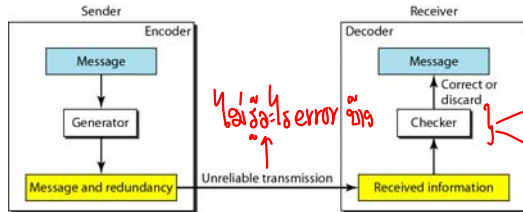


บทที่ 10 Error Detection and Correction

10.1 INTRODUCTION

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

10.1.2 Redundancy (block codes only)



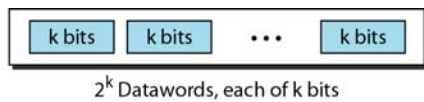
10.1.3 Detection Versus Correction

10.1.4 Forward Error Correction Versus Retransmission

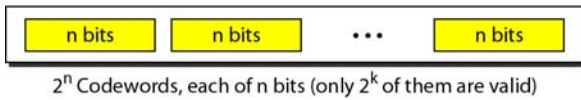
10.1.5 Coding

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	Dataword	Codeword
00	000	00	00000
01	011	01	01011
10	101	10	10101
11	110	11	11110

10.2.3 Hamming Distance : d(A,B)

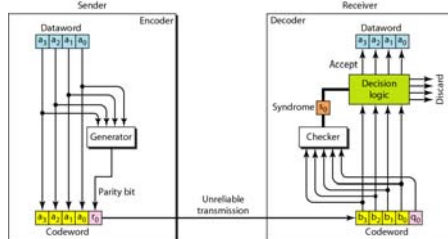
10.2.4 Minimum Hamming Distance : d_{min}

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)



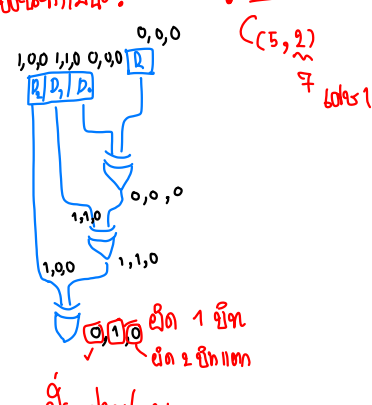
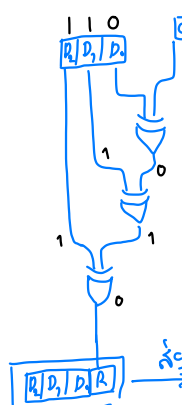
$$p = p_1 \oplus p_2 \oplus \dots \oplus p_n$$

$$p = \bar{p}_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n) + p_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n) + \bar{p}_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n) + p_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n)$$

$$= \bar{p}_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n) + p_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n)$$

$$= \bar{p}_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n) + p_1 (\bar{p}_2 \oplus \dots \oplus \bar{p}_n)$$


parity และ 2-map แล้วมัน



if data is wrong even bits, this fail.

$(40, 28)$ 12 peritite

$$\begin{array}{ccccc|c} 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ \hline 1 & 1 & 1 & 1 & 1 & 1 \end{array} \quad \begin{array}{ccccc|c} 1 & 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 \\ \hline 1 & 1 & 1 & 1 & 1 & 1 \end{array}$$


 2.ตัว 2.ตัว
 2.ตัว 2.ตัว

เลขตัวหลัก
 เลข parity
 เลขเลข

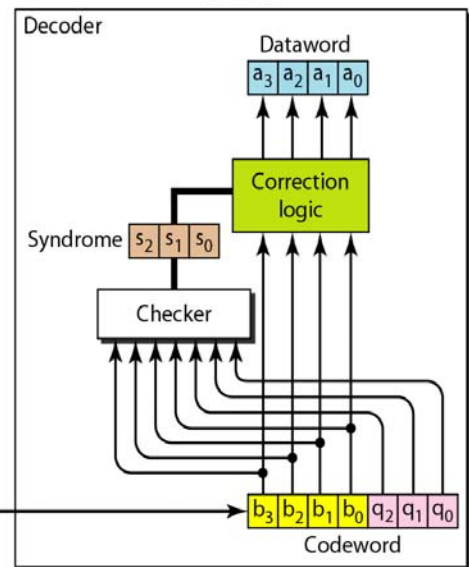
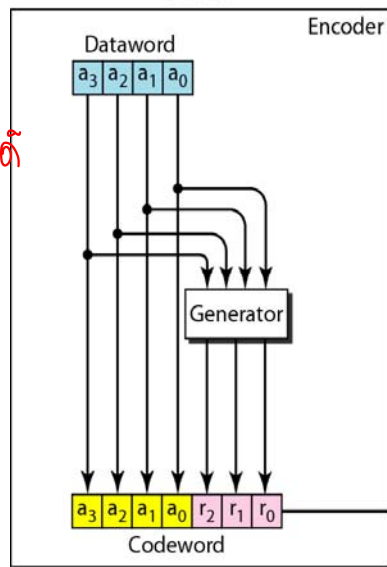
1	1	0	0	1	1	1	1	Row parities
1	0	1	1	1	0	1	1	
0	1	1	1	0	0	1	0	
0	1	0	1	0	0	1	1	
0	1	0	1	0	1	0	1	Column parities

$$\begin{array}{ccccccc|c}
 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\
 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0-110n \\
 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\
 0 & 1 & 0 & 1 & 1 & 0 & 1 & 0-110n \\
 \hline
 0 & 1 & 1 & 1 & 0 & 0 & 0 & 1
 \end{array}$$

Nothing perfect!

