AAA - The Contribution of the AdV in an Increasing European Spatial Data Infrastructure - the German Way

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Key words: German SDI, AdV, AFIS-ALKIS-ATKIS-Reference Model, AAA Data Model, GeoInfoDok, ISO, OGC, UML, OMG

SUMMARY

The Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany (AdV) developed a common AAA-application schema for AFIS, ALKIS and ATKIS basing on the AFIS-ALKIS-ATKIS-Reference Model for the basic Geodata sets of all public surveying and mapping authorities in Germany. The AAA-application schema is ISO-based (ISO/TC 211 in form of the 19100 series of standards), describes the structure and setup of basic geodata in an object-oriented manner and constitutes a modelling frame for the integration of expert data. Thus, with the AAA model a fundamental technical and practical contribution for the German SDI (GDI-DE) is available now. Vice-versa, the development of the GDI-DE using the AAA concept will bring about a considerable input for its further dissemination and implementation.

AAA is described in the "Documentation on the Modelling of Geoinformation of Official Surveying and mapping in Germany (GeoInfoDok)", which is published in www.adv-online.de. The advantages of AAA-modelling are the integration of the Spatial Reference System, the Real Estate Cadastre and Topography in one AAA-application schema, the harmonisation of cadastral and topographic data, the AAA basic schema as base for the modelling of application-specific thematical schemas and the data exchange process, using NAS (Standard-Based Data Exchange Interface). AAA contains descriptive and illustrative data in several product groups for AFIS, ALKIS and ATKIS (Digital Landscape Models (ATKIS-DLM), the Digital Terrain Model (ATKIS-DGM) and Digital Topographic Maps (ATKIS-DTK). AAA will enable the surveying authorities to provide their customers in business and administration with data of high quality.

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1. INTRODUCTION

Right now a redesign of the German digital cadastral information system ALK (Automated Cadastral Map) - which has been in use for approximately one decade - is under development. Besides the ALK, which mainly represents geometric features like parcels, buildings and so on, a separate database (ALB – 'automated land register') with all the titles of the land records exists. Both systems were usually separated for historical and technical reasons.

The new model integrates both information models within one conceptual data model that is named ALKIS (Official Cadastral Information System). But ALKIS was also launched in order to harmonize the cadastral information and the topographic database ATKIS (Official Topographic-Cartographic Information System). After doing this harmonization semantically in all common used feature classes, ALKIS und ATKIS formed the new data model. By integration of the geodetic reference points as well, AFIS (Official geodetic points information system) becomes another part of the data model. Thus it is called the AFIS-ALKIS-ATKIS data model or the AAA data model.

The former ALK system was originally used mainly within the surveying organizations, performing as a central information system to fulfill all tasks that have to be carried out relating to cadastral issues. Besides that, from the very beginning an objective of the ALK has been also to provide basic geographic data for many GIS applications in various fields in local governments, utilities and so on. Right now there is also a great demand on having access to these valuable data from others like banks, lawyers, notaries.... All of them in general need for up-to-date data for their applications. So a fast data transfer or even an online access to these data using the SDI technology could be very helpful in future. Currently, a lot of projects are established in order to build up a national geographical data infrastructure. That will help to ease the access to the public geodata and reach interoperability between different geoinformation systems within various state administrations.

Therefore the approaches aiming at GIS interoperability like the ones which are coming up from the concepts of the international standardization organization ISO (International Organization for Standardization) and from the OGC (Open Geospatial Consortium) are very useful in this field and have to be taken into account by modeling the new AAA application schema. The goal of the international standardization is to create foundations for the common, holistic and cross-field use of geodata at various locations by individuals, applications and systems based on a standard description of the content of existing or planned data inventories, the functionalities of data processing and communication. The modeling is

based on the results of ISO/TC 211 in the form of the 19100 series of standards at their current stage of processing. The data exchange interface also uses parts of the OGC specifications.

The concept of the AAA data model was developed by the Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany (AdV) called **AdV**. This conceptual data model is completely object oriented and describes geographic and non-geographic features as well as their relations (associations). In order to describe this model in a standardized way it has been based on the ISO draft standards in the field of geographic information.

