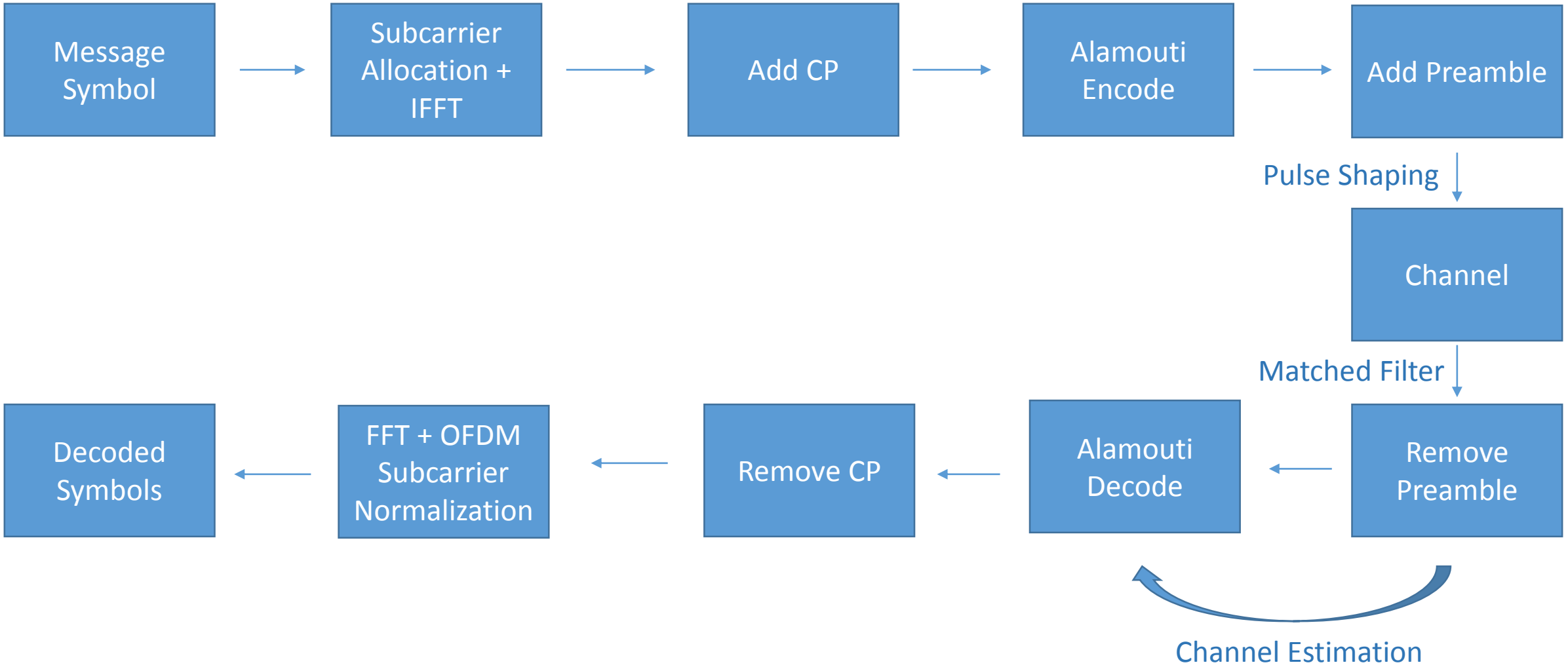
MIMO-OFDM

第六組　王君璇
朱文瑄

Block diagram

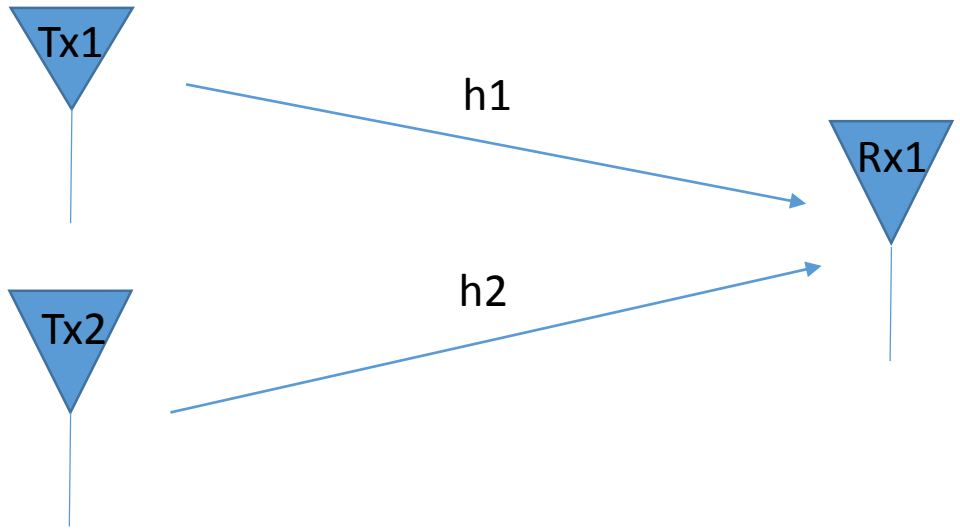


Subcarrier Allocation

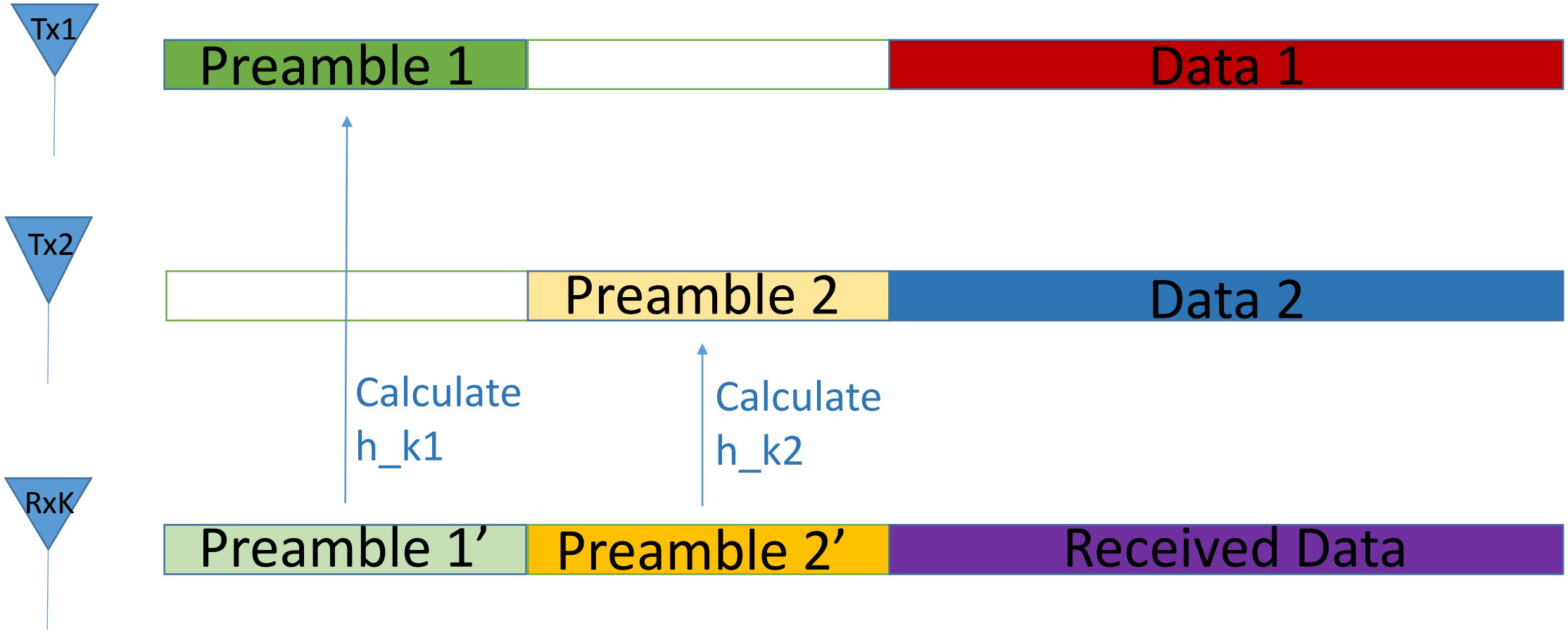
- We set the null subcarrier at 0 and add pilot subcarriers to both sides every 5 subcarriers
- We assume that this is a slow fading channel, so we use interpolation to calculate the frequency specific channel coefficients from the pilot subcarriers
- System parameters: FFT size = 256, message subcarriers = 128

