Software and Systems Engineering

CPE3202

Pornpawit Boonsrimuang

Contents

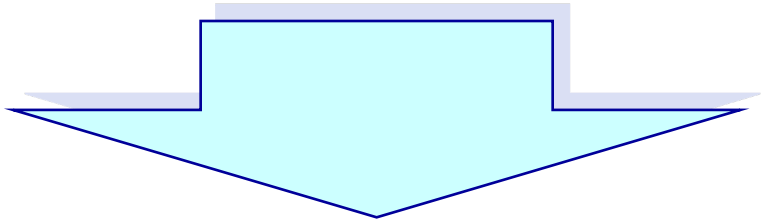
Introduction

- One of the limitations of using OFDM technique is the larger peak to averaged power ratio (PAPR).
- The larger PAPR signal would cause the severe degradation of bit error rate (BER) performance due to the inter-modulation noise at Non-linear Amplifier
- The PAPR reduction techniques can be categorized into two major methods

  1.) distortion and 2.) distortion-less

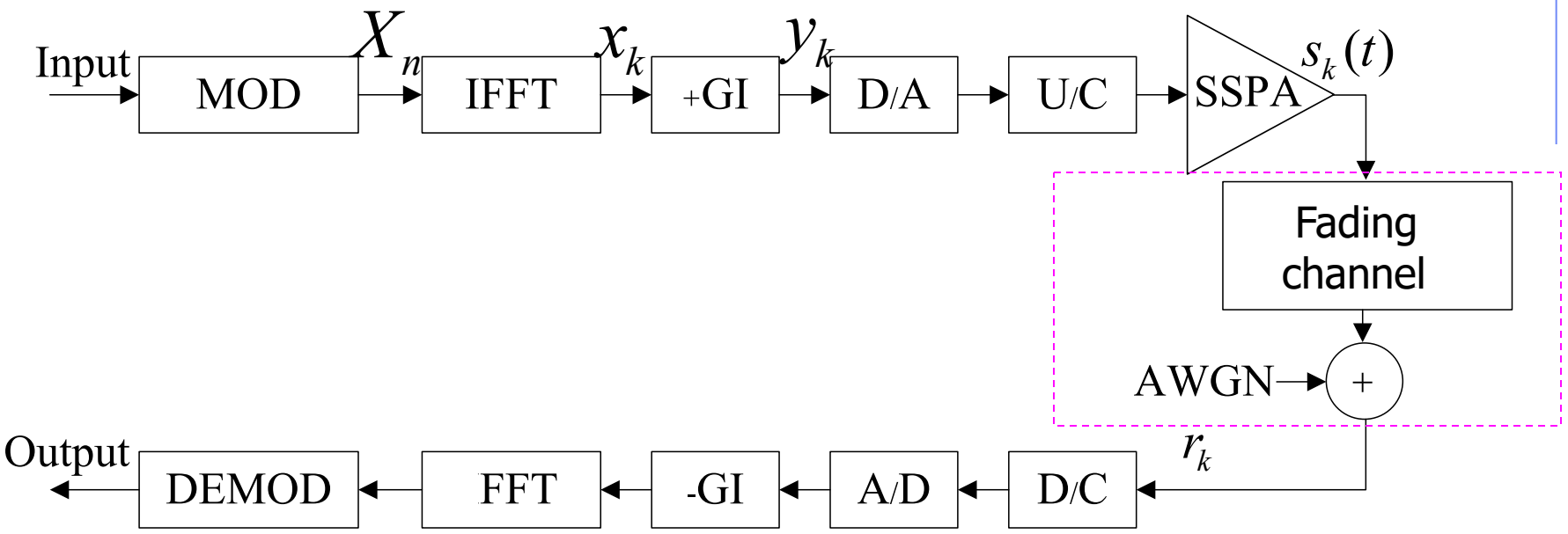
Objectives of Research

Improve PAPR and BER performances with higher transmission efficiency



the Permutation Sequence (PS) Method for OFDM Signal with embedded very few Side Information

