



Research Consortium in Speckled Computing

SpeckMAC: Low-power MAC Protocol for Specknets

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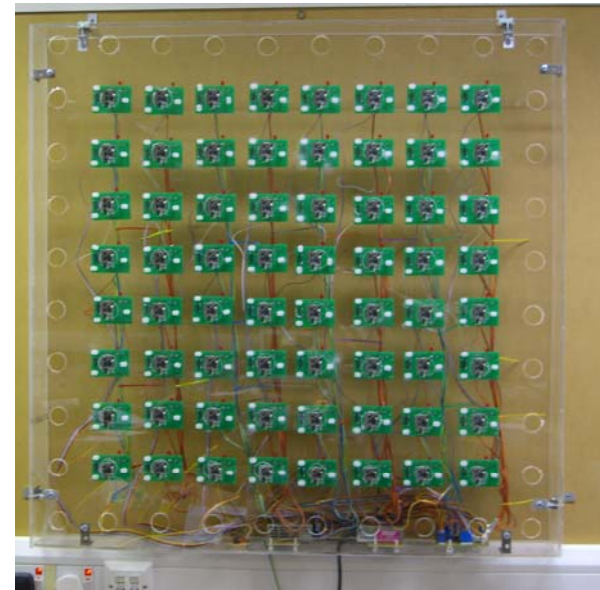
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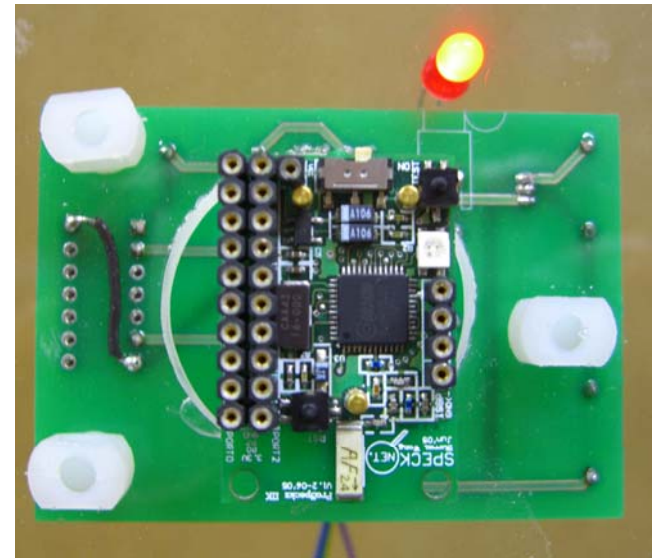
Perspeckz 64 – Test Platform

- Test Platform for up to 64 Prospeckz-IIk devices
- Used in validation of:
 - SpeckMAC
 - MANET Routing
 - Evacuation Application



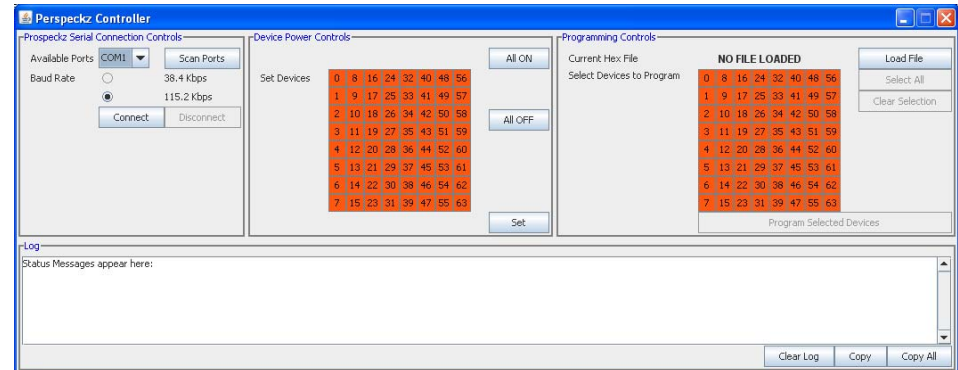
Perspeckz 64 – Hardware

- Individually controllable power supplies
- Control hardware with prospeckz / PC interface



Perspeckz 64 – Software

- PC Interface:
 - Wireless Programming of devices
 - Power controls to adjust network topology

