



MeshMAC

***“Enabling Mesh Networking over 802.15.4
through distributed beacon scheduling”***

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ETTX 2009 -The First European
TinyOS Technology Exchange

Tuesday, February 10, 2009, Cork, Ireland



Outline

- Introduction
- Problem definition
- Protocol operation
- Evaluation tests
- Conclusions and future agenda



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Introduction

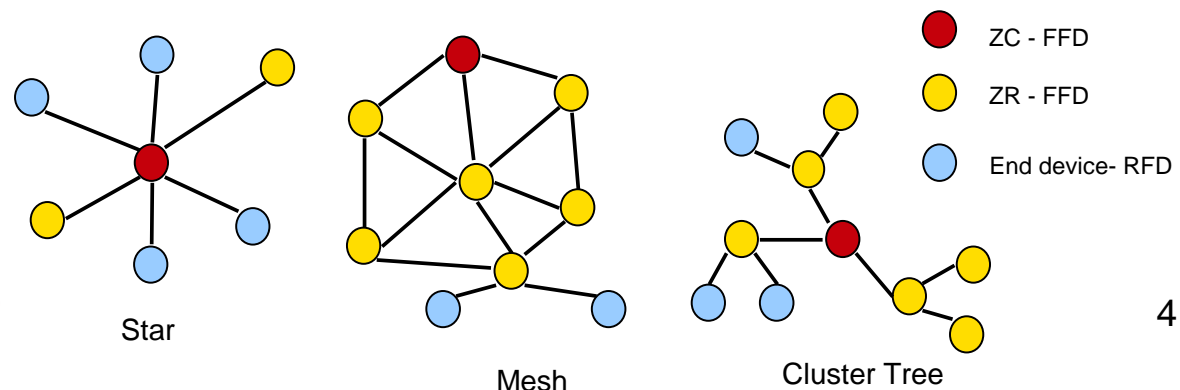
- MeshMAC extends 802.15.4 standard to enable mesh networking in the low power beacon mode through the use of distributed beacon scheduling.
- It is implemented on top of the Open-ZB IEEE802.15.4 implementation of TinyOS-1.x.
- It has been evaluated through both physical test-bed and computer based emulation



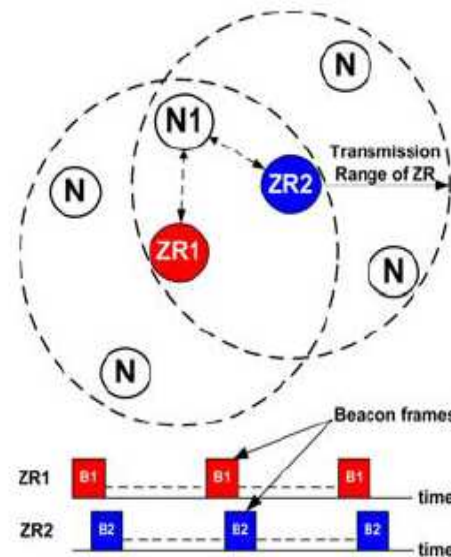
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Problem definition

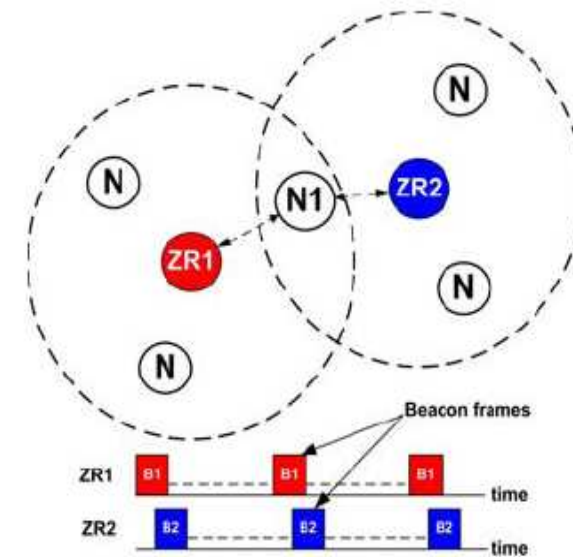
- The IEEE 802.15.4 beacon-enabled mode provides power efficiency due to synchronization mechanisms
- But it offers poor scalability (star topology → limited to coordinator range).
- A. Koubaa defines a Time Division Beacon Scheduling (TDBS) mechanism for cluster-tree topology in which each cluster is managed by one ZC to synchronize child nodes that belong to same cluster.



