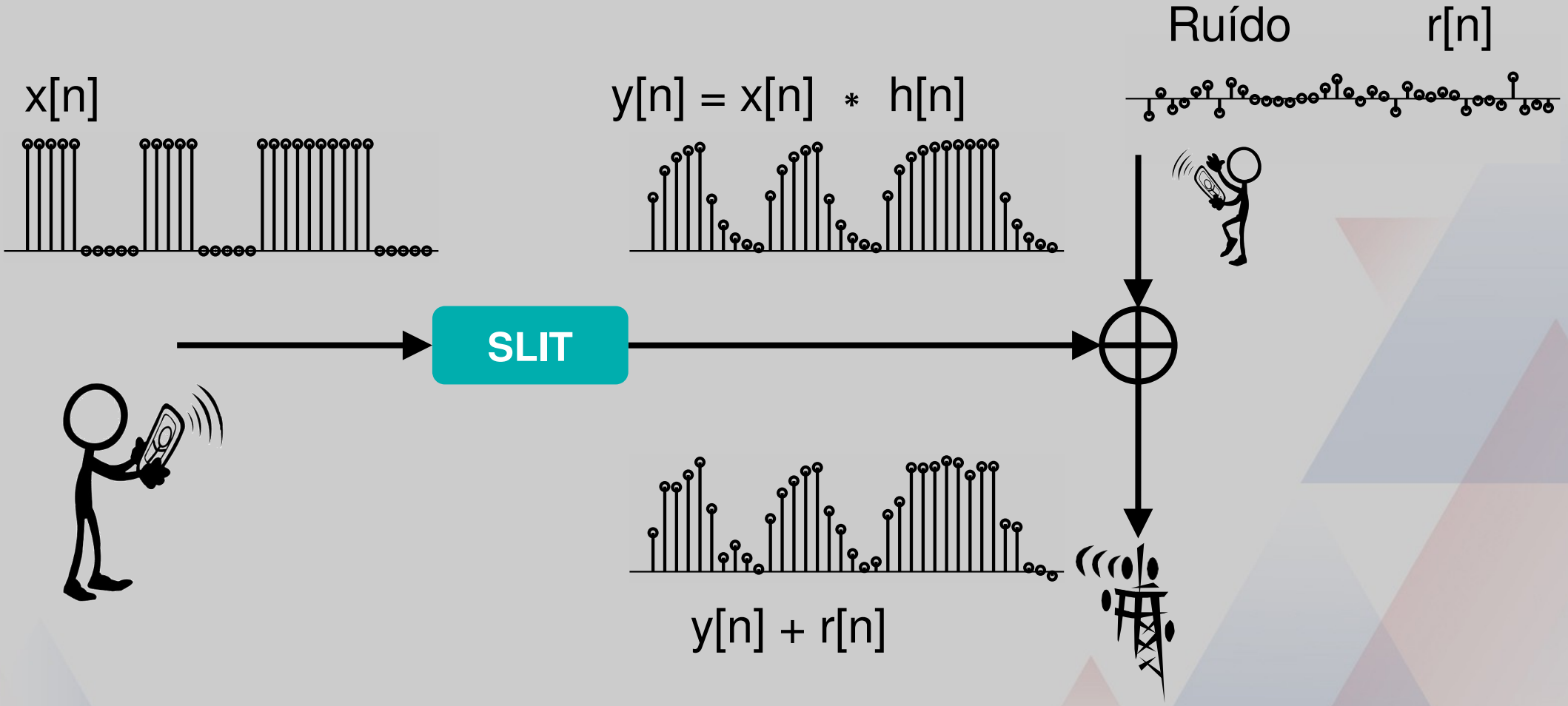
# INTRODUÇÃO AOS SISTEMAS DE COMUNICAÇÃO

