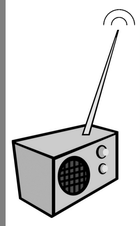
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Prototype Bidirectional Transceiver SDR Implementation of IEEE 802.11b Standard

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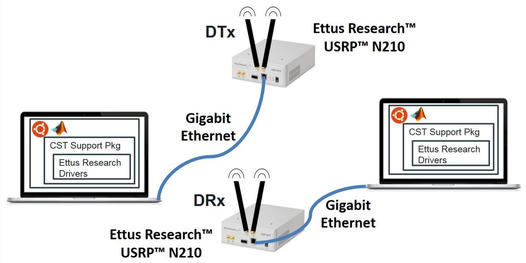


What is a Software Defined Radio?

Software-defined radio (SDR) is a communication system that implements in software that typically used to be only defined in hardware, incl. tuners, modems, multiplexers, etc.

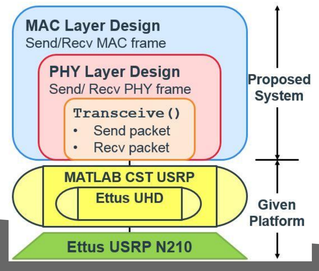
Background

- We adopt the IEEE 802.11b physical (PHY) and medium access control (MAC) layer (DATA & ACK) packet structure specifications in our implementation.
- We use a DBPSK PHY layer and CSMA/CA/ACK MAC layer - all operations remain functionally compliant with the IEEE 802.11b standard.
- Design methodology using a common operating environment.
- Standard tools like MATLAB Coder™ and MEX interface are used for speed up and to enforce timing consistency in the processing steps.



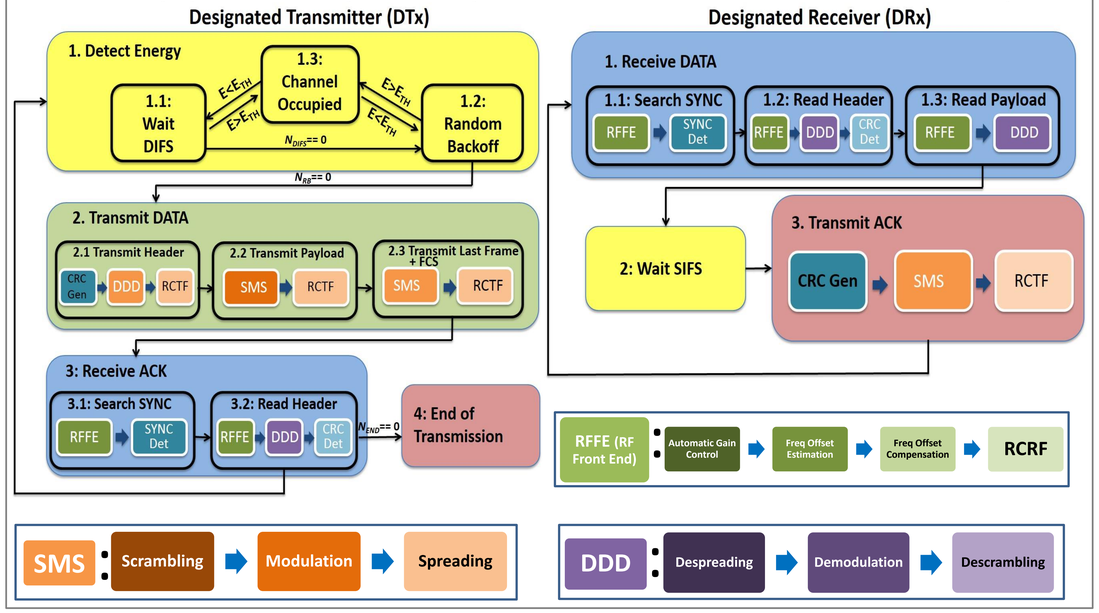
Abstract

- Software defined radio (SDR) requires deep knowledge of the operating environment and intricate tuning of existing code.
- Our design allows optimal selection of the parameters to meet timing requirements of the processing blocks associated with the link layer.
- At the core of our system design is the *transceive* function that enables our wireless transceiver implementation to simultaneously receive and transmit at a near-constant time interval.