- Mesh topology is preferred over cluster-tree topology in large scale networks due to its robustness and scalability.
- But there should also be a mechanism to solve direct and indirect frame collisions.



a. Direct beacon frame collision



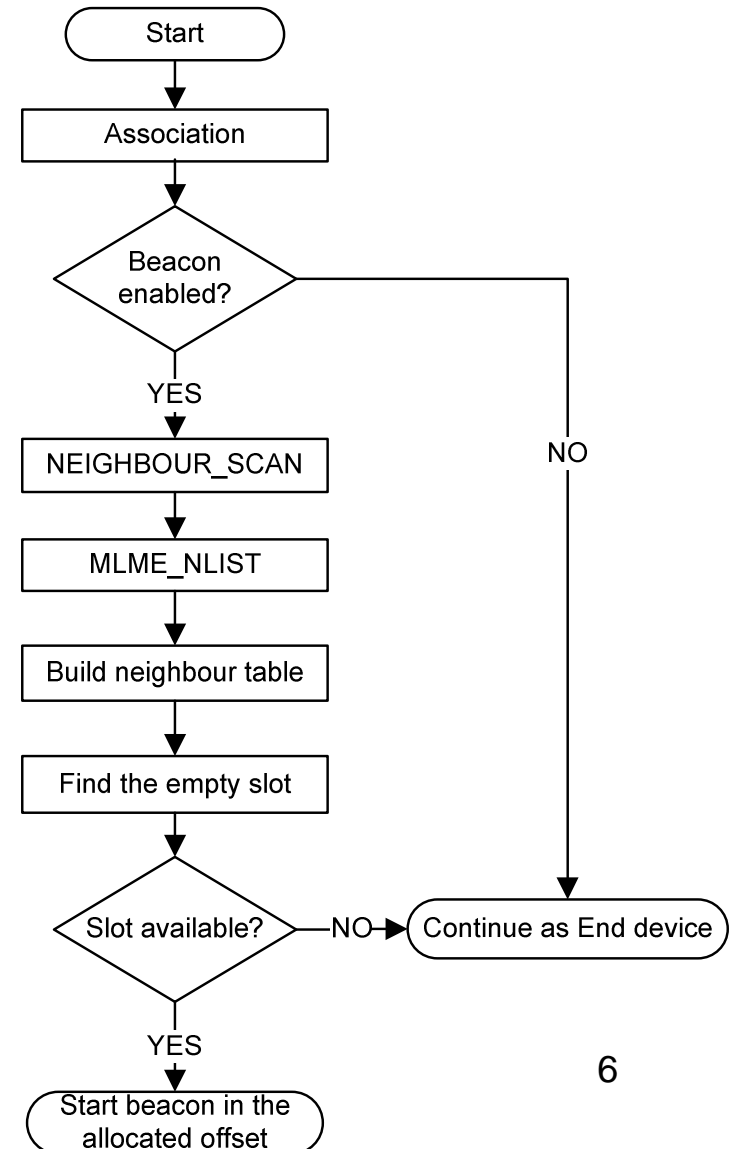
b. Indirect beacon frame collision



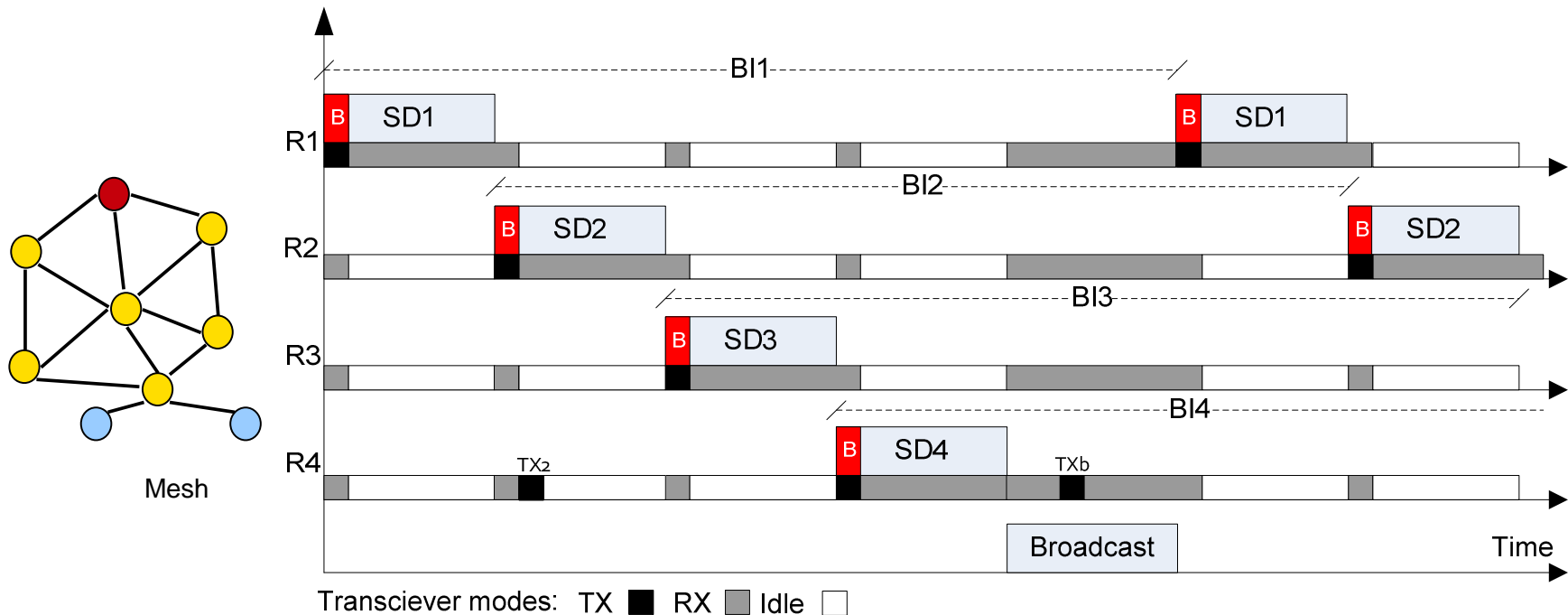
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- MeshMAC schedules all beaconing devices in a 2 hops neighbourhood to avoid direct and indirect collisions.
- The node uses NEIGHBOUR_SCAN to obtain beacon transmit time of every neighbour.
- It obtains the neighbours' neighbour list by sending a NLIST command request
- It builds the Beacon Schedule Table (BST) from its neighbours within 2r.
- Finds the empty slot and starts sending beacons

Protocol Operation



- Every router stays active during, its own SD, broadcast SD and also on its neighbors active super frame to whom it wants to send/receive data