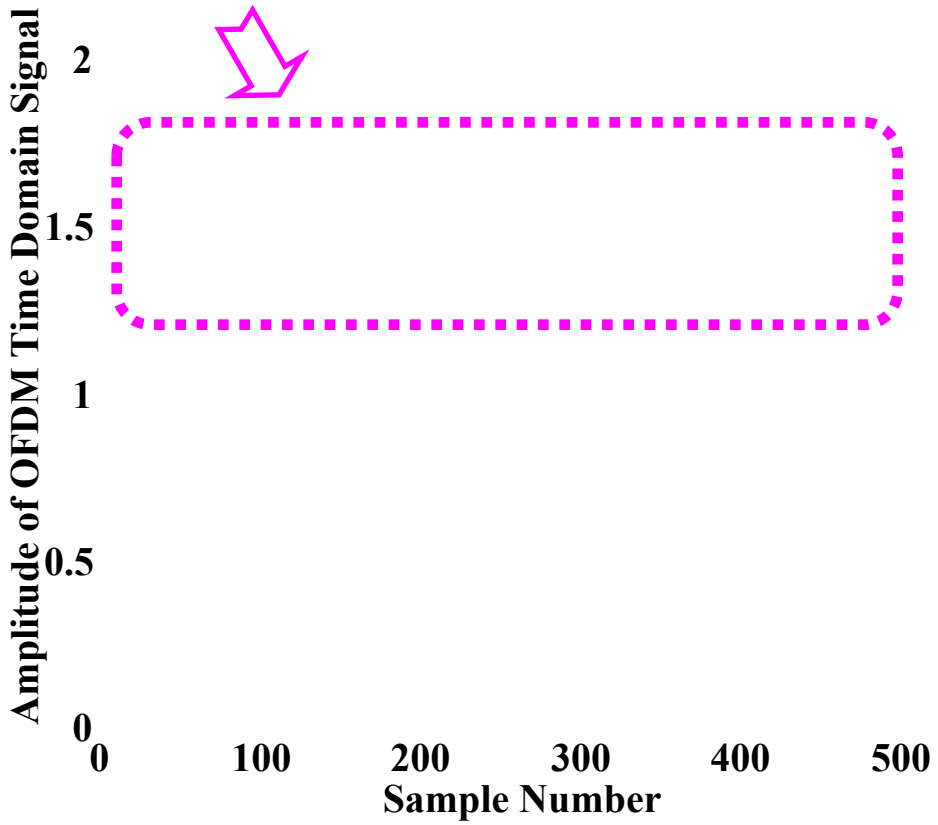
System Model



Conventional OFDM system under the non-linear channel

Definition of PAPR

- *Definition of PAPR*:

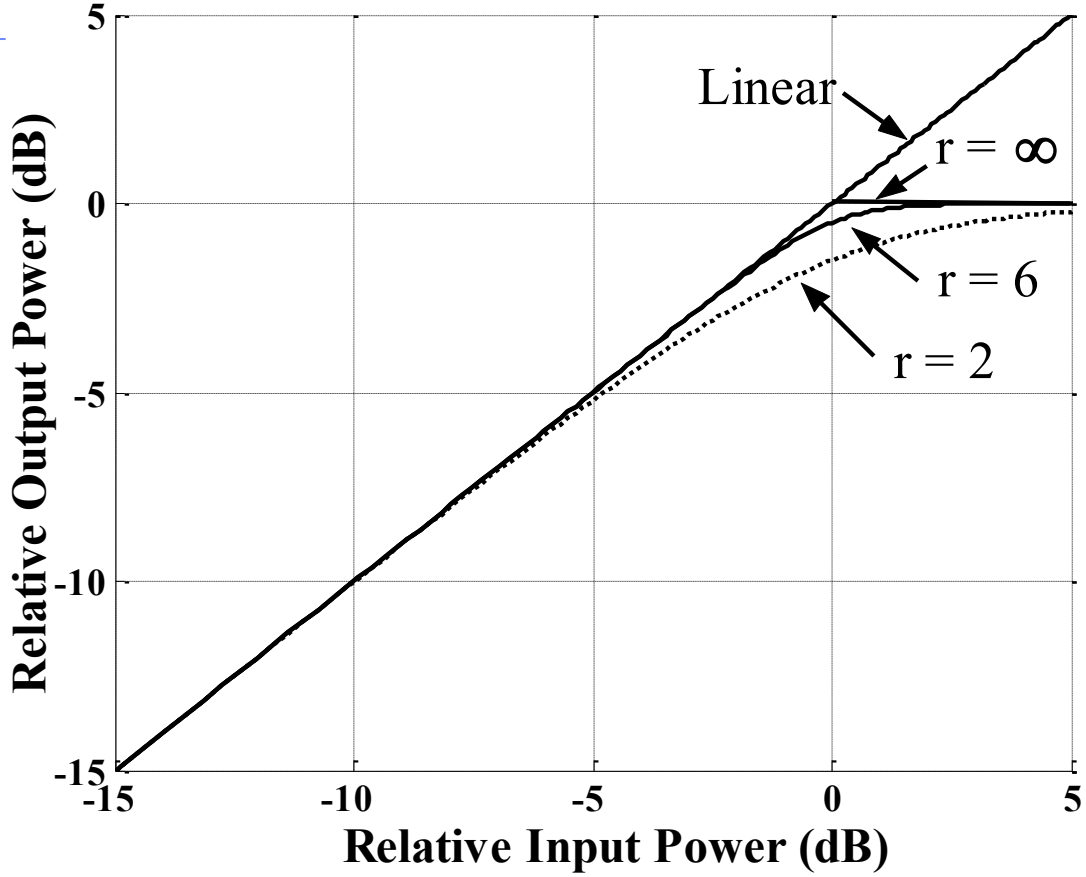


OFDM signals in time domain

$$PAPR = \frac{P_{\max}}{P_{av}} = \frac{\max_{0 \le k \le N-1} |x_k|^2}{E[|x_k|^2]}$$

Characteristics of Non-linear Amplifier

- ***Rapp Model***



