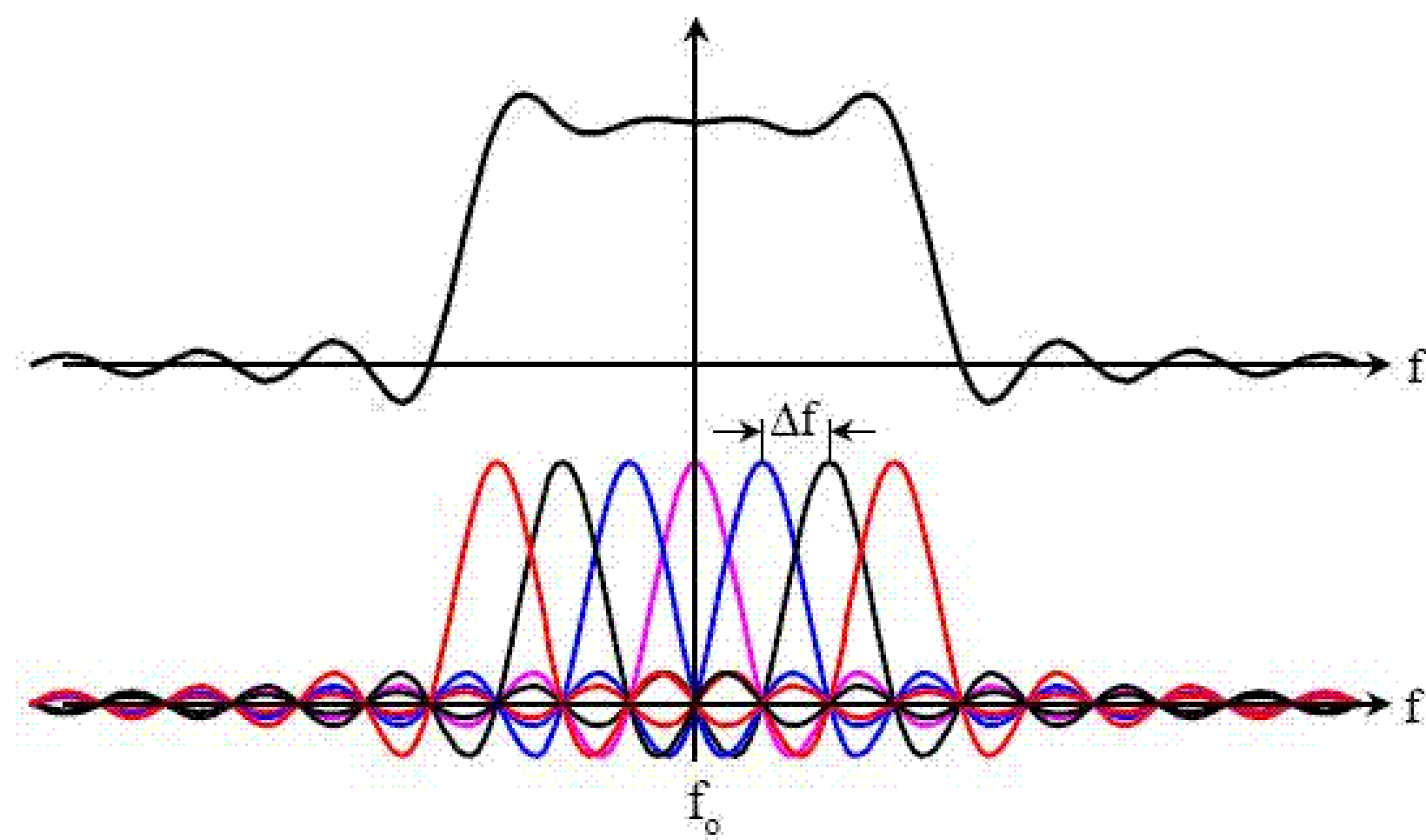


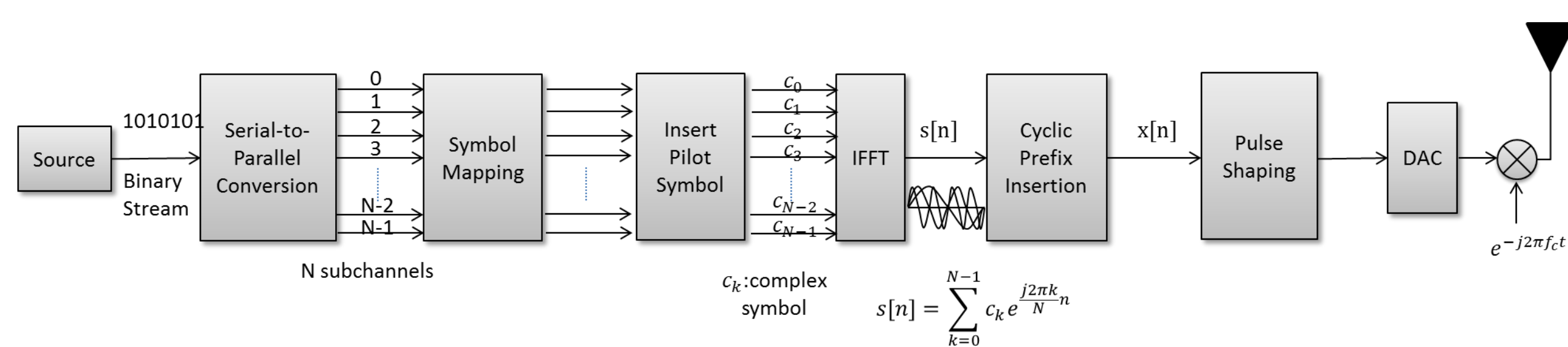
Overview

- Orthogonal frequency division multiplexing (OFDM) is a method of encoding digital data on multiple orthogonal subcarrier frequencies.
- High spectral efficiency, resistant to multipath fading channel, reduced Inter-Symbol Interference (ISI), simplified equalizer and channel estimation, reasonable complexity and efficient implementation

