Cross-layer Design & Optimization for Wireless Sensor Networks

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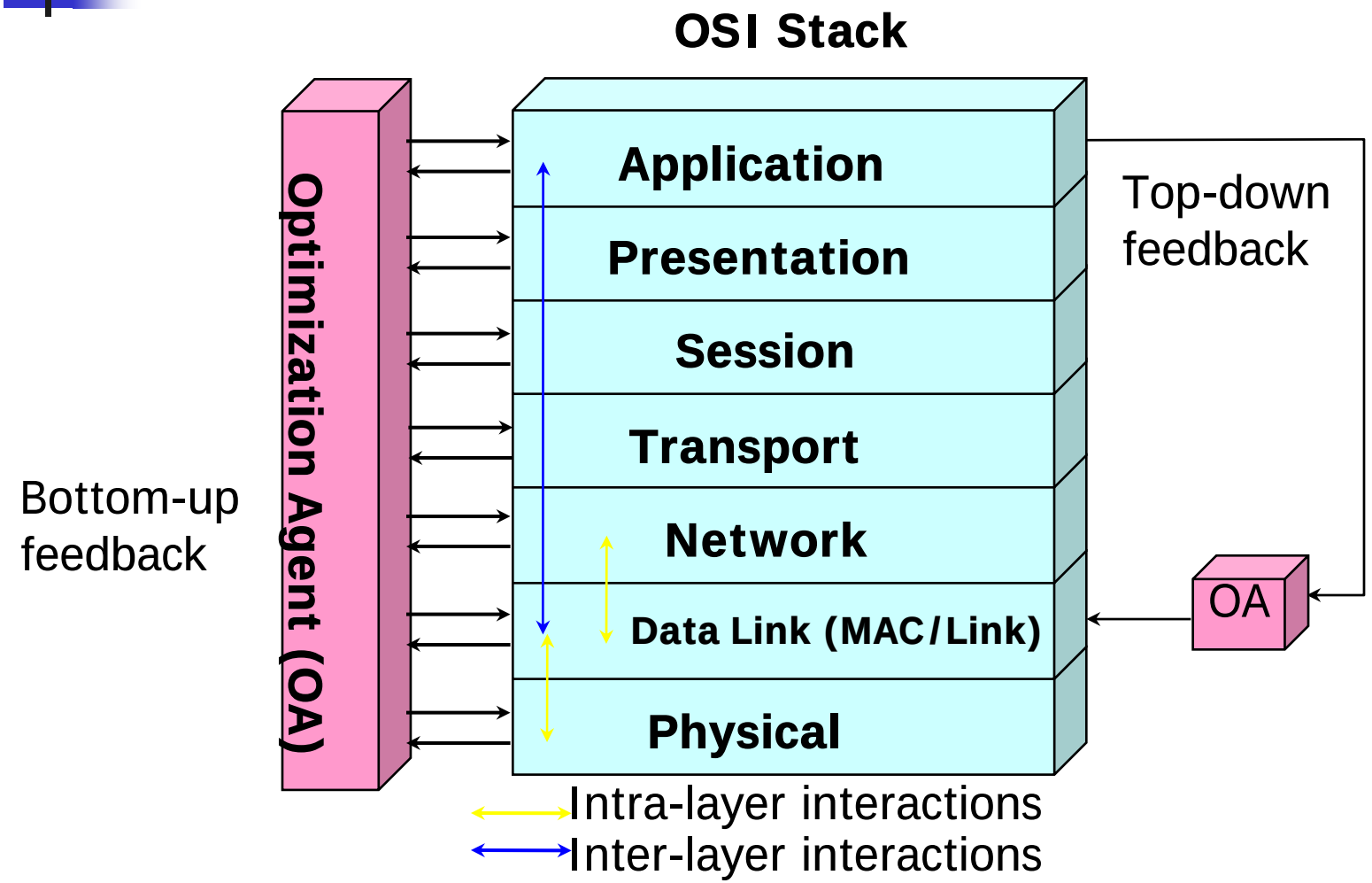
Outline

