Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Improved Spreading Sequences for TG4k FSK PHY

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Re: Presentation on improved spreading sequences for TG4k

Abstract: This contribution is prepared to support comments to TG4k letter ballot.

Purpose:

Properties of Spreading Sequences

- Spreading sequences in TG4k draft currently based on alternating 1s and 0s pattern.
- Cross-correlation properties of such sequences are sub-optimal.
- Performance of differential demodulator can also be sub-par due to incidence of 1/0 transitions.

Proposal

- Expand TG4k FSK draft to include a different set of spreading sequences.

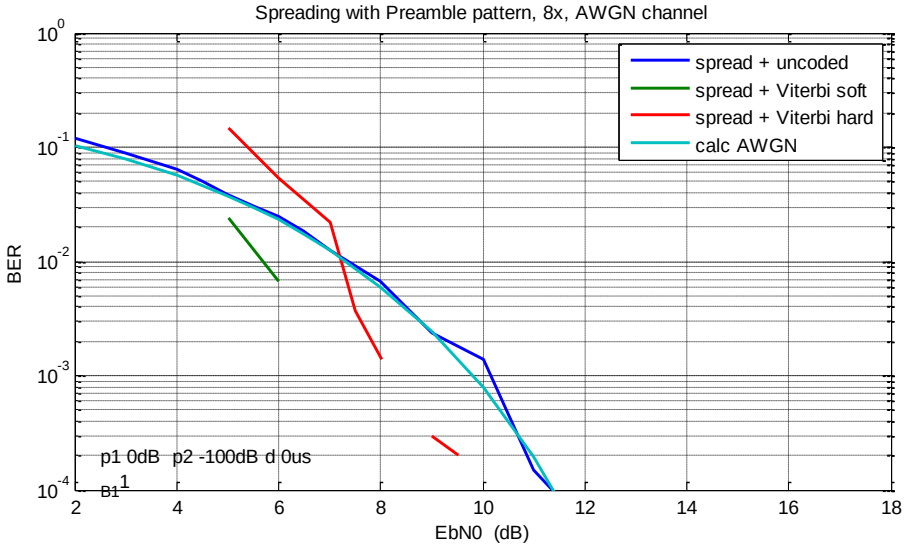
- Proposed sequences should:
  - Have good cross-correlation properties to allow for re-sync in high Doppler channels.
  - Be appropriate for different demodulator architectures.

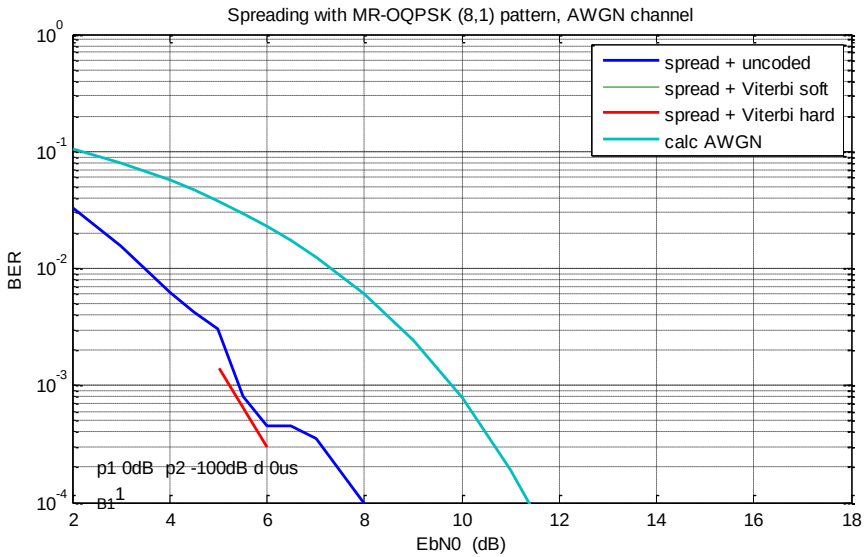
- The proposal is to include MR-OQPSK sequences from TG4g into the TG4k FSK PHY for spreading purposes.

