Nexus—A Global, Active, and 3D Augmented Reality Model

NEXUS

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Overview

Nexus—A Global, Active, and 3D Augmented Reality Model

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- Introduction: context aware applications
- **Global** federation of spatial context models
- **Active** context models
- The **third** dimension
- **Augmented reality** example: the Smart Factory
- Vision and Outlook: the **World Wide Space**

Who are we?

SFB 627 Nexus (Center of Collaborative Studies): Spatial World Models for Mobile Context-Aware Systems

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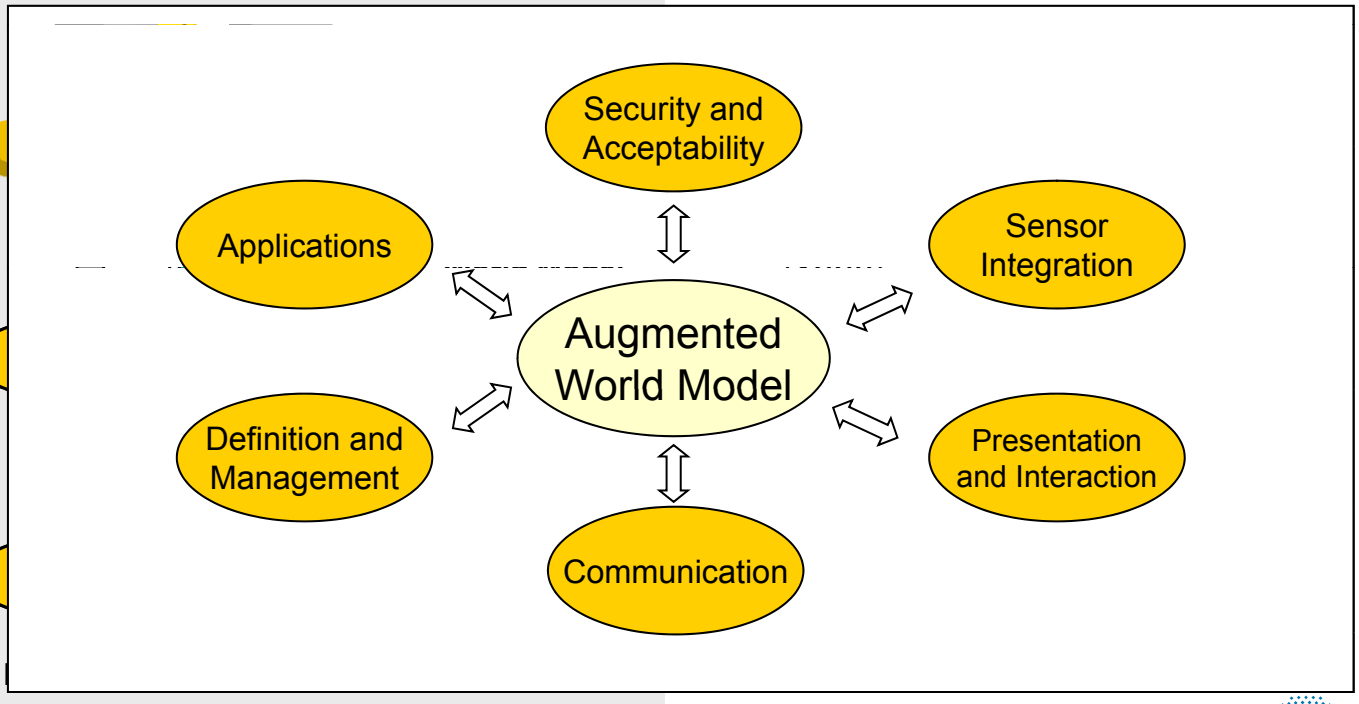
Umgebungsmodelle für mobile, kontextbezogene Systeme



[NEXUS, 1999]

