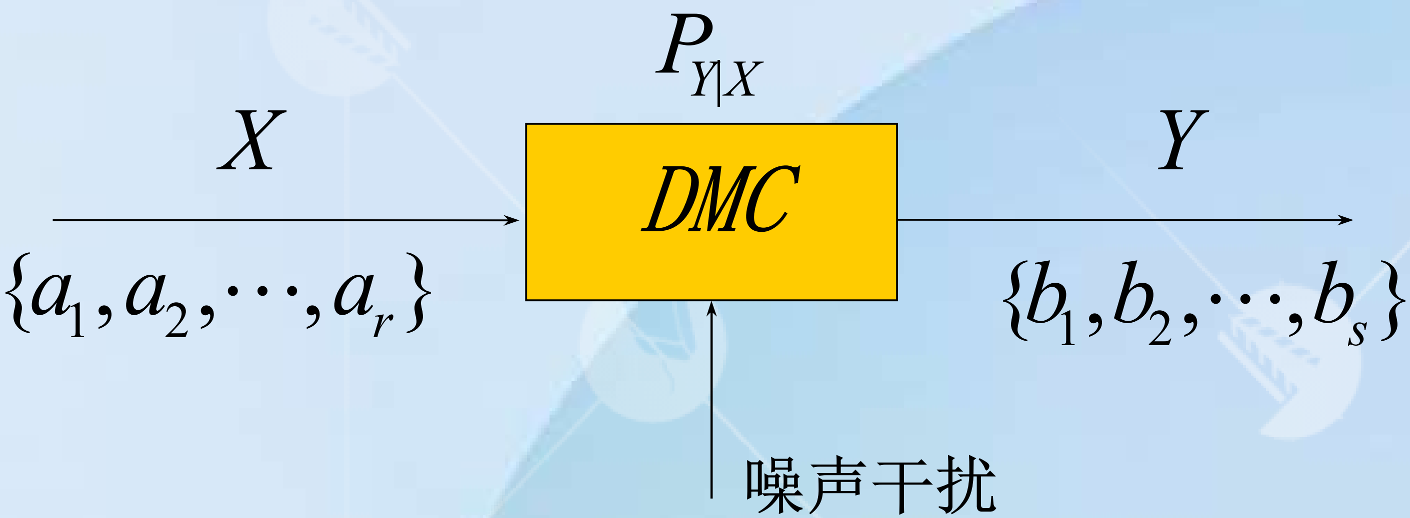
3. 2 离散无记忆信道的数学模型

（1）***DMC***的数学模型 $\{X,\ P_{Y|X},\ Y\}$



$P_{Y|X}$

X

DMC

Y

$\{a_1, a_2, \cdots, a_r\}$

$\{b_1, b_2, \cdots, b_s\}$

噪声干扰

转移概率集合：

$$P_{Y|X} = \{P(b_j \mid a_i) \mid i = 1, 2, \cdots, r; j = 1, 2, \cdots, s\}$$

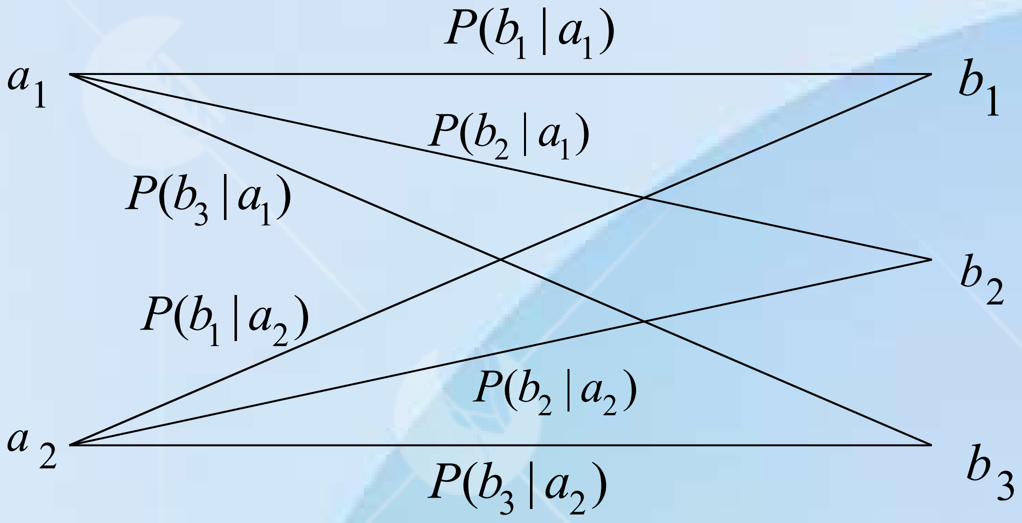
（2）转移（概率）矩阵

$$[P_{Y|X}]=\begin{array}{cccccc} & b_1 & b_2 & \cdots & b_s & \\ & \left[\begin{array}{c} \\ \\ \\ \\ \end{array}\right. P(b_1|a_1) & P(b_2|a_1) & \cdots & P(b_s|a_1) & a_1 \\ & P(b_1|a_2) & P(b_2|a_2) & \cdots & P(b_s|a_2) & a_2 \\ & \vdots & \vdots & \cdots & \vdots & \vdots \\ & P(b_1|a_r) & P(b_2|a_r) & \cdots & P(b_s|a_r) \left.\begin{array}{c} \\ \\ \\ \\ \end{array}\right] & a_r \end{array}$$

