CREW

Cognitive Radio Experimentation World

Online Monitoring of Spectrum Sensing Delay and Energy Consumption in the CREW Benchmarking Framework

UNIVERSITY OF THESSALY

NICTA

ADVANCING CREW EXPERIMENTATION TOOLS

✓ _Problem_: Experimental validation in the field of Cognitive Radio research lags behind in terms of:
- **sensing delay** and
- **energy consumed** during spectrum monitoring.

✓ _Solution_: Our innovative **hardware** and **software** solutions will advance the CREW experimentation tools to enable consideration of the above factors.

NITOS ADVANCED CM CARD

✓ Based on **Arduino Mega** board
✓ **Ethernet Shield** provides for distributed energy measurements
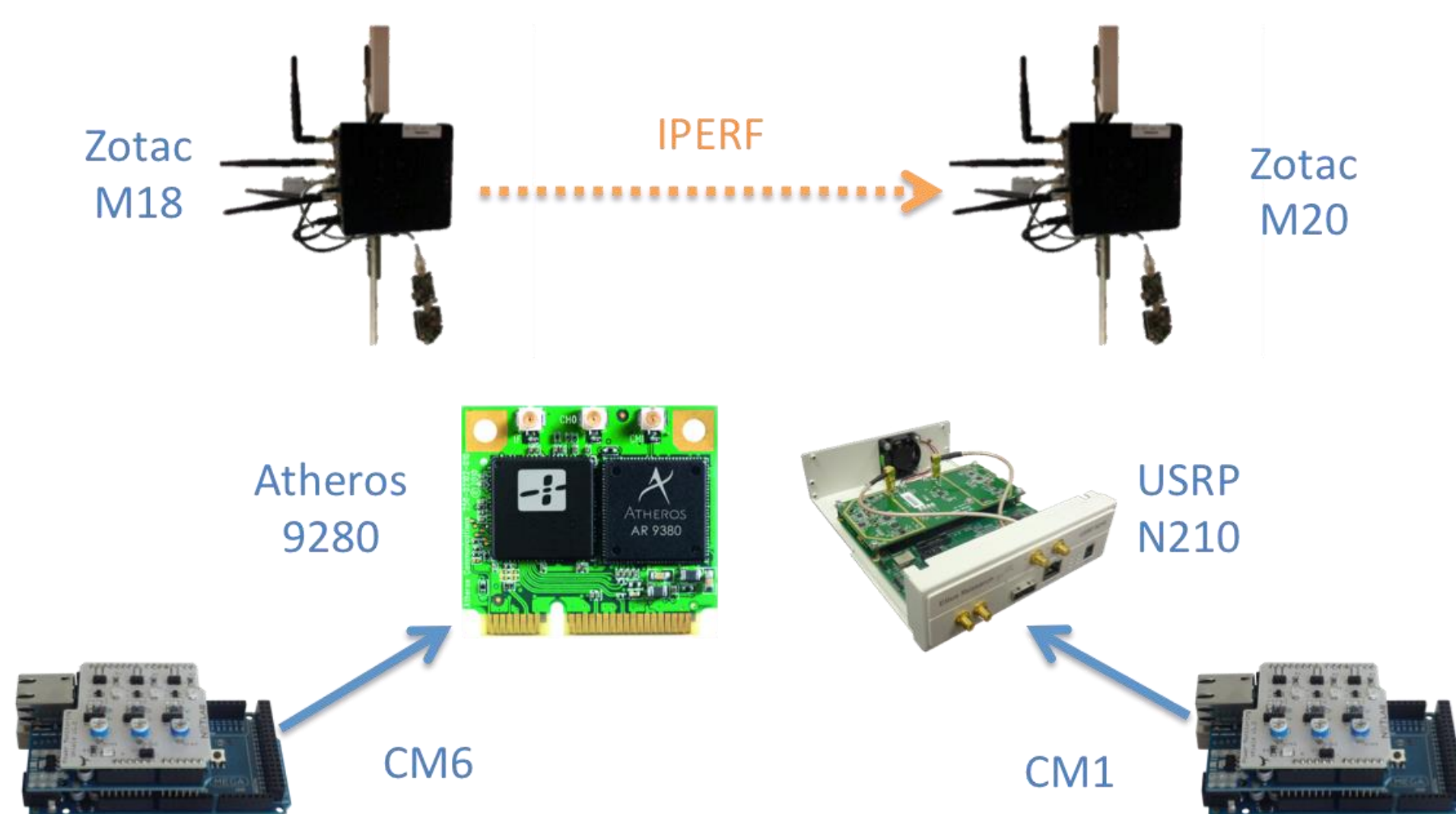✓ **Custom Shield** extended through the **INA139 Current Shunt Monitor**
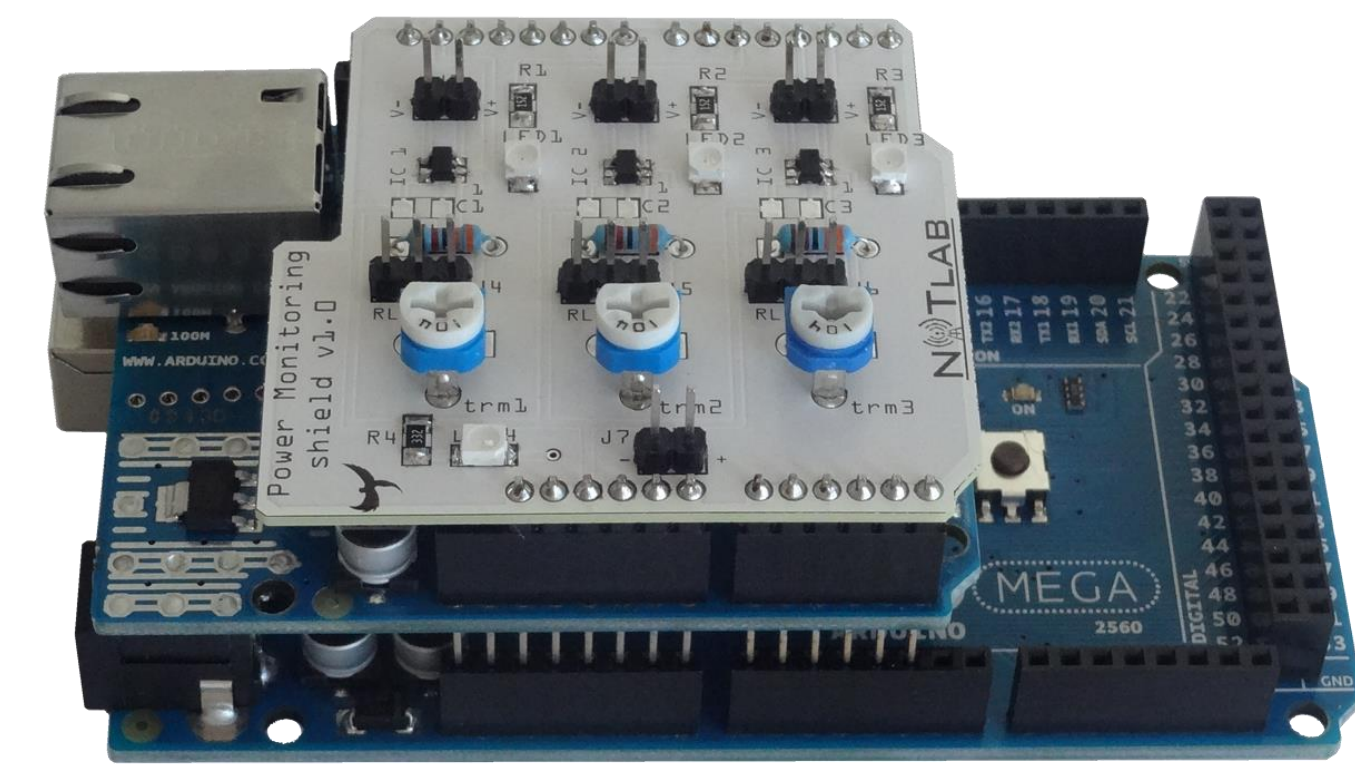
65.000 samples/sec of 10-bit accuracy