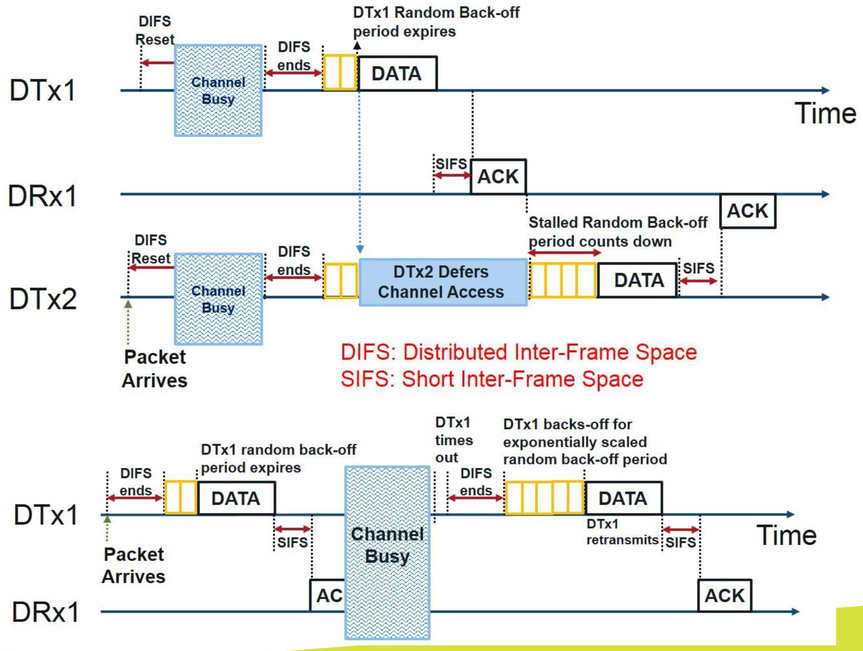
State-action based System Design

•The state machine based design drove code development, enabled modularity of code base and allows for extensibility by the community. Common system blocks in DTx and DRx facilitates code reusability.



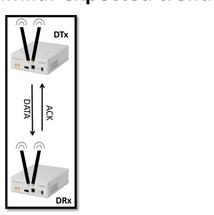
CSMA/CA/ACK MAC Layer

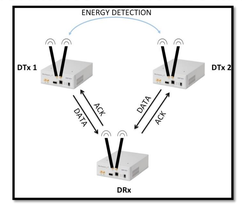
•Code base for MAC layer incorporates channel sensing via energy detection, DIFS duration and binary exponential random back-off for contention resolution.
•MAC Layer shown to mitigate packet collisions and be fair to the two bi-directional links when accessing the common channel for varying payload sizes in the DATA packet.

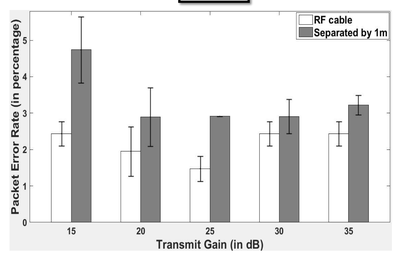


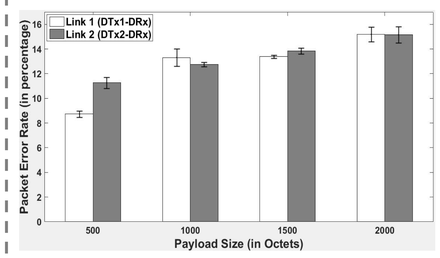
Experimental Results

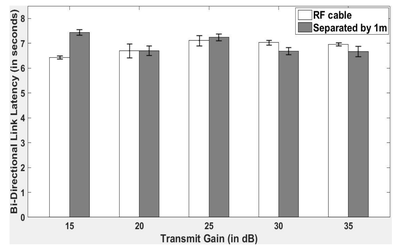
- 2-node: System guarantees a consistent <5% packet error rate and approximately 7 secs of bi-directional link latency (DATA-ACK exchange inclusive of the MAC functions) over a wide range of transmit gains (15-30dB).
- 3-node: Goodput improves with increasing payload size in the DATA packet (500-2000 octets). Similar expected trends in performance for the two links (*Fairness)*.

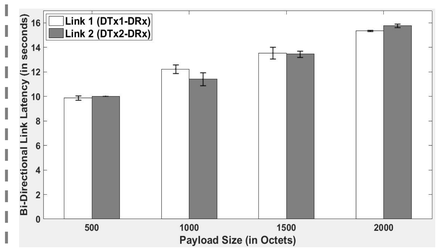


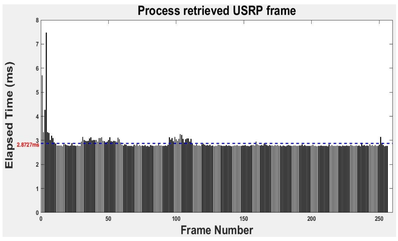


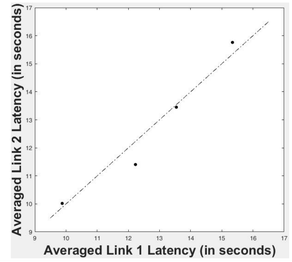












Contributions

- Our work provides a testbed implementing the link layer that complies with the processing definitions in the IEEE 802.11b (1Mbps) specification.
- The software-only approach offers full parameter flexibility allowing the user to reconfigure the system as needed.
- System modeled using a finite state machine (FSM) that transitions only on the clock cycles derived from the USRP clock, allowing for slot-synchronized operations, eliminating the need for external clocks.
- Our software is publicly available under the GNU Public License (GPL).

References

[1] K. R. Chowdhury and T. Melodia, “Platforms and testbeds for experimental evaluation of cognitive ad hoc networks,” IEEE Communications Magazine, vol. 48, no. 9, pp. 96–104, 2010.
[2] MathWorks. “Comm. System Toolbox Support Package for USRP Radio Documentation.”

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