

AN EFFICIENT FREQUENCY HOPPING DEMODULATOR BASED ON POLYPHASE FILTER BANKS

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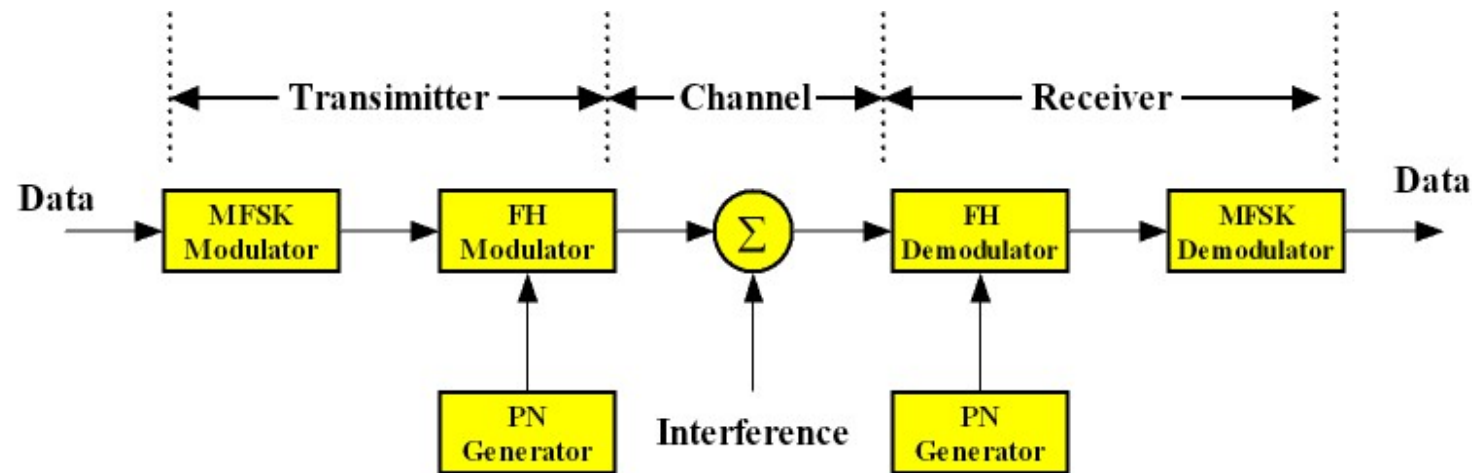
*SDR'11-WInnComm
29 Nov*

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WHY SHOULD WE DO DIGITAL FREQUENCY HOPPING (FH)?

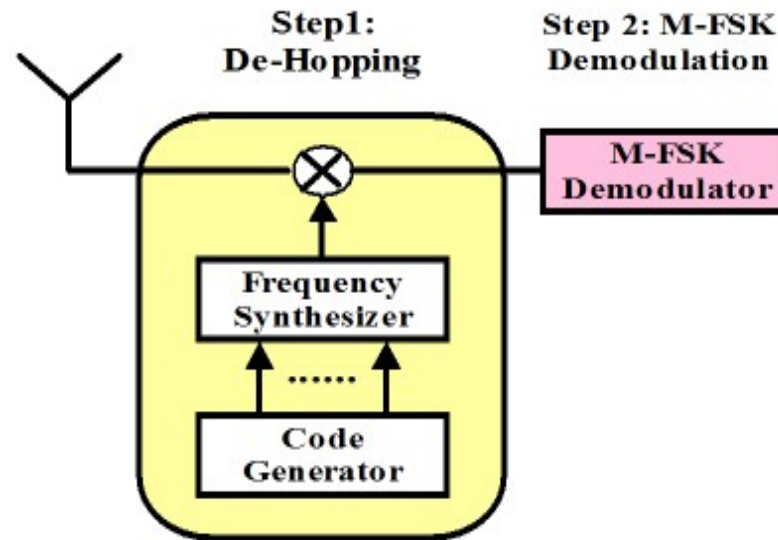
- To Fit Legacy FH Modems into the Evolving Wireless Standards
- To Enjoy the Benefits Provided by Digital Implementation

THE IDEA OF FREQUENCY HOPPING



- MFSK Signal is Often Used as the Underlying Modulation Signal
- The Center Frequency of the MFSK Signal is Varied According to the PN Sequence

