Chapter 0
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- 1 Introduction to Orthogonal Frequency Division Multiplexing (OFDM) Technique
  - 1.1 The History of OFDM
  - 1.2 OFDM and Multicarrier Transmission
  - 1.3 The Applications of OFDM

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- 2 The Basic Principles of OFDM
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  - 2.2 IFFT and FFT
  - 2.3 Modulation
    - 2.3.1 *M*-ary Phase Shift Keying
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  - 2.4 Guard Interval and Cyclic Extension
  - 2.5 Orthogonality
  - 2.6 Advantages and Disadvantages

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- 3 OFDM Transmission over Gaussian Channels
  - 3.1 The Channel Model
  - 3.2 OFDM System Performance over AWGN Model
  - 3.3 OFDM System Performance with Clipping Amplification

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- 4 OFDM Transmission over Wideband Channels
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  - 4.2 Effects of Time Dispersive Channels on OFDM
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- 5 Time and Frequency Domain Synchronization
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    - 5.1.2 Carrier Phase Noise
  - 5.2 Effects of Carrier and Sampling Clock Frequency Offsets
    - 5.2.1 Carrier Frequency Offset
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    - 5.3.2 Frequency Synchronization
  - 5.4 OFDM Synchronization Performance

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    - 6.2.1 Clipping Amplifier Methods
    - 6.2.2 Clipping Amplifier Simulations
    - 6.2.3 BER Performance using Clipping Amplifiers
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- 7 Adaptive OFDM
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  - 7.2 Adaptive Modulation of OFDM
  - 7.3 Adaptive Single- and Multi-user OFDM

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8 OFDM Applications

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- 8.1.2 DAB System Overview
- 8.1.3 DAB Channel Coding
- 8.1.4 DAB Modulation
- 8.1.5 Channel for DAB OFDM System
- 8.1.6 Receiver for DAB OFDM System

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- 8.2.1 Introduction to DVB
- 8.2.2 DVB System Overview
- 8.2.3 Channel Coding and Modulation

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- 8.3.3 Statistic Channel Model for WLAN
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- Appendix B Digital Modulation
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  - B.2 Quadrature Amplitude Modulation

References

- **References**

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- Lab 1 The Studying of MATLAB, FPGA and DSP
- Lab 2 The Implementation of BPSK/QPSK/QAM Mapping/Demapping Function – using FPGA or DSP
- Lab 3 The Implementation of FFT/IFFT Algorithm – using FPGA or DSP
- Lab 4 The Simulation of OFDM System over AWGN Channel and Wideband Channel – using MATLAB or C Language
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- Lab 11 The Implementation of Equalization – using DSP or FPGA
- Lab 12 The MC-CDMA System Simulation – using MATLAB or C Language

Lab 1 The Studying of MATLAB, FPGA and DSP

- 熟悉MATLAB, FPGA 和 DSP之使用。
- Matlab
  - 基本概述
  - MATLAB基本運算
  - MATLAB常用的基本數學函數
  - 矩陣的處理與運算
  - 繪圖功能
  - 程式設計

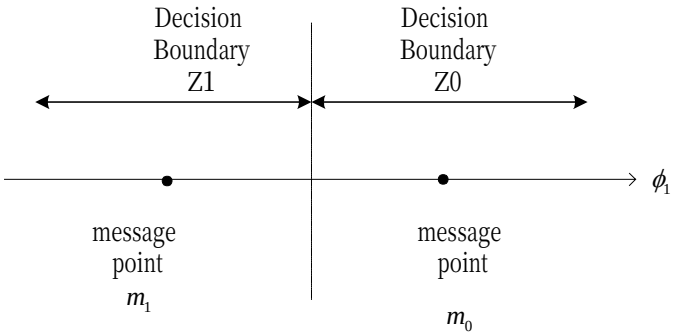
Lab 1 The Studying of MATLAB, FPGA and DSP

- **FPGA**
  - **Xilinx Foundation 4.1i**
  - **Xilinx FPGA Architecture**
    - **Introduction to FPGA**
    - **The architecture of Virtex-E**
    - **The architecture of Virtex-II**
  - **Xilinx Foundation 4.1i -Introduction**
  - **Xilinx Foundation 4.1i -Project Manager Window**
    - **Creating a new project**
    - **HDL Editor**
    - **Synthesis setting**
    - **Simulation**
    - **Implementation**
    - **Tabbed Information**
    - **Using CORE_Generator**
  - **Some Useful Command**

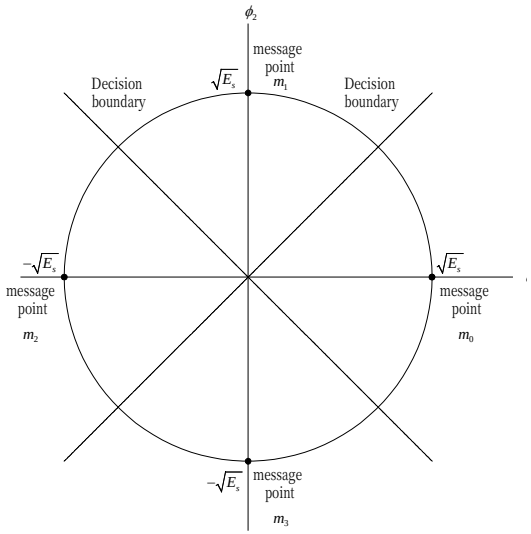
Lab 2 The Implementation of BPSK/QPSK/QAM Mapping/Demapping Function – using FPGA or DSP