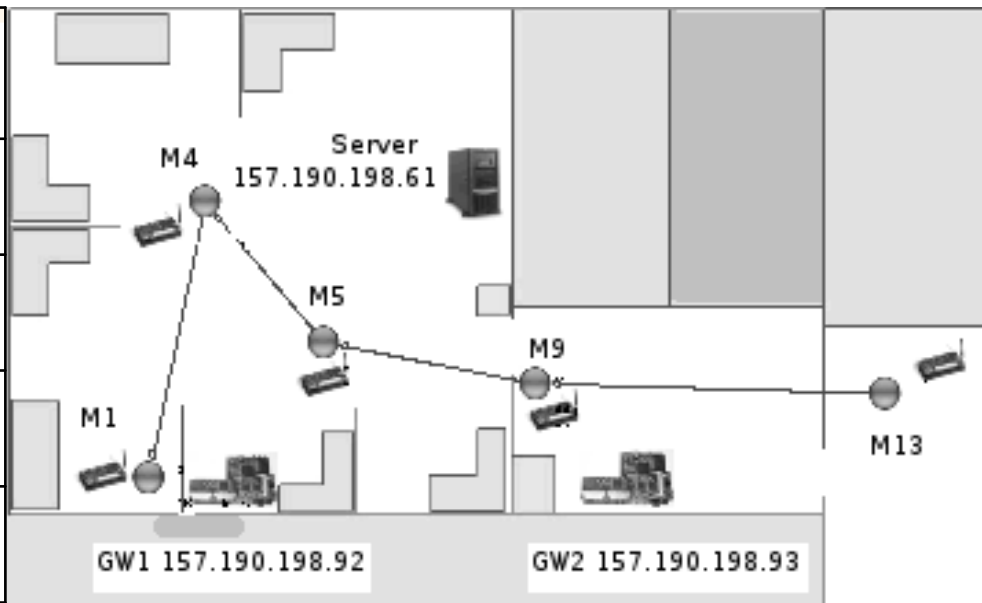




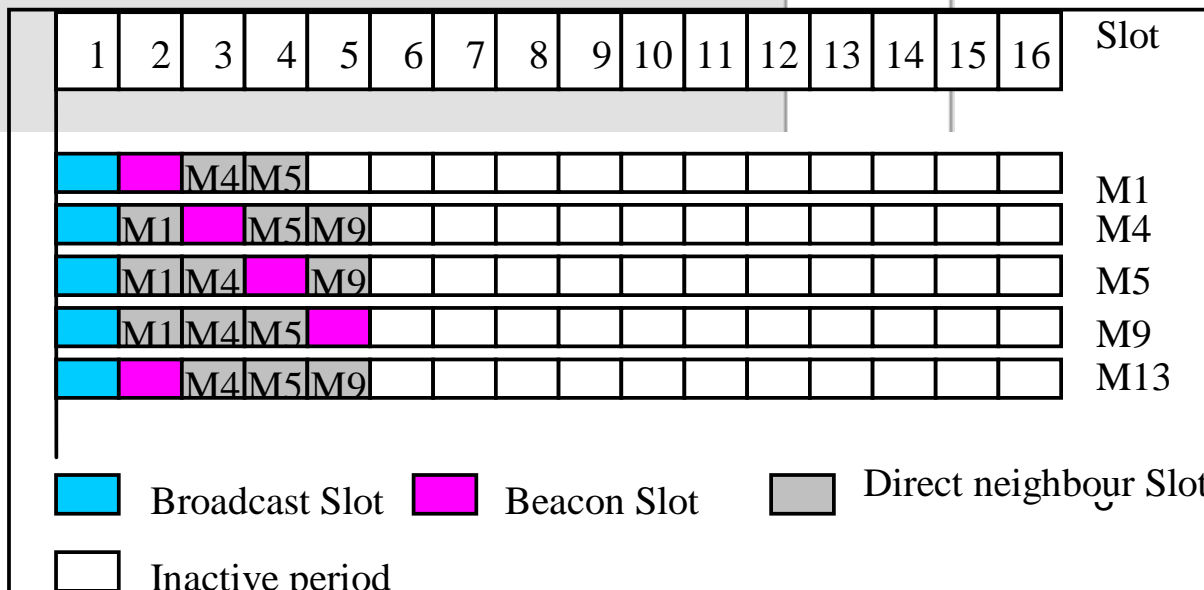
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Distributed Beacon scheduling test

