

# Context Models in Nexus – Complexity and Consistency



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# Overview



- Our view on context and context models
- Complexity of context models in Nexus
  - Geometric complexity
  - Semantic complexity
  - Dynamic complexity
- Consistency and inconsistency in Nexus
  - Levels of (in-)consistency
  - Schema- and model (in-)consistency

# What is context?



## Definition:

**Context** is the information that can be used to characterize the situation of an entity.

Entities are persons, locations or objects which are relevant for the behaviour of applications.

# Context categories



- User context (personal factors)
  - Age
  - Type of device
  - Gives a presentation: yes/no?
  - Blood pressure
- Location dependent context (external factors)
  - The context of the entities at the users location:
    - E.g. the conference room: lighting, equipment, ...
  - General context at the current location:
    - Time



# What are context models?



## Definition:

***Context models** are models which provide context information about the entities relevant for an application.*

- Nexus combines:
  - Dynamic context models (data captured frequently by appropriate sensors)
    - E.g. mobile objects, traffic situations, temperature
  - Static context models (permanent storage)
    - E.g. streets, buildings, digital libraries, ...



# Overview



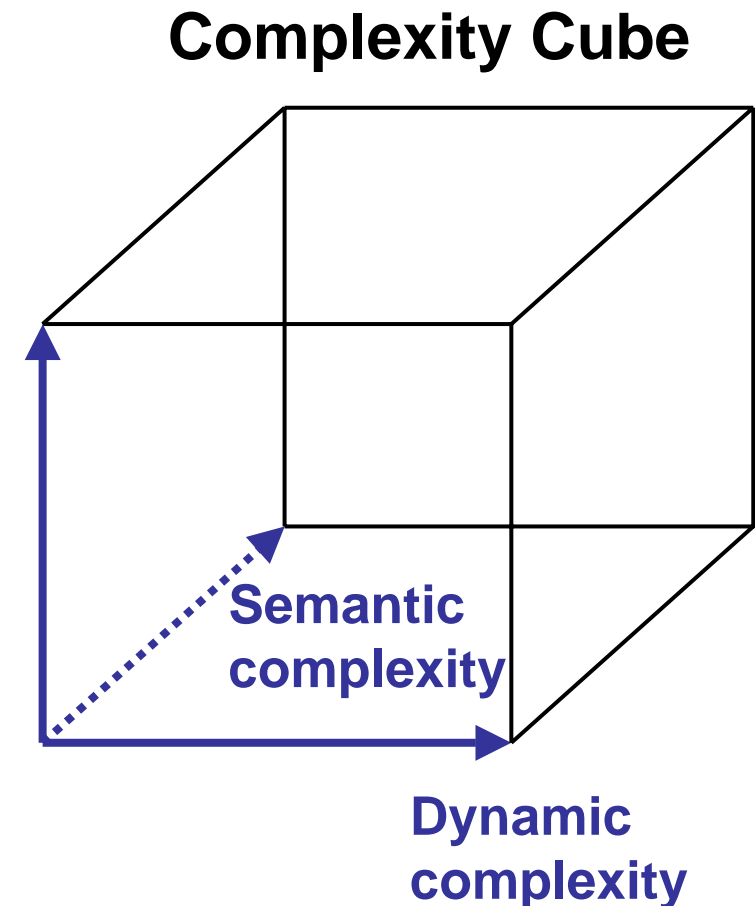
- Complexity of context models in Nexus
  - Geometric complexity
  - Semantic complexity
  - Dynamic complexity

# Complexity of context models



- Context models have a certain degree of complexity:
  - Geometric complexity
    - Scale, detail, dimension, texture
  - Semantic complexity
    - Content, relations
  - Dynamic Complexity
    - Temporal and mobile objects and attributes, update rates