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A Clear Trend

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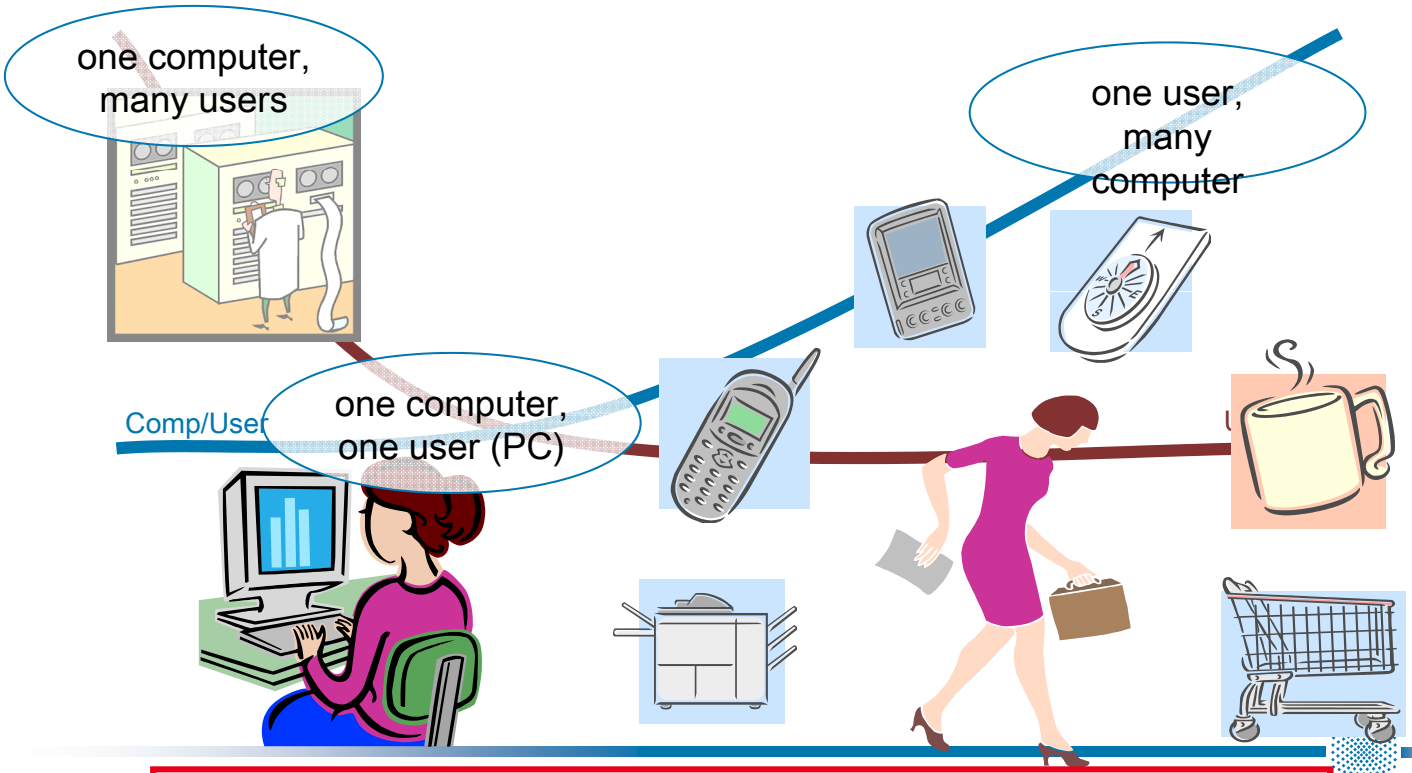

Situation Work Place → Everyday Situations

Context-aware applications

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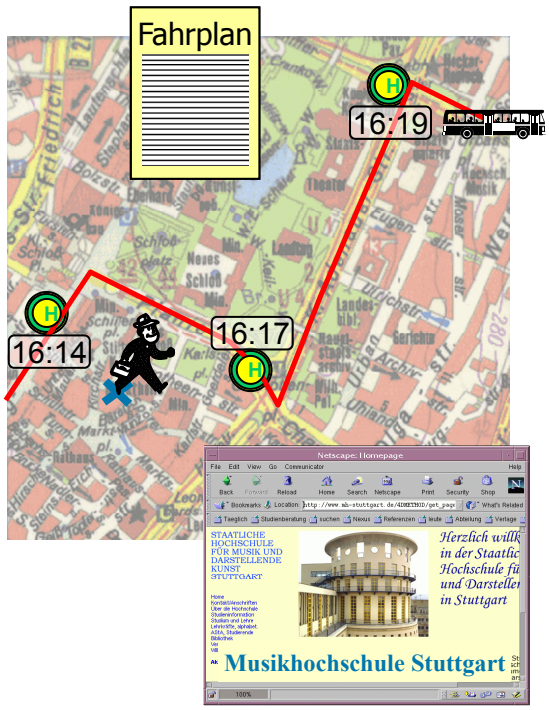
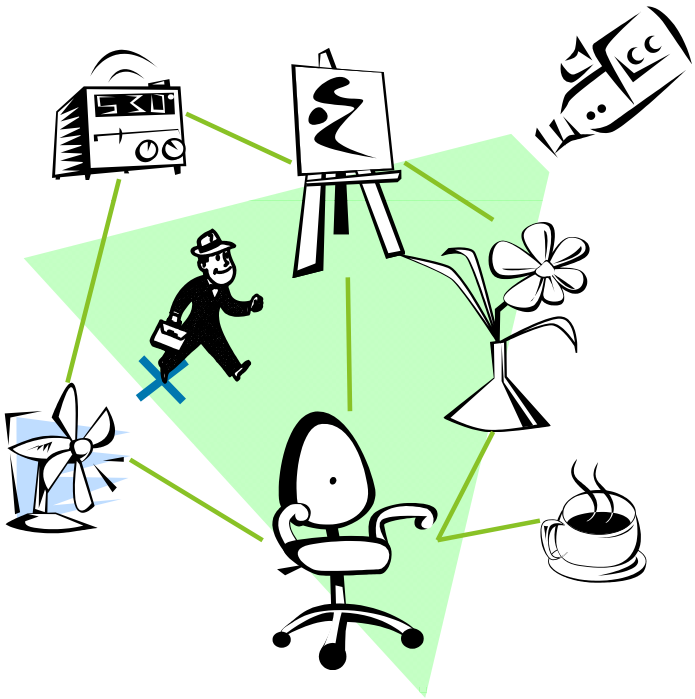
mobile computing



