Modeling Location for Pervasive Environments

By:

- Richard Glassey
- Ian Ferguson

SmartLab
The Pervasive and Global Computing Group
www.smartlab.cs.strath.ac.uk

Overview

- Aspects of Location-Aware Computing
- Developments in Location Modeling
- Seven Challenges
- Our approach: *SpaceSemantics*

Location-aware Computing

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- Location Sensing and Modeling
  - Important for context awareness and pervasive systems.
  - Not dependent on each other
  - But useful combined
- PhD Focus: Location Modeling
  - Development of models
  - Challenges ahead
  - Proposed approach

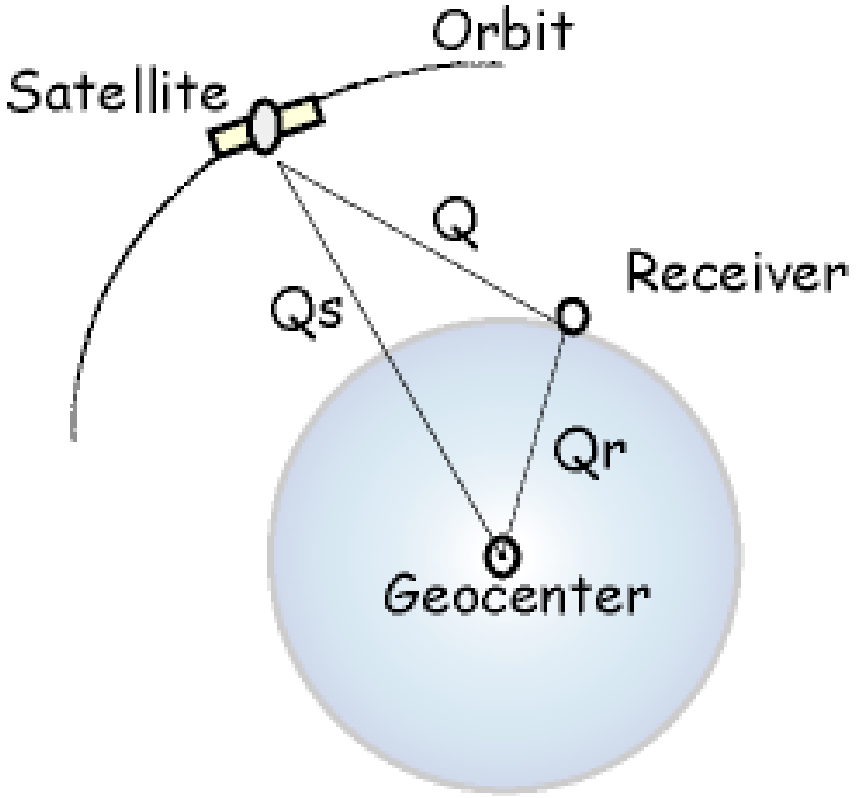
Pervasive and Global Computing

Developments

- Several specific model types
  - Geometric
  - Symbolic
  - Hybrid
- Aspects for comparison
  - Accuracy
  - Comprehension
  - Complexity

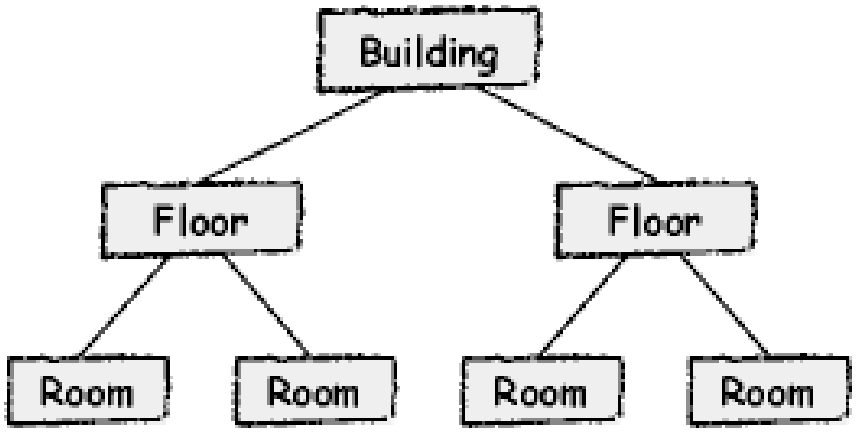
Geometric Model

- GPS WGS84 [1]
  - ie (20.04, 51.3, 0)
- Pros:
  - Accurate
  - Uniform
- Cons:
  - Absence of meaning
  - Dependence on sensor technology (GPS)



