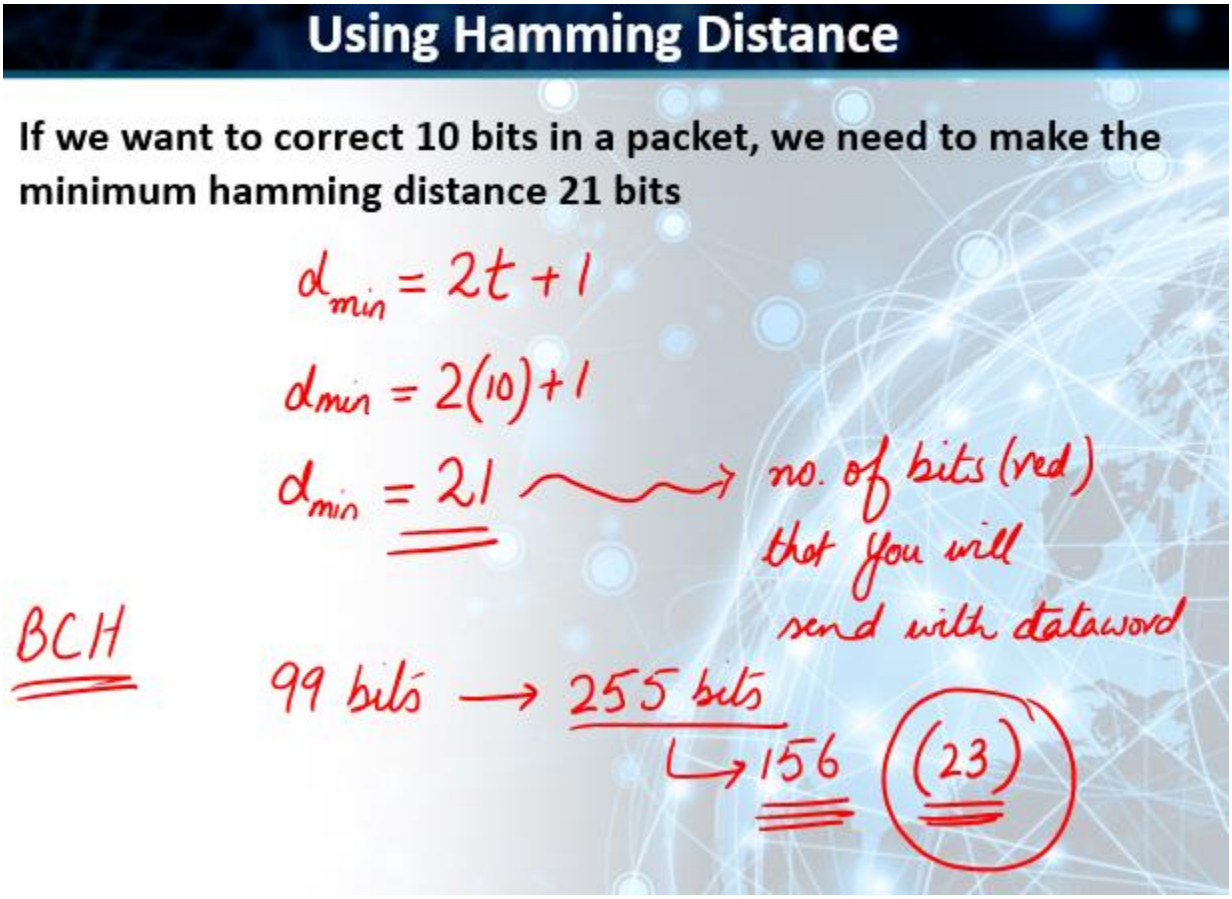
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$d_{min} = 2t + 1$

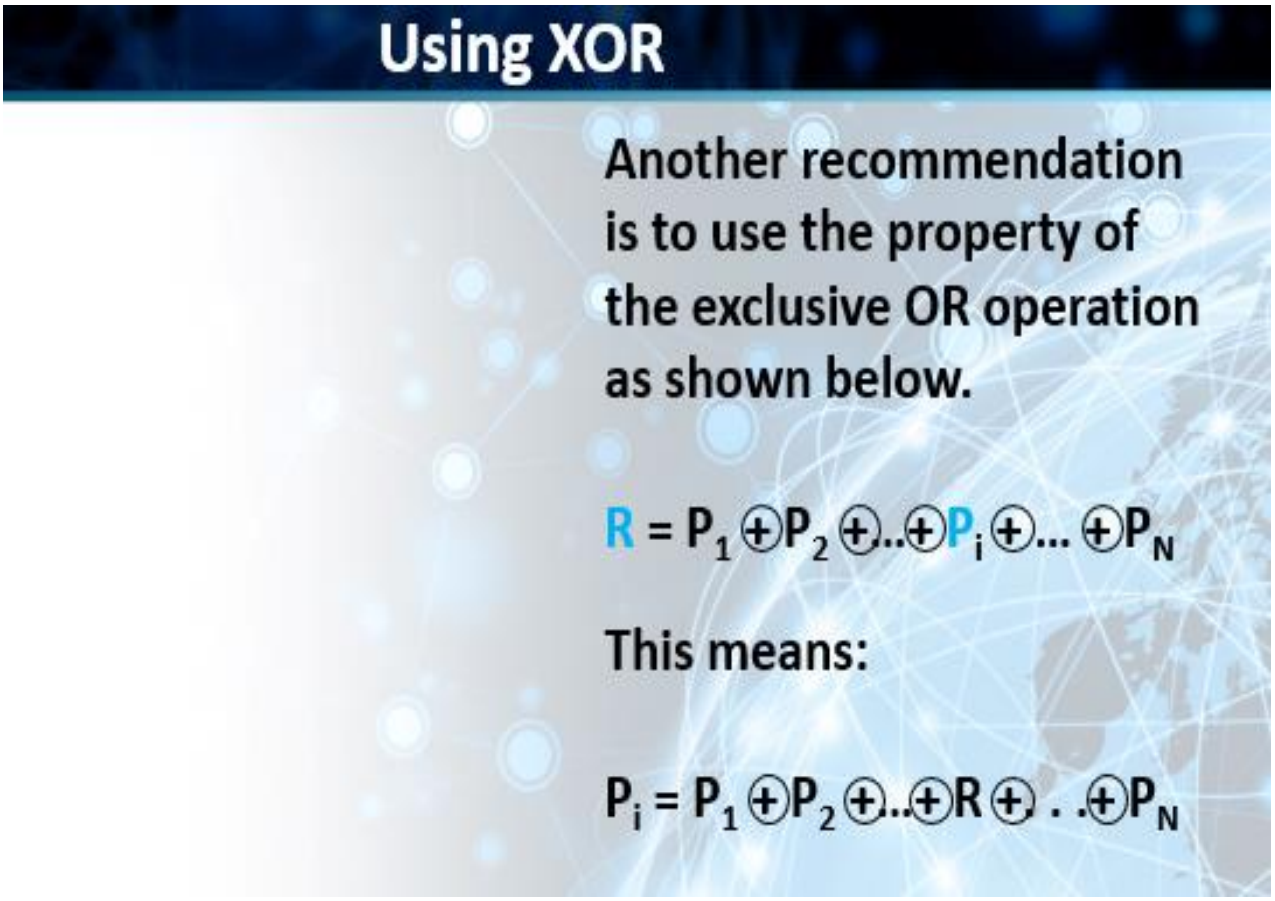
