The AAA Model as Contribution to the Standardisation of the Geoinformation Systems in Germany

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Key words: ISO, CEN, OGC, AdV, Spatial Data Infrastructure

SUMMARY

Germany is a classic example of a country that takes great pride in it's highly accurate maps and cadastral data. In the last three decades several independent geoinformation systems has been developed in the field of cadastre and topographical mapping. Right now a redesign of the German digital cadastral information system ALK (Automated Real Estate Map) is under development. The new approach - called ALKIS (Official Cadastral Information System) - was launched in order to harmonize the structures of ALK and the topographic database ATKIS on the one hand and to integrate the cadastral map and the land titles into one single model which was usually separated for historical and technical reasons. Adding also the geodetic reference points (AFIS) almost all official data of the surveying and mapping agencies are defined in a common and harmonized data model, called the AAA data model (AFIS-ALKIS-ATKIS Data Model).

For that reason the Working Committee of the Surveying Authorities of the States of the Fedaral Republic of Germany (AdV) has started developing a new conceptual data model based on international GIS standards which help to fulfill this harmonization. That will bring the surveying and mapping agencies in Germany to a nation wide well defined data that can be used as a baseline for many other thematic application schemas. For the inreasing efforts in building up a apatial data infrastructure the AAA data model can generally be used for standardization of these thematic data as well and could help to standardize the Geoinformation in Germany brick by brick.

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1. INTRODUCTION

After finishing the Documentation on the Modelling of Geoinformation of Official Surveying and Mapping in Germany (GeoInfoDok) by the Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany (AdV) and the already started step by step implementation of AFIS, ALKIS and ATKIS (AAA data model) there is an inreasing demand to fit the existing thematic data systems into the new framework and potentially use the methodology of the AAA data model. Precondition to this approach is the consequent use of existing an acepted geoinformation standards developen by CEN, ISO and OGC.

The AAA application schema covers the following themes:

– AFIS (Official geodetic points information system)

– ALKIS (Official Cadastral Information System)

– ATKIS (Official Topographic-Cartographic Information System).

Using ISO 19100 and UML

The standards AFIS, ALKIS and ATKIS of the AdV are described in the GeoInfoDok in conceptual format on the basis of ISO 19109 Rules for Application Schema. This means specifically:

– Modelling in UML with the software tool Rational Rose

– Compliance with the regulations of ISO 19103 for the use of UML

– Use of ISO 19107 (and therefore by implication ISO 19111), ISO 19115, ISO 19123

– Automated derivation and mapping of feature catalogues in accordance with ISO 19110

Automated derivation of the interface for exchange of AFIS, AKIS and ATKIS objects, the NAS, completes this picture.

2. THE BENEFITS OF USING ISO STANDARDS IN THE AAA DATA MODEL

ISO standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing,

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accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations [ISO, 2001].

ISO has formulated some objectives that are also valid for ALKIS:

– Increase the understanding and usage of geographic information

– Increase the availability, access, integration, and sharing of geographic information

– Promote the efficient, effective, and economic use of digital geographic information and associated hardware and software systems

– Contribute to a unified approach to addressing global ecological and humanitarian problems.

The AdV has adopted these objectives and decided to consider the ISO standards within the new AAA application schema as far as possible.

## 3. APPLICATION OF THE ISO/TC 211 FAMILY OF GIS STANDARD

ALKIS applies a serie of ISO standards which are generally issued as approved international standards (IS). In detail the conceptual AAA application schema is based on the following specifications:

– ISO 19101 Geographic information - Reference model

– ISO 19103 Geographic information - Conceptual schema language

– ISO 19105 Geographic information - Conformance and testing

– ISO 19107 Geographic information - Spatial schema

– ISO 19108 Geographic information - Temporal schema

– ISO 19109 Geographic information - Rules for application schema

– ISO 19110 Geographic information - Feature cataloguing methodology

– ISO 19113 Geographic information - Quality principles

– ISO 19115 Geographic information - Metadata

– ISO 19118 Geographic information – Encoding

– ISO 19136 Geohraphic information – Geographic Markup Language (GML)

The following report will highlight one of the most important issue: The application of encoding rules to derive a standardized data exchange format.

