



Research Consortium in Speckled Computing

Comparison of Low-Power MAC Protocols

Ana Simões and Graham Booth

University of Edinburgh

a.l.gomes-simoes@sms.ed.ac.uk

g.booth@sms.ed.ac.uk



Index

- Application
- Goals of the study
- MAC protocols
- Results
- Conclusions
- Future work

Application

- Nodes transmitting data in a WSN:
 - Nodes should be within a communication distance in order to exchange messages
- Examples:
 - Animal tracking application
 - Tracking passenger in an airport
 - Tracking people in the Informatics Forum

Problems

- Wireless ad-hoc networks:
 - High dynamic
 - Unpredictable topology
- Problems:
 - Power consumption:
 - Small devices with low battery capacity

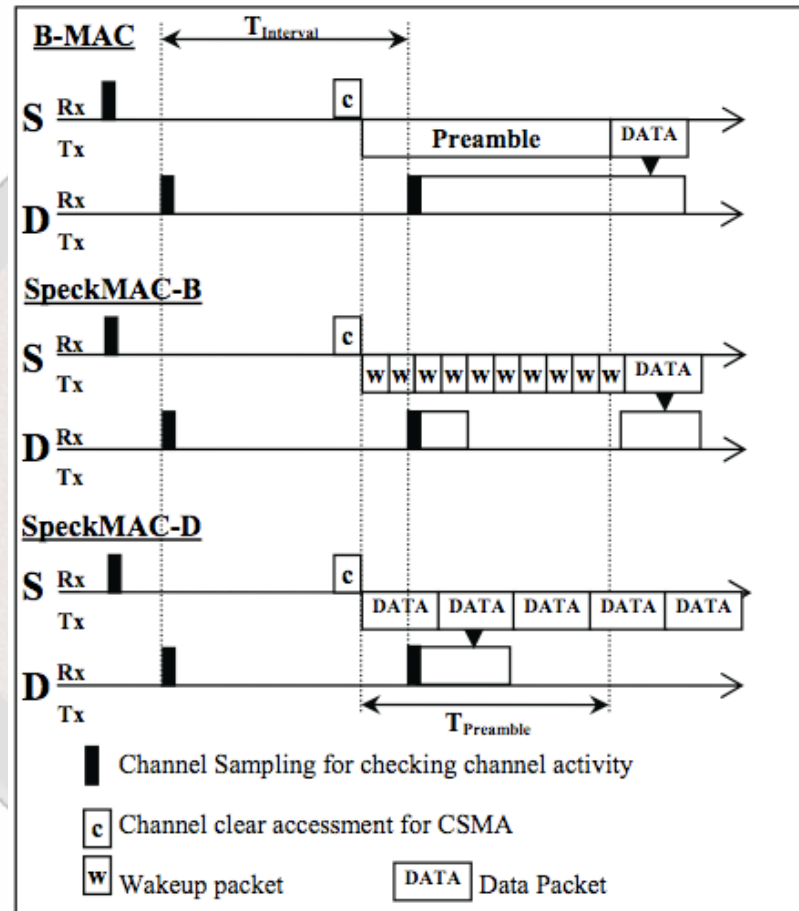
Solutions

- Reduction of the power consumption:
 - Minimising the idle listening
 - Reducing the number of collisions
 - Introducing the duty-cycle
- MAC protocols:
 - Aim to save power, avoid collisions and provide scalability
 - E.g: 802.15.4 (from Zig Bee), SpeckMAC, S-MAC, and B-MAC

Goals of this study

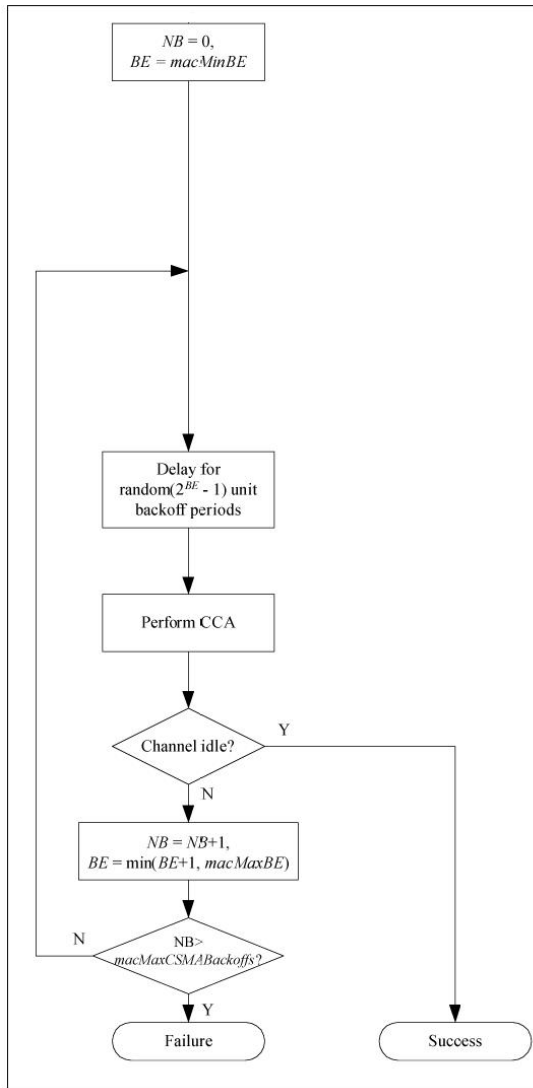
- Comparative study of selected MAC protocols:
 - For Wireless Sensor Networks
 - Using a simulator (SpeckSim)
- Comparison is based on several parameters such as:
 - Power consumption
 - % of packets correctly Tx/Rx
 - Latency
 - Life time

