MIMO Basics for GNU Radio

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Set of MIMO Algorithms

- Generic implementation of popular MIMO algorithms
- Flexible integration into a system, by:
  - Unified transport of channel state information via stream tags
  - Vectorized algorithms for multi-carrier systems
- Algorithms characterized by Code Rate R, M TX- and N RX- antennas

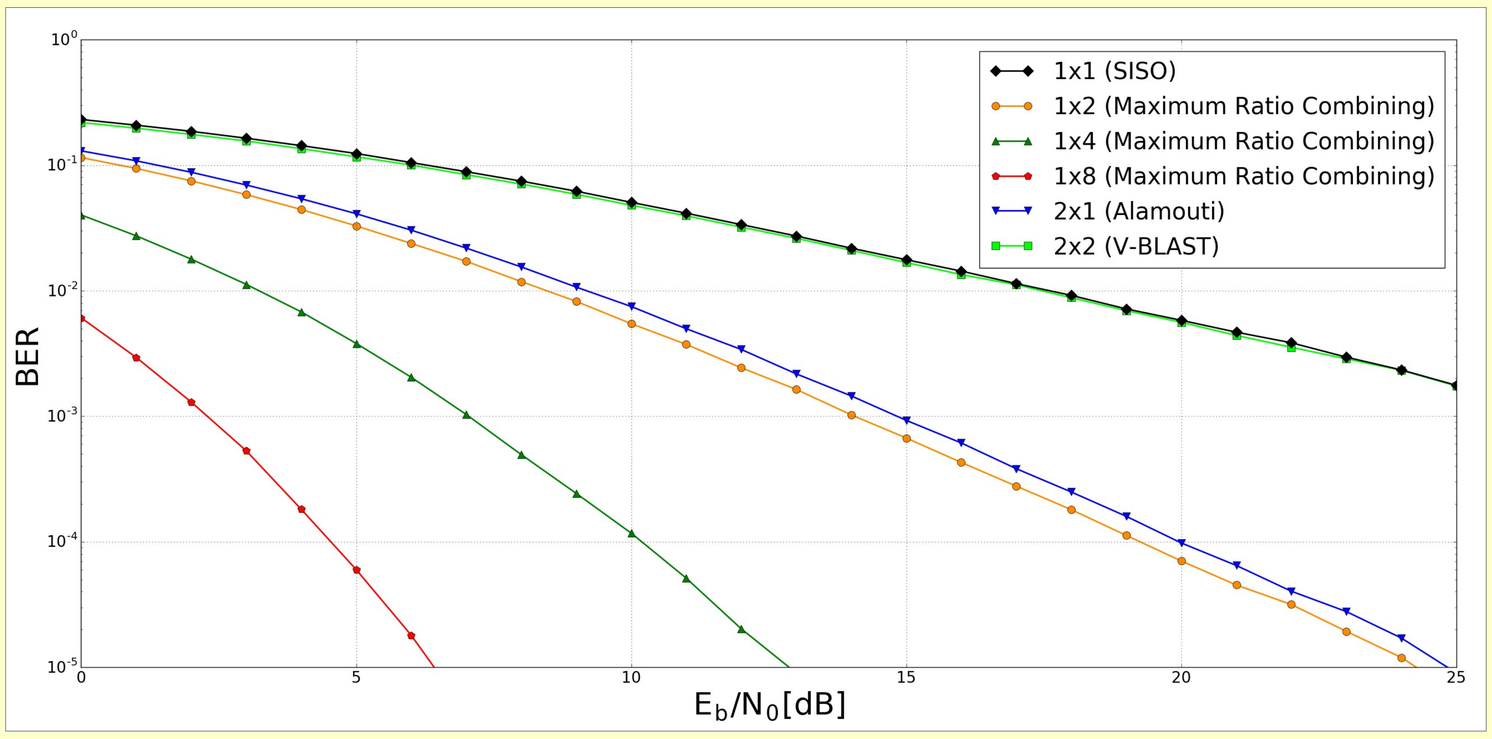

Figure 1: BER simulations on Rayleigh fading channel with BPSK modulation and different MIMO algorithms with normalized transmit power

MISO: Alamouti

- M = 2, N = 1, R = 1
- Full diversity gain
- Linear decoding complexity

MISO: Differential STBC

- M = 2, N = 1, R = 1
- Differential Alamouti-like STBC
- No channel state information required

(*) For (optional) M > 2 cases, the linear algebra template library Eigen is a dependecy.