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3.1 Norm based data exchange interface (NAS)

For defining an external schema (data exchange format), ISO 19118 Encoding defines a framework document for the creation of what are referred to as Encoding Rules, to derive interface definitions for data exchange from a UML application schema. The de-jure standard also describes in an informative Appendix, special Encoding Rules for the creation of XML schema definitions. The variability permitted for mapping UML to XML schemas does, however, result in the ability of ISO 19100 basic norms to be converted in different ways. A stipulation by the AdV would result in AdV-specific interfaces and thus, the purpose of the de-jure standards, namely to achieve inter-operability, would not be fulfilled. There are currently no standardized XML schemas for the basic ISO-standards.
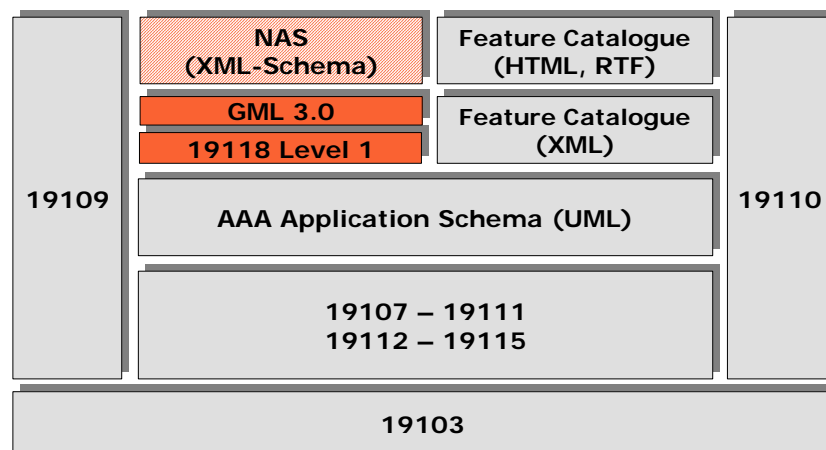
Fig. 4: Derivation of the NAS encoding rules

Besides the official de-jure standards for defining interfaces definitions, there is a de-facto standard, based on the Geography Markup Language (GML) of the Open Geospatial Consortium (OGC), for encoding geoinformation, which is also provided for standardization in the ISO 19100 series as ISO 19136. GML is a system for rules in modeling user specific objects with their specific features in XML schema. For description of object and their numerical, textural, geometrical, temporal und other features can be used a lot of standardized components (e.g. geometry types). By this way a user specific XML is defined in a GML-application schema. GML is gradually achieving market acceptance.

Besides coding of thematic objects NAS contains although operations for communication with a data storage system (updating, inserting, locking/unlocking objects, reservation, request for output products, user-specific updating of secondary database (NBA)) modelled in the application schema, GML-features are embedded in corresponding, principle web-service-qualified operations types using elements of the GML complementary OGC-

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specification Web Feature Service (WFS) and Filter Encoding (FES). In this sense a AFIS-ALKIS-ATKIS-data storage can be compared with a capsulated Web Feature Server, which considers additional AFIS-ALKIS-ATKIS-specific demands.

Tthe AdV uses the new development of AFIS, ALKIS and ATKIS to pursue the objective of creating the basis for a common, unified and interdisciplinary use of geodata. In this sense, existing or foreseeable standard functionality's of application software should be used wherever possible. One example is the NAS described in this Chapter. Use of AdV-specific solutions is largely avoided. Due to the current status of international standardization in the field of metadata and the operations for updating and requesting of GML-data , however, this is currently only possible to a certain degree and with the AFIS-ALKIS-ATKIS specific add on.
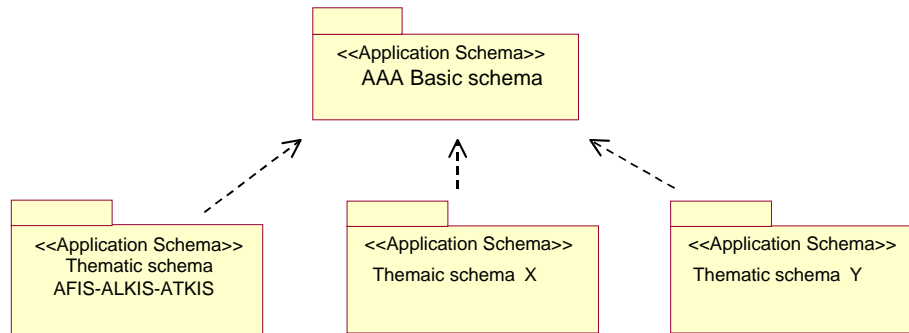
For these reasons, the AdV has decided for the following procedure:

  – The framework document for Encoding Rules defined in ISO 19118, Section 8 is applied for the NAS (Level-1 – Conformity with ISO 19118).

  – "NAS Encoding Rules" according to ISO 19118, Section 8 are defined and documented. These "NAS Encoding Rules" map the conceptual AFIS-ALKIS-ATKIS technical and basic schema on a GML-3.0 application schema. This schema file is specified by the schema AAA.Fachschema.xsd (including additional schema files).

  – The conceptual schema of NAS – operations is set up by using "NAS Encoding Rules" and WFS/FES-xml-schema in XML schema components and specified in the schema file NAS-Operationen.xsd.

  – The "NAS Encoding Rules" are stipulated in conformity with GML 3.0 and furthermore as simple as possible and as far as possible in conformity with ISO 19118 "XML Encoding Rules". This means that NAS uses GML in accordance with GML-specifications.

  – An automatic derivation of NAS is supported, which means that the XML schema definitions of NAS can be derived using the "NAS Encoding Rules", the UML application schema and additional regulations formally described in the form of control parameters.

It is important to note that the stable conceptual model is fully described in the UML application schema. Future adaptations to the IT/GI Mainstream will also become necessary for depiction on specific implementation models (e.g. XML representations).

3.2 AAA Basic Schema as part of the standardisation of technical information systems

The Basic Schema is an independant framework to define domain secific application schema. The offical data of the surveying and cadastral agencies uses this framework as well as other thematic domains (e.g. Rural development).

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The Basisc schema basically defines the application of the fundamental basic structure listed in the 191xx series of standards, especially the spatial information. Based on the conceptual model the GeoInfoDok also defines the normbased data exchange interface (NAS) as a requirement for the communication of AFIS-ALKIS-ATKIS information between different software components.
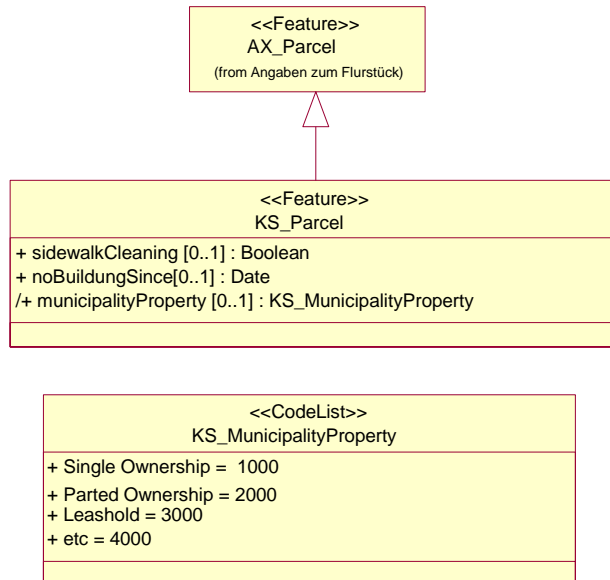
The NAS is based on the XML standards developed by the World Wide Web Consortium (W3C), especially XML, XML namespaces, XML schema, Xlink, Xpointer and Xpath. For the definition of the feature classes the Geographic Markup Language (GML 3.0) is used. GML is also an open GIS standard that is currently integrated into the ISO 19100 serie of standards. The definition of the NAS functionalities (e.g. for updating) is based on OGC standards Web Feature Service and Filter Encoding that have benn extendes due to the requirements of the AAA application schema. The mapping from the conceptuel schema to the external schema (NAS) is managed by the NAS encoding rules.

