Annex A. Abstract Test Suite (p.m.)

(normative)

Will be included after finalizing LADM.

Annex B. Social Tenure Domain Model (STDM)

(informative)

The Social Tenure Domain Model (STDM) is developed as a specialization of the LADM, specifically for developing countries, countries with very little cadastral coverage in urban, or rural areas, for post conflict areas, countries with large scale informal settlement, or large scale customary areas. In developing the STDM the focus has been on modelling the relationships between people and land; independent from the level of formalisation, or legality of those relationships. It is a search for a model that can be used as a basis for the development of a land administration system that can support all forms of land rights, social tenure relations, and overlapping claims to land (van Oosterom et al, 2005; Augustinus, 2006).

There is growing concern about slums, as clearly stated in the year 2000 in the United Nations Millennium Declaration. Given the increasing numbers of urban slum dwellers, governments have recently adopted a specific target on slums. It is contained in the Millennium Development Goal 7, Target 11, which aims to significantly improve the lives of at least 100 million slum dwellers by the year 2020. Because land is literally at the base of slum formation, addressing the slum challenge means taking the land issue seriously. Land titling is important and necessary, but it is not enough on its own to deliver security of tenure to the majority of citizens in most developing counties. Customary tenure and informal settlement tenure have a very strong influence. Individual land titling often works against the needs and aspirations of ordinary people, also because of its cost. There is an urgent need to have a land information system that works differently from the conventional land information system. Land tenure types, which are not based on the cadastral parcel and are not registered, require new forms of land administration systems, including land information management systems.

The LADM originated from areas with formal cadastre and land registry systems. It should be observed that the LADM contains the functionality for the STDM, but under different terminology. Many countries have an incomplete, or absent land administration. Formal terminology as used in the LADM can not always be applied because of the informal environment. In the STDM the same classes as in LADM are used, but sometimes under different terminology: e.g. class RRR is named class SocialTenureRelationship (see Table B1).

LADM class name	*STDM alias*	*Figure*
AdminDocument	SocialTenureInventory	Figure B2
BuildingReserve	Building	Figure B3
BuildingUnit	Unit	Figure B3
Mortgage	Collateral	Figure B2
NetworkReserve	UtilityNetwork	Figure B2
RRR	SocialTenureRelationship	Figure B1, Figure B2
SourcePoint	SurveyPoint	Figure B3
SpatialSourceDocument	SpatialUnitInventory	Figure B2
SpatialUnitSet	AdminSpatialUnit	Figure B2, Figure B3

Table B1. LADM class names with their aliases in STDM

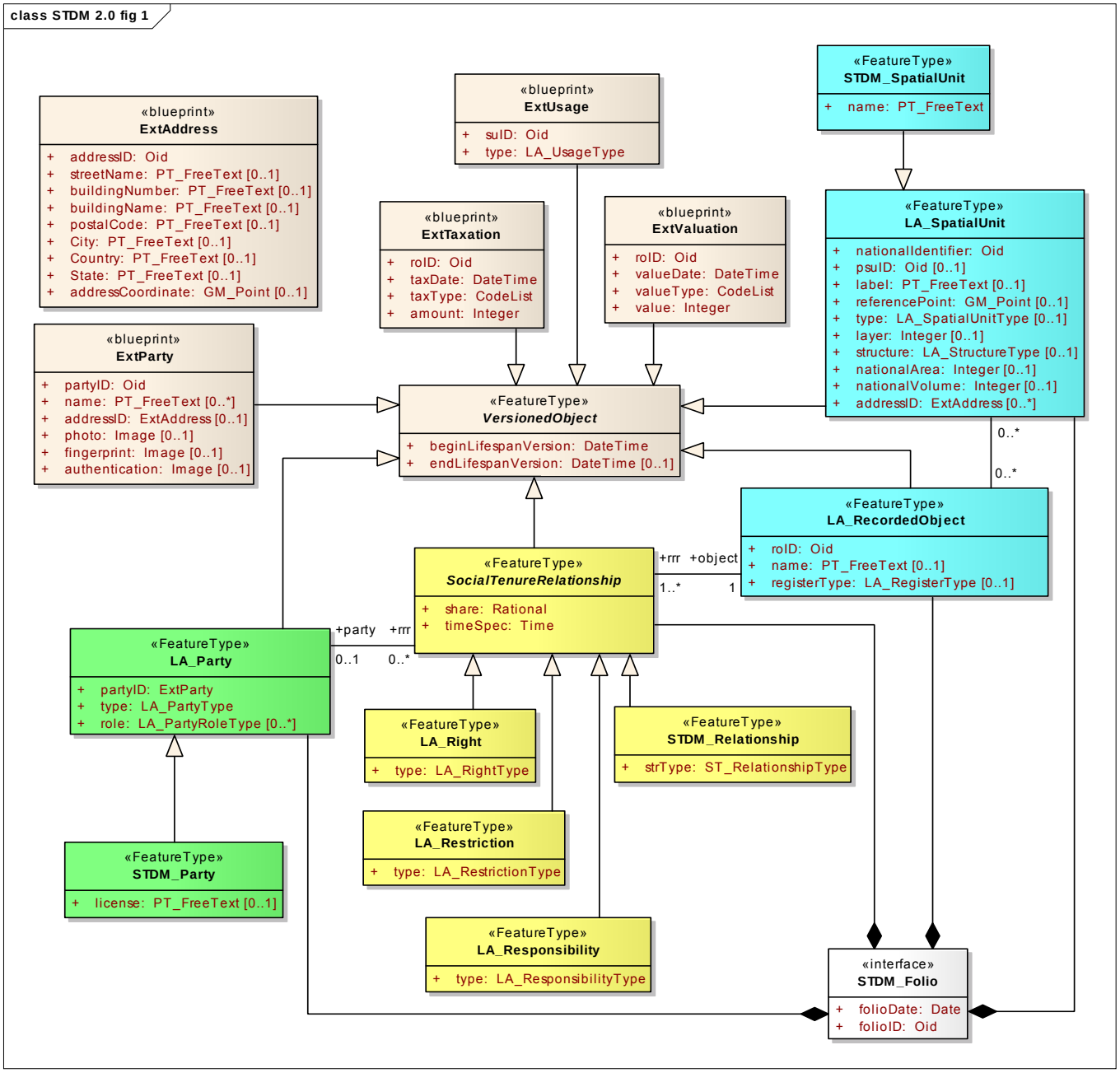


Figure B1. STDM core classes and blueprints for external classes

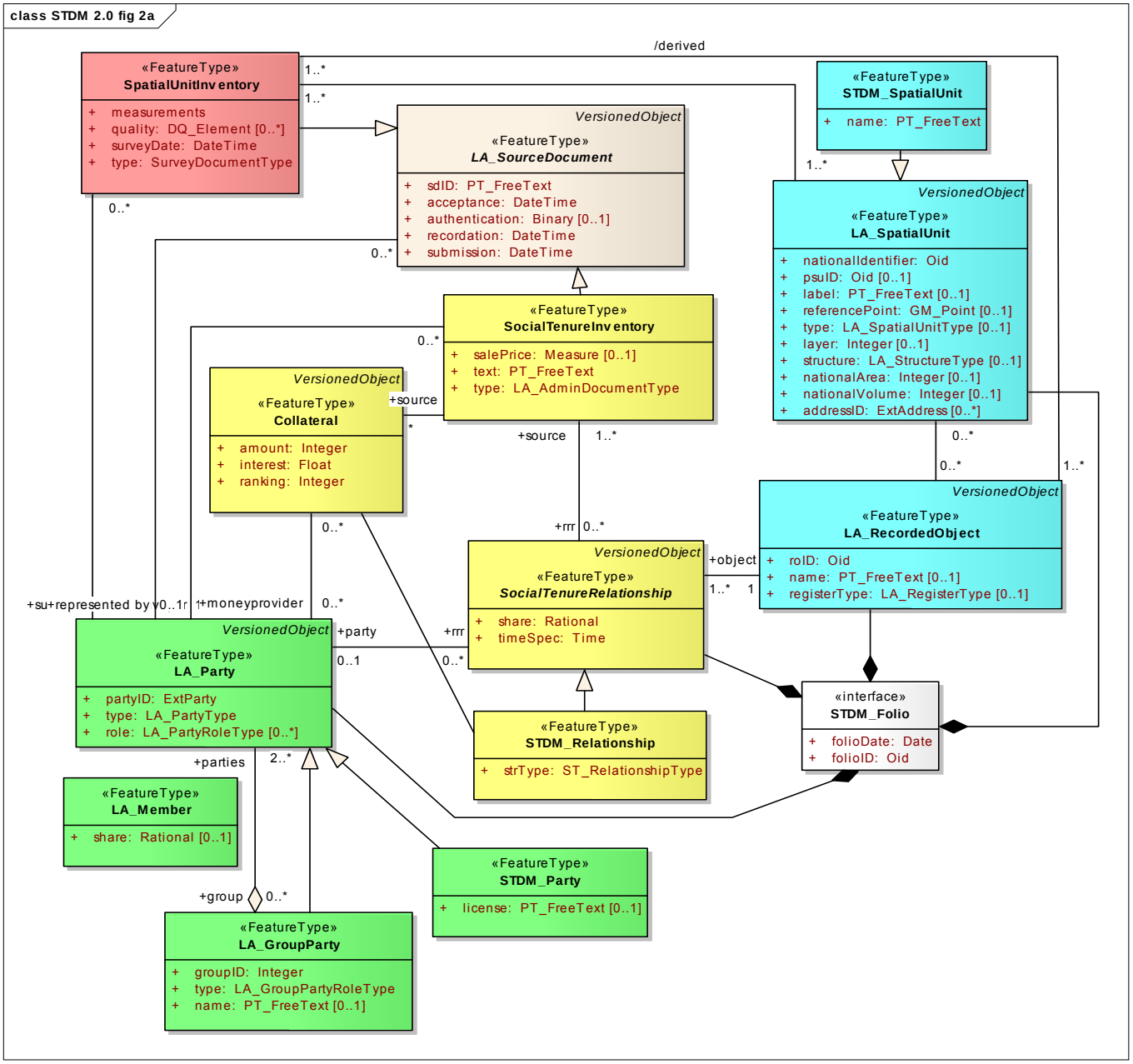


Figure B2. STDM party specializations and refinements of social tenure relationships