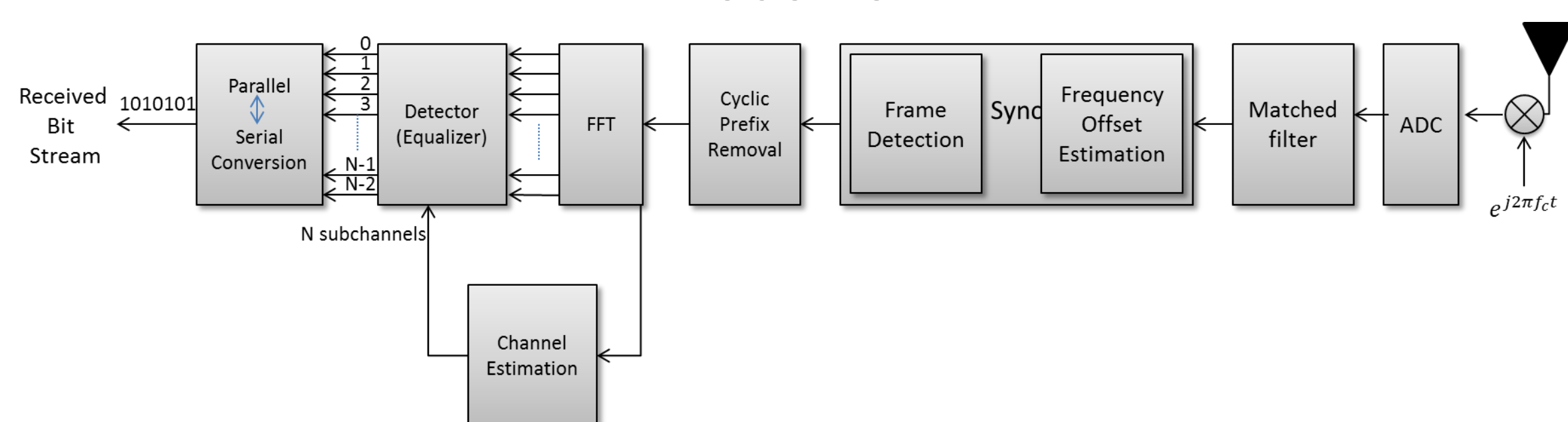


System Design

Transmitter

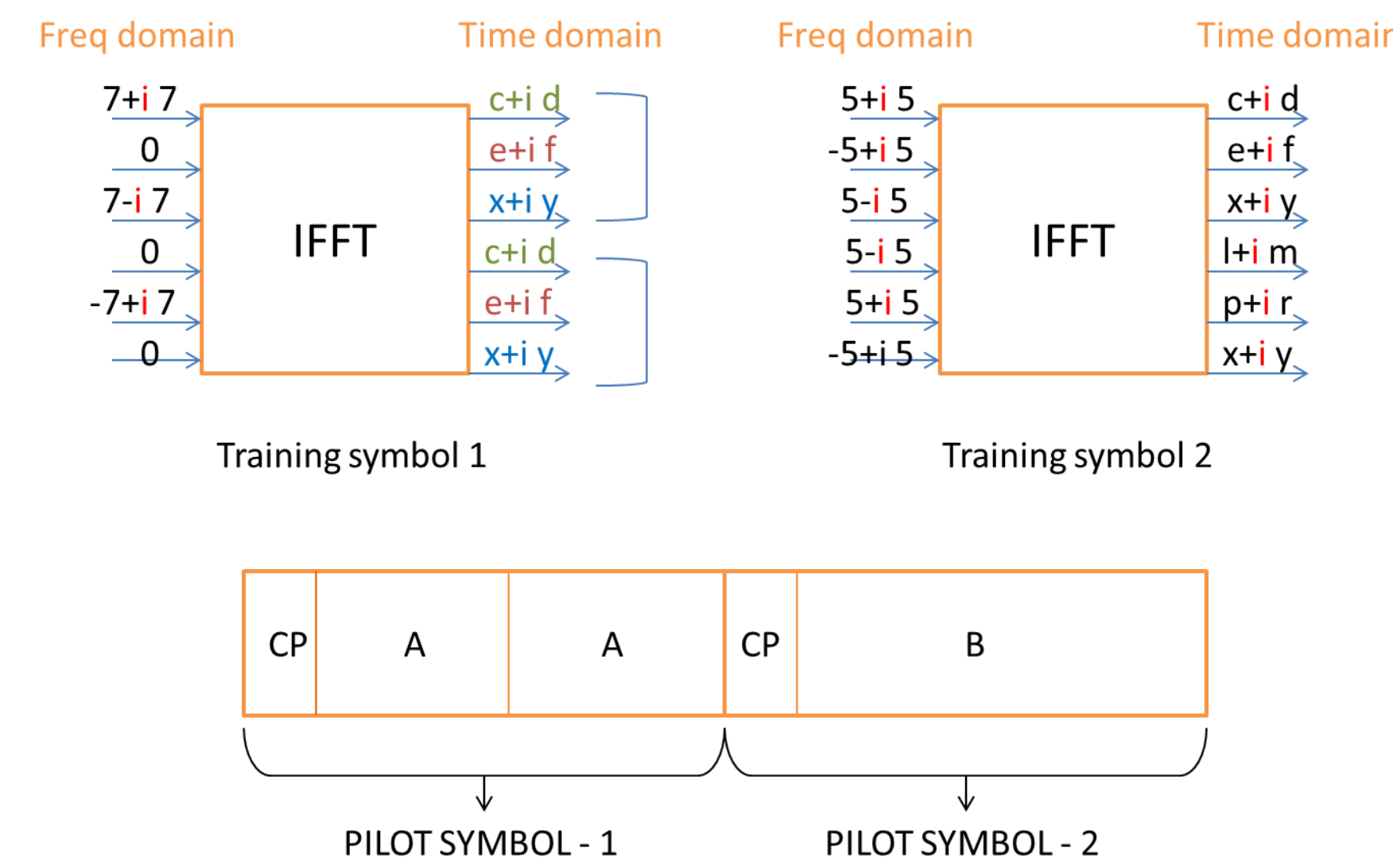


Receiver



Key Features

Pilot Symbol Structure

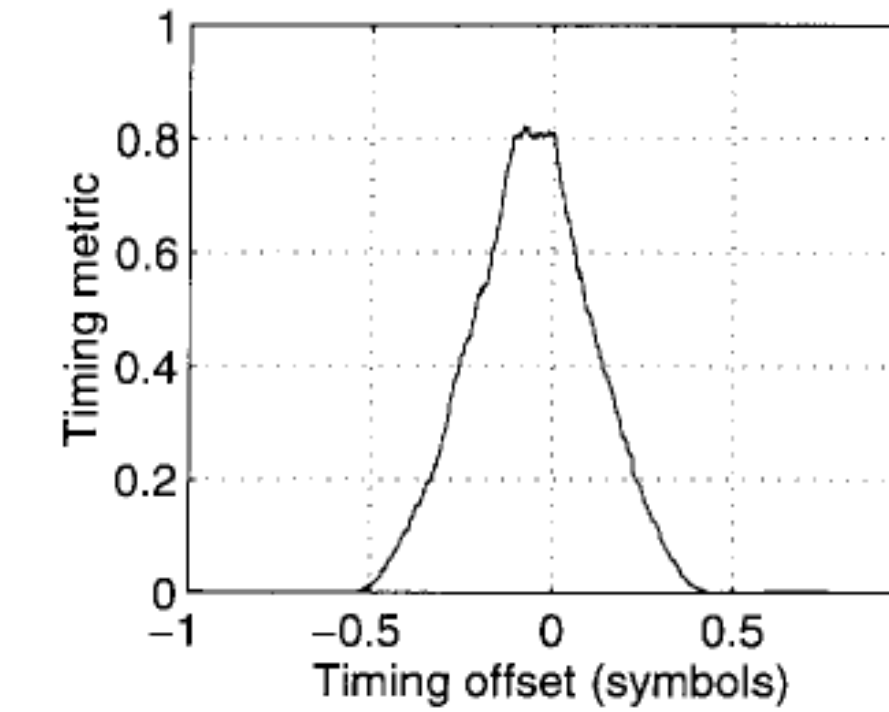