THE LEGACY FH DEMODULATOR

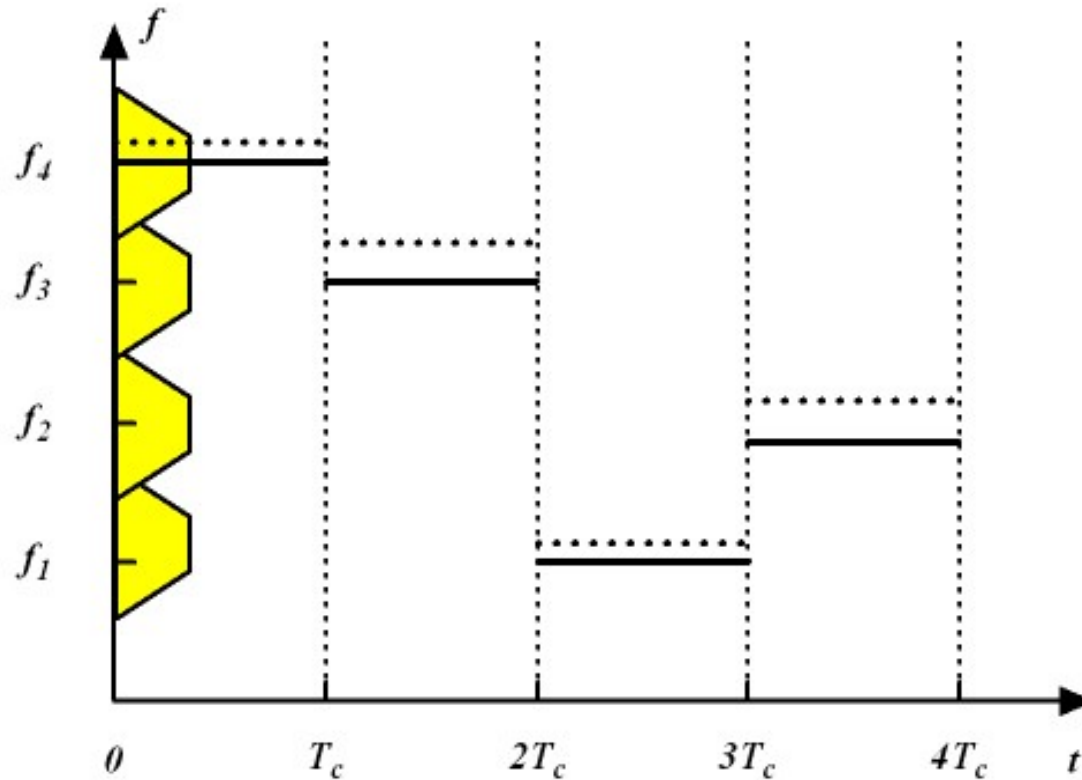


- A Local Frequency Synthesizer Directed by the PN Sequence is Used to “De-hop” the Incoming FH signal.
- An M-FSK Demodulator Recovers the Transmitted Symbol.

