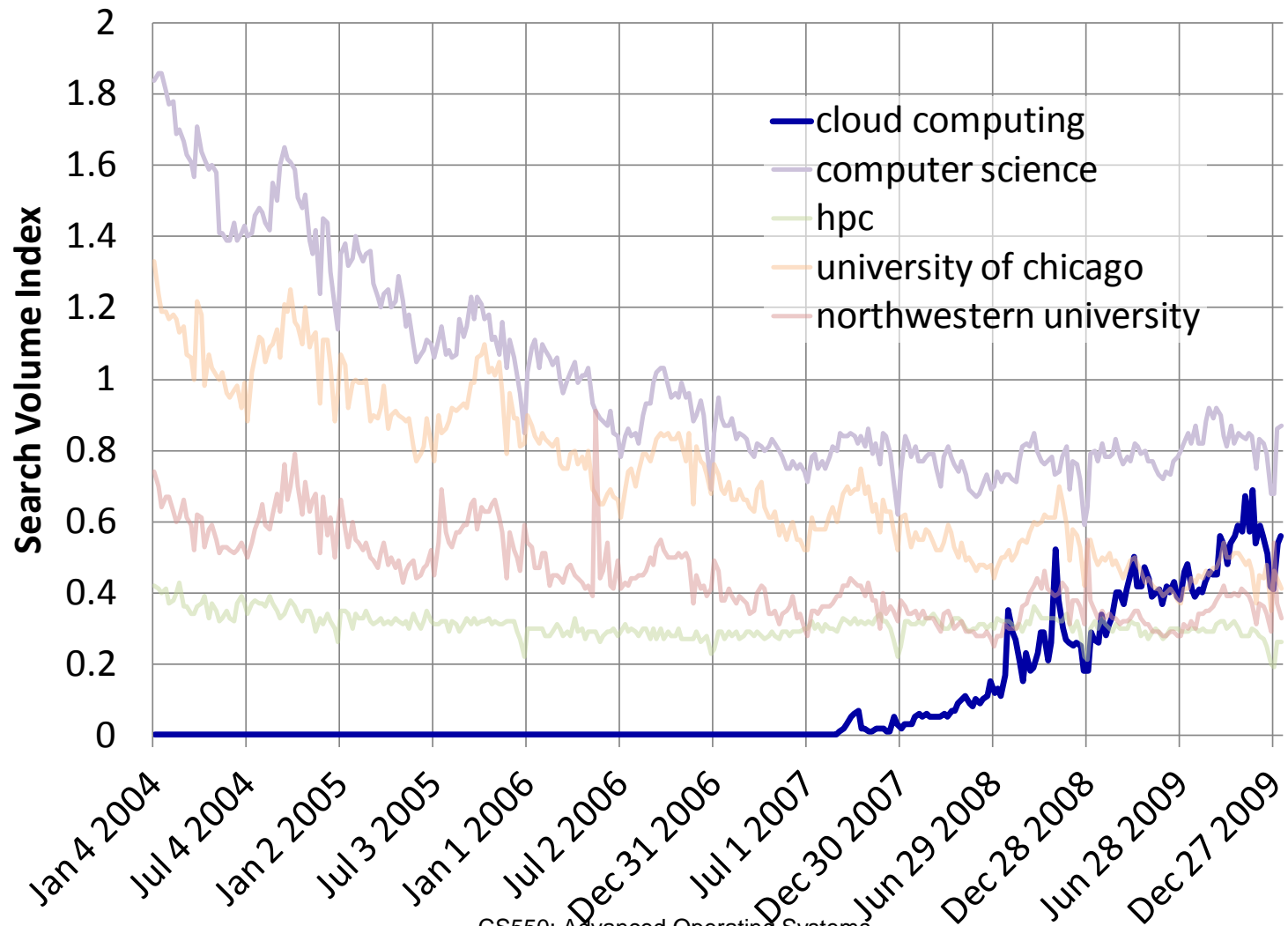# CS 550:
Advanced Operating Systems

Introduction to
Distributed Systems
Part 2

Ioan Raicu
Computer Science Department
Illinois Institute of Technology