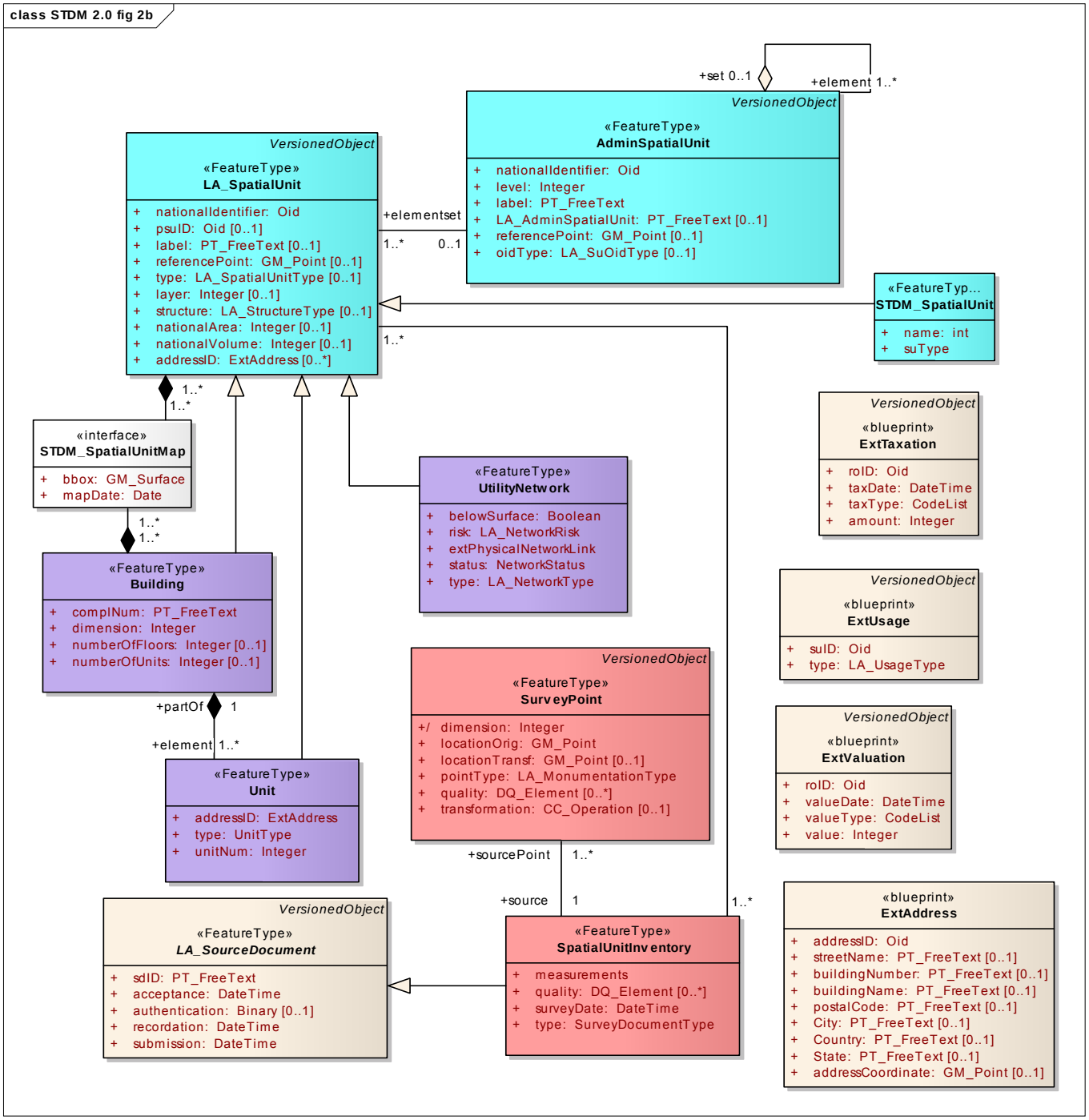


Figure B3. STDM spatial units specializations and survey classes

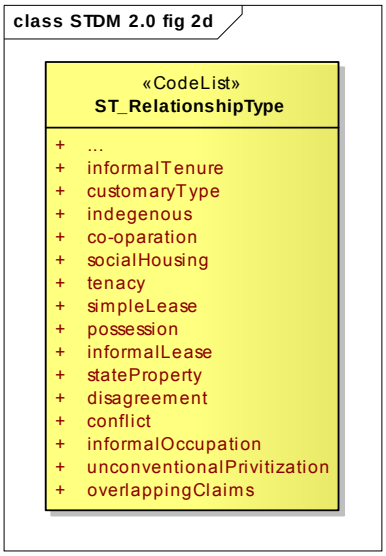


Figure B4. Code list for social tenure relationships

Annex C. Object diagrams (instance level cases)

(informative)

Note that the content of this Annex is based on:

ISO 19109, Geographic Information – Rules for Application Schemas

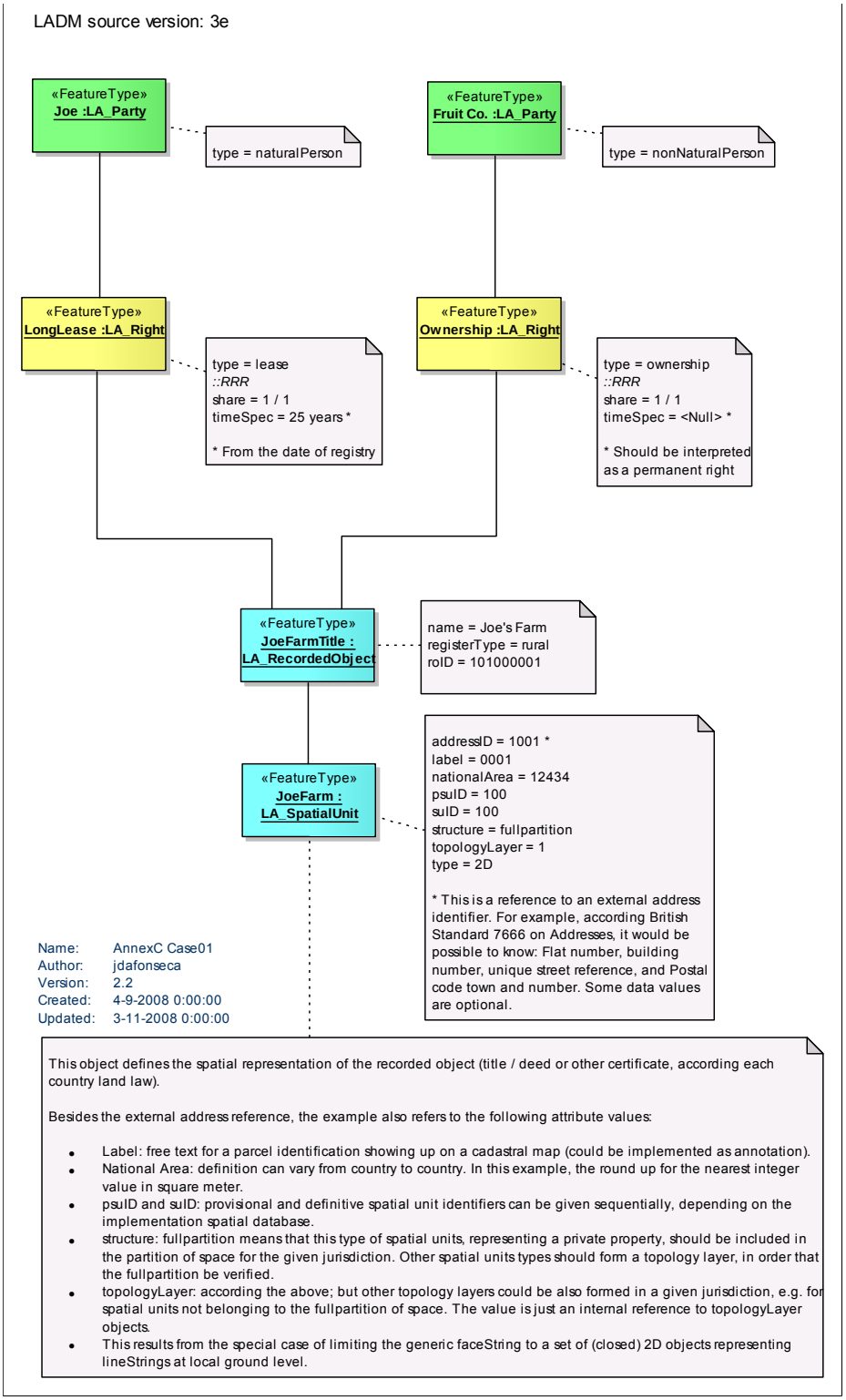
ISO 19110, Geographic Information – Methodology for Feature Cataloguing

ISO 19126, Geographic Information – Feature Concept Dictionaries and Registers

ISO 19131, Geographic Information – Data Product Specification

The examples are partly based on the terminology of the STDM (Annex B).

1. One natural person is leaseholder, another non-natural person is owner, ownership and leasehold based on civil code for a particular country (case 1).
2. A spatial unit with a customary right (under construction).
3. Two persons hold a share in a right, for example one person a ½ share, and the other person a ½ share, or ⅔, and respectively ⅓ (case 3).
4. A serving parcel provides access to four parcels, and the serving parcel is not public (case 4).
5. A group of persons holds a property right on an unstructured parcel (case 5).
6. A legal space building contains individual units (apartments), and a shared unit, with one common threshold on a ground parcel (case 6).
7. A 3D volume parcel with one owner (under construction).
8. A timeshare ownership for the month of February (case 8).
9. A restriction not to change a building because of its monumental status (case 9).
10. Mortgage on ownership, bank included as party (case 10).
11. Mortgage on usufruct of ownership, money provider included as party (case 11).
12. Informal right by a person on a text parcel (under construction).
13. Informal right by a group on a point parcel (under construction).
14. Informal right on a spatial unit (under construction).
15. A conflicting claim on a spatial unit (under construction).
16. A utility network with one owner and a mortgage (bank included as party) (case 16).
17. A pastoralist group with an access right for a certain period (under construction).
18. Parcel with one owner, building on it with a different owner (case 18).
19. Farmer owning several parcels (rural) (under construction).
20. Value as basis for taxation valid for five years (case 20).
21. A milk right to a parcel (under construction).
22. A responsibility to clean the ditches (under construction).
23. A right of use of a road on a property of somebody else (case 23).
24. A restriction area with its own geometry: not allowed to built 200 meters around a fuel station (case 24).
25. Parcel complex with one owner (case 25). *Alternative visualization of attributes.*
26. Complex of parcels and building with one owner (case 26).
27. Complex of several parcels with two owners (under construction).
28. Spatial unit in conflict (under construction).
29. Spatial unit with micro credit (under construction).
30. Tax valuations on condominium rights in Spain (case 30).
31. Marriage and inheritance relationships to property (simple) in Spain (case 31).
32. Marriage and inheritance relationships to property (complex) in Spain (case 32).
33. Spanish '*real estate'* form of property (case 33).
34. Norwegian categories of basic properties (case 34).