- Objectives
- Framework
- Approach
- Results & Findings
- Conclusions

Objectives

- Develop a framework for the cross-layer design and optimization study
- Investigate & explore the various areas where performance gains can be achieved in the context of WSNs

Cross-layer Design Framework



Approach

-> Approach: Study the effects of the wireless channel and performance at PHY to develop insights that can be used to design the optimization agent (OA)

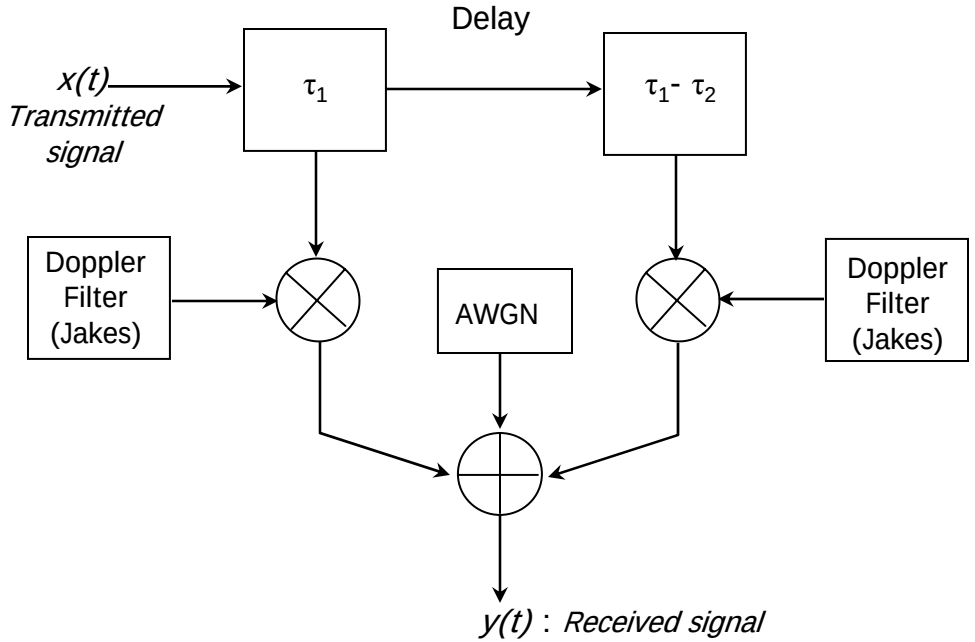
- Tapped delay line implementation for wireless channel modeling
- Performance measurements using the micaz motes from Crossbow, Inc.

Tap Delay Line (TDL) Implementation

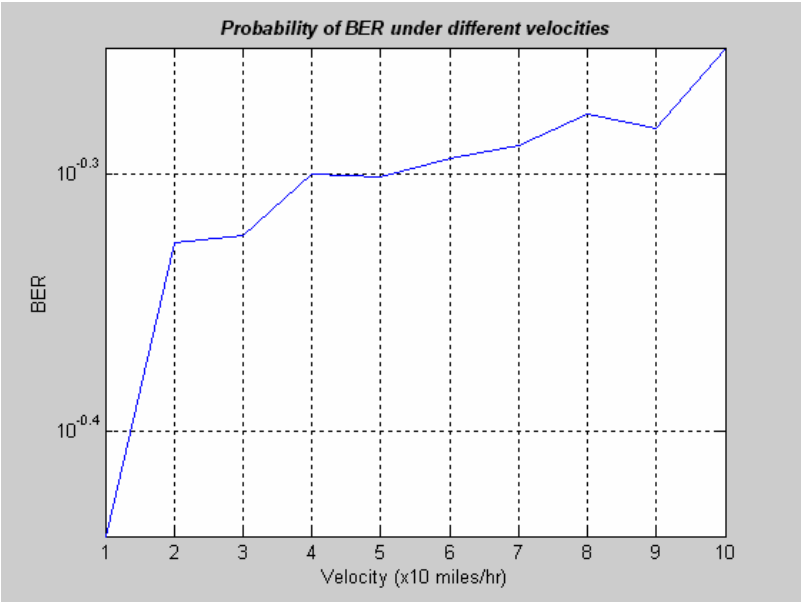
- 2-TDL channel model
- 12-taps TDL channel model from GSM REC.05-05 model to validate the results

