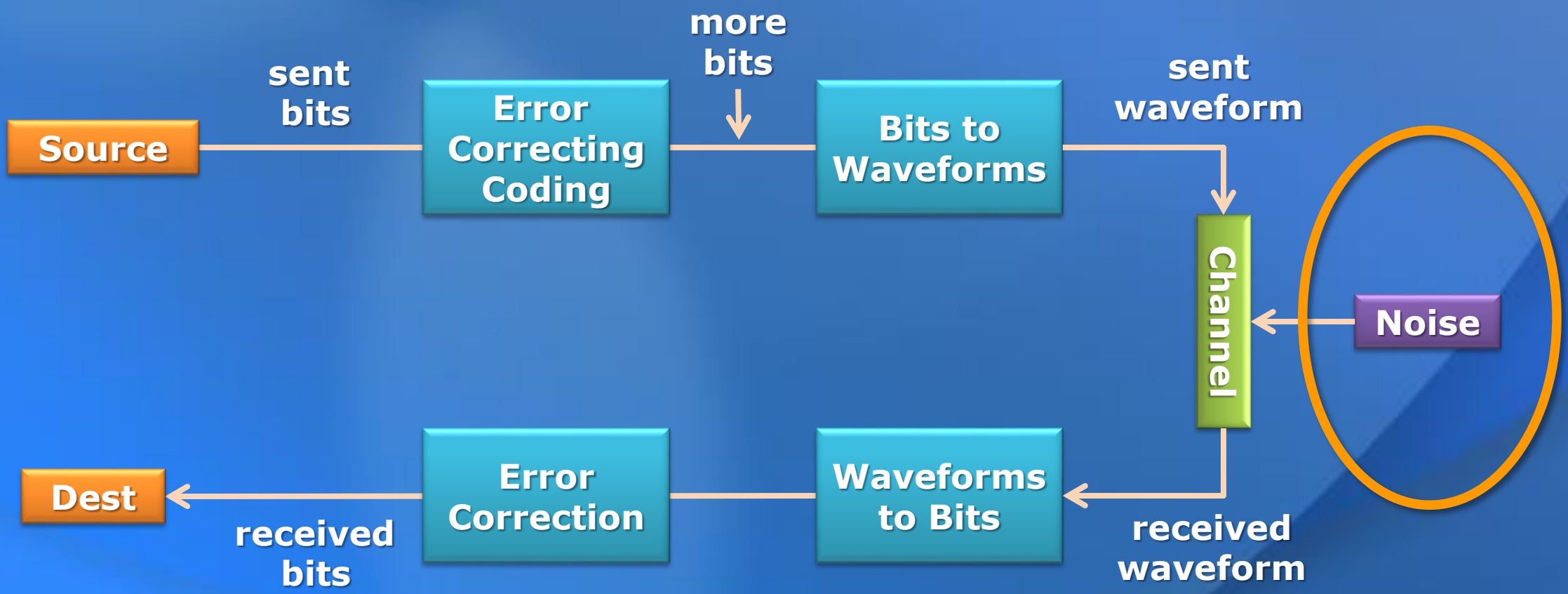