## Ruído e Taxa de Erro

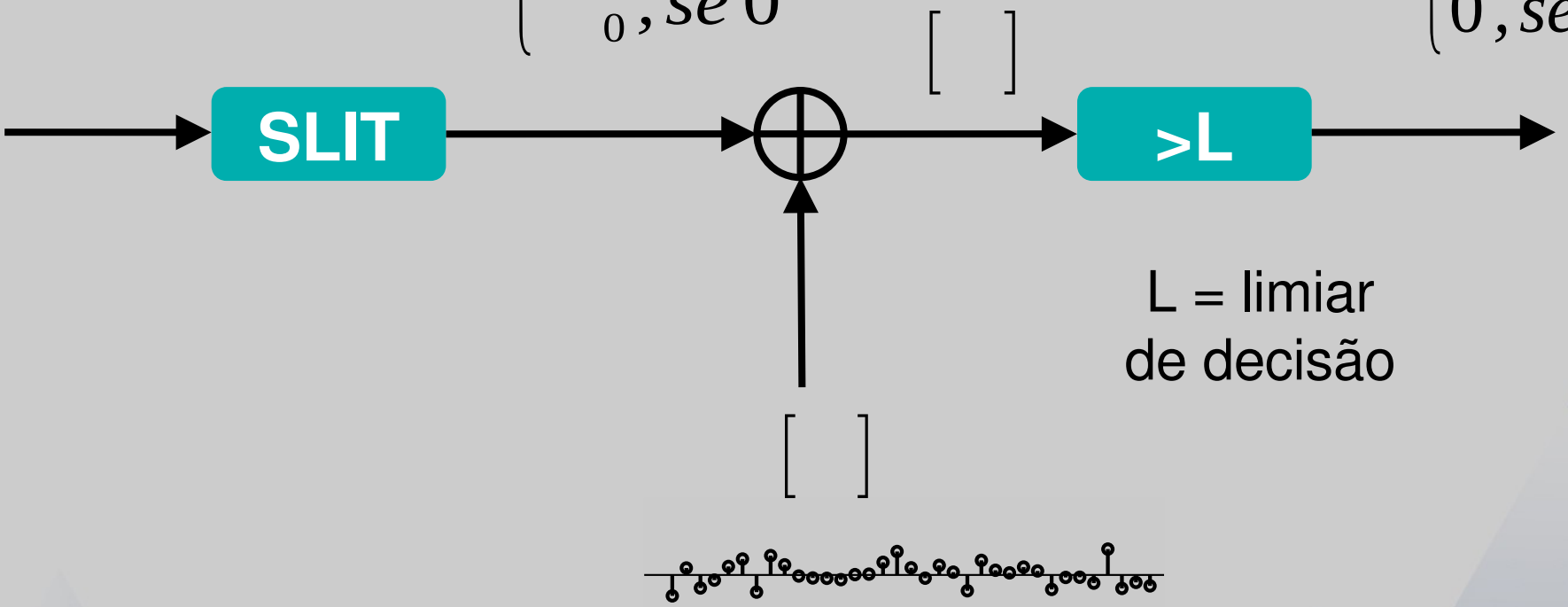
# MODELO DE SISTEMAS DE COMUNICAÇÃO DIGITAL