"smart" environments



Poor device

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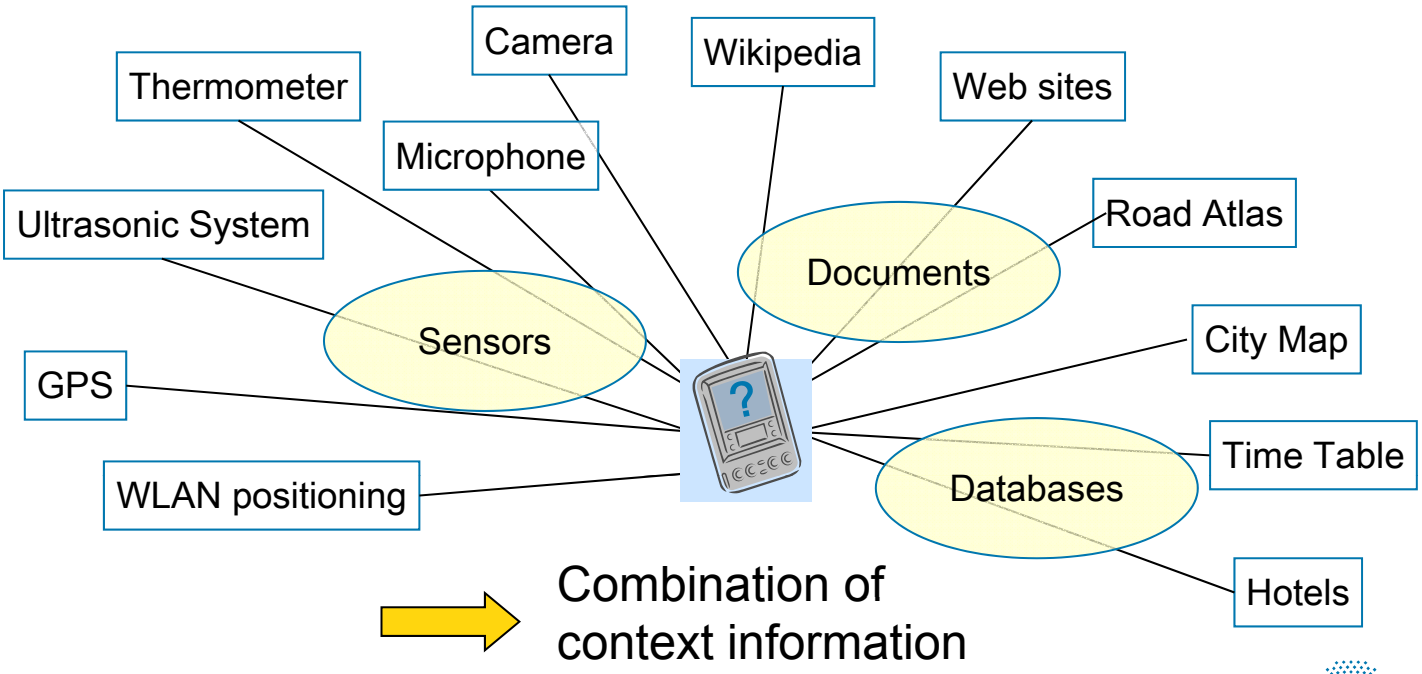

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Abstraction: shared context model

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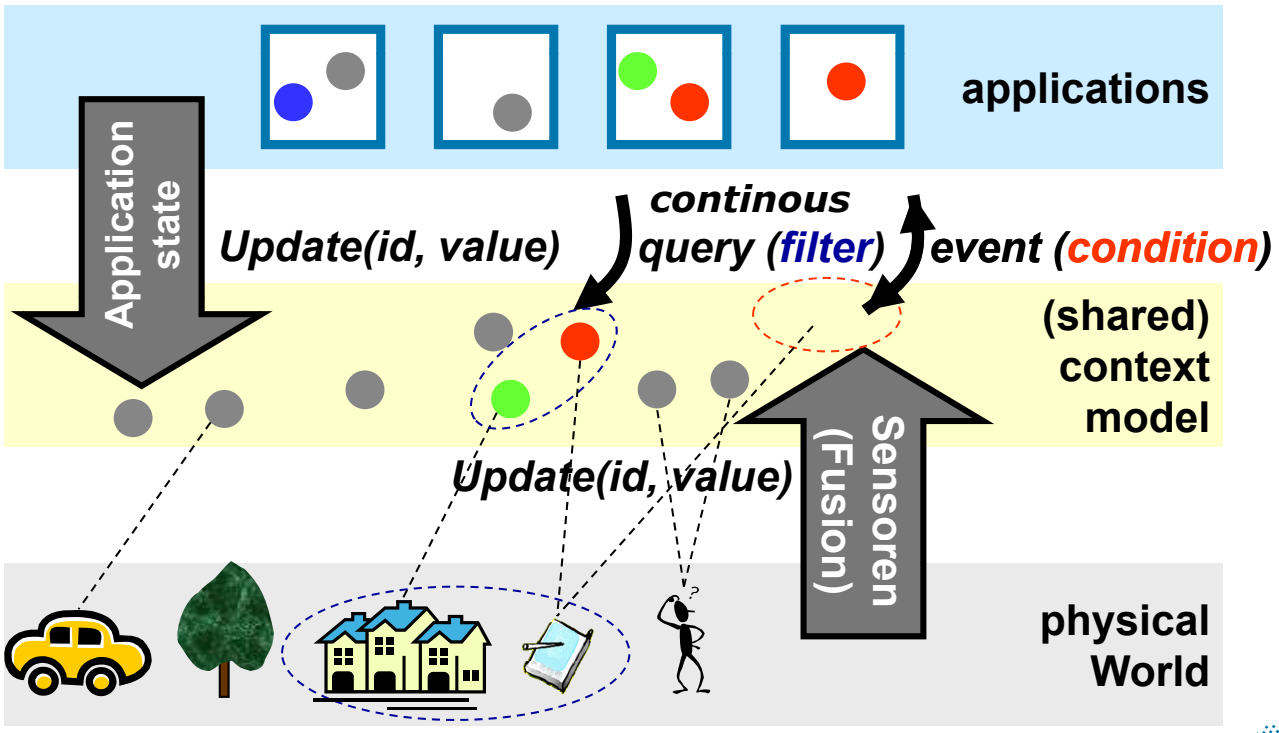

