StonesDB

STOrage-centric Networked Embedded System

Rethinking Data Management for Storage-centric Sensor Networks

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May 30, 2007

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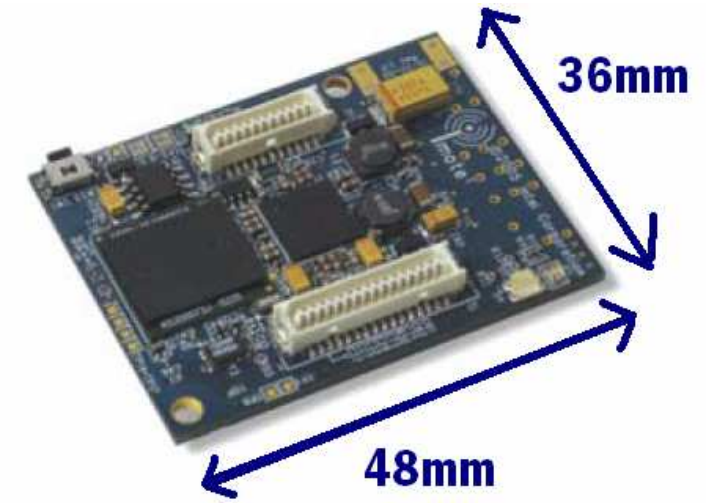
Overview

- Technology Trends
- Data Management
- Motivation
- Design Goals of StonesDB
- Research Challenges
- StonesDB Architecture
- Current Status & Conclusion

Sensor Nodes Hardware Today

- Mica Mote
  - 6 MHz
  - 4 KB RAM
  - 128 KB Flash storage

- iMote2
  - 13-600 MHz
  - 32 MB RAM
  - 32 MB up to Multiple GBs Flash storage



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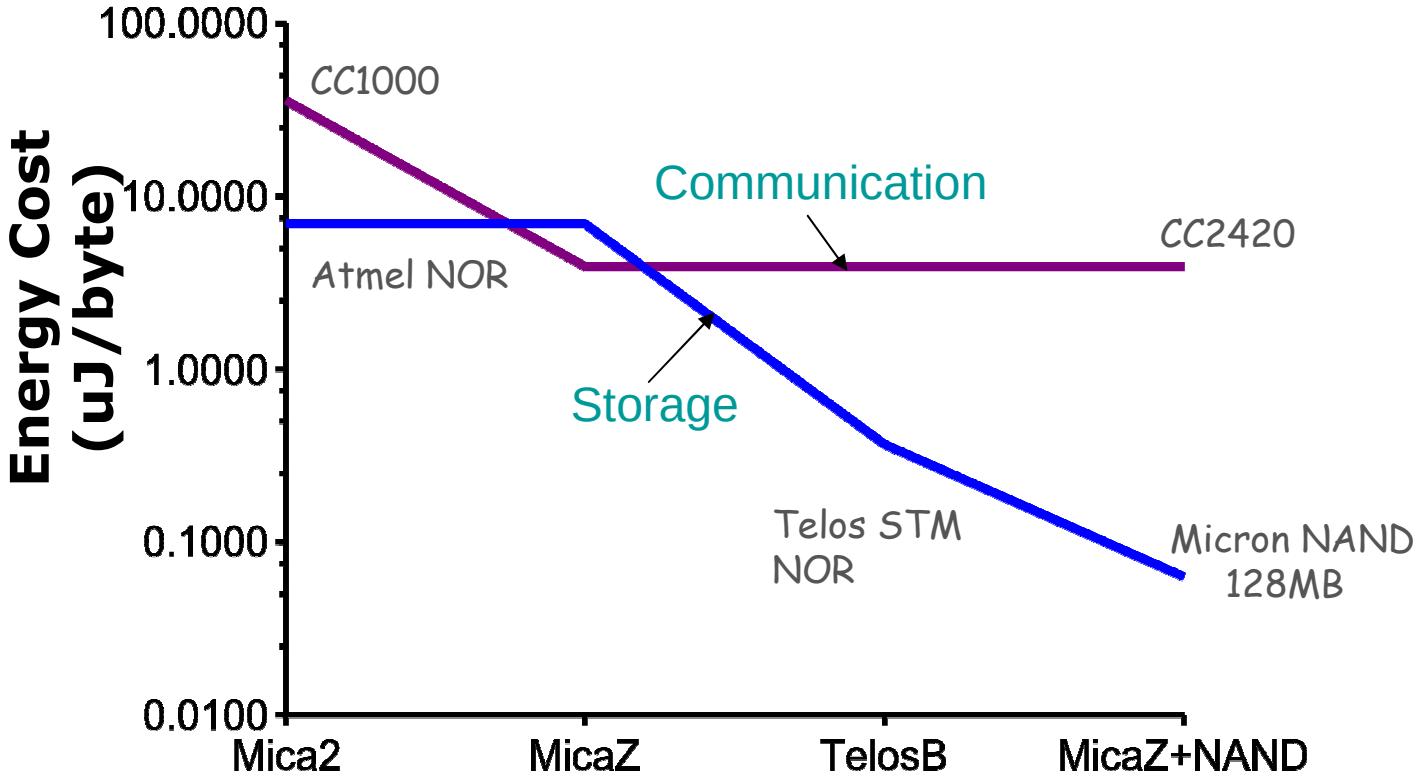
Technology Trends in Storage