SIMO: Diversity Combining

- M = 1, N ≥ 1*, R = 1
- Uses spatial diversity techniques to mitigate fading effects.
- Selection Combining and Maximum-Ratio Combining
- Array gain increases the SNR

MIMO: V-BLAST

- M ≥ 1*, N = M, R = M
- Uses spatial multiplexing technique to increase the throughput.
- Equalization with Zero-Forcing and Minimum Mean Squared Error

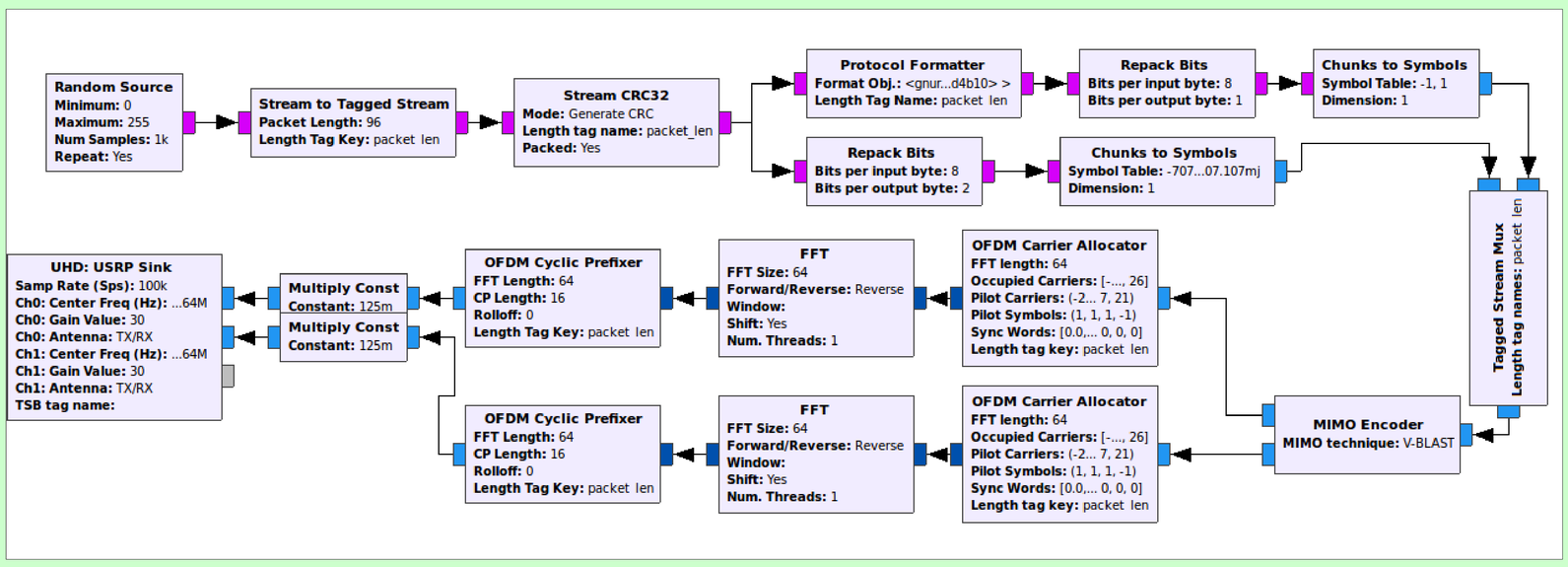

Figure 2: MIMO-OFDM transmitter structure in GNU Radio companion

MIMO-OFDM

- Integration of the MIMO features into the OFDM transceiver of gr-digital
- MIMO applied on each sub-carrier separately by the use of vectorized algorithms
- Training sequences for MIMO equalization on selectable sub-carriers

