Future Perspectives for a Multifunctional use of The Digital Cadastral Map in the Public Sector of Denmark

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Key words: Enterprise architecture, SOA, Organizational interoperability, Collaboration, Land administration, Cadastral map.

SUMMARY

The cadastral register and map are digital and have been it for some years now. The major argument for computerizing the map was broader use of the cadastral map together with other digital maps or administrative data to improve GIS use both in the public and private sector.

The National Survey and Cadastre of Denmark (KMS) is about to start a new production system for updating the cadastral register and map. At national level the focus is on establishing a common public infrastructure for geodata – that will be used in the work of implementing the INSPIRE. At the same time the Danish government has announced a common public strategy for digitizing data and processes in the public sector.

KMS has therefore decided to starte the following activities:
Look at new perspectives of using cadastral information together with other geographical data in different areas in the public sector including demands for accuracy and updating.
Establishing business- and it-architecture model for the use of cadastral map as a reference dataset.

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Lars Erik Storgaard, Denmark and Marianne Bengtson, Denmark

1. INTRODUCTION

Digitizing the public administration
The publication of the common public strategy for the digital administration 2007 – 2010 primo 2007 has indeed put the focus on the need for increased digitizing of the public administration and closer relation between the different datasets – and what this makes of new demands to the enterprise architecture[1] (EA) for the public administration.

One of the goals of the digitizing is to make it easier for the customer to get and deliver information to the public administration, therefore one of the main activities for the authority is to build new inter-related digital solutions, which will create more value for the customer.

The service community for geodata, who handles the cross-public cooperation activities including development of the necessary business- and financial models for cross-public cooperation, has set the following goals for 2008:
- Make the effort of using geodata visible across the public and private sector. Take care of any legal and/or financial barriers for an efficient use of geodata.
- Work for including geodata in still more and more new solution (supporting standardisation activities, best practise and user guidelines)
- Work for a higher access to sector specific data, which other sectors would like to use in different solutions. Clarifie the future conditions related to data responsibility and rights.

Definition of the new common public service areas
The Digital Taskforce under the financial department has started a work with 1) setting up domain committees, who will be managing the development activities across the defined service areas and 2) establishing a common public businessreference model (FORM), which define the service areas including government levels and task areas.

This work focus on building new cooperation structures, which take the existing and future business processes as a starting point for wanted services – independent that data and processes go across different resort areas or sectors. For example it shall be possible for a citizen through services for My property to get information about easements, polluted areas and different environmental data, taxon real property, taxable value, registered area and other relevant property related data. For more information about the work of the digital taskforce use the following link - www.Modernisering.dk

[1] Enterprise architecture describes the connection between the business and the it technology, taking the business vision and goals as a starting point.

The geodata will be a set of common public services, which will be integrated in the different task areas across the new service areas.

Establishment of a national spatial data infrastructure
Building a national spatial infrastructure, where data can be exchanged inside and between the sectors, is only possible through definition of a common conceptuel datamodel. At European level there has been worked with a definition of an European domain model for Landscape Administration (LADM) which probably will be an integrated part of the future business- and it-architecture development across the European countries.

There will also be a requirement of access to metadata – information about how and when data has been registered, who owns the data etc.

It twill also be a requirment to use open standards for exchanging data and services. At national level there is a work going on, defining common public open standards. The Danish government has decided by law that all public institutions by January 2008 have to use open standards when starting new it-projects.

One af the big challenges is how to build-up the architectural connection across the institutions, sectors and ressort areas. (see the table above.)

Interoperability at many levels

	Organizational Interoperability	Semantic Interoperability	Technical Interoperability
Interantional / national level	Streamlining horizontal layered business processes that are common (maybe even consistent) across all public institutions	General agreement upon data definitions across all of government via a common global information model	Agreement on technical standards used and sharing of common services and high-level infrastructure components
Sector level	Coordinate the business processes that span entire sectors (with consideration to national principles)	A sector specific information model including common metadata (with consideration to national principles)	Sector specific technical standards and common services and infrastructure components (with consideration to national principles)
Institutional level	Internal streamlining of business processes (with consideration to national and sector principles)	Institutional specific information models (with consideration to national and sector principles)	Agreement upon standards for the institution (with consideration to national and sector principles)

The implementation of the INSPIRE directive, which relate to an establishment of a common infrastructure for using standardized geodata within the environmental area of Europe, will influence the development on both sector and institutional level.