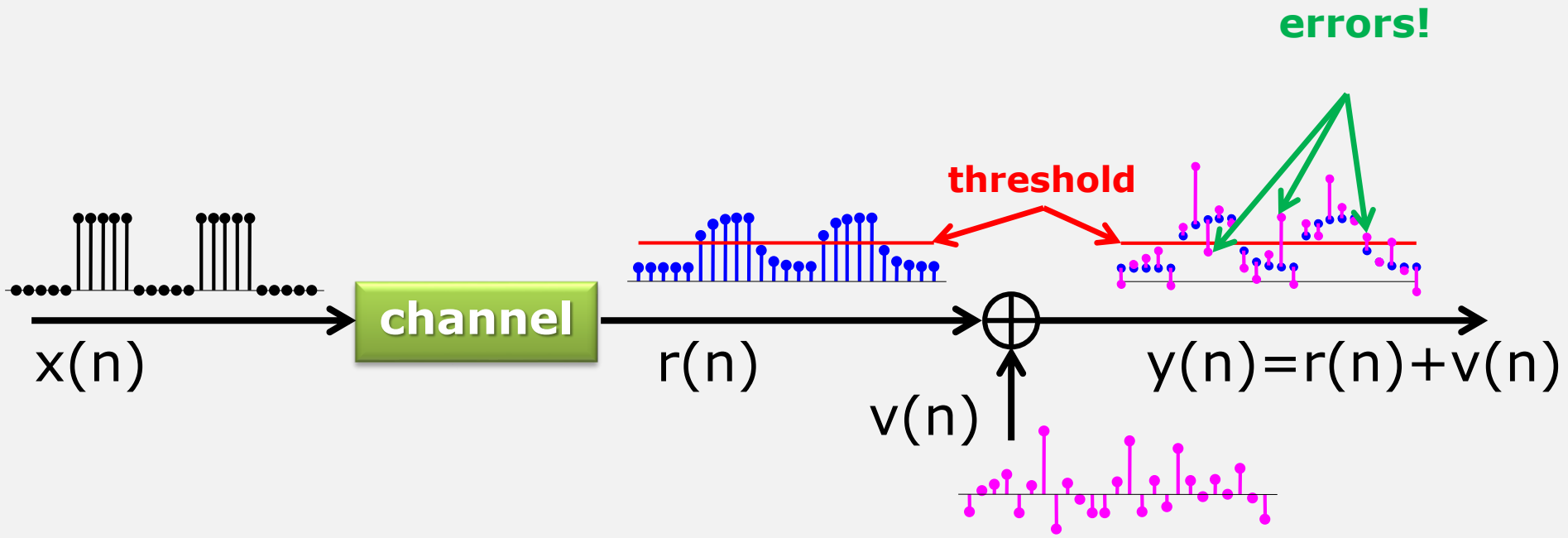
Noise and Bit Errors

