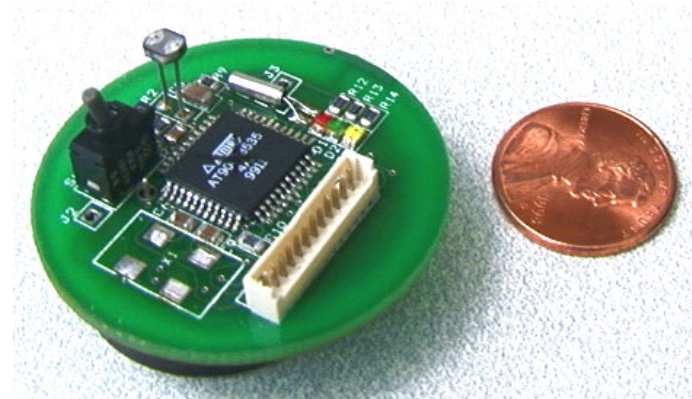


# MAC Protocols for Wireless Sensor Networks



Hans-Christian Halbrodt

Advisor: Pardeep Kumar

Proseminar Technische Informatik WS09/10

Freie Universität Berlin

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## Use cases



## Basics of Wireless Sensor Networks

- Very small units
- Sensor, processor, memory and wireless device on one microchip
- Battery used for power supply
- Typically there are periodically short messages send
- Energy consumption dominated by the radio transmissions
  - Most time spend sleeping with periodically wakeup

## Why not simply use IEEE 802.11 (WLAN)

### WLAN:

- Optimized for high speed transmission:  
(maximized throughput, very low Latency, high availability)
- Idle listening for reliability

### Wireless Sensor Network:

- Optimized for energy saving
- Different structure, short messages expected,  
media less frequently used, sleeping schedules energy saving

## S-MAC

- Ad-Hoc (multi hop)
- Synchronized wakeup (sync via broadcast)
- Virtual carrier sense, virtual clusters, neighbour detection
- Fragmentation support
- Randomized carrier sense time for starvation avoidance
- Adaptive Listening

## B-MAC

- Ad-Hoc (multi hop)
- Keep it simple
- Low power listening (randomized time added), asynchronous wakeup
- Clear channel assessment
- By default no acknowledgements, no fragmentation
- Configurable by higher layers for application requirements

## WiseMAC

- Infrastructure network
- Central access point with connection to other network
- Access point has „unlimited“ energy → Idle listen possible
- Asynchronous
- Table with wakeup schedules



## X-MAC

- Ad-Hoc (multi hop)
- Based on B-MAC
- Strobed announcements including destination address
- Two senders → same target: one announcement + both messages

## IEEE 802.15.4

- Peer-to-peer and star topology possible
- Carrier sense multiple access (CSMA)
- Collision avoidance (CA)
- Full and reduced function nodes

## S-MAC and B-MAC

Test implementation of both with a 20 nodes network

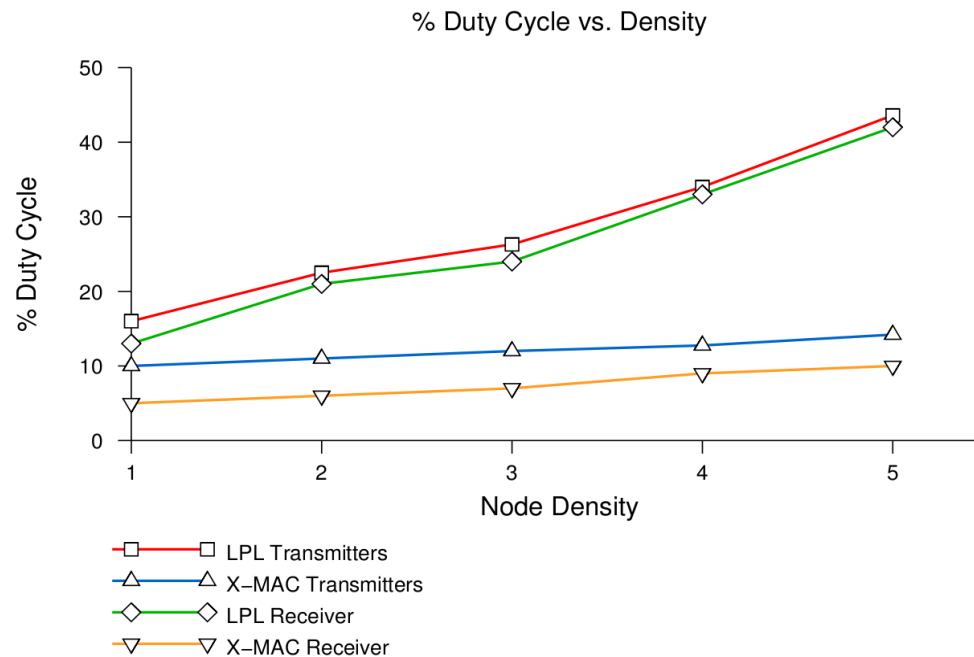
### S-MAC:

- Low Latency with adaptive Listening
- Sync overhead increases with data rate

### B-MAC:

- Small implementation
- With default configuration faster than S-MAC
- Uses less energy than S-MAC

## Advantages of X-MAC



- Less overhearing of preamble communication
- Shorter announce time

## X-MAC and WiseMAC

### WiseMAC:

- Based on IEEE 802.15.4
- Overhearing minimized
- No message forwarding by nodes
- Minimized listen / transmission time

### X-MAC:

- Self configuring (no central instance)
- Ad-Hoc protocol with low overhearing rate

## Conclusion

- X-MAC and WiseMAC seem to be efficient solutions
- Still optimization possible
- Processor and sensor sleep (better) combined with network sleep schedules
- Tests of MAC protocols for large networks missing

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