Geometric complexity

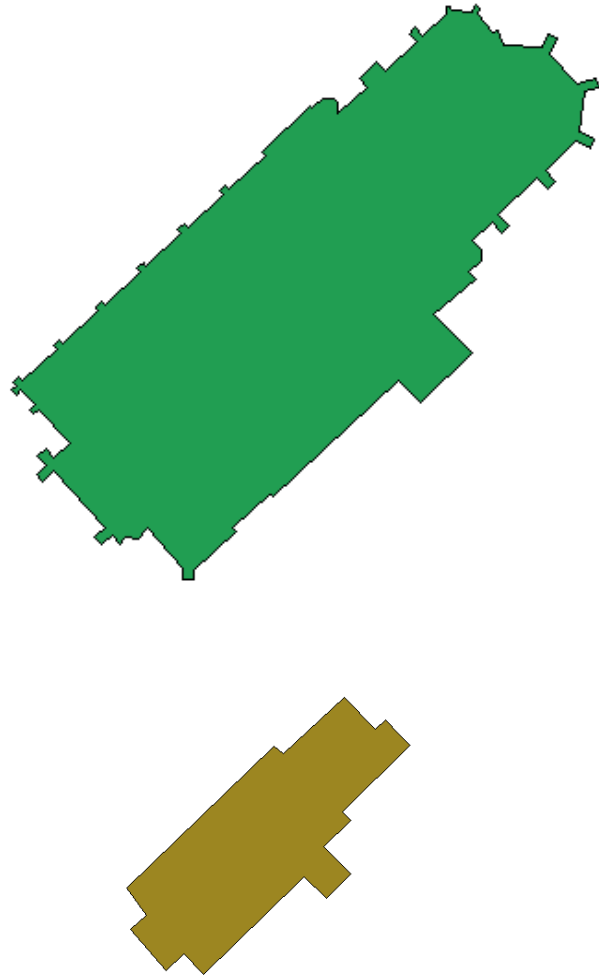


**CM\_Complexity = f(geometric, semantic, dynamic complexity)**

# Geometric Complexity – Levels of Detail I



**Scale**



**Complexity in 2D:**

**Detail**

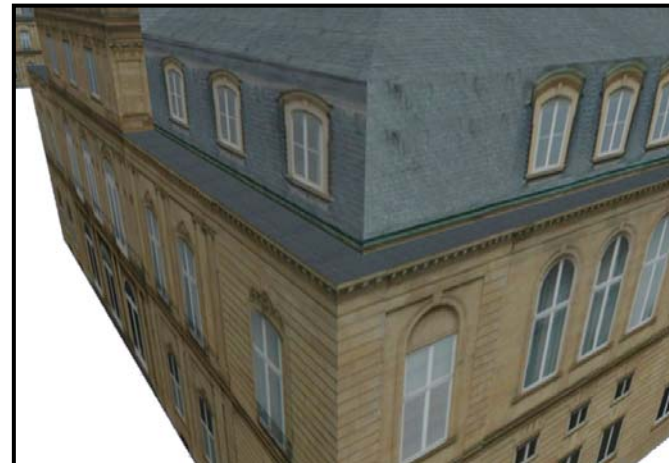
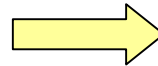
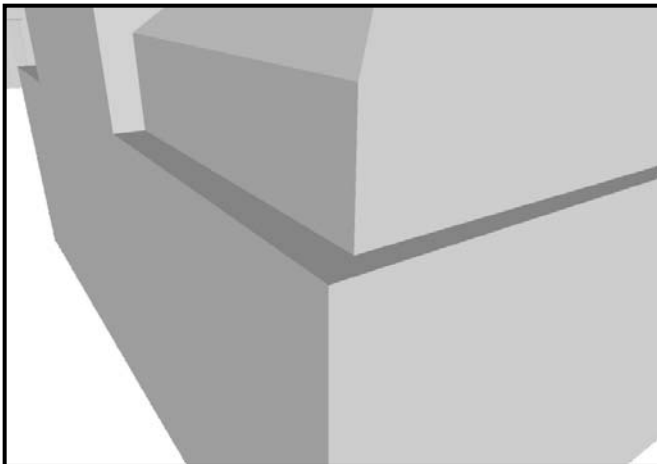
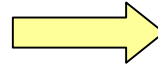
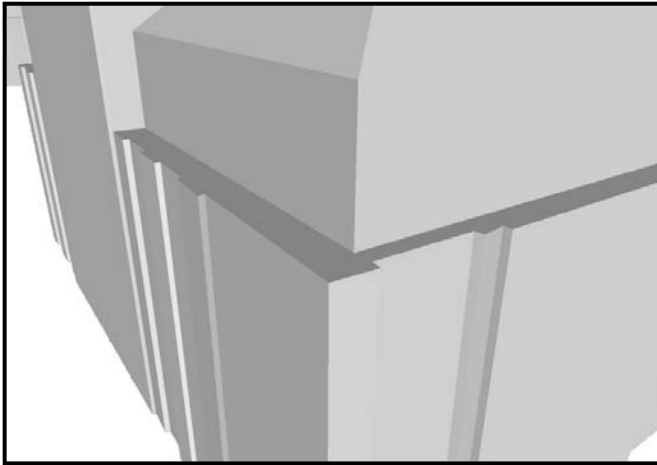