MAJOR DRAWBACKS OF THE LEGACY FH MODEM

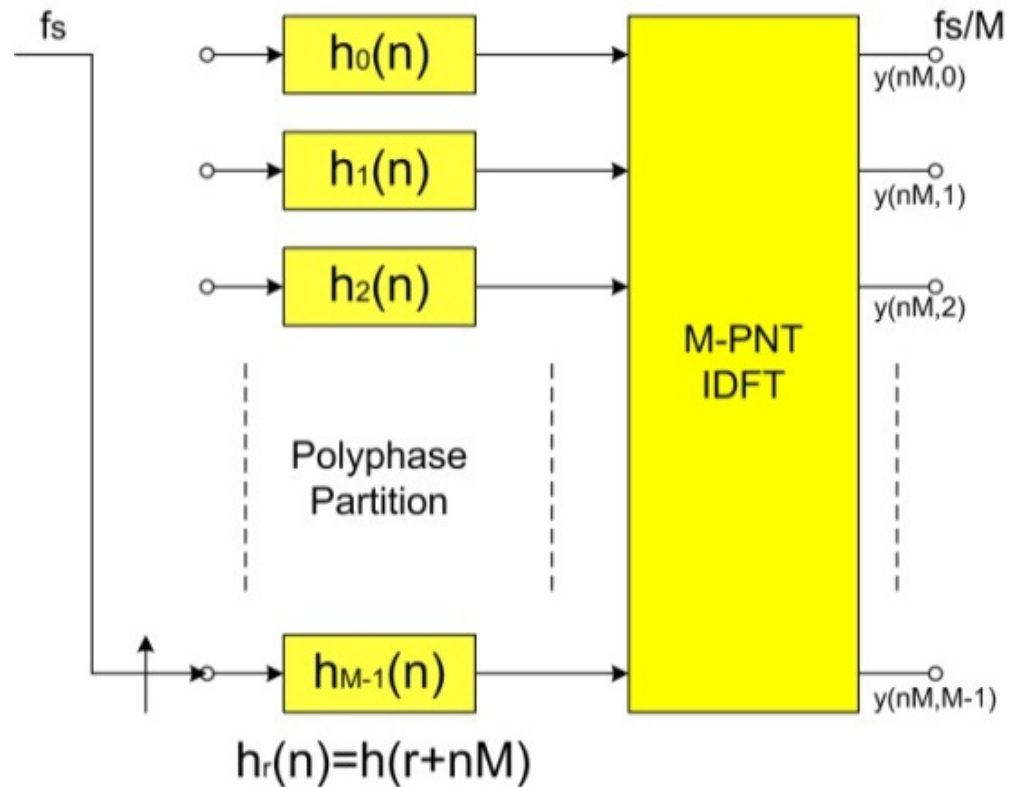
- Slow Acquisition Due to Serial Search
- Performance Degradation Due to Imperfect Synchronization
- Performance Degradation Due to Jamming

THE IDEA OF CHANNELIZING FH SIGNAL



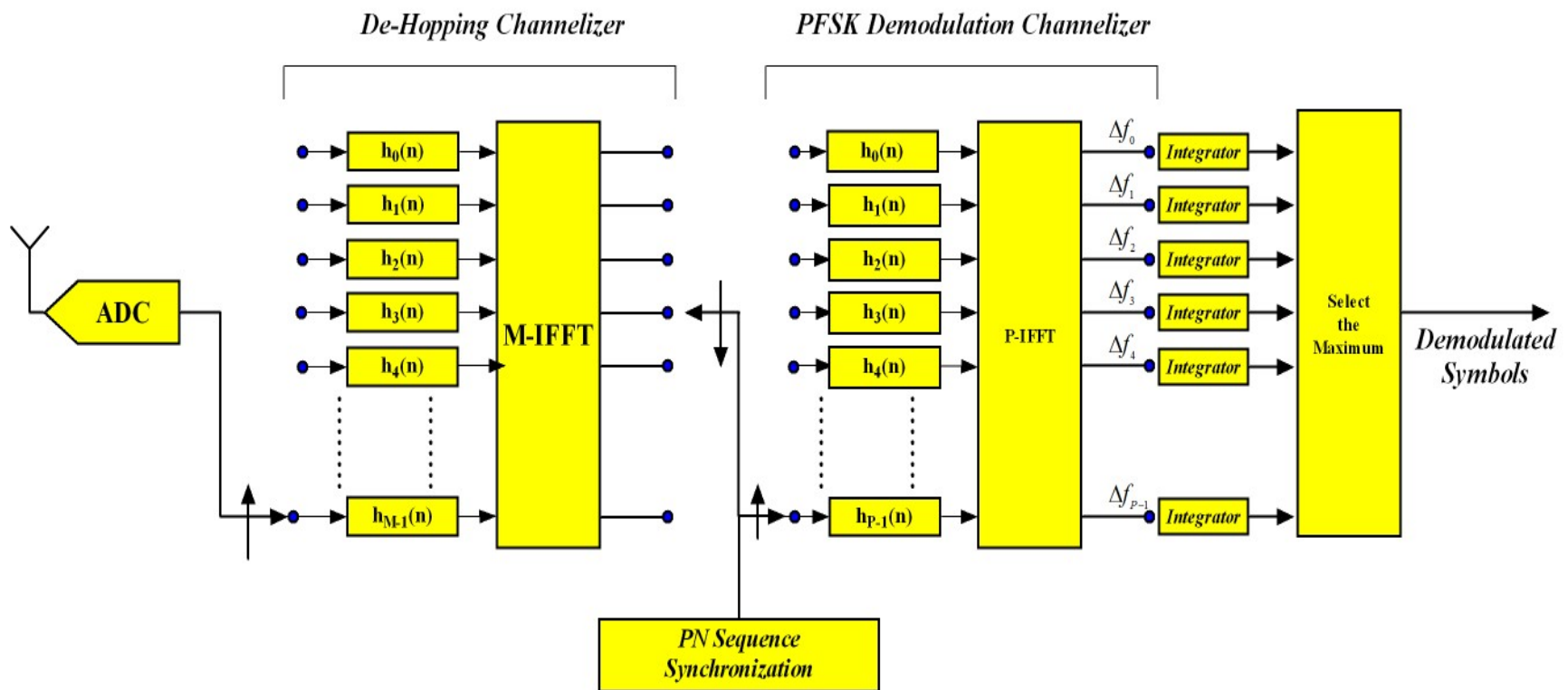
Why not implement a bank of digital band-pass filters ?