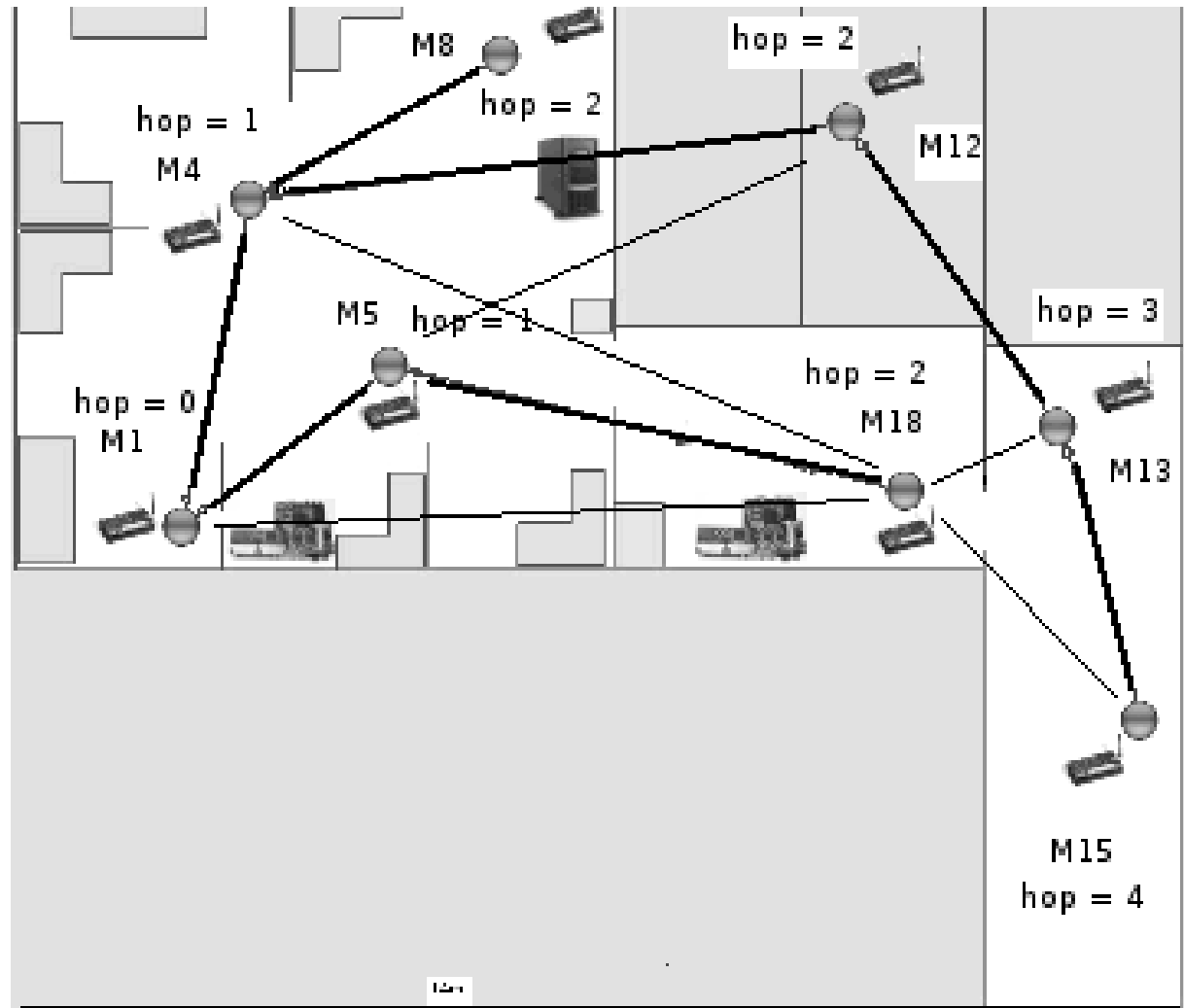
Node	Direct neighbour
M1	M4,M5
M4	M1,M5,M9
M5	M1,M4,M9
M9	M4,M5,M13
M13	M9