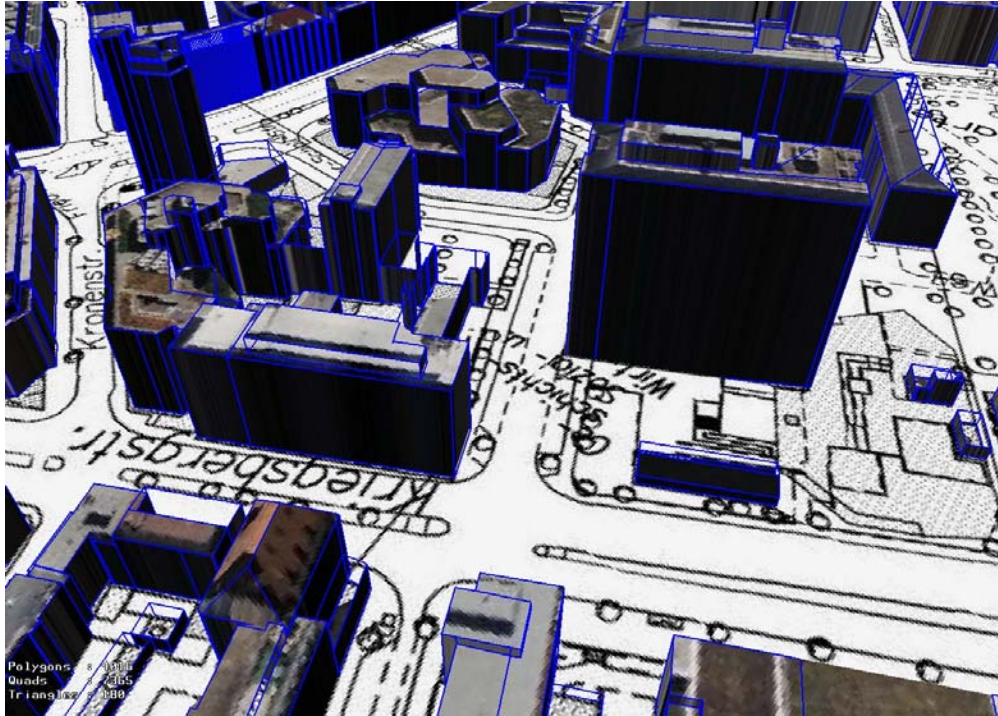
# Geometric Complexity – Levels of Detail II



- Complexity in 3D: Data volume reduction



# Geometric Complexity – Levels of Detail III



Outdoor

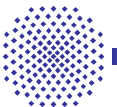
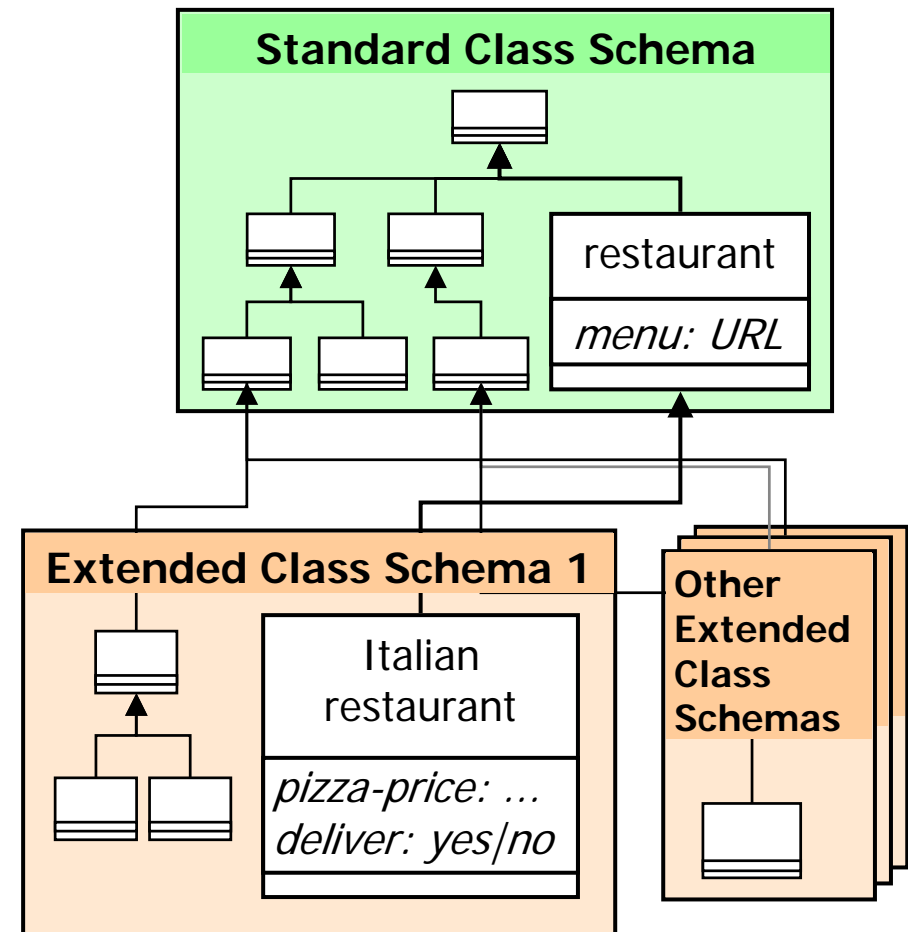
Indoor