TDL implementation

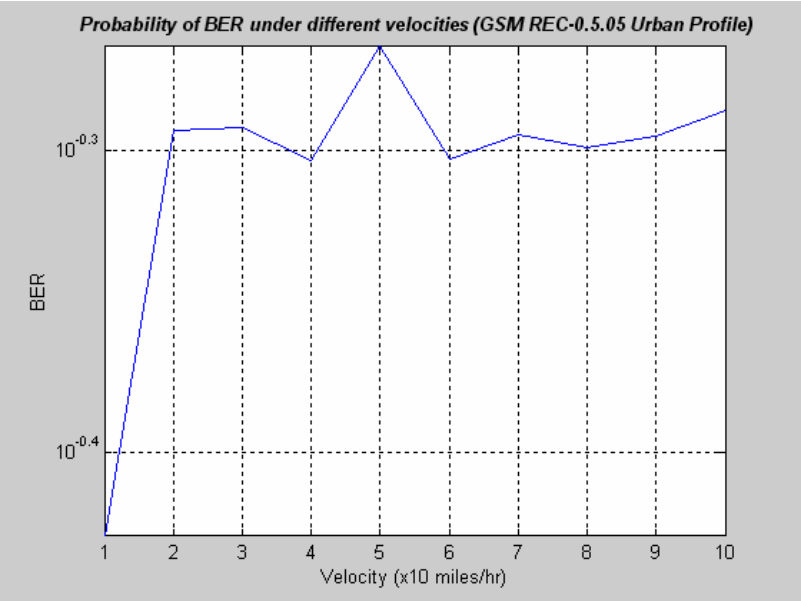
- 2-TDL Model



Results & Findings (1): TDL implementation



(a) BER of 2-TDL model

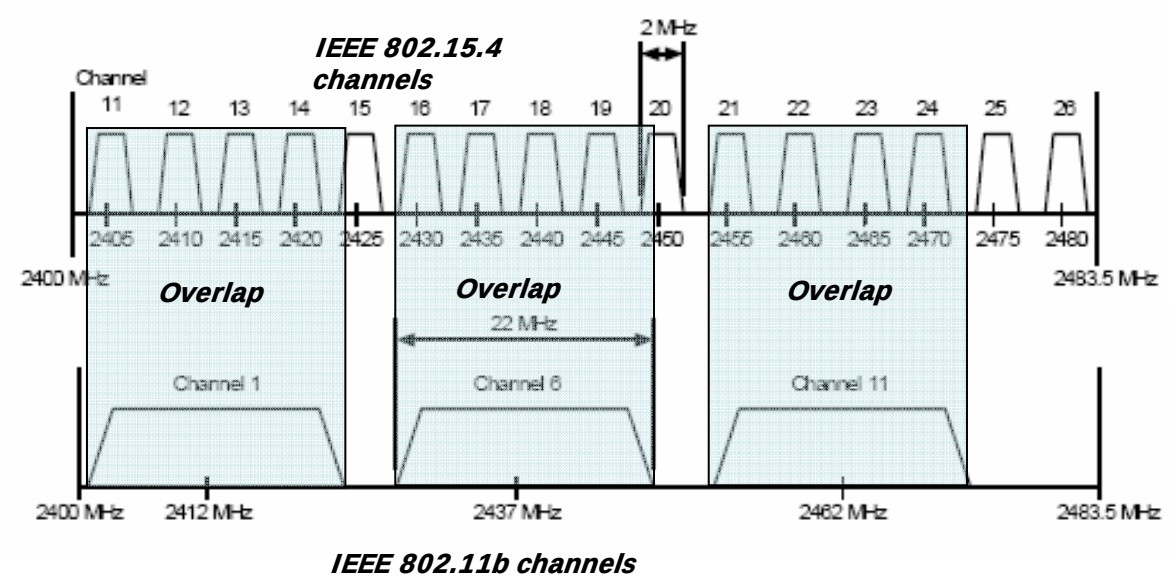


(b) BER of 12-TDL model (GSM REC.05-05)