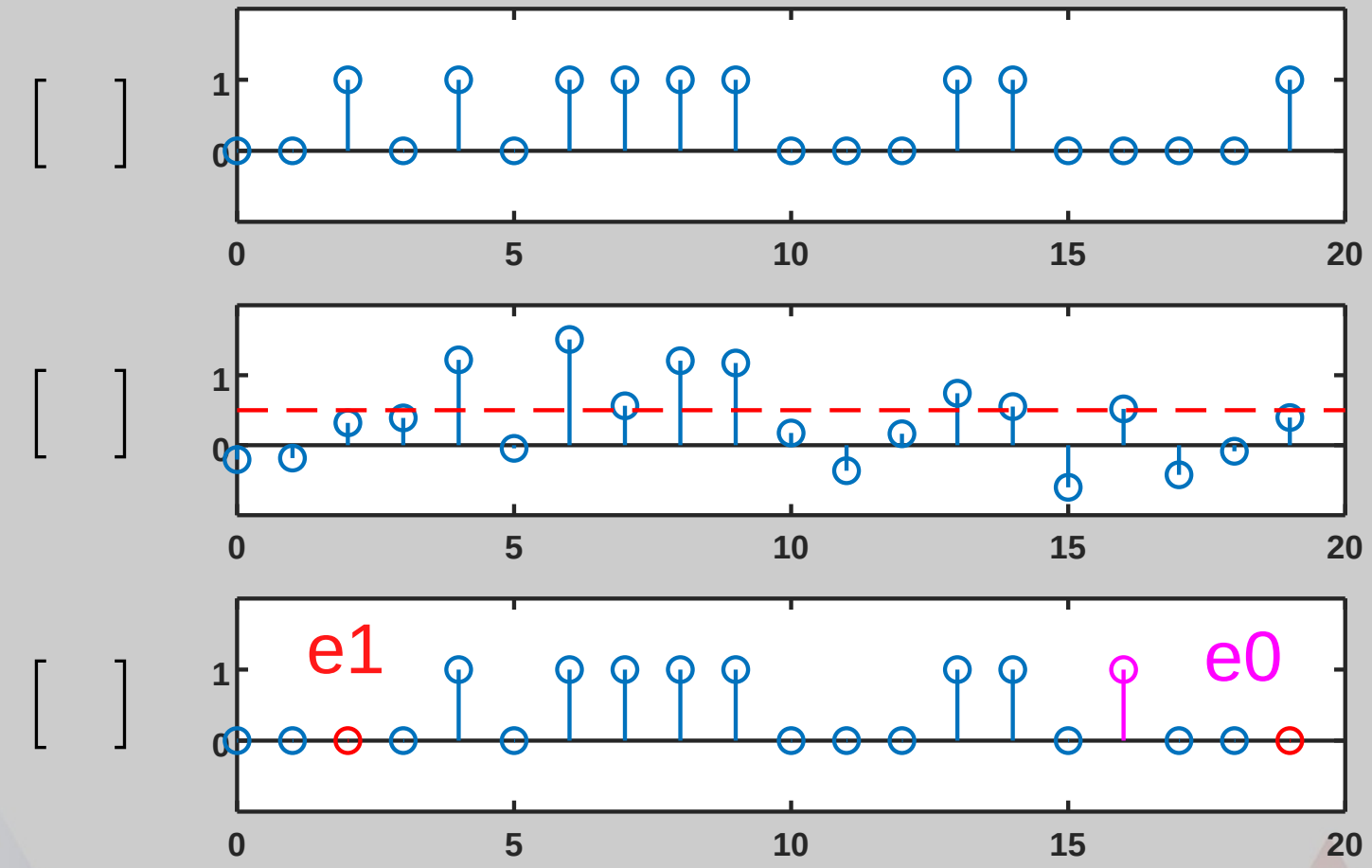
# MODELO SIMPLIFICADO

$$[\quad]=\begin{cases}\quad_1, se\ 1\\ \quad_0, se\ 0\end{cases}$$

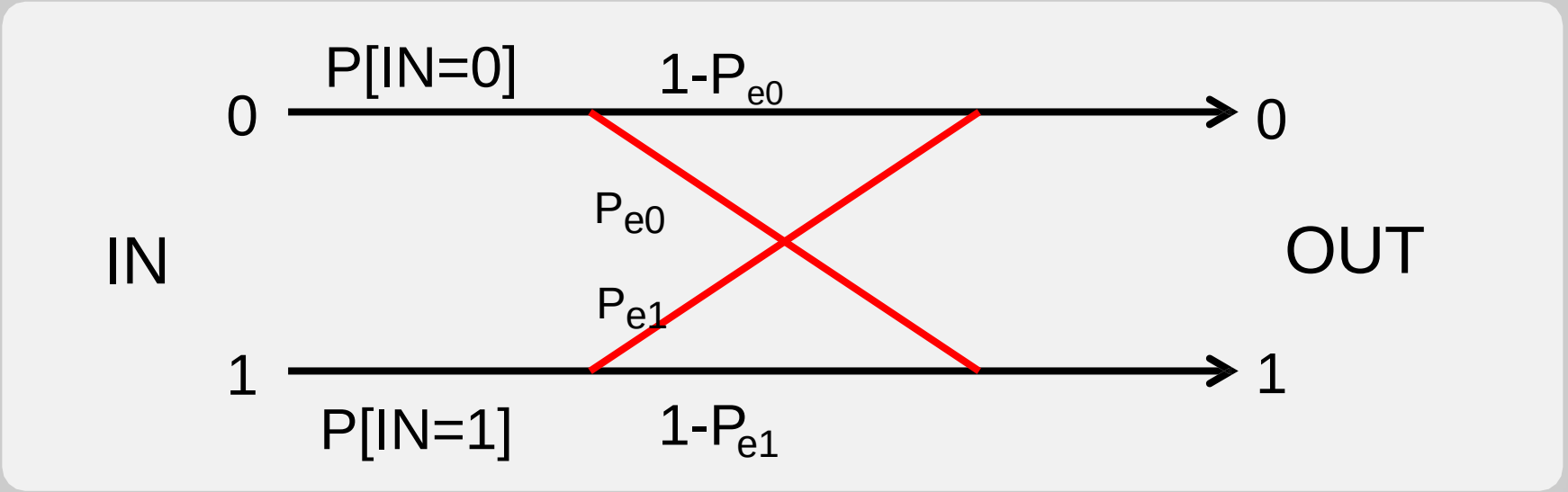
$$[\quad]=\begin{cases}1, se\quad[\quad]>\\ 0, se\quad[\quad]<\end{cases}$$