# Semantic complexity I – Objects and Attributes



- Standard class schema with basic object classes
- Extended class schema with application-specific object classes
- Objects within Nexus can have different attributive depth
  - Only few attributes are required, most are optional

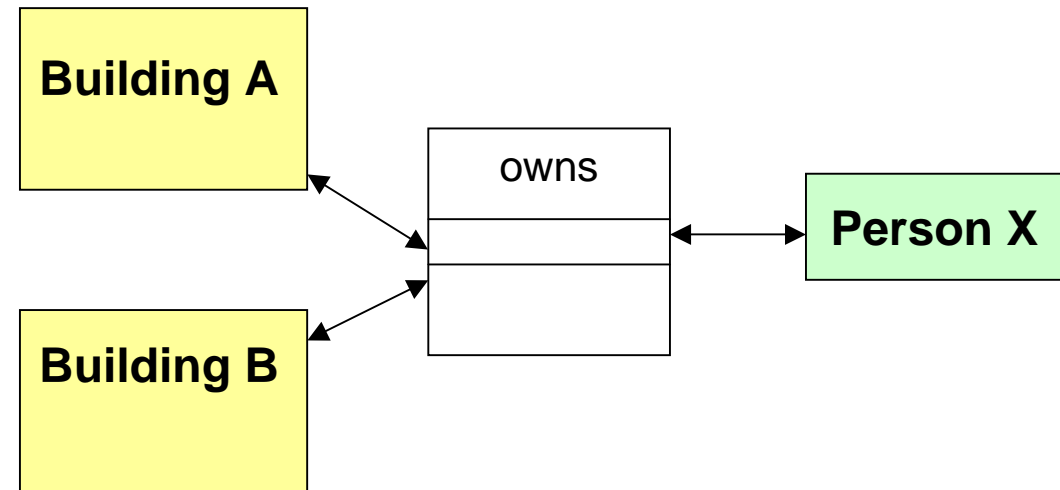


# Semantic complexity II – semantic relations

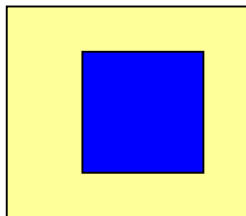


## ■ Organisational relations

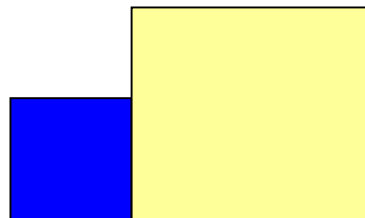
- owns
- heldBy (e.g. rental cars)
- belongsTo
- Etc.



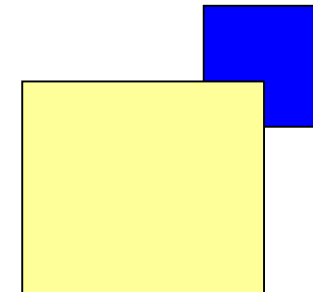
## ■ Topological relations:



Inside



Touches



Overlaps

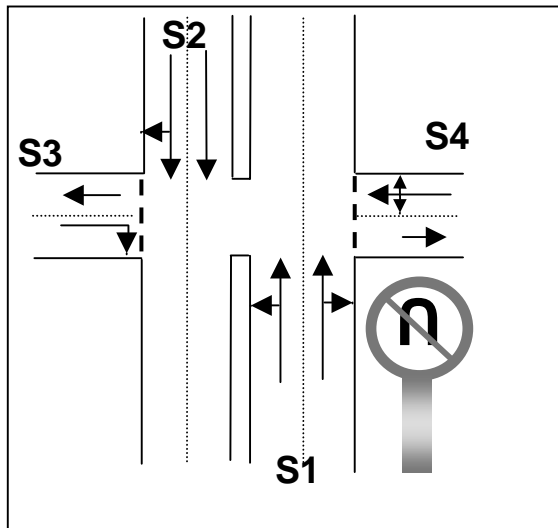


# Semantic complexity III - Navigation

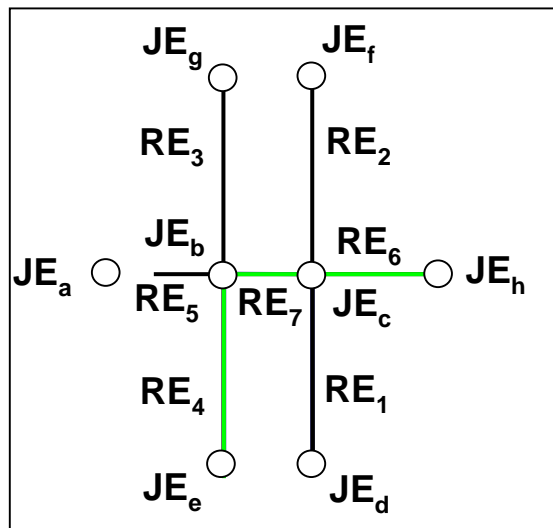


- Graph objects and relations
  - weighted graphs
  - Restrictions: forbidden turns, one way streets, ...