Communication System

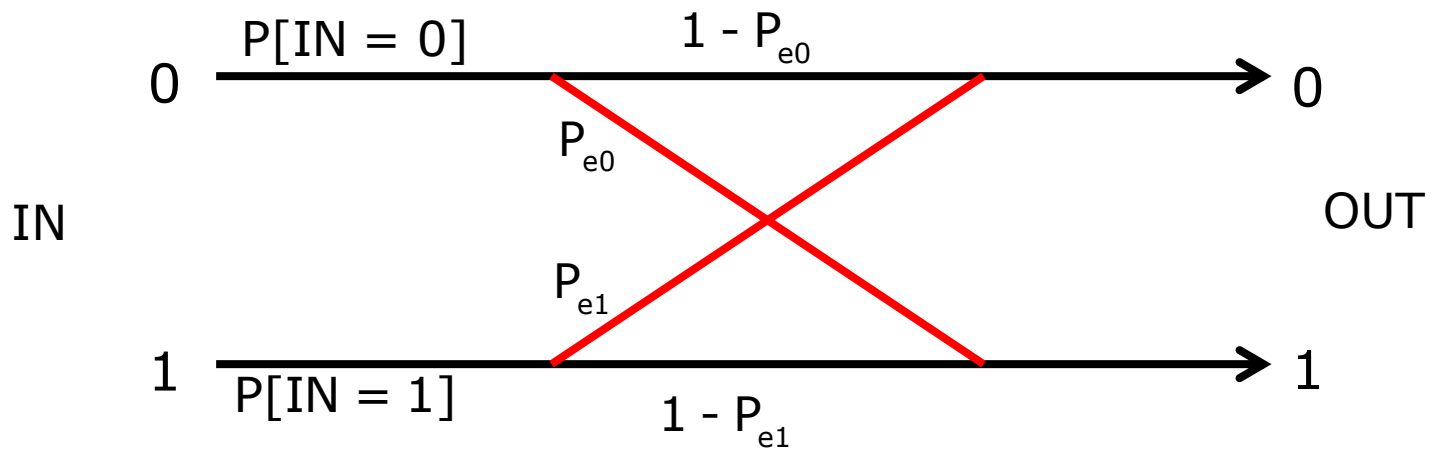


Additive Noise Model



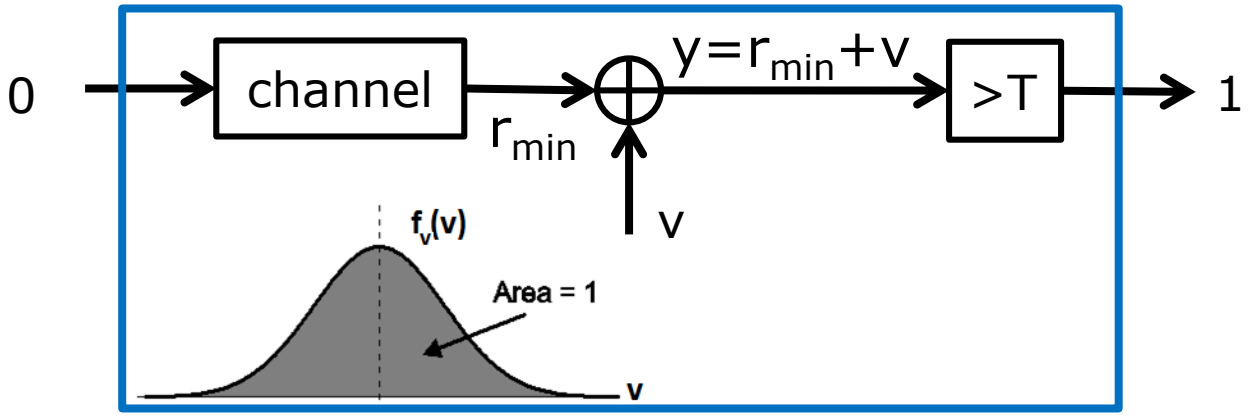
- x(n): channel input
- r(n): channel output without noise
- v(n): noise
- y(n): received signal