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Local context models

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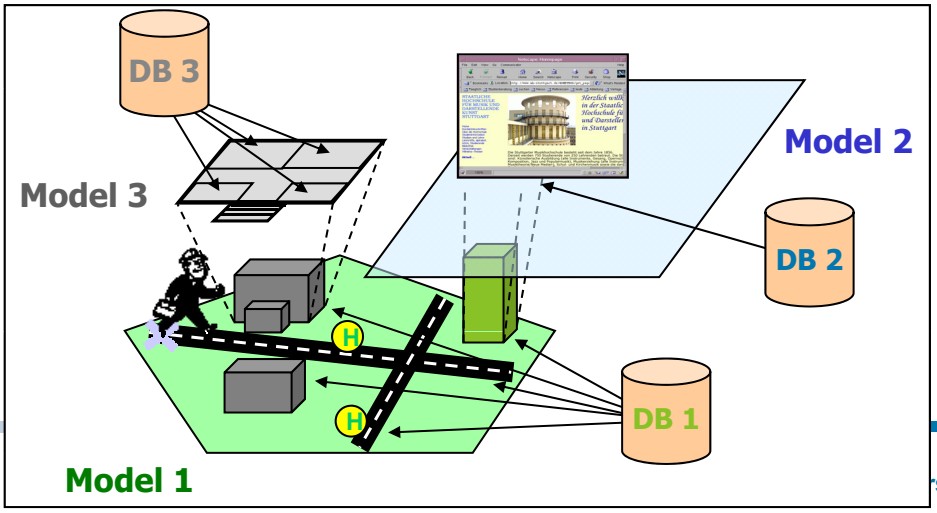
- cover a certain spatial region
- contain a certain set of context information
- are managed by a single server/organisation

Overlap in space and content:

➔ multiple representations of real-world entities



Global context model (the Nexus vision)

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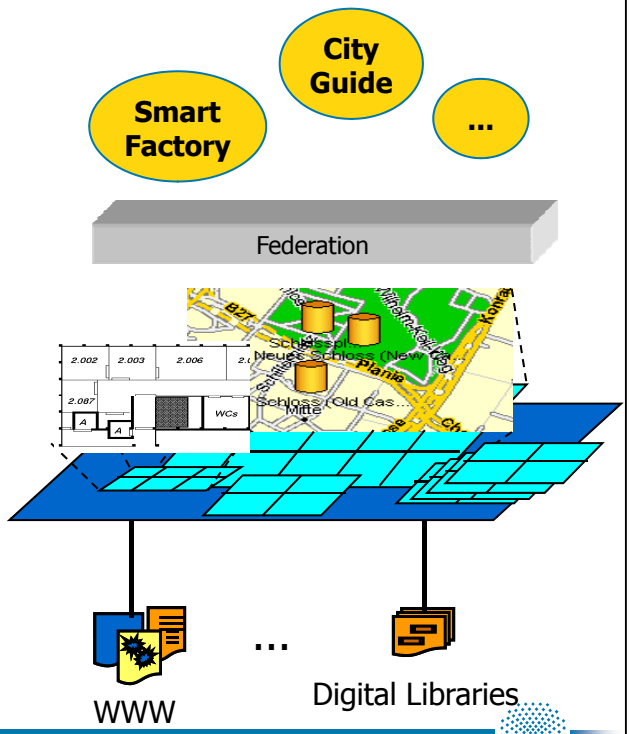
- Federation of local models
  - autonomous data providers
- Exploits spatial structure as integration criteria
  - global, extensible integration schema
  - combines local world model to an integrated view
- Shared: enables interoperability between applications
  - modeling is expensive
  - shared resources
- Open for new servers + applications
  - Web 2.0 trend



Schema Integration and evolution: Augmented World Schema

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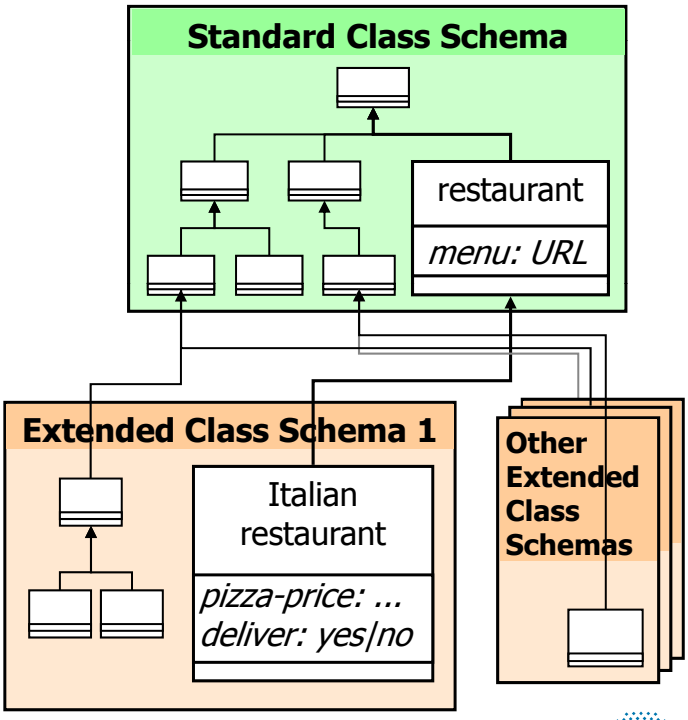
- Standard Class Schema
  - Fundamental object classes, needed by most applications:
    - geographic (maps, ...)
    - dynamic (data from sensors)
    - information (documents, ...)
    - technical (infrastructure)
  - Ensures interoperability
  - Unique identifier for every object instance
- Extended Class Schema
  - For future applications
  - Objects inherit from Standard Class Schema