REMOTE EXPERIMENT IN w-iLab.t TESTBED
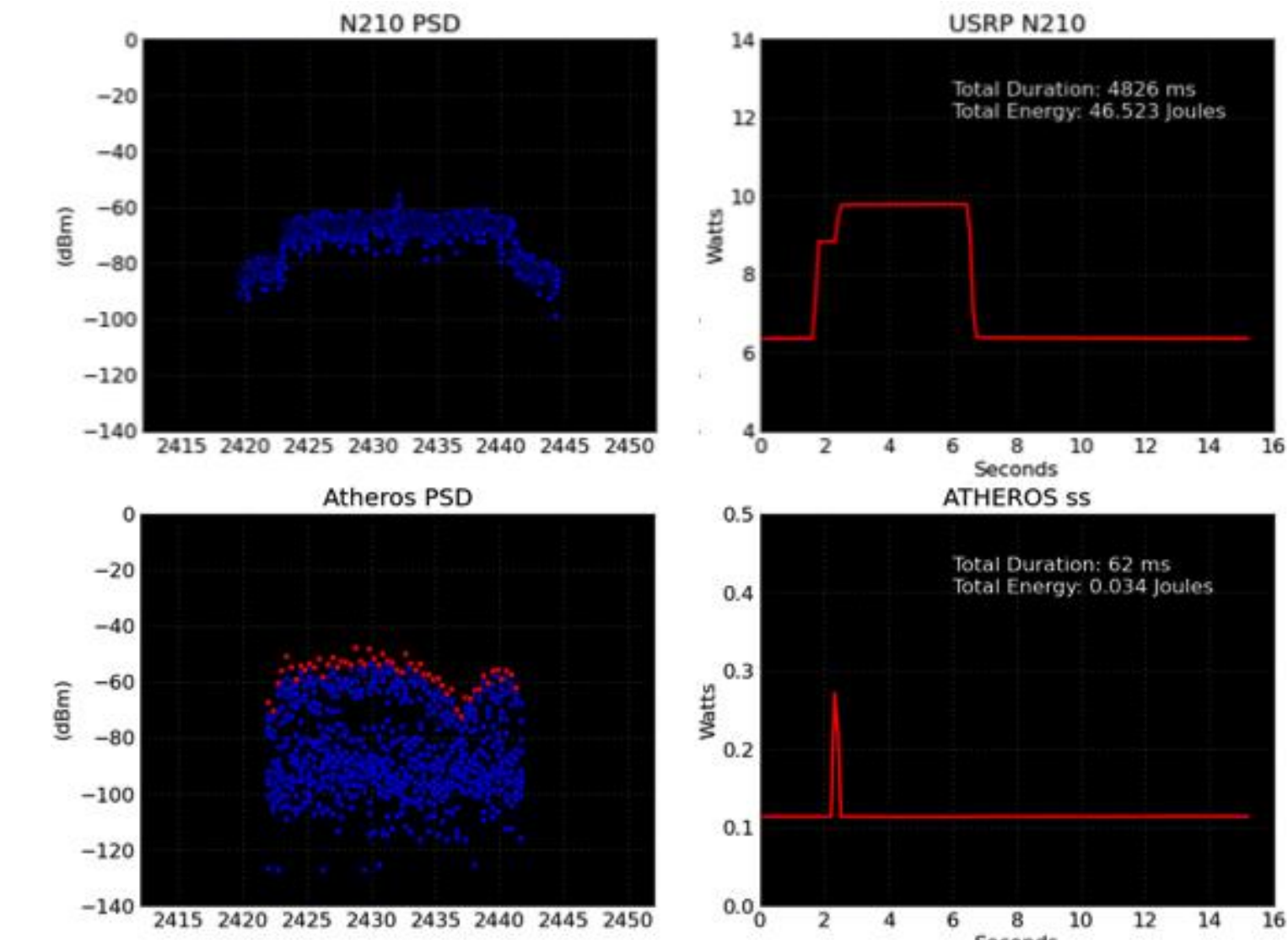
WiFi transmission on 2.4 GHz