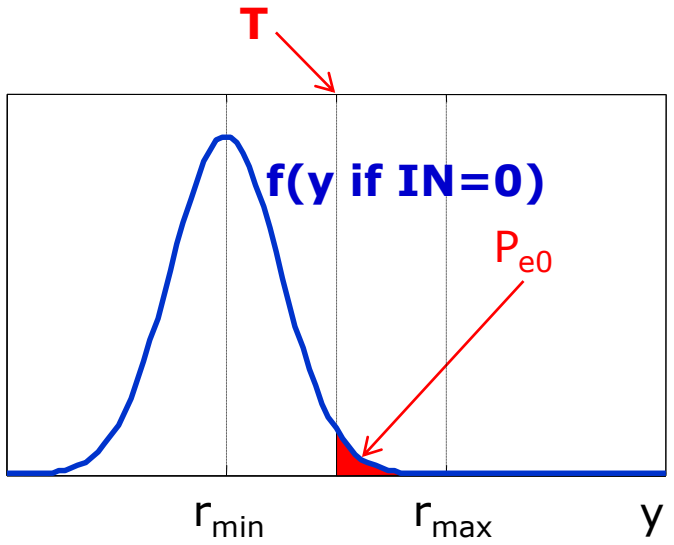
Effect of Noise: Binary Channel Model



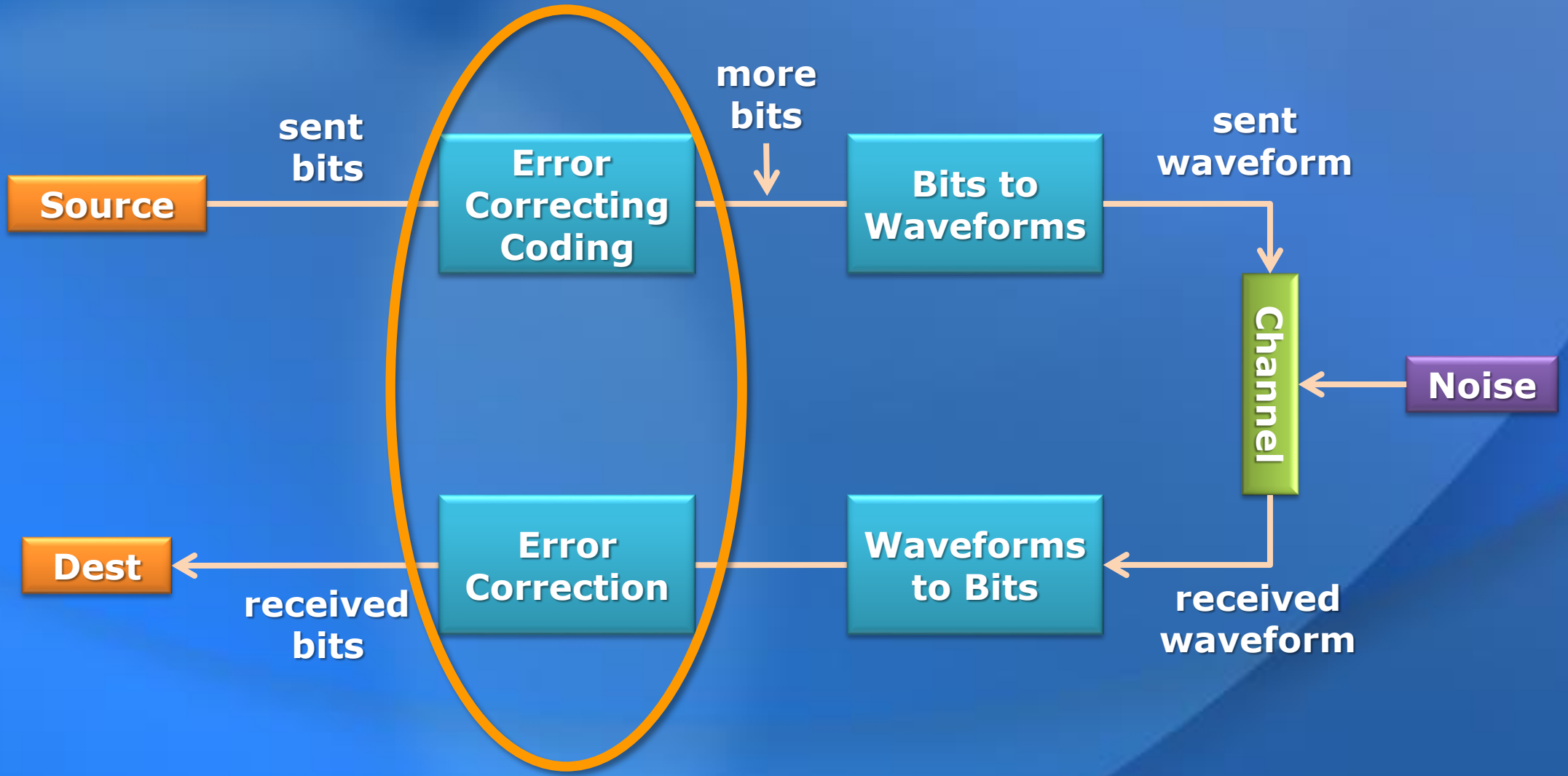
$$BER = P_{e0} \times P[IN = 0] + P_{e1} \times P[IN = 1]$$