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Nexus platform Architecture

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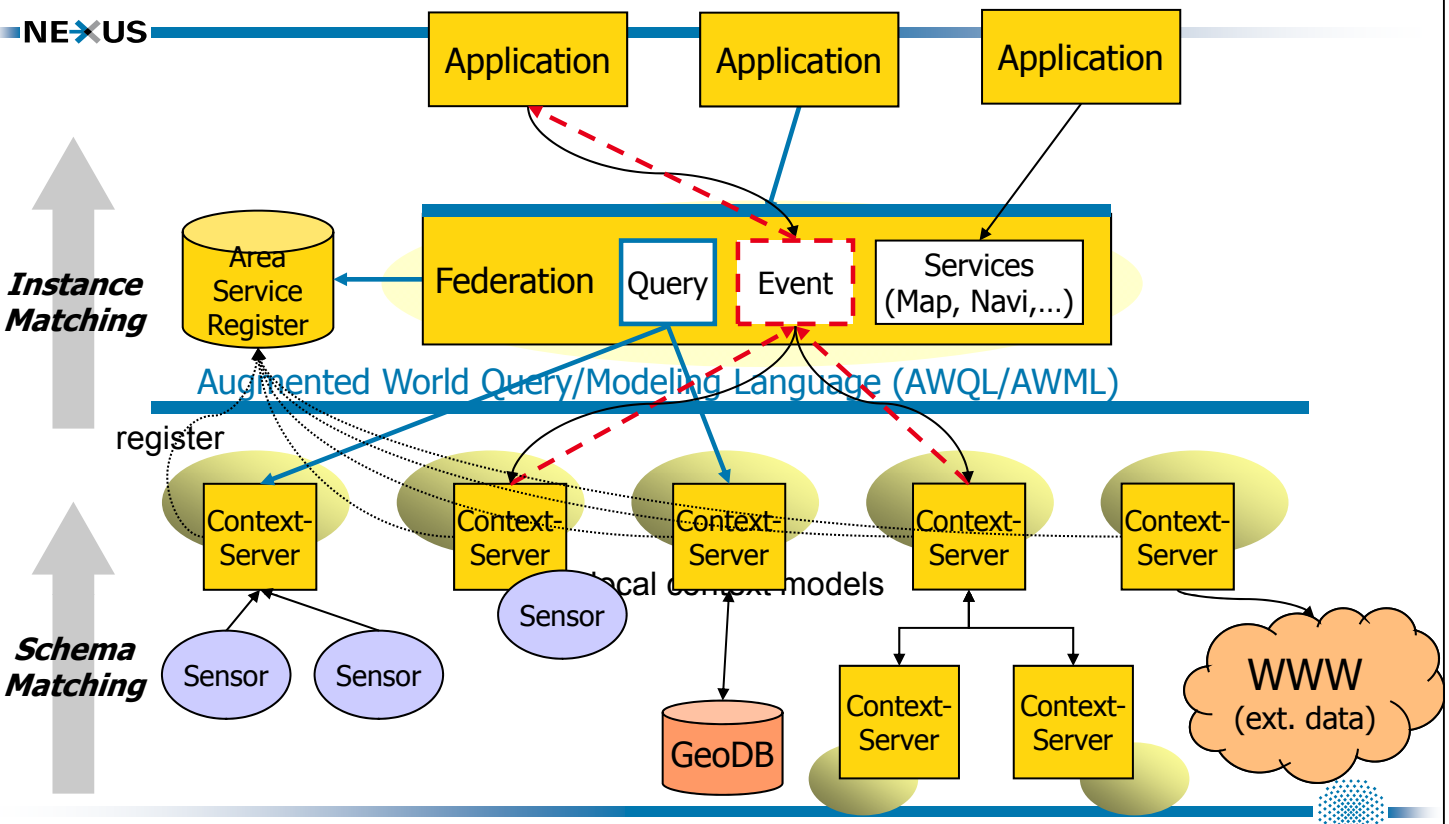

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Instance Matching: e.g., Junctions