MAC protocols



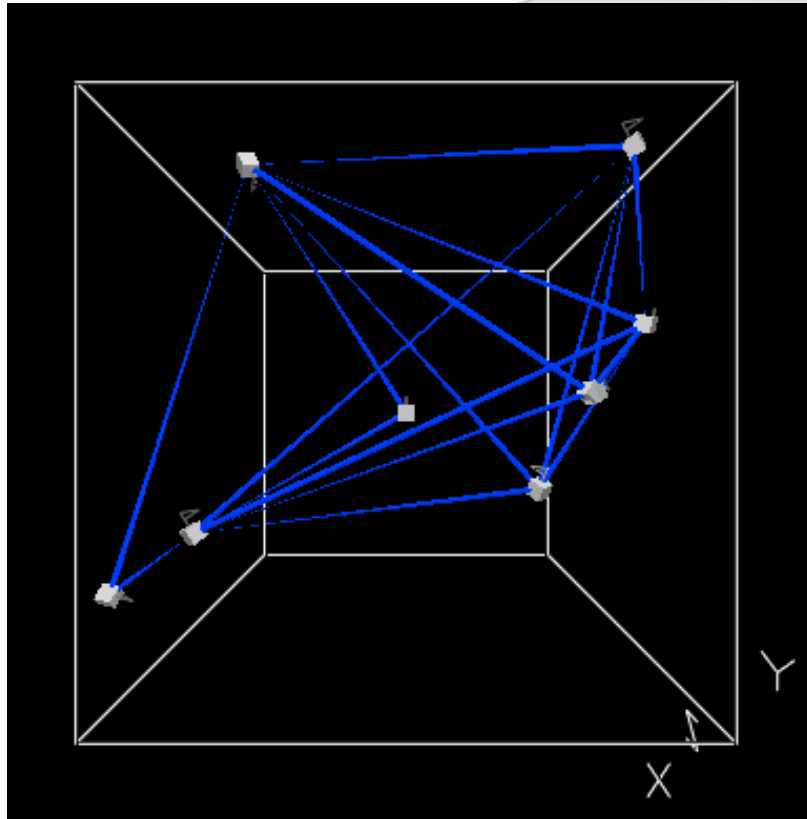
Source: "SpeckMAC: Low-power Decentralised MAC Protocols for Low Data Rate Transmissions in Specknets"

MAC protocols (IEEE 802.15.4)



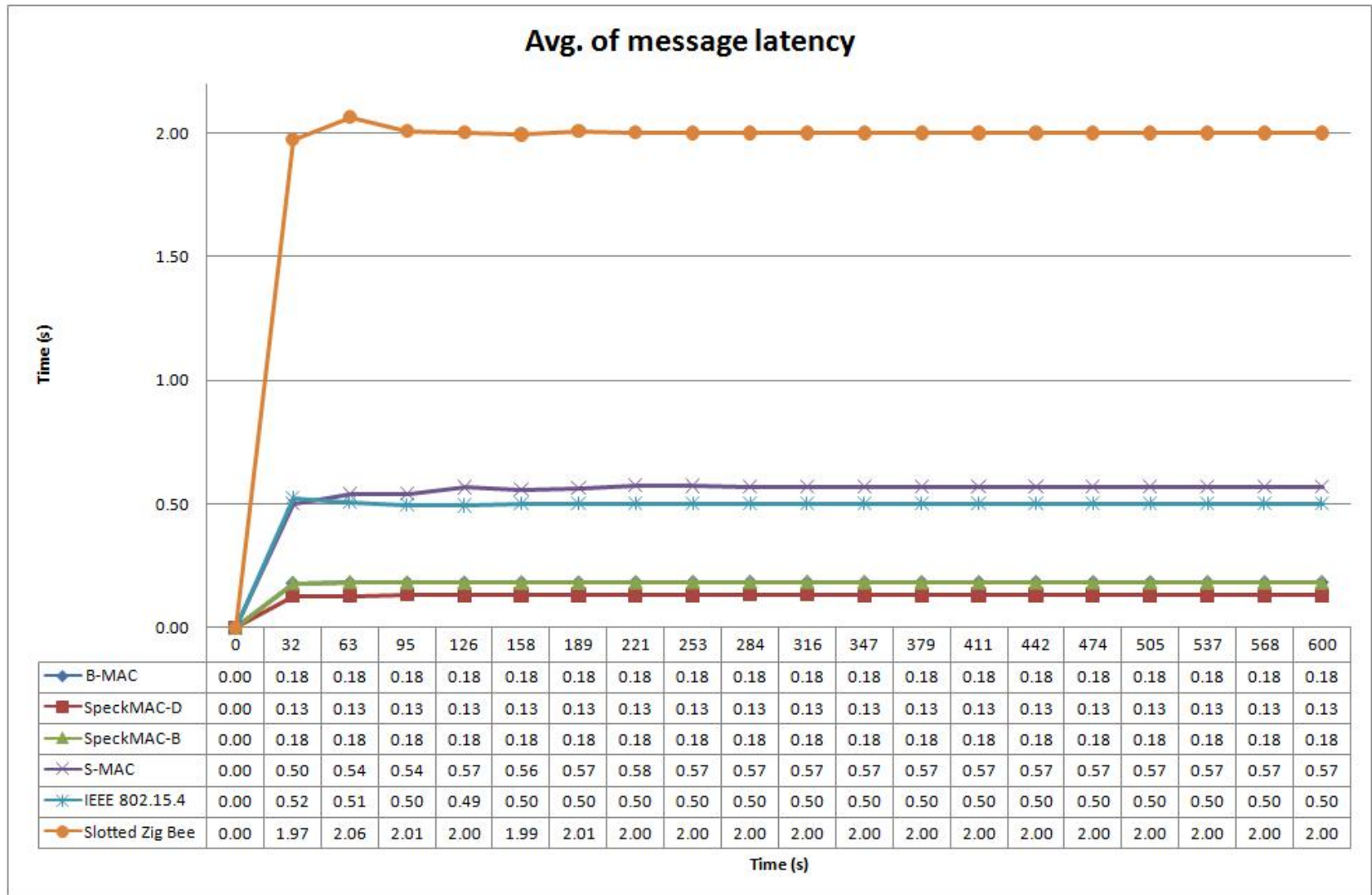
Source: Ieee standard for information technology telecommunications and information exchange between systems-local and metropolitan area networks-specific requirements - part 11: Wireless lan medium access control (mac) and physical layer (phy) specifications. IEEE Std 802.11-2007 (Revision of IEEE Std 802.11- 999), pages 1–1184, 12 2007