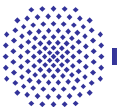
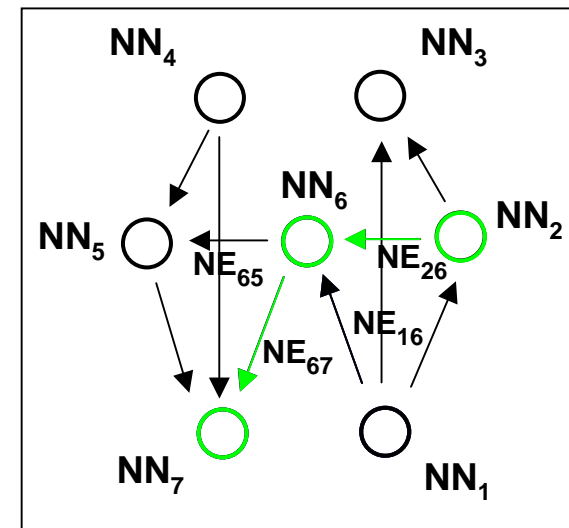
Real world



Topography



Navigation



# Dynamic complexity I



- Temporal objects

- E.g. Construction sites

- Starts at, ends at



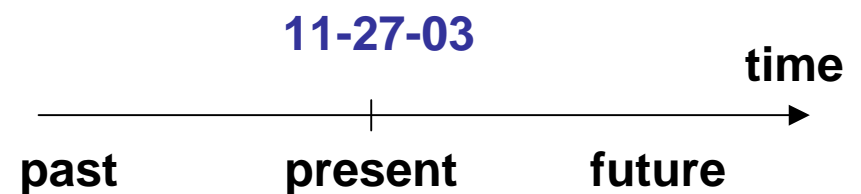
11/03 until 03/04

- Mobile objects

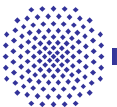


- Modeling temporal relations

- During, before, between, ...



- Degree of update rates



# Overview



- Consistency and inconsistency in Nexus
  - Levels of (in-)consistency
  - Schema- and model (in-)consistency