- 利用FPGA or DSP實現OFDM系統傳送端之Mapping與接收端之Demapping Function。

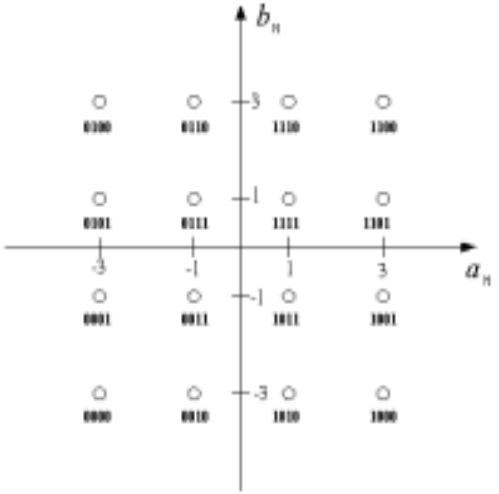
BPSK



QPSK

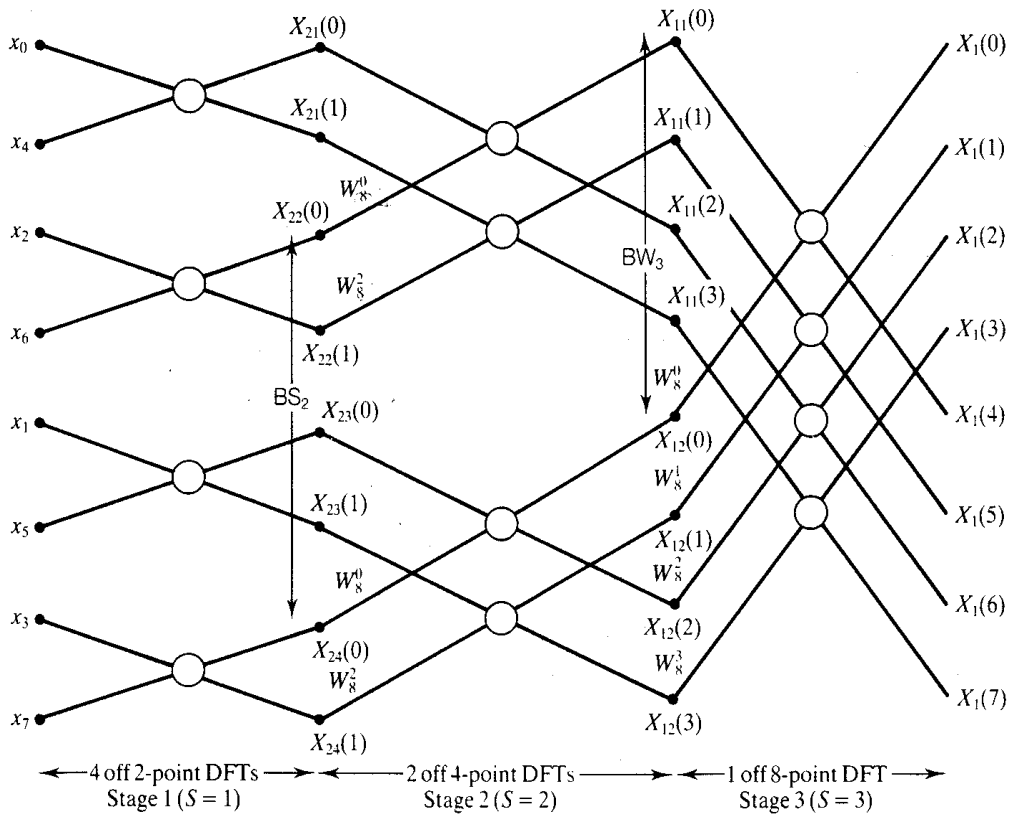


16-QAM



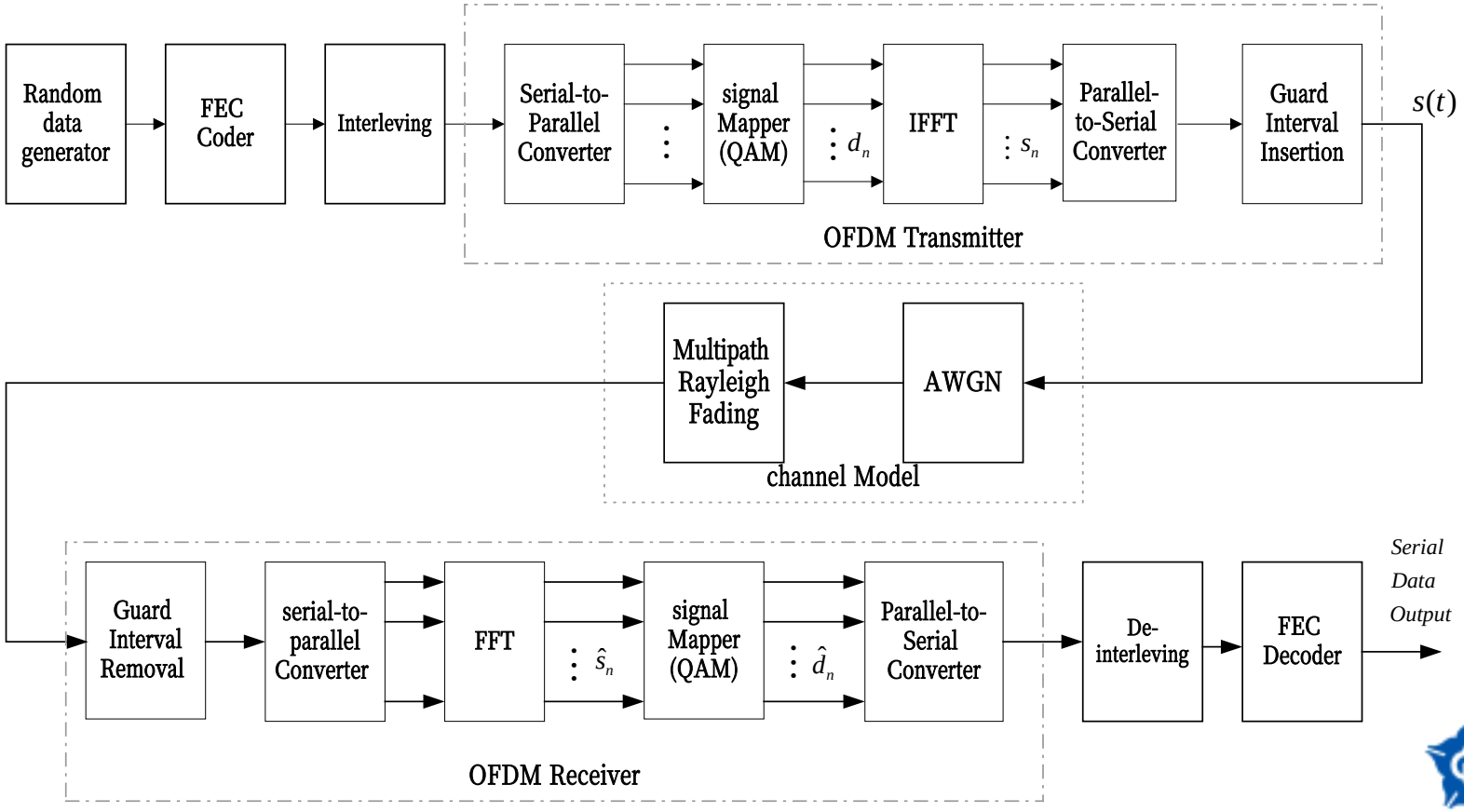
Lab 3 The Implementation of FFT/IFFT Algorithm – using FPGA or DSP

- 利用FPGA 或 DSP實現OFDM系統傳送端之IFFT與接收端之FFT Algorithm。
- FFT butterflies for an 8-point DFT



