

Support of Multi-dimensional Application Needs in Wireless Sensor Networks

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Motivation

- Current research focuses on functional needs
 - sense, compute, and communication
- More sensor applications have non-functional needs
 - timeliness, reliability, accuracy
 - some applications have multiple needs
 - different applications may have differing needs
 - these needs come at certain costs

These non-functional needs are cross-cutting issues and better addressed by interactions among different layers

Challenges

- Specification of non-functional needs
- Execution Architecture
- Algorithms for satisfaction of joint non-functional needs

Challenge 1: Specification of Non-functional Needs

- reliability
 - percentage of nodes participating
 - a set of nodes covering the area
 - desired completeness of the answer set (recall)
- timeliness
 - period, deadline, or relative to other events
- accuracy
 - absolute bounds (e.g., ± 5)
 - relative bounds (e.g., $\pm 10\%$)

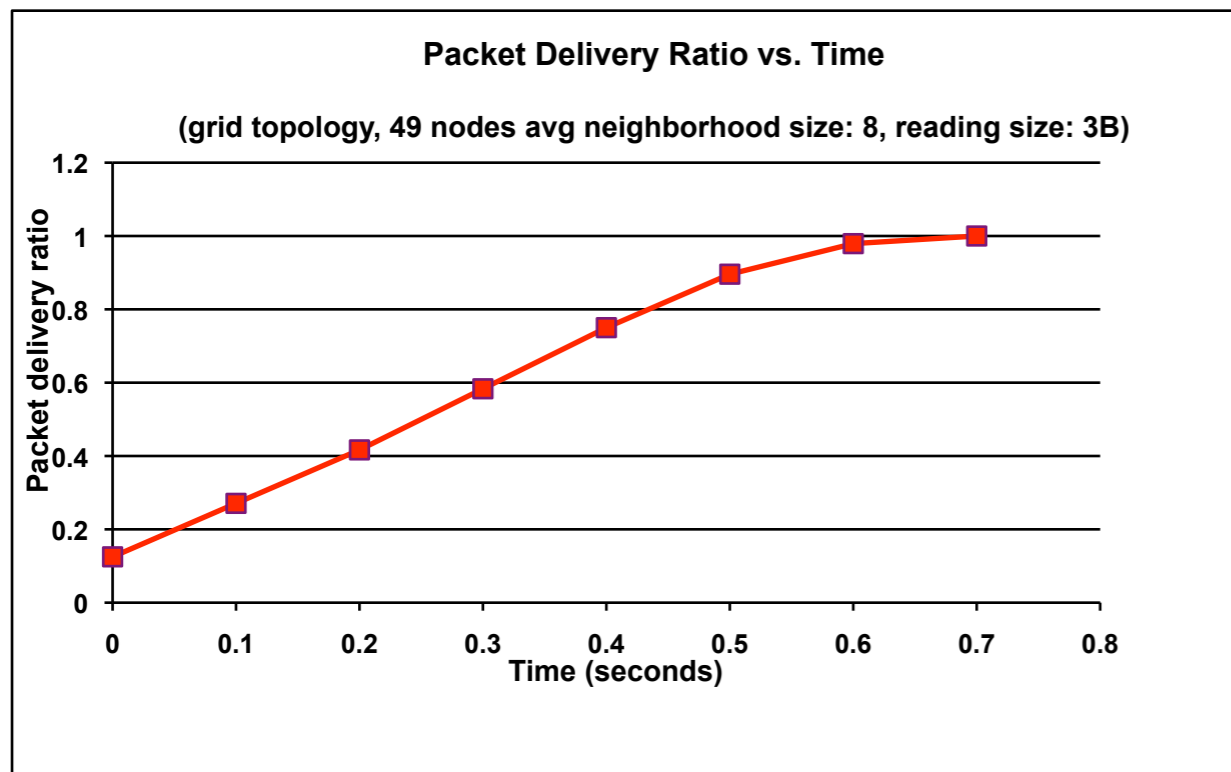
Challenge 2: Execution Architecture

- traditional client-server approach
 - does not exploit computation and storage capabilities on sensor nodes
- in-network processing approach
 - limited types of data access
 - complexity of optimally splitting computation between sensors and servers
 - no direct way to exploit application's tolerance of quality
- hierarchical approach
 - should not be too narrow