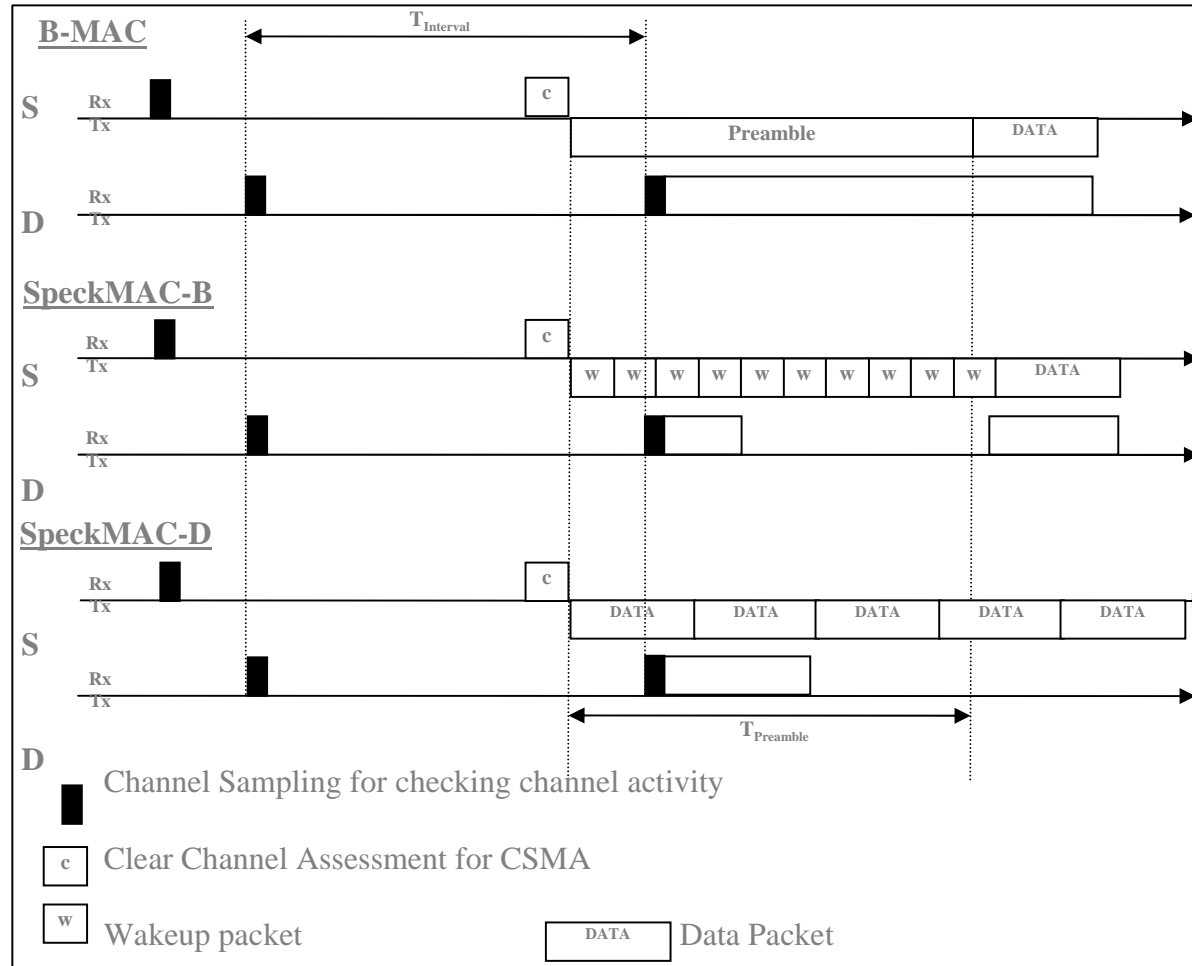


- Prospeckz SW stack for Experiment control and Results Collection

SpeckMAC



Comparison of B-MAC, SpeckMAC-B and SpeckMAC-D



Berkeley MAC Protocol

- B-MAC
 - Periodically ($T_{interval}$) listen to the channel for activity
 - Rxer turns on if channel sensed to be busy and turns off after data pkt is Rxed or after Timeout
 - For Data Transmission, source sends a Preamble ($T_{preamble}$) before sending Data pkt, to wake up destination node during channel listening phase
 - For correct operation: $T_{preamble} > T_{interval}$



SpeckMAC Protocol (1)

- SpeckMAC
 - Use redundant retransmissions instead of long preamble
 - SpeckMAC-Backoff sends Wake-up pkts
 - SpeckMAC-Data sends actual Data pkts, repetitively
 - SpeckMAC-B fills preamble space with small Wakeup pkts
 - Each Wakeup pkt contains info. about Dest. Address of data pkt and timing info. about when the source node is expected to send the Data pkts.
 - Every node will periodically ($T_{interval}$) listen to channel for activity (similar to B-MAC)



SpeckMAC Protocol (2)

- SpeckMAC
 - If activity is sensed, node turns on Rxer and waits for reception of pkt – either Data or Wakeup
 - If Data pkt is Rxed, radio reverts into idle state and resumes periodic listening
 - If Wakeup pkt is Rxed, node reverts to idle state and backsoff for duration specified by the Rxed timing info. provided the destination address specified in the wakeup pkt matches its own address or a broadcast address
 - Node turns on Rxer again after the back-off duration in anticipation of Data pkt, and reverts to periodic channel listening after receipt of Data pkt