Scenario 1

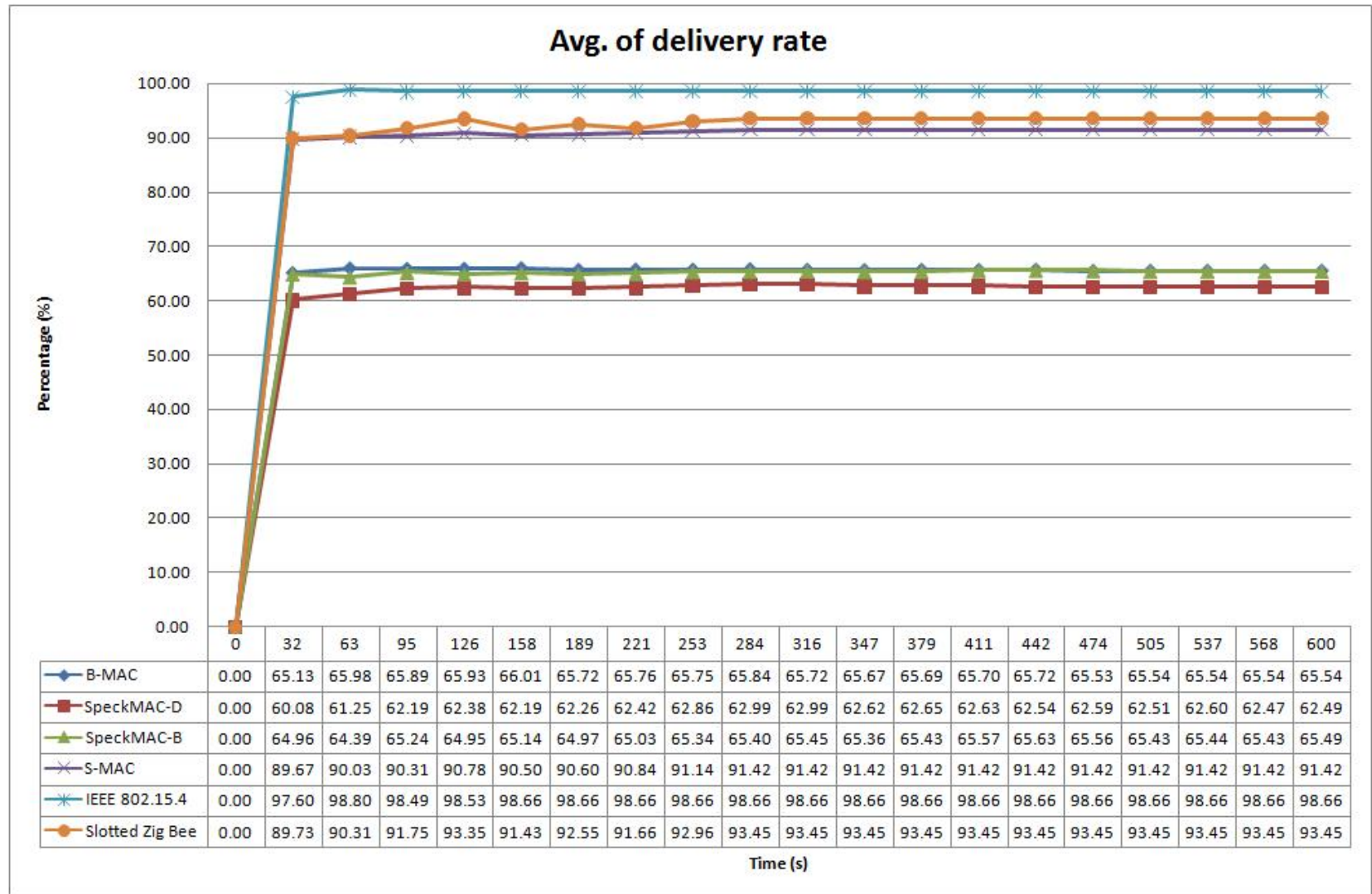


- 1 Fixed node in a fixed position
- 8 Mobile nodes moving

