Easy Flow of Cadastral Information between Organisations

Towards a Core Cadastral Domain

The idea for the introduction of a Core Cadastral Domain Model was launched at the FIG Congress in Washington 2002. During this meeting there was a great deal of attention for the issue of standardisation: the FIG guide on standardisation was presented and it was decided to continue the work of the FIG Task Force on Standardisation in the 'FIG Standards Network'. Standardisation is also one of the main themes of interest for the FIG Working Week in Paris 2003. The issue of standardisation in relation to Cadastre will be managed within FIG by Commission 7, 'Cadastre and Land Management'.

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It may be observed that great efforts are being made in the direction of standardisation of the Cadastral Domain. In Germany, the Working Committee of the Surveyors Authorities of the States of the Federal Republic of Germany (AdV) has begun developing a new conceptual data model for the Official Cadastral Information System (ATKIS) based on ISO standards. The Cadastral Subcommittee of the US Federal Geographic Data Committee has developed a complete Cadastral Data Content Standard for the National Spatial Data Infrastructure. The US National Integrated Land System (NILS) provides business solutions for the management of cadastral records and land parcels information in a Geographic Information System environment. In New Zealand the new Cadastral Survey Exchange Format, as part of the Landonline survey and title automation programme, is based on the LandXML. The European market is becoming more integrated. So far, property transactions have remained fairly nationally delineated and complaints have been made about the lack of a single mortgage market. In order to speed up the integration process, Landmäteriet Sweden has initiated a project for providing the market with a single point of access to land information across the borders: the EULIS project.