M-PATH CHANNELIZER



This is a Bank of M Band-pass Filters!
But, ... At the cost of **1 filter plus an M point FFT !!!**

PROPOSED DIGITAL FREQUENCY HOPPING DEMODULATOR



BENEFITS OF OUR PROPOSED DEMODULATOR

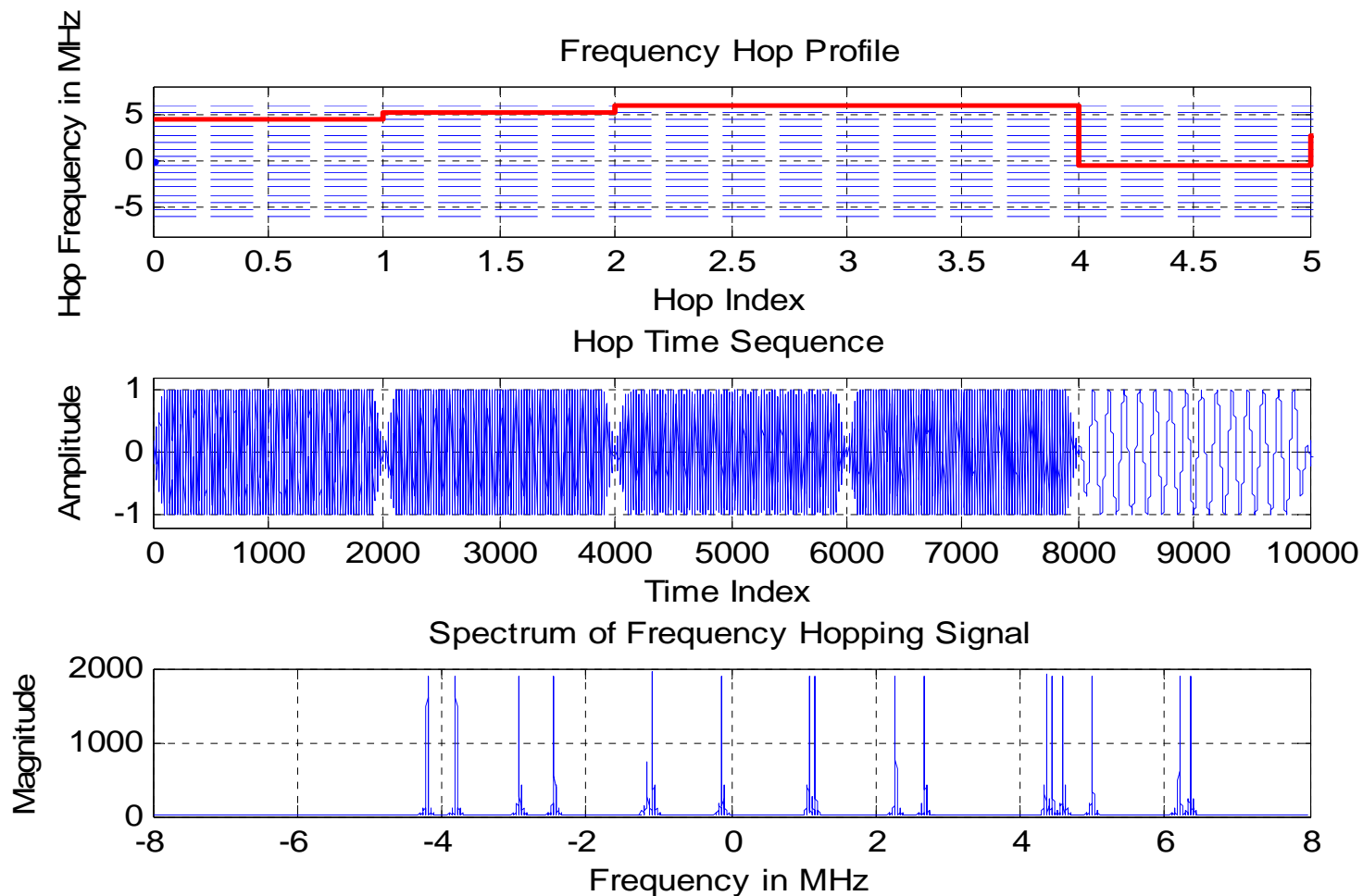
- Fast Acquisition Based on Parallel Search