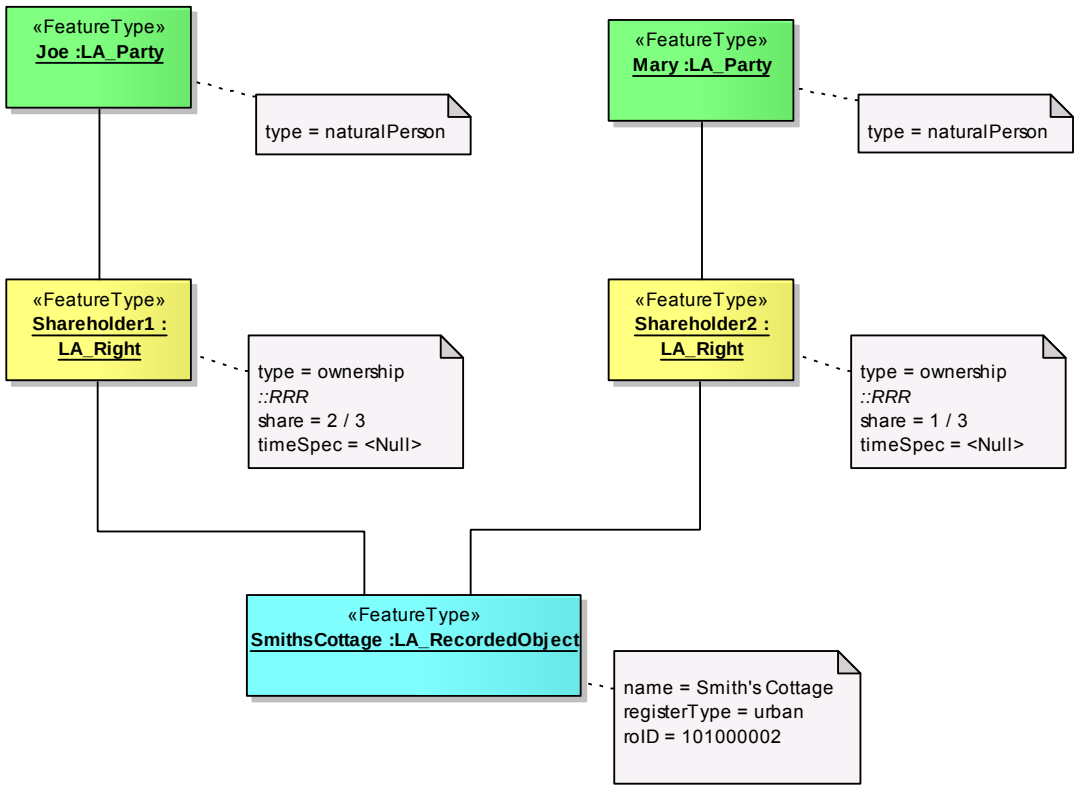
Case 1

object AnnexC Case03

Object Diagram, Case 03 - Sharing ownership situation (Formal Rights)

Description:
Two persons hold a share in a right (one person a share of 2/3 and the other person a share of 1/3).

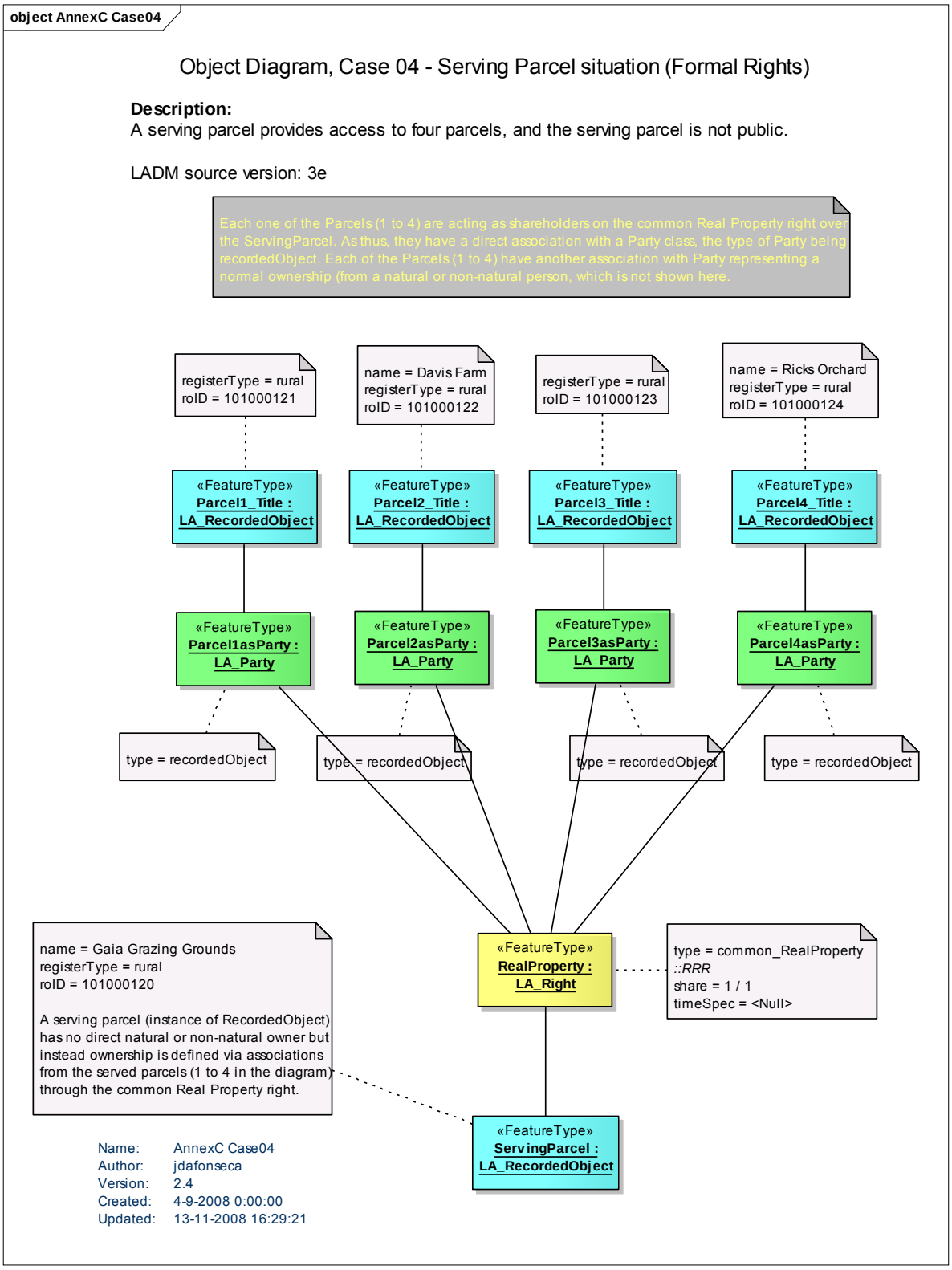
LADM source version: 3e



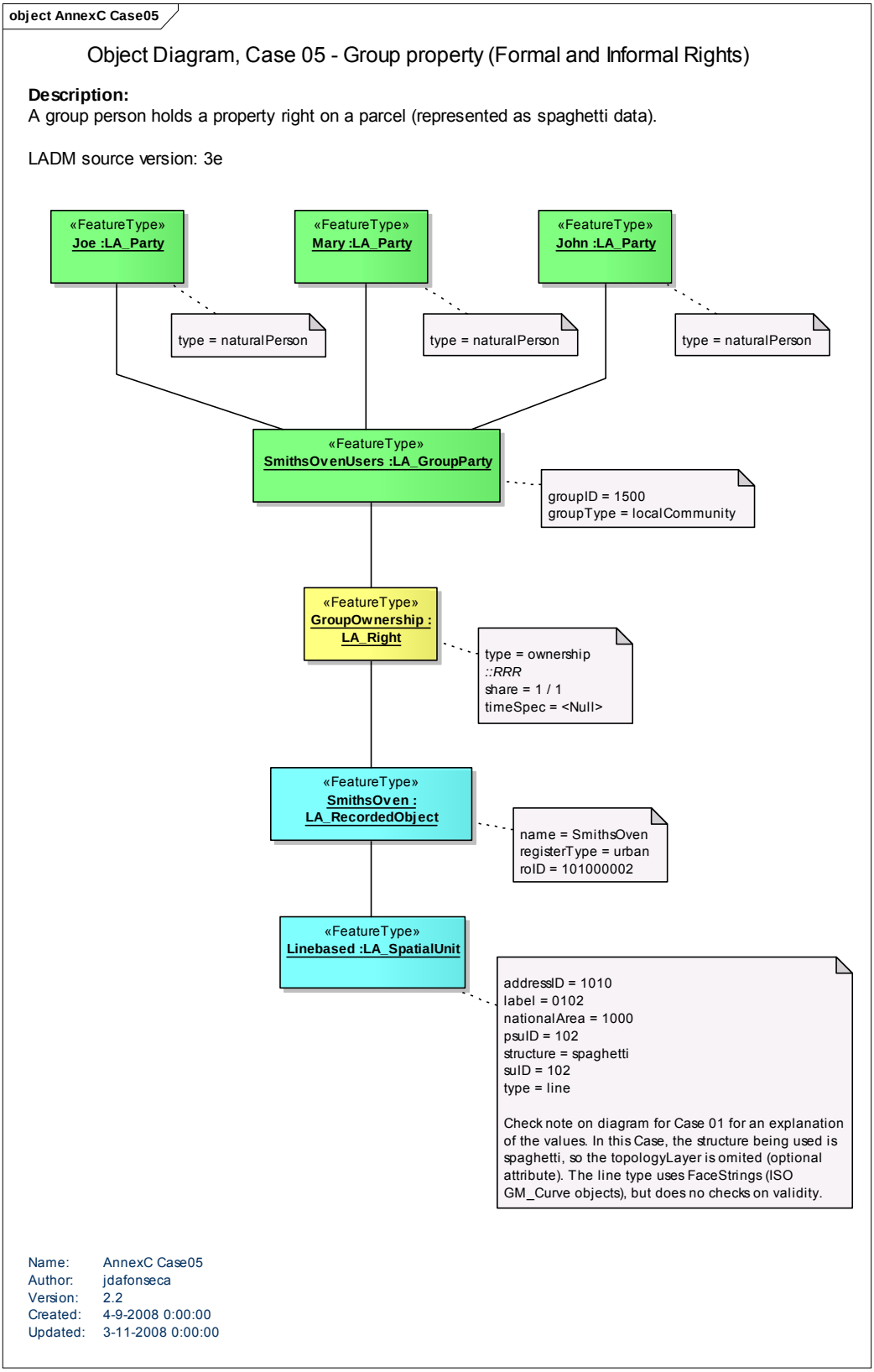
Note: Object (instance) names on this diagrams do not correspond to a real implementation, e.g. in a valid database data type. Instead, more meaningfull daily life names were used for clarity, e.g. Mary as an instance of the Party class.

