EE597

Simulation Project 1
Digital Modulation

Submitted by:
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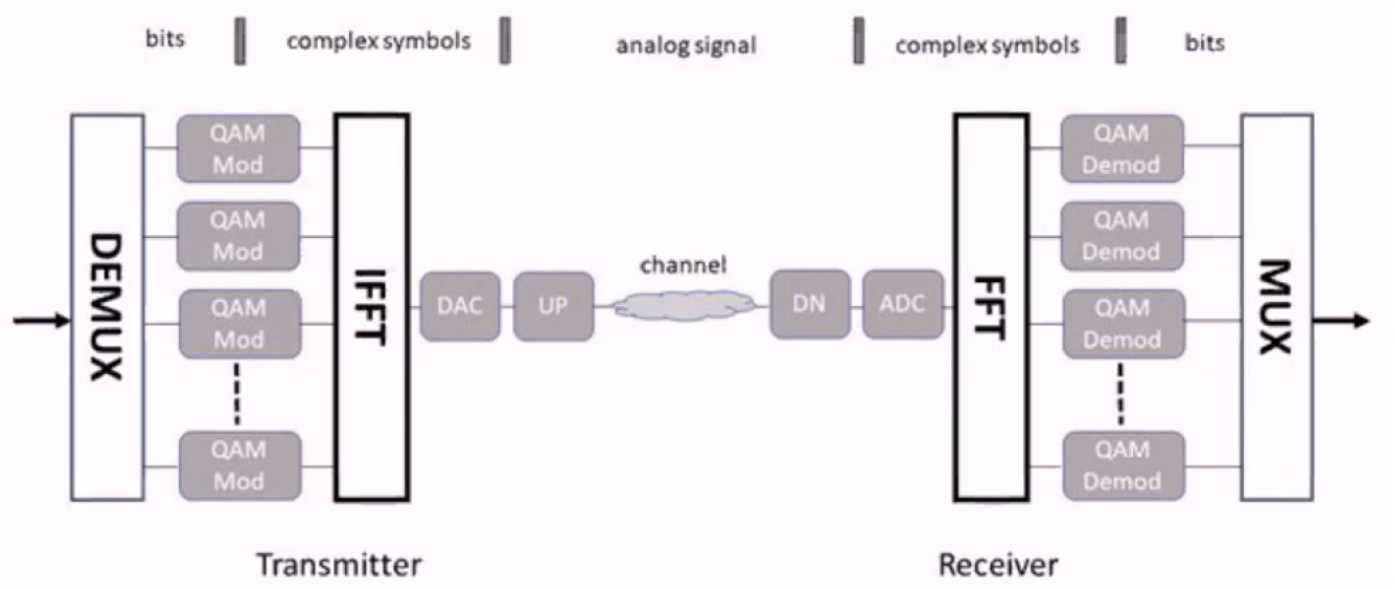
Introduction

In this assignment, we have used MATLAB to simulate a sinusoidal waveform wireless transmission with different modulations in an AWGN channel with various SNR levels. We have implemented an end-to-end wireless transmission system from transmitter to the receiver and evaluated several metrics such as BER, SER, EVM and Packet loss.

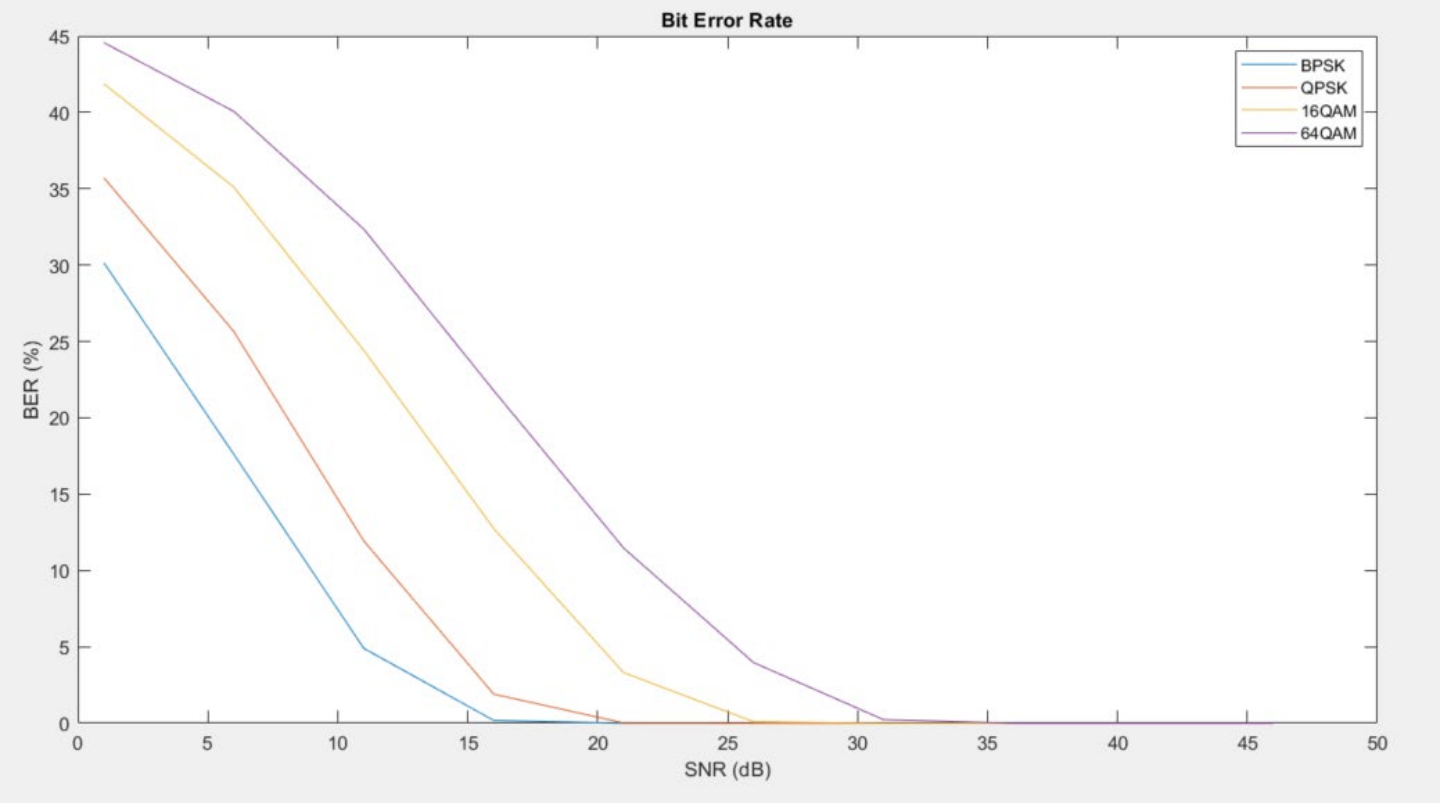


Some important information:

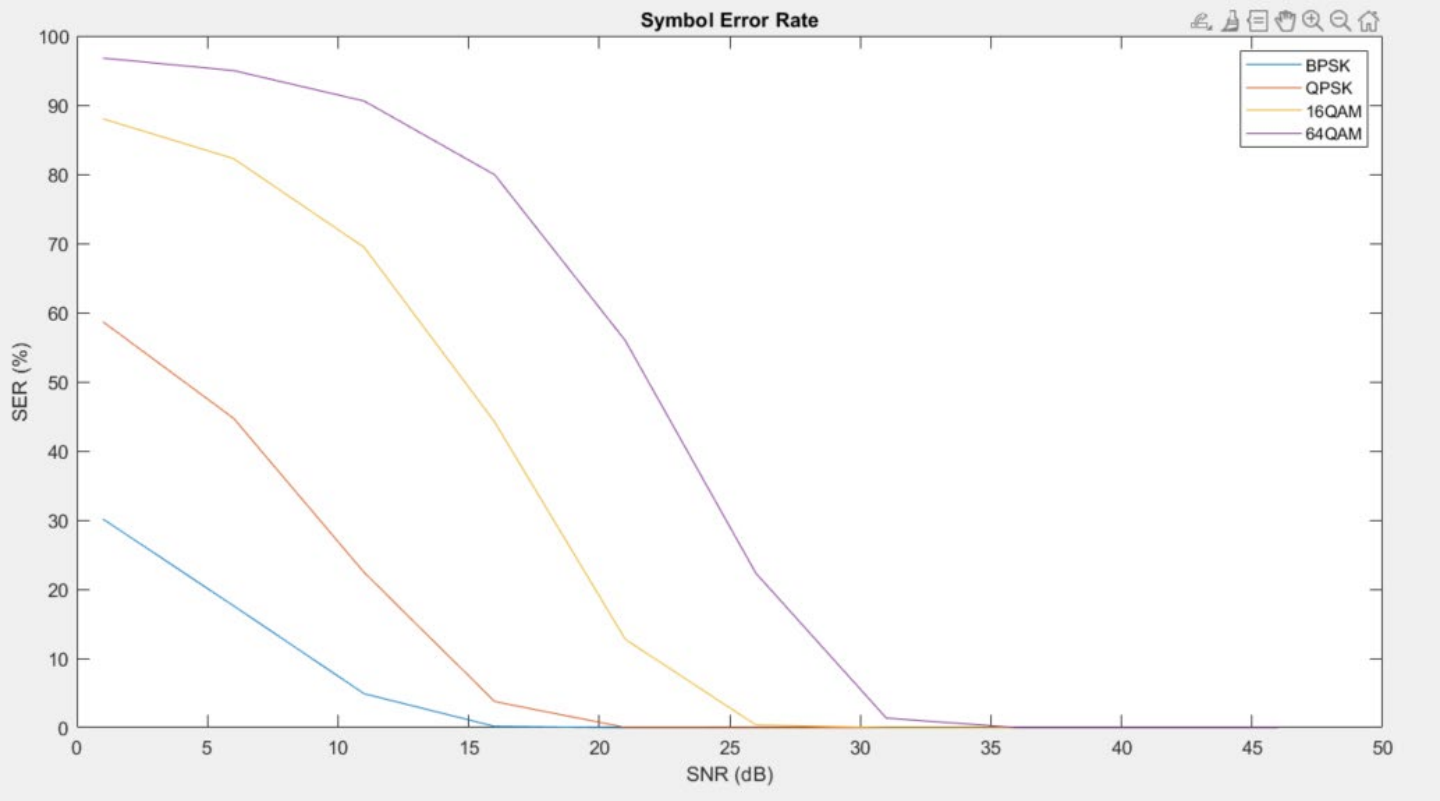
1. We have used awgn() function for the noise component.
2. For higher number of packets, the code execution may take longer than 5 mins in several cases.