The packages of the AAA Basic Schema are independent of any thematic content and can therefore be used completely or partially depending on the requiremnts of the thematic application. Generally, it is also possible to use not just feature classes of the basic schema but also propriate thematic feature classes like "building" or "parcel" by adding specific properties or attributes.

This methodology and most of the defined information (profiles of ISO standards" are generally appropriate to be applied in differnt domains. This will help to standardise not only the official data of the surveying and cadastral agencies but also in many different domains. That will bring us one step toward a interoperable spatial data infrastructure in Germany.

3.3 Example: Using a parcel for municipalty issues

In case of an integrated modelling of the municipality content, it could be necessary to describe additional information to the existing parcel feature provided by the surveying authorities. A possible approach could be the following modelling example:

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```
        ┌─────────────────────────────┐
        │        <<Feature>>          │
        │         AX_Parcel           │
        │ (from Angaben zum Flurstück)│
        └─────────────────────────────┘
                      △
                      │
        ┌─────────────────────────────────────────────────────┐
        │                  <<Feature>>                         │
        │                   KS_Parcel                          │
        ├─────────────────────────────────────────────────────┤
        │ + sidewalkCleaning [0..1] : Boolean                  │
        │ + noBuildungSince[0..1] : Date                       │
        │ /+ municipalityProperty [0..1] : KS_MunicipalityProperty │
        ├─────────────────────────────────────────────────────┤
        │                                                      │
        └─────────────────────────────────────────────────────┘

        ┌─────────────────────────────────────┐
        │            <<CodeList>>             │
        │       KS_MunicipalityProperty       │
        ├─────────────────────────────────────┤
        │ + Single Ownership =  1000          │
        │ + Parted Ownership = 2000           │
        │ + Leashold = 3000                   │
        │ + etc = 4000                        │
        ├─────────────────────────────────────┤
        │                                     │
        └─────────────────────────────────────┘
```

The prefix enables to distinguish between feature classes of different domains although they are defined within one data model. "AX_" means the AAA data model, „KS_" means the specific information model of a municipality. The required information whether the real estate is owned by the municipality is modelled as a derived attribute, because these information are already available in the AAA data model. Modelling aditional information as an extension to the AAA data model there should not any redundancies to the original data that could cause inconsistencies.

The benefit of using the same methodology or even the same feature classes is to reach an common understanding of the provides data. If you want to provide not just maps but also object information it is necessary to have a standardized description of the data content. The standard series of ISO/TC 211 (ISO 191xx) provides a framework for this. Additional web service (WFS, Web Feature Service) are able to deliver these object information in a standardized way.

4. CONCLUSION

By harmonization all official data within one data model and using internationl GI standards, the surveying and mapping agencies in Germany will provide a nation wide well defined data that can be used as a baseline for many other thematic application schemas.

The main reason is the consistent application of the ISO conceptual standards in the field of geographic information and using web services (WMS, WFS) for providing the data. So some essential advantages will arise for the users by the new conception:

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- The implementation of the concept under consideration of international standards will ensure investment safeguarding, vendor independence and standardization of public geospatial data

- Definition of a universal, browser readable interface (XML encoding) for all public geospatial data

- The AAA basic schema becomes a core data model that can easily be combined or extended with other data from various administration in order to build up a spatial data infrastructure in Germany.

For the inreasing efforts in building up a apatial data infrastructure the AAA data model can generally be used for standardization of these thematic data as well and could help to standardize the Geoinformation in Germany brick by brick.

REFERENCES

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Open Geospatial Consortium, **OGC**: http://www.opengeospatial.org

BIOGRAPHICAL NOTES

Markus Seifert is head of the project team "SDI Standards" that is modeling the conceptual schema of the AAA data model. Furthermore he represents the Bavarian Organization for surveying and cadastre in serveral national working groups concernig the standardization of public geospatial data. On behalf of the Working Committee of the Surveying Authorities of the States of the Fedaral Republic of Germany (AdV) he is the head of the German delegation at ISO/TC 211 and CEN TC 287.

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