MIMO-OFDM Receiver

Synchronization

- Equal gain combining (without co-phasing) as a reference signal for synchronization
- Schmidl & Cox synchronizer for correction of time and frequency offset

MIMO Channel Estimation

- Orthogonal Walsh sequences on different TX streams
- Constant tracking of channel state due to cyclicality of the correlation with the training sequences
- Linear interpolation over sub-carriers

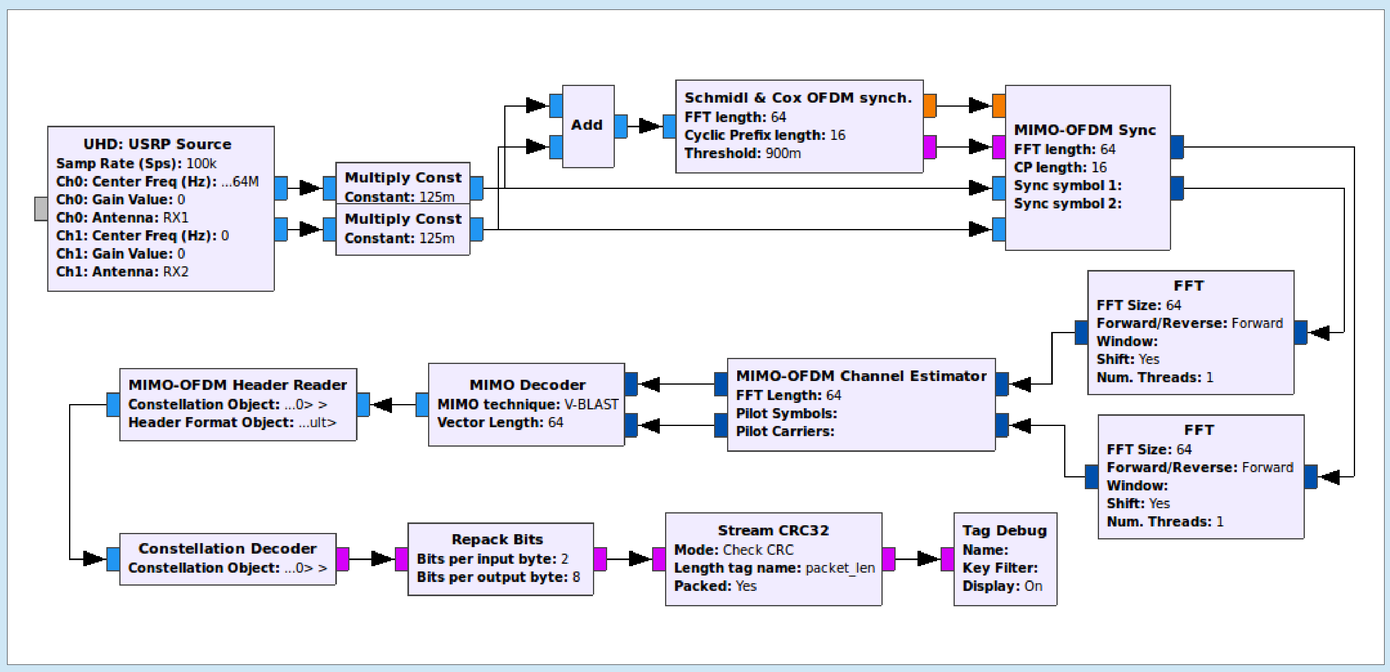

Figure 3: MIMO-OFDM receiver structure in GNU Radio companion

GitHub: https://github.com/kit-cel/gnuradio