2. NEW PERSPECTIVES OF USING CADASTRAL INFORMATION

The Cadastral map as a reference dataset
The cadastral map is a key component of the national cadastre. It illustrates property boundaries and ownership data from across Denmark. It also provides information about protected forests, polluted areas, coastal erostion areas and cliff protection.
The cadastral map is a digital legal document. It is intended to present the cadastral register in visual form, such that individual parcels can be identified along with their attribute data (cadastral number, road access, etc.).

Today's cadastral map is based on historical, hand-drawn property maps that have been digitized and geo referenced. In-field surveys and measurements have improved the precision of the digital cadastral map. This excludes the environmental data found in the maps (protected forests, polluted areas, etc.), which are generated and updated by the responsible public agencies. The cadastral map is updated daily, as new property registrations, boundary changes and field surveys are submitted to the National Survey and Cadastre for approval.
At present KMS works on implementing a new system for the updating process of the cadastral map. The system is called MiniMAKS and builds on the written-on architecture solutions, like SOA. MiniMAKS supports digital communication between state, municipalities, chartered surveyors and other partners in the register-related process. It is expected to improve quality assurance and processing time for changes to the national cadastre.

Today the cadastral map is being used for registration and analyzing in relation to environmental and planning legislation. In the field of land use management the cadastral map and the land register is being used for getting clear, transparent and accessible information about land use regulation including information about property owners. The cadastral map is also being used in different contexts in the private sector.

There is during these years focus on using the cadastral map as reference dataset when building business- and it-solutions for handling future digital administration and new services for the citizens. In the later part named Examples in using the cadastral map as reference dataset in a SOA solution we will go through some of these new solution architectures.

This development/ move towards loosely joined connection between reference data and different sector specific data set up new requirements to the data foundation to meet the future needs:
- Requirements to dataquality, -accuracy, updating freqvens and topology rules.
- Connection to other public registers.
- Relations to selected topographic object types.
- Handling the cadastral information at several levels (3D)

3. LOOSELY JOINED CONNECTIONS AND SOA

The Danish National IT and Telecom Agency has in 2007 focused the effort on developing conditions for an IT-architecture, which can support the public sector's strategy for e-Government. The frames are to secure an effective and safe operation of the public sector's information- and communication technology and to make up the base for coherent public systems.

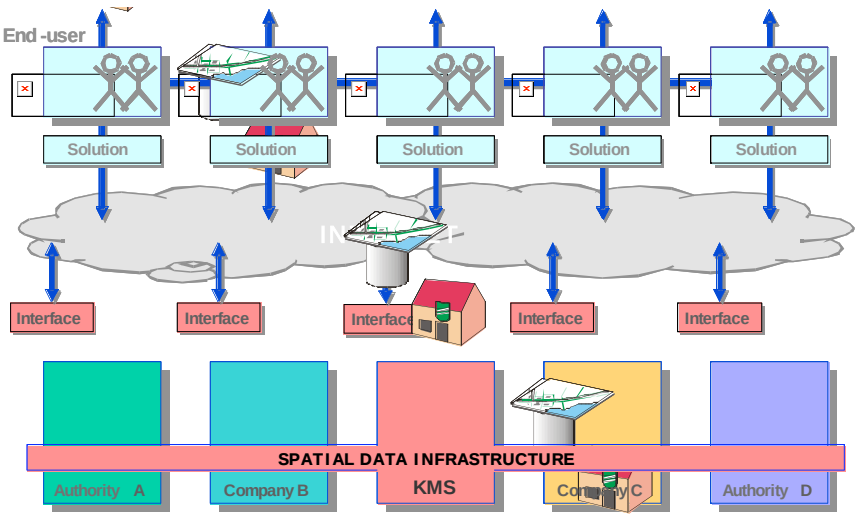
There is implemented a number of initiatives, which are to spread out the knowledge of the central principles in architecture for e-Government. That concerns for example principles for Service Orientated Architecture (SOA) as well as development and use of web services.

