EE – 442 OFDM Project

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OUTLINE

Structure of OFDM

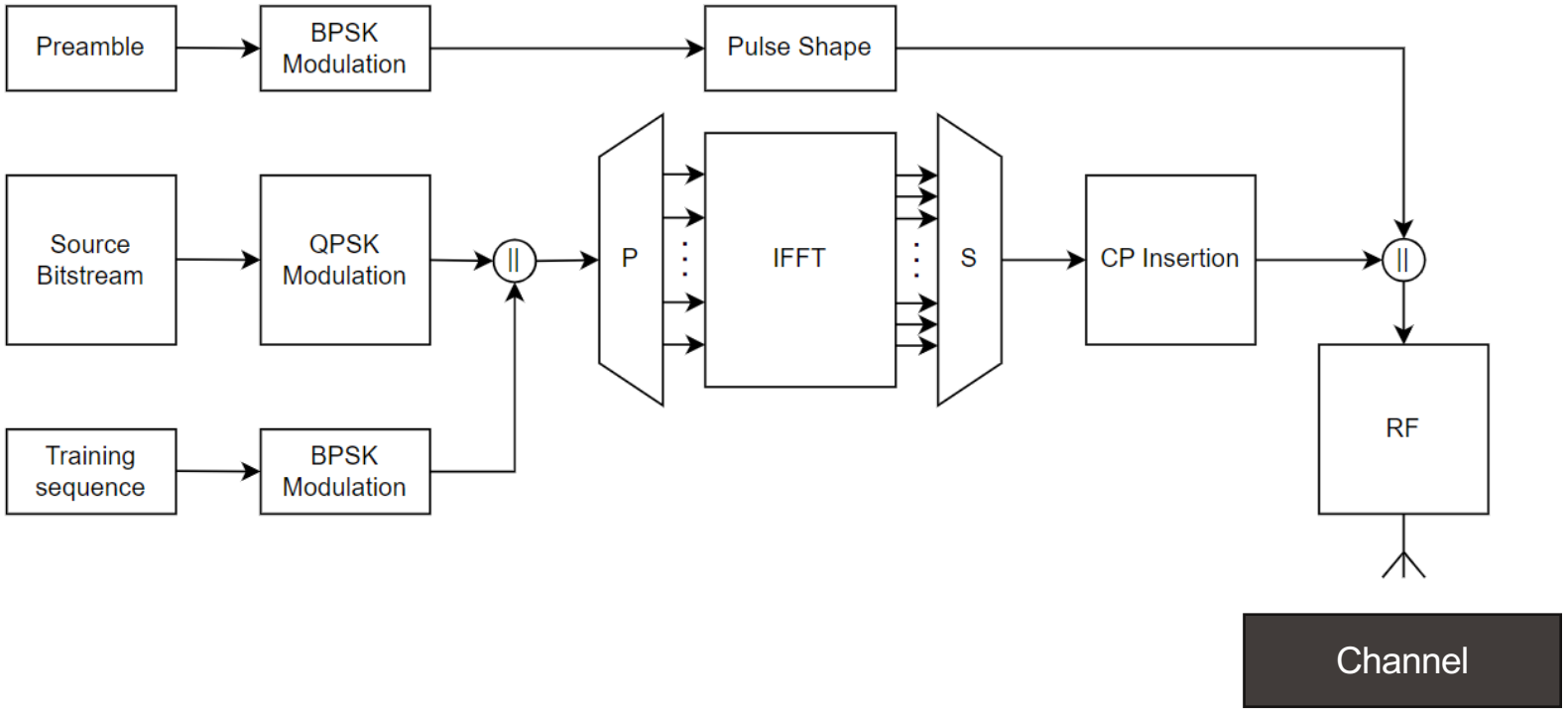
Results

Channel estimation

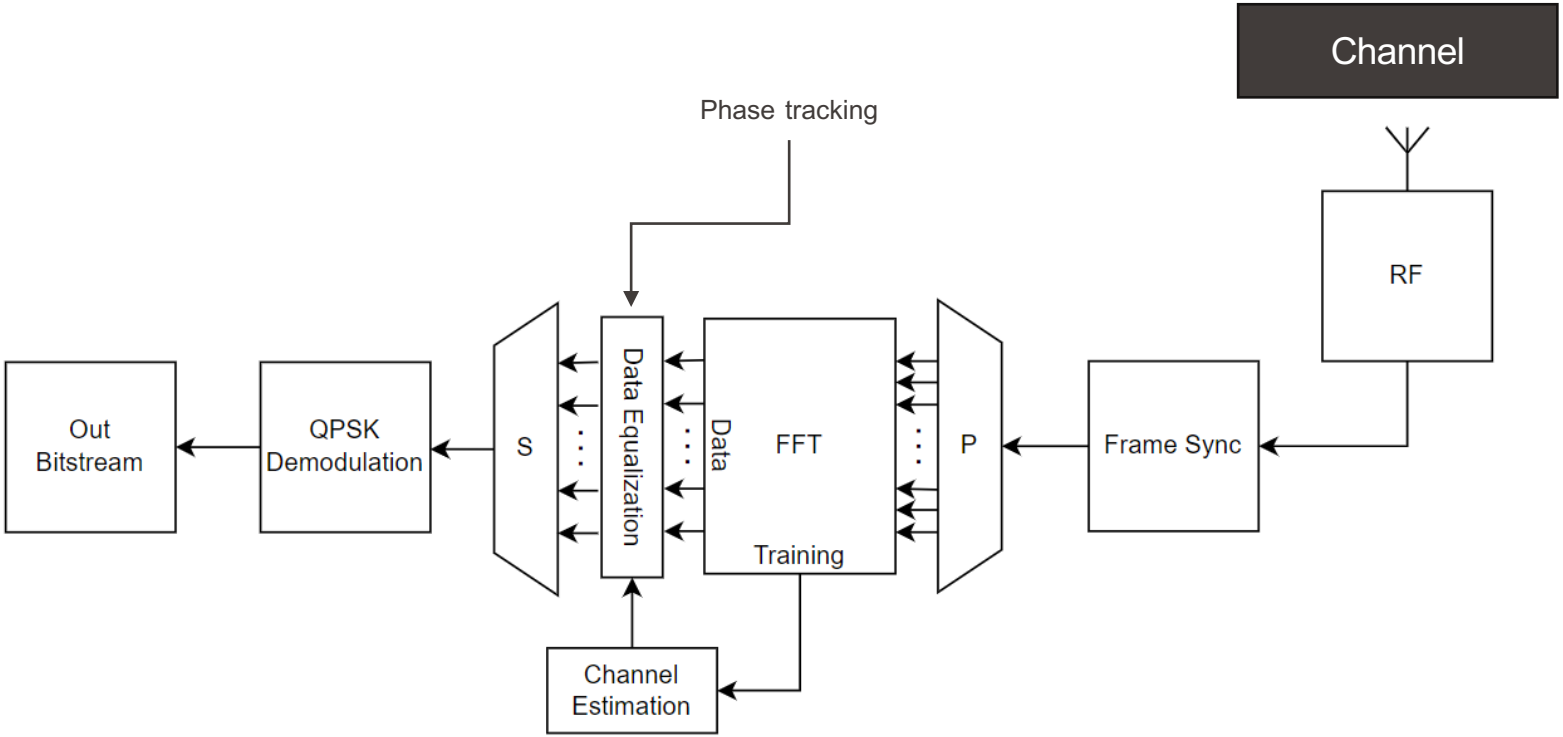
Channel modelization

Limits of OFDM and solutions

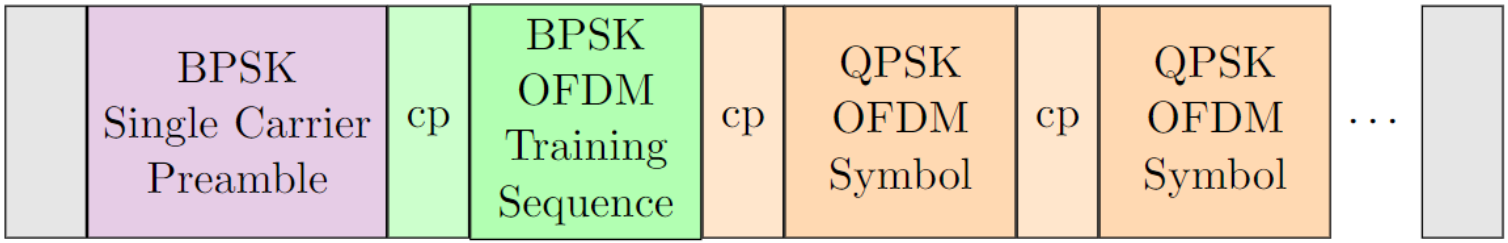
Transmitter Structure



Receiver Structure



Data Structure



Data sending - Testing