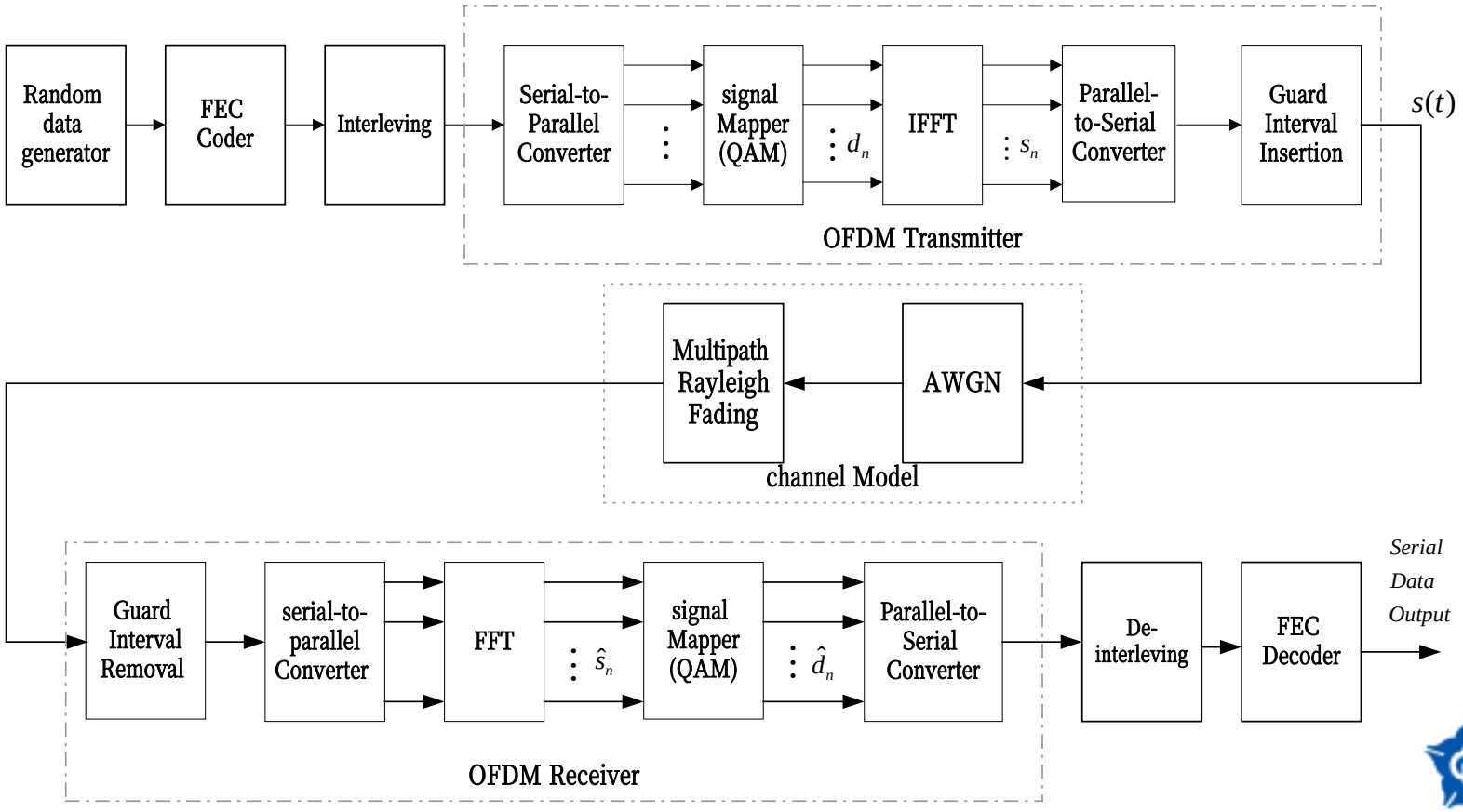
Lab 4 The Simulation of OFDM System over AWGN Channel and Wideband Channel – using MATLAB or C Language

- 完成整個OFDM系統之程式撰寫與模擬，包括傳送端、接收端與通道模型(包括AWGN Channel and Wideband Channel等)，透過程式語言的撰寫與模擬，以期讓學生對於OFDM有更深入之了解與體驗。



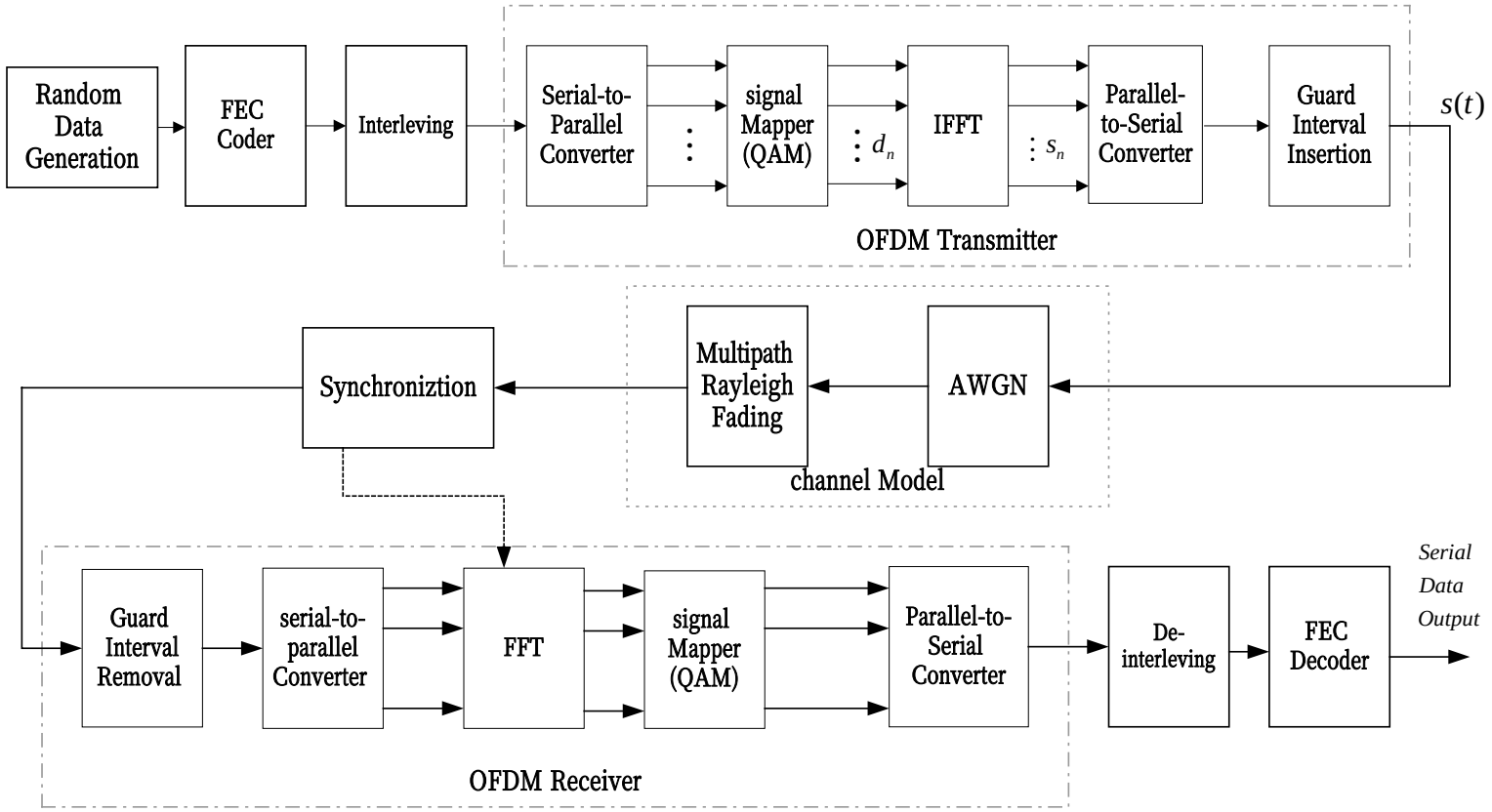
Lab 5 The Implementation of Baseband transmitter with QAM Modulation in OFDM System– using DSP or FPGA