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Data Management

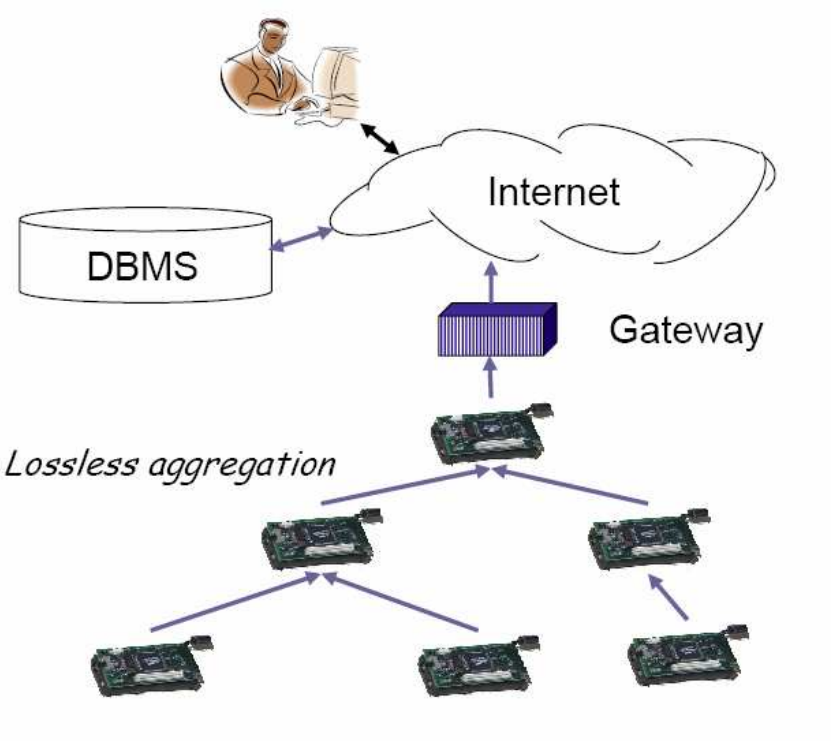
- Queries on live data:
  - Only small window of data is important
- Queries on historical data
  - Database outside the sensor network:

    Continuous stream of data, aggregated within network and archived outside network
  - Sensor network as database:

    Query processing on data archived locally on sensor nodes

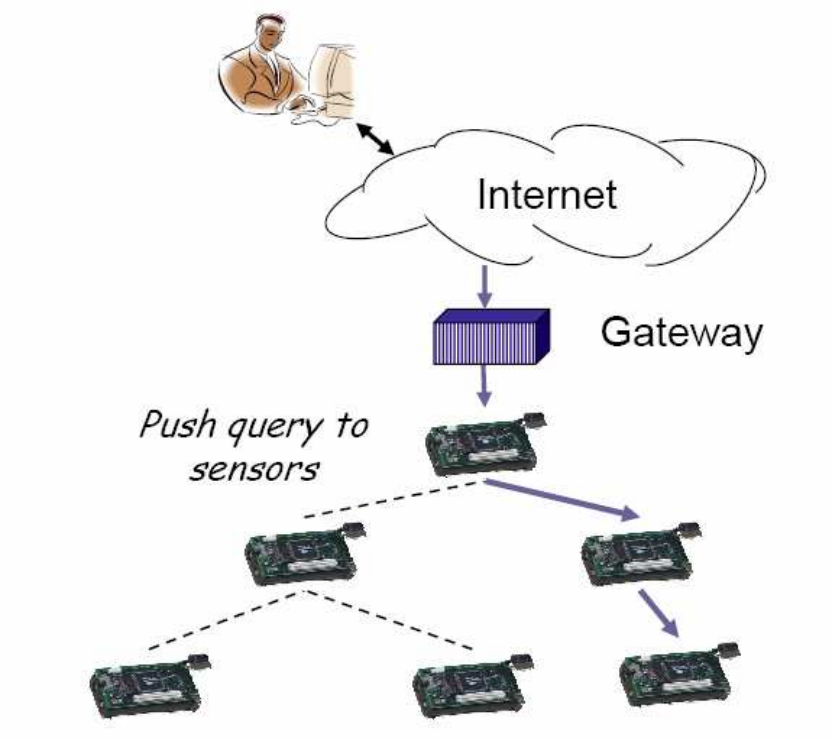
Data Management: Historical data

Database outside the sensor network



- low data rates
- high query rates

Sensor network as database



- high data rates
- low query rates

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Motivation

- What if sensor nodes are equipped with high-capacity and energy-efficient local storage?

Design Goals of StonesDB

- Exploit local flash memory
- Optimize for energy-efficiency
- Exploit resource-rich proxies
- Support a rich set of queries
- Support heterogeneity

Research Challenges

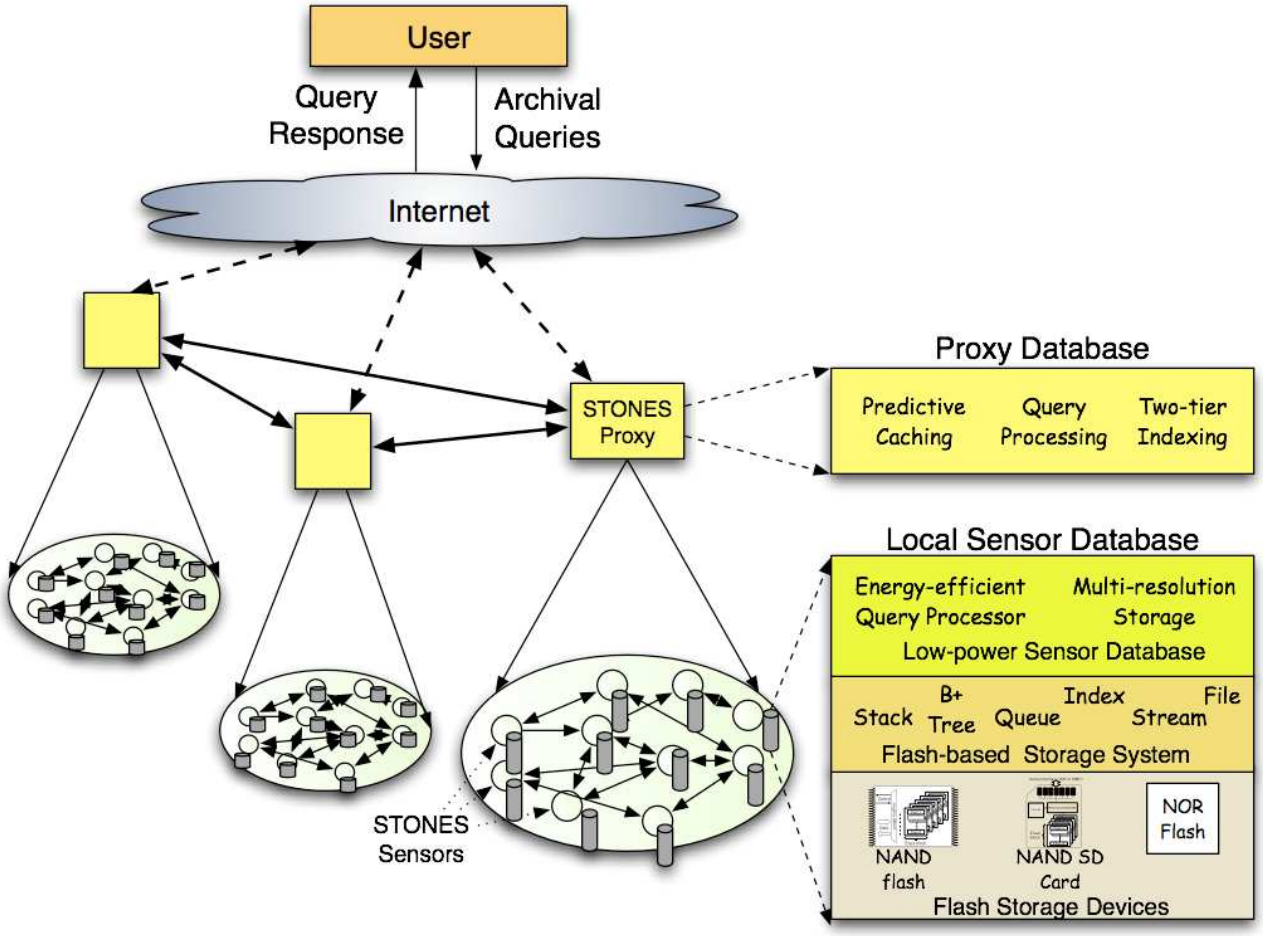
- Optimize for Flash and RAM Constraints
- Optimize for Energy Efficiency
- Handle Finite Storage
  - Data Aging & Multi-resolution