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- Random bitstream of size (symbols per frame * bits per ofdm symbol, number of frame)

$$\text{Bitstream} = \underbrace{\begin{bmatrix} 1 & 0 & \dots & 0 \\ 0 & 1 & \dots & 1 \\ \vdots & \vdots & \ddots & \vdots \\ 1 & 1 & \dots & 0 \end{bmatrix}}_{\text{Number of frames}} \Bigg\} \text{(Bits per OFDM symbols} \times \text{OFDM symbols per frame)}$$

Data sending - visualization

- Lena Image and EPFL logo image (PAPR)
- Conversion from 256x256 uint8 to a bitstream of 524288 bits.

[1,0,0,…0,1,1,1]

- Reshaped into a matrix:

$$\begin{bmatrix} 1 & \dots & 1 \\ 0 & \dots & 0 \\ \dots & \dots & \dots \\ 0 & \dots & 1 \end{bmatrix}$$

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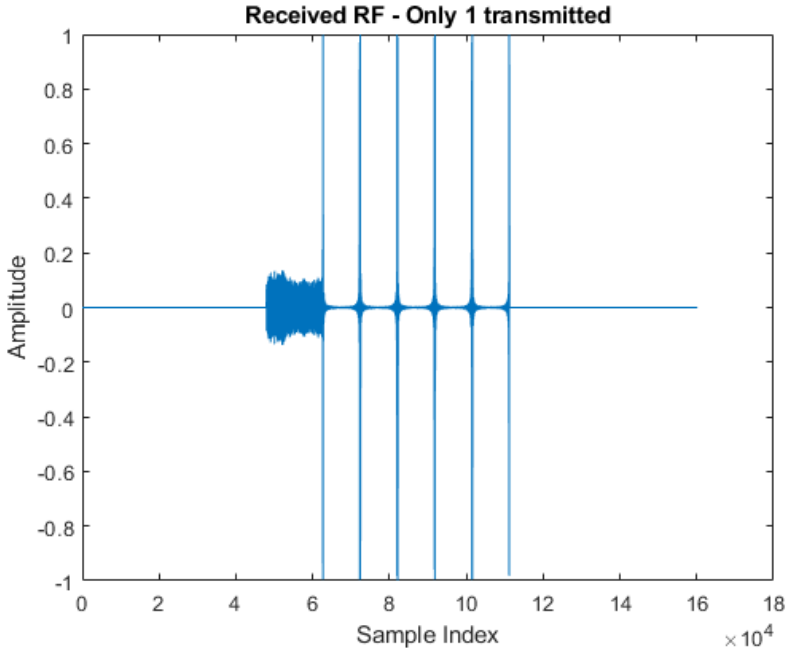
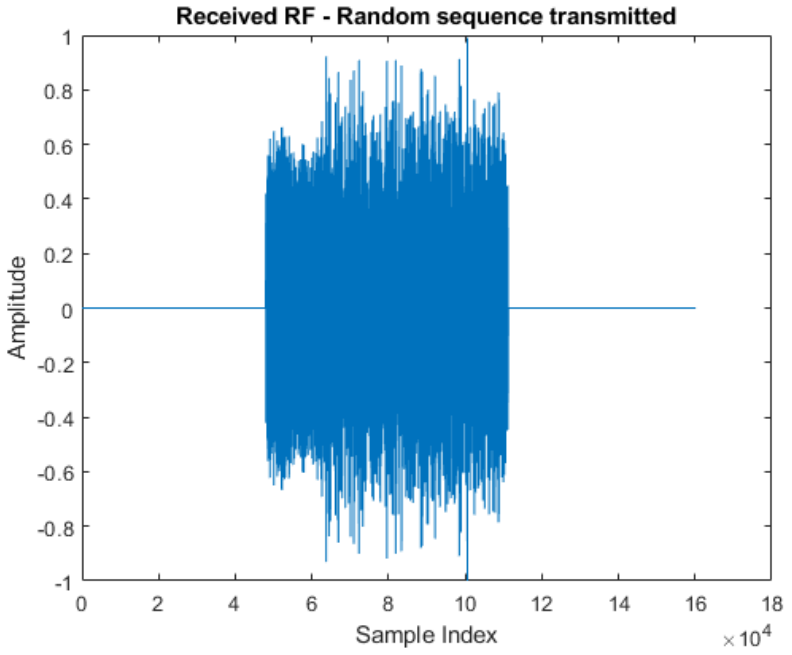
One's vs Pseudo-random





