


MIMO-OTDM

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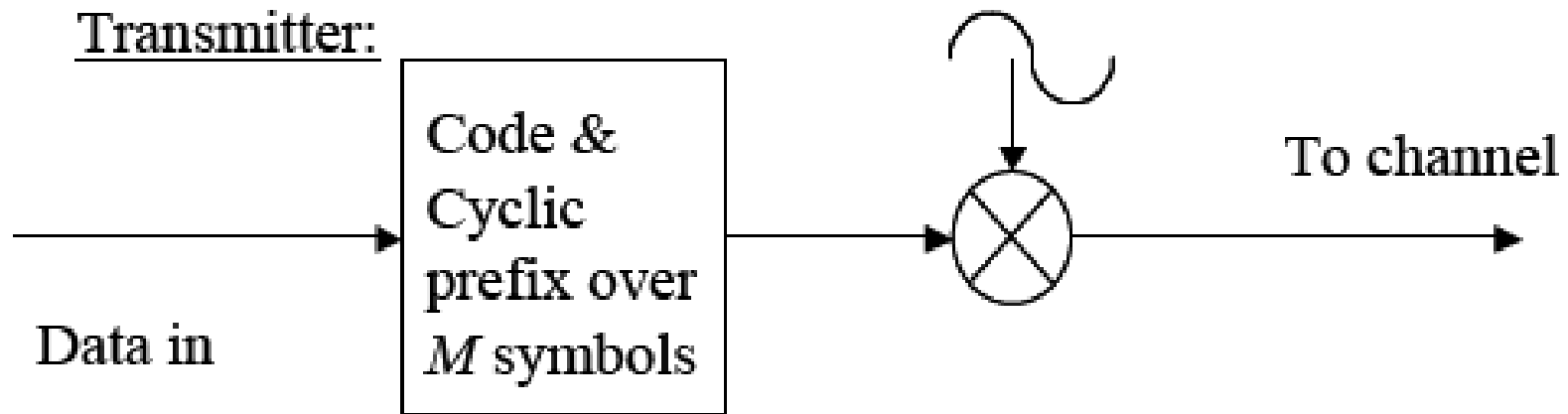
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Abbreviations and acronyms

- OTDM: Orthogonal Time Division Multiplex
- SC-FDE: Single Carrier Frequency Domain Equalization