Metrics and Plots

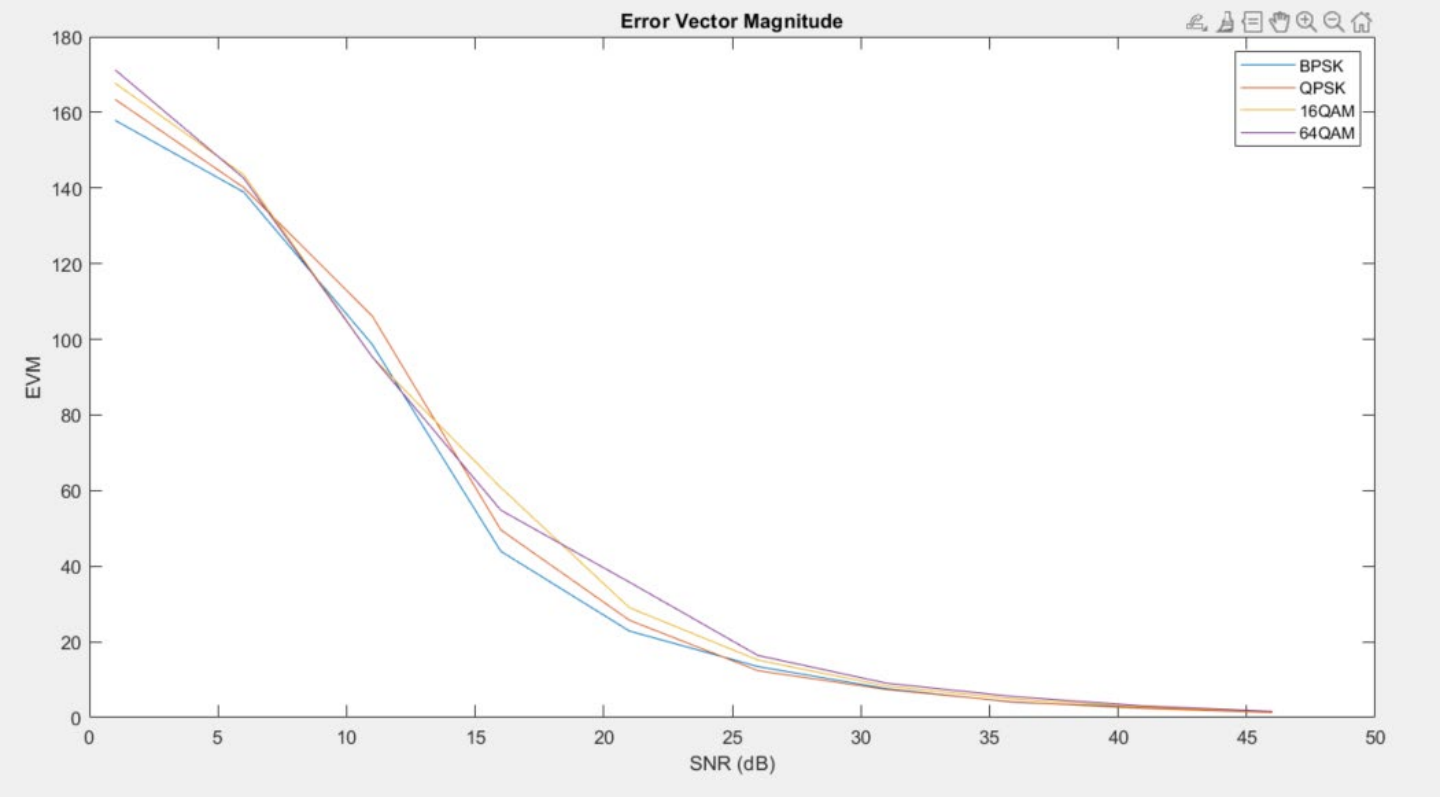
- BER v/s SNR plot for 40 packets:



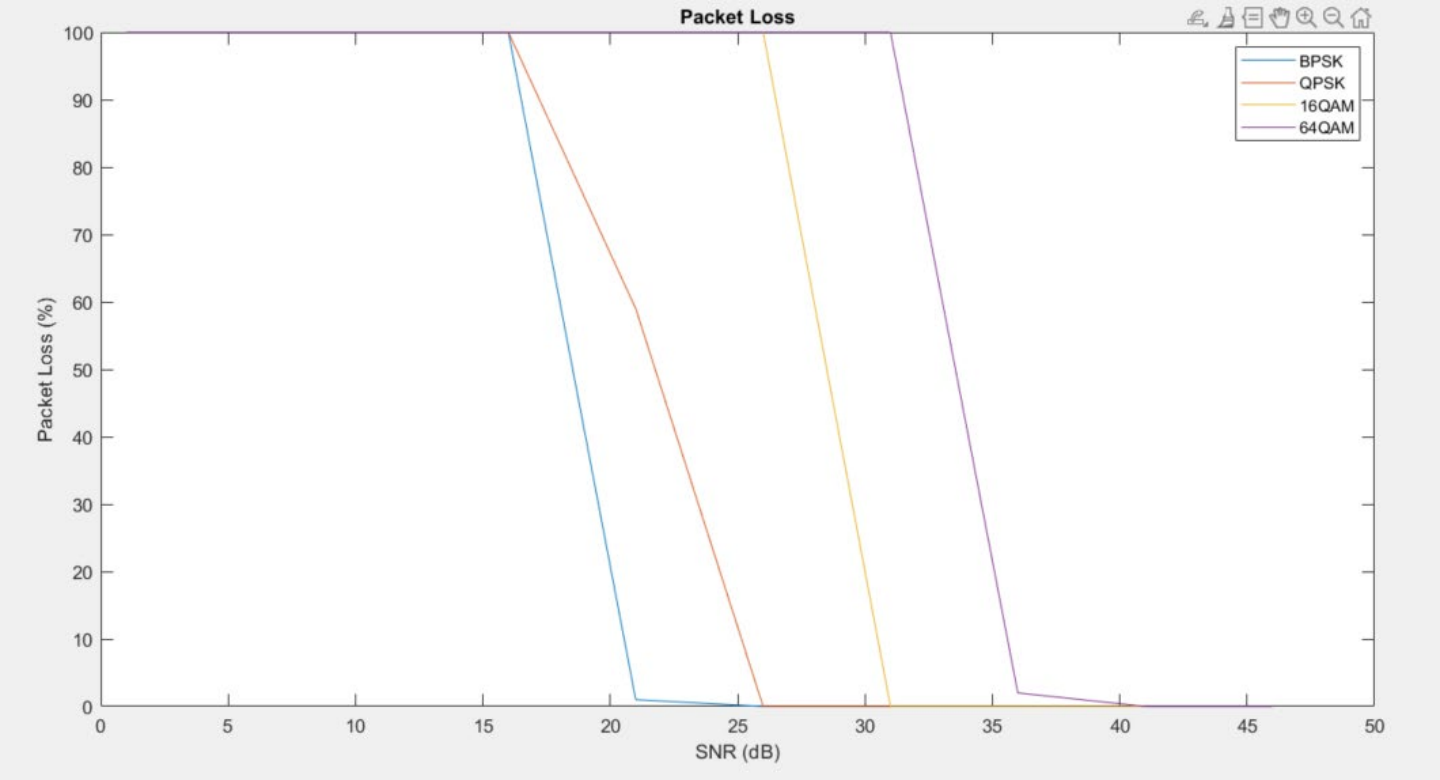
- SER v/s SNR plot for 40 packets:



- EVM v/s SNR plot for 40 packets:



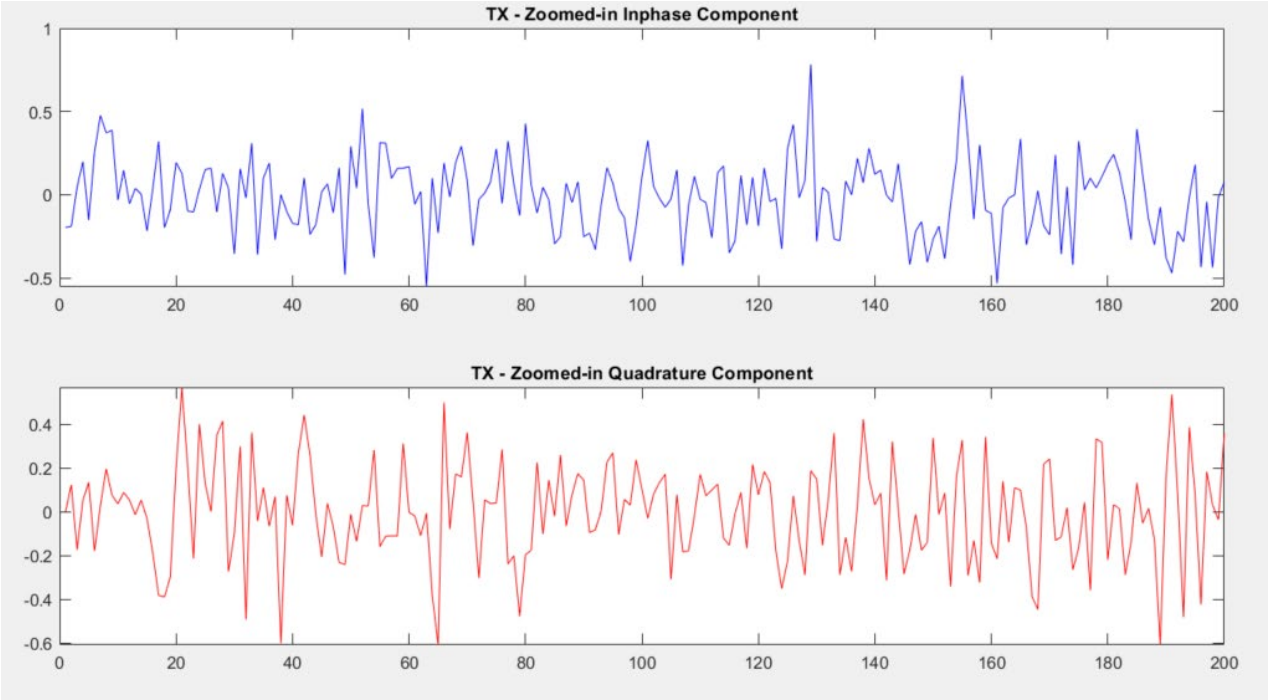
- Packet Loss v/s SNR plot for 40 packets:



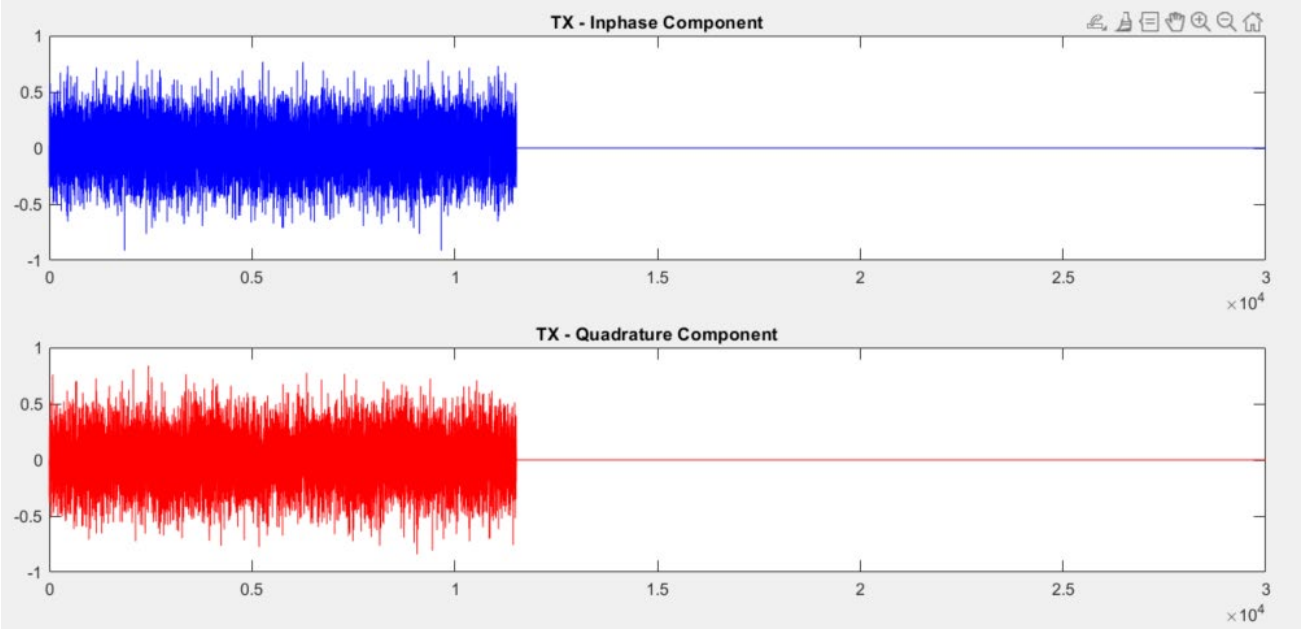
- Following are the threshold snr for different modulation schemes.
    - BPSK_threshold_snr: 20
    - QPSK_threshold_snr: 24
    - 16QAM_threshold_snr: 29
    - 64QAM_threshold_snr: 36

Below are the plots for SNR value smaller than the threshold SNR in each case:

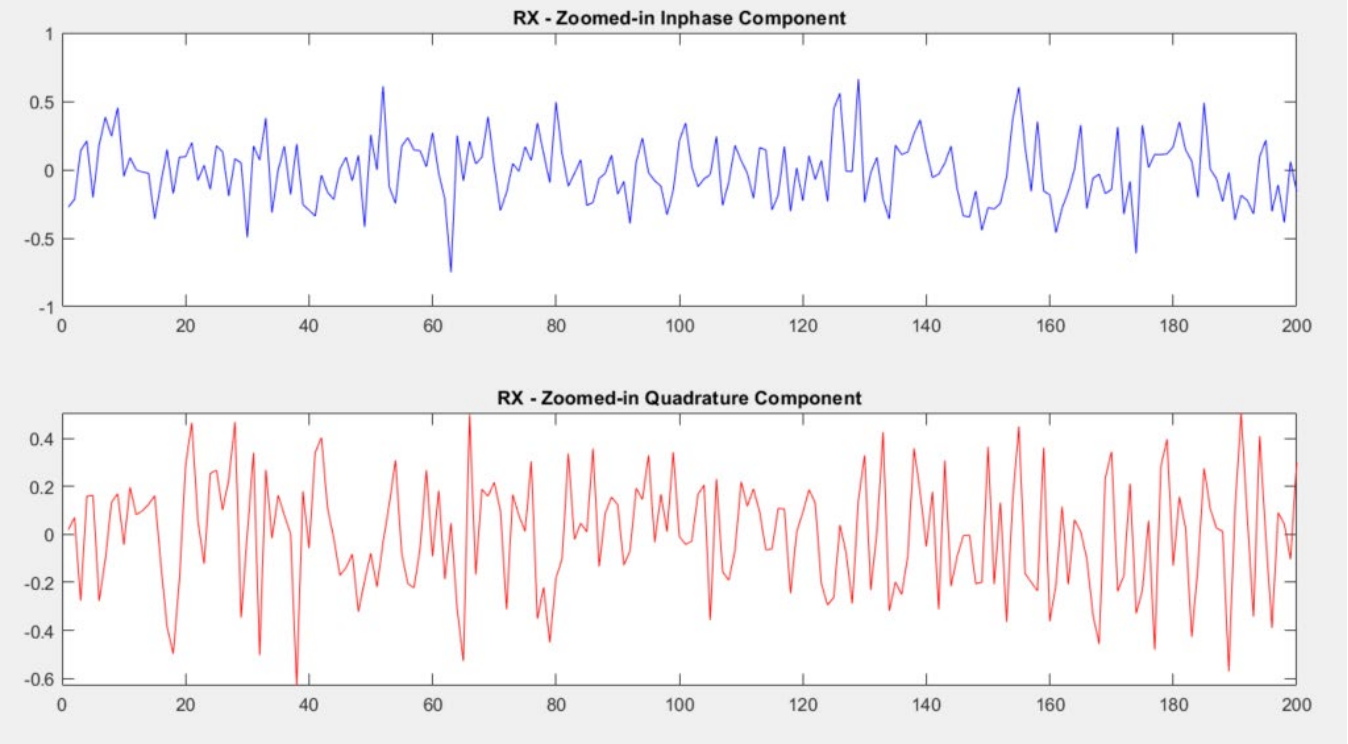
- SNR chosen for **BPSK**: 18
  Command: run('BPSK', 18, 40, 1440)
    - TX_waveform zoom in version:



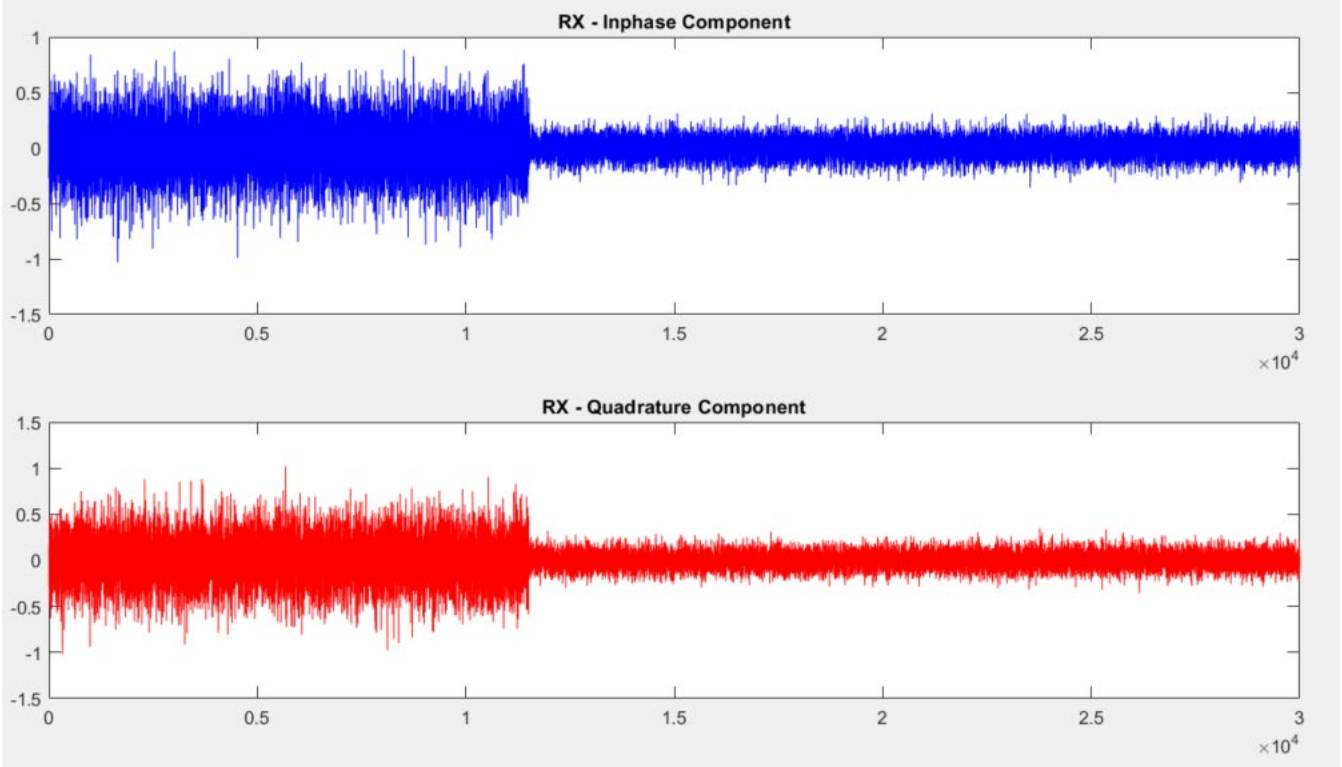
    - TX_waveform zoom out version:



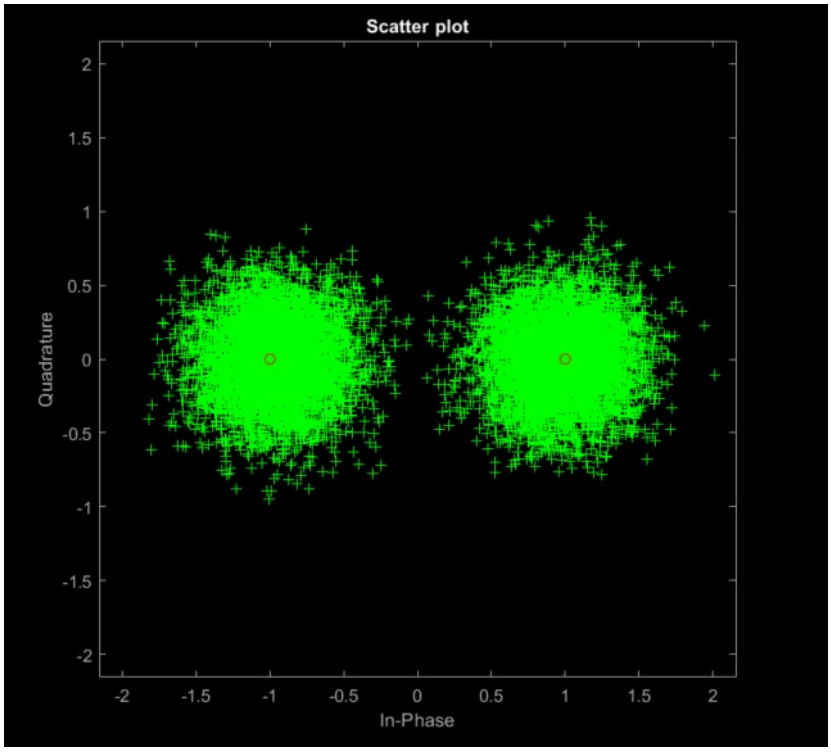
- RX_waveform zoom in version:



- RX_waveform zoom out version:

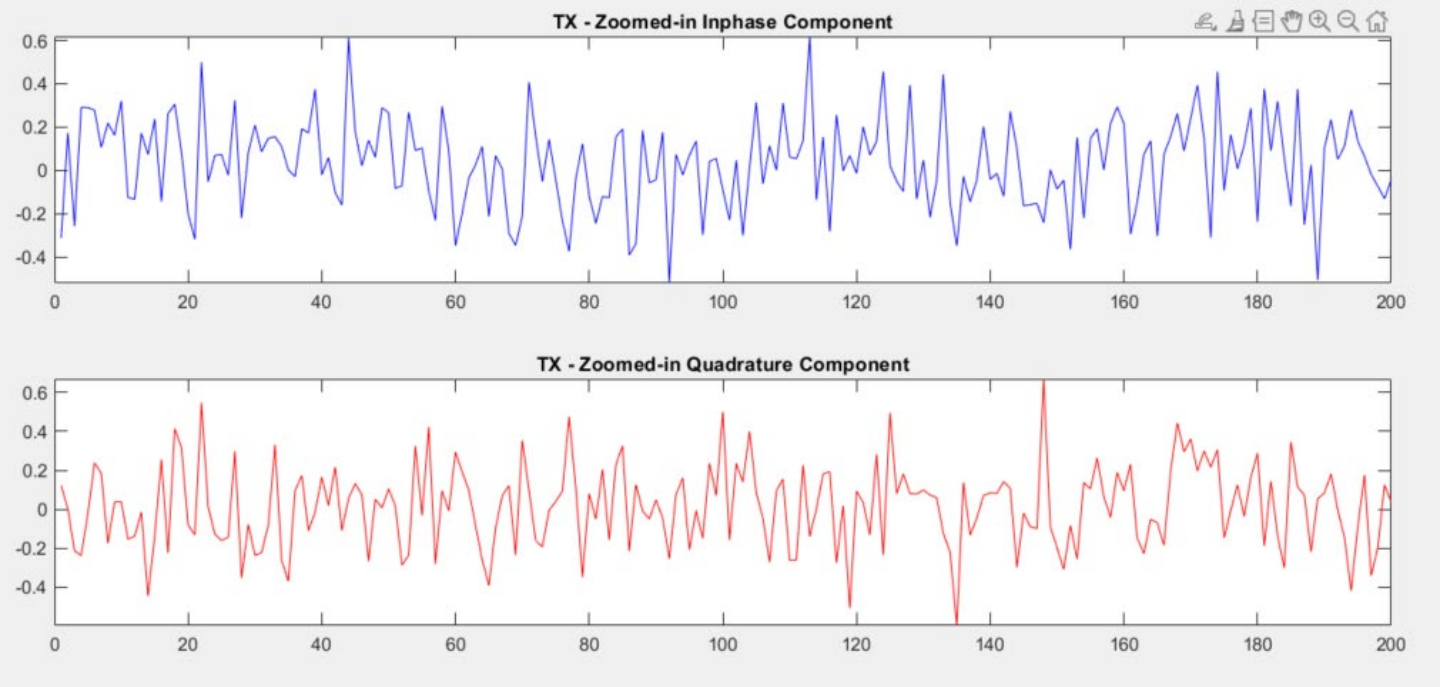


- Constellation plot for TX (in red circle) and RX (in green plus signs):