# EXEMPLO

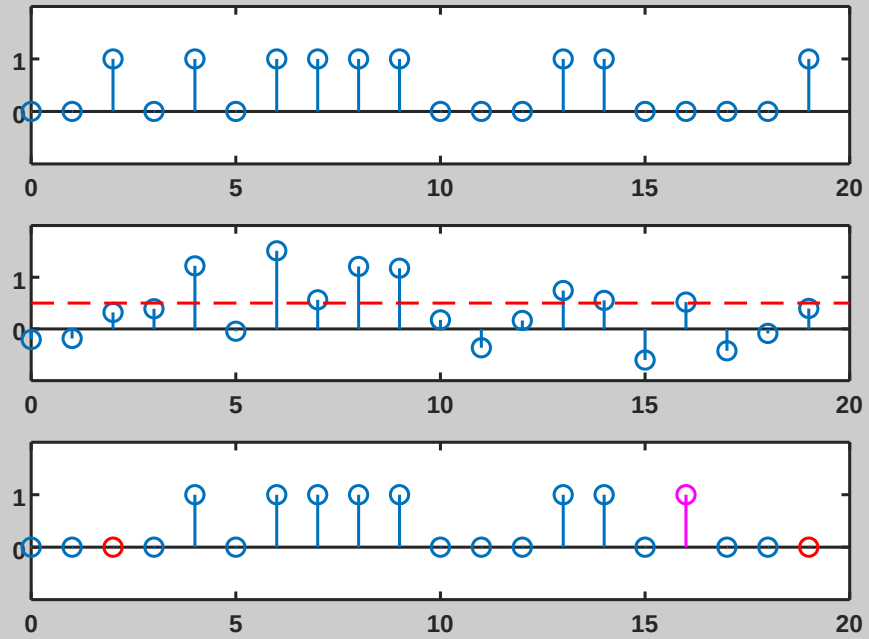


# CANAL BINÁRIO




$$BER = P_e = P_{e0} \cdot P[IN=0] + P_{e1} \cdot P[IN=1]$$

# EXEMPLO: PROBABILIDADES




$P[IN=0] = 11/20$

$P[IN=1] = 9/20$

$P_{e0} = 1/11$

$P_{e1} = 2/9$

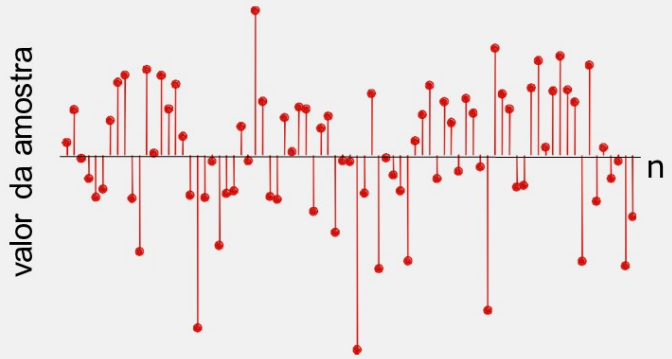
$$BER = P_e = P_{e0} \cdot P[IN=0] + P_{e1} \cdot P[IN=1] = 3/20$$

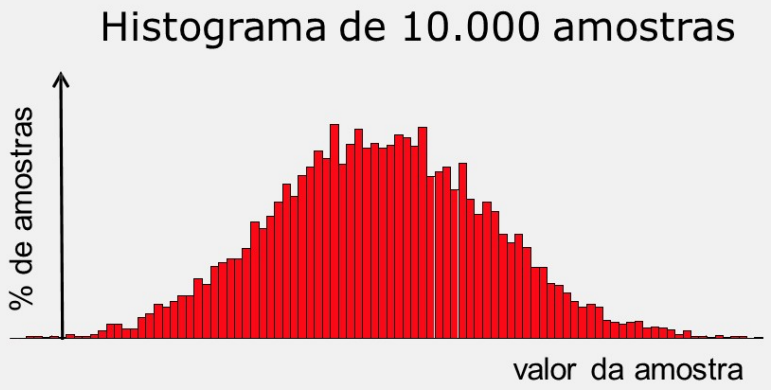
# RELAÇÃO SINAL-RUÍDO

- (desvio padrão)

