Title
Schedule and Latency Control in S-MAC

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Approaches: Global Schedule and Latency Control by Adjusting Schedules

Selecting Global Schedule

Goal:
Nodes in multiple clusters can incrementally switch to one global schedule

Algorithm:
- Assign unique schedule id (randomly)
- Nodes incrementally shift schedules
  - Prefer schedule with lowest id
- Over time, all nodes shift to a single global schedule

Control Sleep Schedules

- Select and control sleep schedules to obtain different effects on propagation delay
- Different latencies in different directions when nodes on the path adopt different sleep schedules
- Skew sleep schedules to allow rapid data forwarding in one direction, and slow forwarding in the opposite direction

Latency Analysis

In a line topology of N nodes (no adaptive listening)
- \( P \): schedule phase difference
- \( T_f \): length of a frame
- \( t_{cs} \): carrier sense delay at hop \( n \), which is random
- \( t_{m} \): mean carrier sense delay
- \( t_{tx} \): transmission delay
- \( D(N) \): total delay

\[
E[D(N)] = \frac{T_f}{2} (N - 1)[(P + T_f] + t_{cs} + t_{tx}
\]

Conclusions:
- Average latency linearly increases with the number of hops
- Average latency can be controlled by adjusting \( P \)

Implementation and Demo

- Simulation: ns-2
- Implementation:
  - Motes running TinyOS
  - PC-104
- Visualization: NAM in real time

Conclusions

- S-MAC can adopt single global schedule
- S-MAC can control schedules to get different latency effects
- We have quantified latency analytically and validated those results experimentally