This work will become important for the accessibility and the use of public data and also for the use of geographical data. At the same time the organization of the work with data standardization will support geographical data's use as shared reference data.

Special focus points in the efforts in gaining loosely joined systems are the demands for data models and a need for binding cooperation's and rules and standards for data exchange. The cadastral map is to be included in these systems. Today the cadastral map is stored locally by the individual users - authorities, municipalities. The map is brought up to date, is maintained and is stored at KMS who also puts it at the disposal of his customers, typically private, through "The Digital Map Supply" in connection with the use of web services, WMS and WFS. Many users do not make use in provisionally of this possibility of data influx, but choose to store own local copy of the map. The drawbacks to this are numerous: The users risk working on an outdated map, and there is to be sold relatively much data base space to the storage of the map etc.

It has therefore to be worked for that the use of web services is spread out mostly possibly for the users. Data are stored one place – at the data owner, who has the responsibility for maintenance and bringing up to date of data. The users reach data through web services, so that they get a brought up to date copy of the map on their own system, which is deleted again as soon as it is not used any more. Next time the map is to be used, gets the user a new extract of the map with the data host through web services.

The principles in loosely joined connections are sketched below.



The above are not only to be used in connection with distribution of the cadastral map, but for all types of data that several users use. For that this has to be able to let itself do, is it essential that they set up shared frames and rules for the data modelling, data architectures and the use of data. In Denmark this work is based in The Danish National IT and Telecom Agency's OIO2.

The systems KMS implements these days are designed by the principles in loosely joined systems, service oriented architecture and web services. Focus is on developing components that can be used in different context.

SOA

SOA stands for an IT-architecture that creates connection between and overview of a company's business models and technological platforms. The subject is about dynamic adjusting systems and the central point is that loosely joined connections are based on open standards.

SOA describes therefore a way of designing IT-solutions. The fundamental idea is that IT-solutions are implemented, thus they are flexible and re-usable and thus can be adjusted faster, more easily and more cheaply. SOA architecture builds on principles about recycling, minimal dependence, flexibility, visibility and the use of standards. The architecture consists of a list of services. All these services have one or more characteristics that other programmes/users can get access to. It's the communication between these services that makes up SOA.

[2] OIO is a shared public condition for the cooperation about creating public communication and service coherently based on shared architecture and standards. OIO focuses on creating connection and exploit new prospects in the information technology to improve the public service across authority boundaries.

It's about establishing dynamic working procedures, which build on the use of software components, which are accessible on the net, and can act independently of what computer system they are implemented at.

SOA is an obvious choice to systems that are included in e-Government. The Danish government White Book about it-architecture recommends that government it-systems follow the principals of Service Oriented Architecture (SOA) when the focus is on creating new customer services and build-up a stronger interoperability across the public sector.

Web services
Web services can be used to implement a service-oriented architecture. A major focus of Web services is to make functional building blocks accessible over standard Internet protocols that are independent from platforms and programming languages. These services can be new applications or just wrapped around existing legacy systems to make them network-enabled.

A web service can be described as functionality accessibly via the Internet. Such functionality might be the geo-coding of an address - a function, which takes an address as input and returns its geographical position. It could also be a function, which takes a geographical extent as input and returns a map for this area. A web service contains no graphic user interface. In order to be able to use the web services these have to be implemented in an application, which has a graphic user interface. That means that a web application easily can use web services.