Results

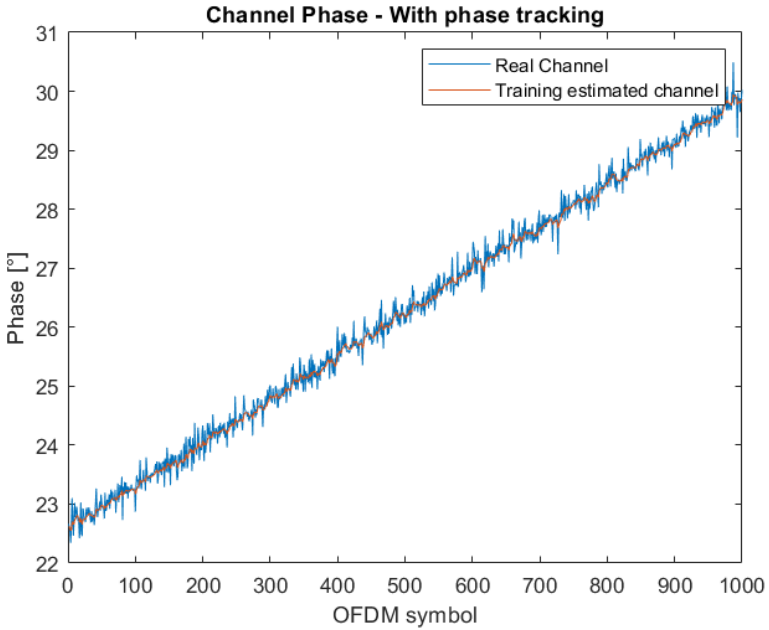
Symbols per Frame

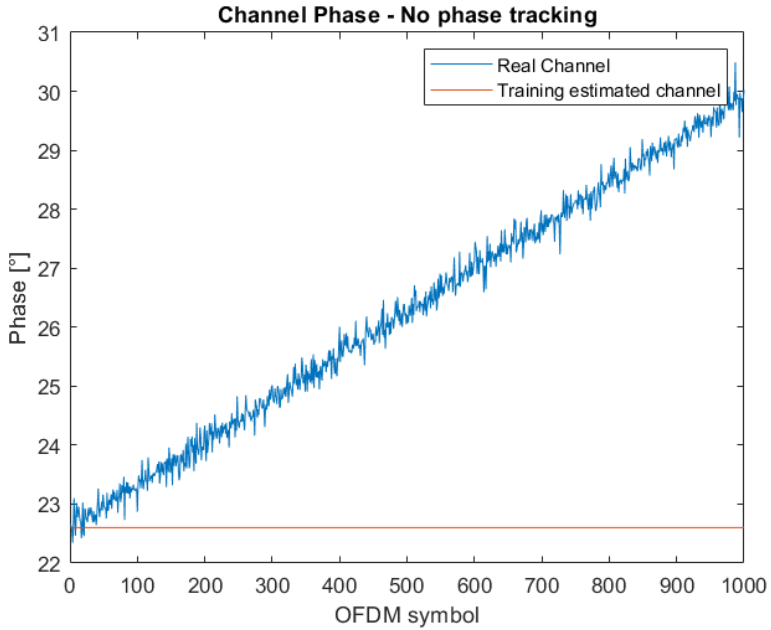
64 frames (16 symbols per frame)