# Consistency and Inconsistency in Nexus



Possible (in-)consistencies

world

schema ↔ schema ... schema

schema-inconsistency

model-inconsistency

model (data) ↔ model ... model

federation

application ↔ application

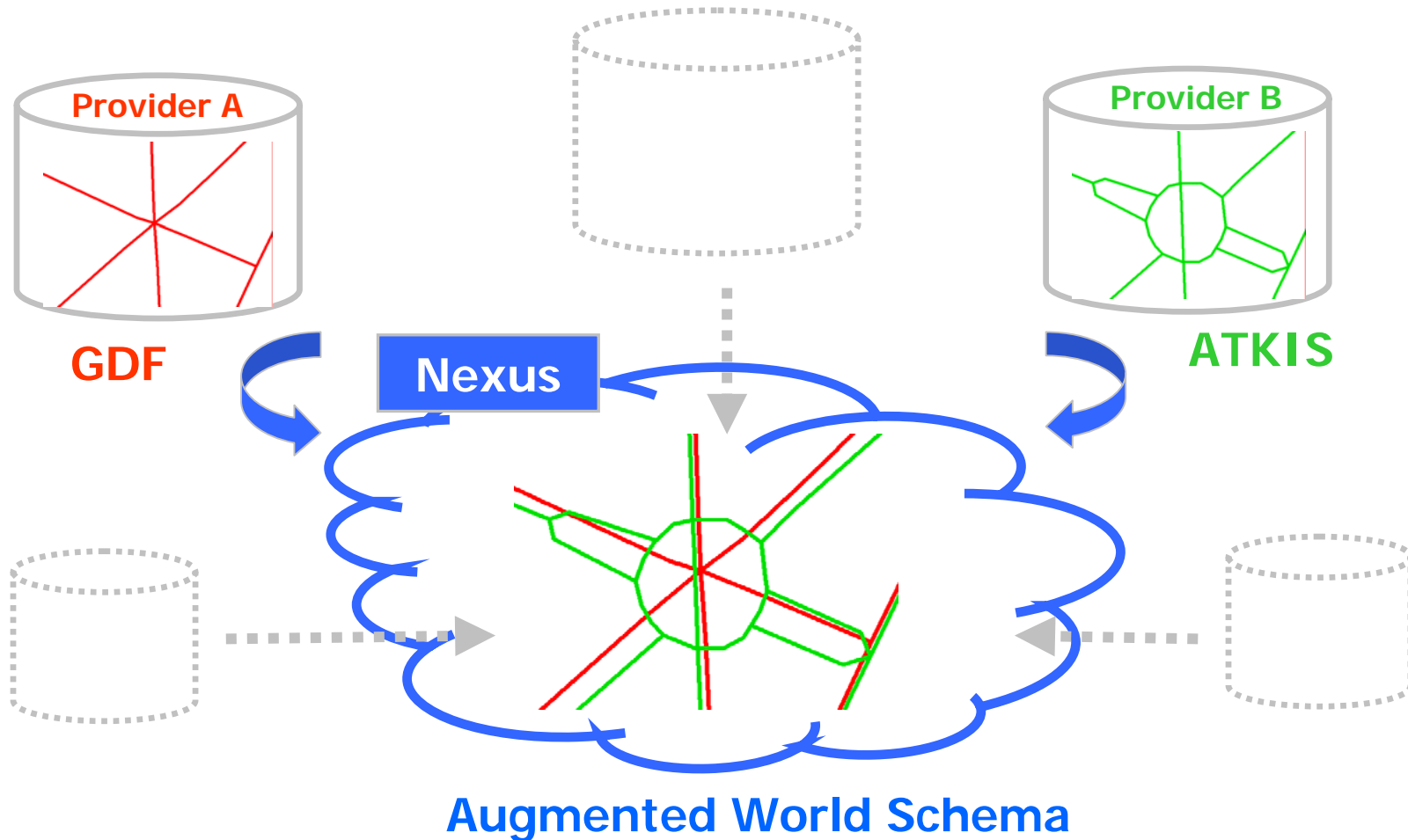




# Inconsistency of geospatial data



- Multiple representations of the same real world object



# Schema Integration



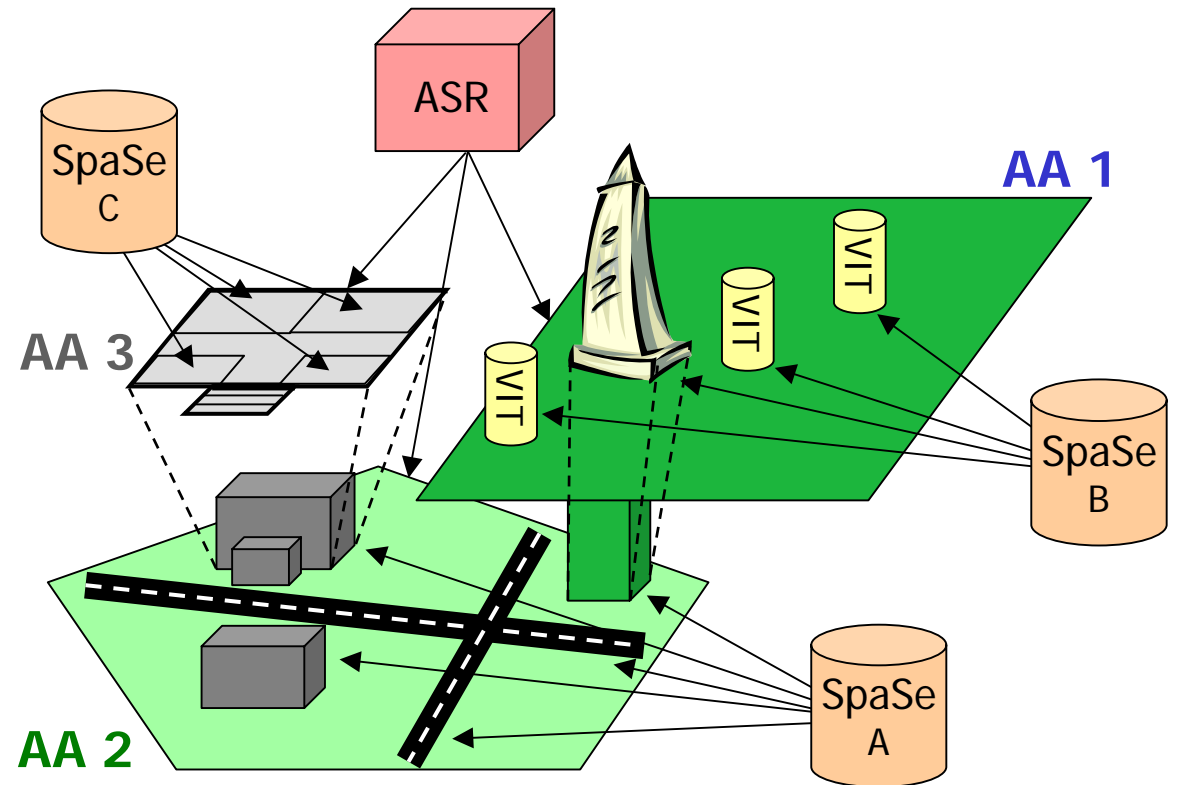
GDF	Relation	AWS	Relation	ATKIS
Junction	1:1	Junction Element	2:1	Object Part
Road Element	1:1	Road Element	1:1	Object Part
Road Element	n:1	Simple Road	1:1	Object
Road	1:1			
Road	n:1	Complex Road	1:1	Complex Object
Intersection	1:1	Complex Junction		