4. THE DIGITAL MAP SUPPLY BASED ON SOA

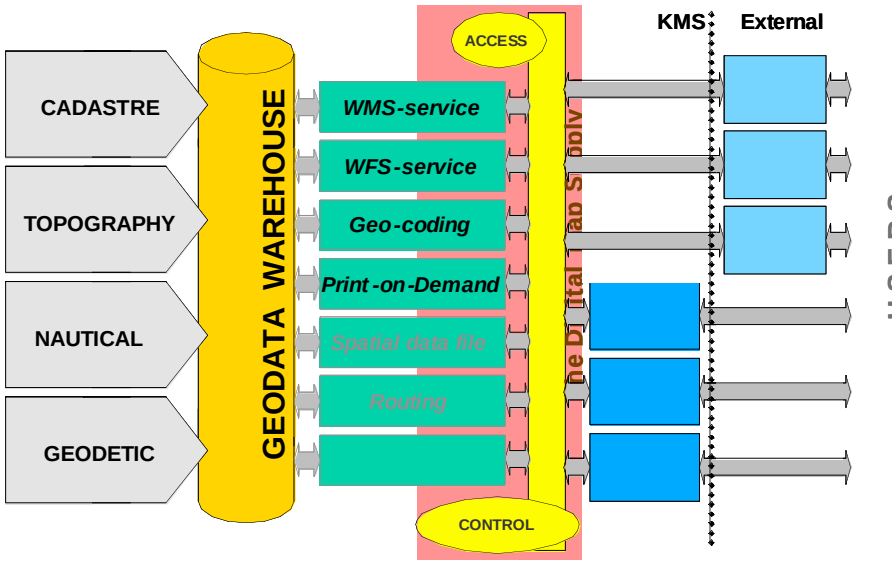
"The Digital Map Supply" is KMS overall system for distribution of geodata via the internet. The system handles more than 100.000 enquiries today daily. The Digital Map Supply is established as an element in the geographical infrastructure and liver for INSPIRE's demand for the establishment of services for the teaching of fundamental geodata.

A cornerstone in the infrastructure influx for KMS:
- The Digital Map Supply is to reduce the technological and financial barriers for the use of maps and geodata.
- The Digital Map Supply is to increase the accessibility and the current interest of geographical data and functionality for the users.

The interface between the infrastructure and the use:
- IT architecture
- Technology- and data standards
- Business models
- Data and functionality
- Operation and support

Digital distribution of geodata makes it possible to improve the efficiency and accuracy of our professional users' data collections on an ongoing basis. Subscribers to the Digital Map Supply receive their geodata via internet servers, eliminating shipping time and

resources. They also gain access to rolling updates of their local data collections, ensuring the maximum precision of the data on which they rely. Timely updates can be critical for such users as ships' captains and sailors, who rely on accurate nautical charts in their work and leisure activities. The architecture for the Digital Map Supply is sketched here:



Digital Map Supply can serve a central function in a variety of mapping applications. Geodata from the Supply can be integrated into mainstream IT solutions and web services that have a geographical element. Digital Map Supply is build up by the principles of WMS/ WFS.

