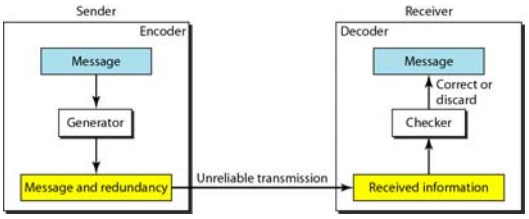
บทที่ 10 Error Detection and Correction

10.1 INTRODUCTION

10.1.1 Types of Errors : single-bit error / burst error

10.1.2 Redundancy (block codes only)



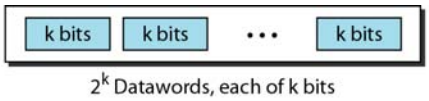
10.1.3 Detection Versus Correction

10.1.4 Forward Error Correction Versus Retransmission

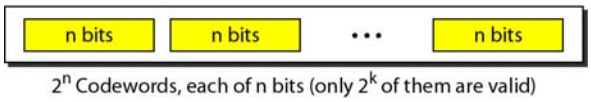
10.1.5 Coding

10.1.6 Modular Arithmetic

10.2 BLOCK CODING : Datawords and Codewords



Coding scheme : C(n,k)



10.2.1 Error Detection

10.2.2 Error Correction

Datawords	*Codewords*
00	000
01	011
10	101
11	110

Dataword	*Codeword*
00	00000
01	01011
10	10101
11	11110

10.2.3 Hamming Distance : d(A,B)

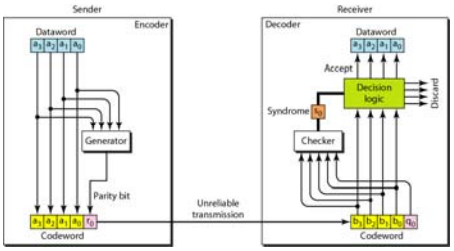
10.2.4 Minimum Hamming Distance : d_{min}

10.3 LINEAR BLOCK CODES

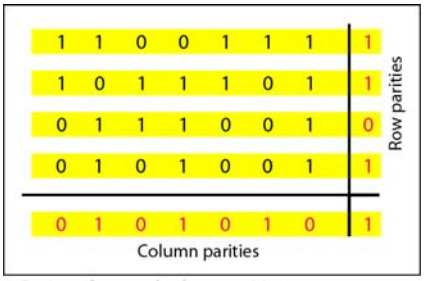
10.3.1 Minimum Distance for Linear Block Codes

10.3.2 Some Linear Block Codes

Simple Parity-Check Code (Even)

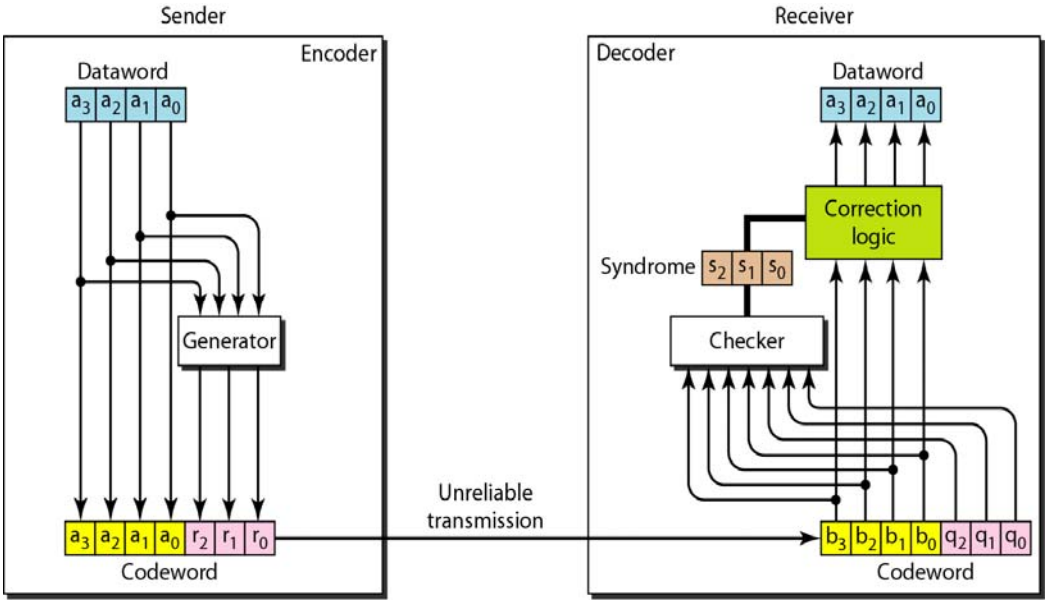


Two-Dimensional Parity-Check Code



a. Design of row and column parities

Hamming Codes C(7, 4)



1) Transmitter : $r_0 = a_2 \oplus a_1 \oplus a_0$ $r_1 = a_3 \oplus a_2 \oplus a_1$ $r_2 = a_1 \oplus a_0 \oplus a_3$

2) Receiver : $s_0 = b_2 \oplus b_1 \oplus b_0 \oplus q_0$ $s_1 = b_3 \oplus b_2 \oplus b_1 \oplus q_1$ $s_2 = b_1 \oplus b_0 \oplus b_3 \oplus q_1$

Syndrome	000	001	010	011	100	101	110	111
Error	None	q_0	q_1	b_2	q_2	b_0	b_3	b_1

Hamming Codes C(11, 7)

1) Transmitter : $r_1 = t_{11} \oplus t_9 \oplus t_7 \oplus t_5 \oplus t_3$ $r_2 = t_{11} \oplus t_{10} \oplus t_7 \oplus t_6 \oplus t_3$

$r_3 = t_7 \oplus t_6 \oplus t_5$ $r_4 = t_{11} \oplus t_{10} \oplus t_9$

2) Receiver : $s_1 = r_1 \oplus t_{11} \oplus t_9 \oplus t_7 \oplus t_5 \oplus t_3$ $s_2 = r_2 \oplus t_{11} \oplus t_{10} \oplus t_7 \oplus t_6 \oplus t_3$

$s_3 = r_1 \oplus t_7 \oplus t_6 \oplus t_5$ $s_4 = r_4 \oplus t_{11} \oplus t_{10} \oplus t_9$

11	10	9	8	7	6	5	4	3	2	1
d	d	d	r_8	d	d	d	r_4	d	r_2	r_1