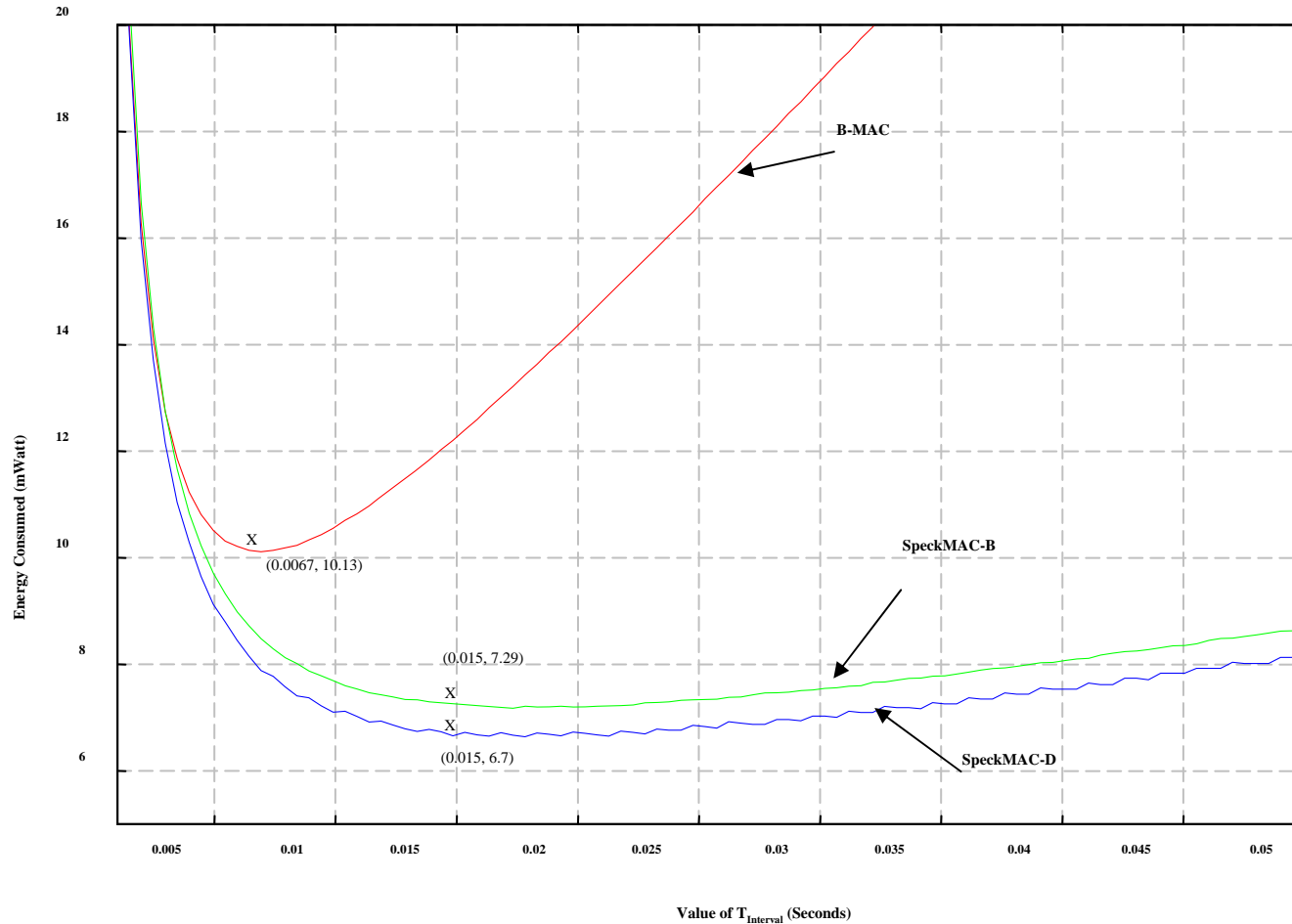


SpeckMAC-D

- SpeckMAC-D
 - Fills long preamble space with repetition of Data pkts
 - Unlike B-MAC, each Data pkt has a 3-byte short preamble
 - Nodes will listen to the channel periodically at intervals specified by ($T_{interval}$), and if activity is detected, then node will turn on its Rxer to enable Data pkt reception.
 - Node places the radio in idle state for a duration ($T_{interval}$), before resuming periodic channel listening