Zotac M18 — IPERF → Zotac M20

Captured by 2 Spectrum Sensing devices

Atheros 9280   USRP N210

Power monitored by 2 NITOS ACM cards

CM6   CM1

EXPERIMENTAL EVALUATION

N210 PSD   USRP N210

Atheros PSD   ATHEROS ss

Power Spectral Density   **Power Consumption**

Total Duration: 4826 ms
Total Energy: 46.523 Joules

Total Duration: 62 ms
Total Energy: 0.034 Joules

Cross-technology interference avoidance and cognitive prototyping

cnit

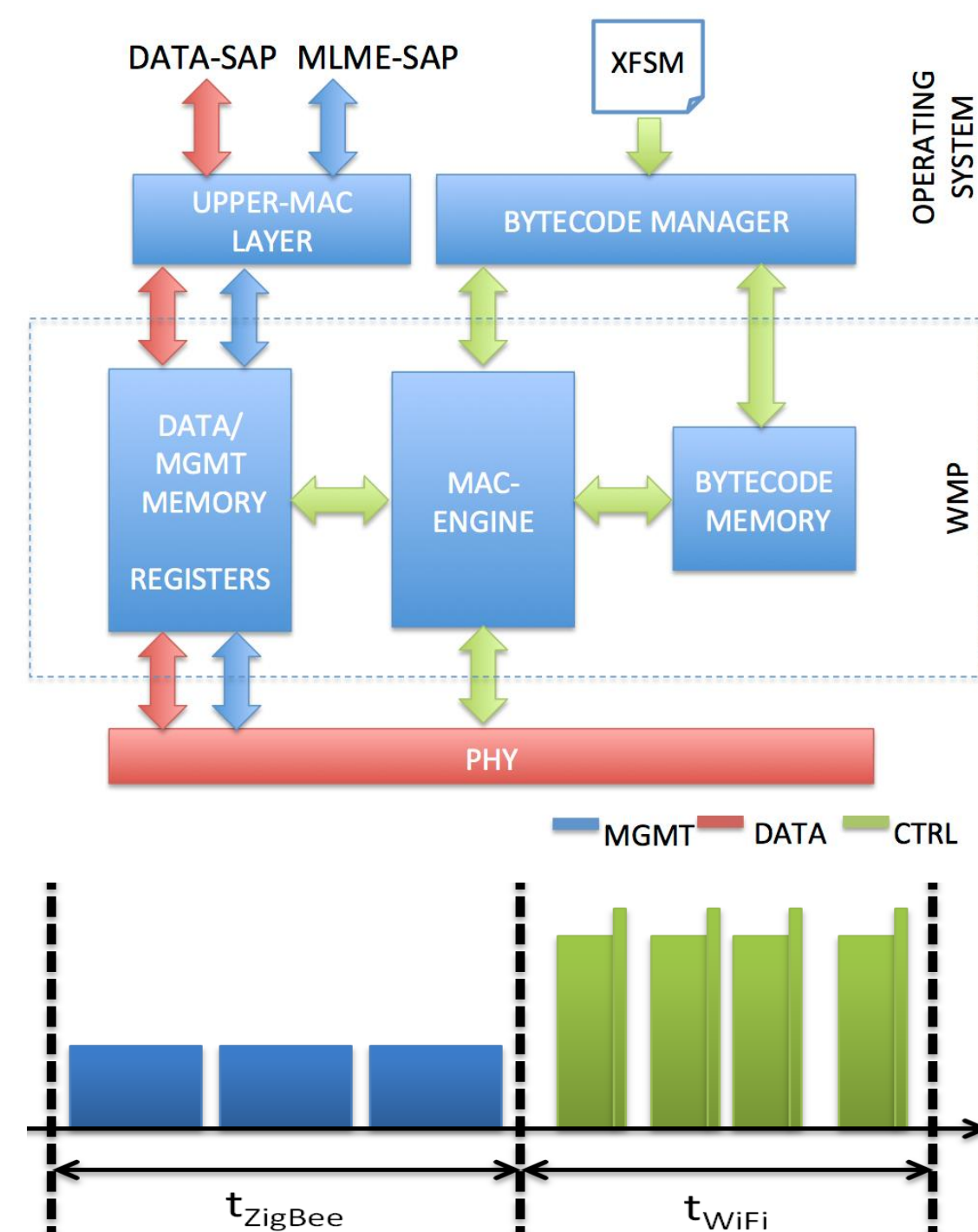TX   CCA (128us)   TX
TX/RX (192us)
RX/TX (192us)
WiFi
ZigBee
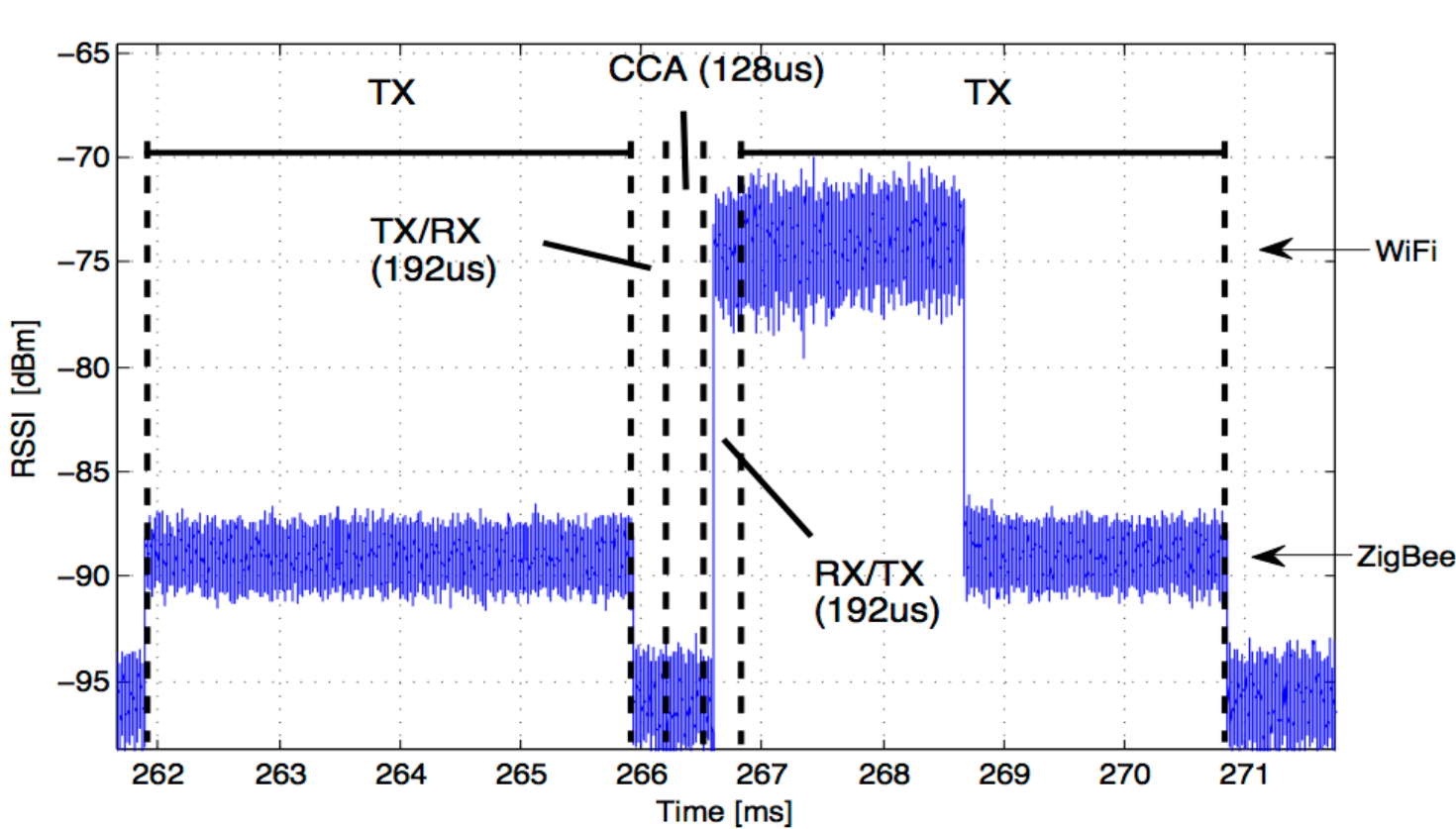
MAC Programmability
- clean separation between the MAC protocol logic at the highest level
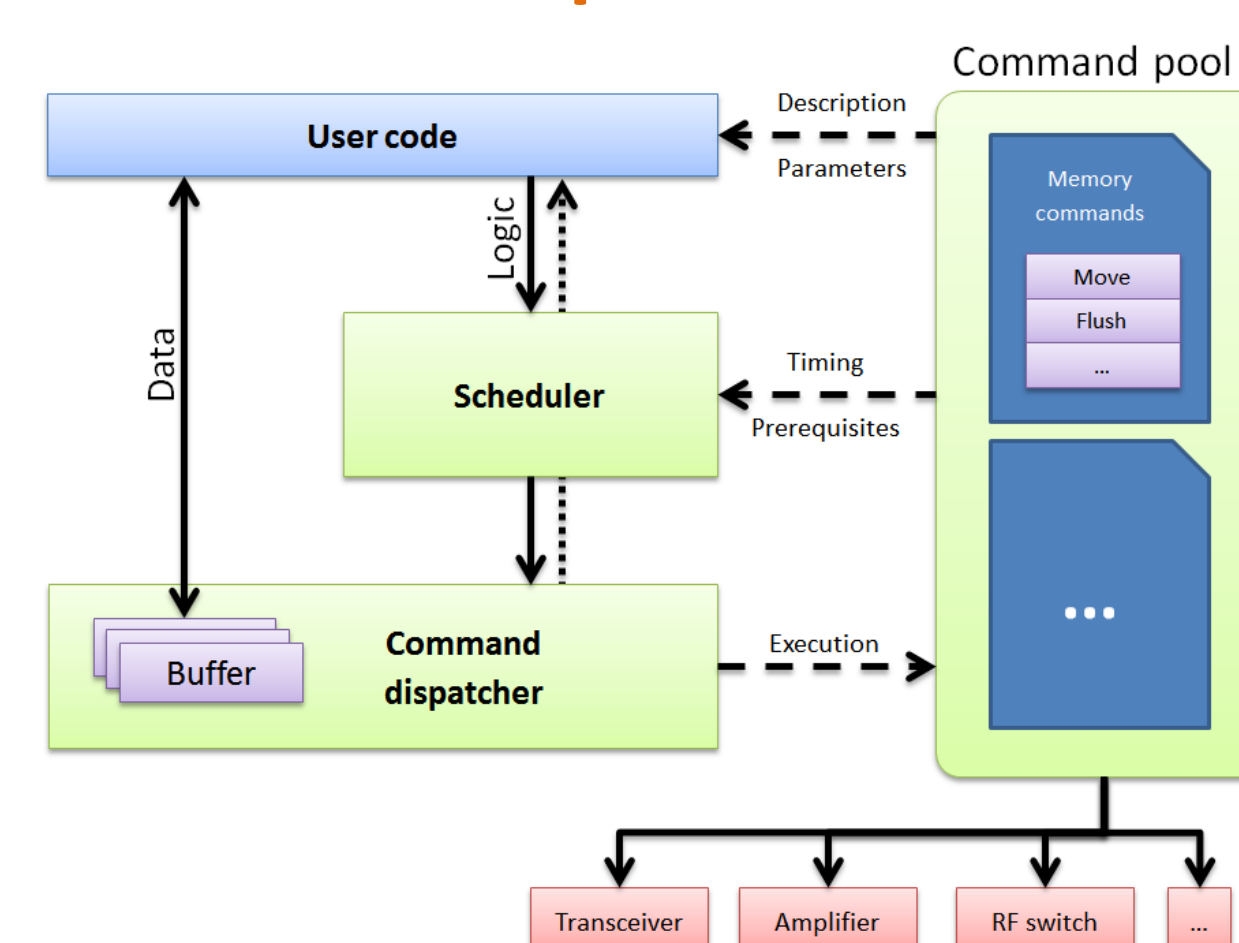- easy way to compose new MAC designs and getting feedback from the radio capabilities