Schmidt and Cox Algorithm (SCA)

$$P(d) = \sum_{m=0}^{L-1} (r_{d+m}^* r_{d+m+L})$$

$$R(d) = \sum_{m=0}^{L-1} |r_{d+m+L}|^2$$

$$M(d) = \frac{|P(d)|^2}{(R(d))^2} \Rightarrow \text{Timing Metric}$$



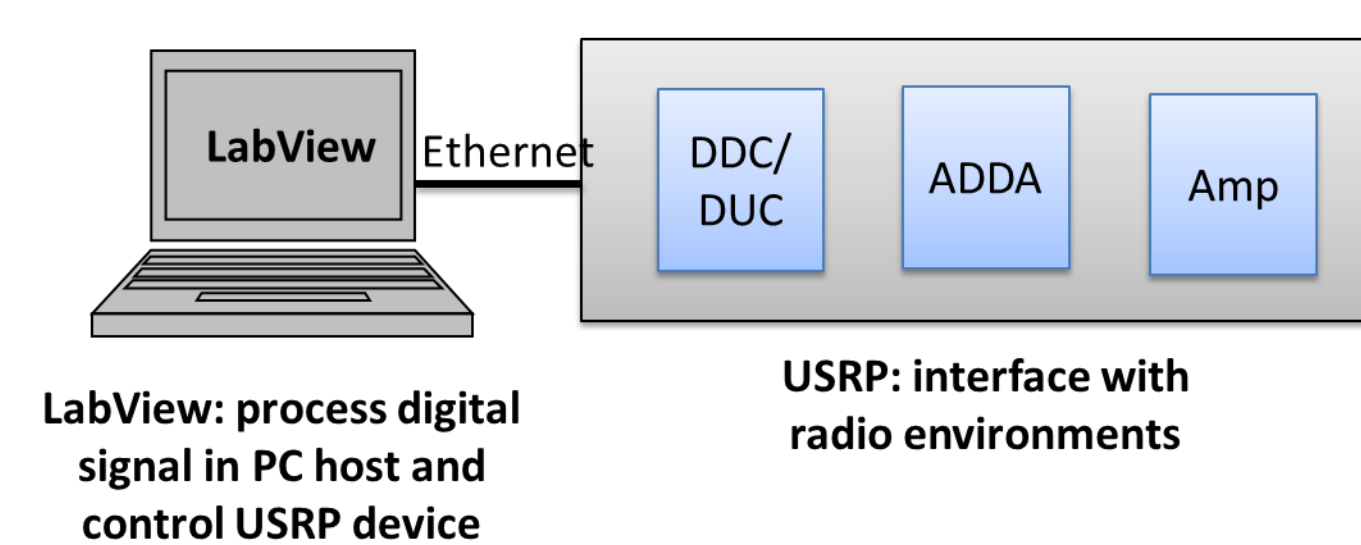
- $\hat{\phi} = \text{angle}(P(d)) \Rightarrow \hat{\Delta f} = \hat{\phi} / (\pi T) \Rightarrow$ Moose algorithm
- $\frac{\hat{\phi}}{\pi T} + \frac{2z}{T} \Rightarrow$ Cox & Schmidl algorithm