CS 550
Advanced Operating Systems
January 18th, 2011

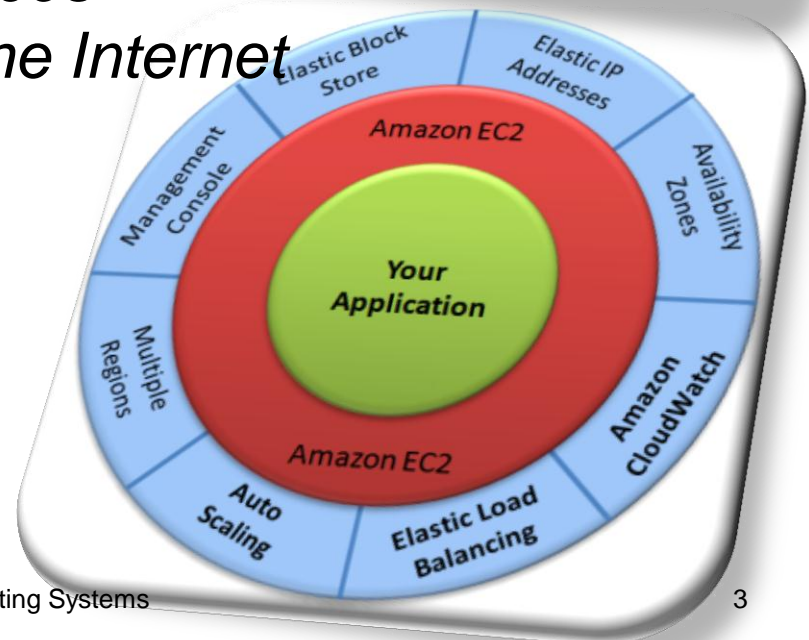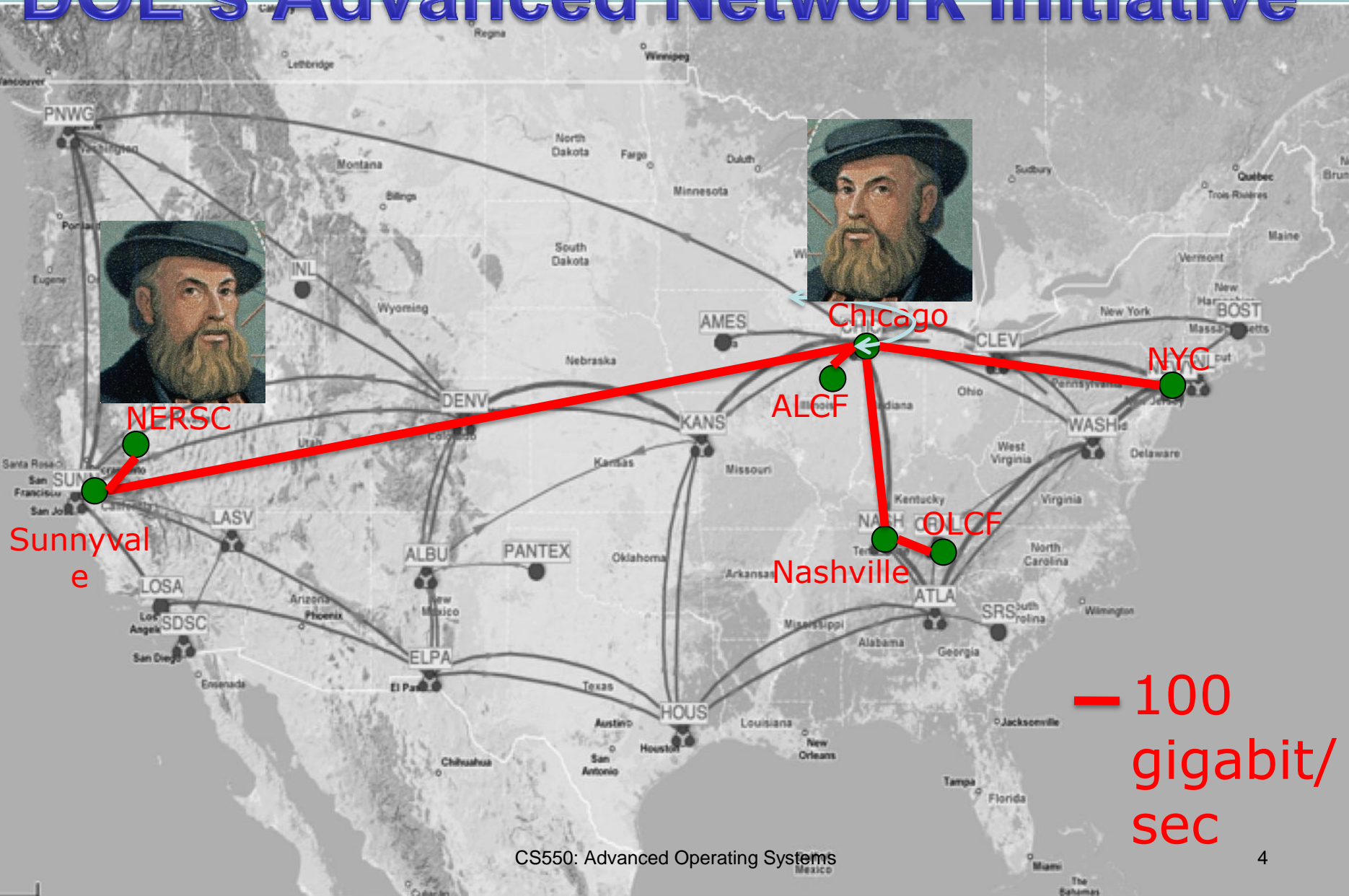# Cloud Computing: An Emerging Paradigm