- 利用FPGA與DSP實現OFDM baseband function之運作，包括傳送端與接收端之實現，完成資料之傳送與接收。此實驗之通道模型假設為理想通道，暫不考慮AWGN Channel 及 Wideband Channel。



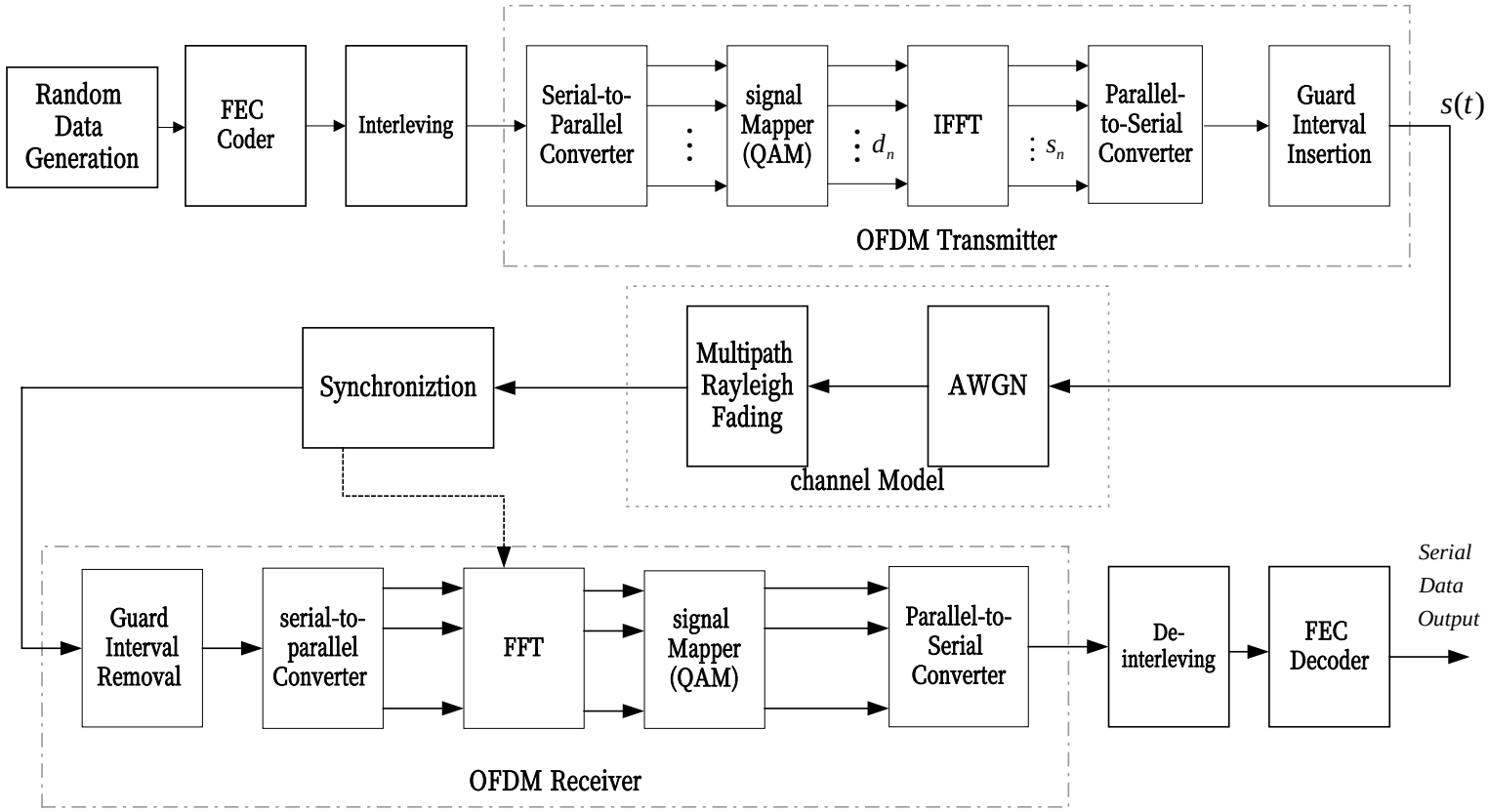
Lab 6 The Simulation of Coarse Synchronization - using MATLAB or C Language

