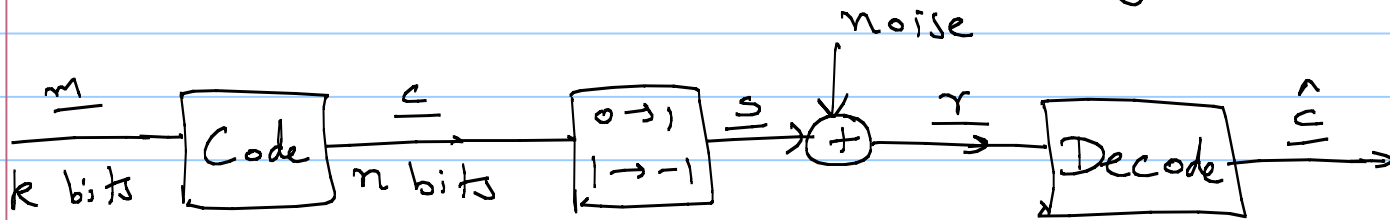


Lecture 42

Note Title

11/3/2008

BPSK over AWGN for coding:

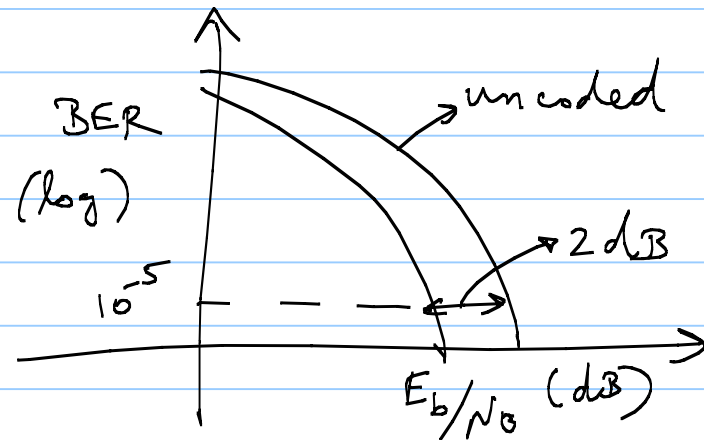


1-1 mapping

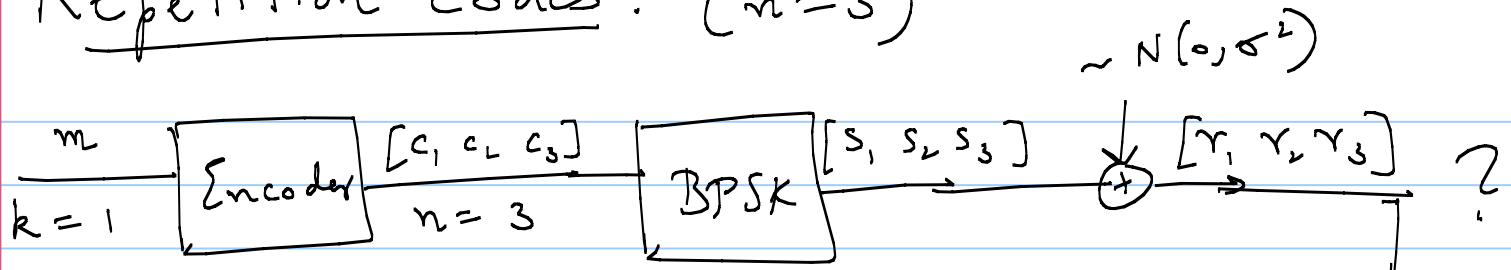
$$\text{Code} = \{c\}$$

$$R = \frac{k}{n} \text{ bits/sym}$$

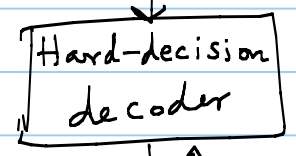
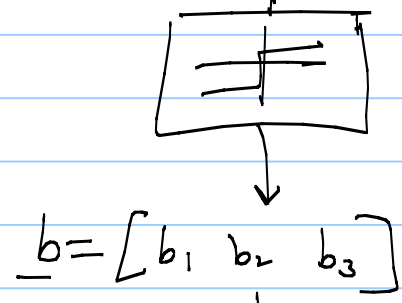
$$\frac{E_b}{N_0} = \frac{1}{2R\sigma^2}$$



Repetition codes: ($n=3$)



\underline{m}	\underline{c}	\underline{s}
0	0 0 0	1 1 1
1	1 1 1	-1 -1 -1



\underline{b}	$\hat{\underline{c}}$
0 0 0	0 0 0
0 0 1	0 0 0
0 1 0	0 0 0
1 0 0	0 0 0
0 1 1	1 1 1
1 0 1	1 1 1
1 1 0	1 1 1
1 1 1	1 1 1

Fix $m=0$

$$p = Q\left(\frac{1}{\sigma}\right) \rightarrow \left(\Pr(\hat{b}_i \neq c_i)\right)$$

$$P_e = 3p^2(1-p) + p^3 = 3p^2 - 2p^3 \approx 3Q^2\left(\frac{1}{\sigma}\right)$$

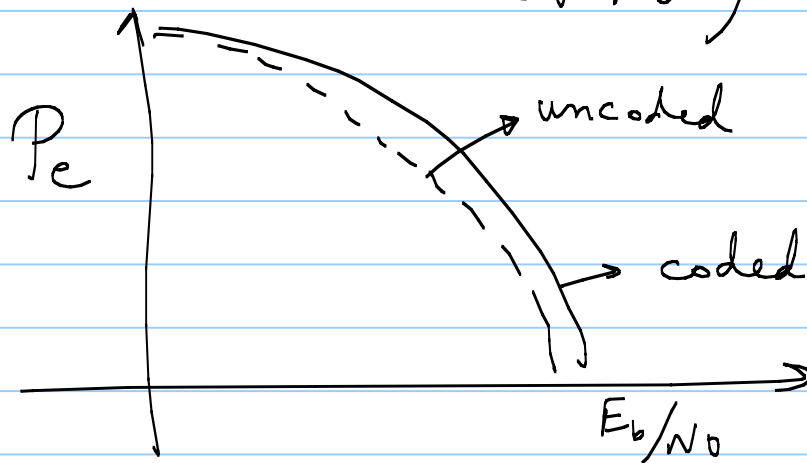
$\hat{\underline{c}}$ (or \hat{m})

$$P_e(\text{coded}) \approx 3 Q^2\left(\frac{1}{\sigma}\right) \quad \frac{E_b}{N_0} = \frac{3}{2\sigma^2}$$

$$P_e(\text{uncoded}) = Q\left(\frac{1}{\sigma}\right) \quad \frac{E_b}{N_0} = \frac{1}{2\sigma^2}$$

$$P_e(\text{coded}) = 3 Q^2\left(\sqrt{\frac{\frac{2}{3} E_b}{N_0}}\right)$$

$$P_e(\text{uncoded}) = Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$$



$$P_e = Q\left(\frac{3}{\sqrt{3}\sigma}\right) = Q\left(\frac{\sqrt{3}}{\sigma}\right)$$

$$\frac{E_b}{N_0} = \frac{3}{2\sigma^2}$$

$$P_e \text{ (coded)} = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) = P_e \text{ (uncoded)}$$

→ Repetition code provides no coding gain.