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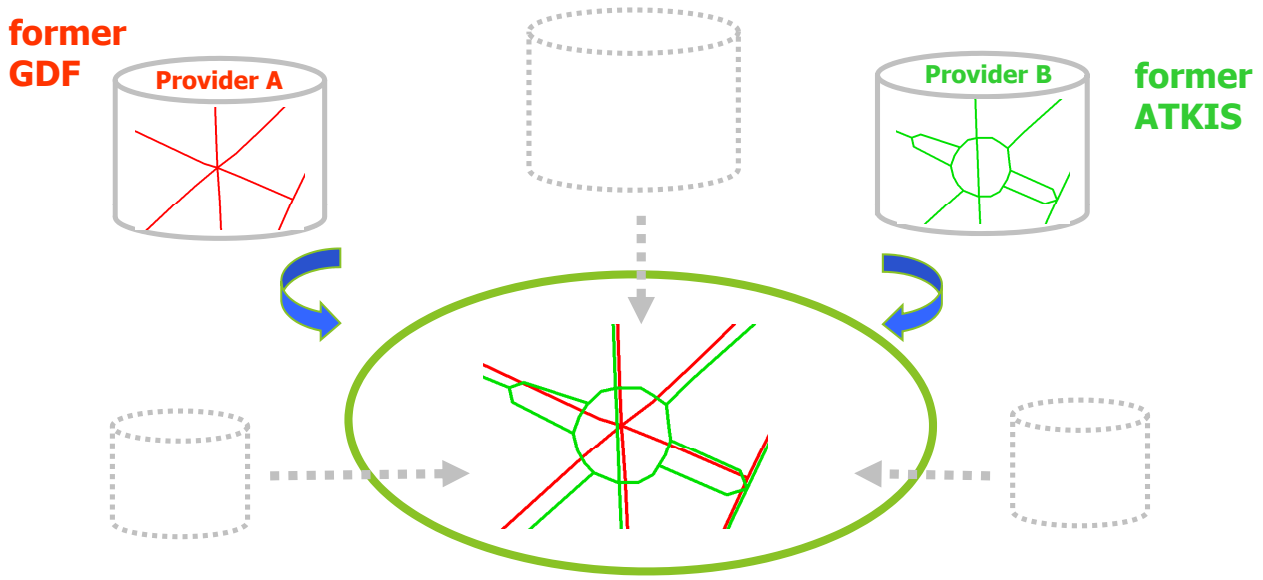
- Multiple representations of the same real world object



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Instance Matching: Syntactical Merge

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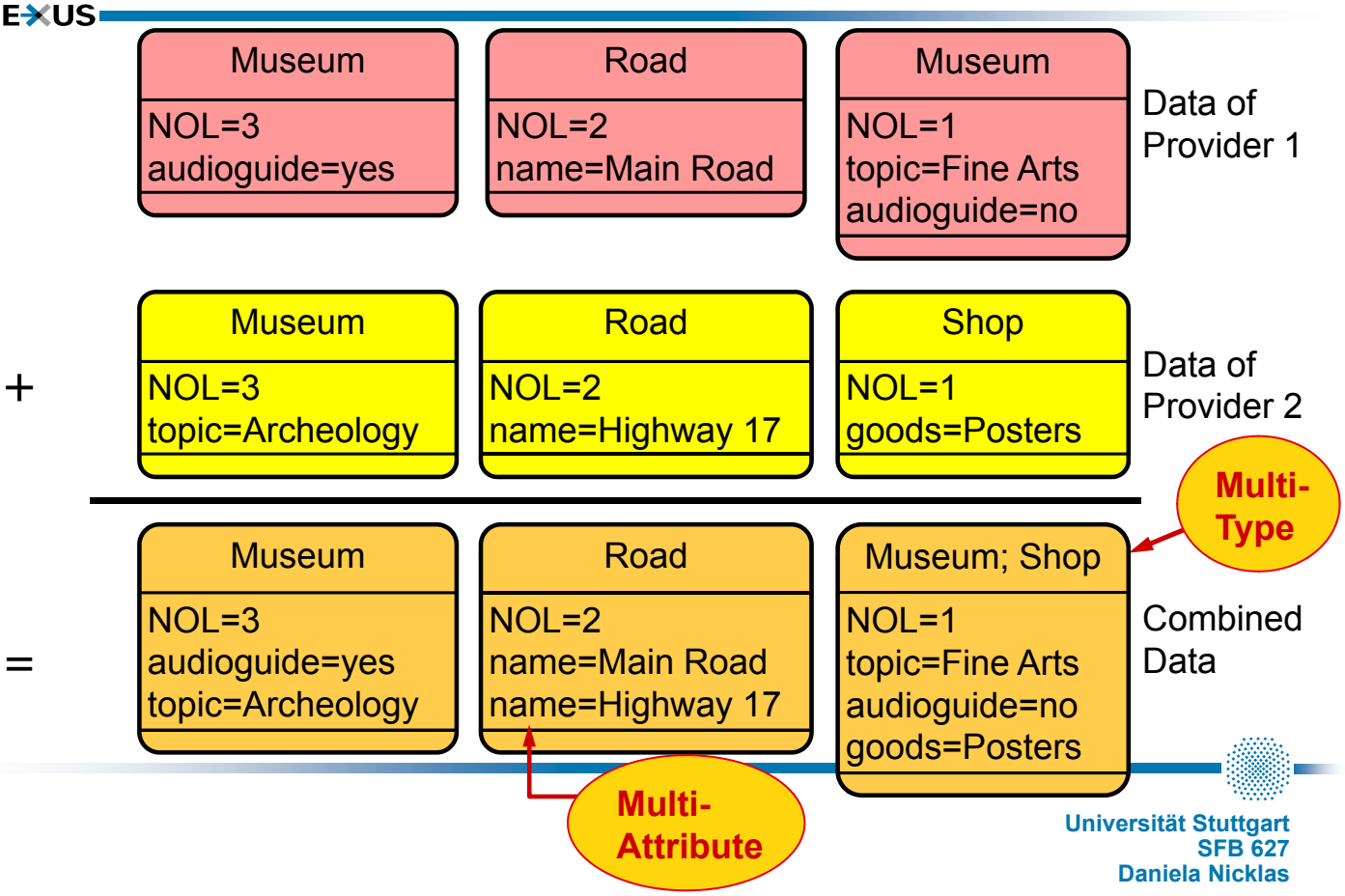

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Spatial events

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- Proactivity is important in mobile, location-aware computing
- Can be supported by event observation/notification mechanism