信道加一个输入，必然会产生一个输出，因此，转移矩阵中各行s个转移概率自身是完备的，即各行s个转移概率之和为1。

$$\sum_{j=1}^{s} P(b_j|a_i)=1\ ,\ i=1,2,\cdots,r$$

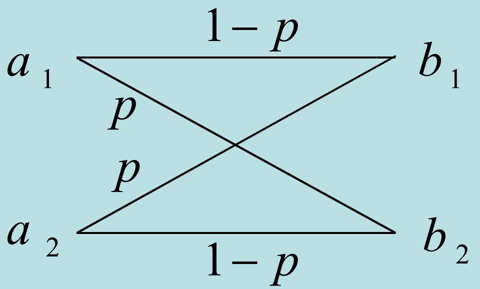
（3）信道线图



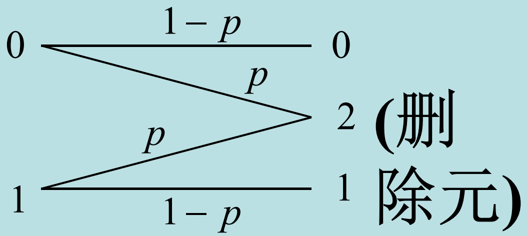
转移概率矩阵

$$[P_{Y|X}]=\begin{array}{c} \\ \\ \end{array}\begin{array}{ccc} b_1 & b_2 & b_3 \\ \left[\begin{array}{c} P(b_1|a_1) \\ P(b_1|a_2) \end{array}\right. & \begin{array}{c} P(b_2|a_1) \\ P(b_2|a_2) \end{array} & \left.\begin{array}{c} P(b_3|a_1) \\ P(b_3|a_2) \end{array}\right] \end{array}\begin{array}{c} \\ a_1 \\ a_2 \end{array}$$

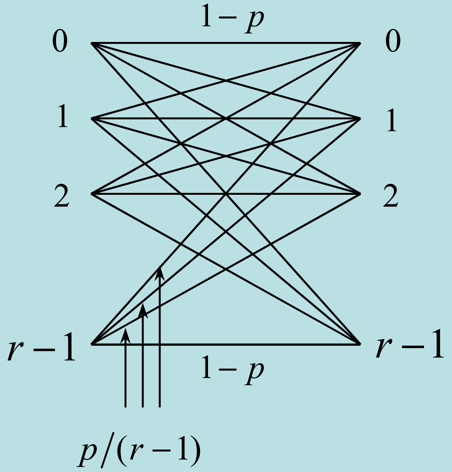
一些DMC线图



2进制对称信道(*BSC*)

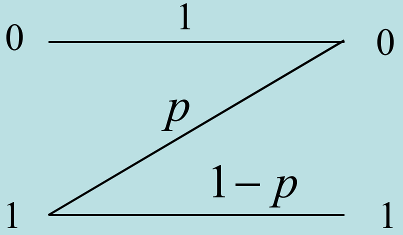


2进制删除信道(*BEC*)



*r*进制均匀信道

(*r*-ary uniform channel)



Z型信道

(*Z*- channel)