SC-FDE: Transmitter structure

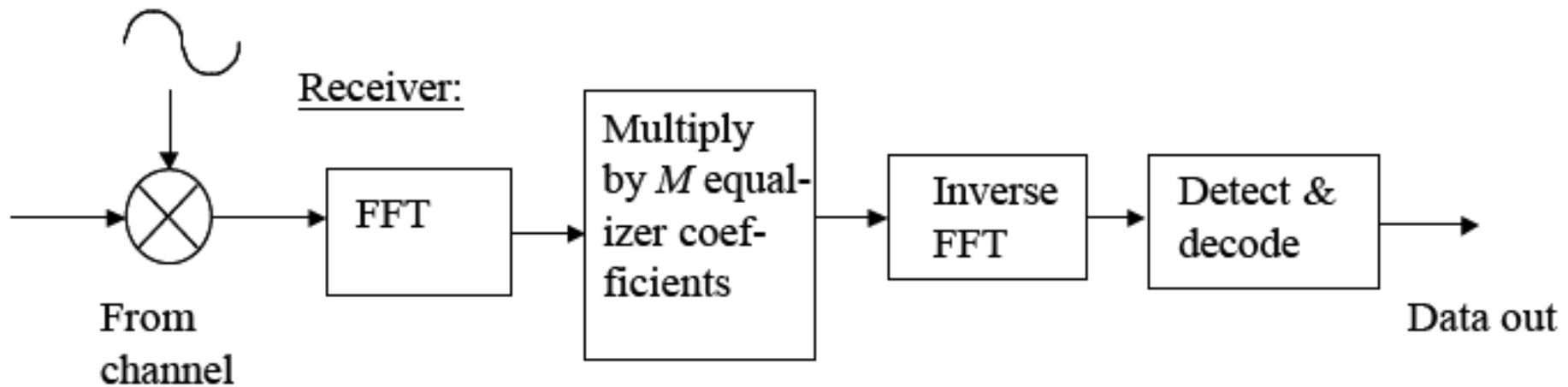


Channel length: L

CP length: $P(P > L)$

Block length: $M+P$

SC-FDE: Receiver structure





M-point FFT output

Space-Time Block Codes

2×2 STBC

■ Input: $[x_1, x_2]$

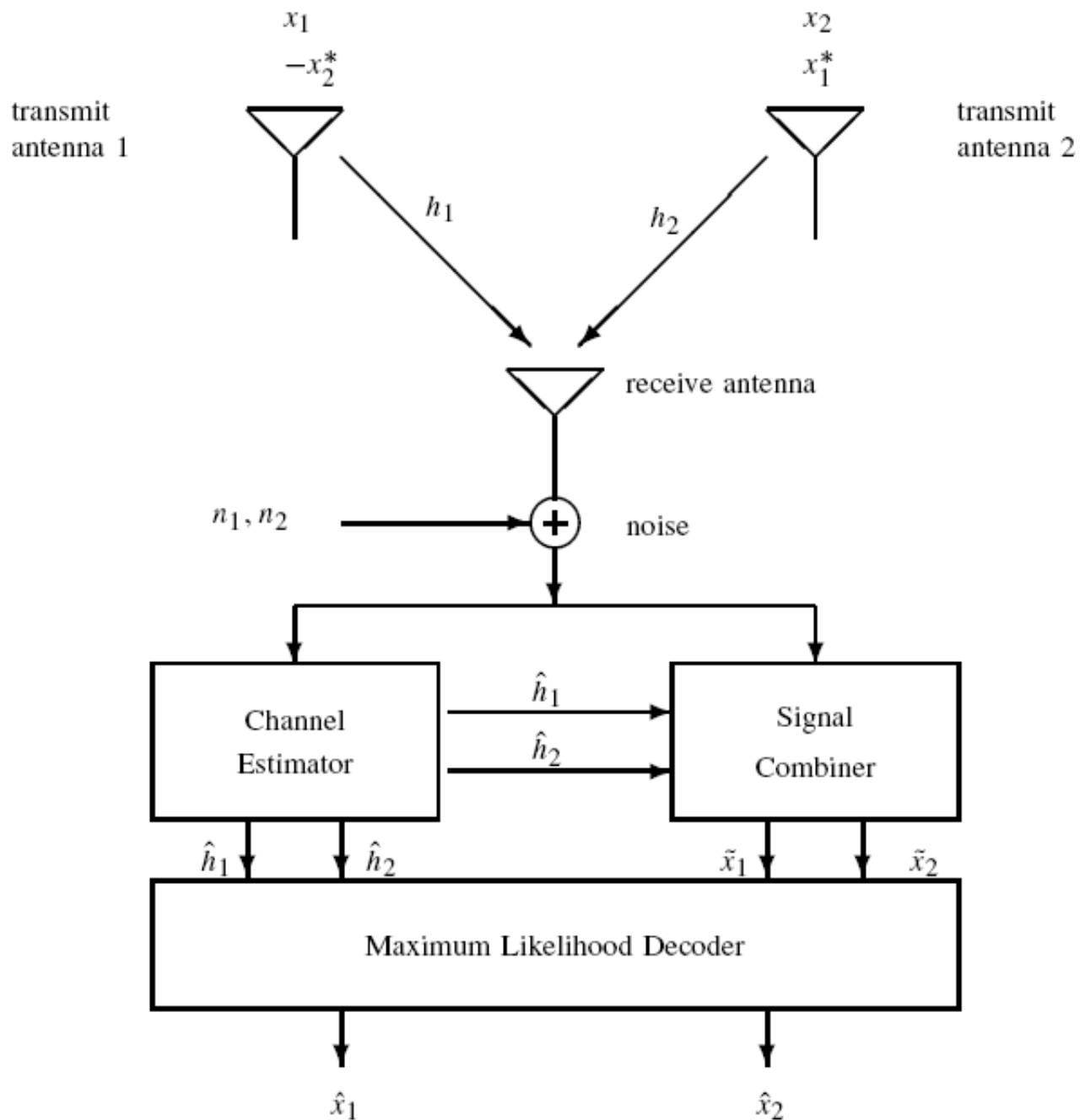
■ Output: $X = \begin{bmatrix} x_1 & -x_2^* \\ x_2 & x_1^* \end{bmatrix}$