Space-time diversity (2x1 Alamouti)

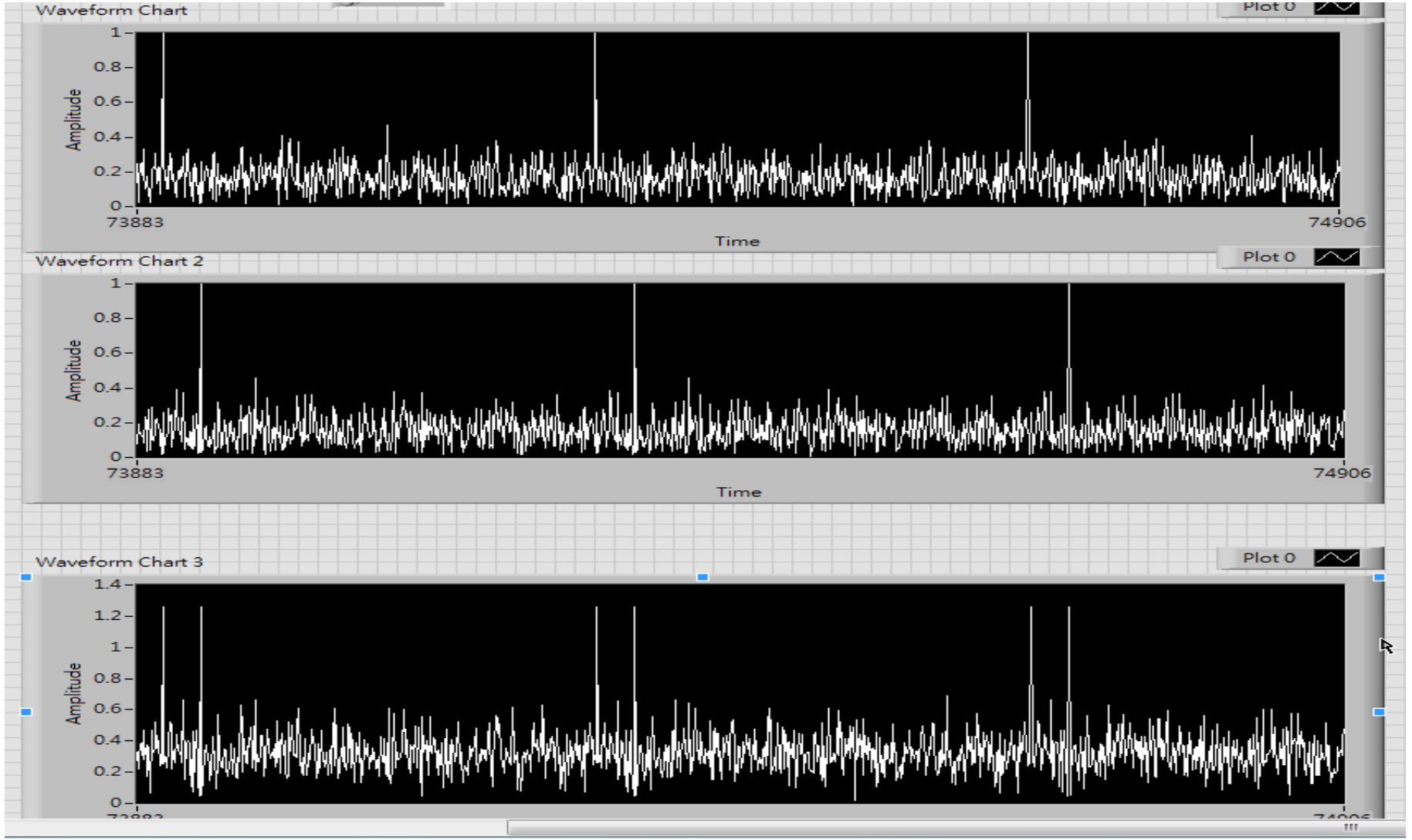
- $\begin{bmatrix} y_1 \\ {y_2}^* \end{bmatrix} = \begin{bmatrix} h_1 & h_2 \\ {h_2}^* & -{h_1}^* \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$
- $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \frac{1}{|h_1|^2+|h_2|^2} \begin{bmatrix} {h_1}^* & h_2 \\ {h_2}^* & -h_1 \end{bmatrix} \begin{bmatrix} y_1 \\ {y_2}^* \end{bmatrix}$
- Decode two symbols every two time slots
- Rate = 1
- Can be extended to 2xN case with MRC