WMS

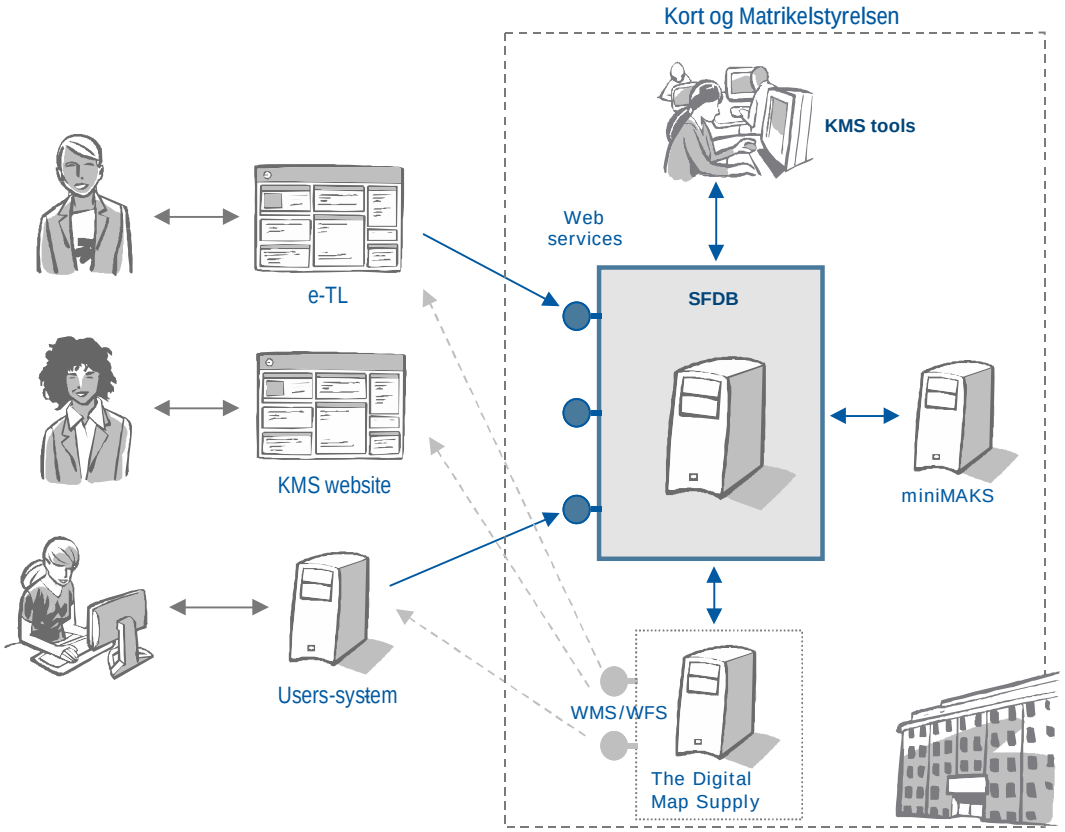
The WMS-specification deals with the mostly read OGC (OpenGIS®) specification. With a WMS you can fetch a screen picture from a server and shows the one that a map in one's own GIS. This is this specification which among other things is used by the Digital Map Supply and many other Danish services. A WMS delivers data in a screen size like Jpeg or PNG, but can also deliver data in vector sizes calculated for lead such as SVG or Flashes (SWF). You can say that WMS is mated to show maps as raster data.

One of the maps that KMS exhibits through the Digital Map Supply - using the WMS technology - is the cadastral map.

EXAMPLES IN USING THE CADASTRAL MAP AS REFERENE DATASET IN A SOA SOLUTION

With the establishment of MiniMAKS KMS gets a modern cadastral map, which can be integrated into other systems and that will make up the reference for geodata and property data in the e-Government. KMS works on two projects, where the cadastral map is used like reference for other geodata. The first one is about the digital title deed registration, e-TL and SFDB, and the other is about establishing the system for handling the physical land use planning and administration in Denmark, PlanDK.

e-TL and SFDB
KMS is the State's infrastructure company for geodata and competence centre for the public use of geodata. It's KMS' objective to make maps and geodata to an everyday tool for citizens, companies and the public sector. Like a natural element in this mission KMS has, in cooperation with The Danish Court Administration, taken on to complete a project, which is to develop a system (SFDB) for the handling of spatial referred easements and buildings at rented property. The system has to subsequently drift's consecutively with KMS' other geodata systems. See below.



SFDB has to contribute to improve the overview of the law state on the individual property by being basis for the building up of a national register over spatial referred easements and buildings at rented property. The local SFDB has to work consecutively with the new e-TL,

where the title deed registration documents will still be registered. The purpose of the project, which includes the development of SFDB, is concrete to live up to the changes in the title deed registration law §§ 10, 19 and 22, there concern demands for a geographical spatial referring of easements and buildings at rented property.

The general goal is for instance:
- To improve the overview of the law state on the individual property gene-easy building up of a national register over spatial referred easements and buildings at rented property.

- In addition to this there is the goal:
- To lighten the working procedures of professional departments, who in the daily handle easements and buildings at rented property.
- To facilitate the work with wiping out outdated easements on the individual property.
- To exploiting the technological prospects, which exist today in the area, in greater extent than earlier.

The background to the project is to follow up on the ongoing changes in the title deed registration area, where they both a new title deed registration law and a new implement electronic title deed registration system (e-TL) based on SOA.

