Neighbor Cardinality Estimation with Low-Power Transceivers: Implementation and Experimental Results

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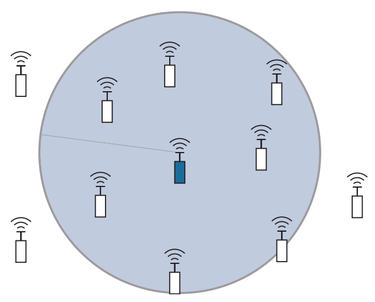
Introduction

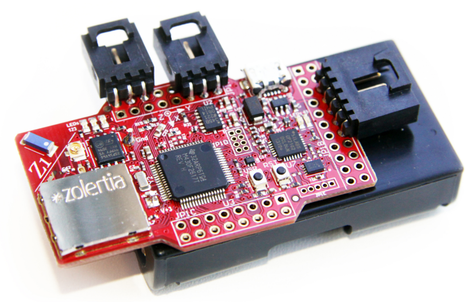
Neighbor cardinality
- The number of nodes in range of a transceiver
- Important for performance of protocols



Counting vs. estimation
- Counting not always possible
- Exact number not always necessary
- Estimation can be faster

Work done
- Implemented on Z1 sensor nodes
- Studied time and energy efficiency
- Evaluated performance of estimation with experiments

Implementation on Z1 Nodes



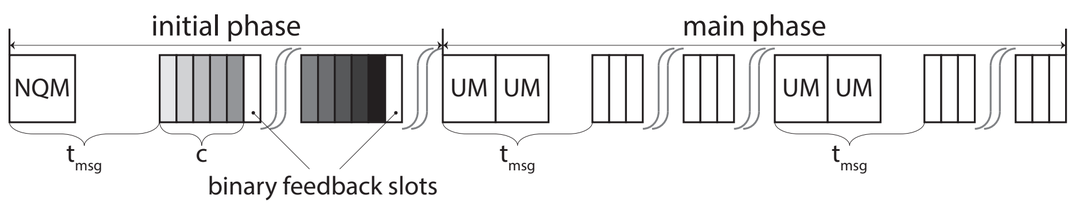
Environment
- TinyOS based on nesC
- Sensor node: low-cost, low-power

Tasks
- Communication between the nodes
- Synchronization between the nodes
- Implementation of the estimation protocol
- Optimization for limited resources

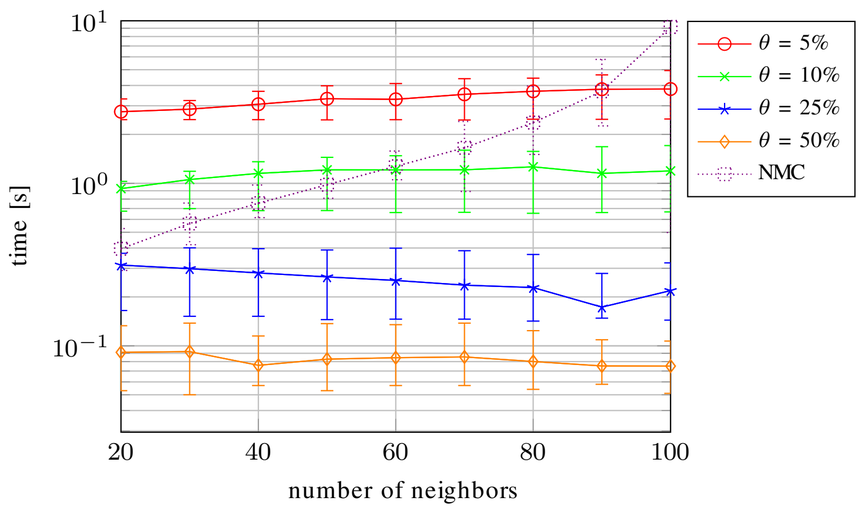
Multi-Feedback Estimator

Basic idea
- n nodes transmit with probability p in a timeslot
- Probability for empty slot: $P_0 = (1-p)^n$
- Observe s slots, where e slots are empty
- Estimate $\widehat{n} = \frac{\ln \widehat{P}_0}{\ln(1-p)}, \quad \widehat{P}_0 = \frac{e}{s}$

Steps
1. Broadcast parameters (p and s)
2. Count emtpy slots
3. Estimate number of neighbors
4. Estimate accuracy θ
5. Calculate parameters for next round



Experimental Performance Analysis



References

- H. Adam, E. Yanmaz, and C. Bettstetter, “Contention-based estimation of neighbor cardinality," IEEE Trans. Mobile Computing, Mar. 2013.
- M. Rappaport, E. Yanmaz, and C. Bettstetter, “Neighbor cardinality estimation with low-power transceivers: Implementation and experimental results”, sumbitted for publication, 2013.