Active context models

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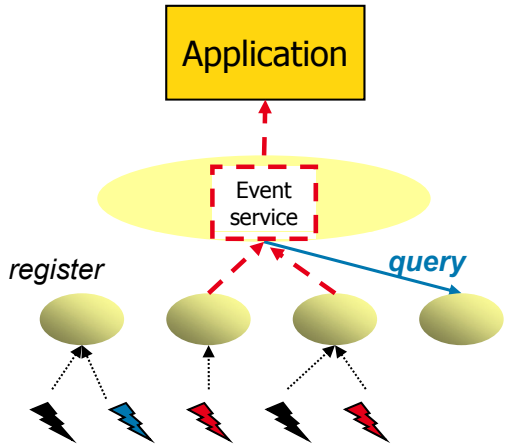
- Event based communication:
  - subscribe for information
  - register observation
  - send notifications
- Continious queries:
  - register query
  - send current result
  - observe changes to the result
  - send delta to last result
- Challenges:
  - find best place for observation (reduce data transfer)
  - combine complex events out of distributed simple data



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The third dimension

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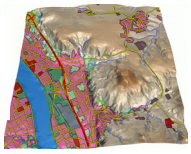
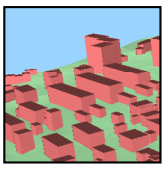
- Nexus platform: 2D → 2,5D → 3D
- Requirements:
  - indoor and outdoor
  - composed objects
  - different coordinate systems
  - accuracy: up to centimeters
  - required information: location (geometry and topology)
  - optional information: texture, normal vectors, material
- CityGML
  - models in 5 levels of details
  - Nexus extensions: material types, normal vectors

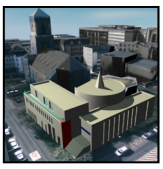
LoD0: terrain



LoD1: blocks

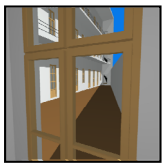


LoD2: + roofs



LoD3: complex architecture

LoD4: + indoor



Smart Factory

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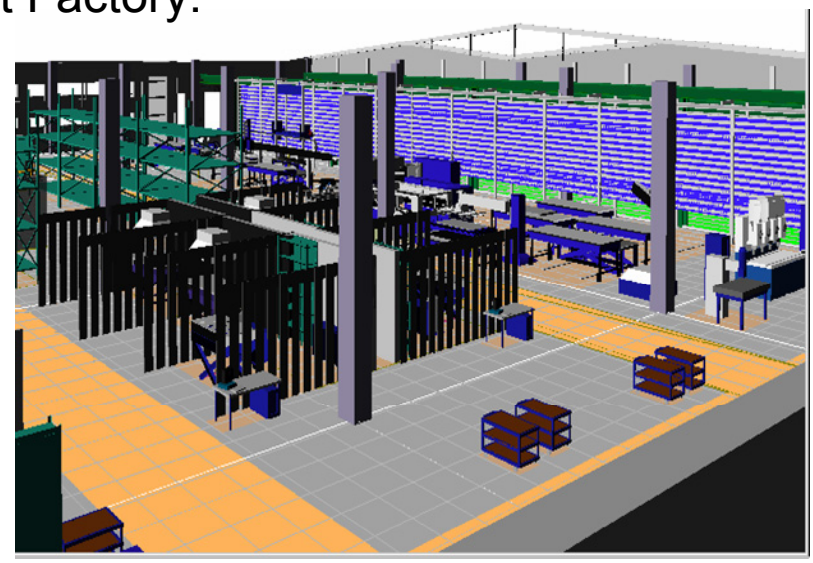
- Context-awarness in production environment
- Detailed model of Smart Factory:
  - Locations of objects:
    - machines, installations, tools, work pieces, fixtures, etc.
  - State of objects:
    - e.g., mechanical wear of tools



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Example: AR applications

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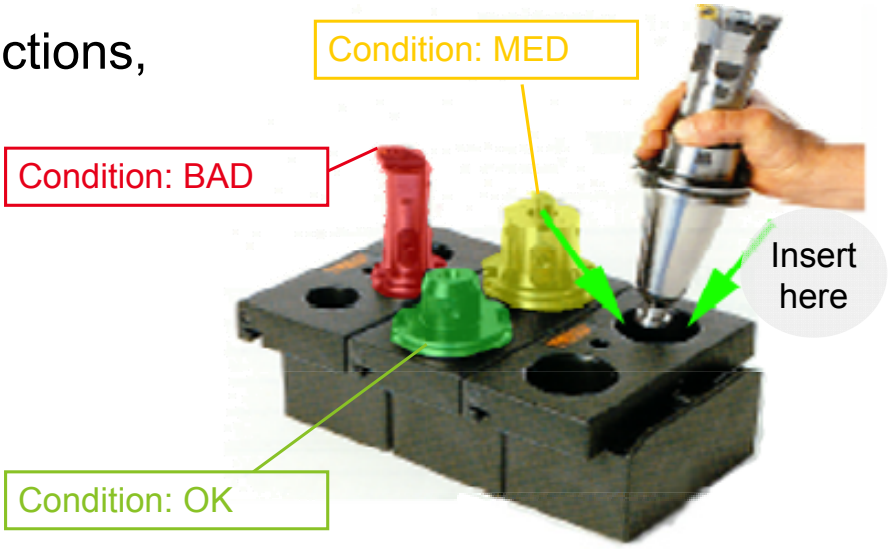
- Display machine/tool state
- Navigation to tool
- Assembly instructions, documents, etc.



