The Implementation of a Model-Driven Approach in Germany
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Data Modelling and Model Driven Implementation of Data Distribution Workshop
Copenhagen, 28.- 30.01.2015
• The application schema of the German mapping and cadastral agencies
• Modelling aspects related to data distribution
• Implementation of the Model Driven Approach
• Challenges for the future, summary
The modelling approach

**ALK**
Automated Real Estate Map

**ALB**
Automated Real Estate Register

**ATKIS**
Official Topographic and Cartographic Information System

**AFIS**
AFIS-ALKIS-ATKIS Application Schema

**AFIS**
Geodetic Reference Points
Objectives of the AAA data model

**Thematic**
- Integration of all official data (different scales!) in only one data model (Geodesy: AFIS, Cadaster: ALKIS, Topography: ATKIS, Surface: DTM)
- Management of thematic profiles (feature catalogues)
- Consider regional profiles of the application schema

**Technical**
- Use of international (accepted) GIS standards (ISO, OGC)
- Use of registries where feasible (CRS, UoM, code lists, OID)
- Use of modern software tools for the model management
- Automatical generated implementation schemas (GML) and feature catalogues
- Easy extensibility of the data model for multiple use in different thematic domains; strategic data component of the SDI

**Economical**
- Limited to core tasks
- Fully digital and GIS-supported maintenance of the official reference data
- Support and creation of new data delivery channels (e.g. SOA)
- Allow quality measures (e.g. automatical data testing)
Profiles of OGC and ISO Standards
Example: Spatial Schema

ISO 19107
Spatial Schema: Geometry Schema

Profile: Selection of the needed Elements; only a few are necessary
As simple as possible!

AAA contains several profiles:
• Spatial schema
• GML
• Filter Encoding
• …

ISO 19107
Spatial Schema:
Geometry Schema

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As simple as possible!

AAA contains several profiles:
• Spatial schema
• GML
• Filter Encoding
• …
AAA basic schema (modelling principles, profiles of GI standards…)

Standardised data exchange interface (XML)

AAA schema

3D information
Real Estate prices
Rural development
Town planning

Thematic exchange interfaces (XML)

AAA schema as basis for any thematic information system

Cadastre (ALKIS)

Modelling of thematic data within the SDI
AAA Data Model as an integration module
Complex use case

```
class Main

Filter Encoding 2.0
(from OGC)

Web Feature Service 2.0
(from OGC)

OWS Common 1.1
(from OGC)

AAA VersioningSchema
(from AdV)

AAA Basic Schema

«ApplicationSchema»
Web Feature Service Extensions
(from AdV)

Rural Development Schema

AFIS-ALKIS-ATKIS Schema

«schema»
AAA_FeatureCatalogue
(from AdV)

LEFIS
NAS-Operations
```

AFIS-ALKIS-ATKIS-Ausgabekatalog
(from NAS-Operationen)

LEFIS

Web Feature Service 2.0
(from OGC)
AAA Data Model as an integration module

Simple use case

Simple Use Case
- No AAA specific classes needed
- Only basic rules and components should be adopted, such as OID, geometry profile, modelling principles, registry (CRS, codelists, schemas)…
- No requirements for data exchange interface
<table>
<thead>
<tr>
<th>1-2</th>
<th>3-8</th>
<th>9-16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country Code</strong></td>
<td><strong>Prefix or Namespace</strong></td>
<td><strong>Local ID</strong></td>
</tr>
<tr>
<td>• worldwide unique</td>
<td>• starts with state code (2 digits)</td>
<td>• any character string</td>
</tr>
<tr>
<td>• in principle not necessary (only Germany)</td>
<td>• followed by code for data provider or for preliminary identifiers</td>
<td>• unique within the namespace</td>
</tr>
<tr>
<td>• not changeable by data provider</td>
<td>• needs registration to secure uniques</td>
<td>• allowed characters A-Z, a-z, 0-9</td>
</tr>
<tr>
<td></td>
<td>• a corresponding registry is under development</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• fully automated registration is planned</td>
<td></td>
</tr>
</tbody>
</table>
Versioning support for storing of changes over time

Versioning rules:
• major changes of attributes cause the „deletion“ of the object
• minor changes of attributes cause a new version
• no structural differences between current and historical data
• conceptually:
  • object „container“ holding all versions, one ID for one object
  • each version carries ID and life cycle information
• ISO Feature Model has no support for versions → each version is represented as a feature
Data Versioning for flexible data delivery

- Incremental update information directly out of the data base
- Information extraction for ANY time stamp possible (the current date is only a specific case)
- Serves data delivery and allows the management of historical information
• The application schema of the German mapping and cadastral agencies
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• Challenges for the future, summary
Implementation: Model Management

Maintenance Group

AAA AFIS
AAA ALKIS
AAA ATKIS

resolve issues
document changes

submit issues
read

Redmine

Data Providers
Developers
Users

publish

AAA SVN

harvest
changes

AAA EAP

sync

ISO HM
SVN

sync

use
Implementation: Model Management
Implementation:
Model Management
Each feature instance is tagged with the thematic profiles of the AAA application schema to which it belongs.
Each type, property or enumerant in the AAA application schema is tagged with the thematic profiles to which the model element belongs ("AAA:Modellart")

In addition, the thematic profiles are identified for which a data provider must provide information and missing information is not allowed ("AAA:Grunddatenbestand")
Each type, property or enumerant of a thematic profile can be associated with a regional profile, typically on the state level. Profiles may be managed in a separate profile definition (3ap file) or in the model ("AAA:Profile").