Name: AnnexC Case03
Author: jdafonseca
Version: 2.2
Created: 4-9-2008 0:00:00
Updated: 3-11-2008 0:00:00

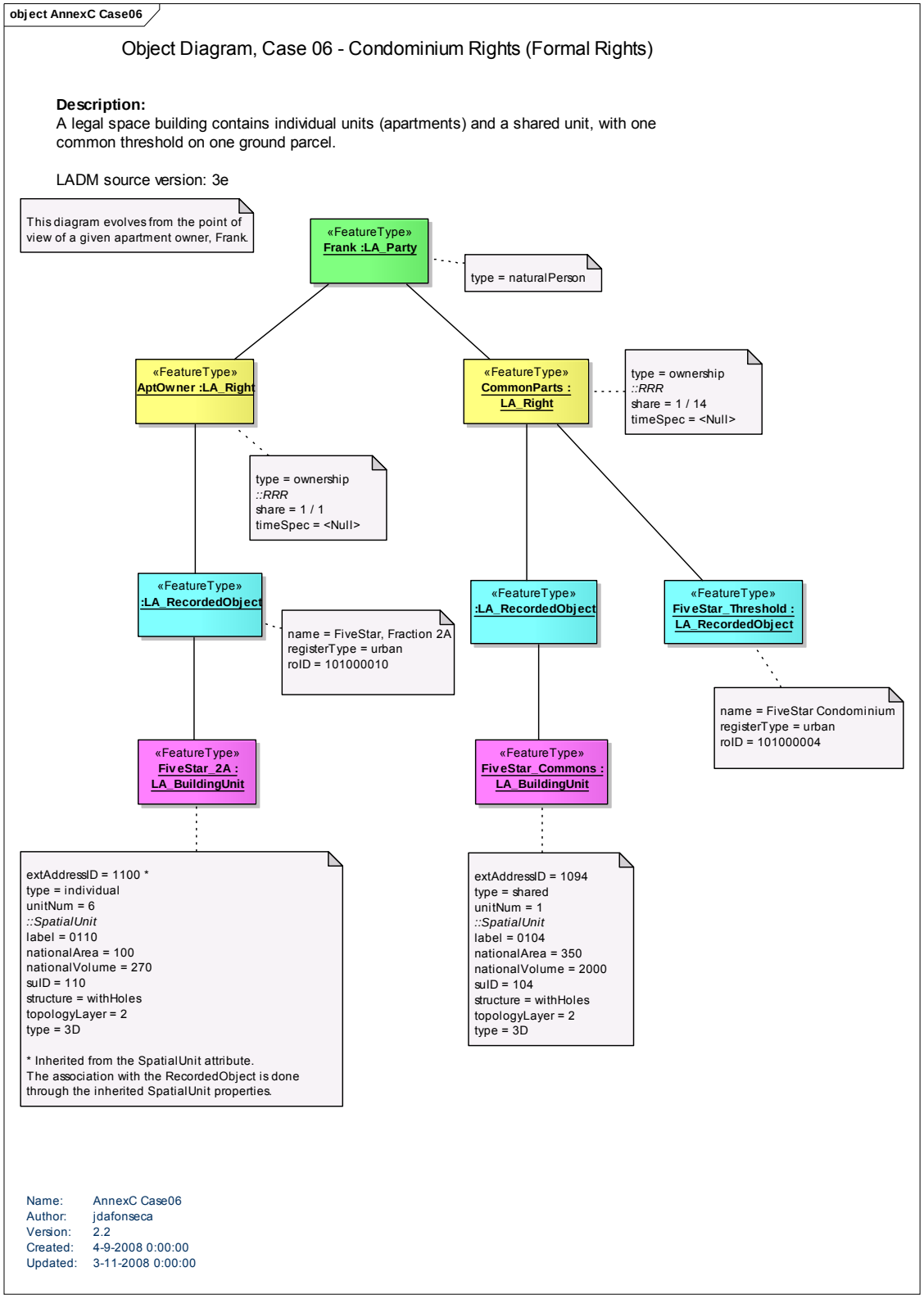
Case 3



Case 4



Case 5



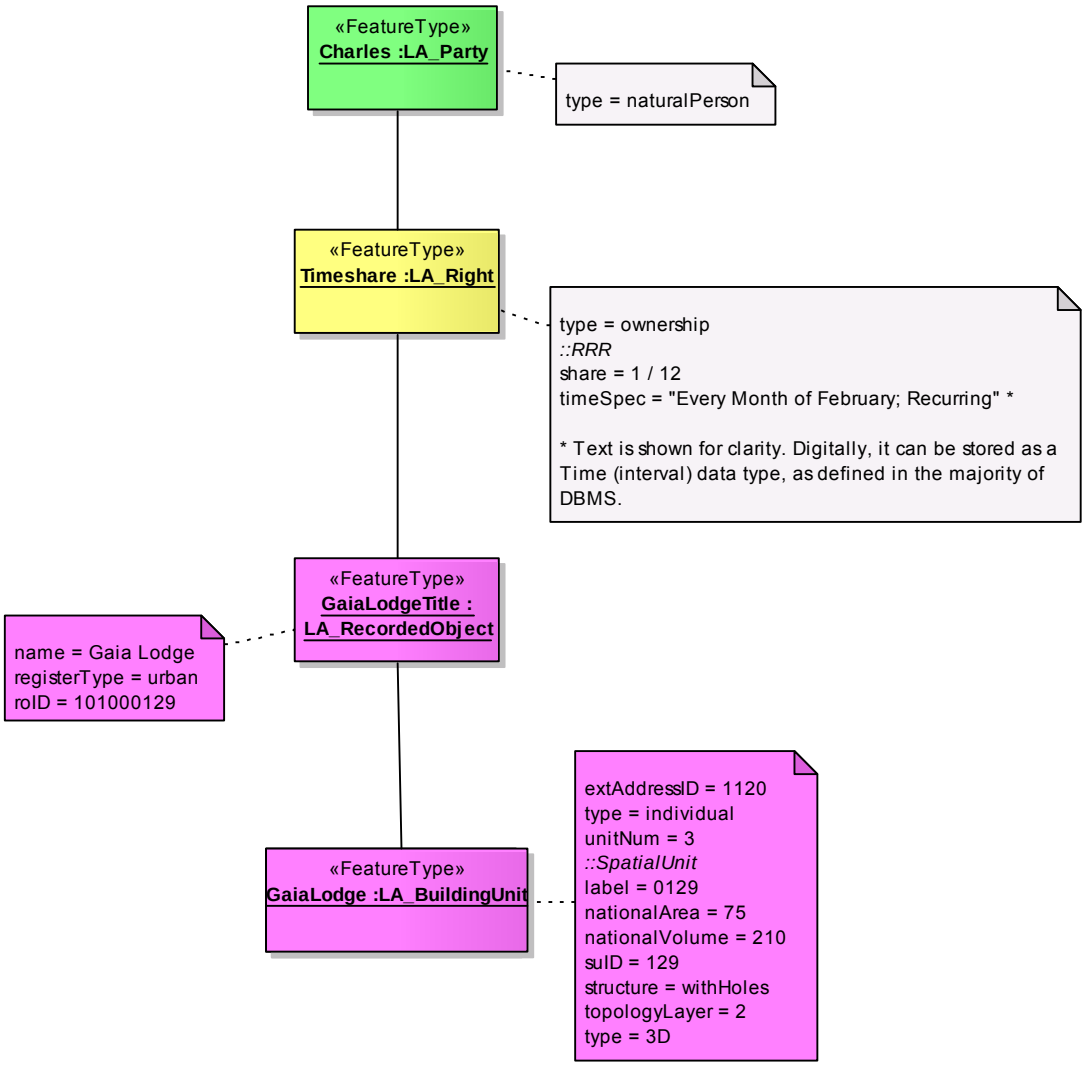
Case 6

object AnnexC Case08

Object Diagram, Case 08 - Timeshare Rights (Formal Rights)