A number of public-legal availability restrictions (e.g. beach protection and polluted properties) and other information concerning properties is spatial referred to the cadastral map, which clearly shows the current property situation. The cadastral map ties the property situation together with the infrastructure for geodata. Spatial referring of easements and buildings at rented property has to be able to be presented compared with the valid property situation, which is clear from the cadastral map and the registration ought therefore to happen consecutively with the cadastral map.

The spatial referring of easements and buildings at rented property has the following purposes:
- Secure and document the law state on the property, including the geographical position of easements and buildings at rented property.
- Informed about the law state.
- Ensure that information about the law state is brought up to date and well-constructed with other information concerning the exploitation of property.

SFDB will contain the geographical spatial referring of easements and buildings at rented property and ensure that the spatial referring is still up-to-date and related to the current property situation (the cadastral map).

The e-TL is to support the concrete processes, which are connected with the spatial referring of easements or buildings at rented property. This is valid both in connection with notification for title deed registration, in connection with the cancellation of an easement and in

connection with easement distribution in connection with parcelling out and other cadastral changes.

The e-TL system is in connection with the notification of an easement to secure the storage of the relevant documentation in e-TLs database. This also concerns documentation of the geographical position of an easement or a building at rented property at the time where the easement was registered. The legal documentation happens in the shape of an e-Rids, which is a PDF-document, which shows the geographical position in the light of a map, e.g. the cadastral map. The data that e-TL passes on for SFDB at KMS, are to be formatted like a GML-document, which is it standardized size for the exchange of geodata.

Services for updating
The information which is put available, must not become obsolete, but has still to be understandable and unambiguous, as long as the registered easement or building-right is valid. There is therefore a need for functionality to bring up to date the registered information's about the spatial referring in connection with changes of the property situation.

The functionality for the bringing up to date of an easement will most often be reached via systems from professional users (people in the title deed registration system, practising chartered surveyors and people in KMS), which reports changes to existing spatial referred easements or on standardized form in connection with property changes in consequence of improvements of the cadastral map.

Enquiries on spatial referring
SFDB has to support enquiries on spatial referring from external and internal users. e-TLs portal is in connection with the use of interface against KMS to make possible that there have to be able to be put information about the geographical position of registered easements and buildings at rented property for availability, placed together with the current property situation, as if it's clear from the cadastral map, and other relevant geographical data.

By providing the information about the geographical position and placement of easements and buildings available the cadastral map as a reference, security is gained property evaluations for that there are a clear connection to the other property information, including registrations concerning buildings at rented property, etc, as well as public-legal availability restrictions, which are registered at the cadastral map.

KMS has made an architecture-related decision about displaying SFDB's data via web services through the Digital Map Supply. Other access than enquiries (e.g. bringing up to date) however happens directly against SFDB.

Methods for spatial referring
An easement will be able to be spatial referred in more different ways. SFDB are worked on following methods for spatial referring:

E: Indirectly spatial referred - the easement concerns the whole property.

M: Indirectly spatial referred - the easement includes the entire parcel.

