CMPE 259
Sensor Networks

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Storage and Querying
Overview
Overview

- Sensors sense/generate data.
- Users/applications interested in data.
- Require an infrastructure for data access and storage.
- Common user operations are:
  - Queries (monitoring).
  - Actuate and control.
Types of queries

- **Historical:**
  - What is the average rainfall over past 2 days?

- **Current:**
  - What is the current temperate in Rm# 226?

- **Long running:**
  - Temperature in rm# 226 over the next 4 hours every 30 seconds.
Issues

- How to identify relevant sensors?

- Computation vs. communication tradeoff.
  - Where to process query?
    - Inside the sensor network (route query).
    - At centralized location (route data).
      - Large amounts of data transfer: efficiency?
  - How to process query?
Billions of objects populate space.
Each produces and locally stores data.
Location aware.
Can be selectively monitored, queried and controlled.

Physical world enhanced with data.
Characteristics

- Dataspace
  - Data lives on the object
  - Users access not only “local” information but can navigate entire dataspace
  - Spatial world divided in 3-D datacubes
    - CS Bldg., street, block etc
  - Communication, messaging and computation techniques for querying and monitoring required
Querying and monitoring

- Queries are spatially driven.

- Steps:
  - Identify relevant datacubes.
  - Identify relevant nodes (dataflocks).
    - Datacube directory service.
  - Aggregation for queries on several datacubes.
    - E.g., information about Manhattan taxi cabs
Architecting DataSpace

- Querying and monitoring.
  - Multicast mechanisms.
    - (attribute, value) pair mapped to a multicast address.
  - Group membership based on:
    - Physical location.
    - Attribute (temperature, #vehicles, etc.).
  - Mapping (attribute, value) to multicast address.
    - E.g., using hash tables.
  - Condition on the index attribute of query mapped to multicast address.
    - Query reaches all objects satisfying condition on index attribute.
    - Objects perform check for remaining conditions and respond or not.
Where to provide functionality?

- Network versus application layer.
Network as DataSpace engine

- **Space Handle** identifies datacube.
- **Subject Handles** are (attribute, value) pairs such that attribute is indexed.

**DataSpace address**

Based on location of datacube  Based on relevant attribute

<space-handle>  <subject-handle>
Using geographic routing infrastructure

- Route message based on physical location.
  - Use GPS coordinates for location.
- Once query reaches a region use multicast.