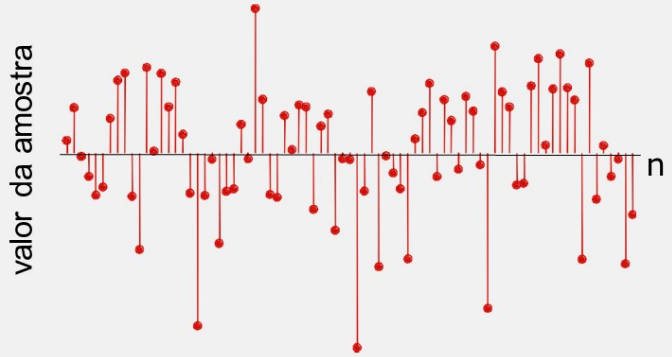
20dB = A potência do sinal é 100x a potência do ruído

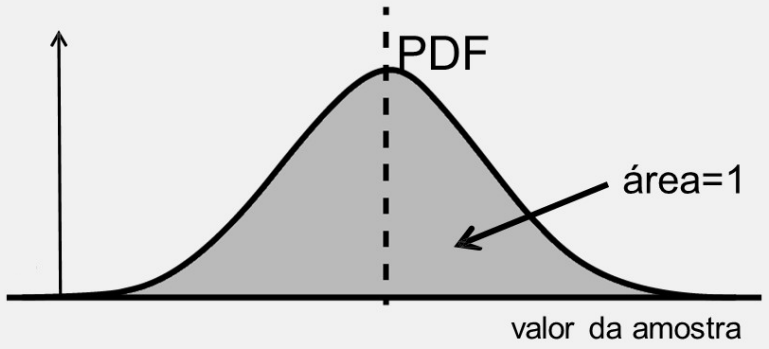
# RUÍDO GAUSSIANO



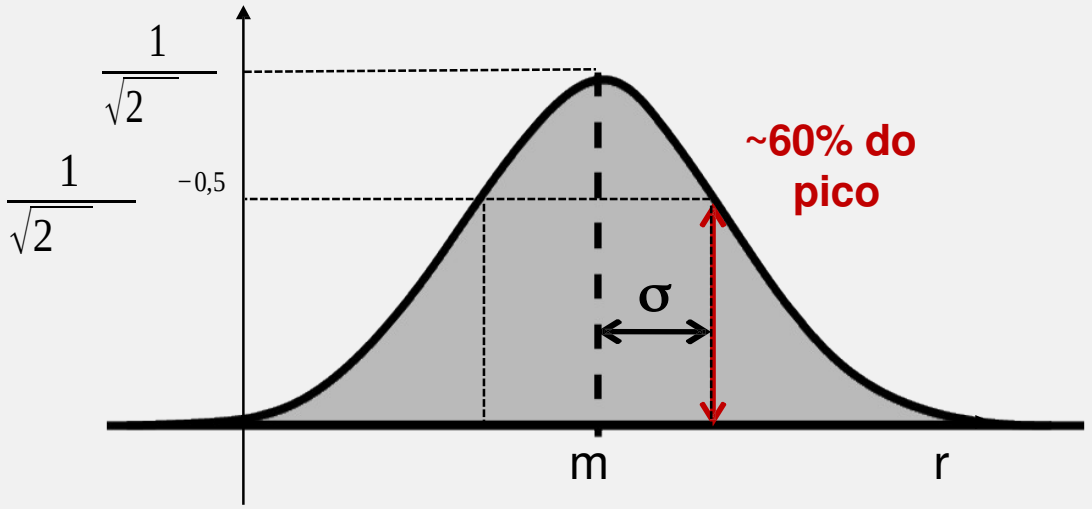