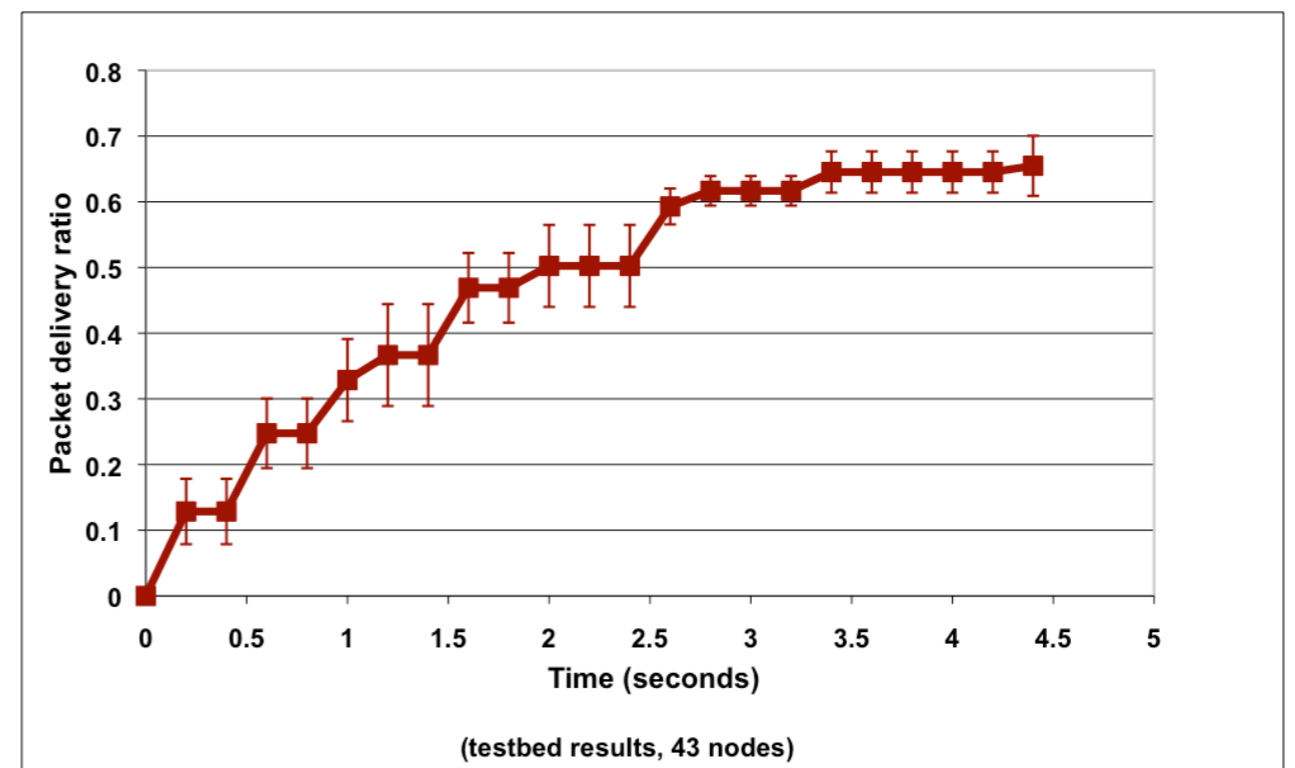
Challenge 3: Algorithmic Support

- maximize certain combination of non-functional needs subject to energy budget
- minimize energy consumption subject to specified constraints (maybe multiple)

Example: Timeliness and Reliability



In a network without link failures



In a network with link failures