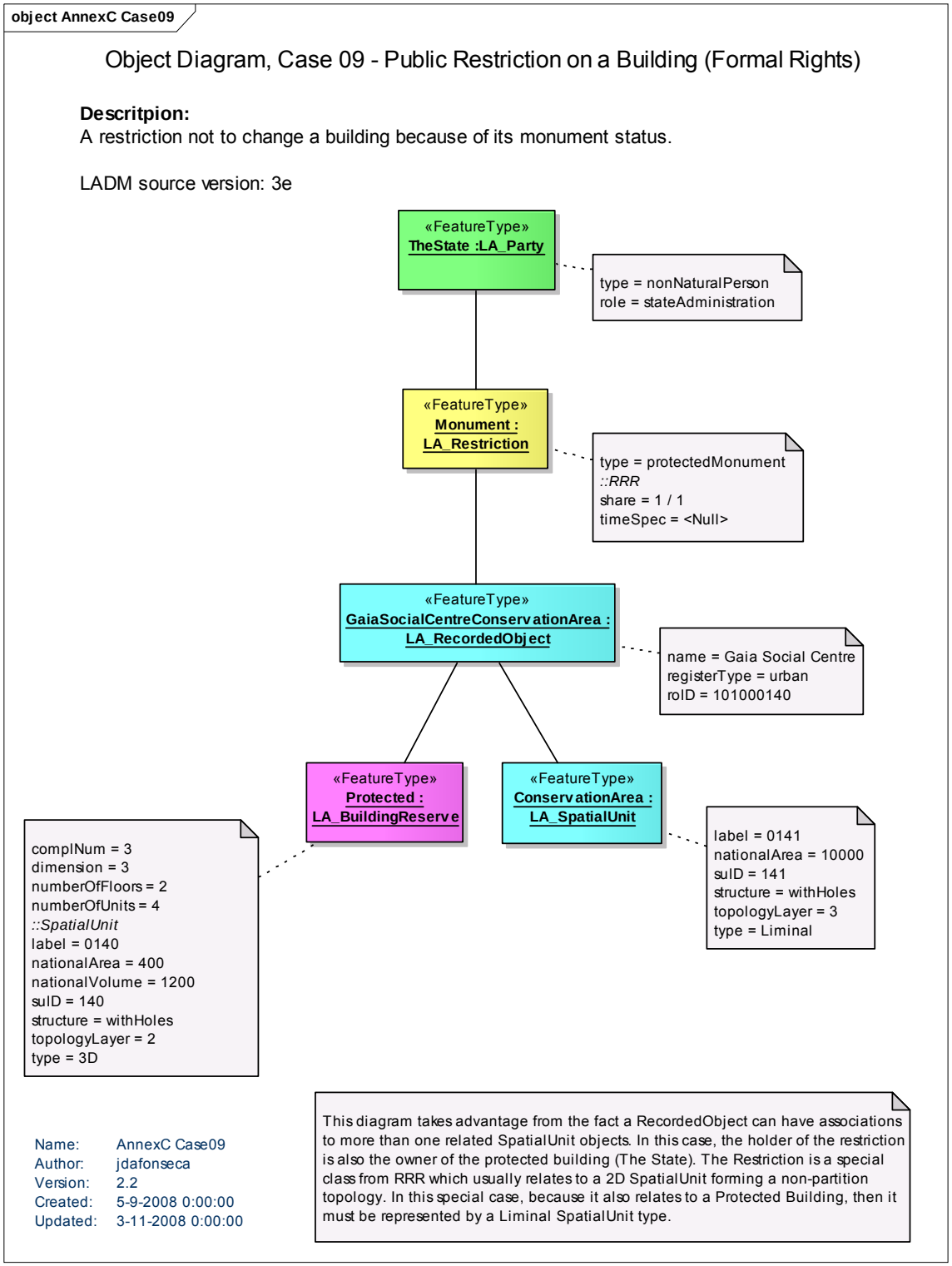
Description:
A timeshare ownership for the month of February.

LADM source version: 3e



Name: AnnexC Case08
Author: jdafonseca
Version: 2.2
Created: 5-9-2008 0:00:00
Updated: 3-11-2008 0:00:00

Case 8



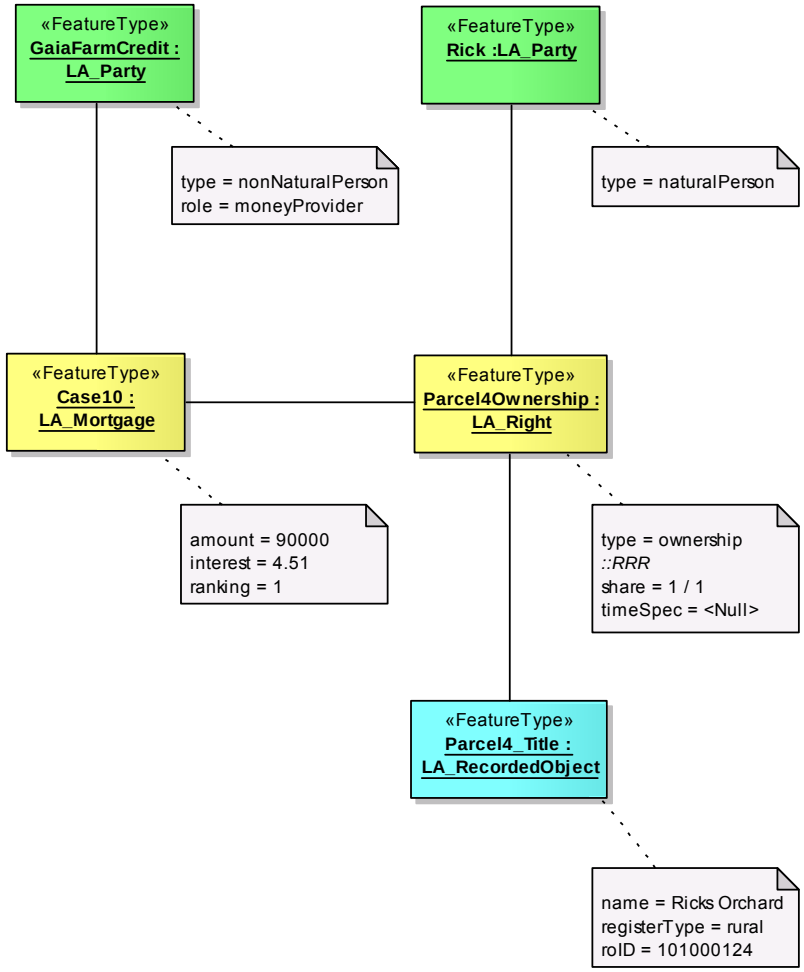
Case 9

object AnnexC Case10

Object Diagram, Case 10 - Mortgage on Ownership (Formal Rights)

Description:
Mortgage on ownership, Bank incuded as Person.