# Augmented Areas



- Cover a certain area
- Contain certain types of objects
- Consistent



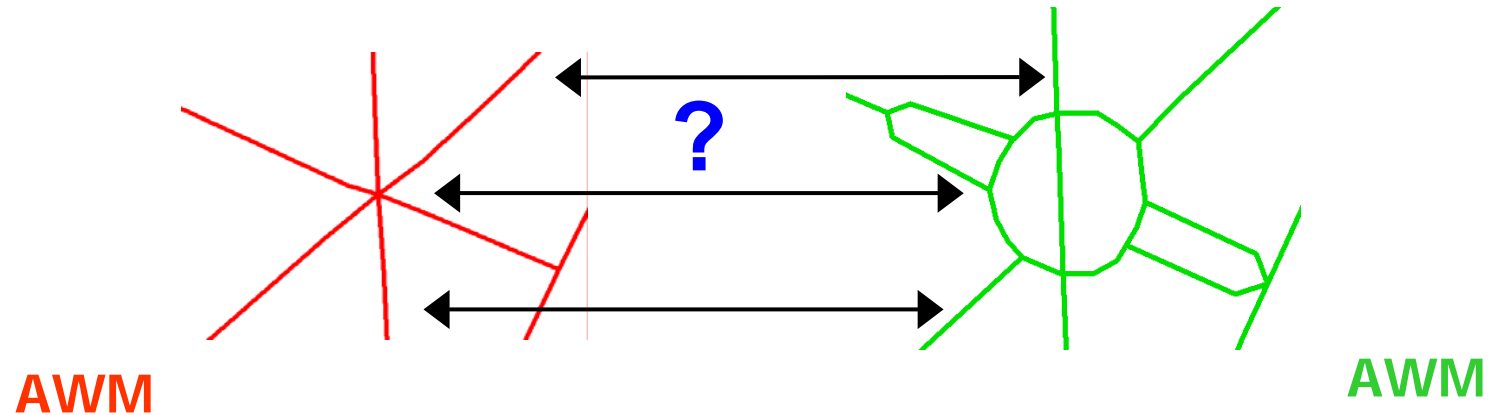
- Augmented Areas may overlap
  - Multiple representations of objects