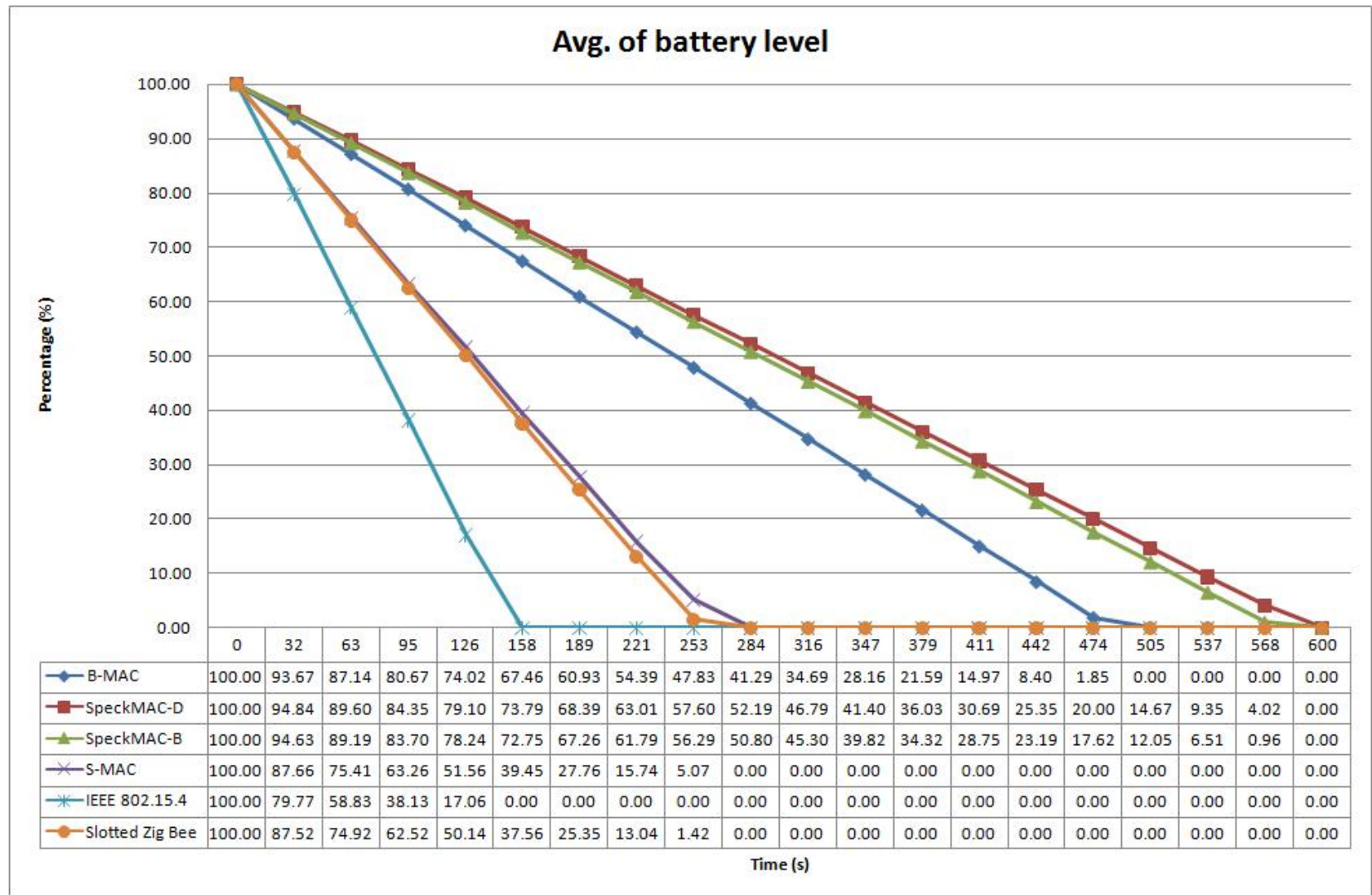
Results (Scenario 1)



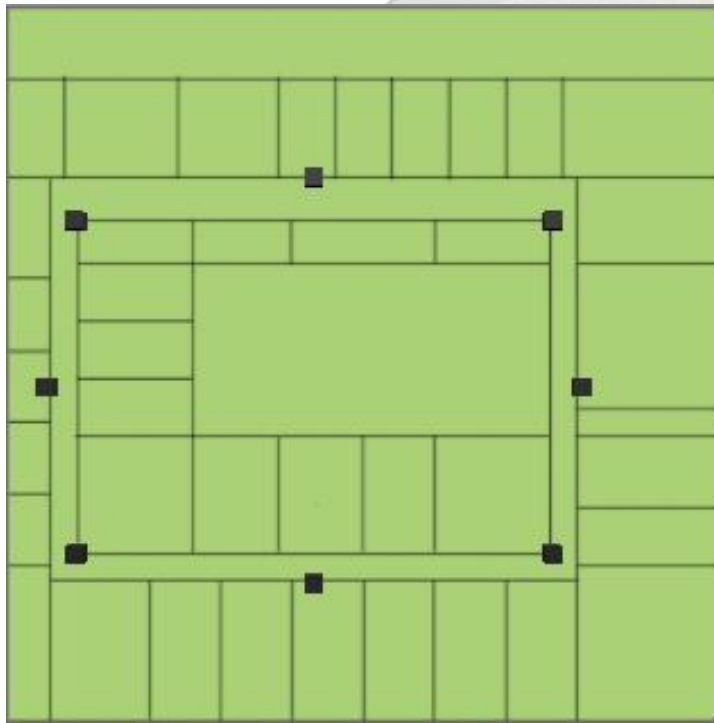
Results (Scenario 1)



Results (Scenario 1)