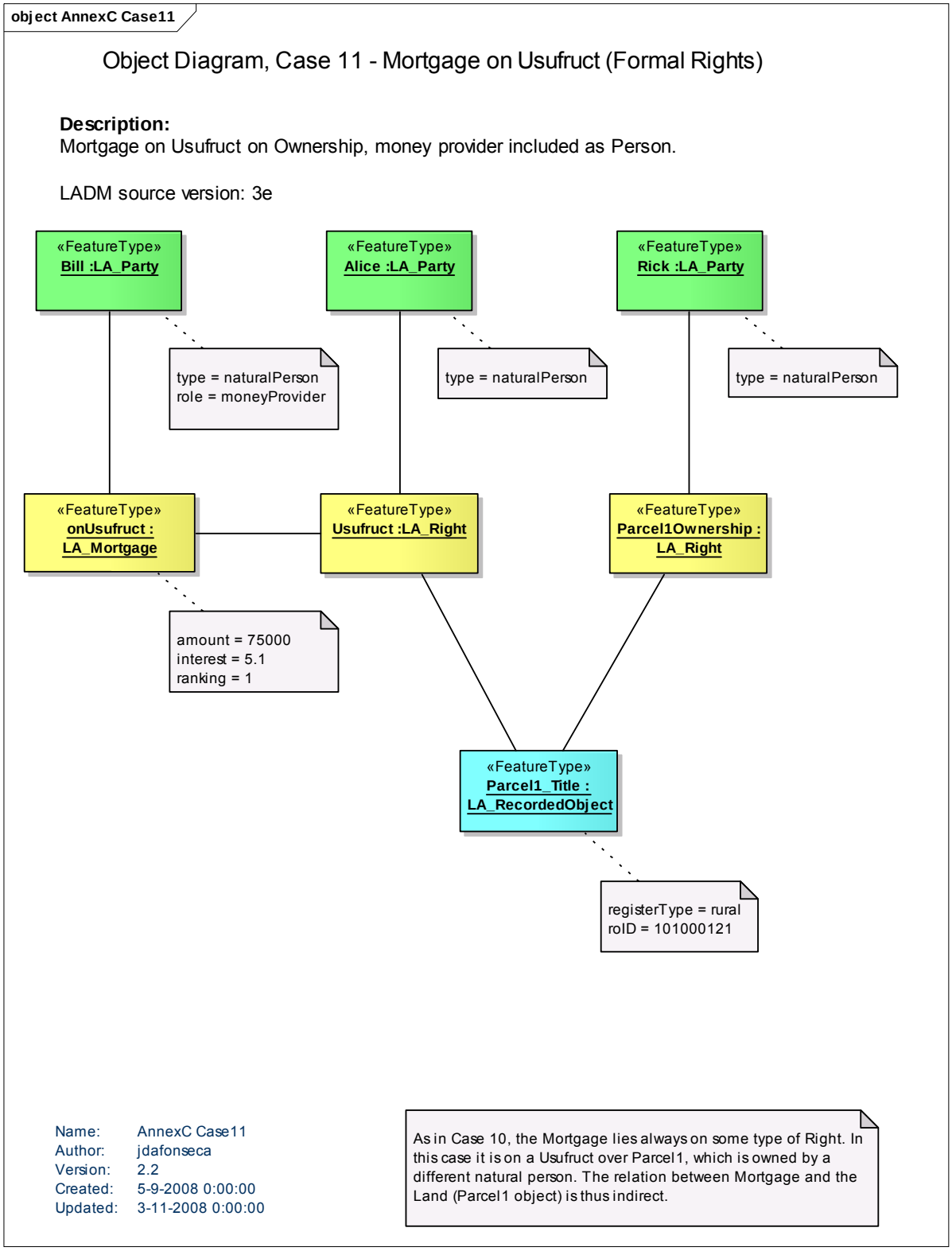
LADM source version: 3e



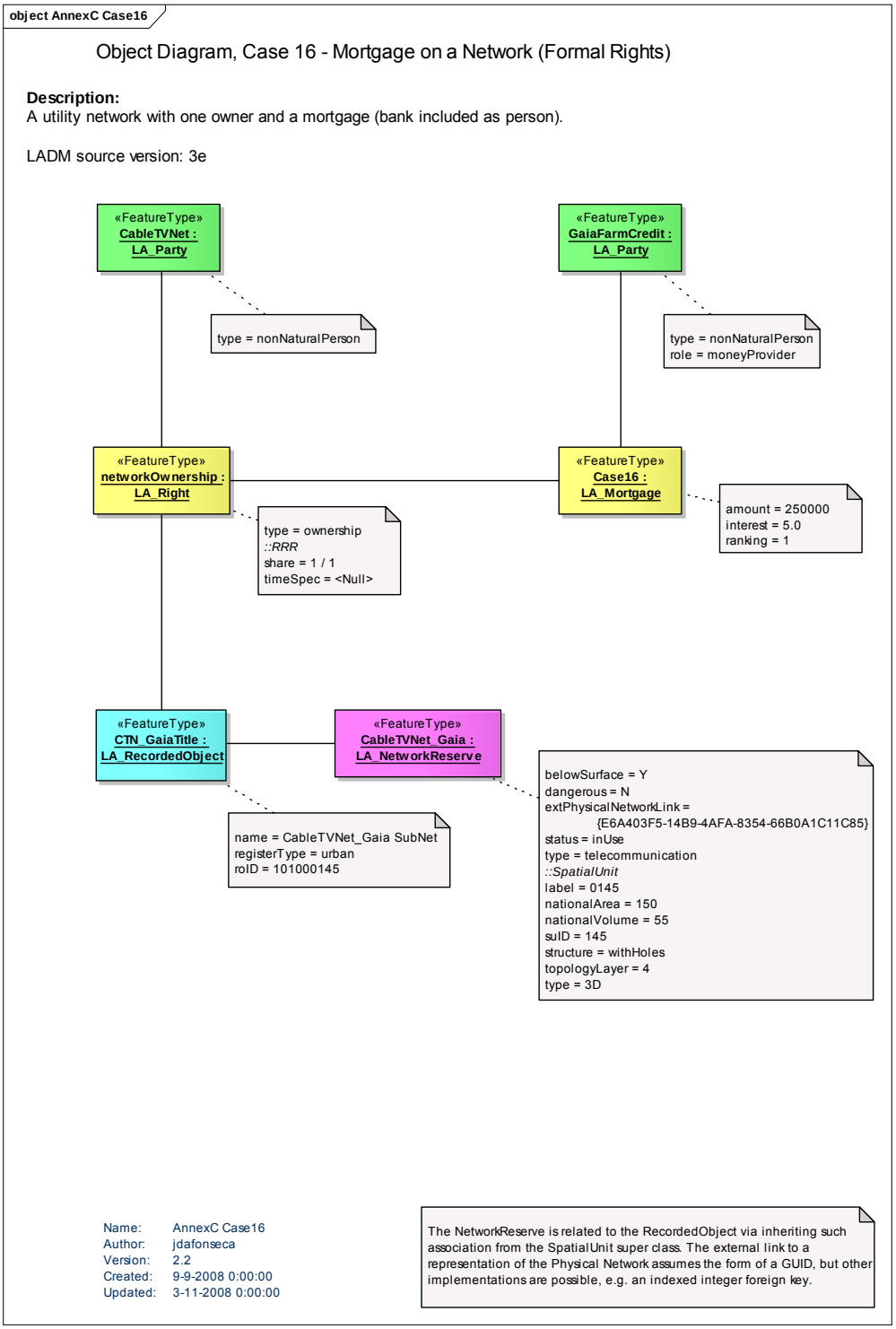
Name: AnnexC Case10
Author: jdafonseca
Version: 2.2
Created: 5-9-2008 0:00:00
Updated: 3-11-2008 0:00:00

The Party role related to the Mortgage supplies a mean to constraint the association between these objects, which can be enforced by using a OCL constraint on the Mortgage class.

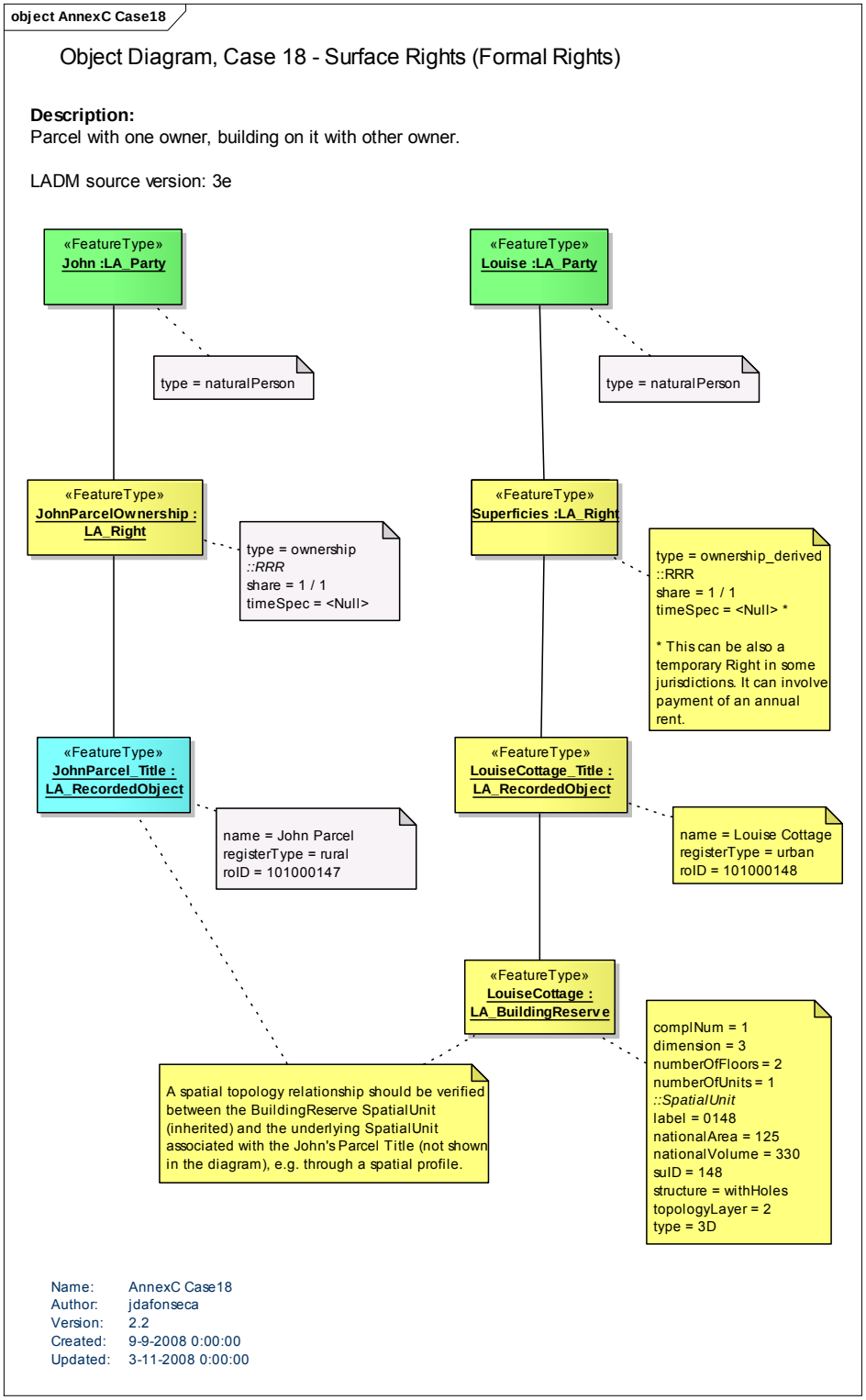
Case 10



Case 11



Case 16



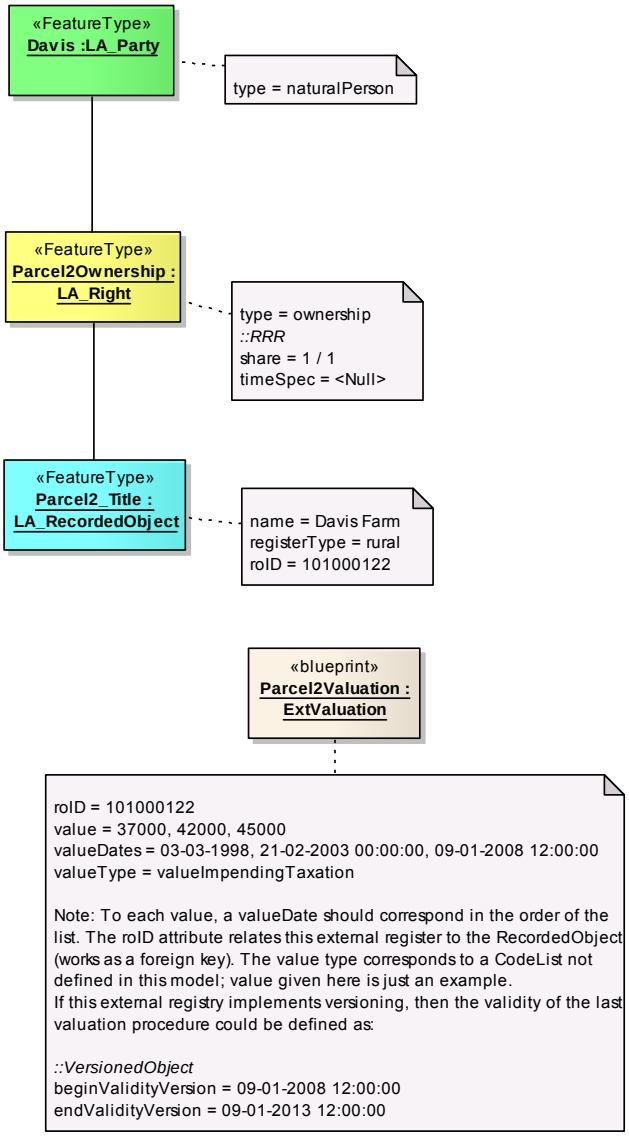
Case 18

object AnnexC Case20

Object Diagram, Case 20 - Land Tax Validity (Fiscal Role)

