Spring 5-23-2018

Improvement of 802.11 Protocol on Fully Programmable Wireless Radio

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Introduction

The growth in the number of connected device usage has led to a rapidly increased data traffic on wireless network and the demand for access to high speed and stable Internet connection is becoming more prominent. However, current off the shelf wireless cards are not programmable or observable across layers of the standard protocol stack, which leads to poor practical performance.

Object

Implement and improve an 802.11 protocol, which is a Wifi style protocol, on fully programmable wireless radios.

Methods

Wireless Open Access Research Platform (WARP) V3 [1] is a scalable wireless platform providing programmable functionality at every layer of the network stack.

Figure 1 WARP node [2]

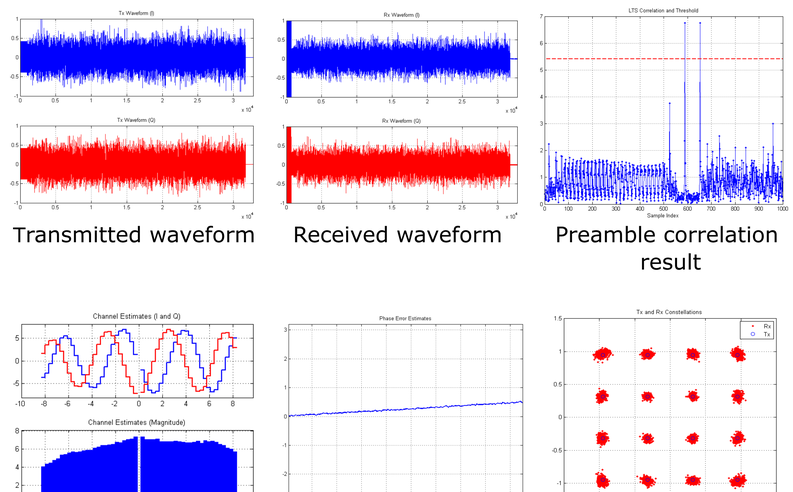
Data Flow [1][3]

1. Samples to be transmitted are created in MATLAB as part of the custom PHY.
2. MATLAB downloads the samples to buffers on the transmitting WARP node.
3. MATLAB sends a trigger to transmitter and receiver nodes.
4. The transmitter node flushes its buffers through its radios while the receiver node loads its buffers with received data through its radios.
5. The received data is processed offline in MATLAB.

Results

SISO OFDM (Serial Input Serial Output)

Using 1 antenna at each transmitter and receiver.



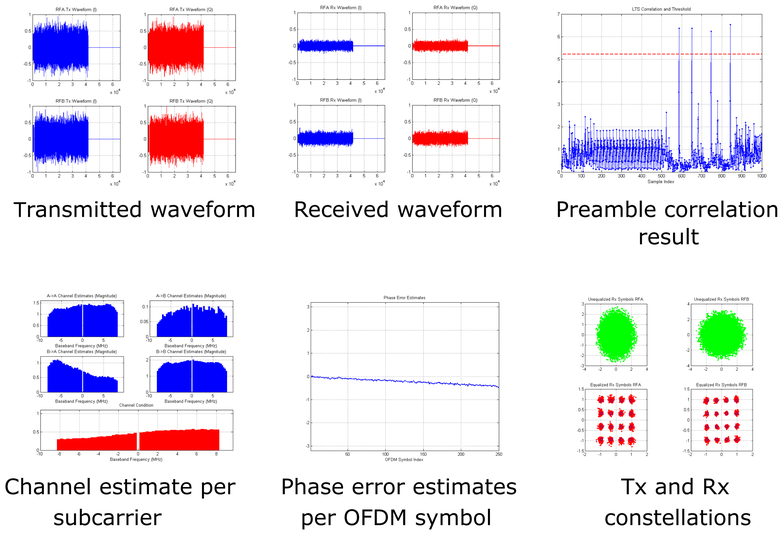
Transmitted waveform | Received waveform | Preamble correlation result

Channel estimate per subcarrier | Phase error estimates per OFDM symbol | Tx and Rx constellations

Figure 2 Plots with SISO OFDM [1]

MIMO OFDM (Multiple Input Multiple Output)

Using 2 antennas at a transmitter to send two separate data streams and 2 antennas at the receiver to disentangle them.



Transmitted waveform | Received waveform | Preamble correlation result

Channel estimate per subcarrier | Phase error estimates per OFDM symbol | Tx and Rx constellations

Figure 3 Plots with MIMO OFDM [1]

Conclusions

In the project, MATLAB is used to control WARP nodes and perform signal processing. However, the previous results confirm that OFDM transmission and reception are done offline in MATLAB, which takes ~6sec.

Using spatial multiplexing technique, MIMO delivers higher data rate by transmitting multiple data streams simultaneously. Also, SISO has an increasing phase error per OFDM symbol while MIMO's is decreasing by using space time block coding technique.

Future Work

In the future, the communication time should be reduced for real-time implementation. Additionally, any type of data (e.g. video streams) should be able to be transmitted and received through the WARP nodes.

Reference

[1] Rice University WARP project. Retrieved from http://warpproject.org/trac/wiki/WikiStart

[2] Mango communications. Retrieved from http://mangocomm.com/

[3] E. Aryafar, N. Anand, T. Salonidis, and E. Knightly. 2010. WARPLab: A Flexible Framework for Rapid physical Layer Design

Acknowledgements

The authors acknowledge the support of the Semiconductor Research Corporation (SRC) Education Alliance (award # 2009-UR-2032G) and of the Maseeh College of Engineering and Computer Science (MCECS) through the Undergraduate Research and Mentoring Program (URMP).

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