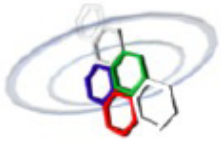
ULB

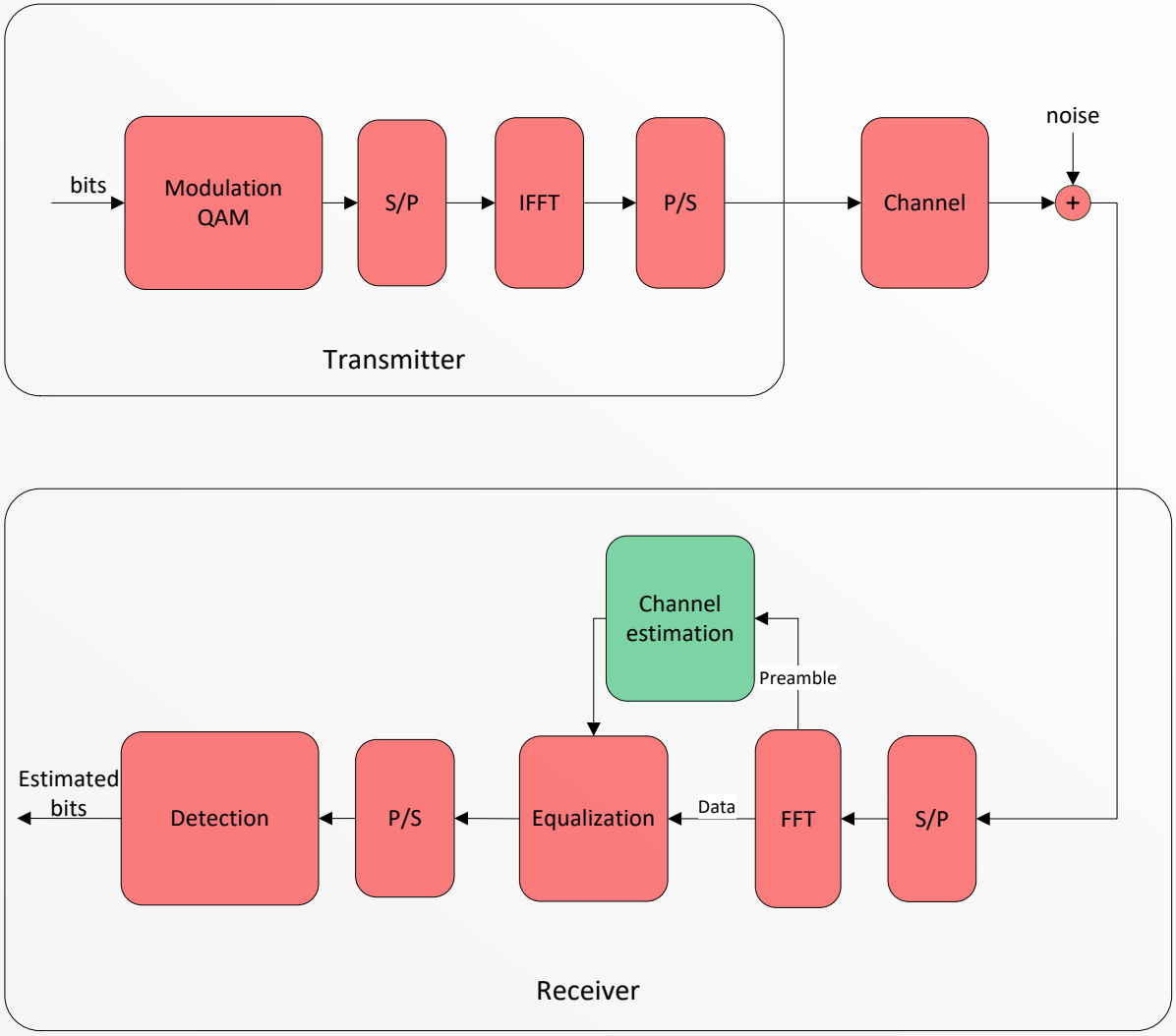


WIRELESS COMMUNICATIONS
RESEARCH GROUP

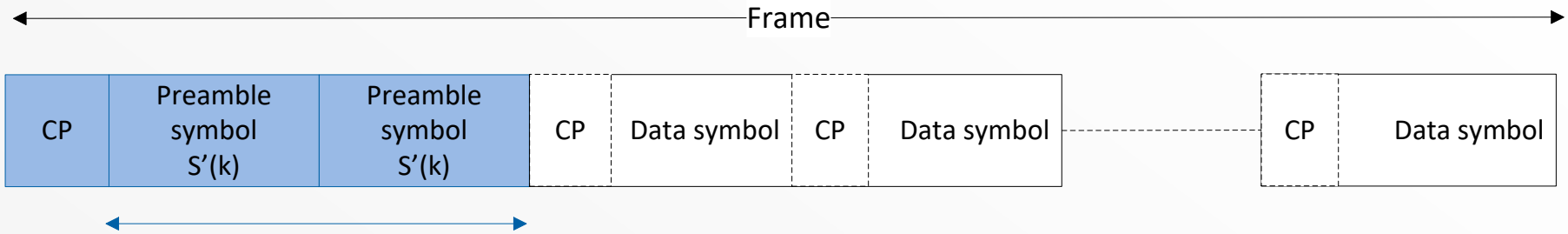
OPERA.ULB.AC.BE

Conception of a complete OFDM communication channel

Objective


bits
Modulation QAM
S/P
IFFT
P/S
Channel
noise
+
Transmitter
Channel estimation
Preamble
Estimated bits
Detection
P/S
Equalization
Data
FFT
S/P
Receiver

New frame



Known symbols used for the channel estimation

Channel estimation

- Spectrum of a preamble symbol: $S'(k)$
- Spectrum of the received preamble symbol: $R'(k)$

$$R'(k) = H(k)S'(k) + W(k)$$

- Estimation of the channel:

$$\widehat{H}(k) = \frac{R'(k)}{S'(k)} = H(k) + \frac{W(k)}{S'(k)}$$

Preamble

- Each subcarrier of S'(k) should have the same amplitude
- Random sequence of -A and +A
- Choose A to achieve the same power as the data symbols

Objective

- Form the preamble and implement the channel estimation
- Assess the accuracy achieved on the channel estimate
  - NMSE as a function of SNR

$$NMSE = \frac{\sum_k |\hat{H}(k) - H(k)|^2}{\sum_k |H(k)|^2}$$

- Assess the BER performance degradation due to channel estimation errors
- **Bonus** : Estimate the channel transfer function from an estimation of the channel impulse response. Compare the performance to the frequency domain estimation. Explain the difference.

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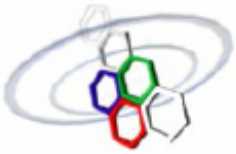
Time domain estimation



- Similar to the burst model:

$$\underline{r} = \underline{\underline{h}}\,\underline{s} + \underline{w}$$

- Convolution product described as a matrix product:

$$\underline{r} = \underline{\underline{s}}\,\underline{h} + \underline{w}$$

- Estimation with a pseudo-inverse:

$$\underline{\hat{h}} = \underline{r} \backslash \underline{\underline{s}}$$

- $\underline{\underline{s}}$ and $\underline{r}$ are limited to the preamble