Performance measurements of WSN using Micaz Motes

- Interference / Co-existence problems
- Transmission range & power transmit levels

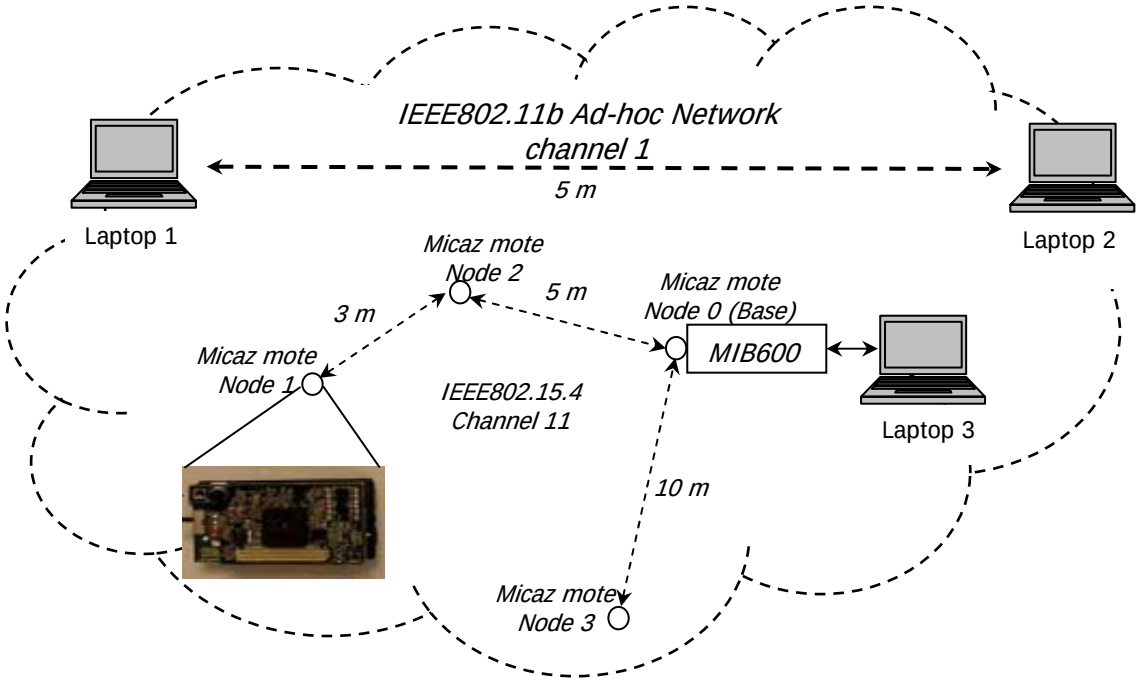
Interference Measurements: Frequency Spectrum



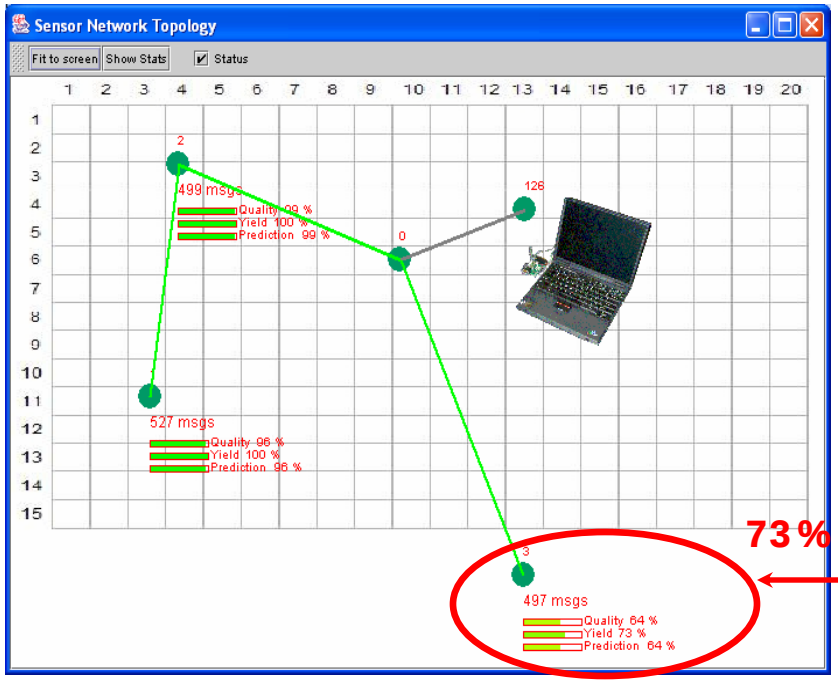
Overlapping of frequency bands between IEEE802.15.4 and IEEE802.11b channels within 2.4 GHz ISM band