# RUÍDO GAUSSIANO



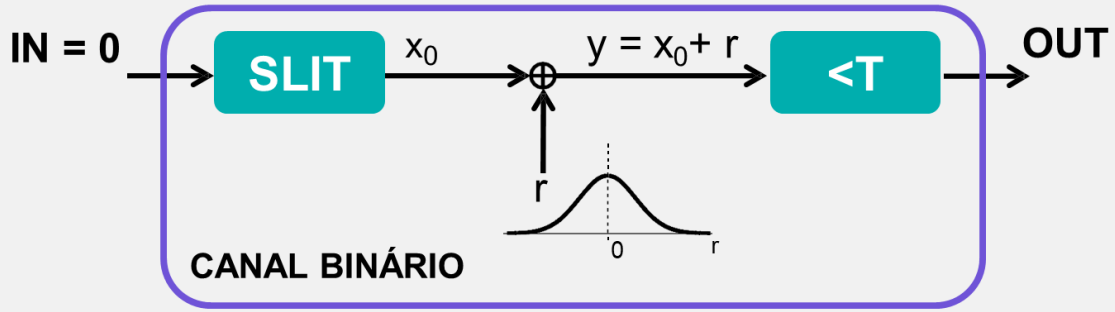



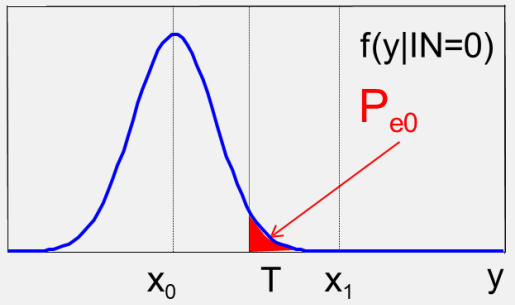
# DISTRUIÇÃO NORMAL

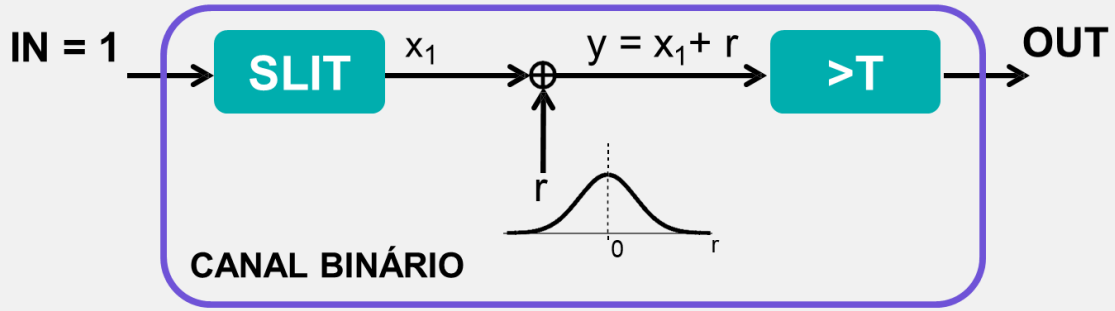
$$( \quad ) = \frac{1}{\sqrt{2}} \quad -\frac{( \quad - \quad )^2}{2 \quad ^2}$$