- 針對文獻中之Coarse同步方法進行程式撰寫與模擬，比較各種方法之優缺點，並探討通道估測與同步方法之結合與模擬。



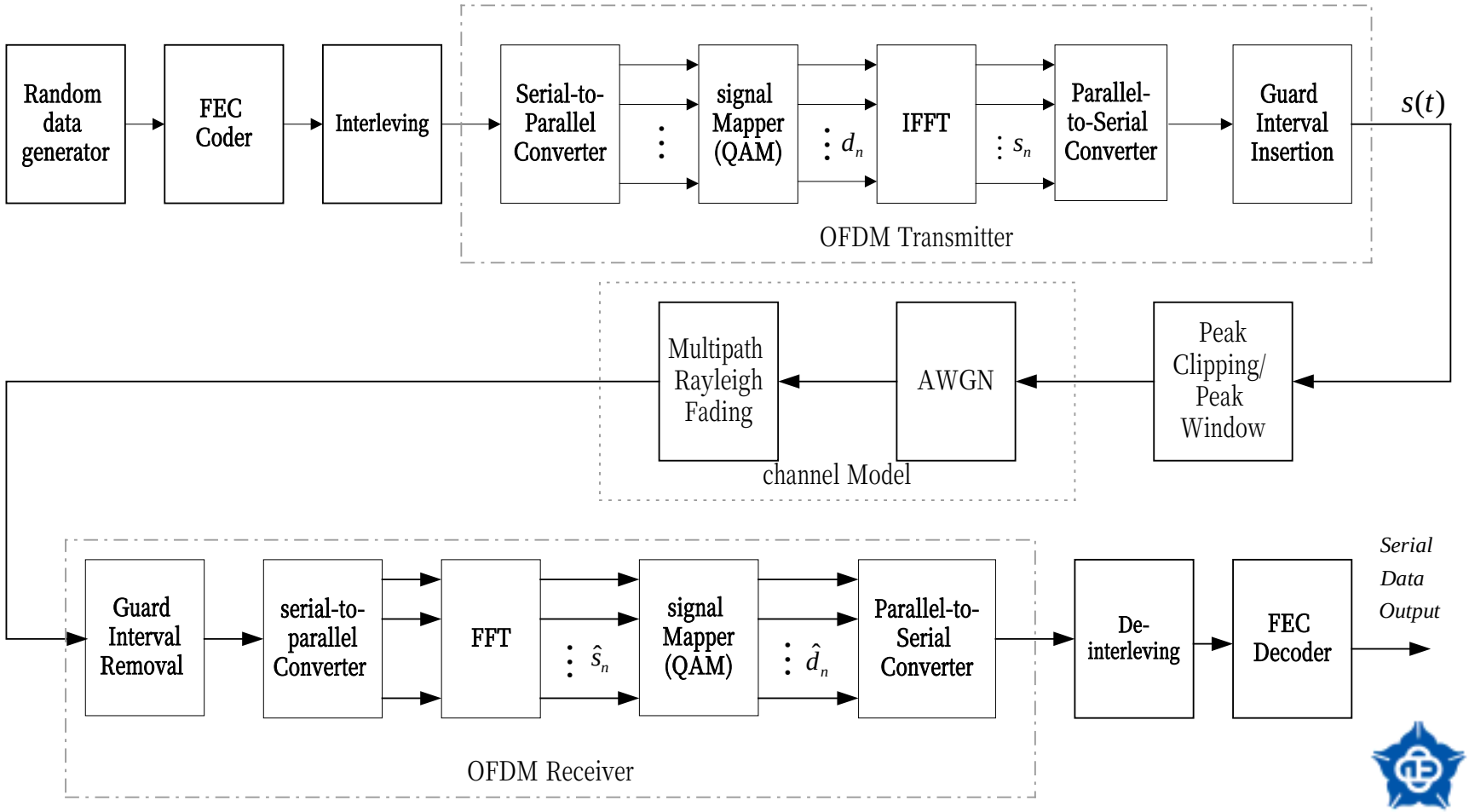
Lab 7 The Simulation of Fine Synchronization– using MATLAB or C Language

- 針對文獻中之Fine同步方法進行程式撰寫與模擬，比較各種方法之優缺點，並探討通道估測與同步方法之結合與模擬。



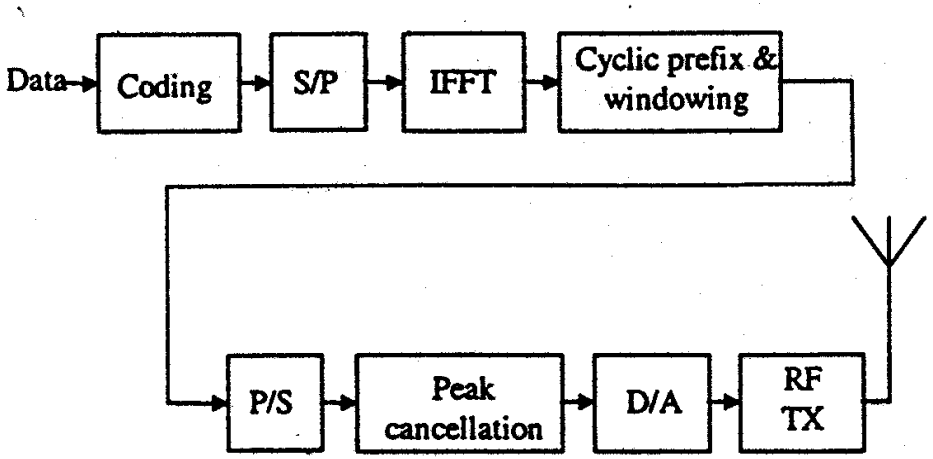
Lab 8 The Simulation of Different Methods to Reduce PAPR – using MATLAB or C Language

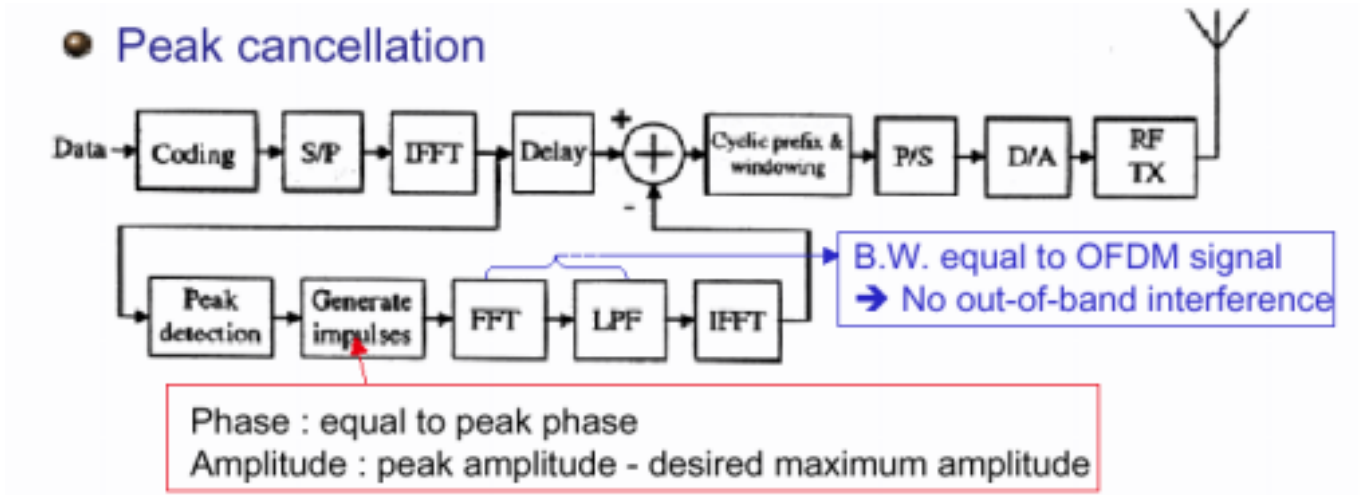
- 針對文獻中之多種降低PAPR方法進行程式撰寫與模擬，比較各種方法之優缺點。



Lab 8 The Simulation of Different Methods to Reduce PAPR – using MATLAB or C Language