Wireless MAC Processor Wireless node programming architecture based on _MAC-Engine_ and software-defined state machine (XFSM) formal description

snapMAC programmable MAC architecture for IEEE 802.15.4 radios that supports runtime protocol changes and parameter adaptation

OML → Coordinator

ZigBee receiver))) (((ZigBee transmitter
WiFi receiver))) (((WiFi transmitter

CROSS-TECHNOLOGY INTERFERENCES
we created a TDMA-like protocol that allows WiFi and ZigBee to efficiently share the spectrum.

Error Sensing events intercept the presence of co-channel interfered transmissions, i.e. IEEE 802.15.4

Wireless MAC Processor (WMP)

DATA-SAP MLME-SAP   XFSM
UPPER-MAC LAYER   BYTECODE MANAGER   OPERATING SYSTEM
DATA/MGMT MEMORY   MAC-ENGINE   BYTECODE MEMORY   WMP
REGISTERS
PHY
MGMT   DATA   CTRL
t_ZigBee   t_WiFi

snapMAC

User code
Scheduler
Buffer   Command dispatcher
Command pool
Memory commands: Move, Flush
Transceiver   Amplifier   RF switch   ...
Description, Parameters, Logic, Data, Timing, Prerequisites, Execution

COGNITIVE LOOP
This solution was used in a cognitive loop to improve the performance of an interfering WiFi and ZigBee network. Results show a significant improvement in throughput and efficient channel usage.