Inside the binary channel

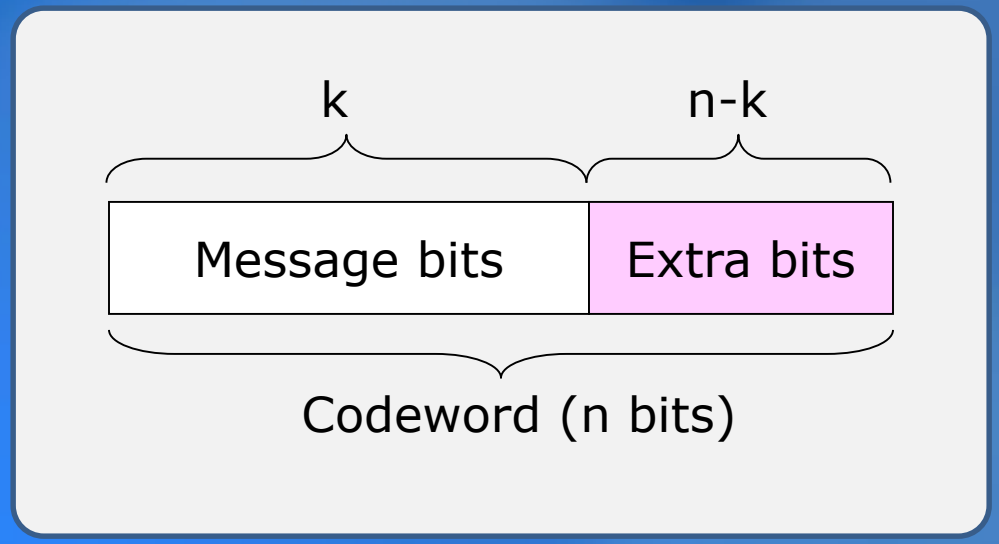




Communication System

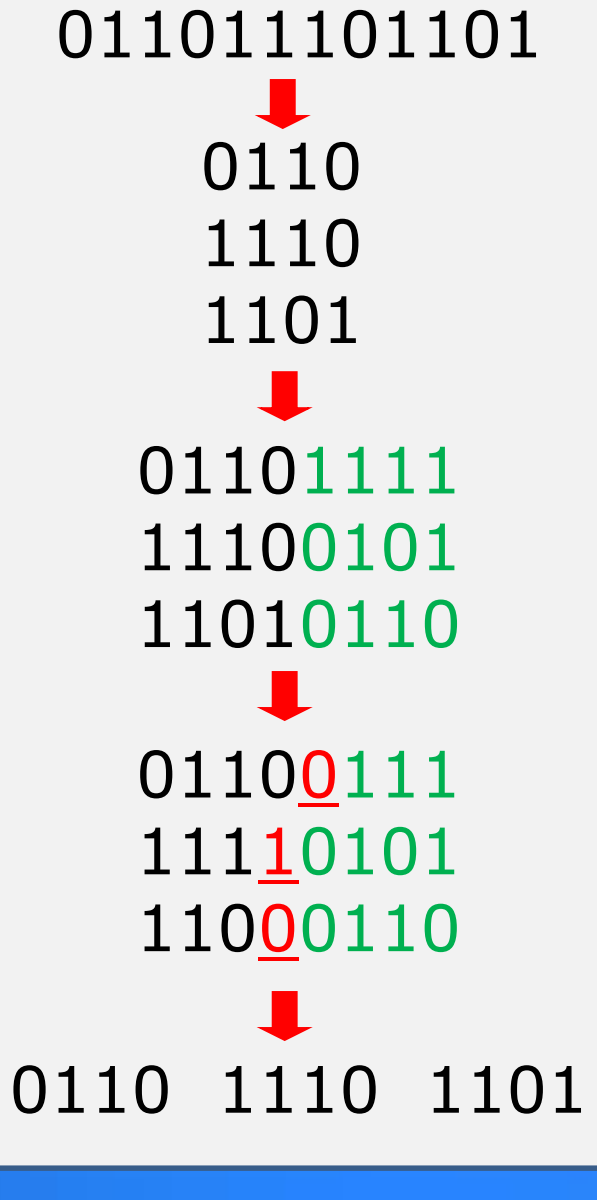


Error Correction: (n,k) Block Codes



- Split message into *k*-bit blocks
- Add (*n-k*) extra bits to each block, making each block *n* bits long.
- By adding a few extra bits, we can *detect* when an error has occurred.
- By adding even more bits, we can actually *correct* the errors.

Channel Coding



Take an input message stream:

Break the message stream into k-bit blocks
(k = 4)

Add (n-k) parity bits to form n-bit codeword
(n=8, k = 4)

Transmit data through noisy channel and receive codewords with some errors

Perform error correction and extract the k=4 message bits from each corrected codeword.

Communication System