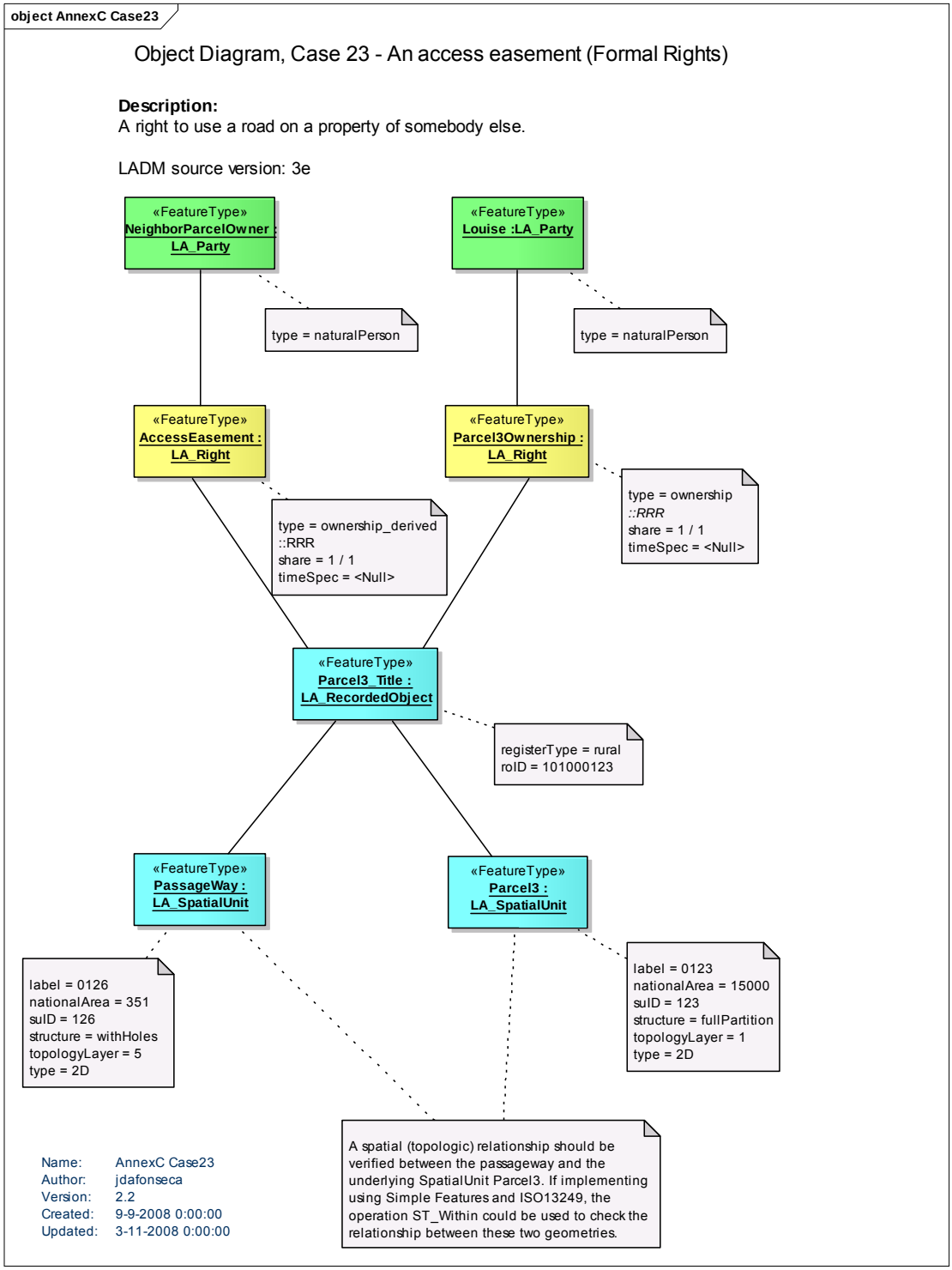
Description:
Value as basis for taxation valid for five years.

LADM source version: 3e



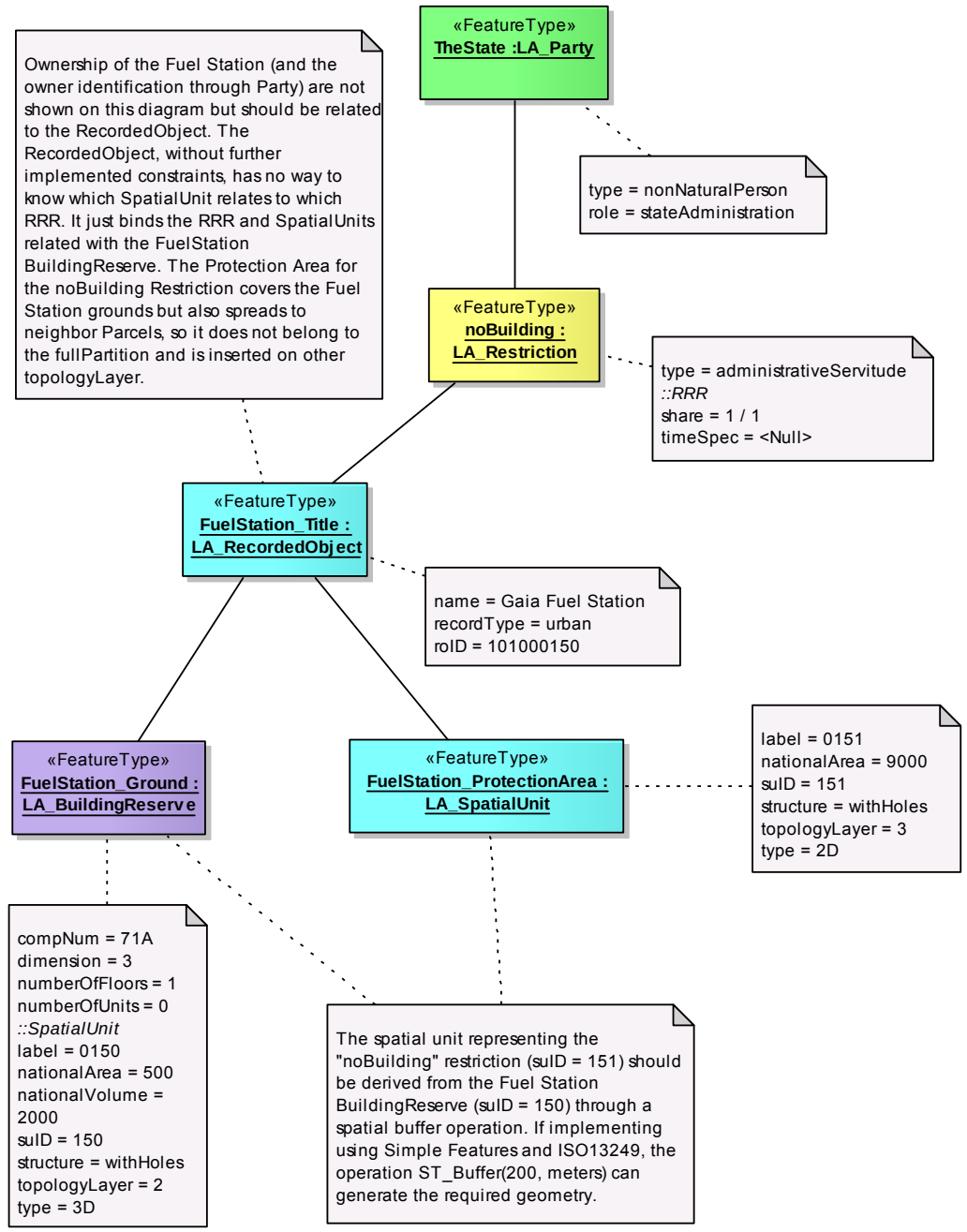
Name: AnnexC Case20
Author: jdafonseca
Version: 2.2
Created: 9-9-2008 0:00:00
Updated: 3-11-2008 0:00:00