AFIS-ALKIS-ATKIS-Profildefinition
Version: 6.0.1
Name: DLKM_TestMIN
# AX_Gebaende --- Objektart/Datentyp
# AX_Gebaende/gebraudefunktion --- Attributart
# AX_Gebaende/weitereGebraudefunktion --- Attributart
# AX_Gebaende/name --- Attributart
# AX_Gebaende/nutzung --- Attributart
Feature Catalogues are derived from the AAA application schema
- typically for one or more thematic profiles
- may be restricted to a regional profile
- may display changes from older version (HTML only)
Information is stored in a structured way in the UML model.
### Generating Feature Catalogues

#### Implementation:

**Output in Microsoft Word**

<table>
<thead>
<tr>
<th>Feature Catalogue</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Defining Terms:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Model:</strong></td>
<td>BLENKEN</td>
</tr>
<tr>
<td><strong>Ground Level:</strong></td>
<td>BLENKEN</td>
</tr>
<tr>
<td><strong>Function:</strong></td>
<td>Angaben zur Karteikarte für Gebäude</td>
</tr>
</tbody>
</table>
Implementation:
Generating Feature Catalogues

Output in HTML, changes highlighted
The NAS, an implementation schema for GML is derived from the AAA application schema, first in UML, then the standard GML encoding rule is applied:

- The NAS is a single data exchange schema for all thematic and regional profiles.

Implementation: Generating Implementation Schemas
Examples of changes in the transformation to the implementation schema for XML Schema:
- Resolve multiple inheritance and mixin classes
- Remove model elements not relevant for data exchange
- Simplify model for data exchange, e.g. replace spatial topologies by simple geometries and make use of GML types without equivalent in the ISO Harmonized Model

Note: this is not yet using the newer Transformation capability of ShapeChange 2.0
Implementation: Registry Integration (Work in Progress)

AAA data references information that will be managed in registers, likely in the GDI-DE registry (under development)
- Coordinate Reference Systems and their components
- Object Namespace Identifiers
- Code Lists

AAA EAP (v7.0.x) → CL-Generator (ShapeChange extension) → Temporary AdV Registry (HTML, ATOM, GML, SKOS)

AAA EAP (v6.0.1) → GDI-DE Registry

AdV Control Bodies: maintain AAA sub-registers
Other control bodies: maintain other sub-registers
Implementation: Generating Feature Catalogues

Temporary Code List Registry

![Image of AdV-Registry Beta](image)

**AA_AdVStandardModell**

- **ID:** [http://services.interactive-instruments.de/aa/ci/AA_AdVStandardModell](http://services.interactive-instruments.de/aa/ci/AA_AdVStandardModell)
- **Typ:** Ermittlung
- **Status:** gültig
- **Gedruckt/Versioen:** 6.0.1 7.0 Beta
- **Veröffentlicht:** 31.05.2009
- **Aktualisiert:** 31.05.2009
- **Modellarten:** alle

**Wertarten**

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Modellarten</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD</td>
<td>AdV-Landschaftsmodell</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DFGM</td>
<td>Festpunktmodell</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DCM2</td>
<td>Digitales Geländemodell2</td>
<td>alle</td>
<td>gültig, Zurückziehung vorgeschlagen</td>
</tr>
<tr>
<td>DCM25</td>
<td>Digitales Geländemodell25</td>
<td>alle</td>
<td>gültig, Zurückziehung vorgeschlagen</td>
</tr>
<tr>
<td>DCM6</td>
<td>Digitales Geländemodell6</td>
<td>alle</td>
<td>gültig, Zurückziehung vorgeschlagen</td>
</tr>
<tr>
<td>DCM50</td>
<td>Digitales Geländemodell50</td>
<td>alle</td>
<td>gültig, Zurückziehung vorgeschlagen</td>
</tr>
<tr>
<td>DHM</td>
<td>Digitales Höhenmodell</td>
<td>alle</td>
<td>Vorgeschlagen</td>
</tr>
<tr>
<td>DKKM1</td>
<td>KatasterkartenModell1</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DKKM200</td>
<td>KatasterkartenModell200</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DKKM500</td>
<td>KatasterkartenModell500</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DLMK</td>
<td>LiegewirtschaftsKatastareModell</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DLML100</td>
<td>LandschaftsModel100</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DLML50</td>
<td>LandschaftsModel50</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DTMI10</td>
<td>TopographischeKarte10</td>
<td>alle</td>
<td>gültig</td>
</tr>
<tr>
<td>DTMI100</td>
<td>TopographischeKarte100</td>
<td>alle</td>
<td>gültig</td>
</tr>
</tbody>
</table>
Challenges

• Maintenance (issue tracker, monitoring of changes, governance, resources, guarantee)
• Change Management of schema updates, both the application schema and the NAS
  – Full Version (not backwards-compatible – 1.0.0)
  – Backwards-compatible version – 1.1.0
  – Bug fixes – 1.0.1
  – Note: different definition of "backwards-compatible" than OGC
• Necessary changes vs. Stable schemas/model
• Software tool changes (Rational Rose, EA)
• Reliable registries for storing code lists, OID, schemas, CRS
• Providing simple model views for data exchange
Summary

- A model-driven approach can be used to improve consistency within AFIS-ALKIS-ATKIS and with other application schemas in the SDI
- Data versioning supports a 4D view and the possibility for flexible, incremental data updates
- Unique object identifiers are essential – as well as the ID management
- The modelling is supported by up-to-date tools
- Tools are published for reuse so developers can follow a model-driven approach, too
Issues for discussion

- ID management and support for linking
  - How to best make Object IDs dereferenceable in a dynamic environment?
- Versioning of models, conceptual schemas and implementation schemas
  - Many different approaches
- Use of INSPIRE tools (PID, registries, EA subversion, ISO schemas)