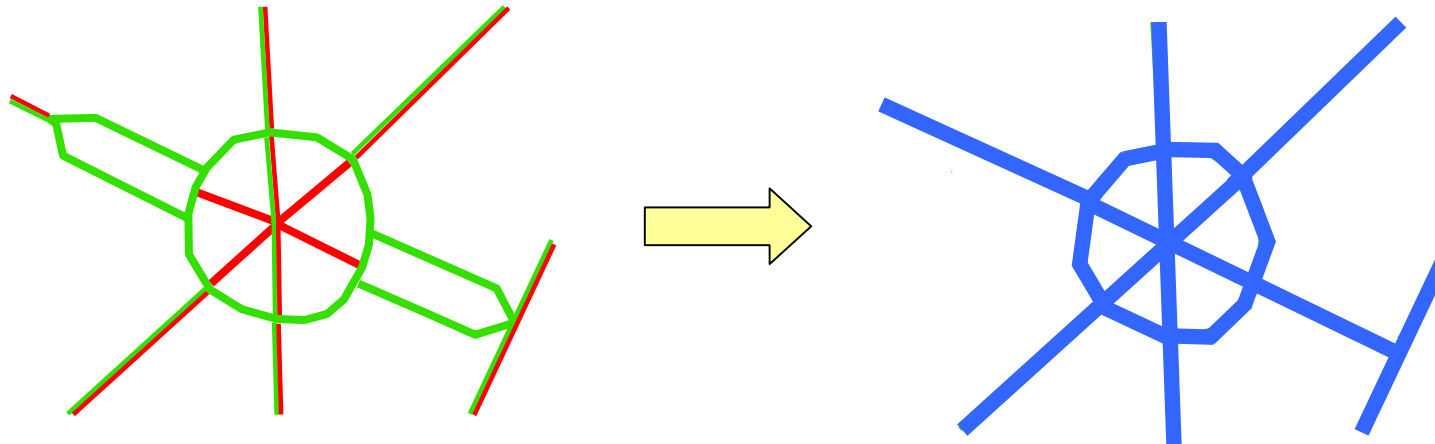
# Model (Object) Integration



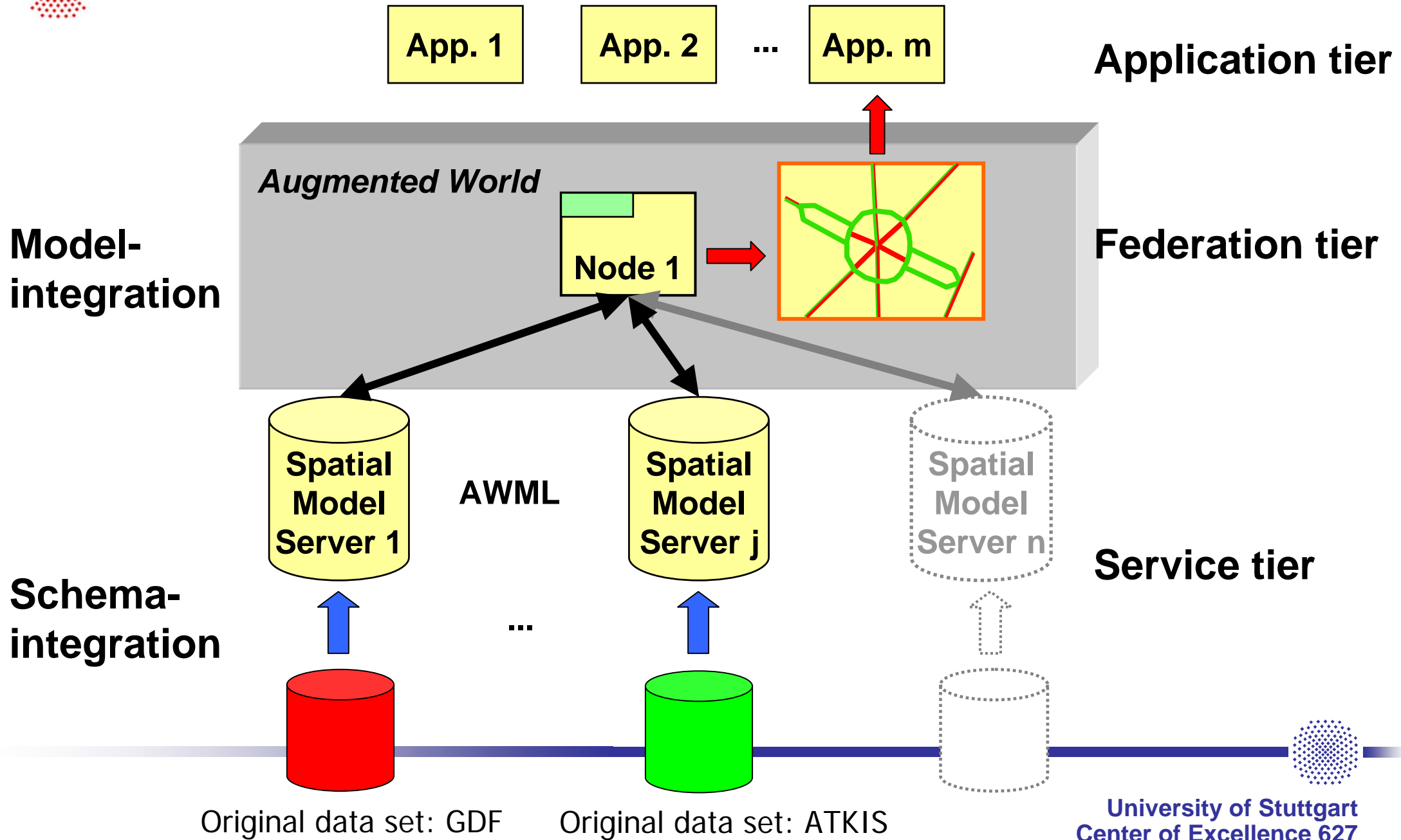
- Identifying and relating corresponding instances



- Merging corresponding instances (conflation)



# Schema and object integration



# Conclusion



- Our view on context models
  - A mixture of highly dynamic and rather static objects and their relations
- Our view on complexity
  - It's a matter of geometric, semantic and dynamic detail
- Our view on (in-)consistency
  - There are different levels of (in-)consistency
  - Our strategy to cope with schema- and model-inconsistencies