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Vision: World Wide Space

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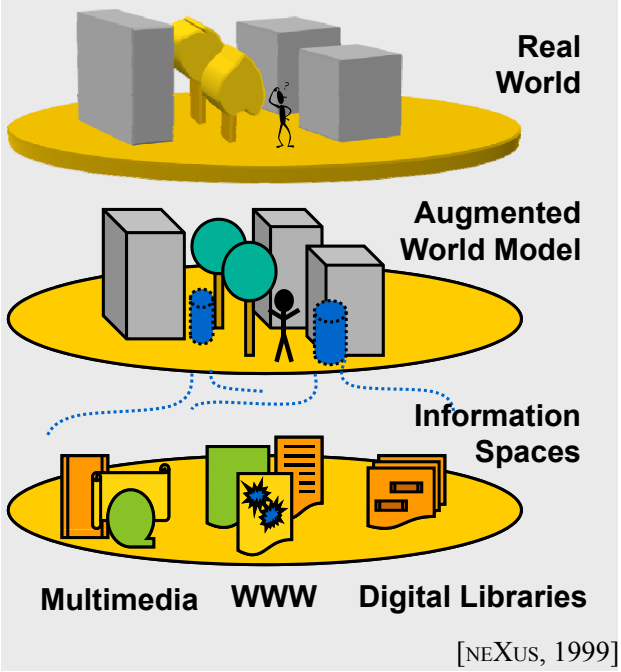
- (Mobile) applications can access context anytime, anywhere
- Challenges:
  - Autonomy of data providers
  - Data integration and semantics (exploiting spatial structures helps!)
  - Quality of sensor data
  - Privacy and security: different views for different users
  - Requirement: high-detailed spatial world models



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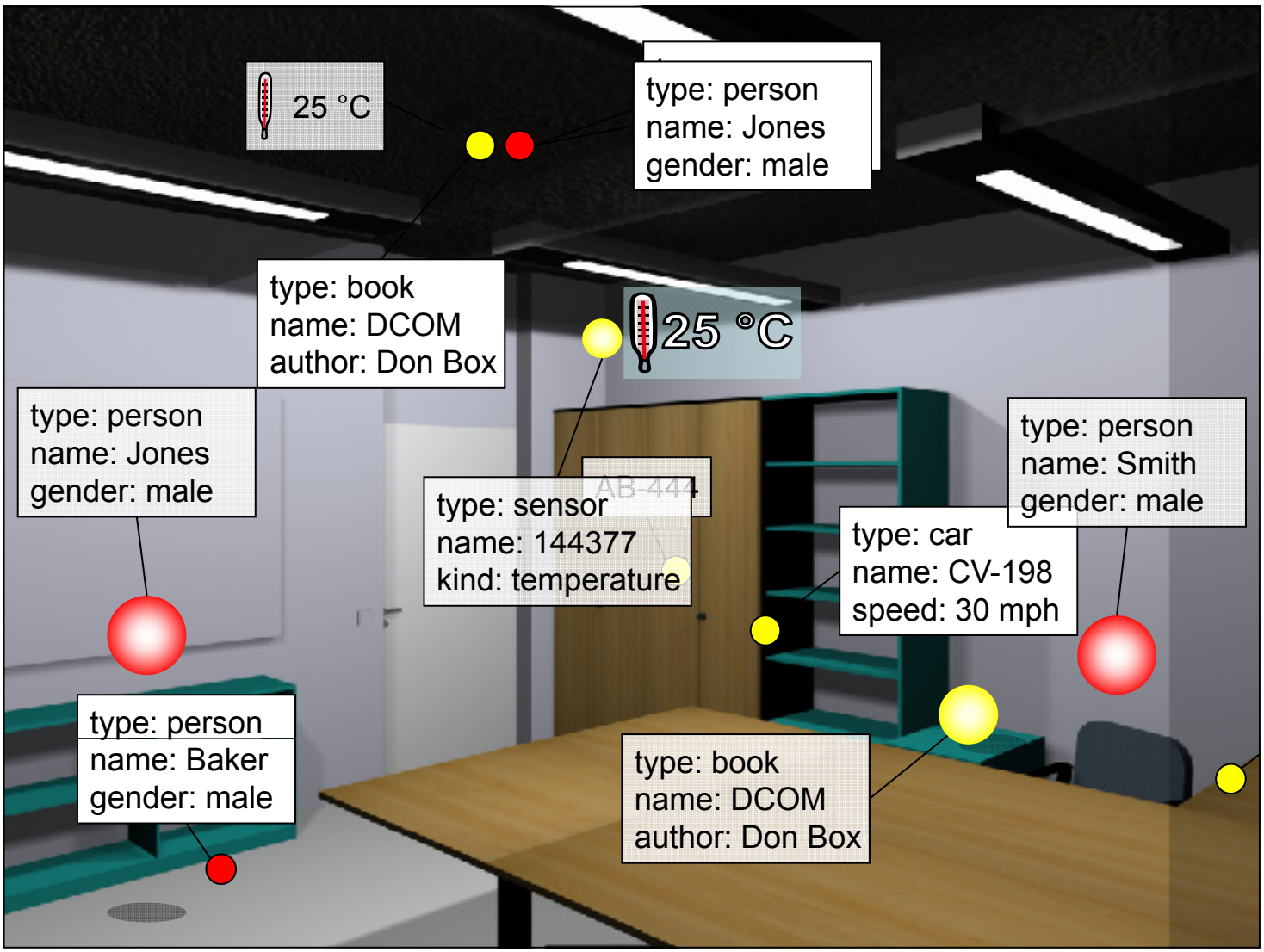

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