Experimental Setup for Interference Measurements

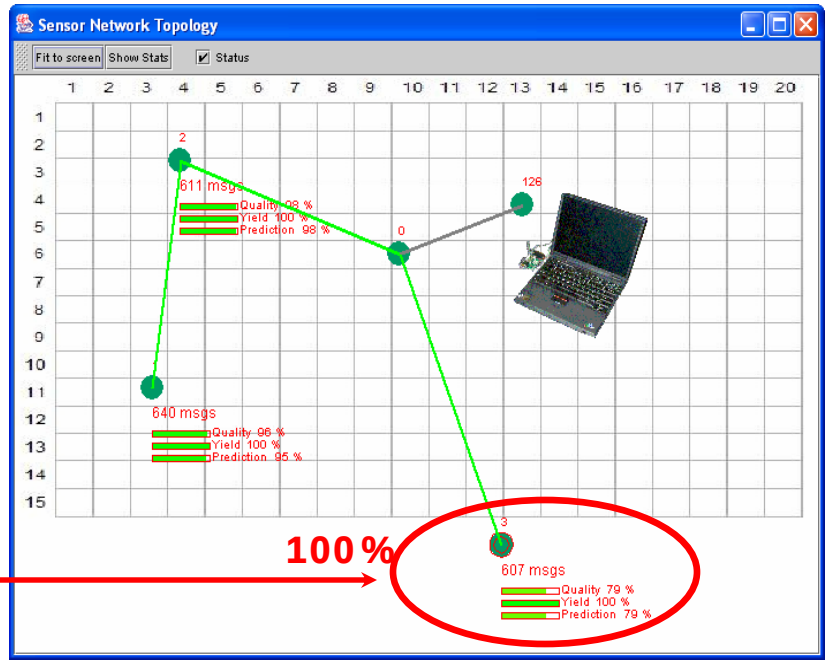
- Setup 2 networks:
  - IEEE802.15.4 network (using 4 micaz motes)
  - IEEE802.11b (via 2 laptops) – interference source