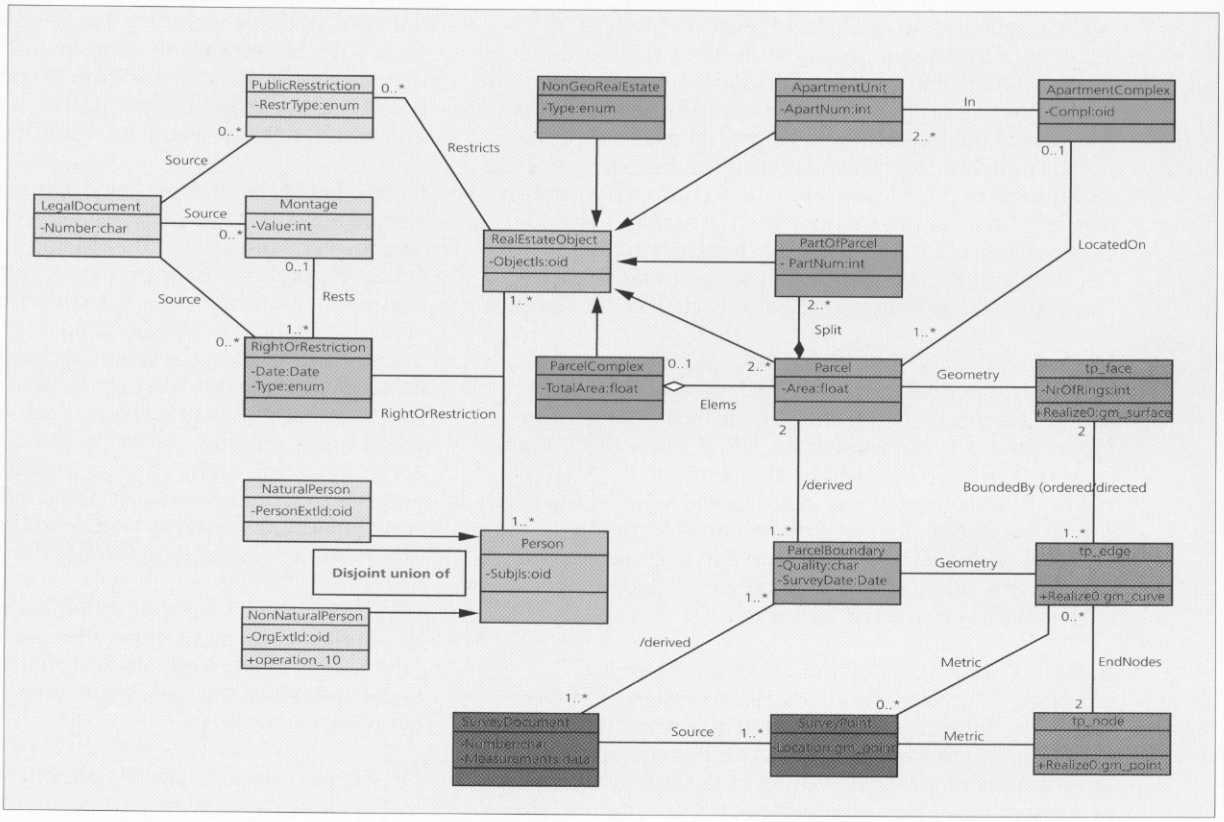

Figure 1, The proposed Core Cadastral Domain Model. Meaning of the colours: Green: real core; Green and yellow: legal/ administrative aspects; Green and blue: real estate object specialisations; Blue, pink and purple: geometric/ topological aspects

Model

Cadastral Information Flow

The introduction of a simple, generic Core Cadastral Domain Model could encourage and support the flow of information relating to land property between different government agencies and between these agencies and the public. Whilst access to data, its collection, custody and updating should be facilitated at a local level, the overall land information infrastructure should be recognised as belonging to a uniform national service so as to promote sharing within and between nations. A Core Cadastral Domain Model in which classes and associations between classes representing objects, attributes and operations are derived from different tenure systems could, in the opinion of the authors, definitively contribute to the efficient fulfilment of local cadastral needs.

Model Overview

The here proposed class diagram for the cadastral domain contains both legal/administrative object classes, like persons and rights, and the geometric description of real estate objects. This means in principle that data could be maintained by different organisations: municipality or other planning authorities, private surveyor, cadastre, conveyancer and/or land registry. The model would most likely be implemented as a distributed set of (geo-) information systems, each supporting parts of the dataset represented. This underlines the relevance of this model; different organisations have their own responsibilities in data maintenance and supply and have to communicate on the basis of standardised processes, perhaps in so-called 'value adding production chains'.

One should not look at once at the whole model as it is presented in Figure 1; the colours are supposed to represent different 'packages' or aspects:

- Green: real core
- Green and yellow: legal/administrative aspects
- Green and blue: real estate object specialisations
- Blue, pink and purple: geometric/topological aspects

Core Classes

The relationship between real estate objects, (e.g. parcels) and persons (sometimes also called 'subjects') via rights is the foundation of every land administration system. Besides rights, there may also be restrictions between real estate objects and persons. Related classes, associations and multiplicity are depicted in the green part of Figure 1, in which it is also shown that RightOrRestriction is an association class between the classes Person and RealEstateObject.

RealEstateObject Specialisation

A RealEstateObject is an abstract class; that is, there are no object instances of this object class. However, it has specialisation classes (which have object instances) such as Parcel, ParcelComplex, PartOfParcel, ApartmentUnit, and NonGeoRealEstate. This phenomenon is represented in blue in Figure 1.

Implementation as a distributed set of information systems

A ParcelComplex is an optional aggregation of Parcels. A ParcelComplex situation might occur in a system where a set of Parcels has a legal/customary meaning.
A Parcel can be subdivided into two or more PartOfParcels. This could arise when 'preliminary' or 'future' Parcels are created during a conveyance, where a Parcel will be split and surveying done at a later date. It could also be helpful in supporting planning processes based on cadastral maps, where establishment of Parcels in the field is done later.

An ApartmentComplex is associated with one or more Parcels. There may be two or more ApartmentUnits in an ApartmentComplex. Note that an ApartmentUnit is intended in the general sense, not just as a unit for living purposes but also for other purposes, e.g. commercial. In other words, all building units with legal/registration significance are included here.

Relationship between parcels and persons via rights is the foundation

Parcels are defined by ParcelBoundaries and have a geometric/topological description. The class ParcelBoundary always has two neighbour Parcels, whereas territorial ParcelBoundary(s) have one 'zero-Parcel' as neighbour, this representing the external territory. Attributes can be linked to individual boundaries; this allows, for example, classification of individual boundaries based on the administrative subdivision of a territory.
The class NonGeoRealEstate can be useful in a case where (complete) geometric description of the RealEstateObject does not (yet) exist. This might apply when only one coordinate is observed inside the RealEstateObject, using Satellite Images or GPS. It might also happen in the case of fishing or mining rights, which are not directly related to a specific location, etc.