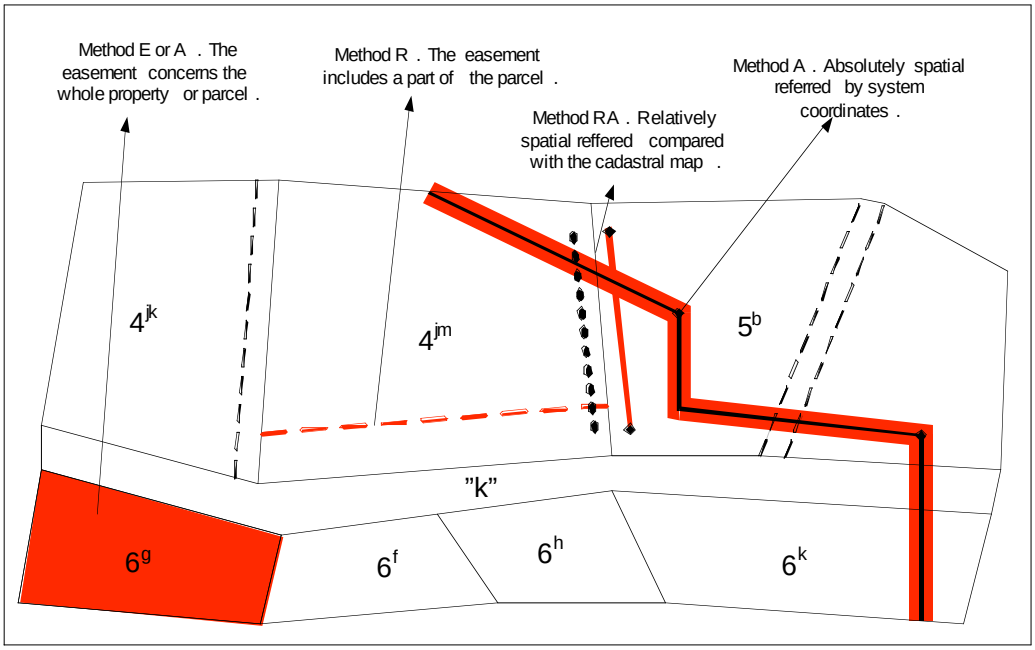
A: Directly spatial referred. Absolutely spatial referred by system coordinates - the easement includes a part of the parcel and are not going to be moved when changes in the boundary picture is been made.

R: Directly spatial referred. Relatively spatial referred compared with the cadastral map - the easement includes a part of the parcel and are to be moved when changes in the boundary picture is been made.

RA: Relatively spatial referred compared with the cadastral map - however system coordinates in GML-file are found. Used in areas where the easement is not spatial referred at the right parcel. That is caused by inaccuracies in the cadastral map.

U: Unidentifiably - can concern whole or parts of the property. The easement does not immediately give possibility of spatial referring.

The described methods are sketched below.



According to the time schedule the e-TL and SFDB are going to be implemented and used in late November 2008. The development of the two systems is just to start and it is the plan to do the test in the beginning of fall 2008.

PlanDK

The chief aim with PlanDK is to create firstly a simple way for the municipalities to register plans to the State, secondly a light access for everybody to the municipalities' plans. With the new Plan-system the plans is only to be notified in the State one time and one place. All

institutions who are to have the plans according to the legislation - as well as others that the municipalities wish, have to have the plans - will automatically receive message about new plans from the system.

The building up of the system happens after the principles in SOA. This means that PlanDK will be able to play together with other systems in the future's e-Government. The system is modular built up and the communication internally in the system between the modules happens with the help of SOAP/XML. Externally the system will be able to deliver data online with the help of WMS/WFS.

Like all others the municipalities will in PlanDK be able to see the plans together with different maps such as the cadastral map, fetch the plans down to own PC or couple oneself on different services (WMS/WFS).

In a new Plan-system information about the plans has therefore to be registered at the Cadastral. The planes' geographical extent ought to be registered with the help of GIS in agreement with the cadastral map. A special challenge is connected with this geographical registration, because the cadastral map in consequence of new parcelling outs, justifications and short straightening outs is under constant change and improvement.

National plane data are not usable, if they are not registered the same way in the whole country. Nationally homogeneous plane information can only be secured in the light of a shared data model of the plane area. This model has to contain provisions about reference data (reference maps), the plans' characteristic data (identification, area use and built-upping area-regulate provisions) as well as rules for how the plans' geographical extent is registered (topological rules). The shared data model must be developed and be arranged jointly between state, counties and municipalities. Experience shows that for that such a data model will be implemented in all municipalities it is to be obligatory for the municipalities. The municipalities are in other words to have the responsibility for that data are established after the agreed upon data model.

Plan-data are furthermore to be built up so that they can play together with other types of data, e.g. property data and other information about availability restrictions. It therefore is important that the data model of plane data is coordinated with data models of other types of data, as well as that here is defined suitable unique keys that can secure unambiguous connection. The national plane data are as far as possible to build on the data that the municipalities themselves use in the daily planning. Data are only to be registered one time. Copy data are to be avoided. This agrees with the principal rules, OIO sets up for the establishment of IT systems and exchange of data.