Symbolic Model

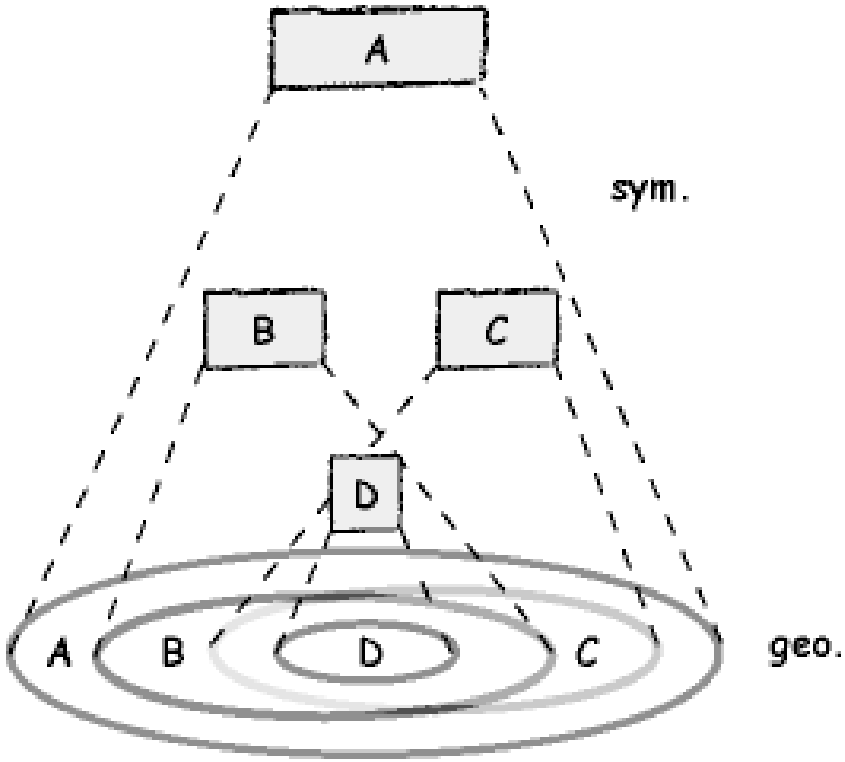
- Active Map Service [2]
- Pros:
  - Understood by human and machine
  - Simple requirements
- Cons:
  - Lacks precision
  - Choice of ontology



Hybrid Model

- Leonhardt [3],Project Aura's ALI [4]

- Pros:
  - accurate and readable
- Cons:
  - Complexity of requirements
  - Limits of inference



Some Thoughts…

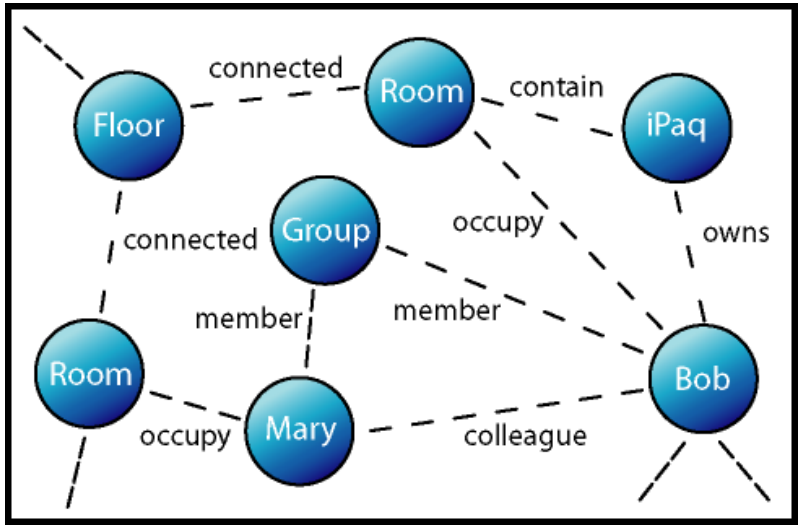
- What is still needed?
  - Models have evolved but they can go further.
- What challenges have to be overcome?
  - 7 significant challenges have been identified.

Seven Challenges

1. Scale of environment
2. Suitable ontology
3. Aggregation of and abstraction over sensor technologies
4. Multiple / transient environments
5. Inference beyond position
6. Open and extensible model
7. Privacy and security

Our Approach…

- Outline of *SpaceSemantics*
  - Organization of model
    - Graph topology of typed nodes and typed relationships between nodes.
    - Model conceptual, logical and physical aspects.



Our Approach…

- Architecture supporting model
  - Decentralized solution across open networked database.
  - Participatory approach similar to P2P or WWW.
  - Various parties supply sections of model which can be joined or overlaid.
- Querying over model
  - Graph traversal over typed relationships.

References…

1. B. Hoffmann-Wellenhof, H. Lichtenegger, and J. Collins. *Global Positioning System: Theory and Practice*. New York, Springer-Verlag, 3rd ed, 1992.
2. Bill Schilit and M. Theimer. *Disseminating active map information to mobile hosts*. IEEE Network, 8(5):22–32, 1994.
3. U. Leonhardt. *Supporting Location-Awareness in Open Distributed Systems*. PhD thesis, University of London, 1998.
4. Changhao Jiang and Peter Steenkiste. *A hybrid location model with a computable location identifier for ubiquitous computing*. Lecture Notes in Computer Science, 2498, Ubicomp 2002.