2. THE NEW APPROACH IN GERMANY

2.1 Modelling and Description Language

The AdV decided to use the Unified Modeling Language (UML) for describing the application schema and the feature catalogue. This language is also used by ISO/TC 211 in the field of geoinformation standardization.
UML was developed by the Object Management Group (OMG) for the purpose of describing application schemas. In order to guarantee standard use of UML in the 19100 family of standards, their application is specified in ISO 19103 Conceptual schema language. The purpose is the complete and unambiguously interpretable, formal description of the content and structure of data inventories. The description is independent from type of implementation and the used programming language. A standard description of all geodata can be achieved with formal languages. The application schemas thus described can be automatically interpreted by suitable programs and translated into internal data and/or database structures.

2.2 The AFIS-ALKIS-ATKIS application schema

The application schema provides the formal description for data structures and data content in one or several applications. It contains the complete description of a database and in addition to geographical data, may also contain other associated data. The fundamental concept of abstracting the real world means the introduction of thematic objects and of rules and regulations on how it is documented and managed. Thematic objects are classified by type. At the type level, the application schema describes the feature types of the real world. Data themselves exist at instance level. They represent individual examples of a feature type in the real world and can be interpreted by the application schema, see also ISO19101 *Reference model* and 19109 *Rules for application schema*.
The purpose of an application schema is to achieve a common and unified understanding of data and document the data content for a specific application environment so as to obtain unique information about these data.

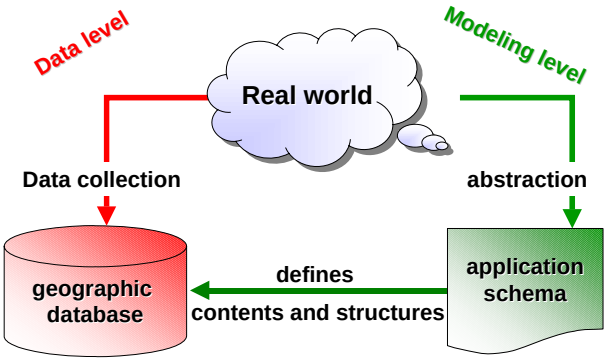

Figure 1: The role of the application schema

The common AFIS-ALKIS-ATKIS application schema offers a unified and object-oriented basic model for AFIS, ALKIS and ATKIS, which wherever possible is to be depicted and managed using the commercially available GIS software.

An application schema can use specifications from various sub-schemas. In the case of the AFIS-ALKIS-ATKIS application schema, mainly sub-schemas from the ISO 19100 series of standards are used. In those areas, where there are no ISO-standards up to now, additional schemata of the Open Geospatial Consortium are used.

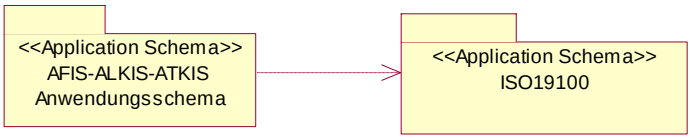

Figure 2: Dependency of the AFIS-ALKIS-ATKIS application schema on the structures standardized from ISO 19100

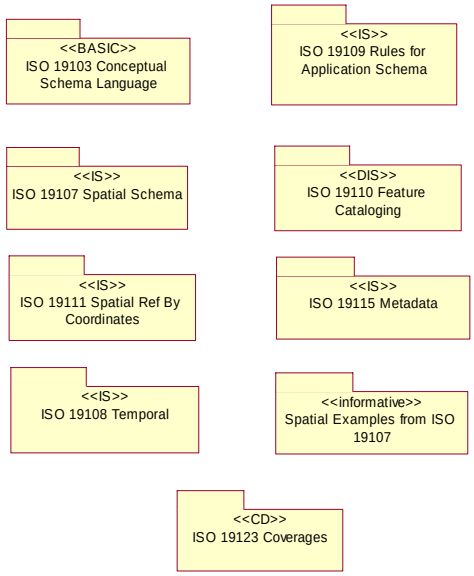

Figure 3: Used components from the ISO 19100 series of standards

The AFIS-ALKIS-ATKIS application schema is sub-divided into the basic schema, the versioning schema and the AFIS-ALKIS-ATKIS thematic or technical schema. The basic schema is the basis on which thematic objects are modeled in the thematic schemas. The versioning schema shows the concept for historicising thematic objects. An internal schema is not part of common modeling. It is created by depicting a conceptual application schema in specific GIS systems as part of the implementation process. The application schema is the basis on which operations for data exchange and technical stipulations for data outputs are defined.