StonesDB Architecture

- Local database
  - a query engine
  - data summarization and aging algorithms
  - an energy-efficient storage substrate

- Distributed data management
  - Cache containing data and query results
  - a query processing engine that determines how to handle each incoming query

StonesDB Architecture



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Architecture of Local Database

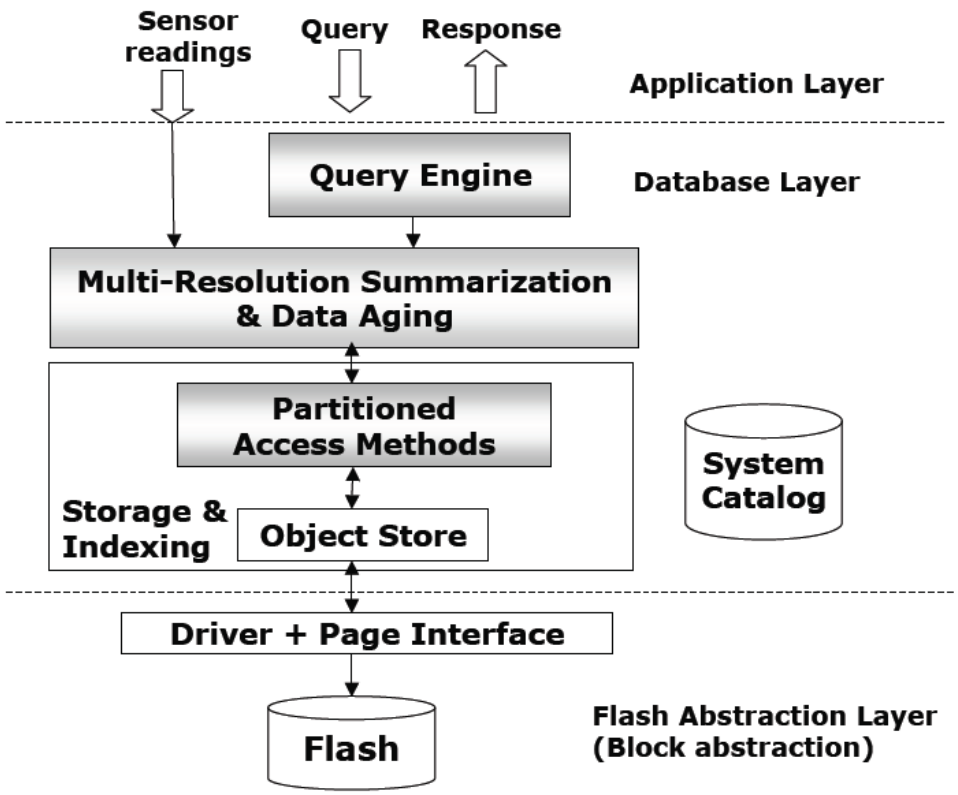

Figure 3: Architecture of the local database

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Current Status & Conclusion

- Implemented Capsule, a flash-based object store
  - Energy efficient data structures (lists, streams, trees)
- Capsule is currently extended with summarization, aging and partitioned indexing
- Investigating other related systems:
  - TSAR separates data from meta-data.
  - PRESTO implements a proxy cache.
- No running system for StonesDB architecture

The End

- Yanlei Diao, Deepak Ganesan , Gaurav Mathur and Prashant Shenoy, *Re-thinking Data Management for Storage-centric Sensor Networks*, Proceedings of the Third Biennial Conference on Innovative Data Systems Research (CIDR), Asilomar, CA, January 2007

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