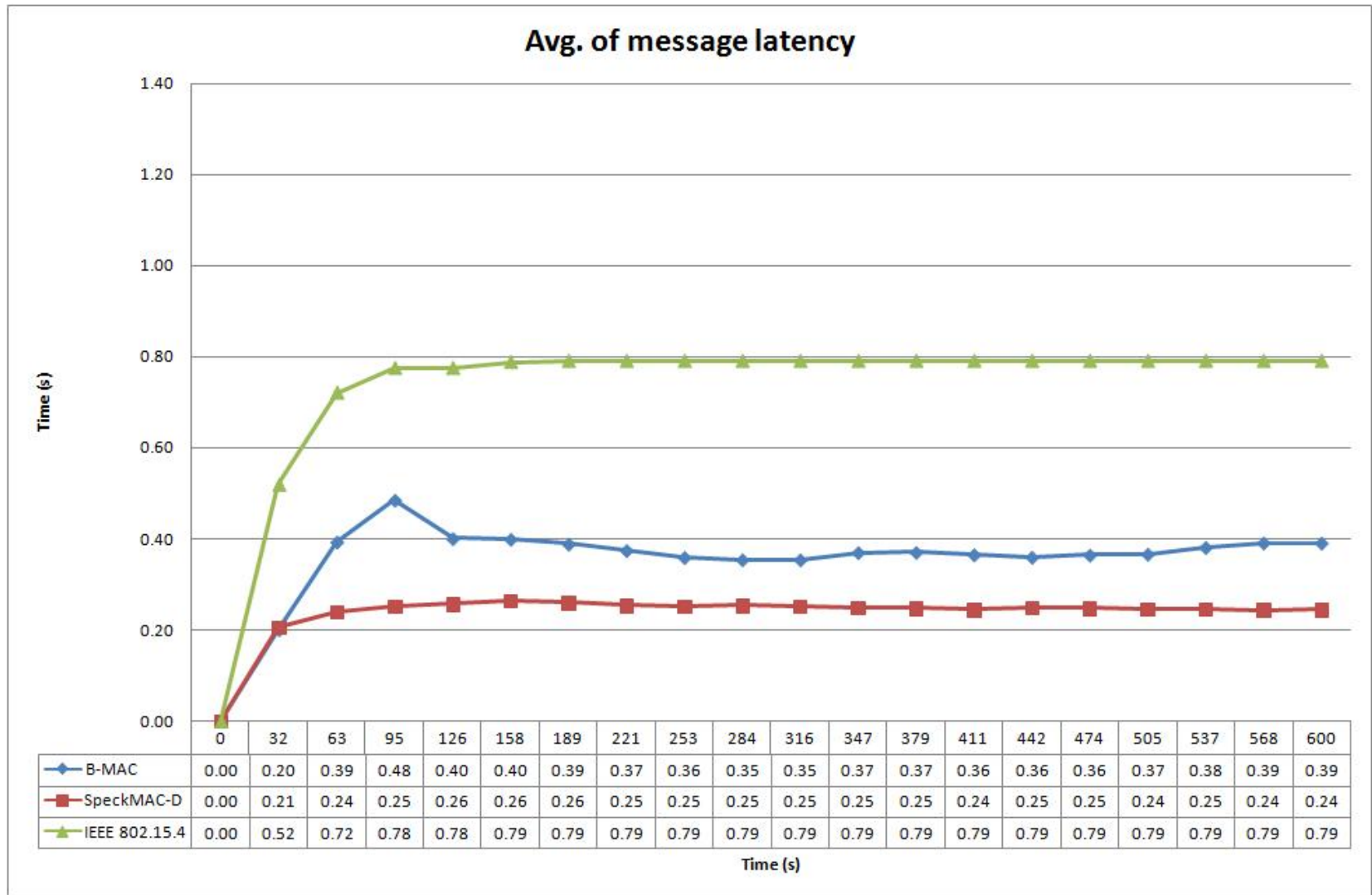


Scenario 2

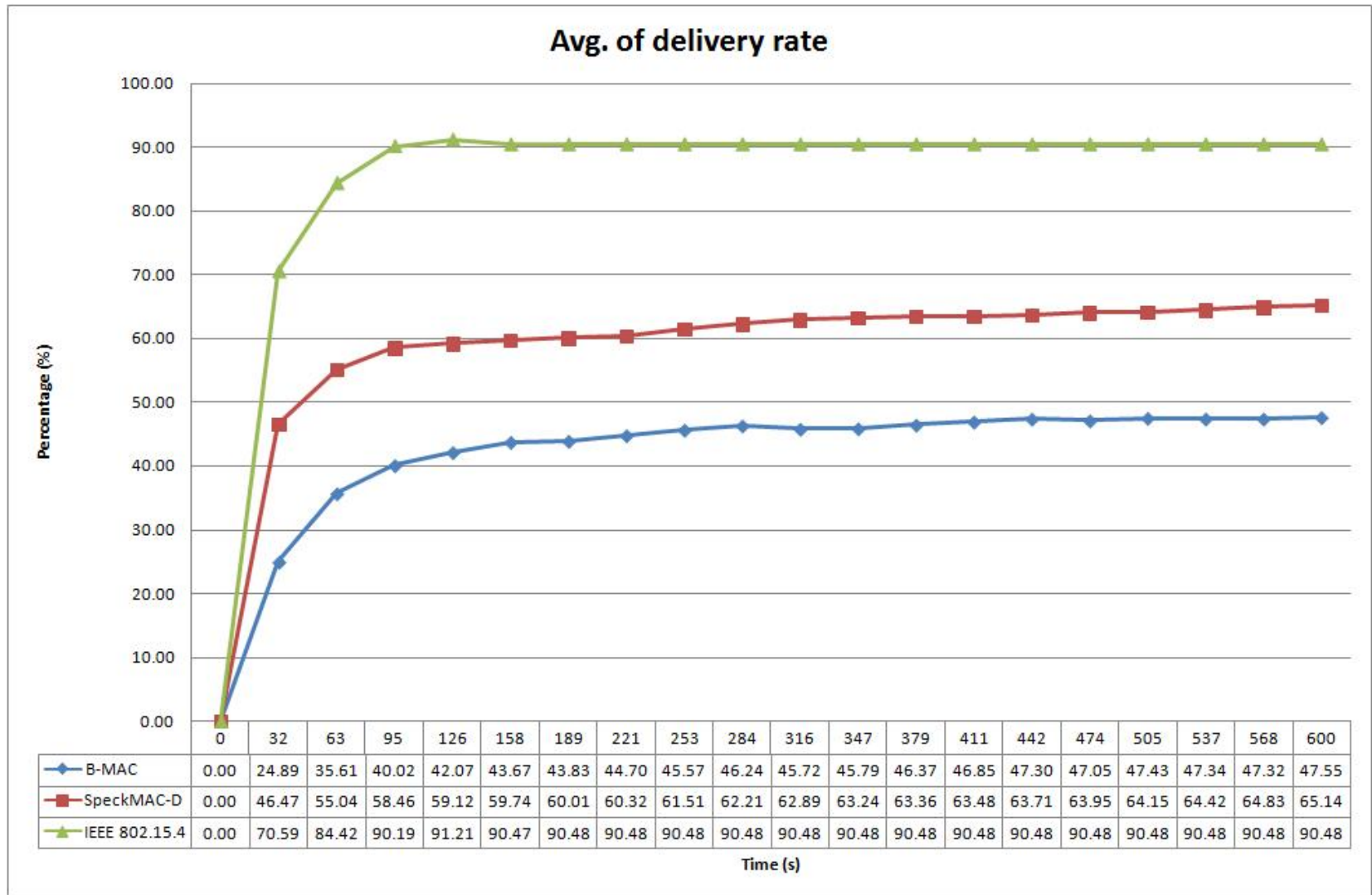


- 1 Base Station in a fixed position
- 7 Fixed nodes in a fixed position

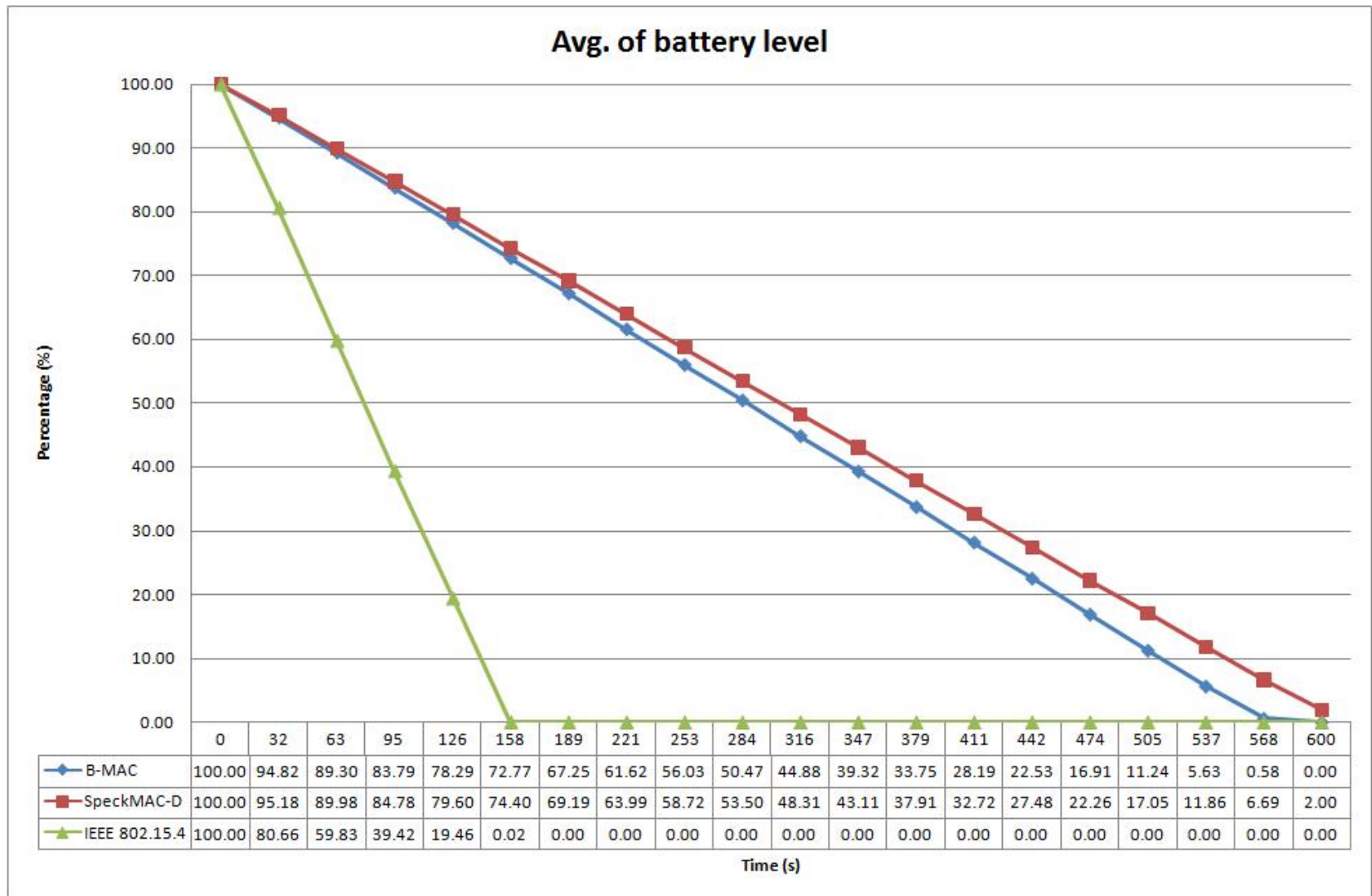
Results (Scenario 2)



Results (Scenario 2)



Results (Scenario 2)

