DOT3 Radio Stack


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Network Stack implementation on a new platform of wireless sensors

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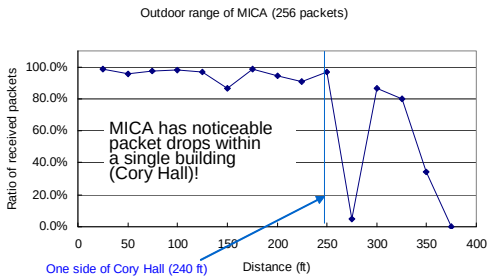
A DOT3 Mote

Motivation

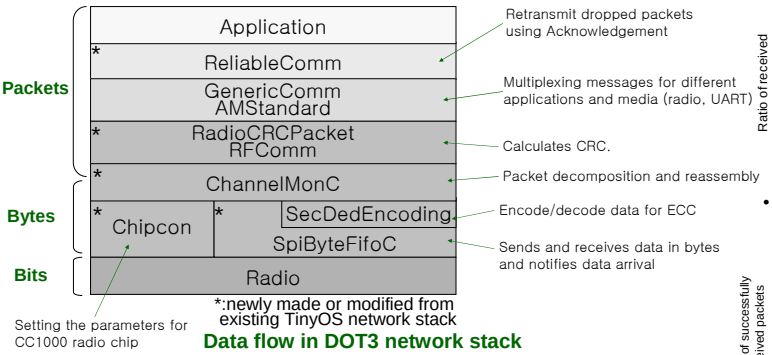

A MICA mote, the current generation of wireless motes in Berkeley


A DOT3 mote with its radio chip (CC1000) in the middle



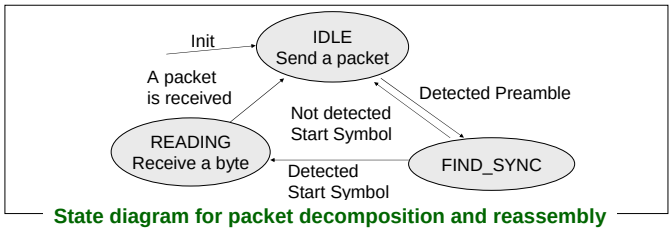
- MICA is not enough for large scale applications.
- DOT3 is a new platform with CC1000 radio chip.
- We aim to have a working network stack for DOT3 in nesC harnessing its improved performance of radio.

Design & Implementation



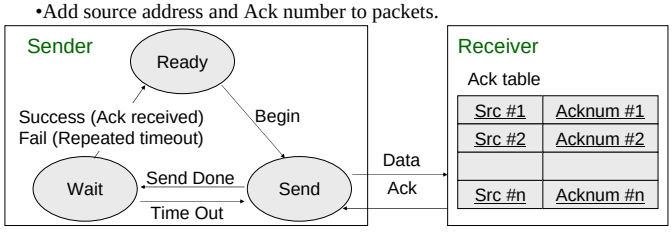
Data flow in DOT3 network stack

- How to decompose and reassemble a packet to and from raw bytes?
  - Sending: sends a byte when the byte buffer is empty
  - Receiving: detects the start of a packet using preamble and start symbol triggers an event when all the bytes are ready.



State diagram for packet decomposition and reassembly

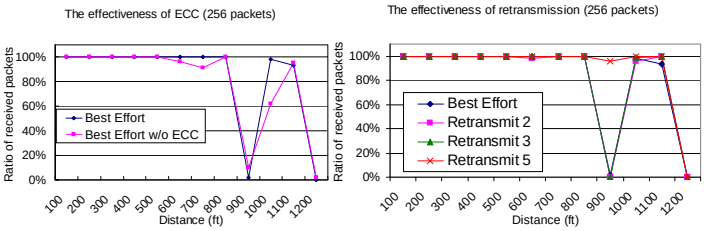
- How to transmit messages reliably?
  - Add source address and Ack number to packets.



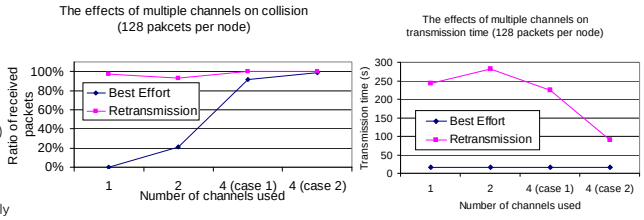
Schematic of reliable transmission

Evaluation

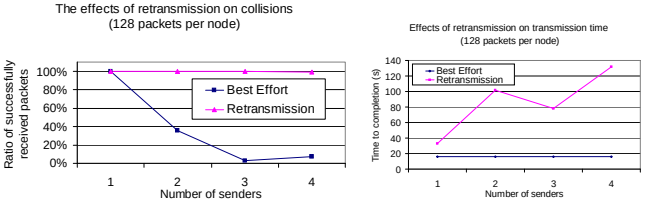
- The sender sends a number of packets and the receiver counts how many packets it received from the sender as we vary the distance between the nodes 100 through 1200ft.
- Ratio of successfully received packets is an indicator of effectiveness of each transmission method



- Transmission with error correction code, no packets were dropped within 800ft compared to 500ft for non-ECC version.
- Retransmission reduced the packet losses with additional costs.



- Using multiple channels reduced the packet losses due to collision.



- Retransmission reduced most of the packet losses due to collision with a little high costs (over 6 times in case of 4 senders).

Discussion and Future Works

- Comparison with MICA
  - Pros: Better coverage and reliability
  - Cons: Slower transmission (60 sec vs. 9 sec for 512 packets) caused by
    - Slower clock rate of radio (19Kbps vs. 40Kbps)
    - Less efficient interrupt handler
  - Modifying interrupt handler (from SPI to timer interrupt) will address this.
- Problems with our reliable transmission method
  - Effective for moderate collision, but not for high collision.
  - Introducing exponential back-off is expected to be helpful.
- Using multiple channels
  - Reduces collision.
  - Currently statically determined, vulnerable to misconfiguration.
  - Dynamic frequency allocation is needed.