$$F[\rho] = \frac{\rho}{[1+(\rho / A)^{2r}]^{1/2r}}$$

Figure Input-output relationship of SSPA.

Frame Structure of PS Method

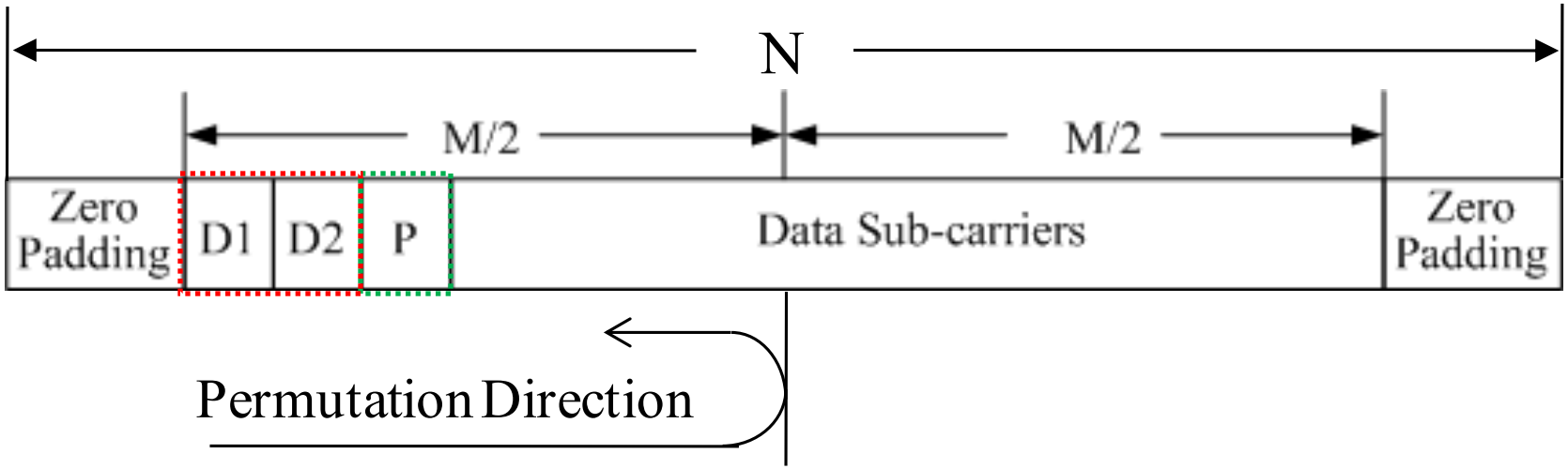
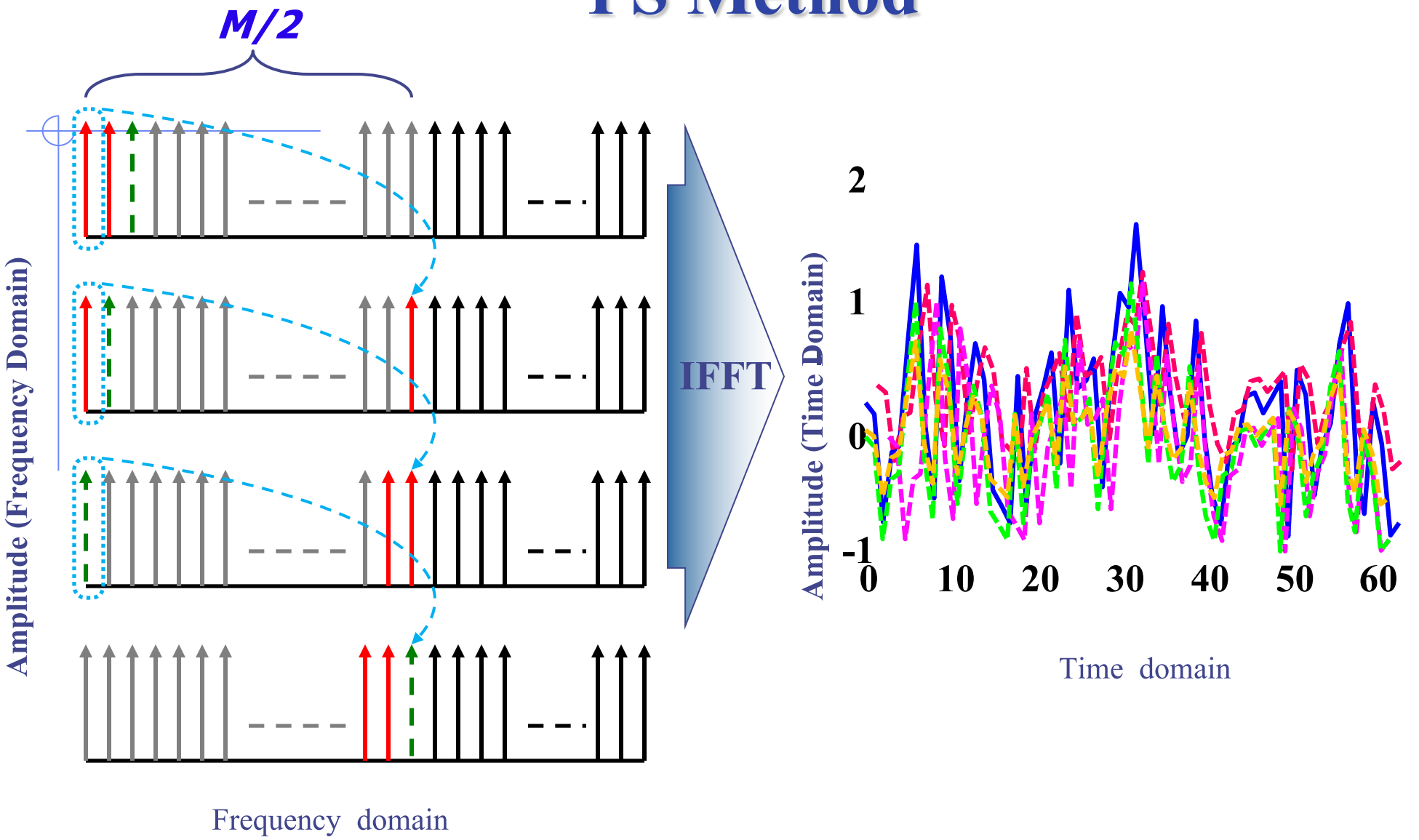