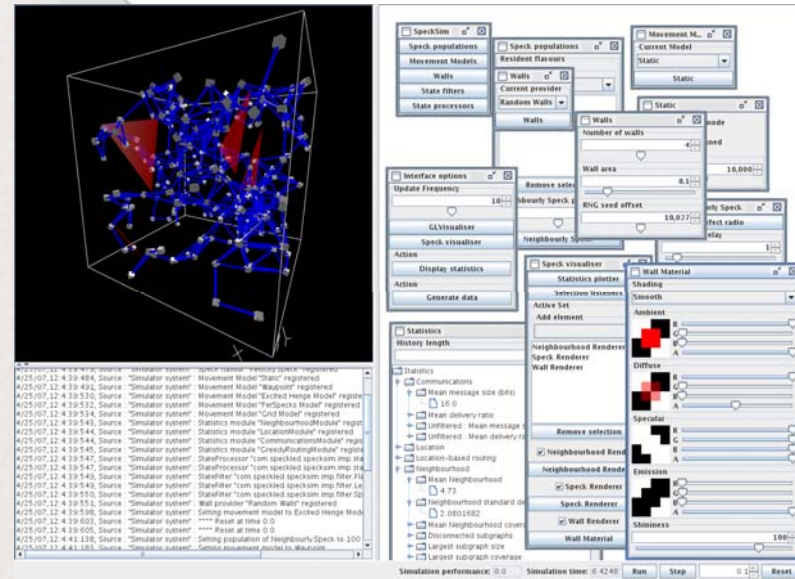


Conclusions

- The best performance in terms of:
 - Energy consumption and latency was exhibited by SpeckMAC-D for all the scenarios considered
 - Delivery rate was exhibited by IEEE 802.15.4 protocol for all the scenarios considered