Hamming Codes $C(7, 4)$ basic စာလေး

Receiver



694 1001

1) Transmitter : $r_0 = a_2 \oplus a_1 \oplus a_0$ $r_1 = a_3 \oplus a_2 \oplus a_1$ $r_2 = a_1 \oplus a_0 \oplus a_3$ } $\left. \begin{array}{l} \text{0 0 1} \\ \text{1 0 0} \\ \text{0 1 1} \end{array} \right\} \text{LSBS } \boxed{1001110}$

2) Receiver : $s_0 = b_2 \oplus b_1 \oplus b_0 \oplus q_0$ $s_1 = b_3 \oplus b_2 \oplus b_1 \oplus q_1$ $s_2 = b_1 \oplus b_0 \oplus b_3 \oplus q_1$ Error 102

0 1 1 1
1 0 1 1
1 1 1 0
1011 110

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

$$S_0 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

សំណុំរឿង ២៧

L> ខ្ញុំចាំបង្កើតការងារស្រស់ស្អាត

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

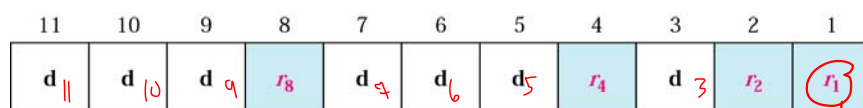
$$\mathbf{r}_4 = \mathbf{t}_7 \oplus \mathbf{t}_6 \oplus \mathbf{t}_5$$

$$\mathbf{r}_8 = \mathbf{t}_{11} \oplus \mathbf{t}_{10} \oplus \mathbf{t}_9$$

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

$$s_3 = r_1 \oplus t_7 \oplus t_6 \oplus t_5$$

$$\mathbf{s}_4 = \mathbf{r}_4 \oplus \mathbf{t}_{11} \oplus \mathbf{t}_{10} \oplus \mathbf{t}_9$$


$$r_e = \underbrace{\hspace{10em}}_{(+)}$$
$$r_4 = \oplus$$
$$Y_2 = \underbrace{\quad}_{\oplus}$$

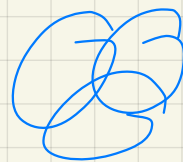
③

1

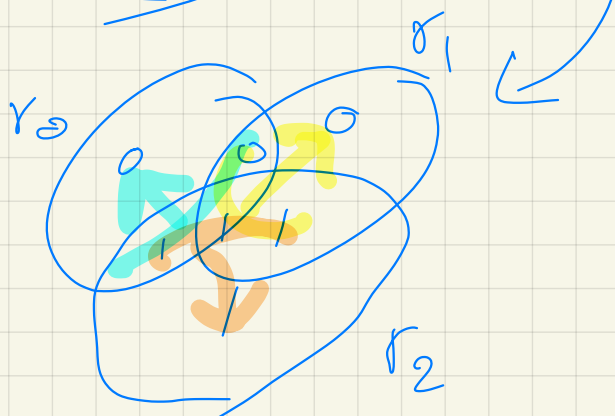
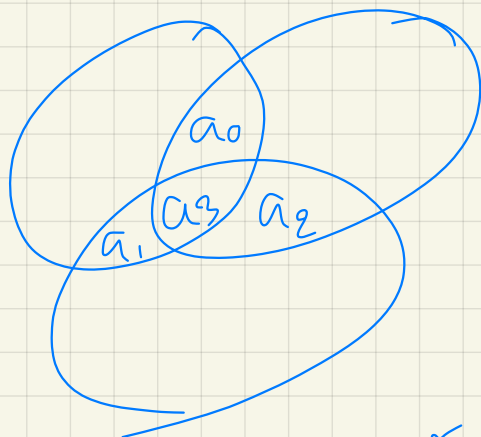
$$d \log \hat{v} \oplus \hat{v}$$

$(7, 4)$

code word $\Rightarrow 3 \rightarrow$

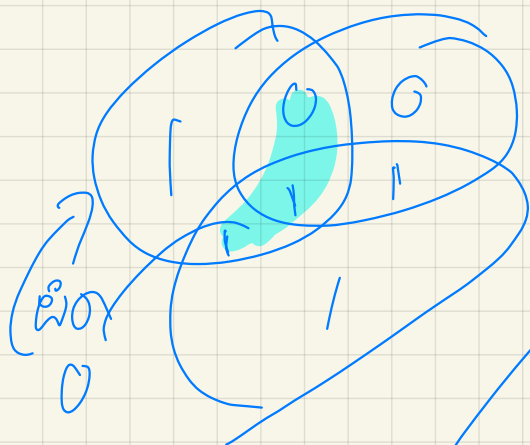


a_3 a_6
 ||| 0

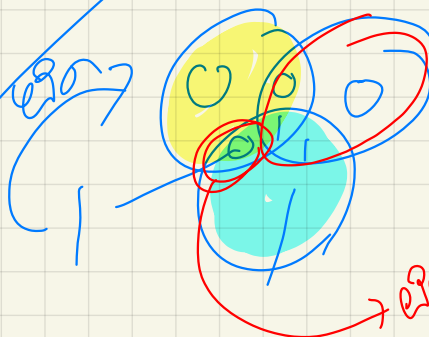


$r_0 = 0$ $r_1 = 0$ $r_2 = 1$

||| 0 | 0 ដំបូង



|| 00 | 00



ដើម្បីរកកូដកំណត់
 set កំណត់

ដំបូងបំផុត