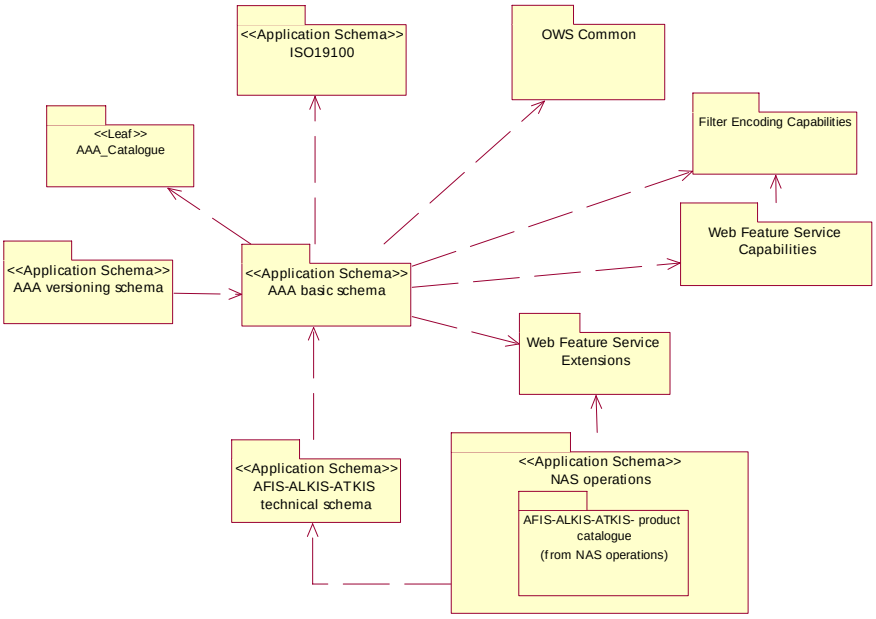

Figure 4: The components of the AFIS-ALKIS-ATKIS application schema

Additionally the AAA application schema uses OGC specification for managing the differential updating (e.g. WFS, OWS Common). For creation of specific products Filter Encoding selects the corresponding feature classes. XSLT scripts map these classes into a product schema that has also been defined in the AAA application schema.

2.3 The AFIS-ALKIS-ATKIS Basic Schema

The following systematic is used for unique designation of the defined classes:

1. Standardized classes maintain the standardized prefix in the class name (e.g. FC for "Feature Catalogue", MD for "Metadata")
2. Classes as AFIS-ALKIS-ATKIS-specific additions to the standardized Feature Catalogue get the prefix AC
3. Classes with fundamental meaning for AFIS, ALKIS and ATKIS get the prefix AA
4. Classes derived from the ISO TS_*Component classes ("simple topology"), get the prefix TA; also the analogously created class for topological surfaces with multiple spatially separated geometries (TA_MultiSurfaceComponent)
5. Classes with commonly used geometries get the prefix AG
6. Classes of independent geometries get the prefix AU
7. Classes of presentation objects get the prefix AP
8. Classes for the modeling of PointCoverages get the prefix AD.