Results & Findings (2): Interference Measurements

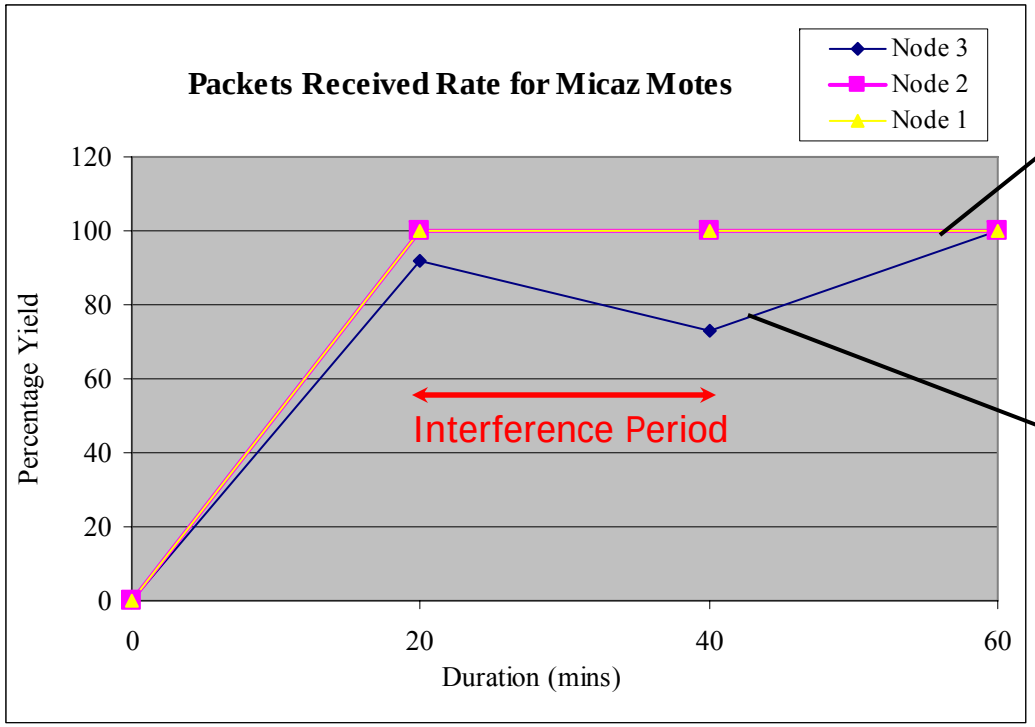


(a) Interference turned on



(b) Interference turned off

Results & Findings (2): Interference Measurements



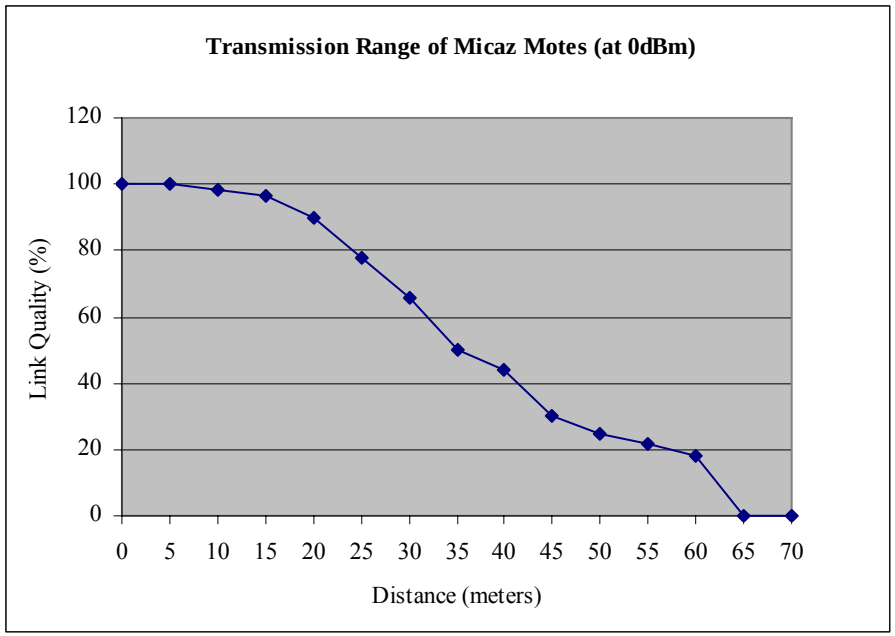
Node 1 & 2 (@ <5 m) unaffected by interference

Node 3 (@ 10 m) more affected by interference

Packets received rate

Results & Findings (3): Transmission range and power levels

- Maximum transmission range of 55-60m



Transmission range for micaz motes set at max power of 0 dBm

Conclusions

- Increasing BER under mobility conditions
- Possible interference within ISM bands and can affect the performance of WSN (especially for long links/hops)
- Max range for micaz motes is around 60m and recommended operating range < 30m
- Many factors need to be considered in the design of WSN
- Insights gained can be used to design and develop the optimization agent, to enhance the performance of wireless sensor networks

Q & A

Thank You