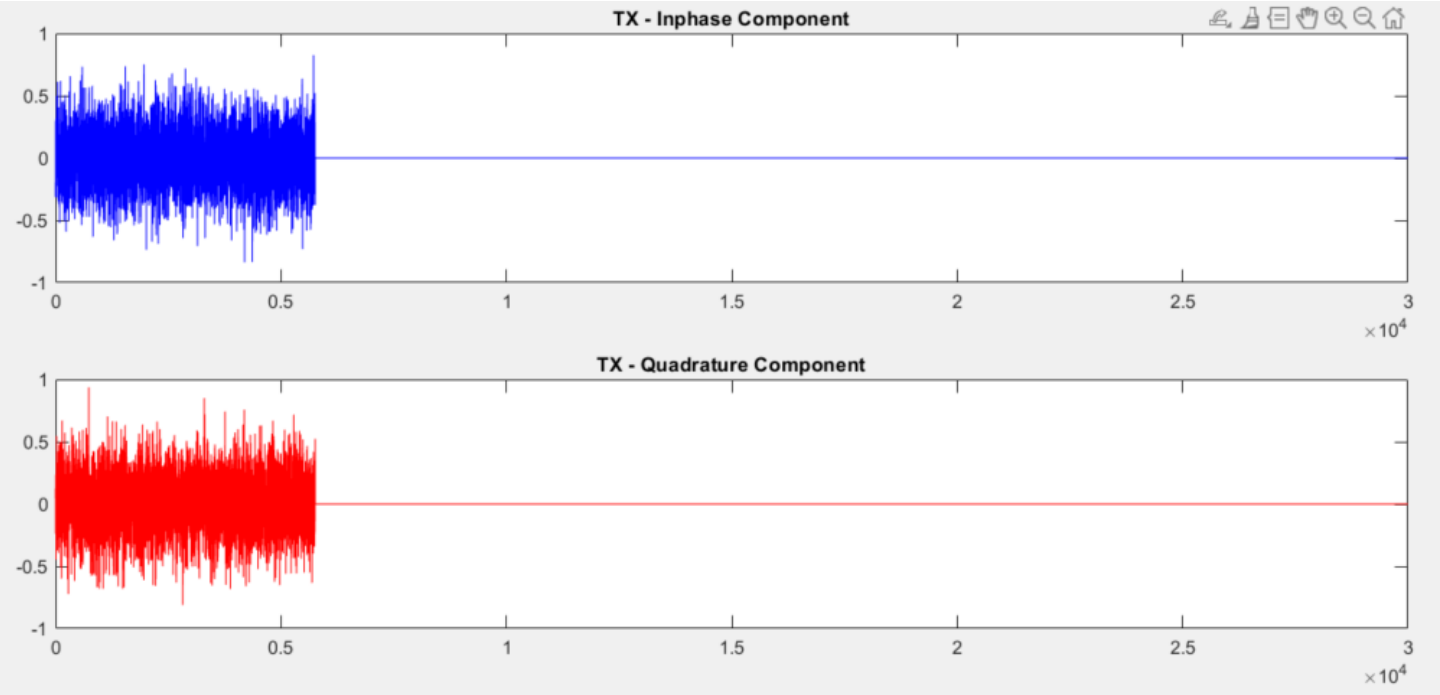


- BER: 0.0184%
- SER: 0.0184%
- EVM: 36.8292
- Packet loss: 75%

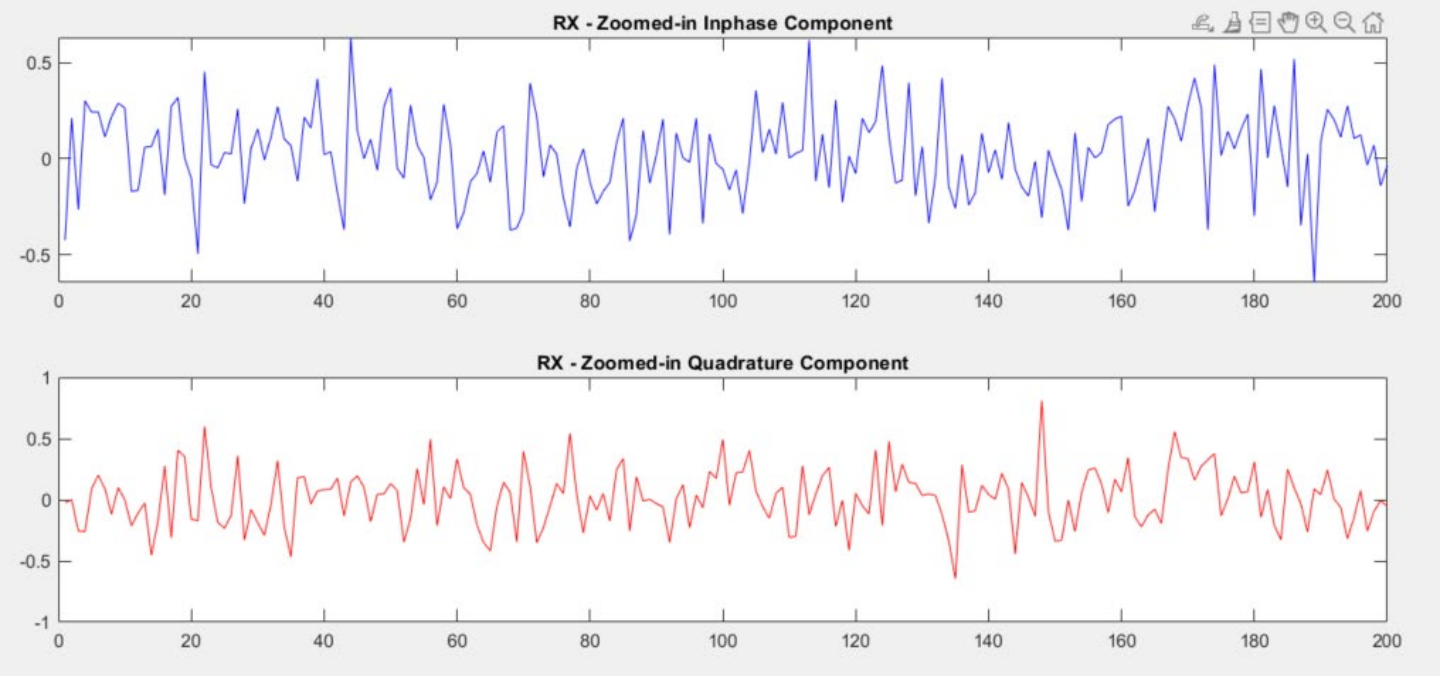
- SNR chosen for **QPSK**: 20
  Command: run('QPSK', 20, 40, 1440)
  - TX_waveform zoom in version:



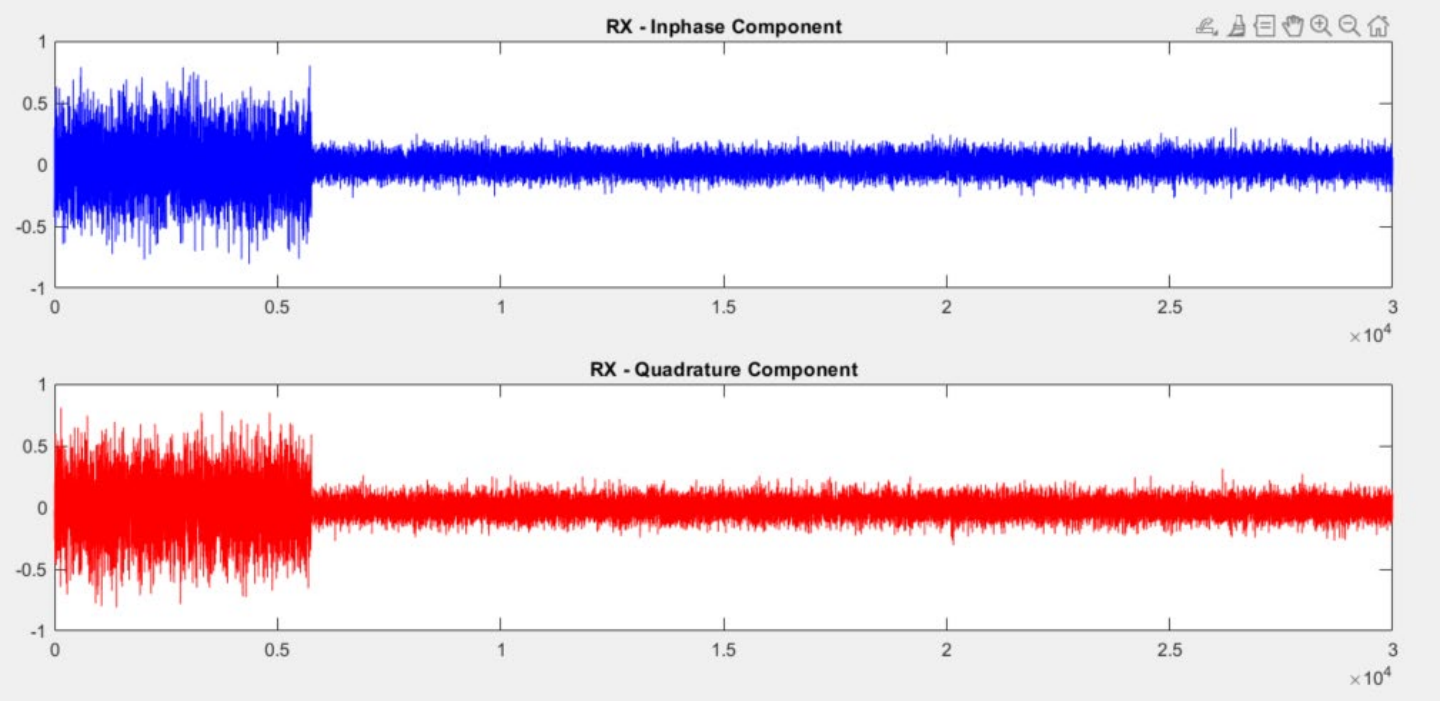
- TX_waveform zoom out version:



- RX_waveform zoom in version:



- RX_waveform zoom out version:



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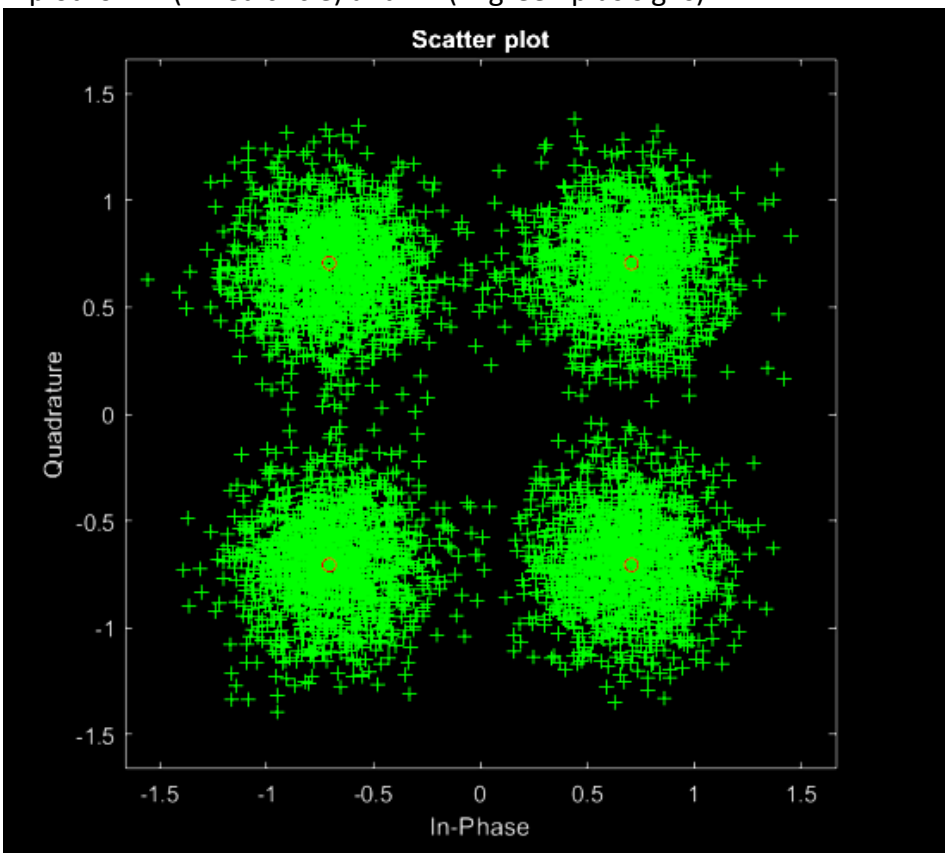
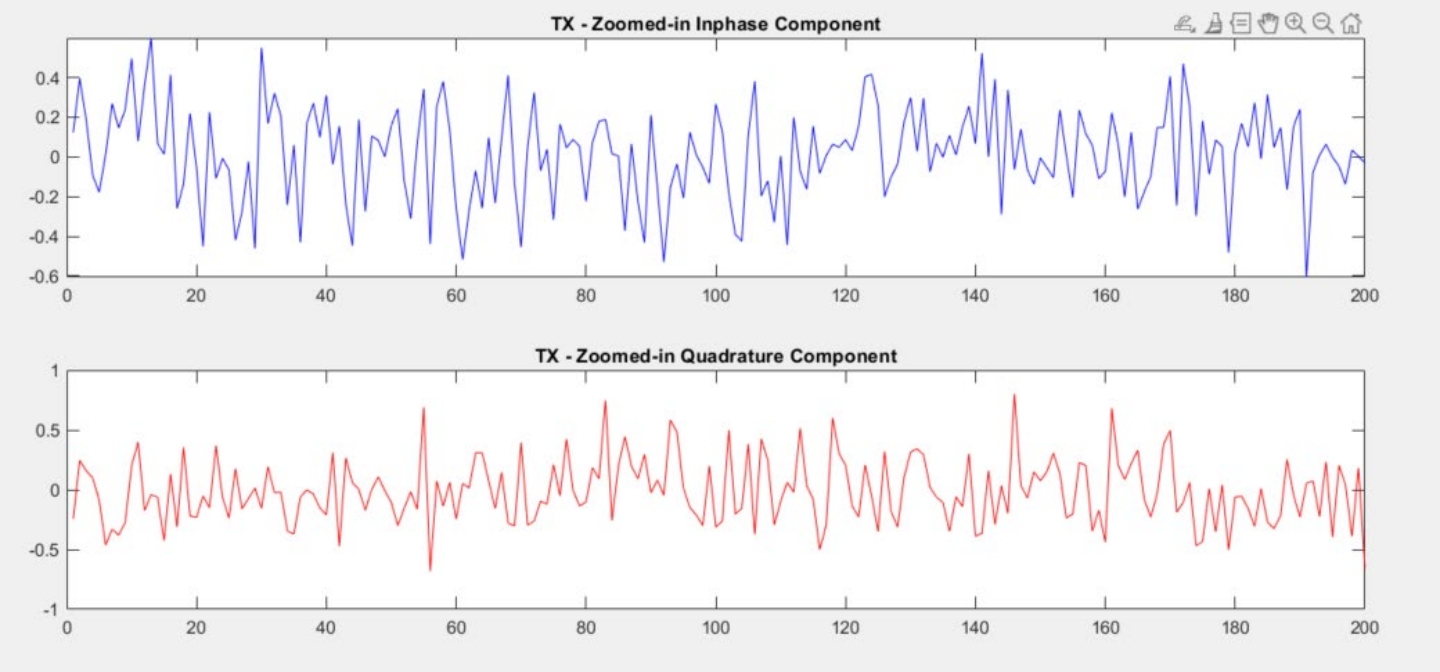