1 frame (1024 symbols per frame)

Results

Effect of phase tracking





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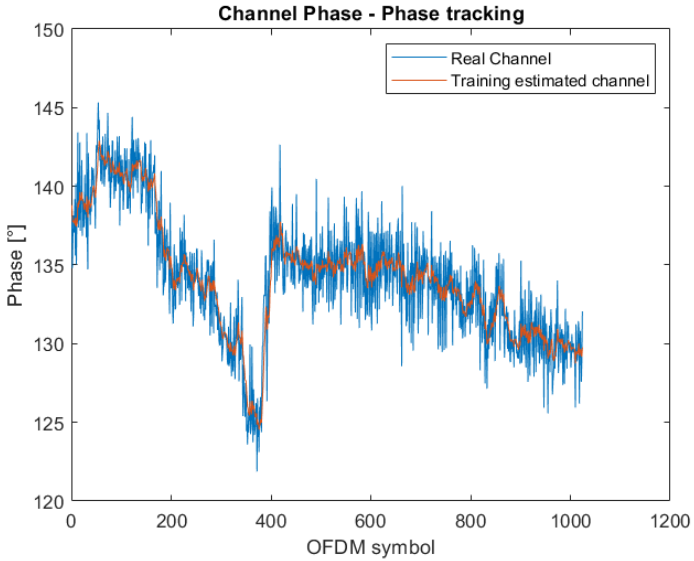
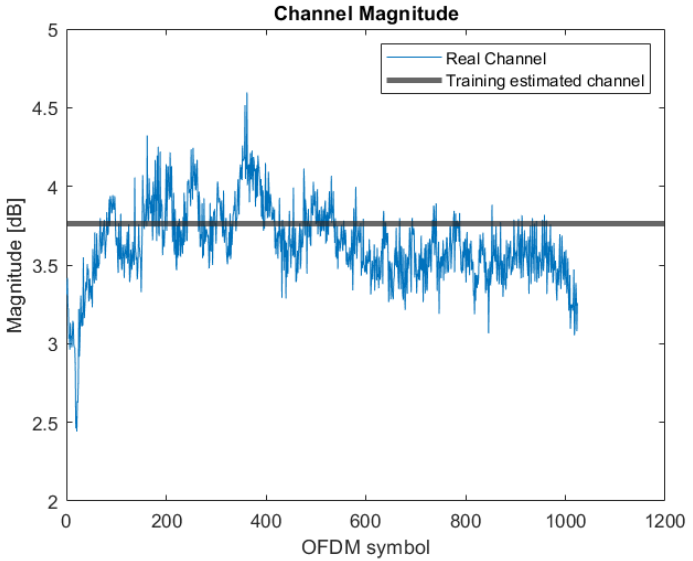
Channel estimation – Phase and Magnitude