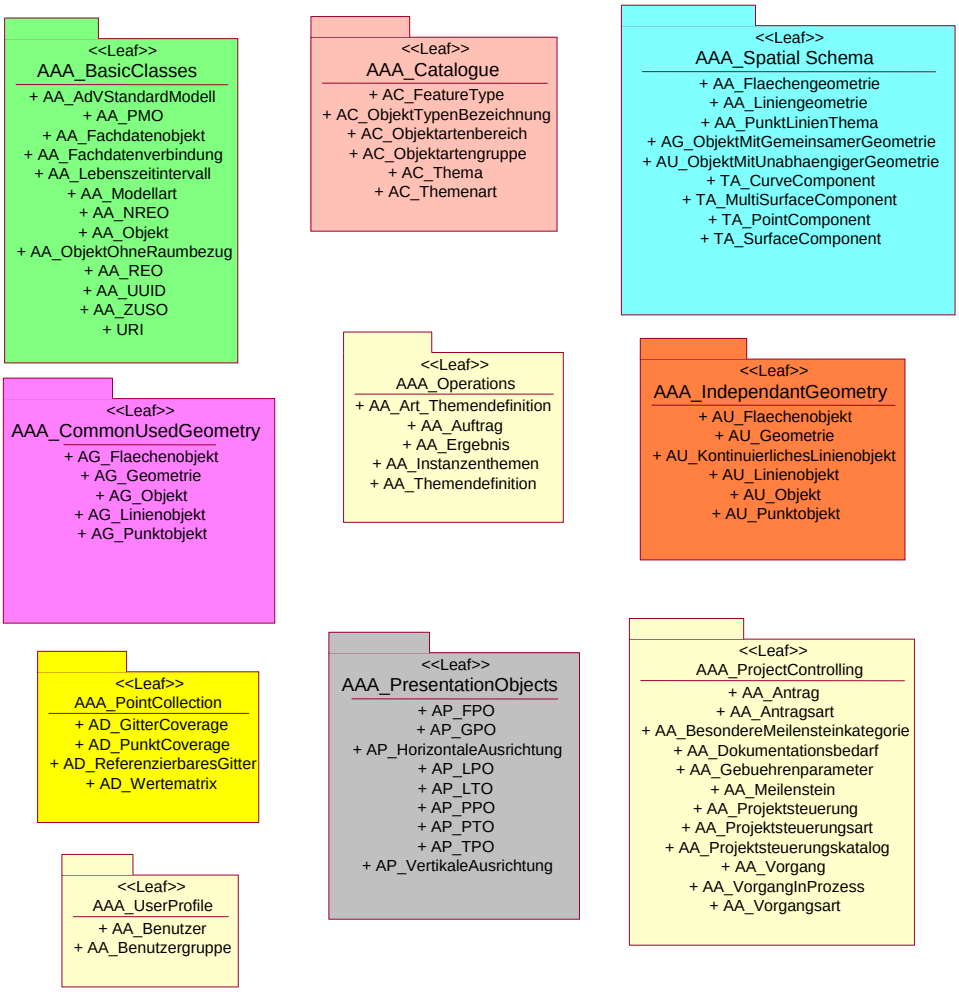

Figure 5: Components of the basic schema

2.4 Standards-based data exchange interface (NAS)

The standards-based data exchange interface (NAS) is used when it is necessary to exchange geoinformation that has been modelled on the basis of the common AFIS-ALKIS-ATKIS application schema. This can relate both to information that has the same structure as the stored data inventories, including the additional data (presentation objects, map geometry objects) and also to information from derived views on these data inventories (e.g. output feature types), but not to data inventories for which the object reference is completely lost (e.g. purely graphically structured data) or data that is to be defined according to a different basic schema (e.g. DXF data).

Accordingly, the NAS is used wherever the application emphasis is on

– the originality of the data,

- the full evaluation capability and
- the feature-specific updating,

in line with the user's requirement. The NAS can be automatically derived from the AAA application schema and is based on international GIS standards (ISO 19118 and OGC GML 3.0).

3. AAA AS A BRICK OF AN EUROPEAN SPATIAL DATA INFRASTRUCTURE

3.1 The Spatial data infrastructure in Germany

The methodology for setting up a spatial data infrastructure in principal is independent from the geographical extent that will be covered. Basically a spatial data infrastructure should meet at least the following requirements:

- Implementation of controlling mechanism for the compliance to the defined SDI standards (monitoring and reporting)
- Organisational framework for the creation process (who will make the decisions?)
- Defining conditions for data access and data use
- Collecting and providing metadata for discovery services
- Providing the data and services within a geoportal
- Defining harmonized geodetic reference systems
- Harmonized data and services
- Standardized description of the provided data (model driven architecture) and based on this methods for model transformation

Most of these points are also addressed by the INSPIRE directive for creating a spatial data infrastructure in Europe. For the last two bullets the AAA data model provides methodology that in principle can be used for the official surveying and mapping data as well as in other domains.

With political acceptance the SDI coordination group in Germany has been reflected the requirements above and decides a three step approach for implementing the SDI in Germany

- Step 1: Make data available by using ISO 19115 metadata standard and the corresponding catalogue services for data searching
- Step 2: Model harmonisation using GI standards (possibly also the AAA-model) and decision on common used SDI-standards or profiles (e.g. WMS, WFS, WPOS...)
- Step 3: Developing of a geoportal for data access.

At the end of the day no one will be forced to implement the AAA data model in any other domain. On the other hand the AAA application schema provides a framework and a methodology that could widely be used to describe and provide the spatial data in a

standardized way. That will open possibilities to map between one data model to another, maybe to handle semantic model transformation. This is a fundamental precondition to make a SDI alive.