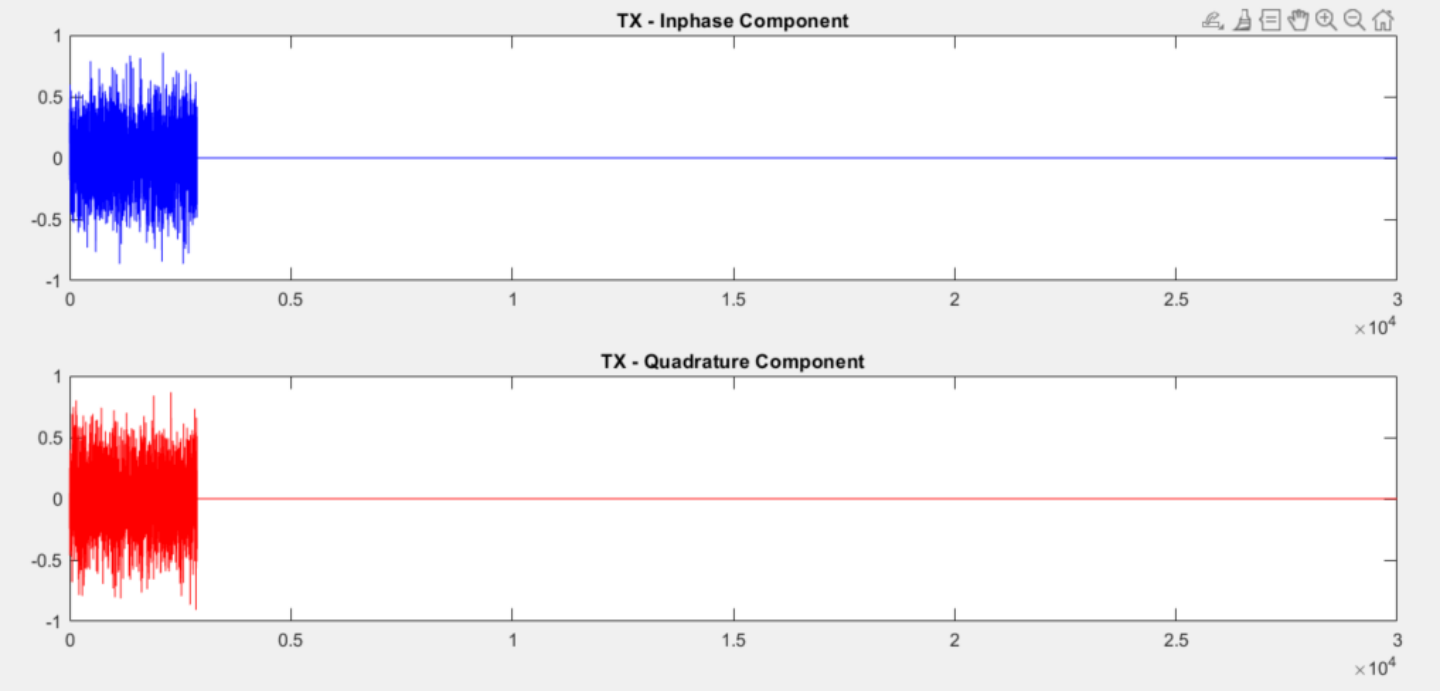
- BER: 0.0569 %
- SER: 0.1133 %
- EVM: 30.2270
- Packet loss: 97.5%

- SNR chosen for **16QAM**: 27
  Command: run('16QAM', 27, 40, 1440)

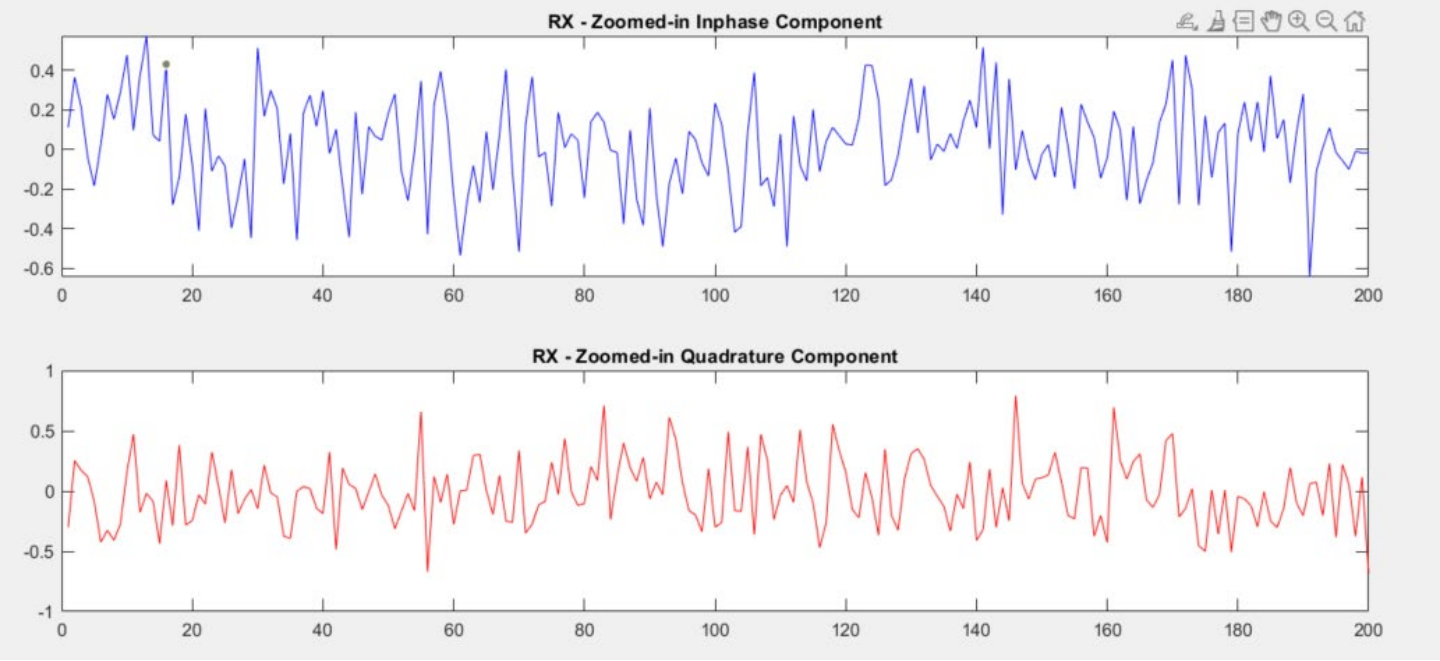
  - TX_waveform zoom in version:



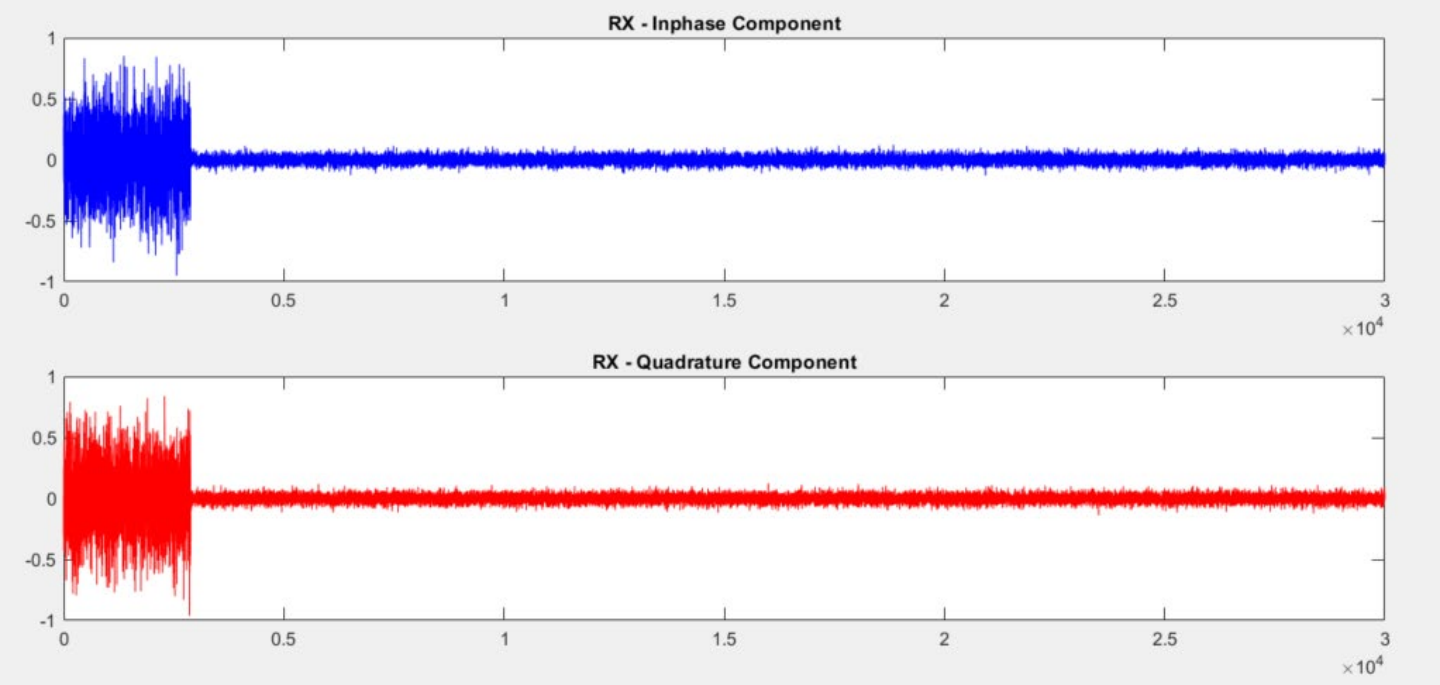
  - TX_waveform zoom out version:



- RX_waveform zoom in version:



- RX_waveform zoom out version:



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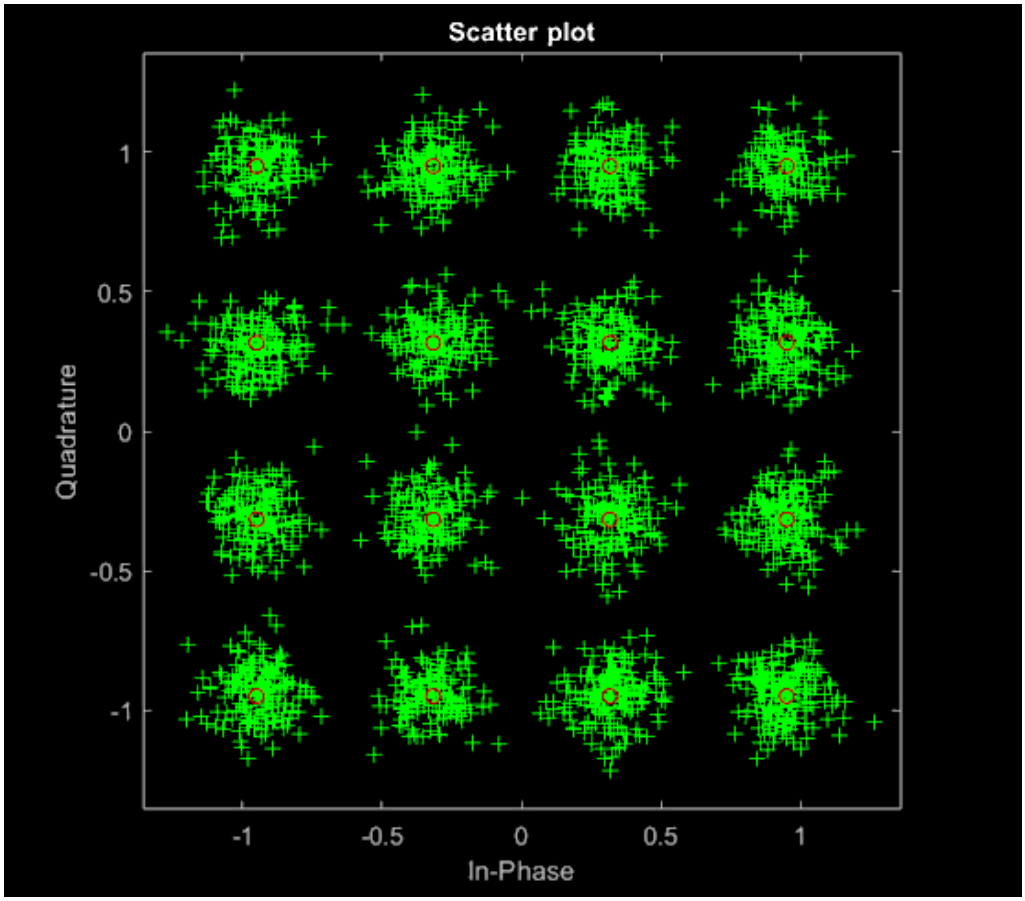
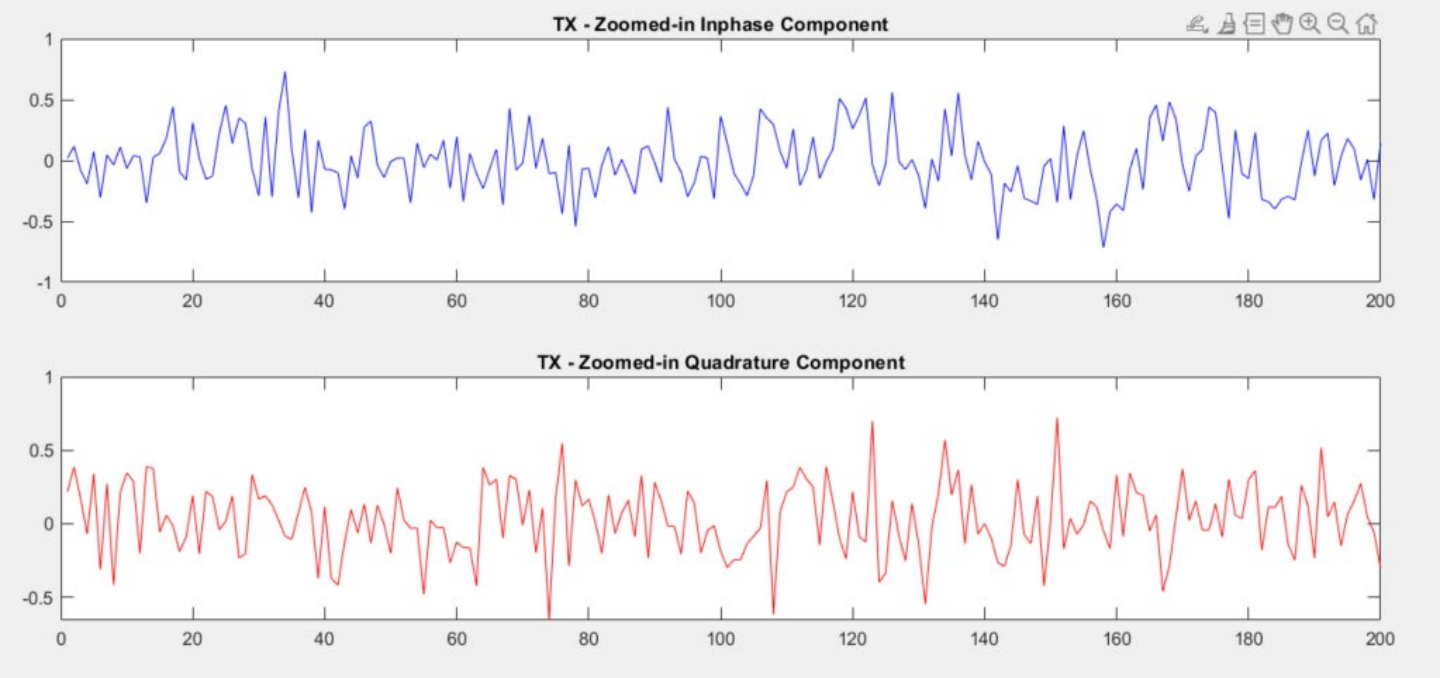


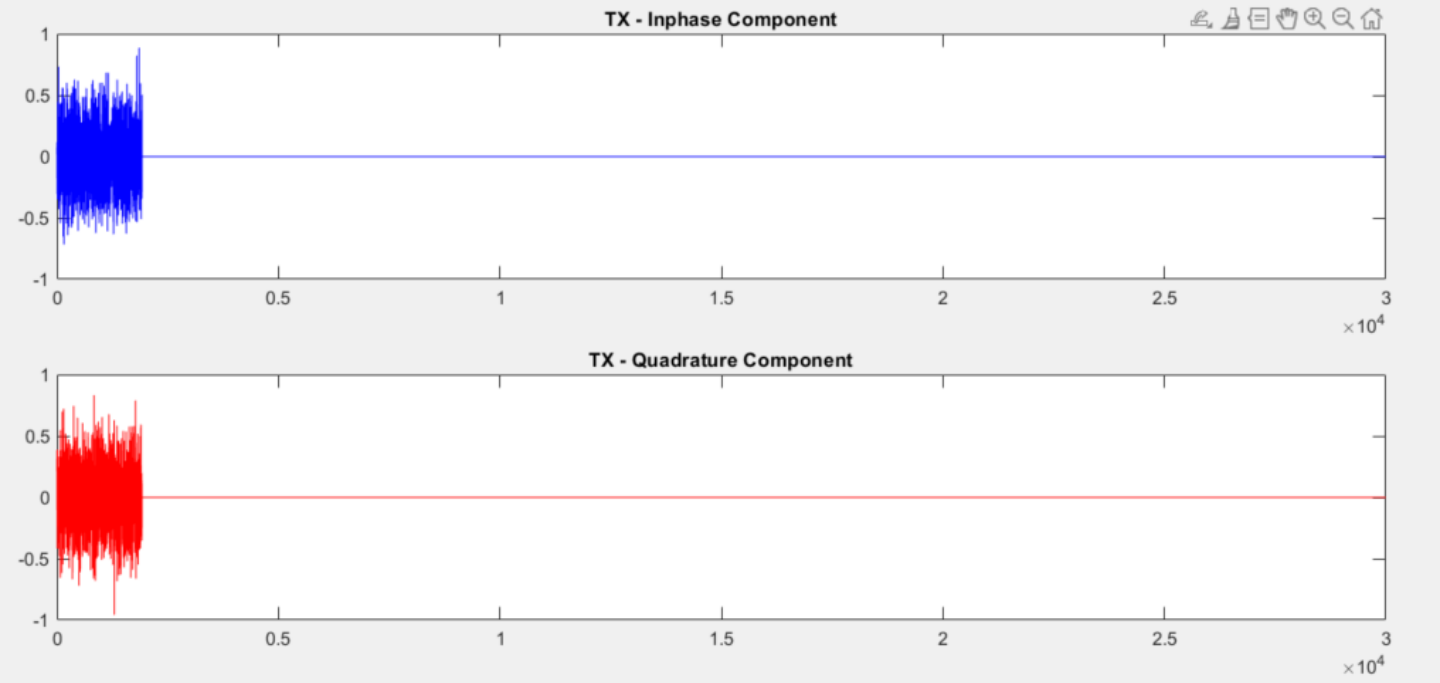
- BER: 0.0336 %
- SER: 0.1345%
- EVM: 38.0894
- Packet loss: 80%

- SNR chosen for **64QAM**: 34
  Command: run('64QAM', 34, 40, 1440)