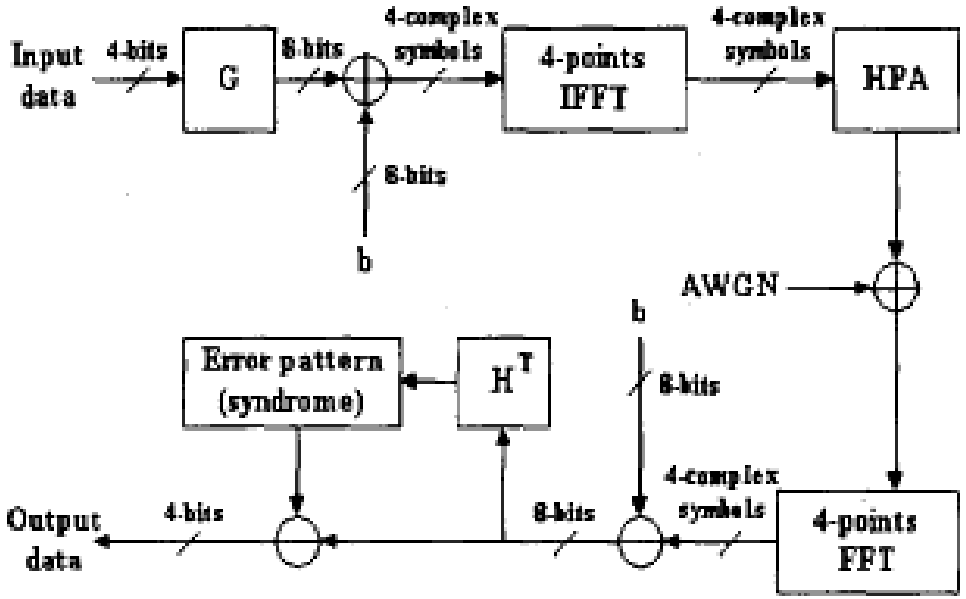
Peak Cancellation





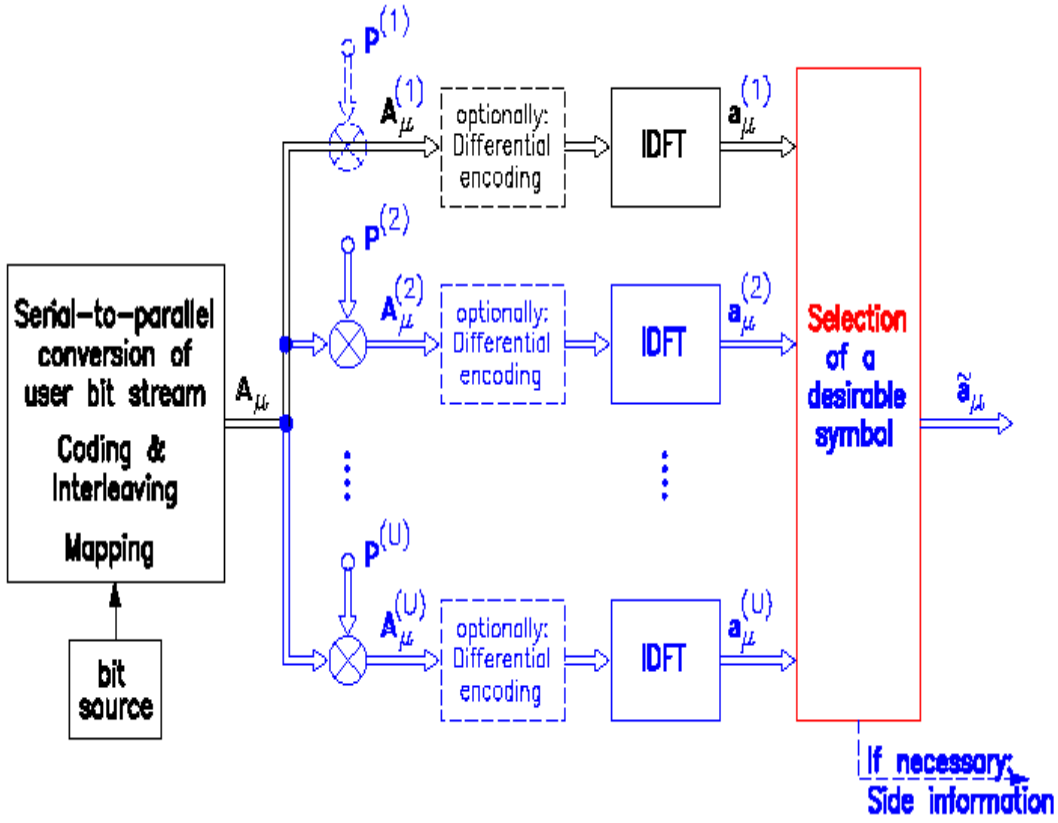
Lab 8 The Simulation of Different Methods to Reduce PAPR – using MATLAB or C Language

- PAP Reduction Codes- block code



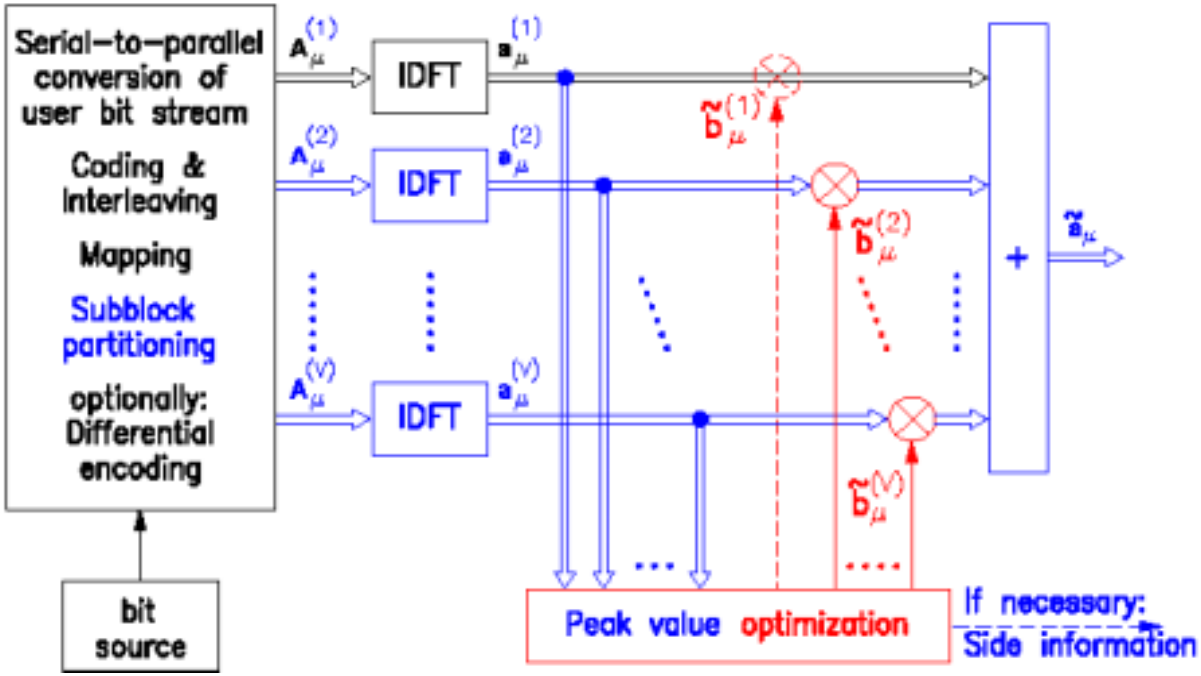
Lab 8 The Simulation of Different Methods to Reduce PAPR – using MATLAB or C Language