Figure. Structure of Frequency domain OFDM symbol for PS method.

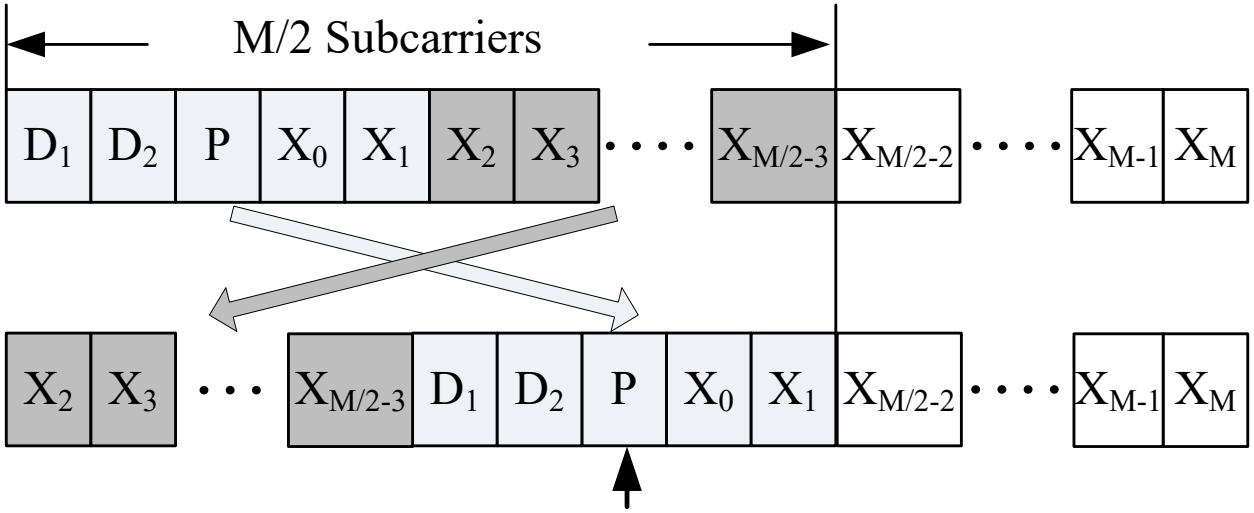
PS Method



Basic concept of permutation sequences (PS) Algorithm

PS Method

Example when L = 6



$$\boldsymbol{X}_{\boldsymbol{R=6}} = [X_2, X_3, \cdots, X_{M/2-3}, D_1, D_2, P, X_0, X_1, X_{M/2-2}, \ldots X_{(M-4)}] \quad \text{(Eq.8)}$$