Legacy — WiFi / ZigBee
TDMA — WiFi / ZigBee

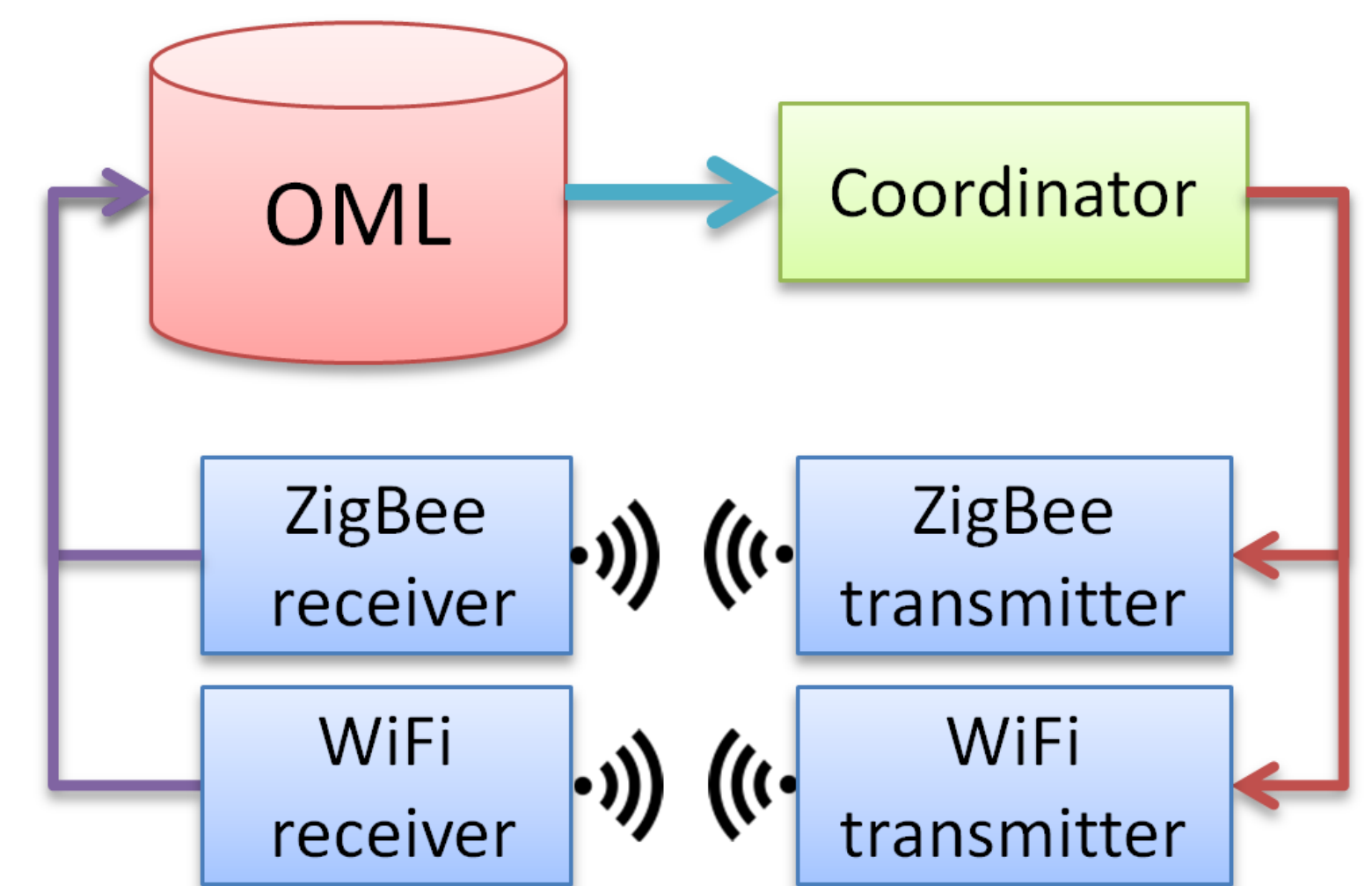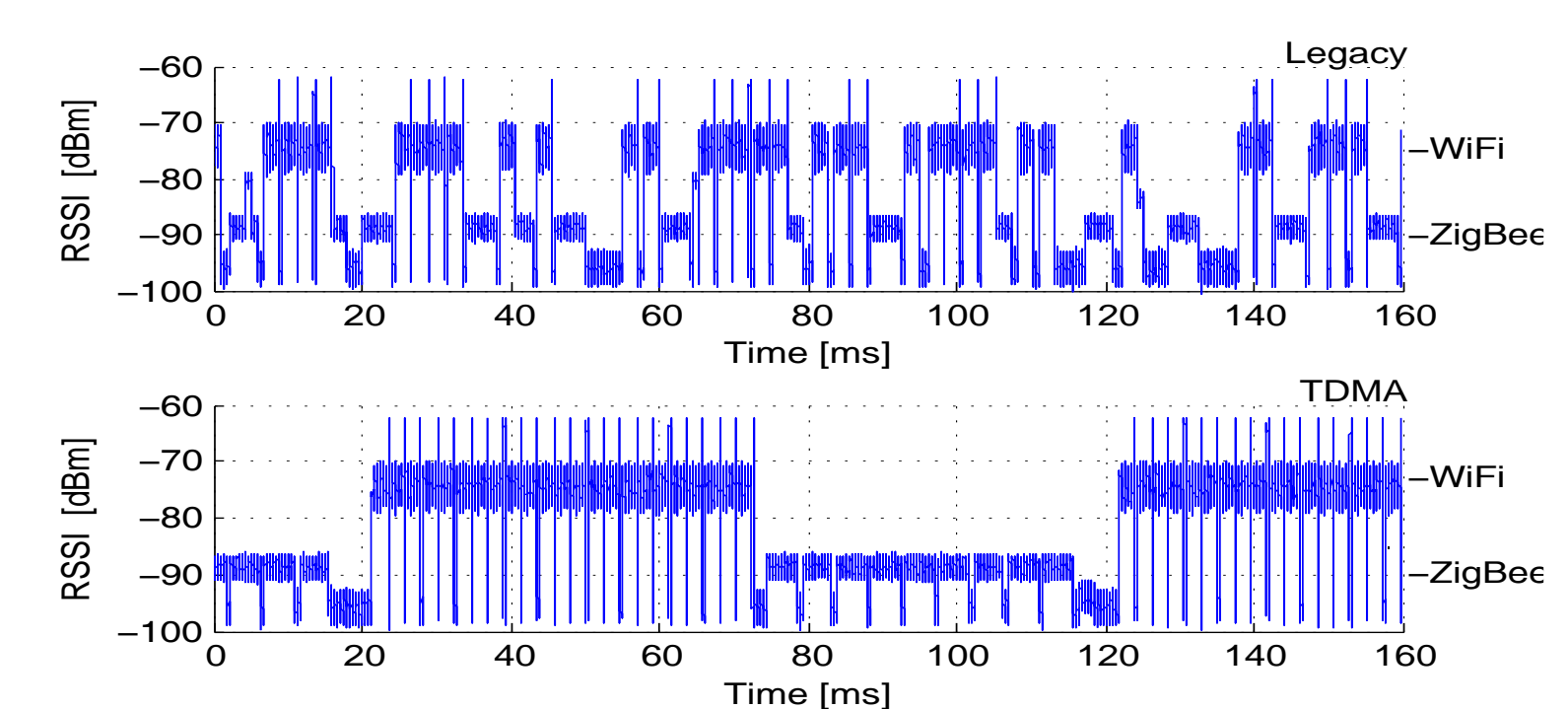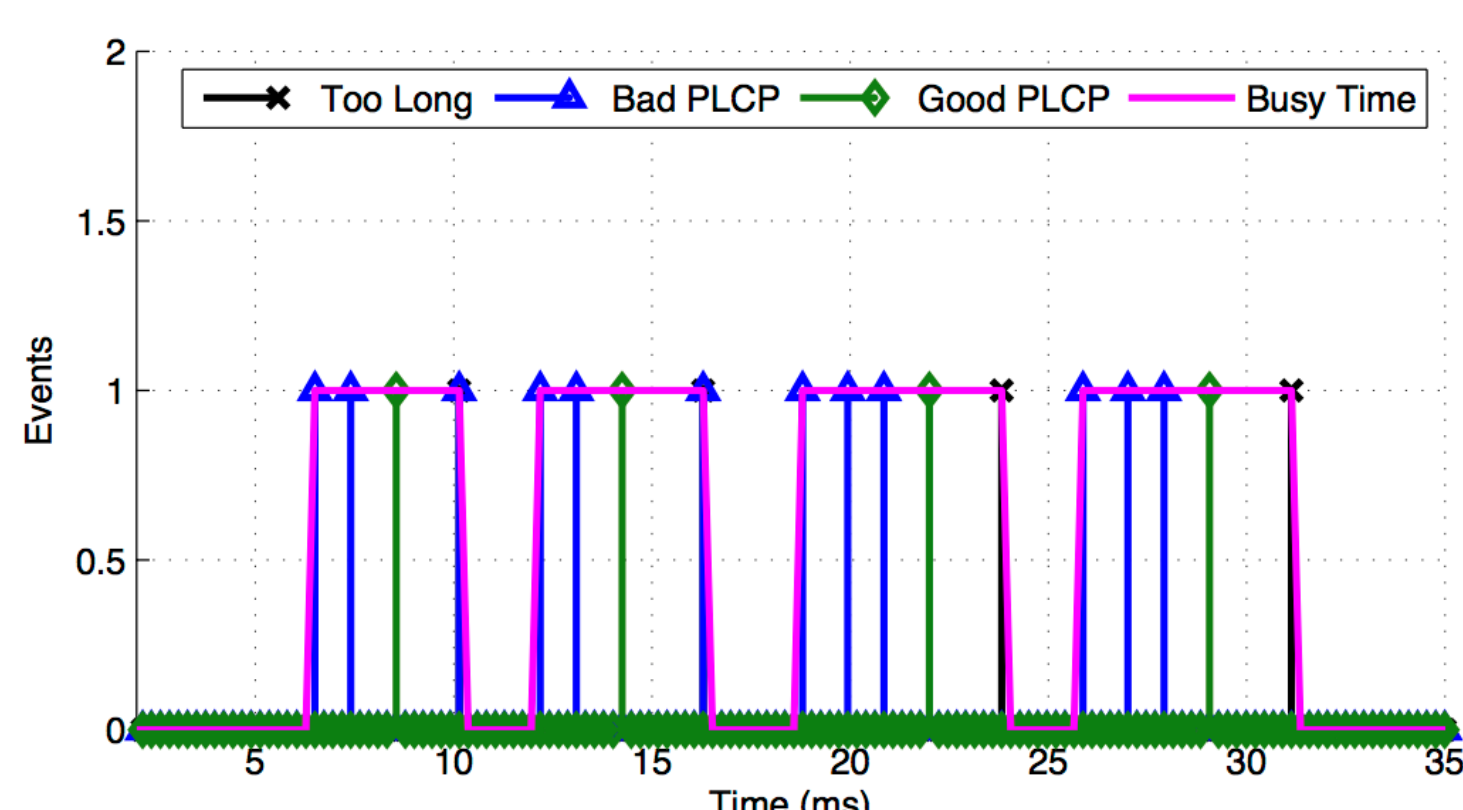**In our Demo**
A live interactive WiFi-ZigBee coexistence experiment with performance evaluation and timeslot occupancy adaptation

PROJECT DATA
Start Date: 01/09/2010; Duration: 60 M
EU Funding: 4.885 M€

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