Cloud Computing

- *A large-scale distributed computing paradigm driven by:*
  1. *economies of scale*
  2. *virtualization*
  3. *dynamically-scalable resources*
  4. *delivered on demand over the Internet*

Clouds ~ hosting

Magellan +
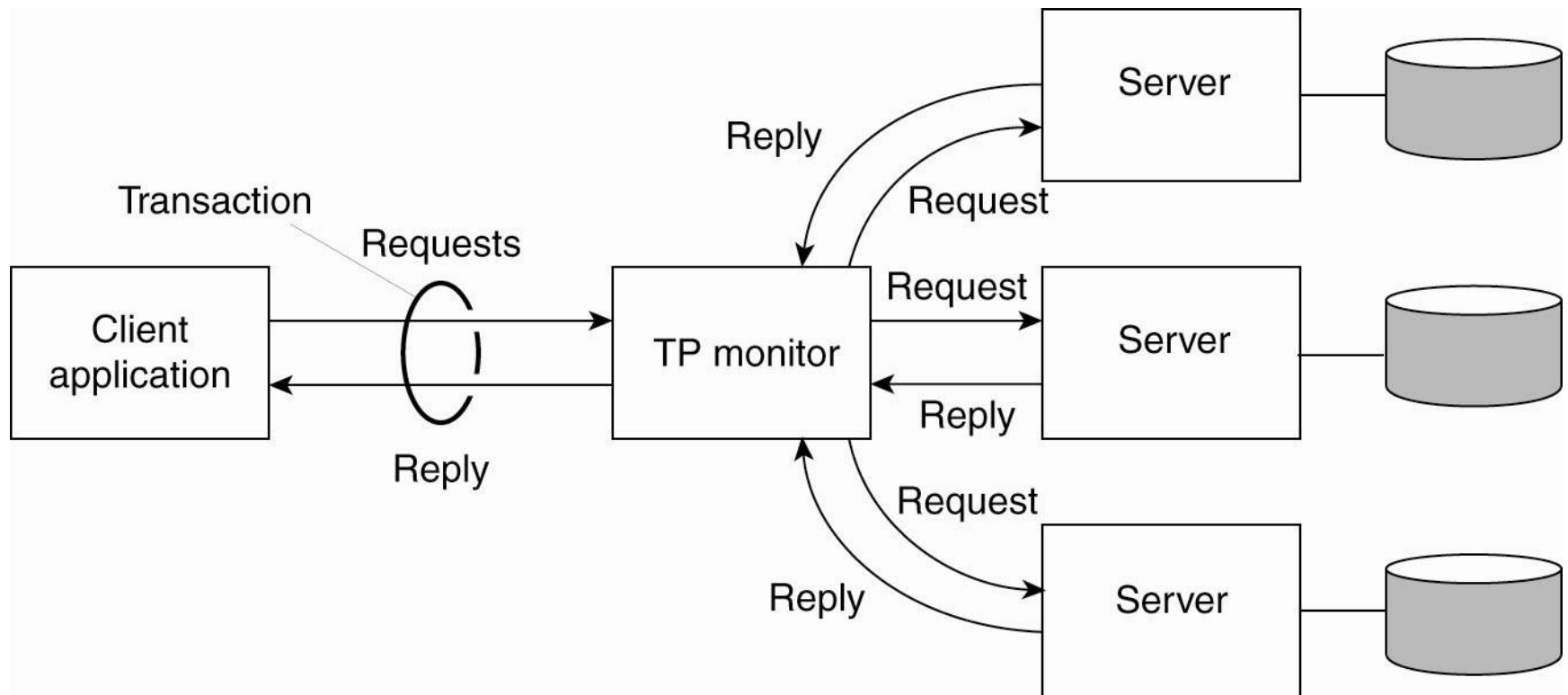# DOE's Advanced Network Initiative