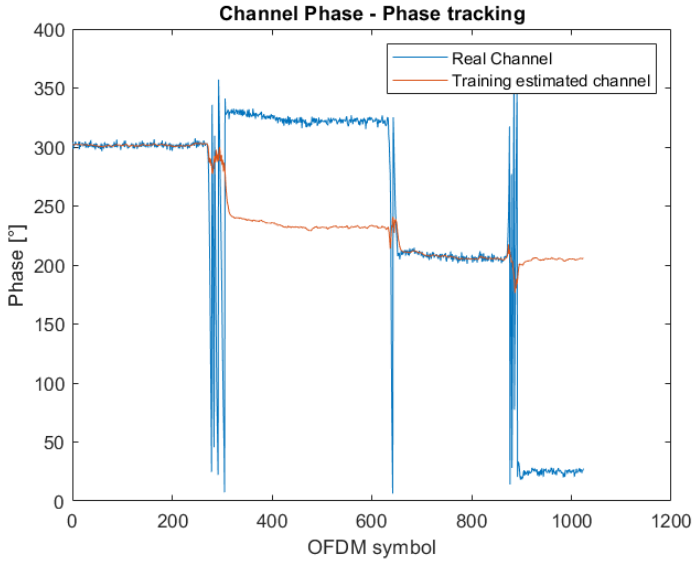
Ideal case

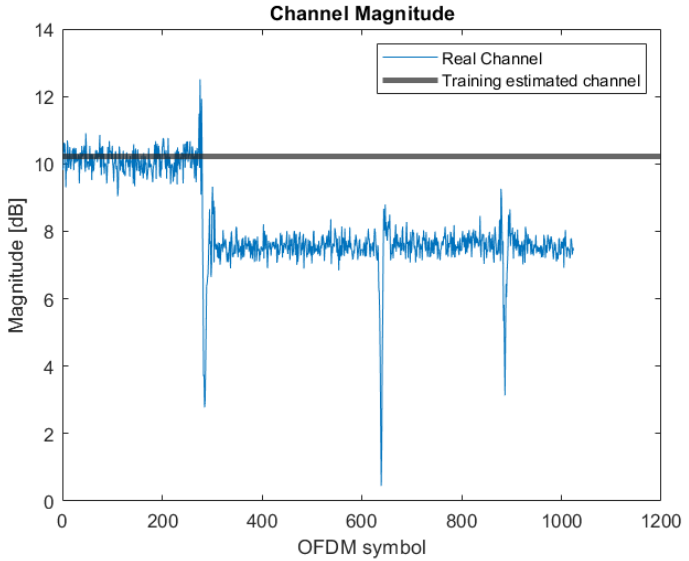




Channel estimation – Phase and Magnitude

Non-Ideal case





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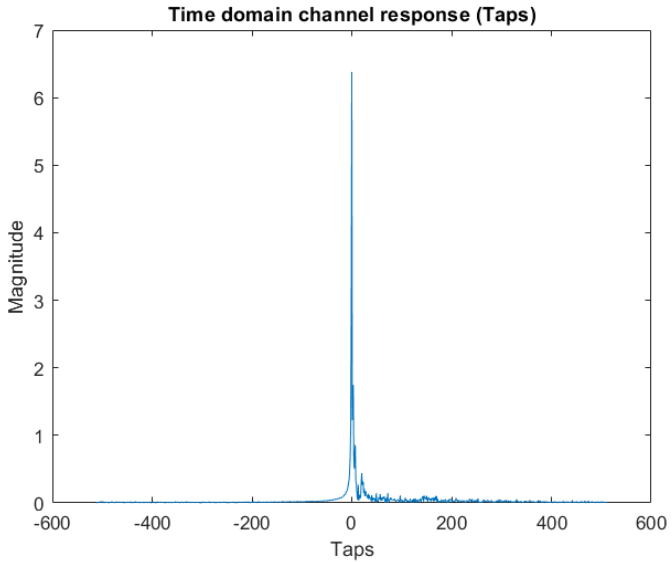
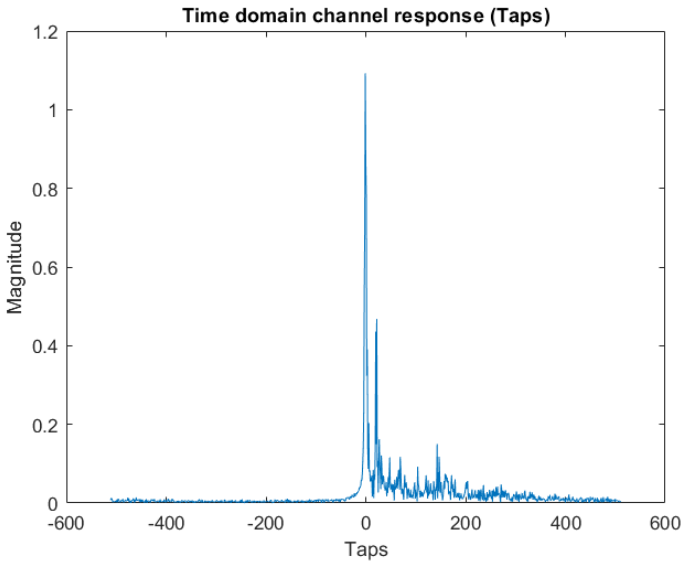
Channel estimation