The channelizer provides access to each hopping center, which allows us to obtain the hopping pattern instantaneously. Thus, parallel search of PN sequences can be performed and, consequently, the expected acquisition time will be significantly reduced.

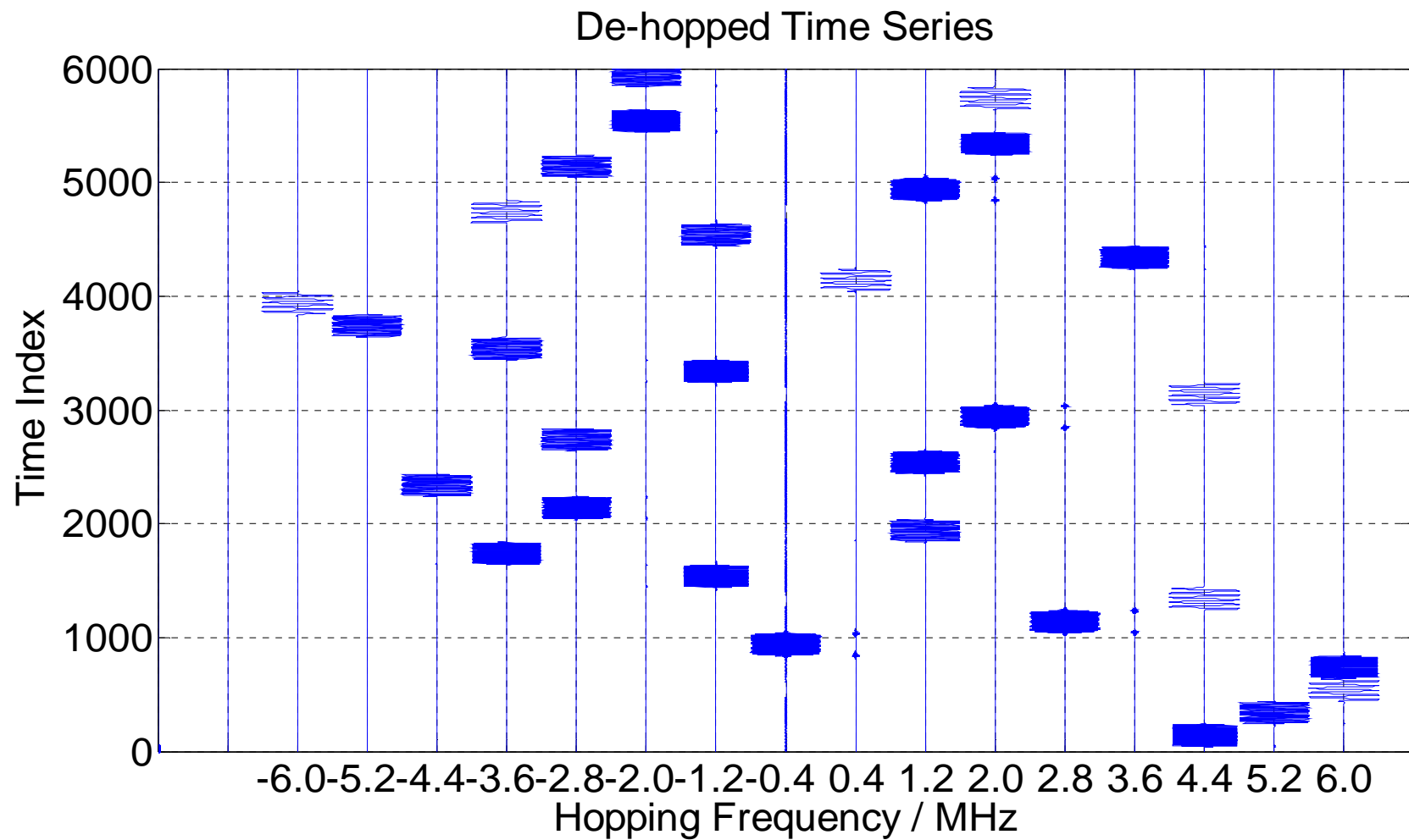
- Simultaneous and Diversity Hopping

- The proposed receiver structure can simultaneously synchronize to and demodulate multiple FH signals.
- The same MFSK signals can be modulated onto different PN sequences; and the receiver enjoys frequency diversity automatically.