Major Clouds

- Industry
  - Google App Engine
  - Amazon
  - Windows Azure
  - Salesforce
- Academia/Government
  - Magellan
  - FutureGrid
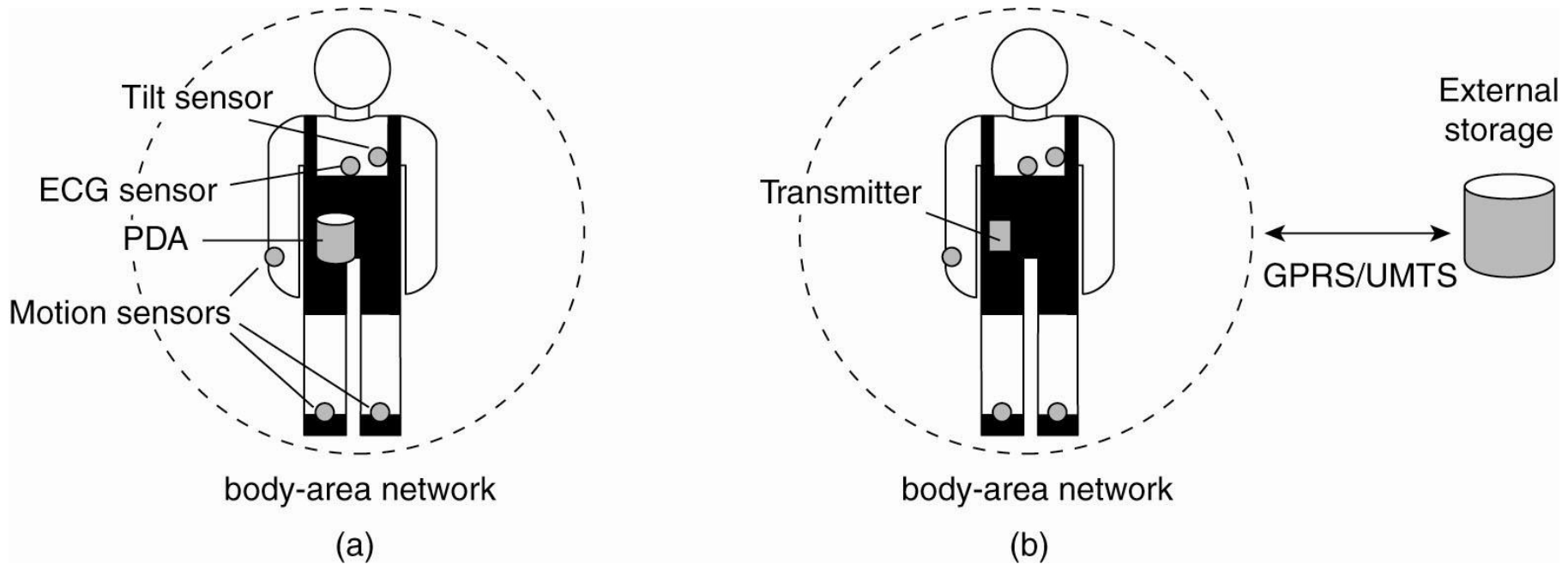- Opensource middleware
  - Nimbus
  - Eucalyptus
  - OpenNebula