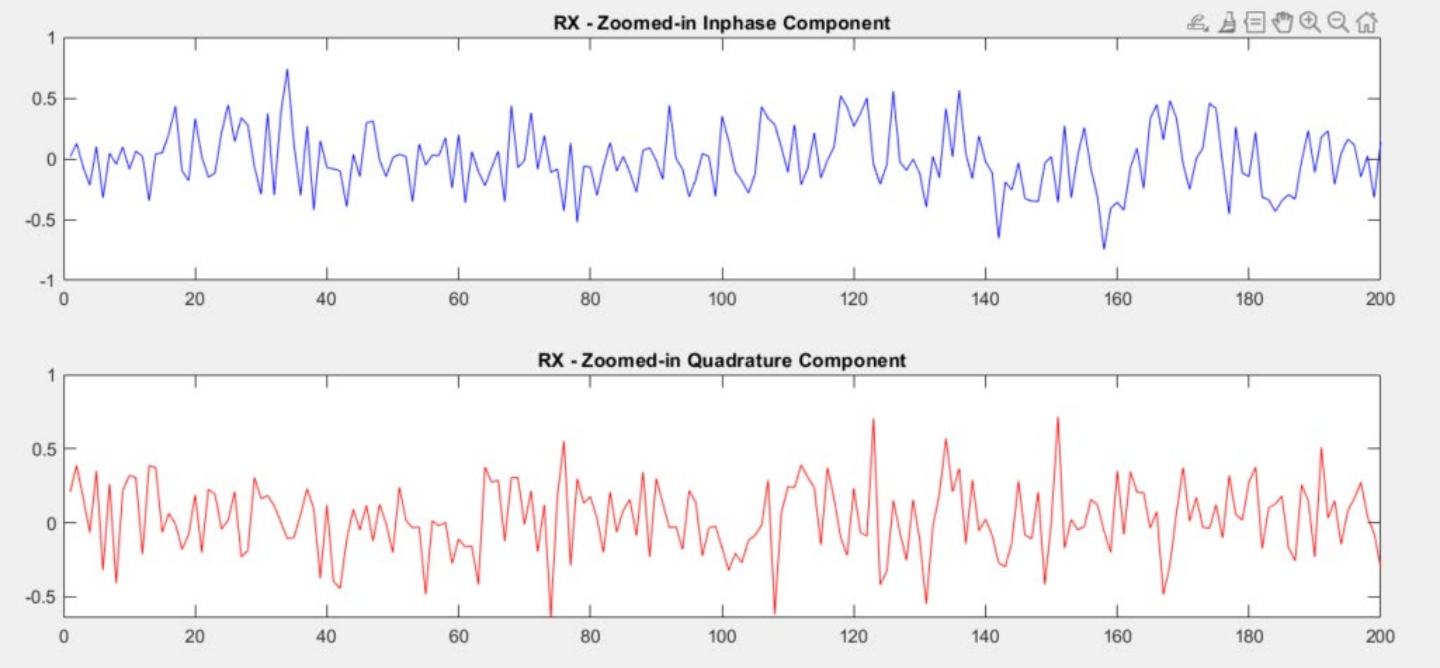
  - TX_waveform zoom in version:



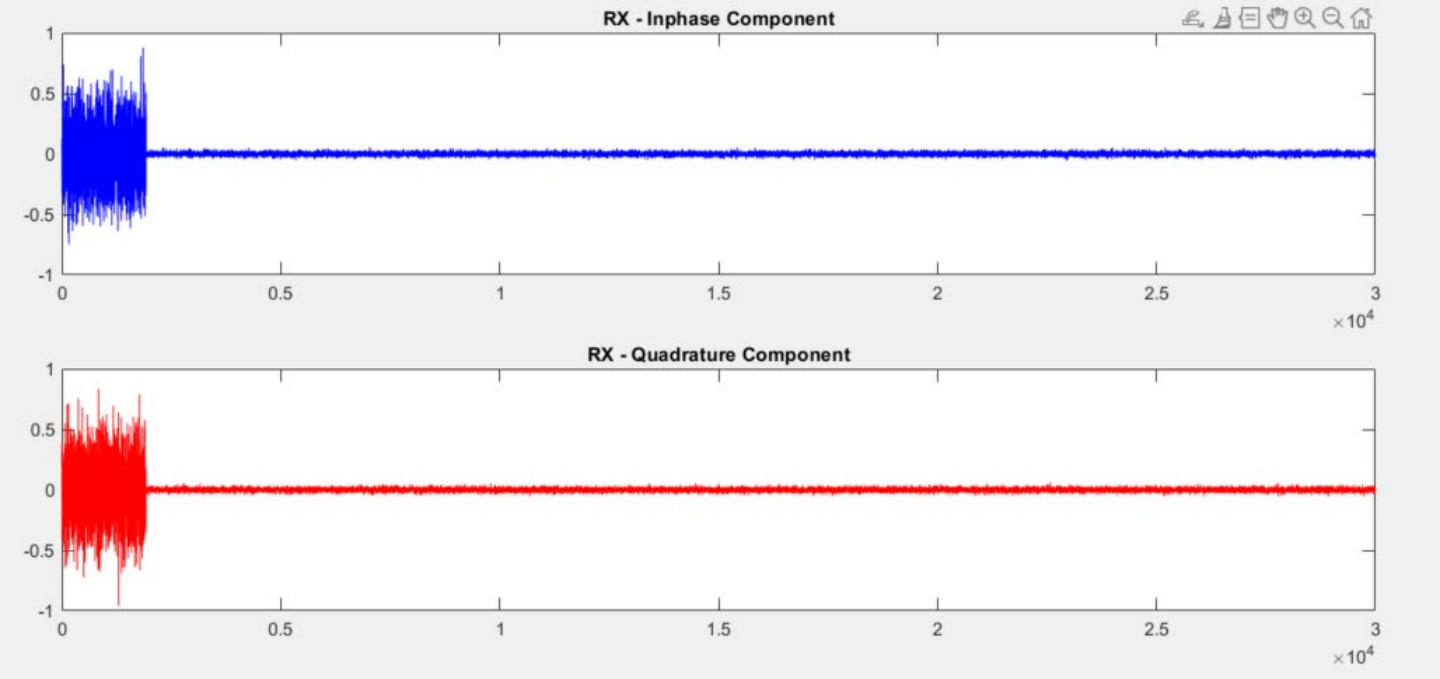
  - TX_waveform zoom out version:



- RX_waveform zoom in version:



- RX_waveform zoom out version:



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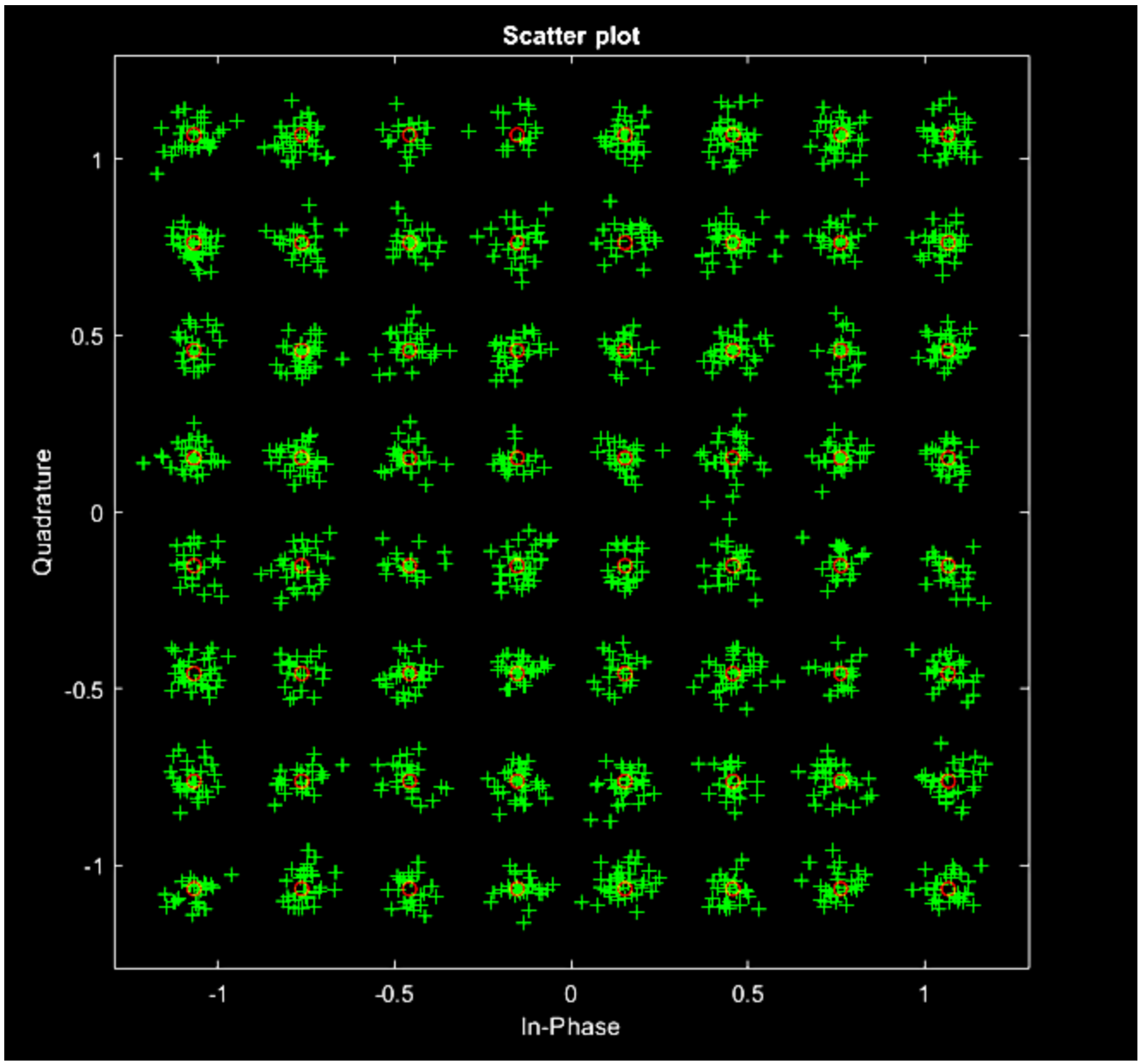

- BER: 0.0056%
- SER: 0.0339%
- EVM: 6.8739
- Packet loss: 40%