4 × 4 STBC

■ Input: $[x_1, x_2, x_3, x_4]$

■ Output:

$$X = \begin{bmatrix} x_1 & -x_2 & -x_3 & -x_4 & x_1^* & -x_2^* & -x_3^* & -x_4^* \\ x_2 & x_1 & x_4 & -x_3 & x_2^* & x_1^* & x_4^* & -x_3^* \\ x_3 & -x_4 & x_1 & x_2 & x_3^* & -x_4^* & x_1^* & x_2^* \\ x_4 & x_3 & -x_2 & x_1 & x_4^* & x_3^* & -x_2^* & x_1^* \end{bmatrix}$$



ML Detection

ML Detection:



ML for STBC

$$\min |\tilde{x}_i - x_i|^2 + (-1 + 2 \sum_{m=1}^{NT} \sum_{j=1}^{NR} |H_{j,m}|^2) \cdot |x_i|^2$$

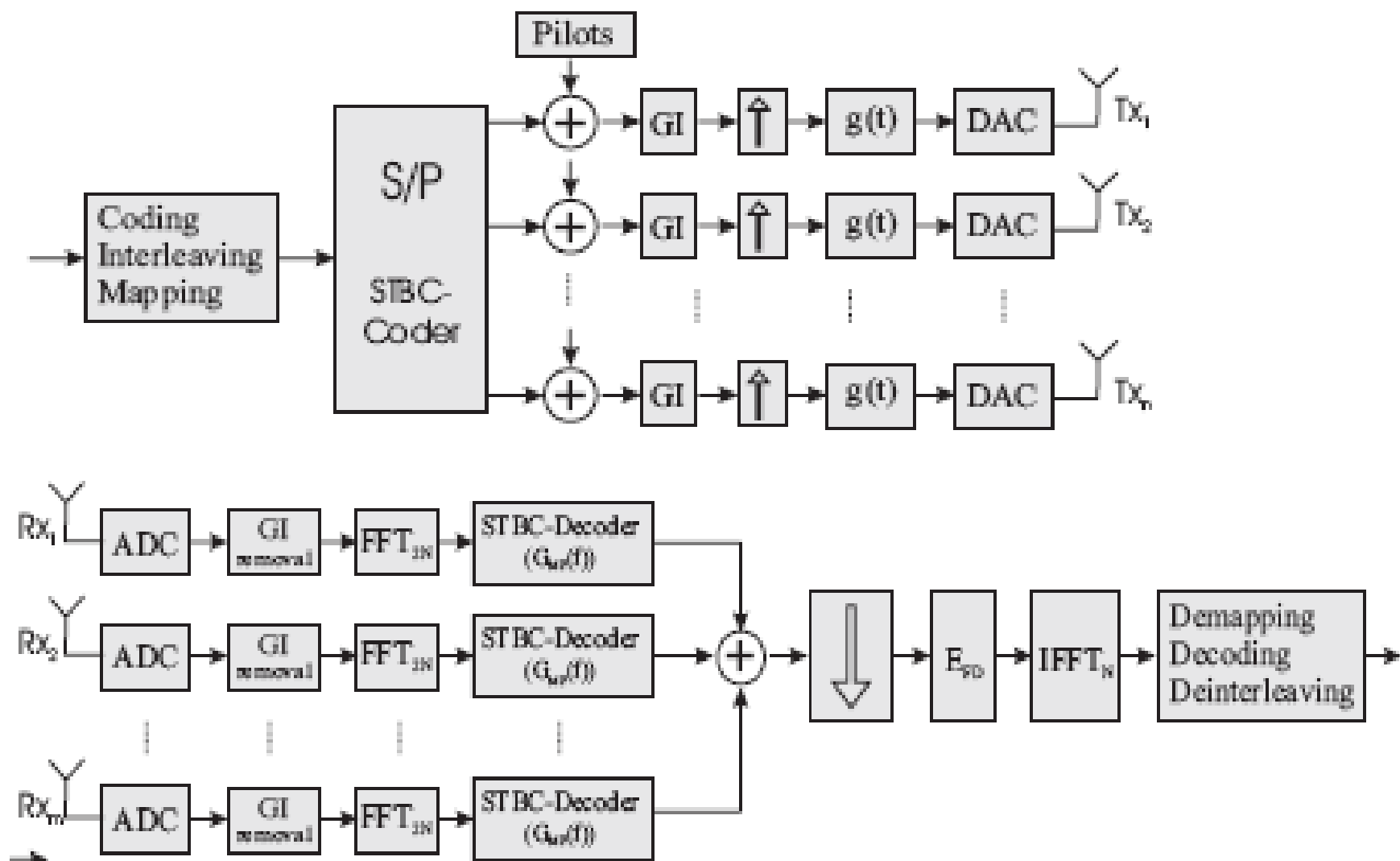
QPSK: $\min |\tilde{x}_i - x_i|^2$

2×2 STBC (QPSK):

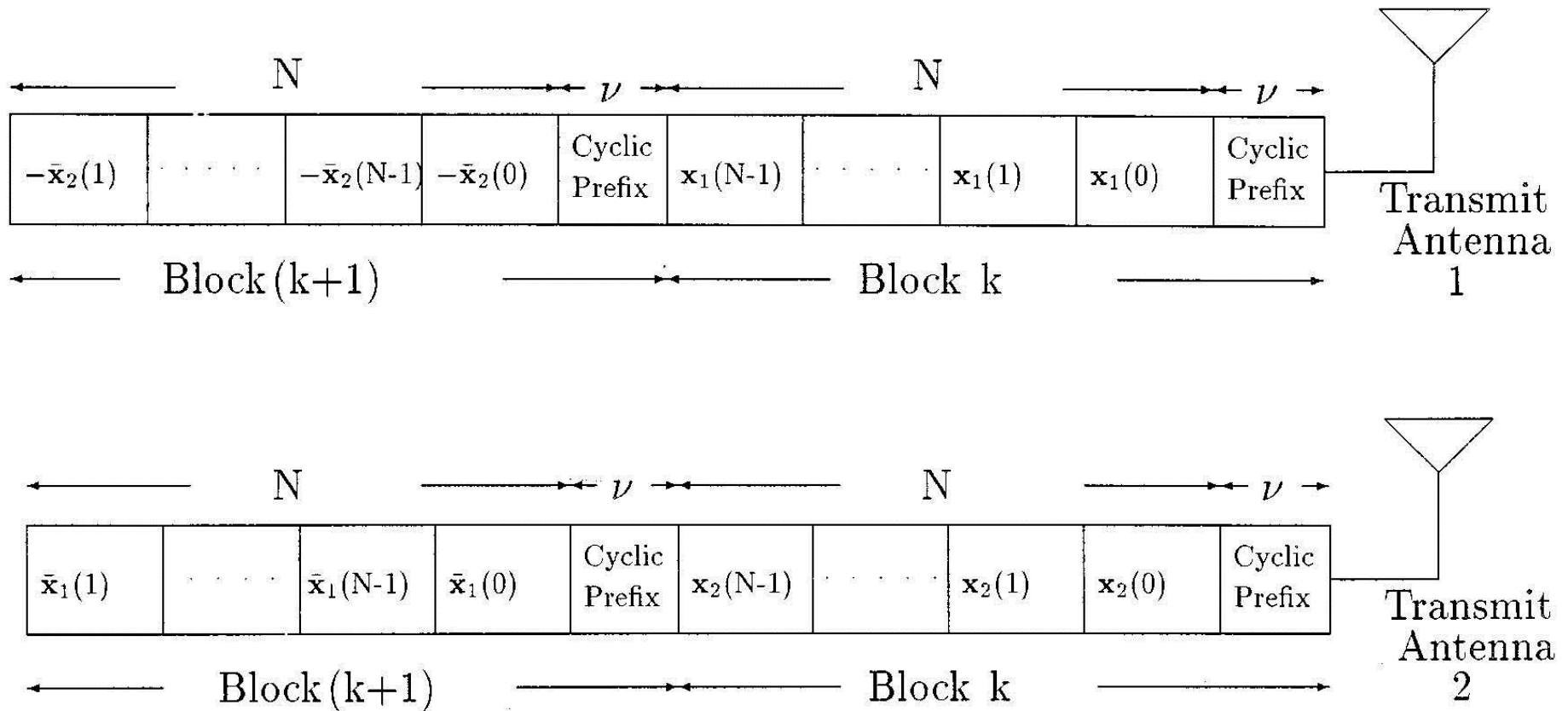
$$\tilde{x}_1 = \sum_{j=1}^2 (R_1^j \cdot H_{j,1}^* + (R_2^j)^* \cdot H_{j,2}) \quad \hat{x}_1 = \arg \min |\tilde{x}_1 - \hat{x}_1|^2$$