$$P = (-1)^{(M/2-L+5)} \cdot \alpha \quad \text{(Eq.9)}$$

$$\tilde{x}_k = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} \tilde{X}_n \cdot e^{j\frac{2\pi kn}{N}} \quad \text{(Eq.10)}$$

Structure of Transmitter for PS Method

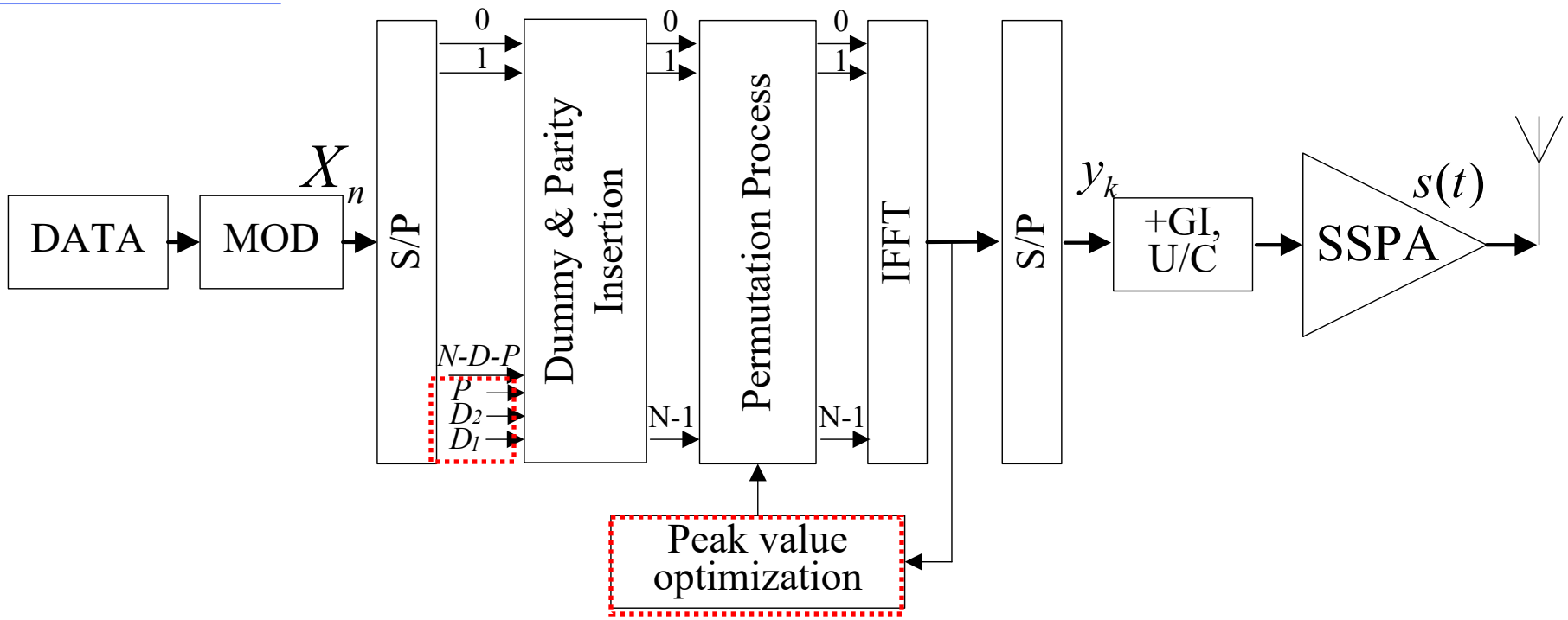
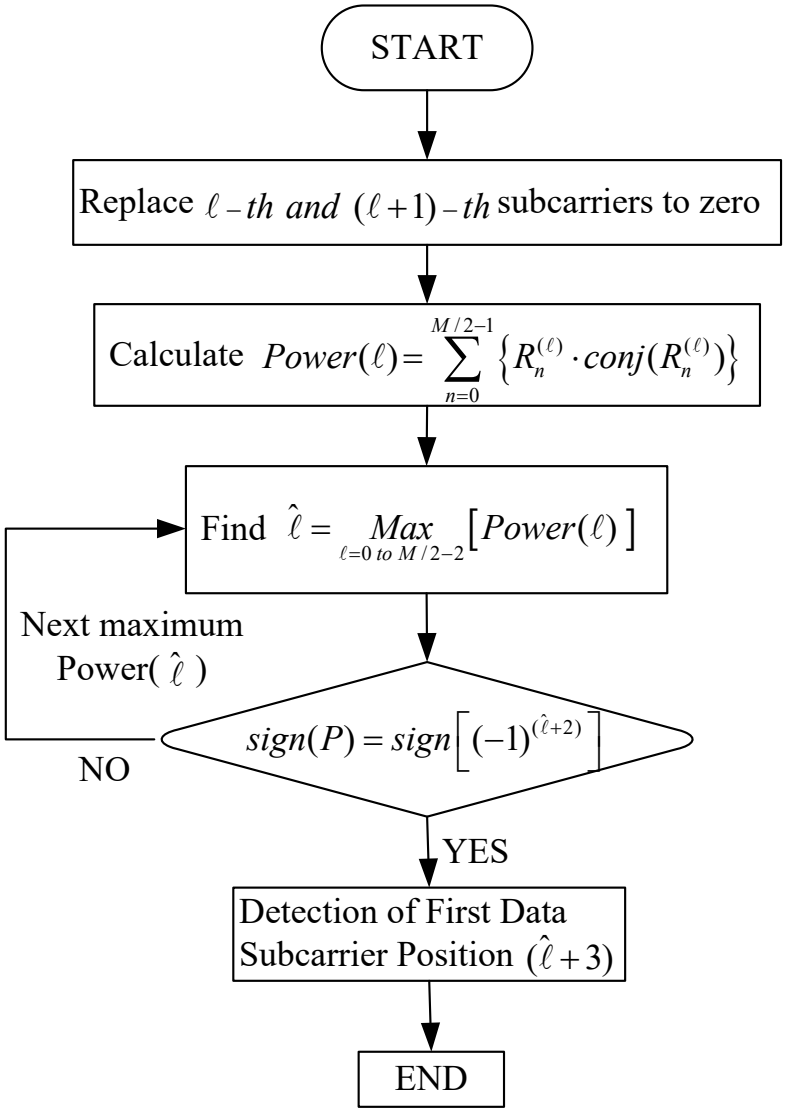