Channel Emulation

- Ideal
- AWGN
- Rayleigh Flat Fading
- Rayleigh Frequency Selective Fading Channel

LabView and USRP

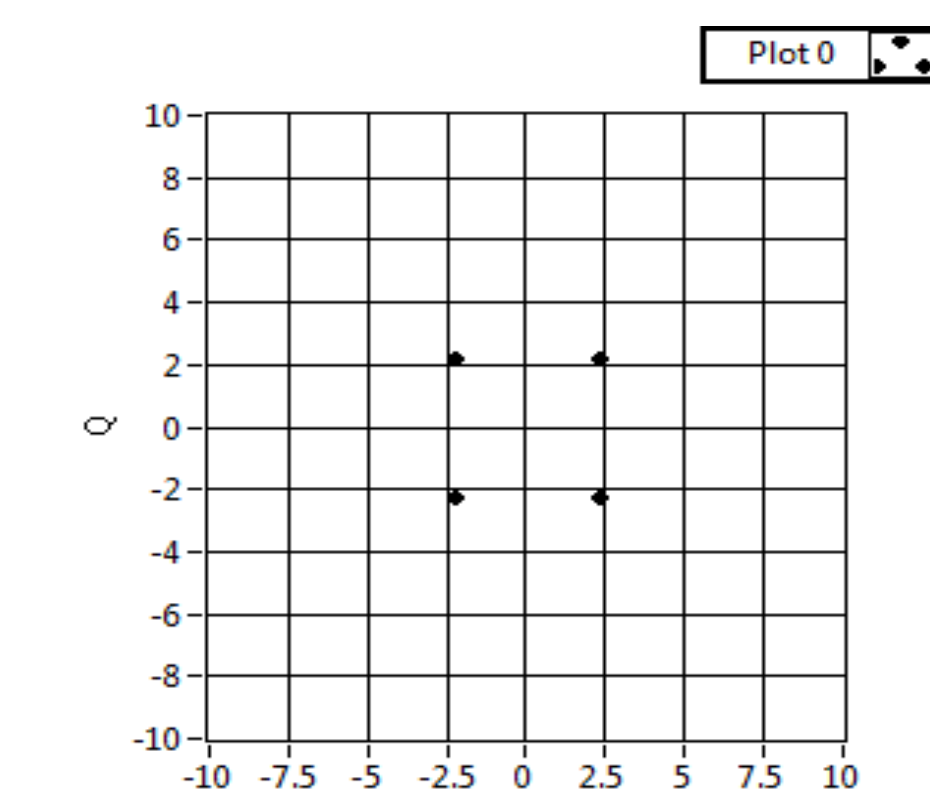
- OFDM is realized by LabView, which is a system design platform for visual programming language and can interface with USRP to implement various communication systems