- **Symbol Scrambling**
  - **SLM**



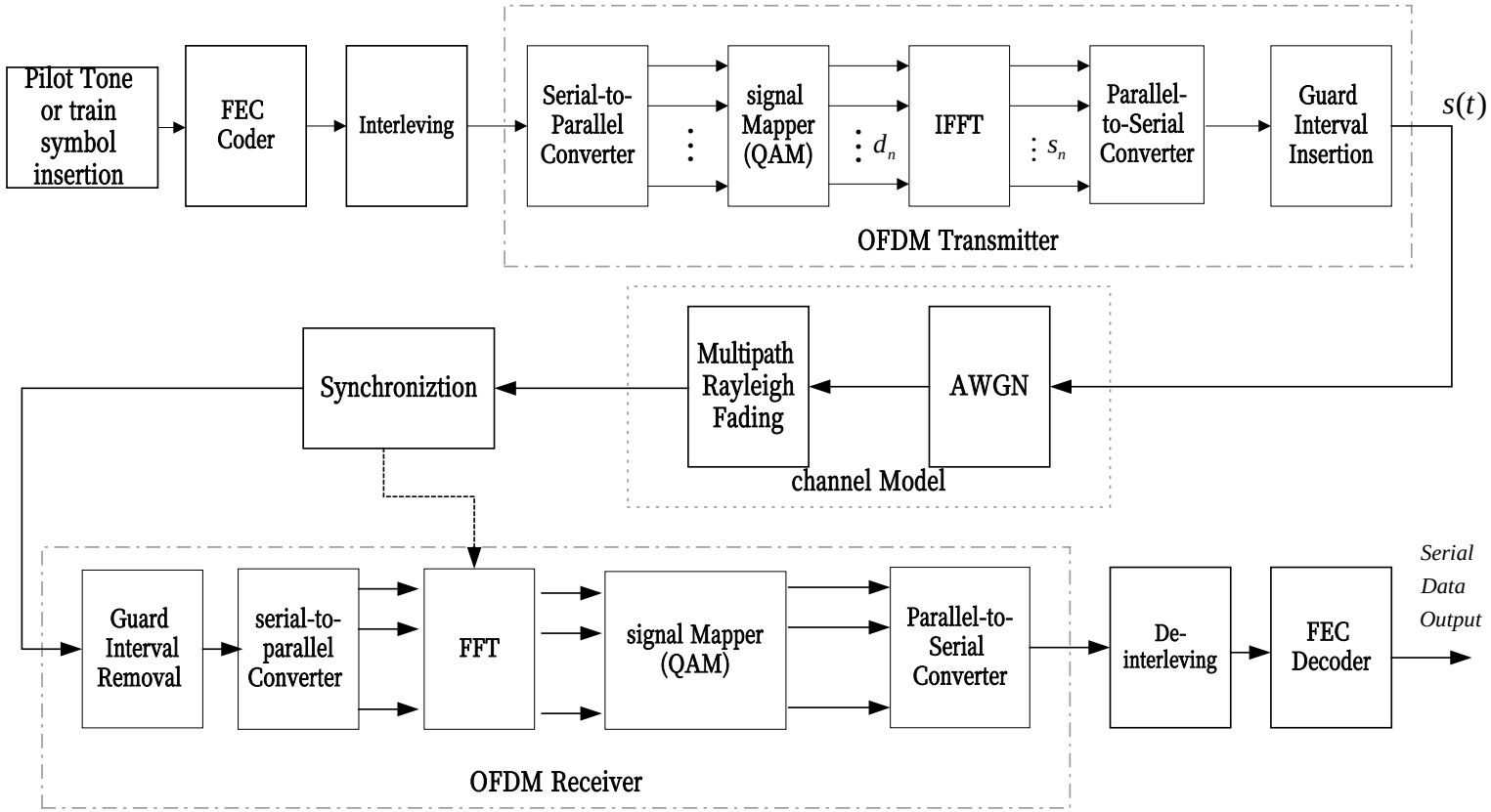
Lab 8 The Simulation of Different Methods to Reduce PAPR – using MATLAB or C Language

