SEA-MAC: A Simple Energy Aware MAC Protocol for Wireless Sensor Networks for Environmental Monitoring Applications

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1 Problem Formulation

Delivery of data from nodes to storage servers must be:

- *Reliable*
- *Fast*
- *Contain sufficient information to fulfill the requirements of people who will handle and process this information.*

Recent technological improvements have made the deployment of distributed devices:

- *Small*
- *Inexpensive*
- *Low-power*

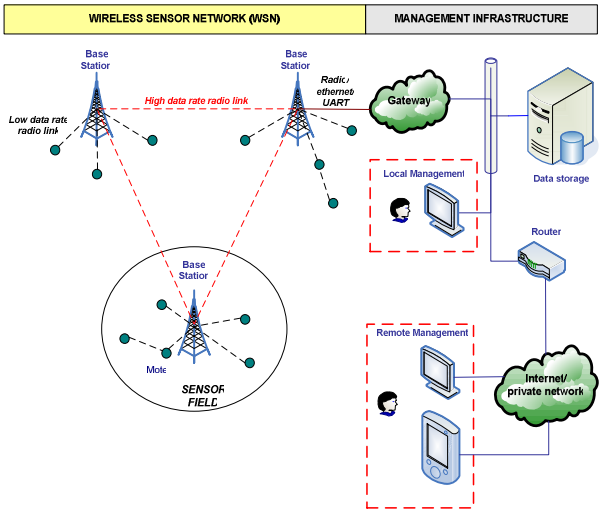
It is our objective to monitor environmental observables such as:

- *Humidity*
- *Temperature*
- *Solar radiation*
- *Environmental noise.*

For that purpose, it is desirable that nodes consume the least amount possible of energy.

2 Proposed Solution

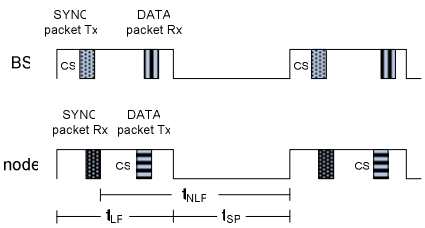
It is proposed a hierarchical network architecture that can scale easily. In this architecture, main network elements are: Nodes, Base Stations, Gateways and Task Manager.



- Appropriate routing and MAC protocols are crucial to accomplish objectives stated before.

- We propose SEA-MAC (Simple Energy Aware MAC protocol) as the Medium Access Control (MAC) protocol for the proposed Network Architecture.

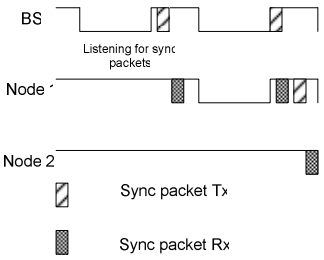
Time Schedule



- SEA-MAC makes use of the advantage that the entire traffic of environmental monitoring applications is periodic.

- SEA-MAC creates a schedule in which nodes only wake up when a sample from environment is taken

Synchronization



- Nodes running SEA-MAC, upon being turned on, turn on their radios to listen for synchronization (SYNC) packets from the BS.

- BS is the only node that can start and maintain synchronization while the other nodes only disseminate it in a multihop environment.

Energy Analysis

$$E = P_{listen}\ t_{csl}\ r_{data} + \left(P_{tx} + (n-1)\,P_{rx}\right)L_{data}\ t_B\ r_{data} + P_{rx}\ L_{sync}\ t_B\ r_{sync} + P_{sleep}\ (1 - t_{cls}\ r_{data} - L_{data}\ t_B\ (n)\,r_{data} - L_{sync}\ t_B\ r_{sync})$$

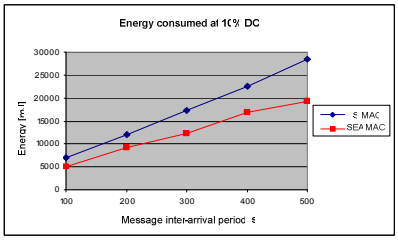
3 Implementation effort

XBow MEP-SYS410

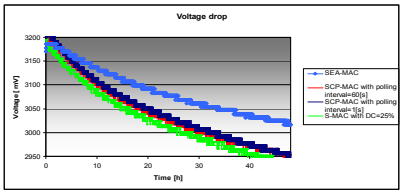
Initial Deployment

4 Results

Simulation



Experiments



5 References

[1] Wei Ye, John Heidemann, Deborah Estrin, "Medium Access Control With Coordinated Adaptive Sleeping for Wireless Sensor Networks", IEEE/ACM Transactions on Networking, Volume: 12, Issue: 3, Pages:493 - 506, June 2004.

[2] Wei Ye, Fabio Silva, John Heidemann, "Ultra-Low Duty Cycle MAC with schedulled Channel Polling", ACM SenSys 2006, November, 2006.

[3] Tijs van Dam and Koen Langendoen, "An adaptive energy-efficient mac protocol for wireless sensor networks", Proceedings of theFirst ACM Conference on Embedded Networked Sensor Systems, pages 171–180, Los Angeles, California, USA, November 2003.

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