Distributed Information Systems

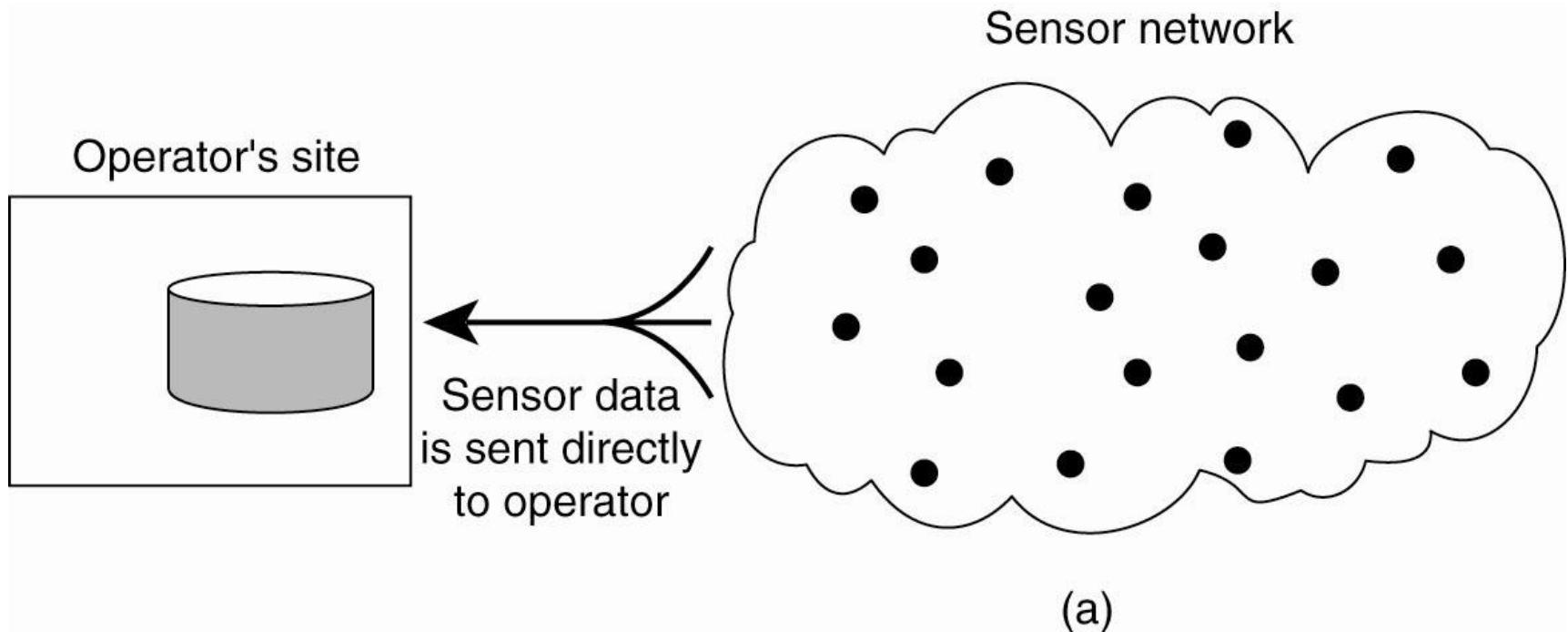- Transaction processing systems

Distributed Pervasive Systems

- ## Electronic health care systems

Monitoring a person in a pervasive electronic health care system, using (a) a local hub or (b) a continuous wireless connection.