Delay Spread, Efficiency and Cyclic Prefix





$$\epsilon = \frac{1024}{1024 + 20} = 98.1\%$$

Maximal efficiency

$$\epsilon = \frac{1024}{1024 + 150} = 87.2\%$$

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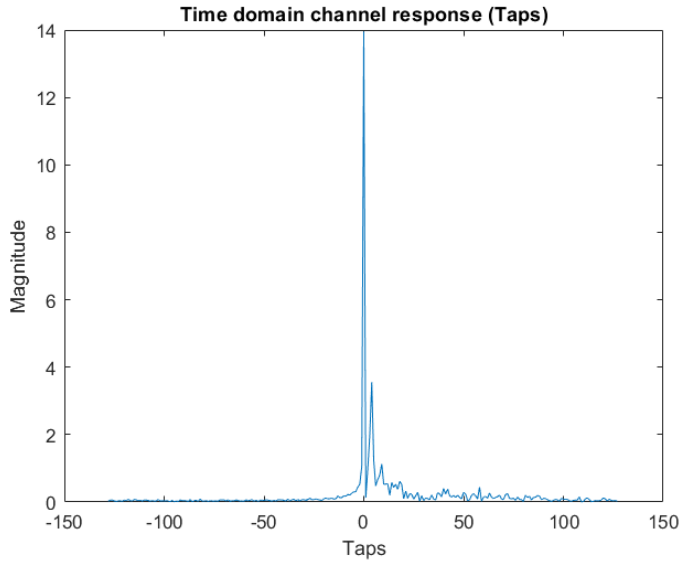
Channel modelisation

Starting point – sample the channel



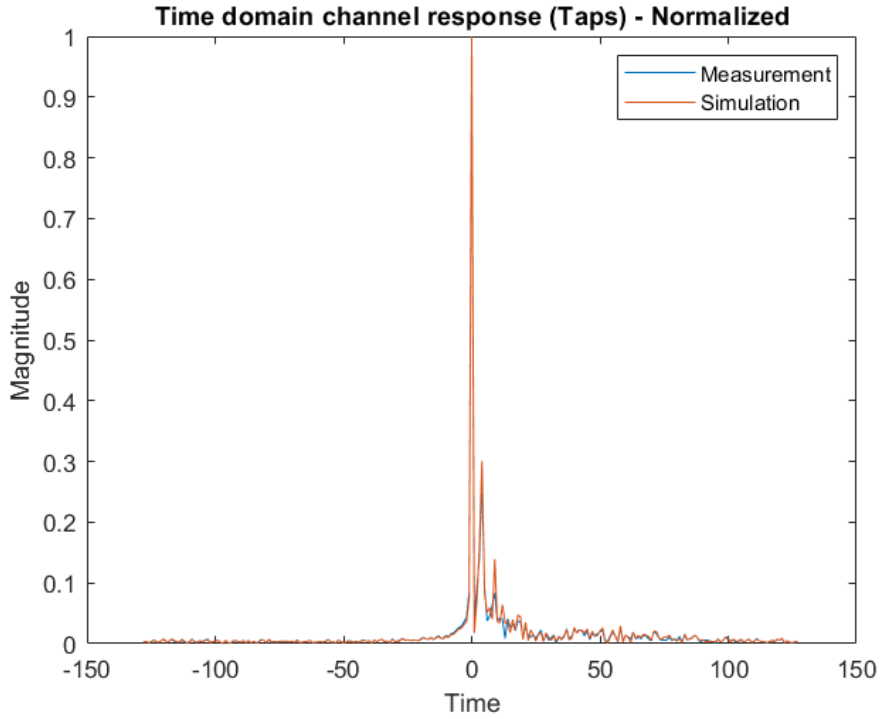
- Bedroom time domain channel response
- Maximal efficiency