BO	8
SO	4
BI	245760 s
SD	15360 s



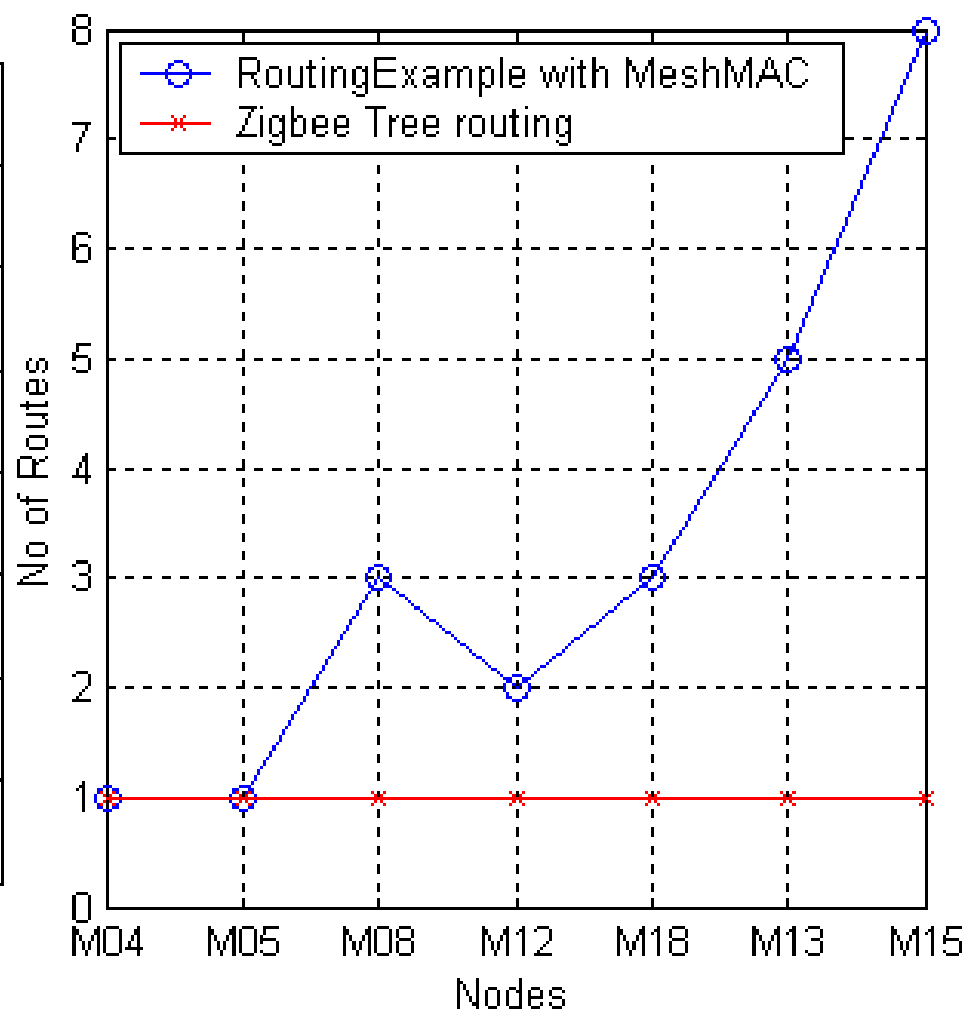
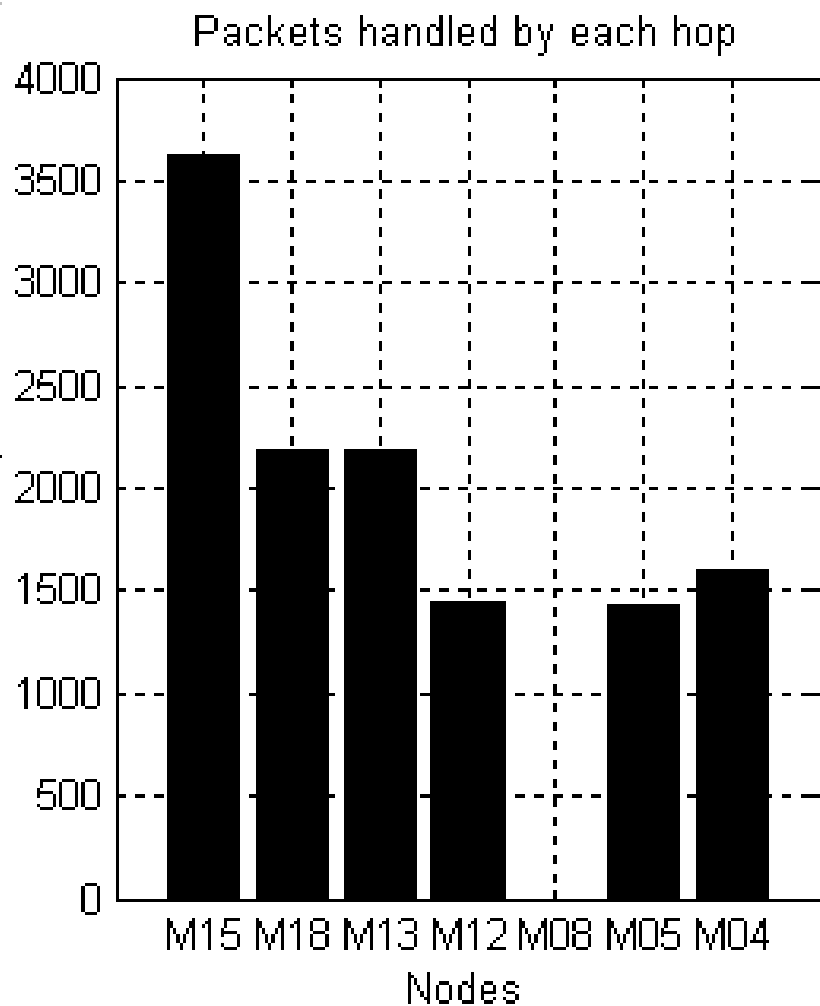
- Routing based on hop a count embedded in the beacons
- If same hop count next neighbour selected on round robin strategy
- M15 generates data every 4.3s to M1 during 7h 30min