Distributed Pervasive Systems

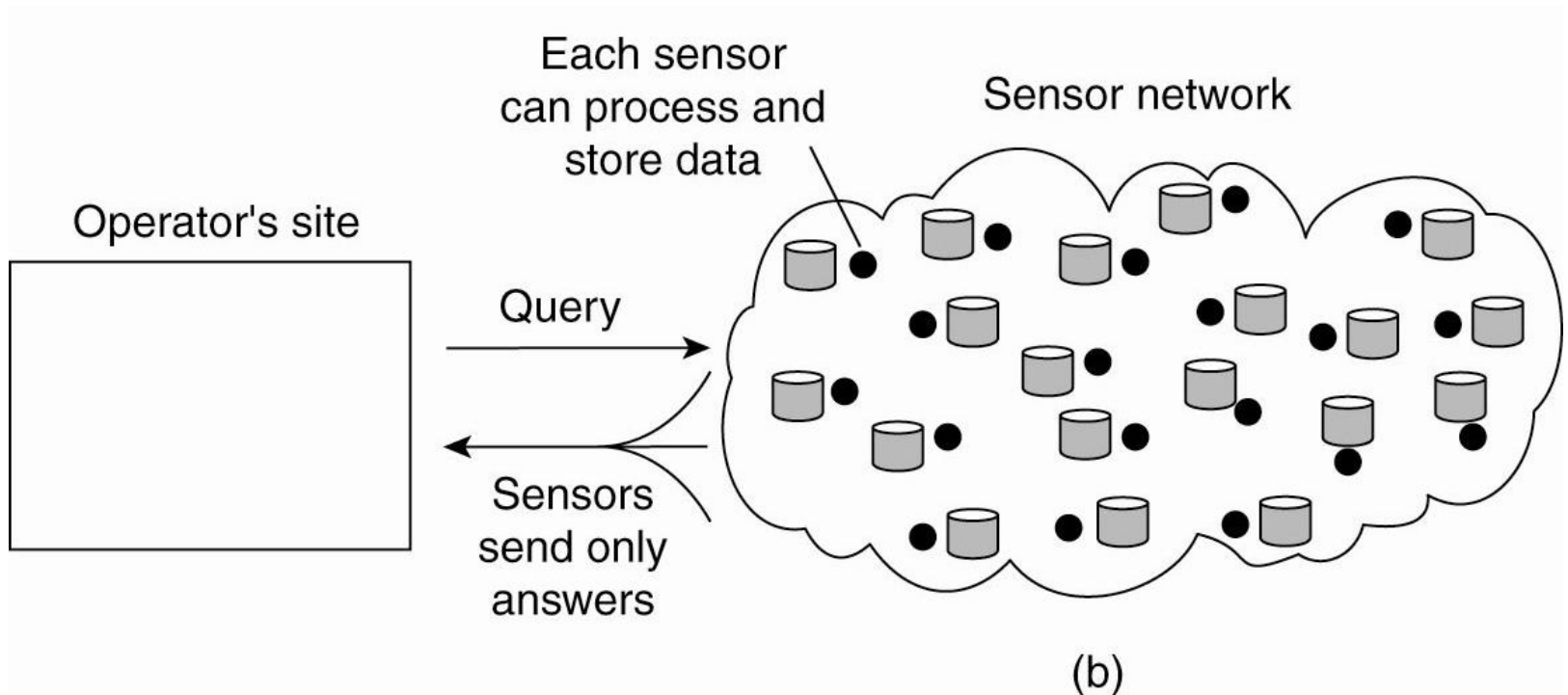- Sensor systems

Organizing a sensor network database, while storing and processing data (a) only at the operator's site or ….

Distributed Pervasive Systems

- ## Sensor systems

Each sensor can process and store data

Sensor network

Operator's site

Query

Sensors send only answers

(b)

Organizing a sensor network database, while storing and processing data … or (b) only at the sensors.

Distributed vs. Single Systems

- Data sharing
  - Multiple users can access common database, data files,…
- Device/resource sharing
  - Printers, servers, CPUs,….
- Communication
  - Communication with other machines…
- Flexibility
  - Spread workload to different & most appropriate machines
- Extensibility
  - Add resources and software as needed

Distributed vs. Centralized Systems

- Economics
  - Microprocessors have better price/performance than mainframes
- Speed
  - Collective power of large number of systems
- Geographic and responsibility distribution
- Reliability
  - One machine's failure need not bring down the system
- Extensibility
  - Computers and software can be added incrementally

Disadvantages of Distributed Systems

- ## Software
  - Little software exists compared to PCs

- ## Networking
  - Still slow and can cause other problems (e.g. when disconnected)

- ## Security
  - Data may be accessed by unauthorized users

Questions

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