$$\epsilon = \frac{256}{256 + 20} = 92.8\%$$

- 3 main peaks @ taps 0, 4, 9
- Create the model of the channel

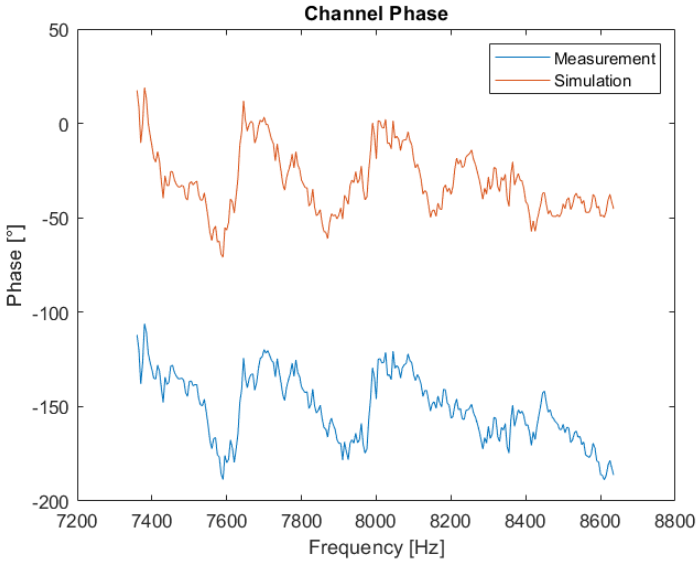
Channel modelisation

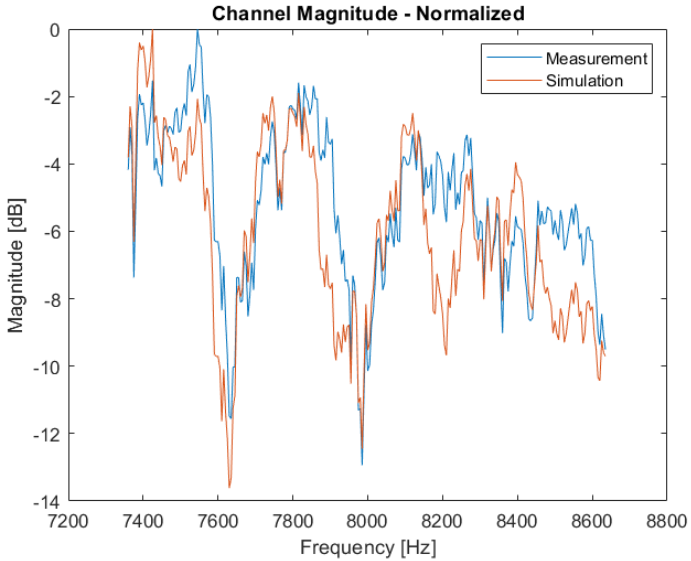
Time domain channel taps



Channel modelisation

Phase and magnitude





How to be more general?

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Limits and solutions

- Limits of the implementation
  - Fast channel variation
  - Single modulation (QPSK)
  - Fixed training structure
  - Multipath → high BER
  - No feedback from the receiver

- Proposed solutions
  - Increase the number of training sequence
  - Implement comb training
  - Change modulation scheme
  - Implement feedback from RX
  - Error correction techniques

Thank you

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