Power Consumption for range of $T_{interval}$

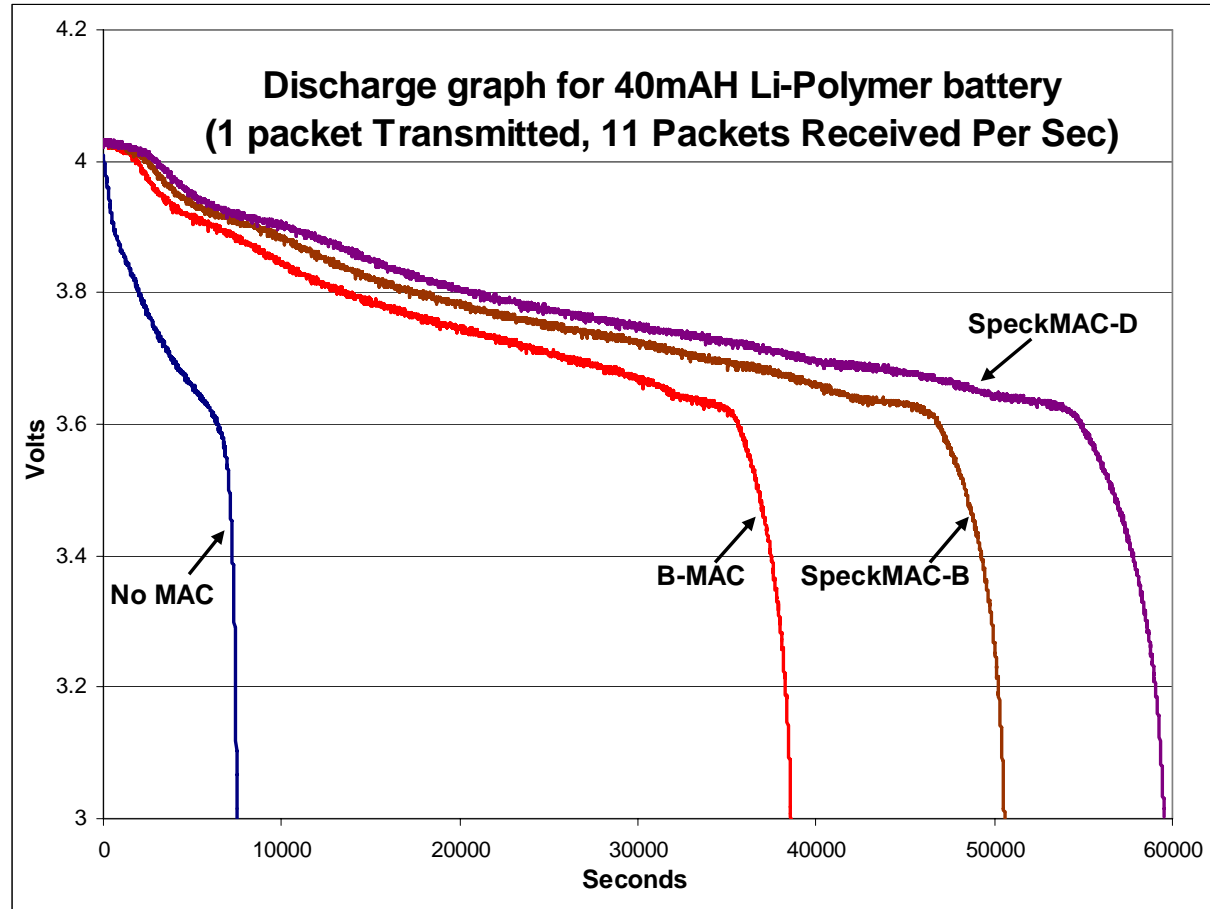


Battery Lifetime Benefit (1)

- Average Lifetime for 40mAh Polymer Li-Ion Battery
 - 12 node Single Hop network
 - Each node transmits 1 packet per second at 0dBm

	No MAC	B-MAC	SpeckMAC-B	SpeckMAC-D
Lifetime	7875s (2.13hrs)	41263s (11.46hrs)	52568s (14.6hrs)	56943 (15.8hrs)
Improvement over No MAC		5.24	6.68	7.23
Improvement over B-MAC			1.274	1.38
Calculated improvement over B-MAC (20)			1.376	1.463

Discharge graph for Polymer Li-Ion battery



Battery Lifetime Benefit (2)

- Average Lifetime for Lithium CR1220 Coin Cells

	No MAC	B-MAC	SpeckMAC-B	SpeckMAC-D
Lifetime	38.8s	8124.3s	14908.8	17701.5
Improvement over No MAC		209.66	384.74	456.81
Improvement over B-MAC			1.83	2.179
Improvement over B-MAC (Polymer Li-ion) for comparison			1.274	1.38

Discharge graph for Lithium CR1220 Coin Cells

