Nexus: A Universal Platform Enabling Context-Aware Applications

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Overview

- The vision of shared world models
- From application needs to the platform
- The Nexus Augmented World Model
- New services: what we can do now
- Conclusion
Vision: Federated, Shared World Models

- Context Model: Information for Context-aware Applications
  - location, identity, time (primary context)
  - environment, POIs, sensor data, relevant web sites
- Shared: enables interoperability between applications
  - modeling is expensive
  - shared resources
- Federated: combining local world models to a global view
- Open
What context-aware applications want to know

Where am I? (want to show on the map)

Where are nearby italian restaurants? (my user is hungry)

Are there any loudspeakers nearby? (want to send audio data to my user)

Is there a wireless network with better bandwidth? (this picture is really big)

→ Queries to the world (about the context)
Augmented World Query Language (AWQL)

I want the position and the information about the nearest 10 exhibits.

**AWQL:**
- simple spatial query language
- restriction: which objects?
- filter: what part of objects?
- nearest: only \( k \) objects, sort by distance

```xml
<awql>
  <restriction>
    <and>
      <equal attr="type" val="Exhibit"/>
      <inside attr="pos">
        the geometry of the room
      </inside>
    </and>
  </restriction>
  <filter>
    <include>pos information</include>
    <excludeallother/>
  </filter>
  <nearest pos="the position">10</nearest>
</awql>
```
Architecture of the Nexus Federation

Augmented World Model
Area Service Register

Domain Schema
Discovery Service

Query Processing
Model Integration

Queries
Results

Registration

see Steffen's talk
Context Servers (Nexus: Spatial Model Server)

- Store local context models
- Common interface: AWQL (easy to wrap)
- Registered at the Area Service Register
- Different types:
  - **Spatial database systems** or GIS for huge or detailed models of seldomly changing data
  - **Location Service**: efficient, main memory management of mobile objects; high update rates, less persistency
  - **Sensors**: either feeding context servers or a tiny Spatial Model Server (ContextCube: 5-sensor platform with 1MB AWQL implementation)
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Ontology

- "the study of existence"
- prerequisite for semantic interoperability, common language (or schema); defines "what is a building"
- should be a standard – but what about flexibility?
- data modeling:

**relational**
- tables and relations

**hierarchical**
- elements and sub-elements

**object-oriented**
- class hierarchies and object instances
Which Ontology for Context-Awareness?

- GML (OGC)
- OpenLS (OGC)
- PML
- Ontologies (e.g. Deepmap, Gaia, ...)
- Semantic Web
- Nexus Augmented World Model
- ...
Extensibility of the Augmented World Model

- **Standard Class Schema**
  - Base ontology
  - Fundamental object classes
  - Needed by most applications
  - Ensures interoperability
  - Unique identifier for every object instance

- **Extended Class Schema**
  - For future applications
  - Objects inherit from Standard Class Schema
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Enhanced services

- Context-aware service discovery:
  - model services (devices, applications, anything user or app. needs)

- Multi-modal navigation:
  - not on one data set, but on the current state of the world (including diff. transportation systems)

- FriendFinder (or FoeWarner)
  - Track mobile users. Privacy!
  - TelCos can do this now. But we can do more ...
More enhanced services

- Spatial Events
  - Define predicates on the real world, get notification
  - "I am near a shoe shop" or "> 5 people at the coffee corner"

- Geocast
  - send messages to geographic areas ("emergency")

- Context-aware communication: model network infrastructure
  - discover Wireless LANs on the way of the user
  - hoarding (pre-fetching)

...
Conclusion

- Vision of federated, shared world models:
  - federation has to cope with complexity and consistency
  - ontology is prerequisite for interoperability
  - extensibility for usability
  - enhanced context-aware services

- Semantic Web – but with an infrastructure that provides efficient management and retrieval capabilities
  → Assumption of Locality
  → Internet for context-awareness