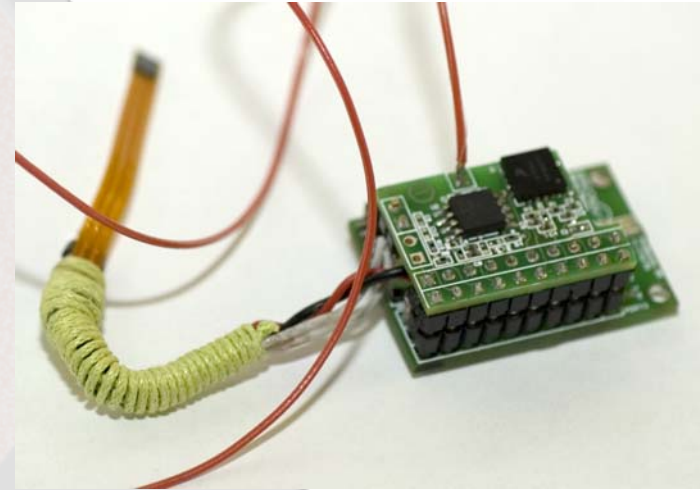
Future Work

- Carrying on from Ana's work
- Protocols will be analysed in the SpeckSim simulator
- The results of the simulation will then be validated by comparing the simulation results of one protocol with its implementation on the energy neutral platform



Future Work: Application

- Class of applications involving people and asset tracking
- For example ‘Smart Badges’ can provide people tracking facilities within The Informatics Forum using SpeckNets

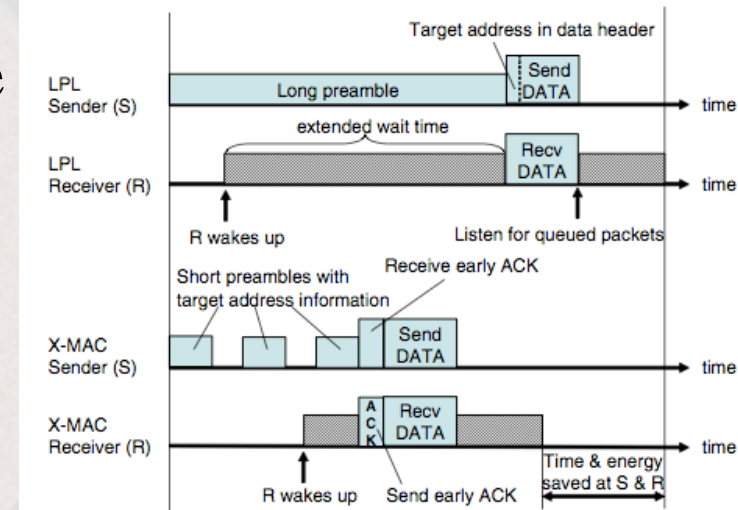


Future Work: Example X-MAC

- X-MAC is an asynchronous protocol, based on B-MAC, which utilises Low Power Listening (LPL)

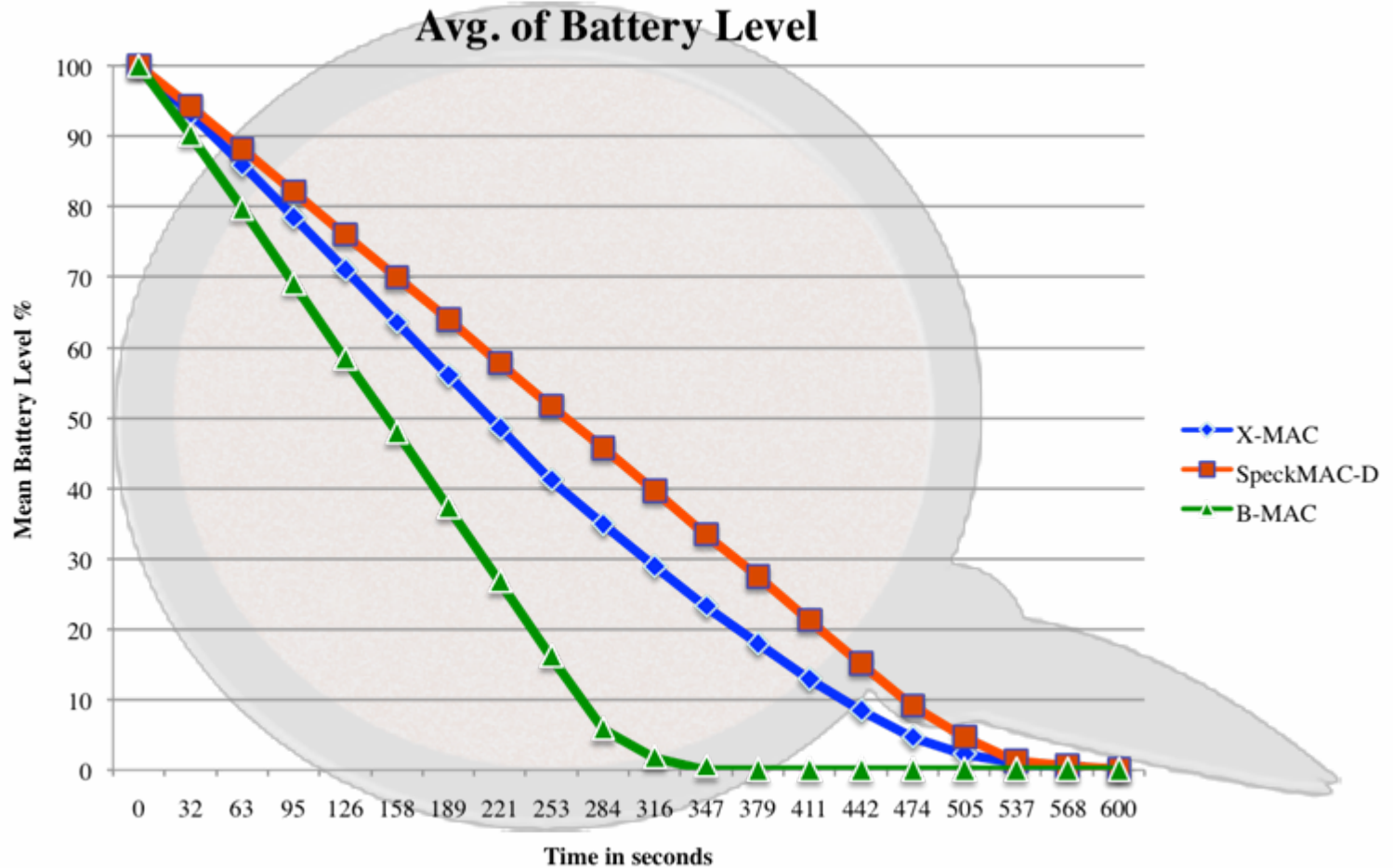
- X-MAC attempts to address the problems of: ‘over-hearing’, excessive preamble, and lack of support for modern radios