3.2 How to use the AAA application schema in other domains

The AFIS-ALKIS-ATKIS basic schema (AAA basic schema) forms the basis for the technical modeling of AFIS, ALKIS and ATKIS objects and for the data exchange process. The thematic schemas are created from this basis. Its application is not limited just to AFIS, ALKIS and ATKIS. Other technical information systems can also use the classes defined in the basis schema for modeling their thematic schema.

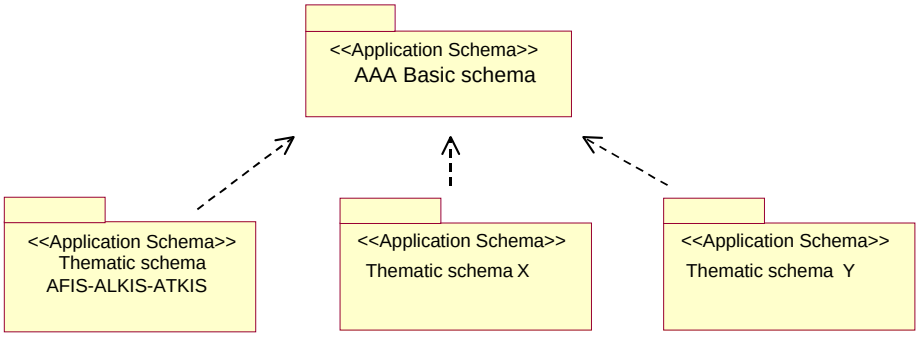

Figure 6: The basic schema as a basis for the modeling of application-specific thematic schemas (e.g. AFIS, ALKIS and ATKIS)

The basic schema is sub-divided into eleven packages - "AAA_Basisklassen" (BasicClasses), "AAA_Katalog" (Catalogue), "AAA_SpatialSchema", "AAA_GemeinsameGeometrie" (CommonGeometry), "AAA_UnabhaengigeGeometrie" (IndependentGeometry), "AAA_ExternalCodeLists", "AAA_Praesentationsobjekte" (PresentationObjects), "AAA_Punktmengenobjekte" (PointCoverages), "AAA_Projektsteuerung" (ProjectManagement), "AAA_Nutzerprofile" (UserProfiles) and "AAA_Operationen" (Operations). These packages are independent of any thematic content and can therefore be used completely or partially depending on the requirements of the thematic application. Generally, it is also possible to use not just feature classes of the basic schema but also appropriate thematic feature classes like "building" or "parcel" by adding specific properties or attributes.

3.3 Example: Using a parcel for municipality 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:

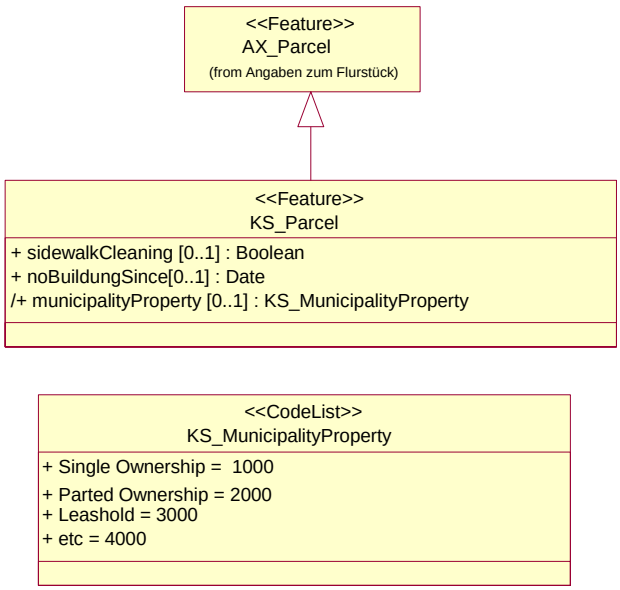

Figure 7: Integrated modelling of different thematic domains

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. By modelling additional information as an extension to the AAA data model there should not be 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 a common understanding of the provided 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) provide a framework for this. Additional web service (WFS, Web Feature Service) are able to deliver these object information in a standardized way.

4. CONCLUSION

The public geospatial data are already variously used. By integration of various datasets in the AAA data model ore using the same methodology the use and further processing of the public geospatial data will be simplified substantially. 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:

– 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 administrations in order to build up a spatial data infrastructure in Germany.

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WWW-Links:

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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 several national working groups concerning the standardization of public geospatial data. On behalf of the Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany (AdV) he is the head of the German delegation at ISO/TC 211 and CEN TC 287.

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