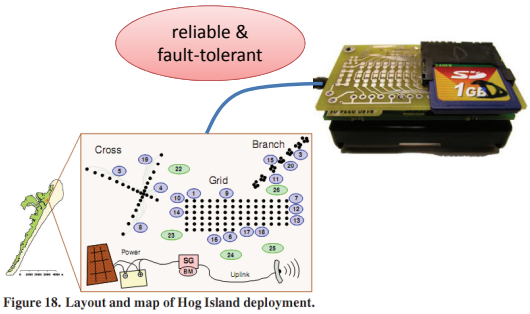

Figure 18. Layout and map of Hog Island deployment.

# LUSTER: Wireless Sensor Network for Environmental Research (SenSys'07)

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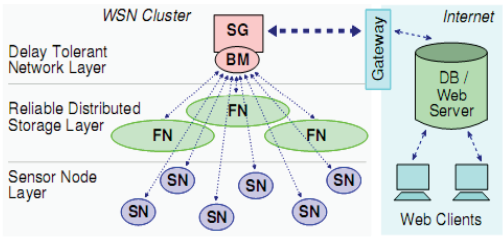
## Outline

- Motivation & Challenges
- Overview: Multi-layer architecture
- LiteTDMA protocol
- Distributed storage
- Delay tolerant networking
- Experiment
- Conclusion

## Challenges due to Harsh Environment

- Fast deployment time
- Deployment assurance
- Reliability
  - Delay tolerance
  - Communication bottlenecks
  - Online data access
  - Storage capacity
  - Redundancy
  - Heterogeneity in sensors and hardware

## Multi-layer Architecture



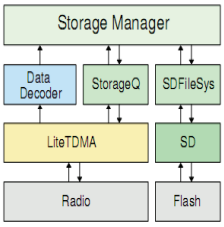

## LiteTDMA Protocol

- Slave nodes dominated by a master node
  - Master slot: slaves listening
  - Slave slots: each slave with a unique timeslot to send messages
  - Sleep slots: no communication, save power
- Time synchronization in master slot
- Broadcast mode (e.g. diagnostic purposes)
- Promiscuous mode for overhearing storage layer
- Acknowledgement (bitmask or CRC)

## LiteTDMA Protocol (cond)

- New node registration
- Dynamic performance optimization
  - Parameter reconfiguration
  - #. slave slots based on #. registered nodes
  - New node admission rate based on #. registered nodes
  - Active slaves with more slots
  - Unregistration of node to save power
- Performance monitoring for debugging

## Distributed Storage

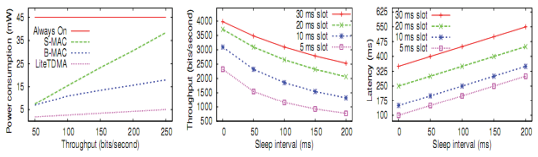



- Storage policy
  - Organization
  - Overwrite
- Coverage & deployment
  - Restrict coverage of storage nodes

## Delay Tolerant Networking

- Overhearing-based logging
  - Storage nodes with sufficient memory
  - Avoid explicit radio traffic between sensors & storage nodes
- Delayed data retrieval
  - Data loss detected by back-end
  - Query for the missing data

## Experiment: LiteTDMA




(a) MAC protocol power consumption as throughput increases.

(b) Sleep interval vs. throughput for slot durations 5–30 *ms*.

(c) Sleep interval vs. latency for slot durations 5–30 *ms*.

## Experiment: Distributed Storage

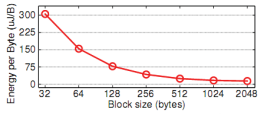



**Figure 12. Energy ($\mu J$ per byte) consumed for writing increasing block sizes to flash.**

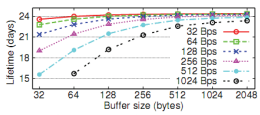



**Figure 13. Lifetime in days of a storage node for increasing buffer sizes and data rates.**

## Experiment: Deployment Experiences

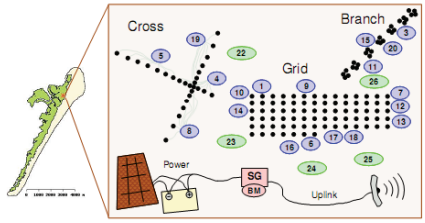
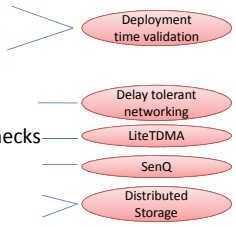



**Figure 18. Layout and map of Hog Island deployment.**

## Conclusion

- Fast deployment time
- Deployment assurance
- Reliability
  - Delay tolerance
  - Communication bottlenecks
  - Online data access
  - Storage capacity
  - Redundancy
  - Heterogeneity in sensors and hardware




## Discussion

- LUSTER focuses on overall system design and ignores optimization opportunities
  - Compression techniques in storage nodes
    - reduce storage space
    - reduce communication cost
  - Data interaction and correlations not taken into consideration
  - Suppression techniques for saving energy