- PTS



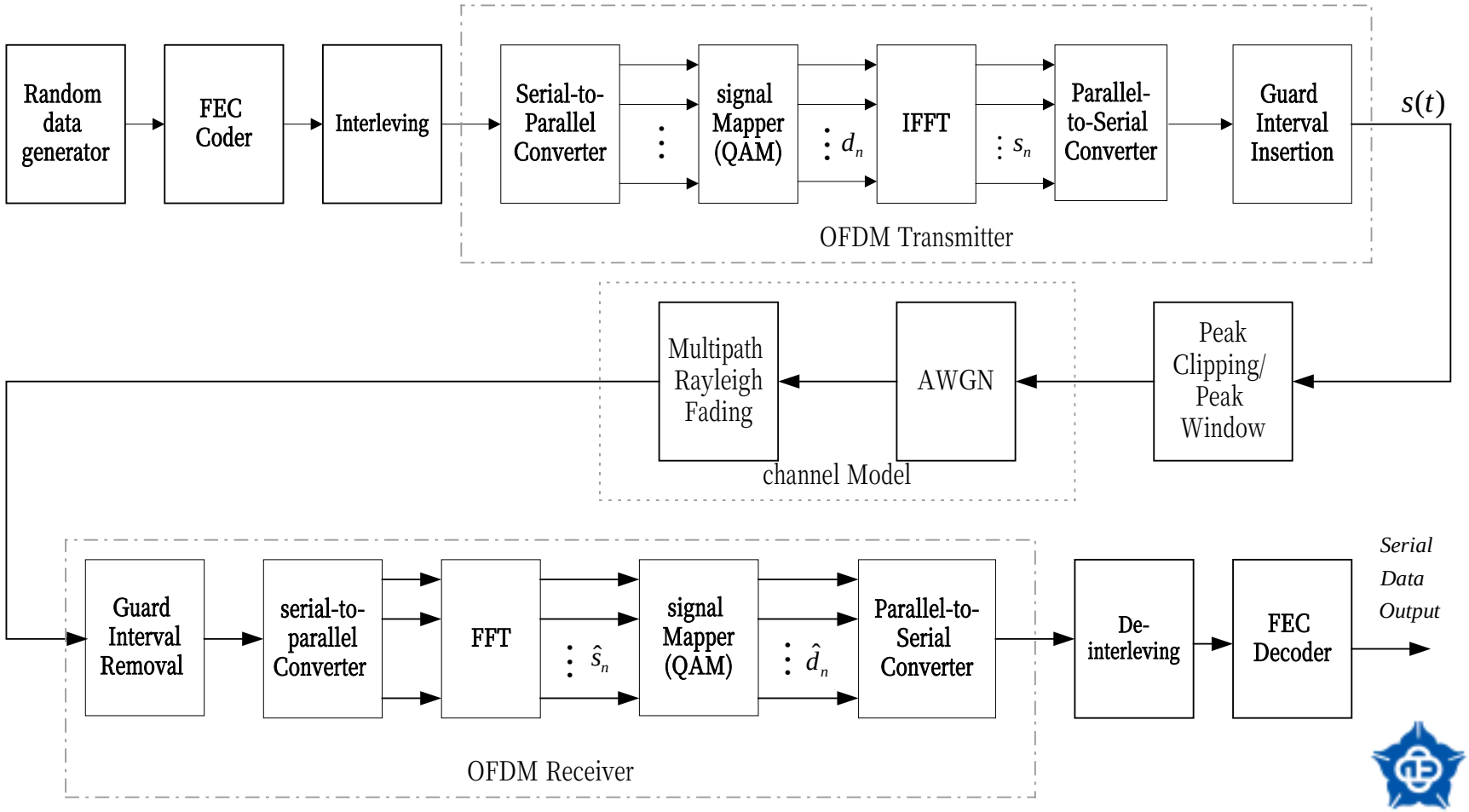
Lab 9 The Implementation of Synchronization – using FPGA

- 利用FPGA實現接收端同步方法之電路設計，包括使用pilot tone或training symbol達到同步之方法等。



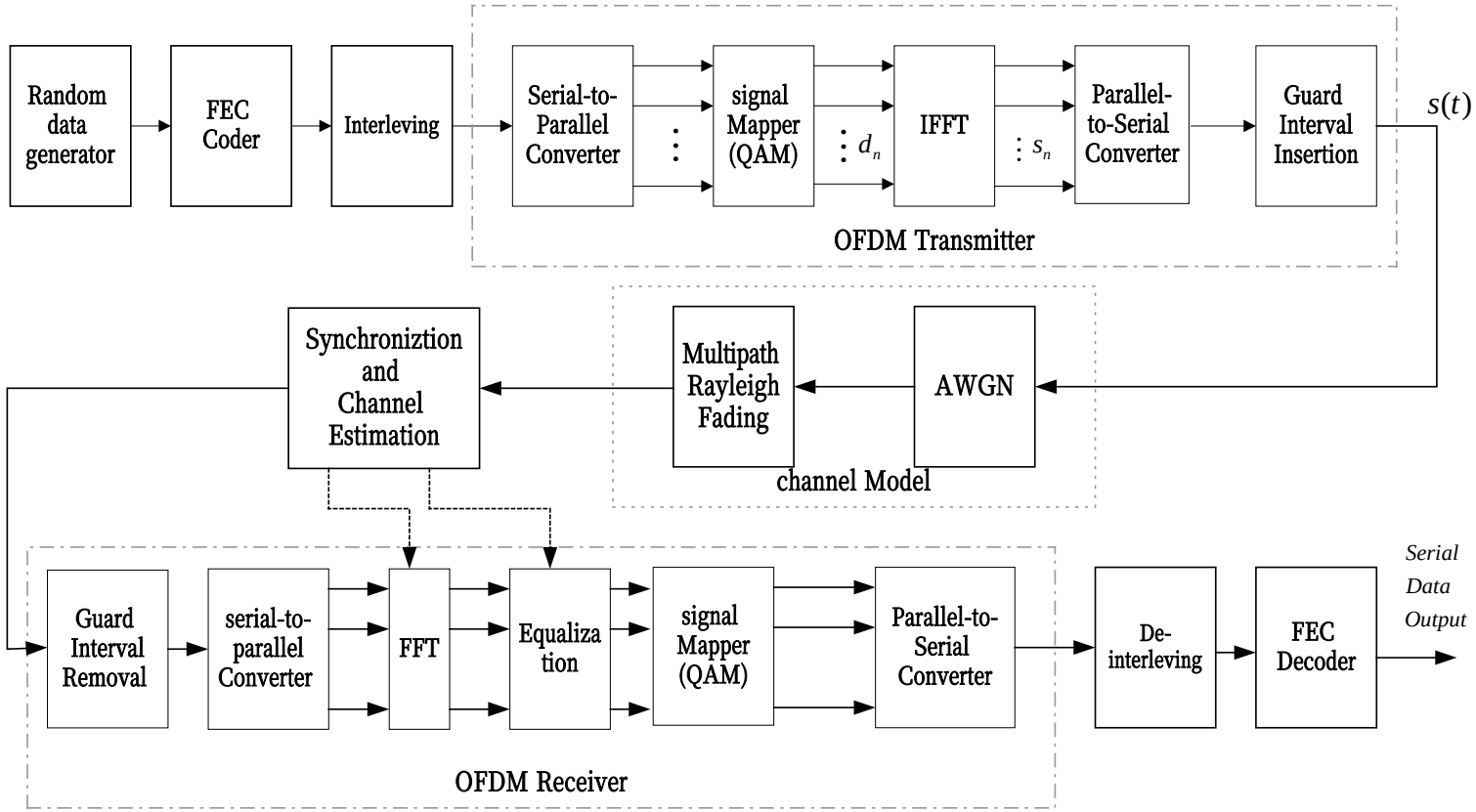
Lab 10 The Implementation of Clipping and Peak Window – using FPGA or DSP

- 利用FPGA 或DSP實現降低PAPR方法之中的Clipping 及 peak window方法。



Lab 11 The Implementation of Equalization – using DSP or FPGA

- 利用FPGA 或DSP實現接收端之等化器電路設計，克服通道效應之影響。
- **Frequency Domain Equalization**



Lab 12 The MC-CDMA System Simulation – using MATLAB or C Language

- 利用程式語言撰寫Multi-carrier CDMA，並進行模擬與分析，進行系統性能之評估。