Surveying Classes

Object classes related to surveying are presented in the colour pink. A cadastral survey is documented in a Survey Document, which is a (legal) source document made up in the field. Most importantly, this document contains signatures. Files containing terrestrial observations - distances, bearings and referred geodetic control - on points are attributes of SurveyDocument, the Measurements. Both ParcelBoundary and SurveyPoint are associated with SurveyDocument. From the multiplicity it may be recognised that one Sur-

veyDocument can be associated with several SurveyPoints. When a SurveyPoint is observed at different moments in time this will result in different SurveyDocuments.

Geometry and Topology

Object classes describing topology are presented in purple. The Cadastral Domain Model is based on already accepted and available standards in geometry and topology. The geometry is based on SurveyPoints and is associated with the classes tp_node (topology node) and tp_edge (topology edge) to describe 'shapes' between points metrically based on SurveyPoints.
Parcels have a 2D geometric description. A Parcel corresponds one-to-one to the tp_face in a topological structure. A face is bounded by its edges in 2D. An edge is related one-to-one to a ParcelBoundary. Every edge has exactly two end points, represented by tp_nodes. An edge may also have several intermediate points. Both intermediate points and nodes are associated with SurveyPoints. The topological primitives tp_face, tp_edge and tp_nodes all have a method ('operation') called 'Realize' which can be used to obtain a full metric representation.

Legal/Administrative Classes

Object classes presented in yellow cover refinements on the Legal/Administrative side. All updates associated with RightsOrRestrictions are based on LegalDocuments as source. In principle, legal data will not be changed without provision of a LegalDocument. The essential data of a LegalDocument is associated with ('can be represented in') the classes RightOrRestriction, Mortgage or PublicRestriction.
The abstract class 'Person' (this is again a class without object instances) has as specialisation classes NaturalPerson or NonNaturalPerson: organisations, companies, co-operations and other entities representing social structures. If a Person is a NaturalPerson it cannot be a NonNaturalPerson, and the other way around. That is, Person is a disjointed union of NaturalPerson and NonNaturalPerson.

Back to Core Classes

Right (a subset based on the type attribute in RightOrRestriction) is compulsory association between RealEstateObject and Person where this is not compulsory in the case of restriction (the other subset in RightOrRestriction). For example, a restriction like encumbrance is only associated with the land: the RealEstateObject.

Classification of boundaries based on administrative subdivision

Property and ownership rights are based on legislation. 'Lookup tables' can support this; for example, the right of 'ownership' might be 'Norwegian Ownership', 'Swedish Ownership', etc. etc. 'Customary Right' related to a region or 'Informal Right' may be included. From a modelling perspective this is not an item for discussion.
The class RightOrRestriction allows for the introduction of 'shares of rights' in the case of a group of Persons holding a fraction of a 'complete' right.

Further Developments

This Core Cadastral Domain Model is just a proposal and a potential point of departure towards a final model. Potential further developments might include:

- Review of multiplicity to allow as much flexibility as possible in the introduction of separate 'packages' of the model
- Maintenance of historical data
- GeodeticReferencePoints
- 3D Cadastral aspects
- Higher level aggregations: sections, municipalities...
- Links to external registrations

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Biography of the Authors

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Christiaan Lemmen has held the post of assistant professor at the International Institute for Geo-Information Sciences and Earth Observation (ITC), Enschede, The Netherlands, since 1999. He is also geodetic advisor to the Netherlands Kadaster, where he has held several appointments since 1983. He is vice-chair Administration of FIG Commission 7 'Cadastre and Land Management'. His areas of special interest are in land administration systems, land consolidation, performance measures, total quality management and workflow management.

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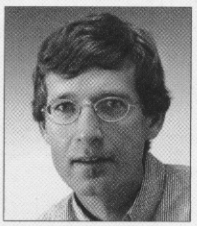

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