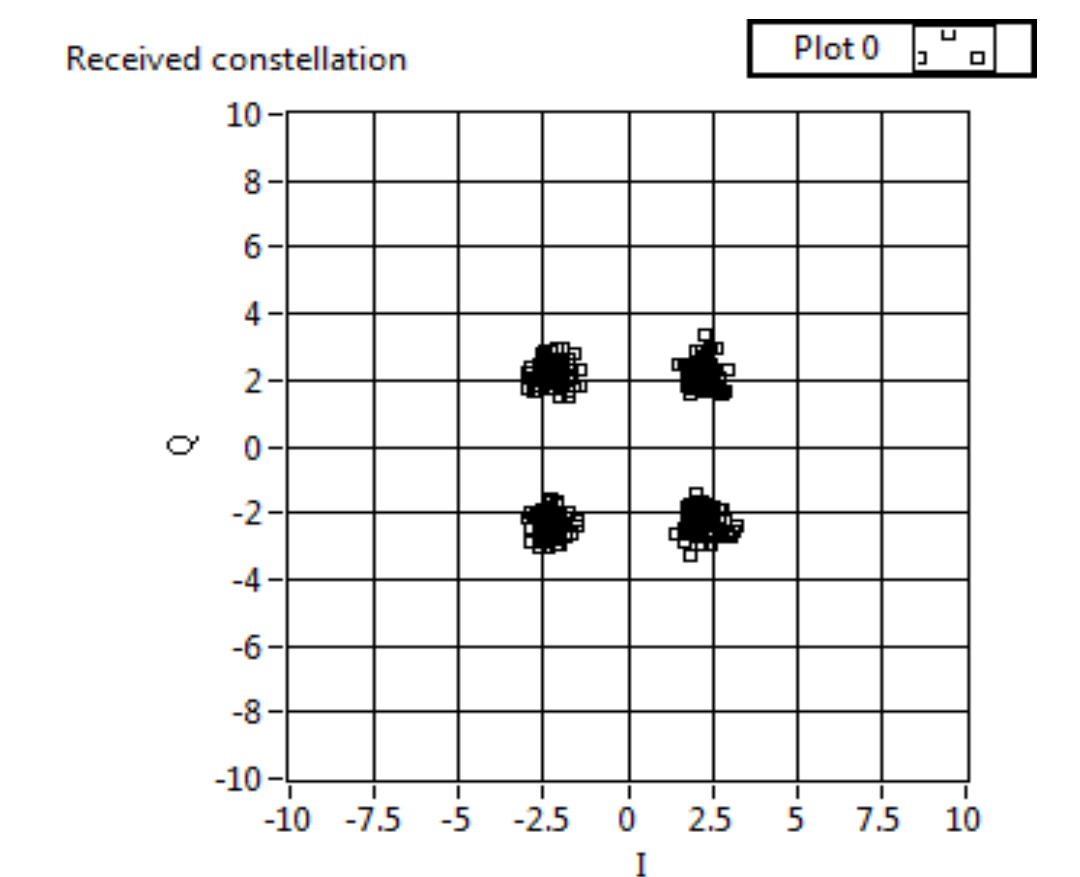
Simulation

PACKET LENGTH	512
NUMBER OF SUB-CHANNELS	64
LENGTH OF CYCLIC PREFIX	16
MODULATION SCHEME	BPSK, QPSK, 16-QAM
TRANSMITTER OVERSAMPLE FACTOR	4
TRANSMIT SAMPLE RATE	4MHz
RECEIVER OVERSAMPLE FACTOR	4
RECEIVE SAMPLE RATE	4MHz
TYPES OF CHANNEL	IDEAL / AWGN / RAYLEIGH FLAT FADING AND RAYLEIGH FREQUENCY SELECTIVE FADING
GAUSSIAN NOISE VARIANCE	0.001
RAYLEIGH FADING VARIANCE	1