- These benefits are achieved by the inclusion of a target node ID and strobing the preamble packet

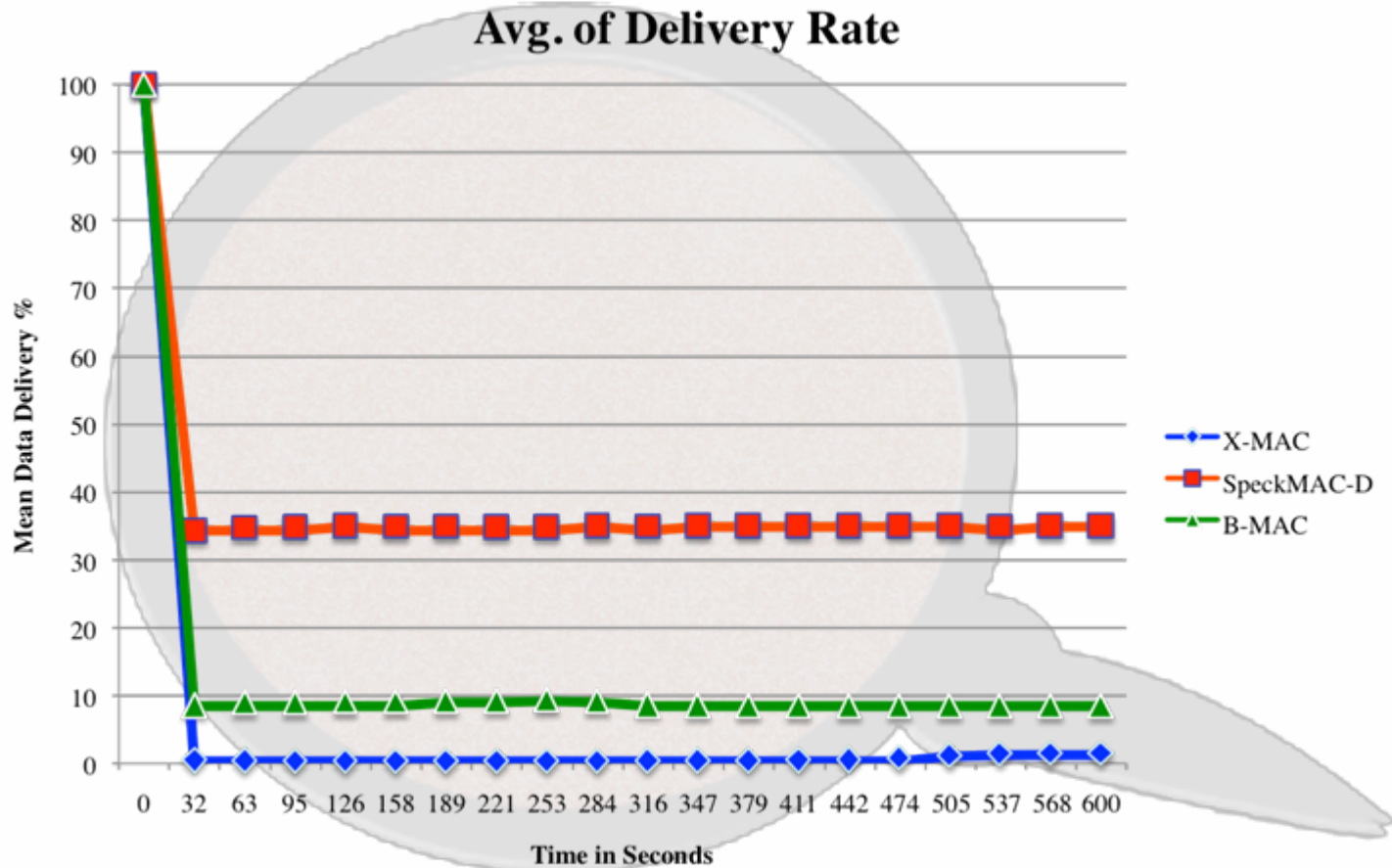


Source: Buettner, M., Yee, G. V., Anderson, E., and Han, R. (2006)

Future Work: X-MAC Results



Future Work: X-MAC Results



Future Work: Conclusions

- The best performance in terms of energy consumption and delivery rate was exhibited by SpeckMAC-D for the Fixed Node scenario
- These results will then be compared with further results gathered on the Informatics Forum Application scenario
- The next protocol for analysis is WiseMAC, a synchronous protocol, utilising scheduling to dynamically adjust the preamble time

Questions



Questions?