SIMULATION RESULTS: SIGNAL TO BE DEMODULATED

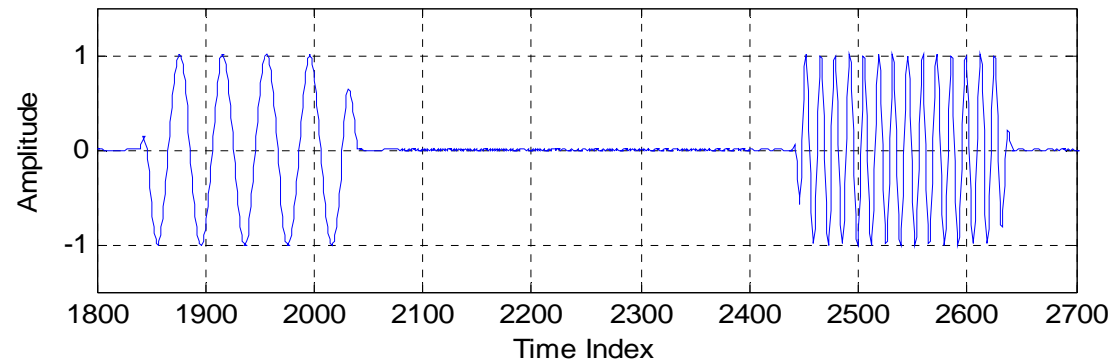


SIMULATION RESULTS: DE-HOPPED TIME SERIES

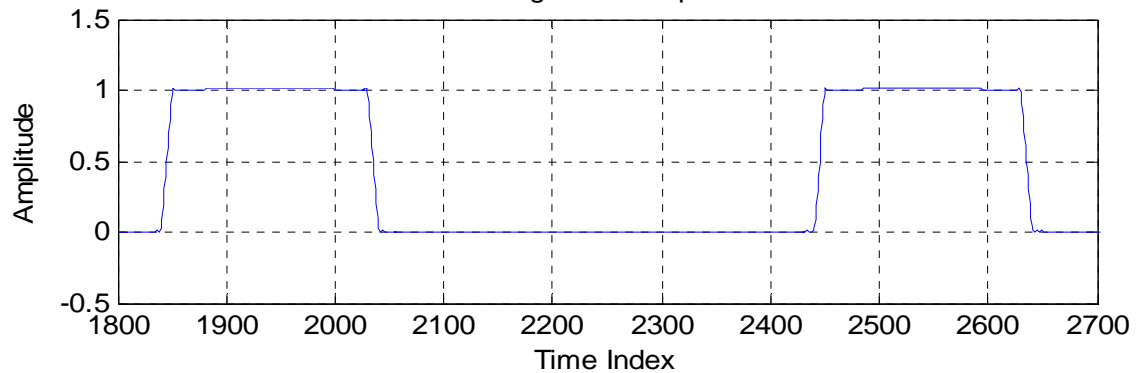


SIMULATION RESULTS: ZOOM INTO 1.2 MHz HOPPING CENTER

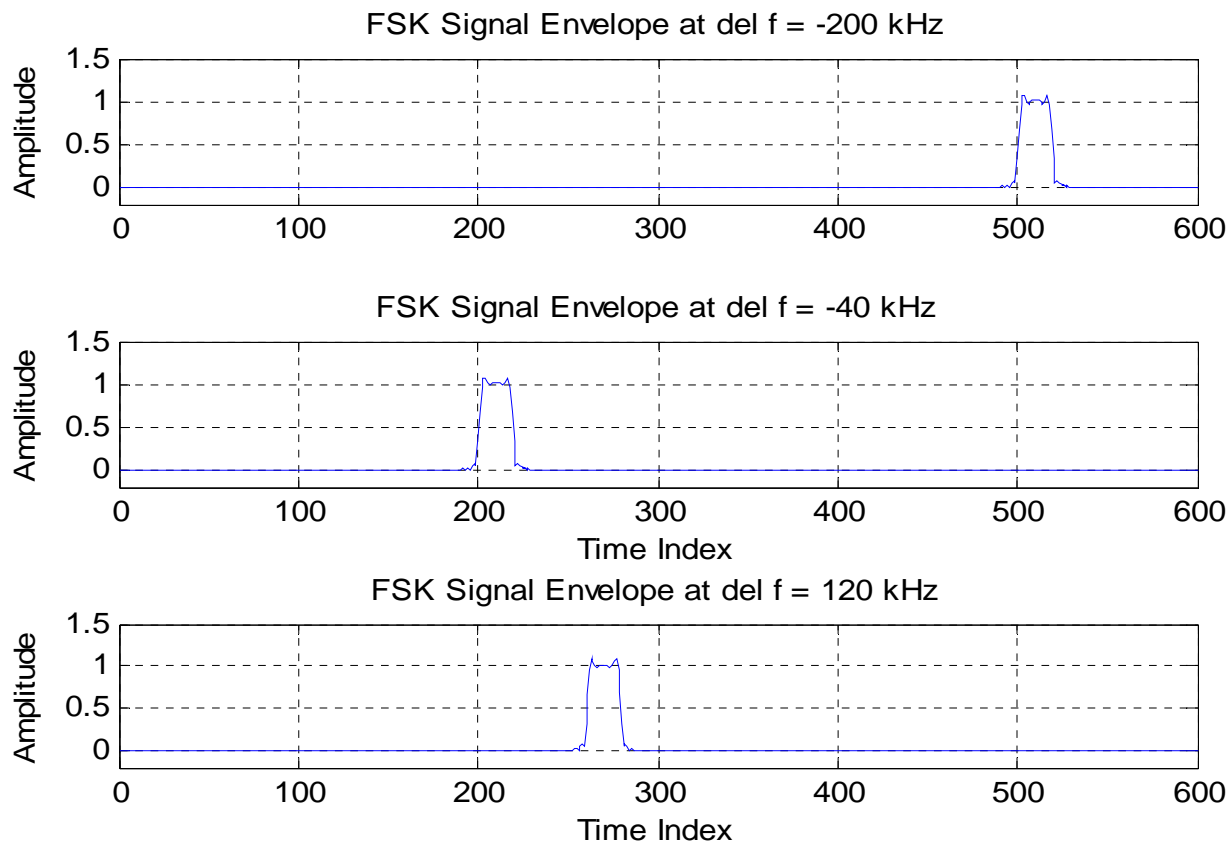
Output Time Series on 1.2 MHz



Signal Envelope



SIMULATION RESULTS: 2ND TIER CHANNELIZER OUTPUT FOR 1.2 MHz HOPPING CENTER



CONCLUSION

Comparing with the legacy FH modem, the channelizer based FH modem has the following benefits:

- Reduced Acquisition Time
- Enhanced System Flexibility and BER Performance via Diversity Hopping and Simultaneous Hopping.
- Easy To Be Implemented On Any SDR Platform

THANKS ☺

Open for Questions !