Simulation Details

- While loop through EbNo levels in some range, generate random information sequence
- FEC/interleaving/spreading applied to sequence according to simulation settings
- Up-sample and filter, then FM modulate
- Apply channel model according to simulation setting
  - AWGN, Tu100 (80 hz Doppler, two paths 22 dB apart)
- FSK demodulation algorithm
  - Identify optimal sync position from x-corr between expected and received sequence over some lag window
  - Apply initial (differential) demod
  - Decimate to sync position, and depending on settings de-spread, de-interleave, Viterbi, etc.
- Compare output to original information sequence

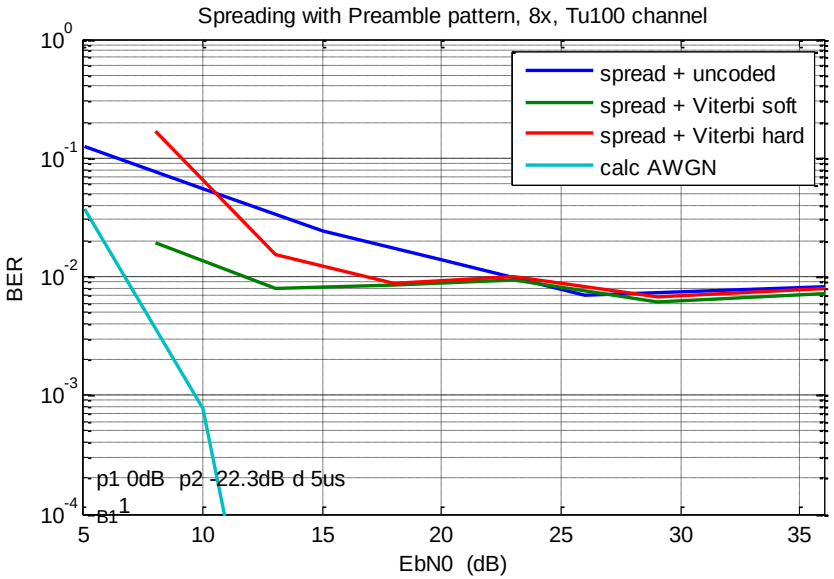
Performance Results (1/2)

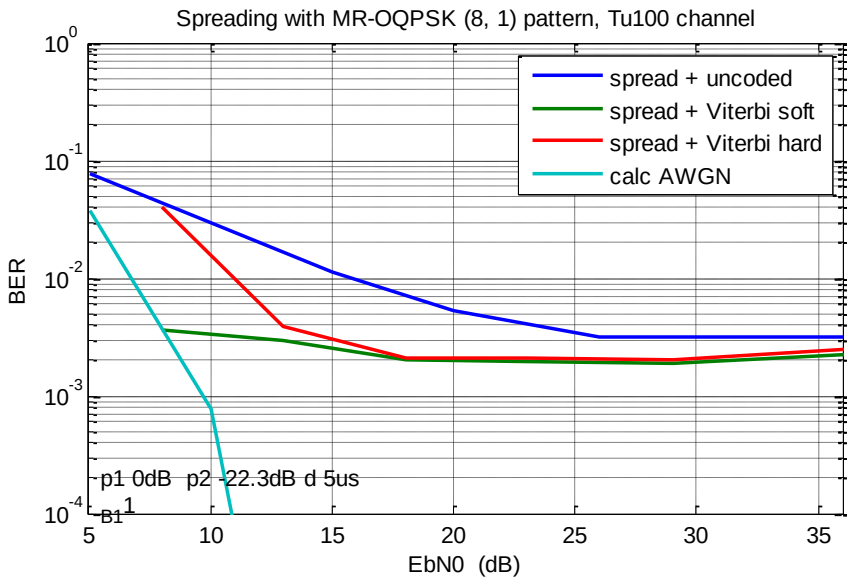




- AWGN channel conditions
- >3 dB BER improvement from MR-OQPSK spreading sequences over alternating 1/0 spreading sequences

Performance Results (2/2)





- Tu-100 channel conditions

- >5 dB BER improvement from MR-OQPSK spreading sequences over alternating 1/0 spreading sequences

Conclusions

- Proposed spreading sequences can offer significant performance gains compared to sequences in the current TG4k draft.

- Thus recommend including MR-OQPSK sequences from TG4g into the TG4k FSK PHY for spreading purposes.