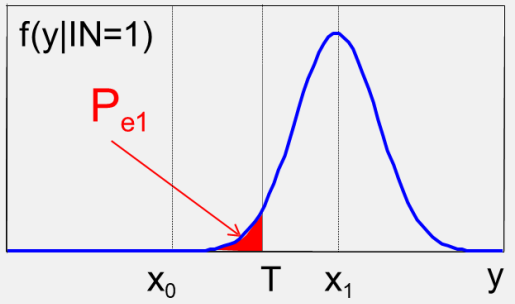


# PDF DO SINAL RECEBIDO



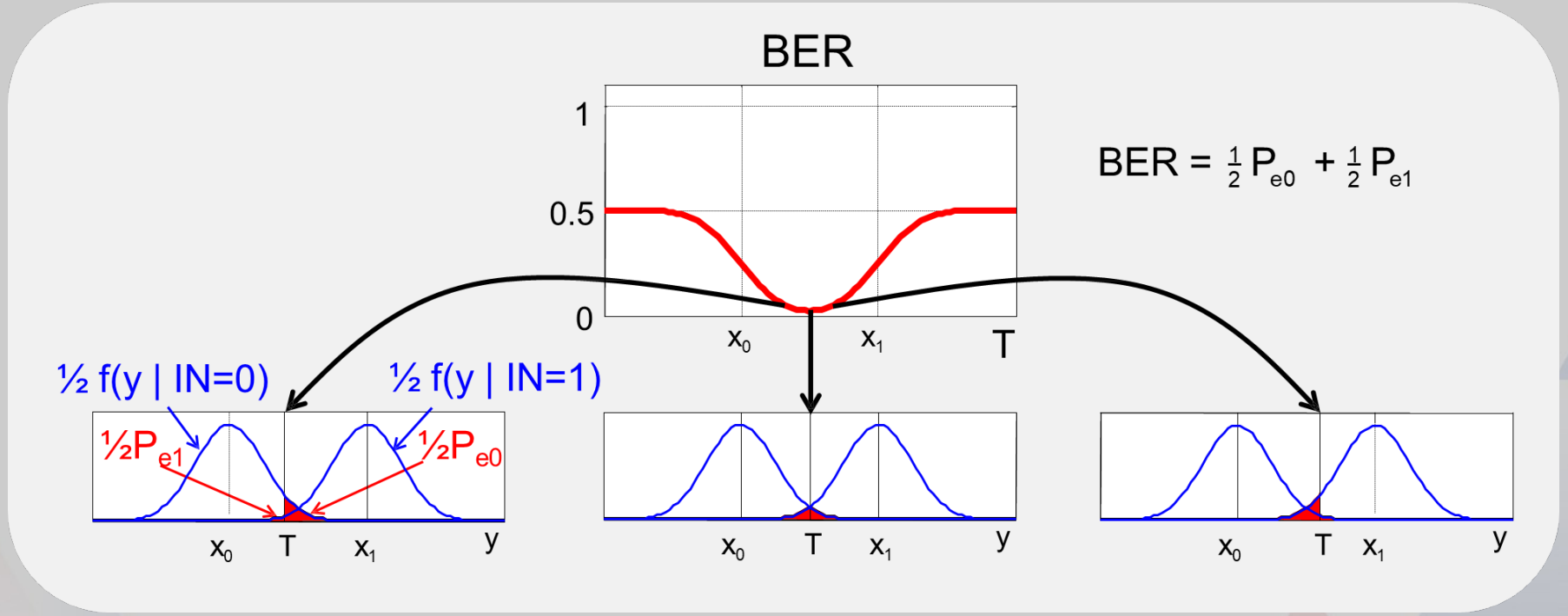



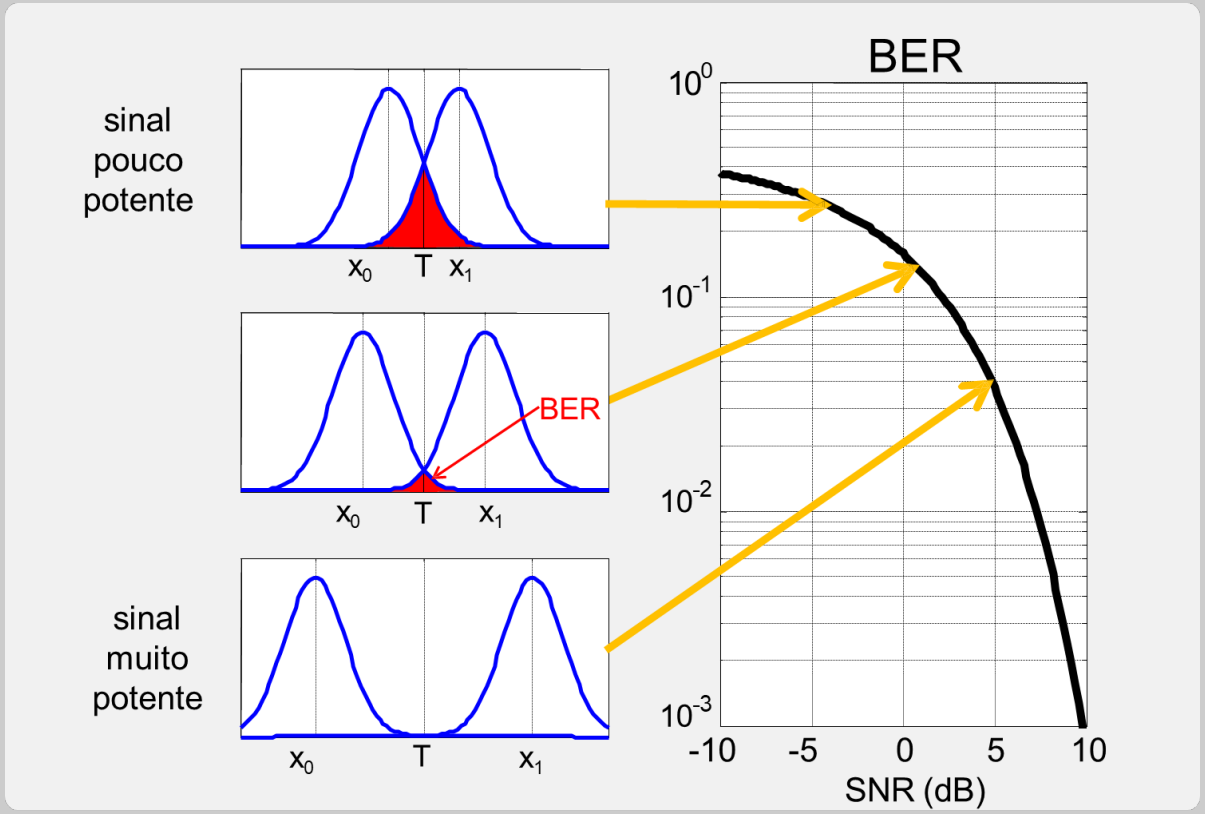



# LIMIAR DE DECISÃO