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Multipath mesh test

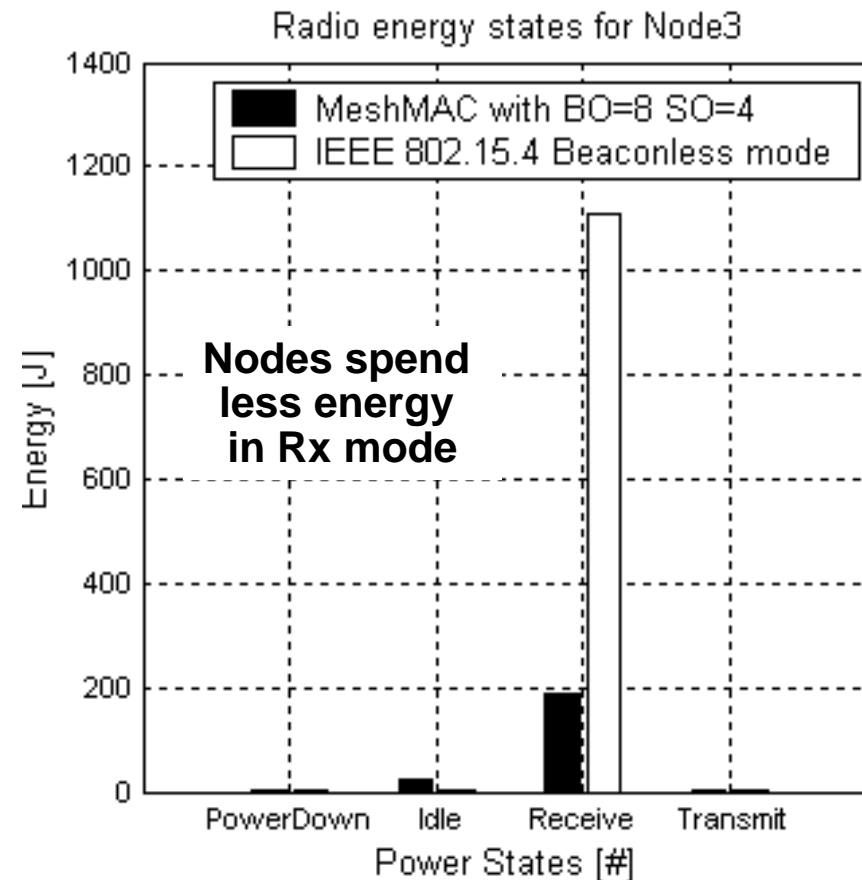
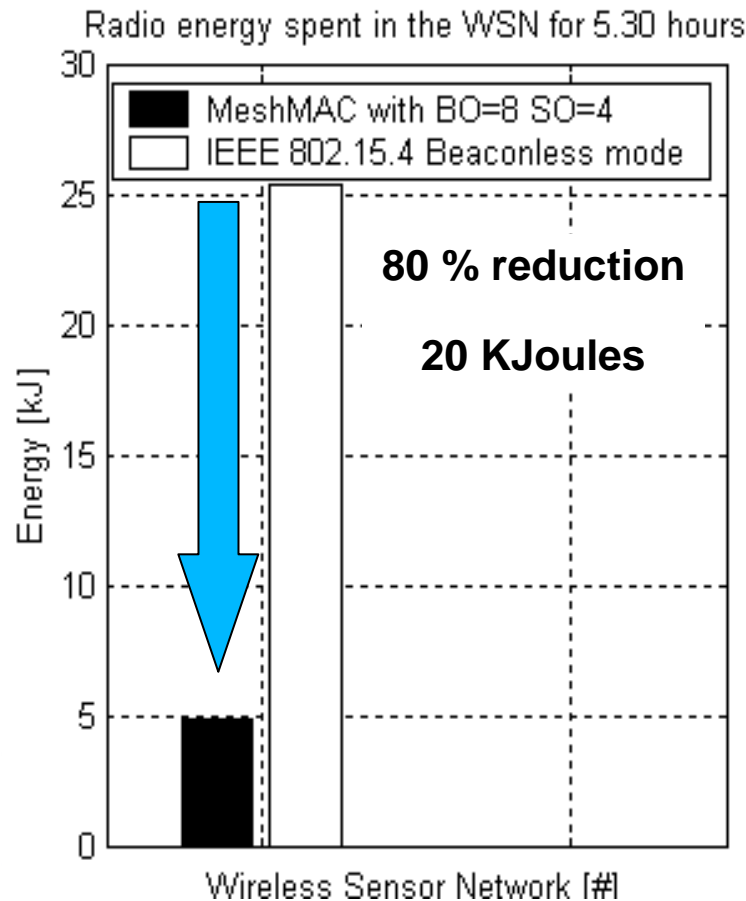




Evaluation

Energy efficiency test

- MeshMac is evaluated with respect to beaconless mode
- Avrora emulator energy monitor is used to collect the amount of energy spent by 25 nodes forming a wireless sensor network.





Conclusions and future agenda

- MeshMAC allows mesh networking over IEEE 802.15.4 through distributed beacon scheduling
- The implementation is over the Open-ZB TinyOS-1.x.
- Evaluation was done in emulator and physical test-beds

- **Future agenda**
 - 1) MeshMAC TinyOS-2.x porting, testing and release
 - 2) Further research to improve the distributed beacon scheduling
 - 3) MeshMAC / bLowPAN integration



Questions?

Please feel free to ask any questions