Fig. Structure of transmitter for the PS method

Flowchart of permutation number for Detection Algorithm



Structure of Receiver for PS Method

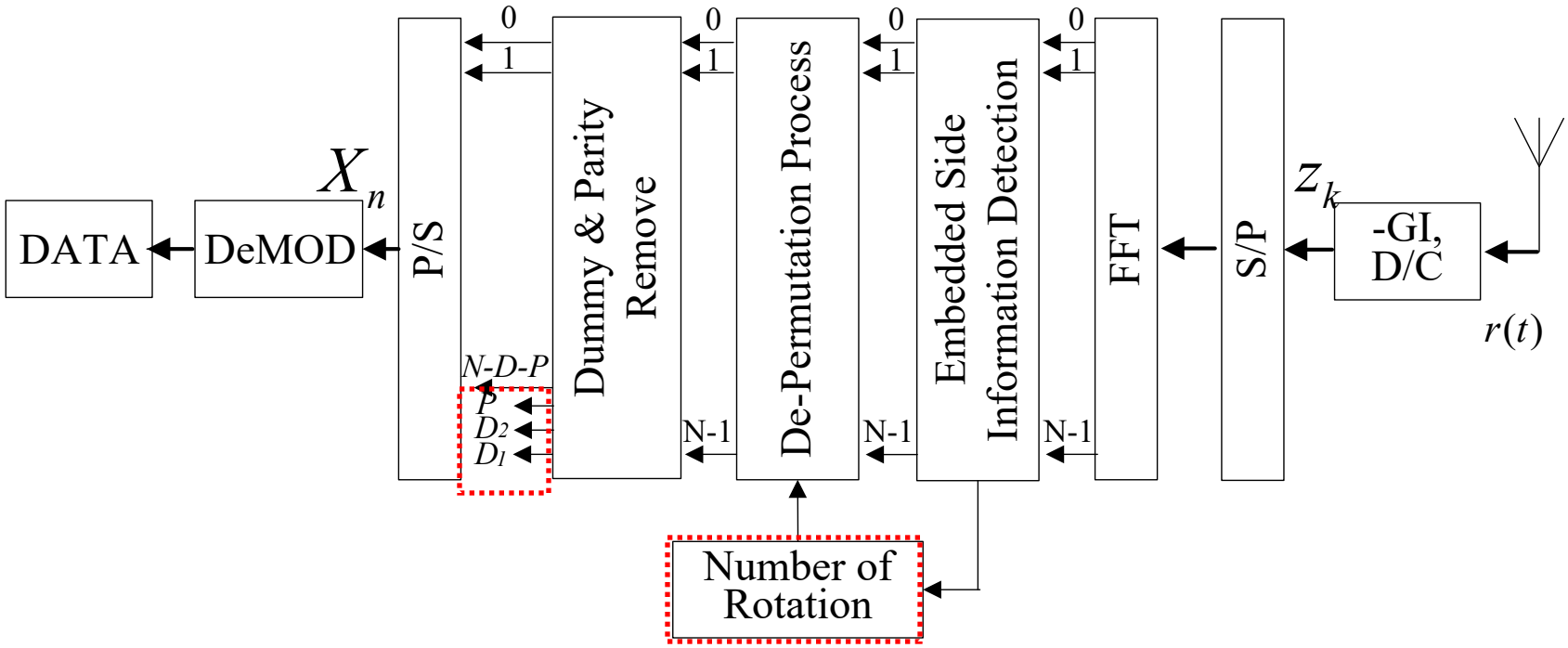


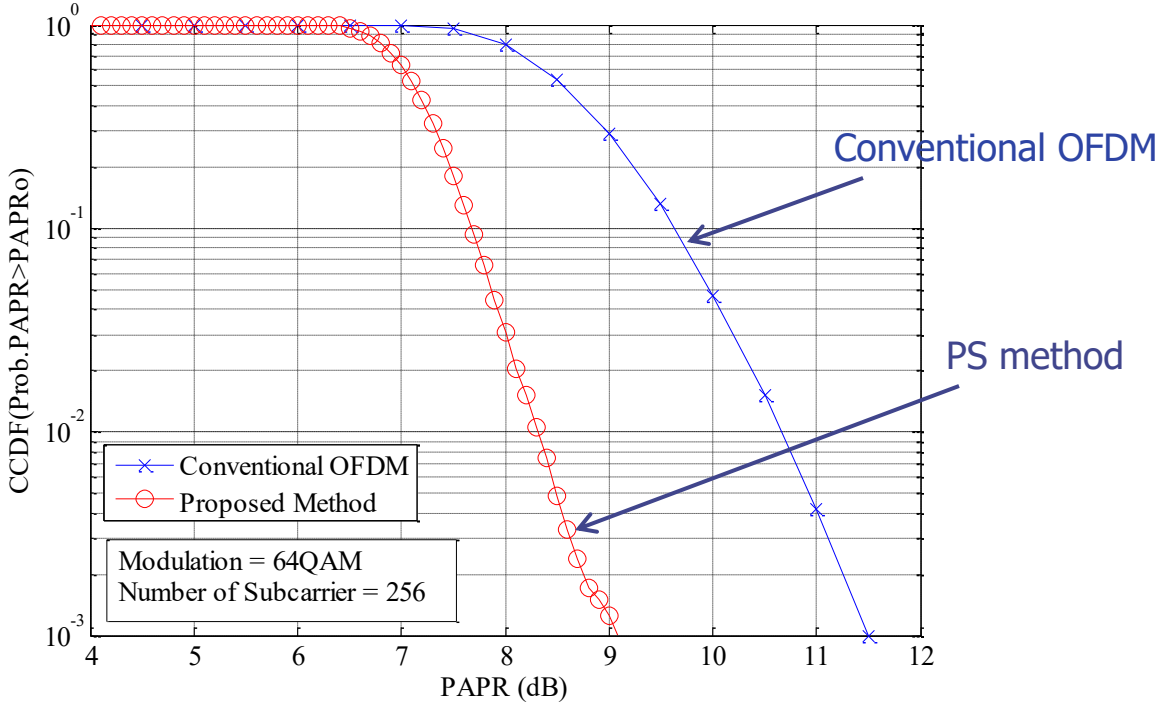
Fig. Structure of proposed OFDM receiver.