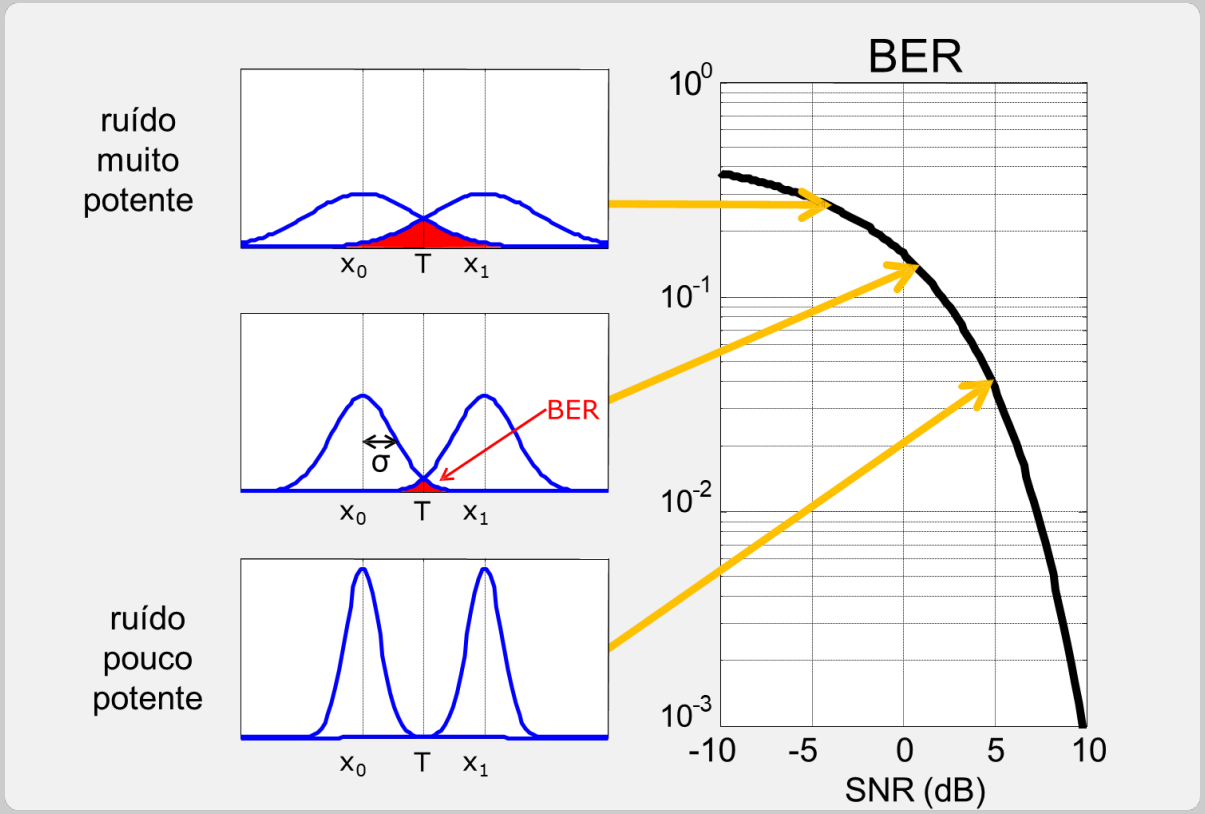
- **Assumindo que 0 e 1 são equiprováveis**



# BER vs POTÊNCIA DO SINAL



# BER vs POTÊNCIA DO RUÍDO



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