The work with establishing a new plane system has result in following demands, which are to be complied with:

- Nationally, brought up to date and valid plane data.
- Register information about identification, area use and property regulation.
- The planes' geographical extent.

- The legally valid documents.

Concerning the data quality the plane system is to ensure:
- Connection between the plans and the Cadastral.
- Connection between the plans and property information.

The system is to be easily accessible, which leads to that:
- The system is to be built up so that it can be as far as possible used directly in the daily handling of the activities by the municipalities, counties and state.
- There has to be established one entrance to national information.
- Data have to be presented and be exchanged in the shared accepted exchange standards. That means that data are exchanged as far as possible in XML and GML-schemes, and that they are put more-availability with the help of WMS and WFS.
- There has to be free access till data.
- Data have to be able to be used by both public and private companies.
- Finally several parties have emphasized the importance of that the system has to be able to be driven so simply as possible.

All the existing plans are expected to be registered in the PlanDK system fall 2008. After this date all access to the plans will be through the PlanDK system by using the portal application or by using webservices in own systems.

5. ESTABLISHING AN ENTERPRISE ARCHITECTURE MODEL FOR USEING THE CADASTRAL MAP AS REFERENCE

Enterprise architecture (EA) describes that logic there is between the business and the need for it infrastructure – and it will support a definition and government of the requirements there are for integration and standardisation to the business.

Architectur cooperation between several institutions cause the EA also to look at the business and it relations across the institutions including requirements for dataquality and access to data/ functionality through services.

When integrating geodata in new it-solution across the public sector, there has to be established a collaboration which take care of how to share data and services with common customers. In this type of cooperation structure, the single institutions EA are used as a starting point for establishment of a common EA for the specific collaboration.

The EA governing structure should ensure the EA is effectively designed and engineered by focusing on the following 4 subjects:

- Panning and Transformation: The EA governance structure must ensure that the EA includes a viable plan for migrating from the existing (as-is) architecture to the future (to-be) architecture.

- Architectural qualities: The EA should emphasize the traditional goals as portability, scalability, interoperability, flexibility and modularity. While the classic meaning of these terms usually applies at the system level, their consideration at higher levels of abstraction can contribute to improve EA quality and usefulness.
- Focus on component based approaches, interfaces and linkages: The EA should emphasize a component-based approach and the incorporation of common components and services, shared processes and emerging shared e-government solutions. This strategy helps eliminate redundancy, increases standardization and increases reusability.

- EA effectively described and documented: The EA must be well described and properly documented, both during initial development and throughout its continuous evolution.

Future focus areas
The national survey and cadastre of Denmark will be working with the following focus areas over the next year to build-up an enterprice architecture to meet the future requirements for using the cadastral map as a reference dataset:

- Define an EA strategy for using cadastral map together with other geodata in the public service areas and other cross-public collaborations.

- Define EA alignment processes for the cross-public collaborations including service agreements, which describe who has the responsibility for carrying out the different EA activities.

- Define common business and it-principles for the future architecture.

- Standardization of selected geodata, which will be included as reference data in common public collaborations.

- Ensure that all common public registers are based on common public data standards. Set up requirements for dataquality and updating freqvens for these data.

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www.xyz-geodata.dk Link to the Service Community for Geodata.

BIOGRAPHICAL NOTES

Marianne Bengtson has been working as a Cartographer at the National Survey and Cadastre of Denmark since 1990. She has been working with topographical data and it-solutions for 15 years. Started working with cadastral data for about a year ago. She had graduated with a Datanom education at the Copenhagen Business School (1999) and with a Diploma in IT at the IT University in Copenhagen (2008). Her thesis was about using EA structure and alignment processes for establishing and integrating geodata in the public sector.

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Brief career history:
2004-2007: Chartered surveyor in Copenhagen commune. Carried out cadastral work and measuring.
2007- : National Survey and Cadastre. Project leader. Works on projects about the cadastral map's use like reference dates. Especially about the spatial referring of easements.

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