$$\tilde{x}_2 = \sum_{j=1}^2 (R_1^j \cdot H_{j,2}^* - (R_2^j)^* \cdot H_{j,1}) \quad \hat{x}_2 = \arg \min |\tilde{x}_2 - \hat{x}_2|^2$$

MIMO SC-FDE



STBC for SC-FDE



FFT output

- DFT :

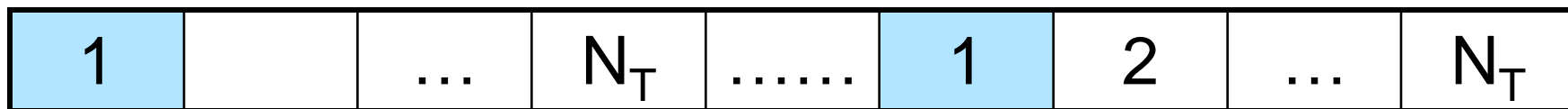
Channel Estimation for MIMO SC-FDE STBC

- Pilot design
- Length of s_1 : N/N_T



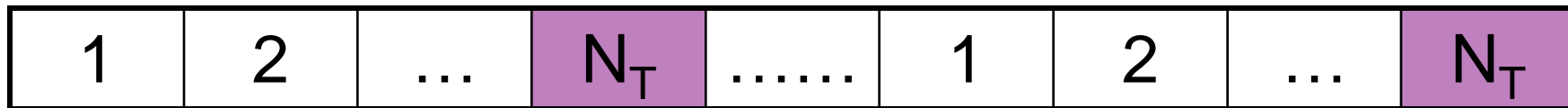
Phase-shifted training sequences

Pilot pattern:



⋮

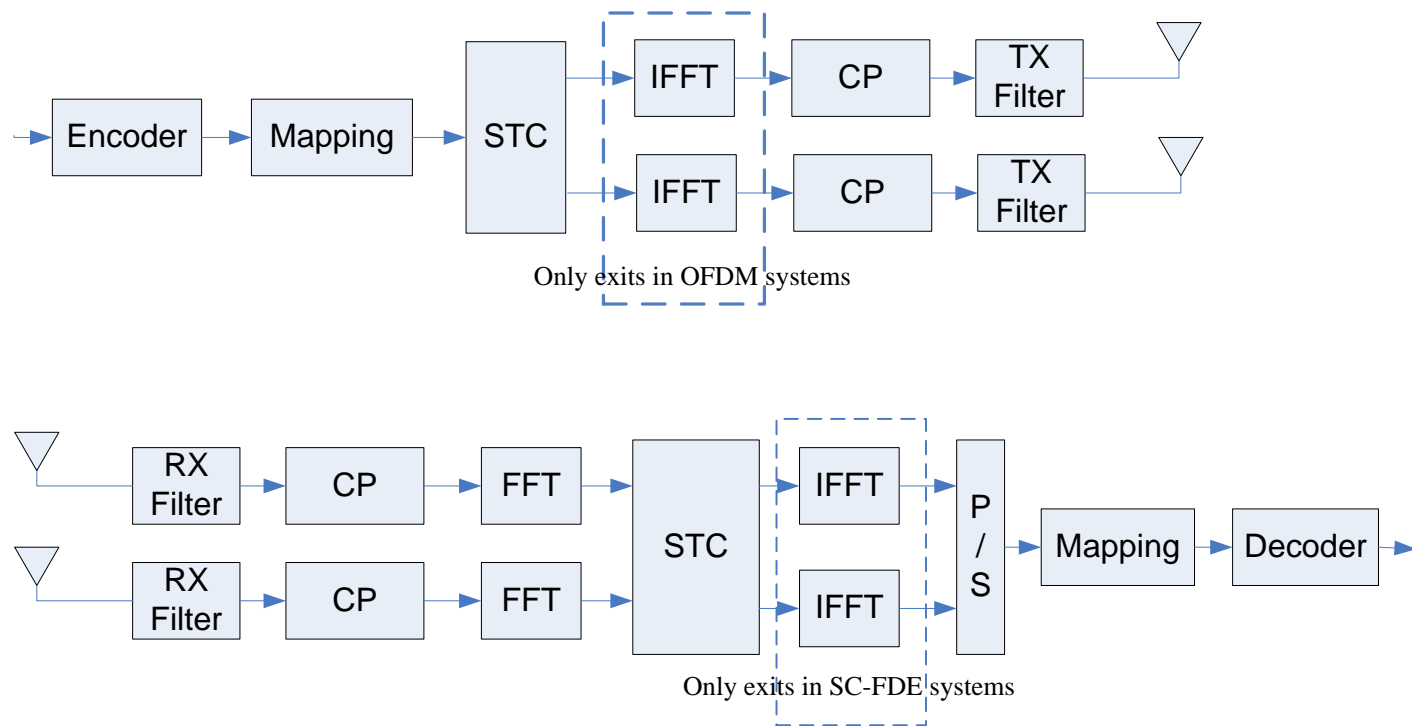
⋮



Desired property of training sequences

- Constant frequency-domain amplitude
- Chu sequences of length P :

MIMO-OFDM vs. MIMO-OTDM



References

- N. Al-Dhahir, “Single-carrier frequency-domain equalization for space-time block-coded transmissions over frequency-selective fading channels,” IEEE Communications Letters, vol. 5, no. 7, pp.304–306, July 2001.
- Tarokh, V. , “Space-time block codes from orthogonal designs”, IEEE Transactions on Information Theory ,Volume 45, Issue 5, July 1999 Page(s):1456 - 1467
- Siew, J.; Coon, etc., “A bandwidth efficient channel estimation algorithm for MIMO-SCFDE”, VTC 2003-Fall, Vol.2 ,pp.1142 - 1146



Thank you!