- **If we want to correct 10 bits in a packet, we need to make the minimum hamming distance 21 bits**
- **A lot of redundant bits need to be sent with the data**



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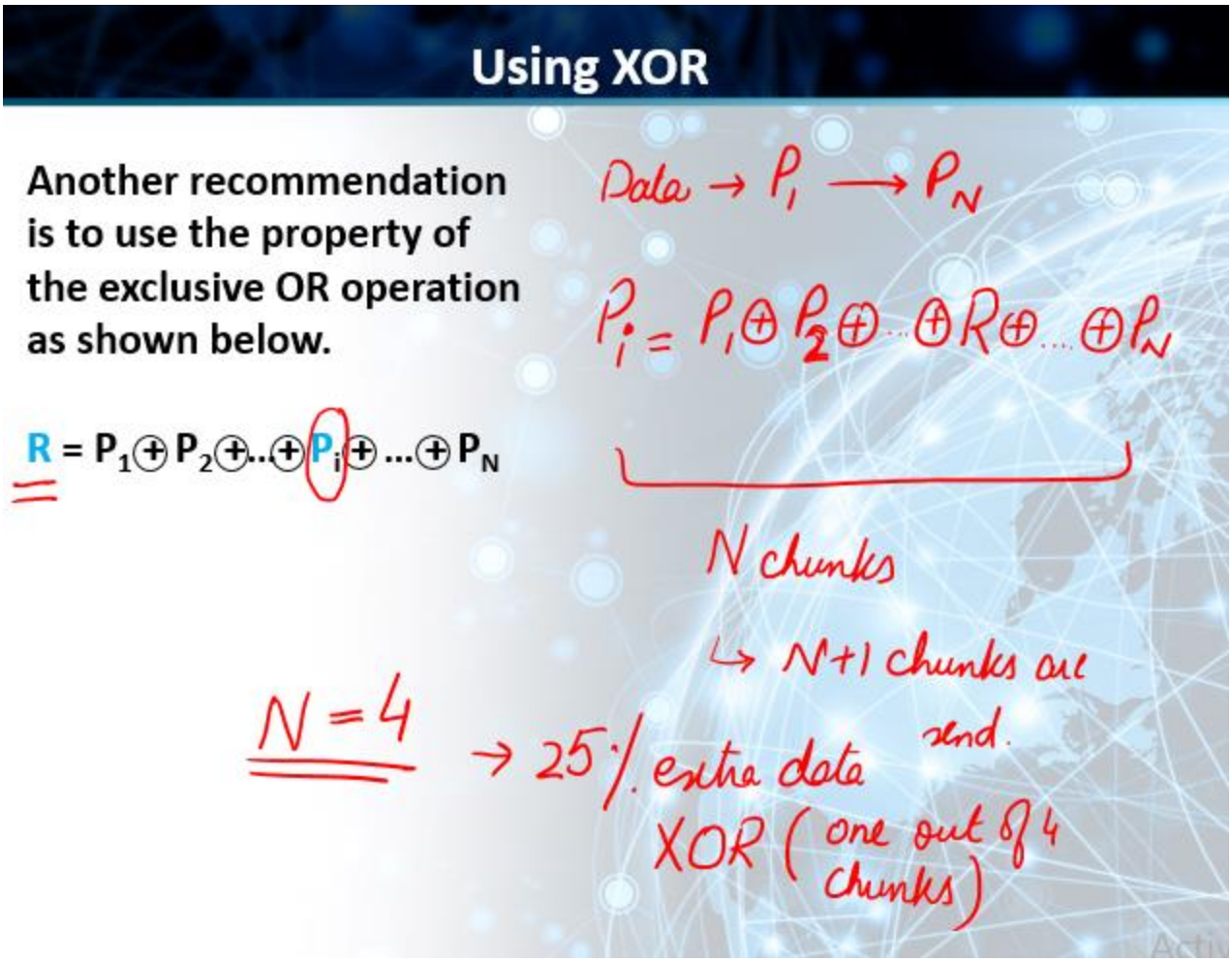