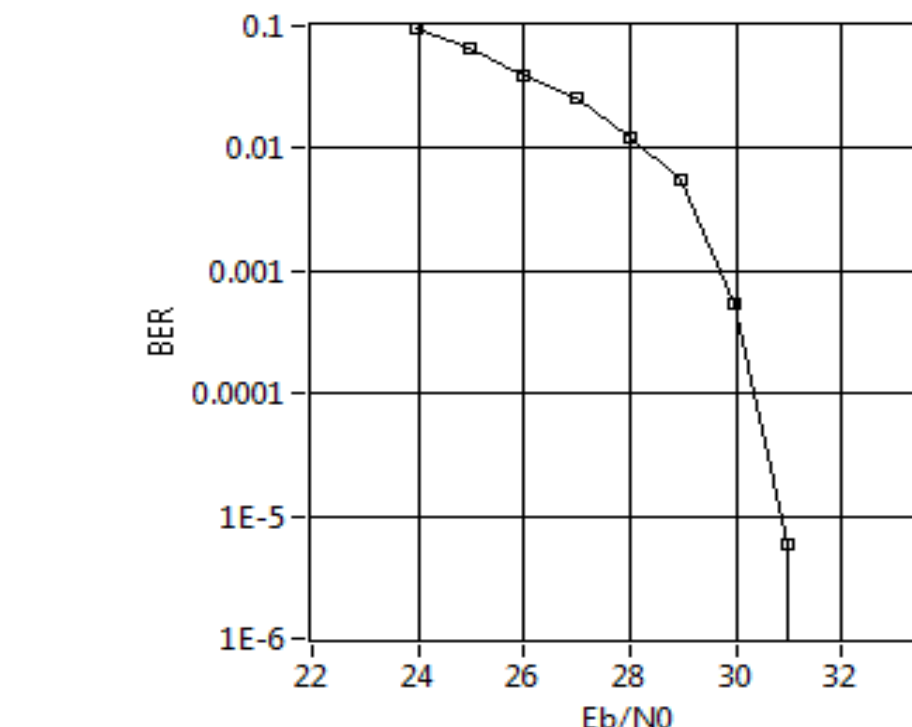
TRANSMITTER CONSTELLATION (QPSK) IDEAL CHANNEL



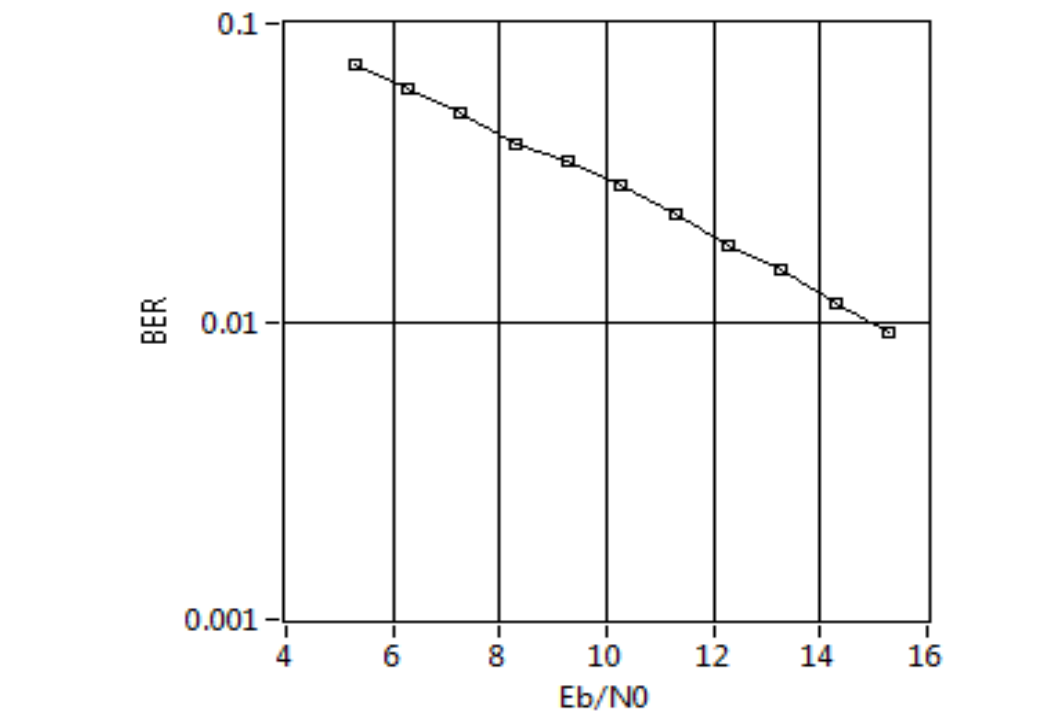
RECEIVER CONSTELLATION (QPSK) IDEAL CHANNEL



BIT ERROR RATE vs SNR CURVE (QPSK) AWGN CHANNEL



BIT ERROR RATE vs SNR CURVE (QPSK) RAYLEIGH FADING CHANNEL



BIT ERROR RATE vs SNR CURVE (QPSK) AWGN CHANNEL

BIT ERROR RATE vs SNR CURVE (QPSK) RAYLEIGH FADING CHANNEL

Implementation on USRP

- Operating at 2.4GHz, BPSK/QPSK/16-QAM