Performance Evaluations

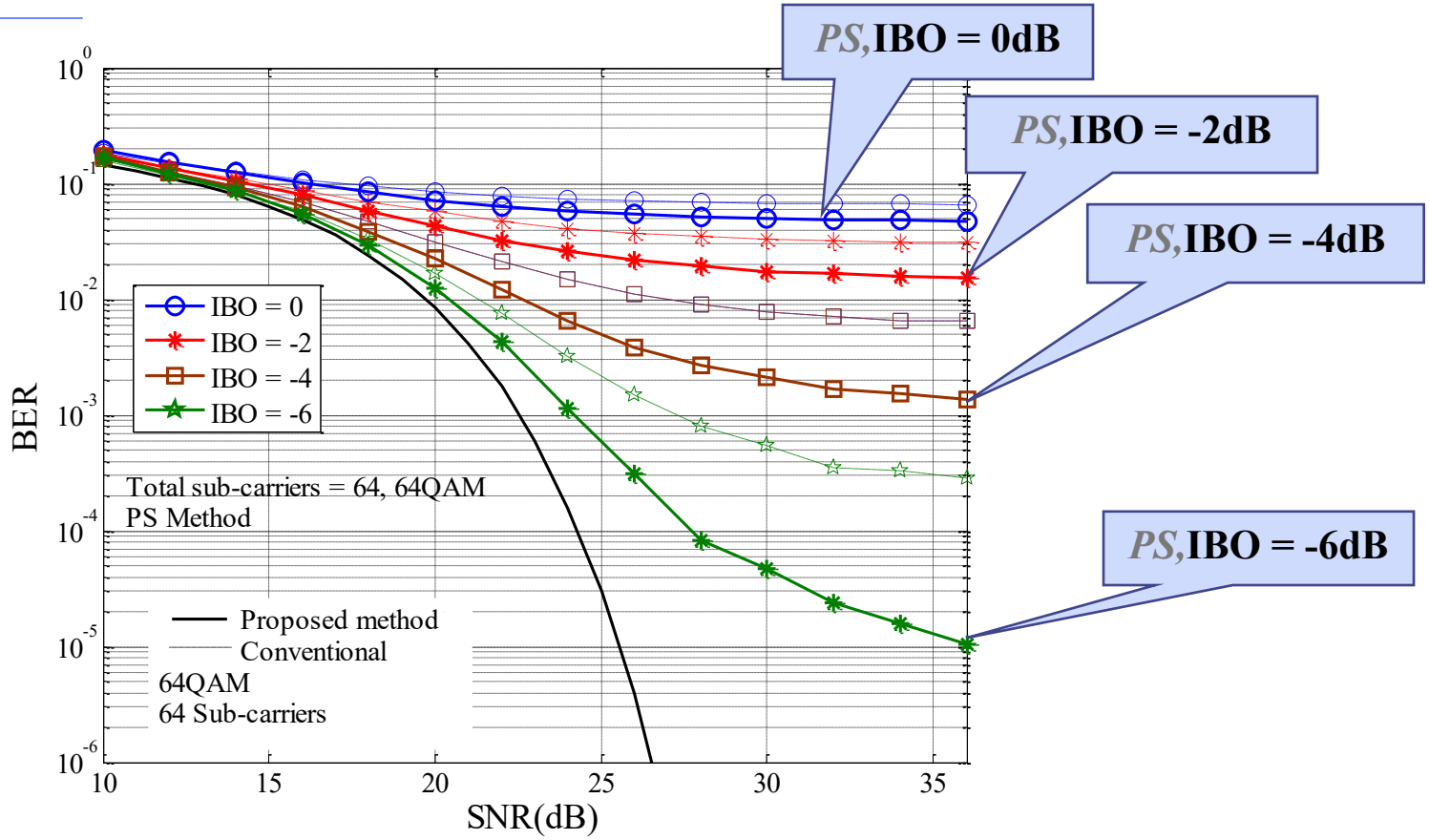
Table 1. Simulation parameters

Modulation method	**64QAM**
Demodulation method	**Coherent**
Allocated bandwidth	**5MHz**
Number of *FFT* points (N=Z+M)	**256**
Number of sub-carriers (M=D+P+K)	**64**
Number of dummy sub-carriers (D)	**2**
Number of parity sub-carriers (P)	**1**
Number of data sub-carriers (K)	**61**
Number of zero padding (Z)	**192**
Symbol duration	**12.8 μs**
Guard interval	**1.28 μs**
Model of non-linear amplifier	**SSPA**
Non-linear parameter of Eq.(2)	***r*=2**
Channel model	**AWGN**

PAPR performance for proposed method



BER performance of proposed method



Conclusions

- The PAPR reduction method for OFDM signal with embedded side information
- The salient future of PS method is to rotate the subcarriers in the frequency domain to reduce the PAPR

Conclusions

- The rotation number at transmitter can be detect at the receiver by using the very few dummy subcarriers
- The PS method can achieve higher transmission efficiency and better BER performance in the non-linear channel