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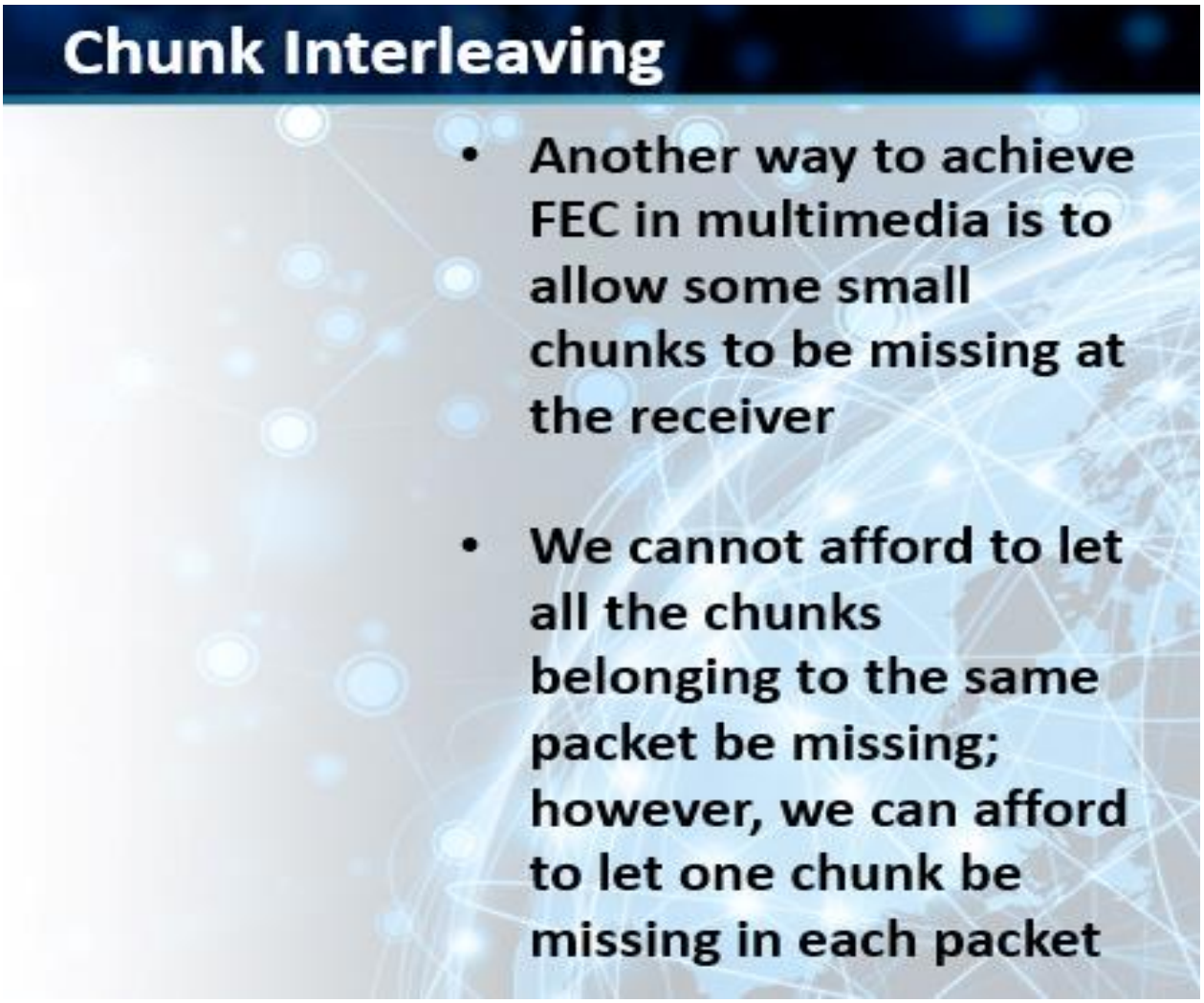
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