Preamble and Channel Estimation



Preamble and Channel Estimation

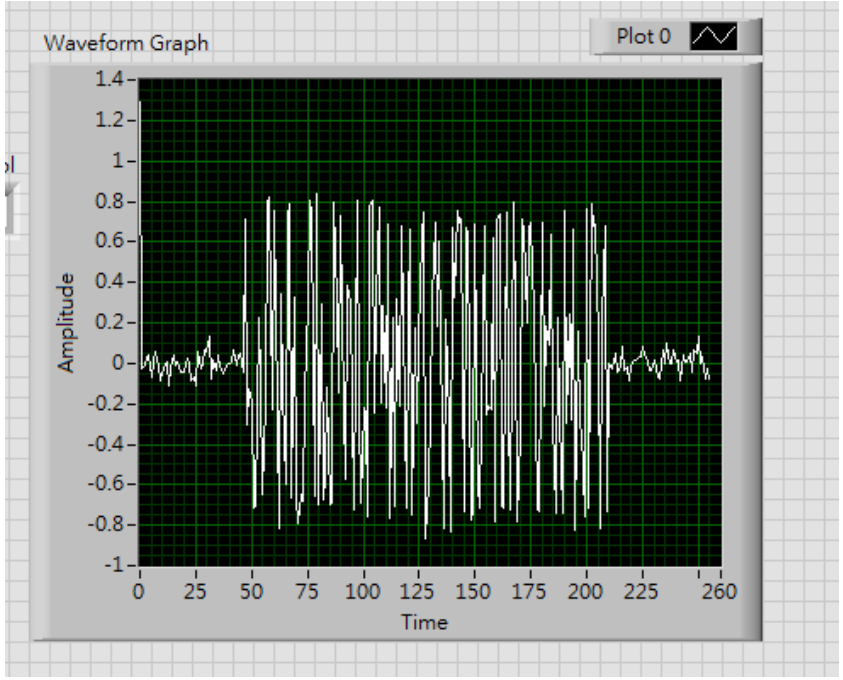


Pulse Shaping Filter

- Implemented using LabVIEW's MT Pulse Shaping Filter and MT Match Filter function
- However, we observed that that the pulse shaping filter drops 4 symbols every OFDM burst
  - To be precise, it drops N/2 symbols where N is the filter length
- Causes the entire OFDM decoding process to fail because FFT can not be performed properly
- Solution: Add extra symbols to the end of every OFDM burst
  - Does not work if you prepend

Results

- Using 16 QAM with a root raised cosine pulse shaping filter we can achieve 0 BER most of the time with both 2x1 and 2x2 schemes
- Compared to lab 4's performance this is a significant increase
- Transmitted at 1.2GHz
  - Initially we tried 2GHz but apparently the USRP can not function at such high frequency ranges



Known Problems and Possible Solutions

- Sometimes the symbol to bits mapper will complain that the “array size in empty”
  - Due to the transmitting rate being slower than the decoding rate
  - Can be solved with a queue

- As mentioned in the previous slide, sometimes we can observe BER spikes (80/512) in the 2x1 scheme
  - Larger BER spikes (100/512) in 2x2 schemes (MRC in time domain)
  - Increasing Tx gain does not seem to fix this

USRP Error Bit Spikes

- 2x2 MRC in time domain case
  - Left: Tx Gain = 0, fluctuations around 0~10 error bits
  - Right Tx Gain = 5, fluctuations around 0~1 error bits

- This issue does not occur in simulations