Case 20



Case 23

LADM source version: 3e



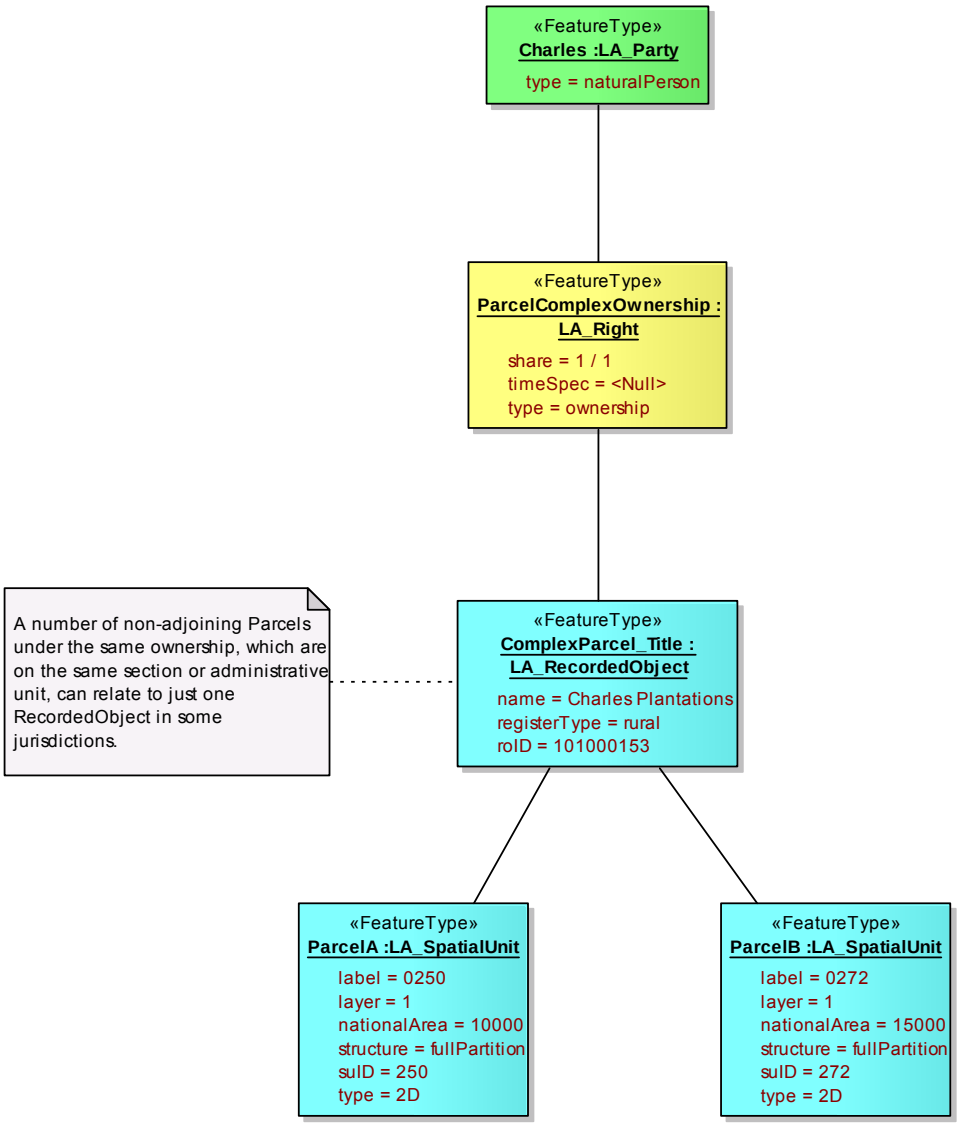
Case 24

object AnnexC Case25

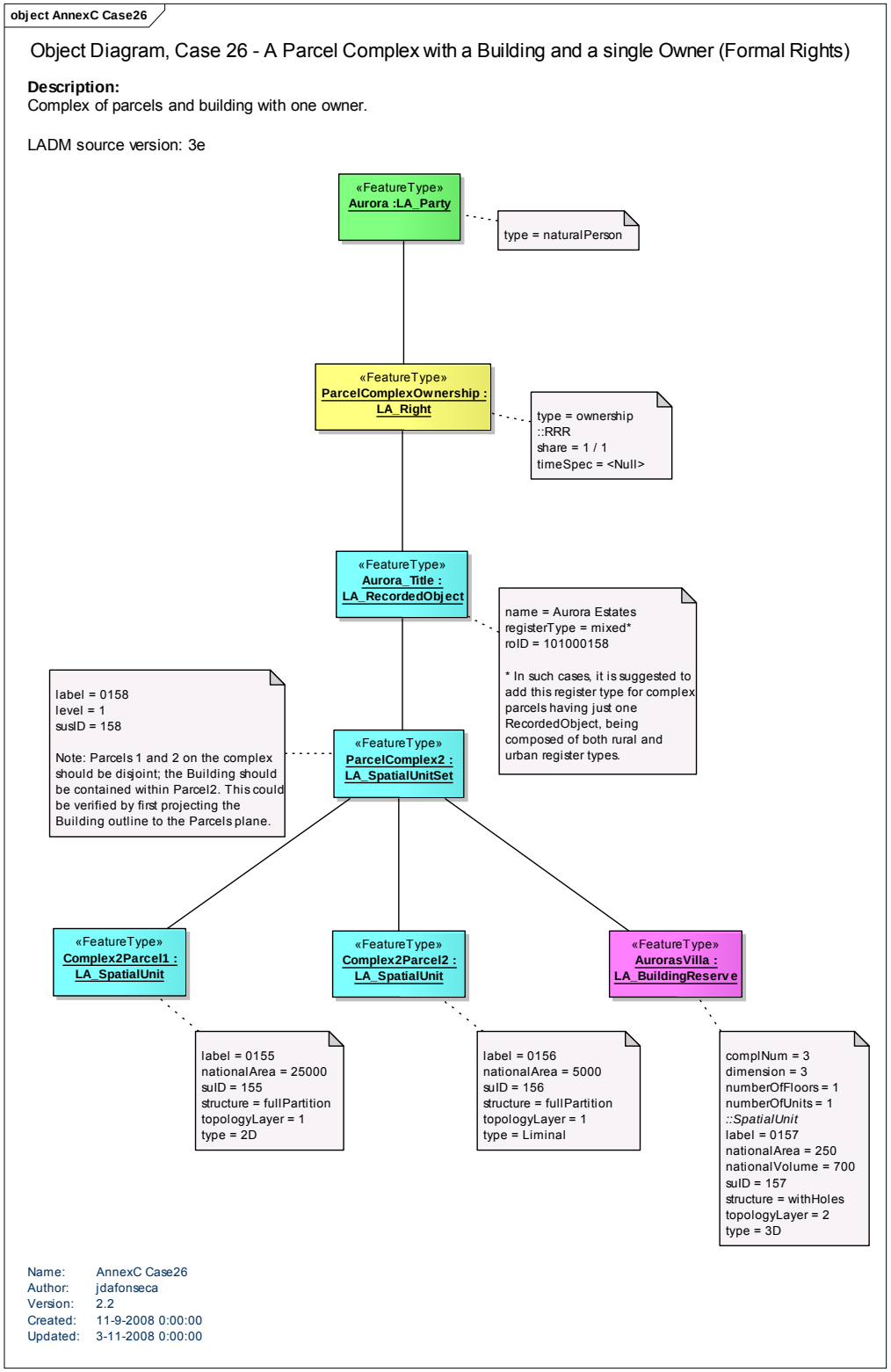
Object Diagram, Case 25 - A Parcel Set with a single Owner (Formal Rights)

Description:
Parcel complex with one owner.

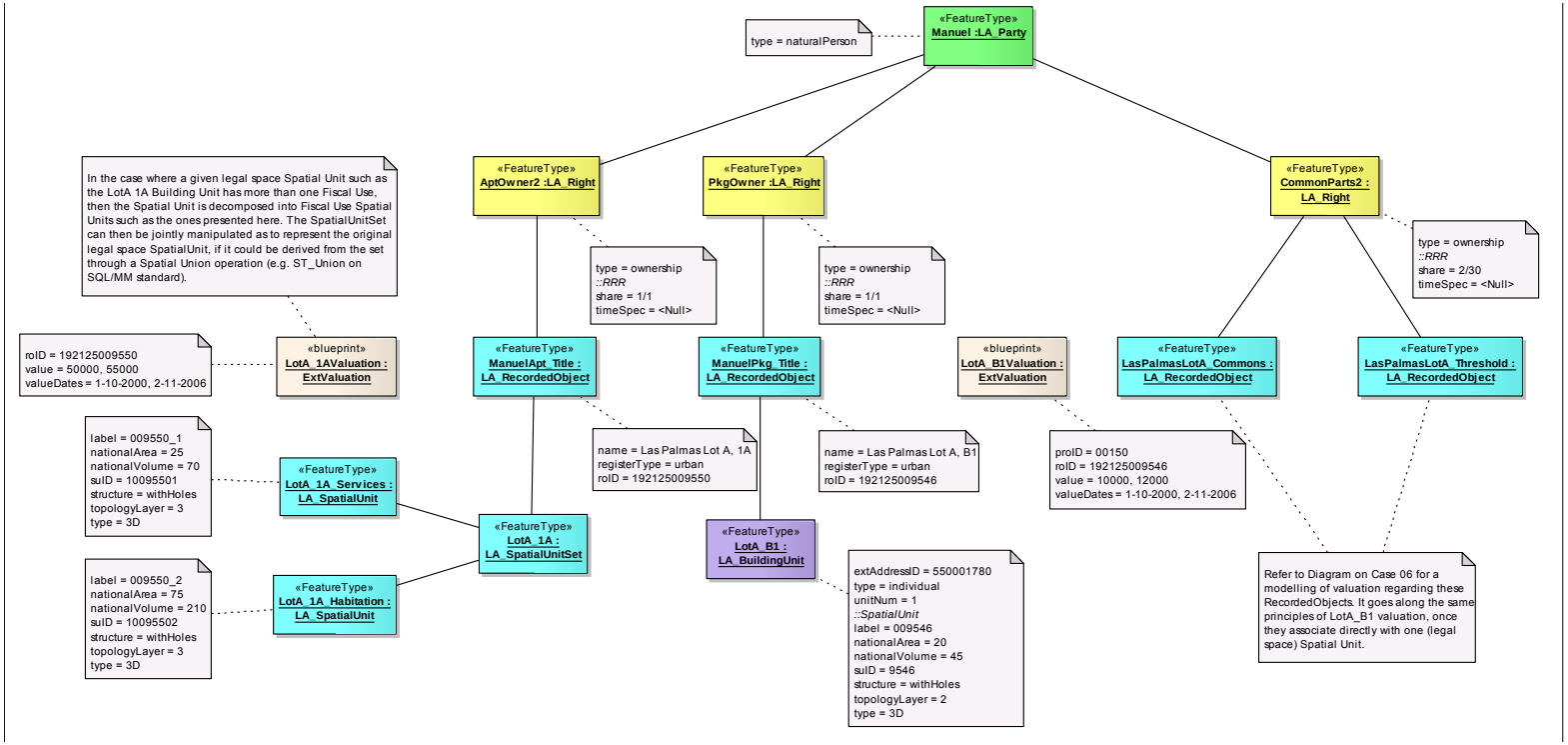
LADM source version: 3e



Case 25

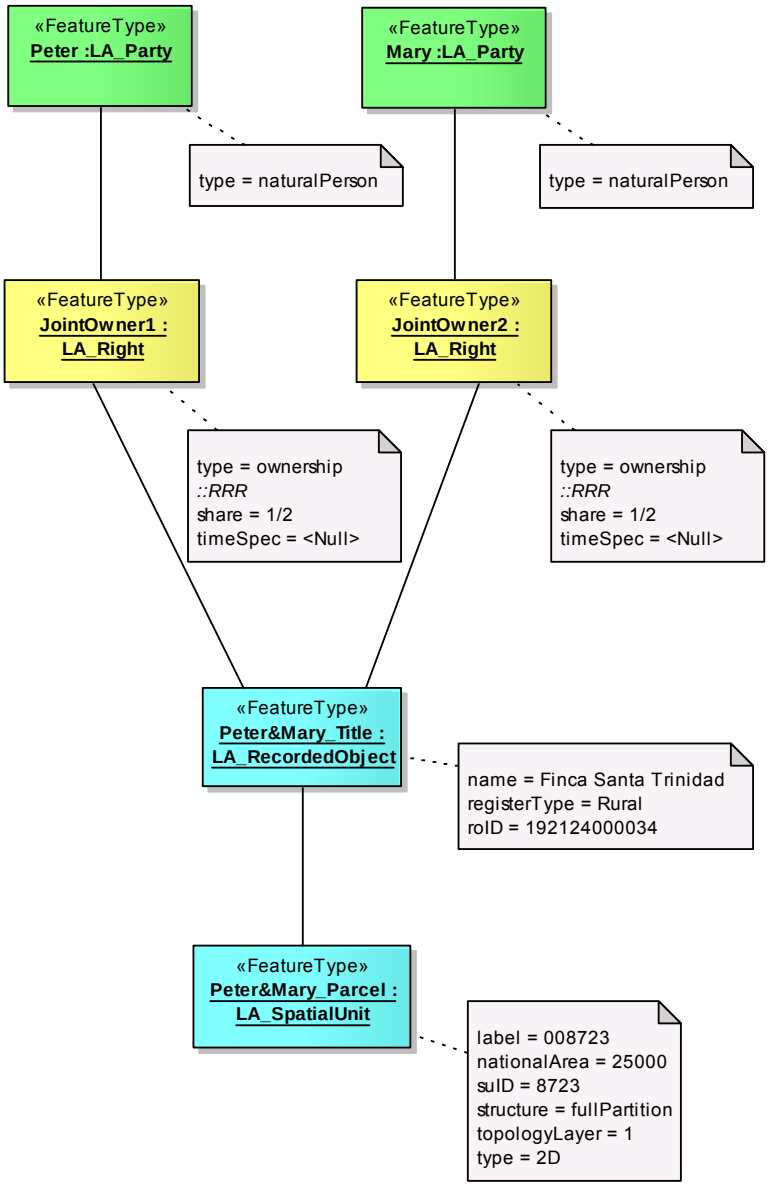


Case 26

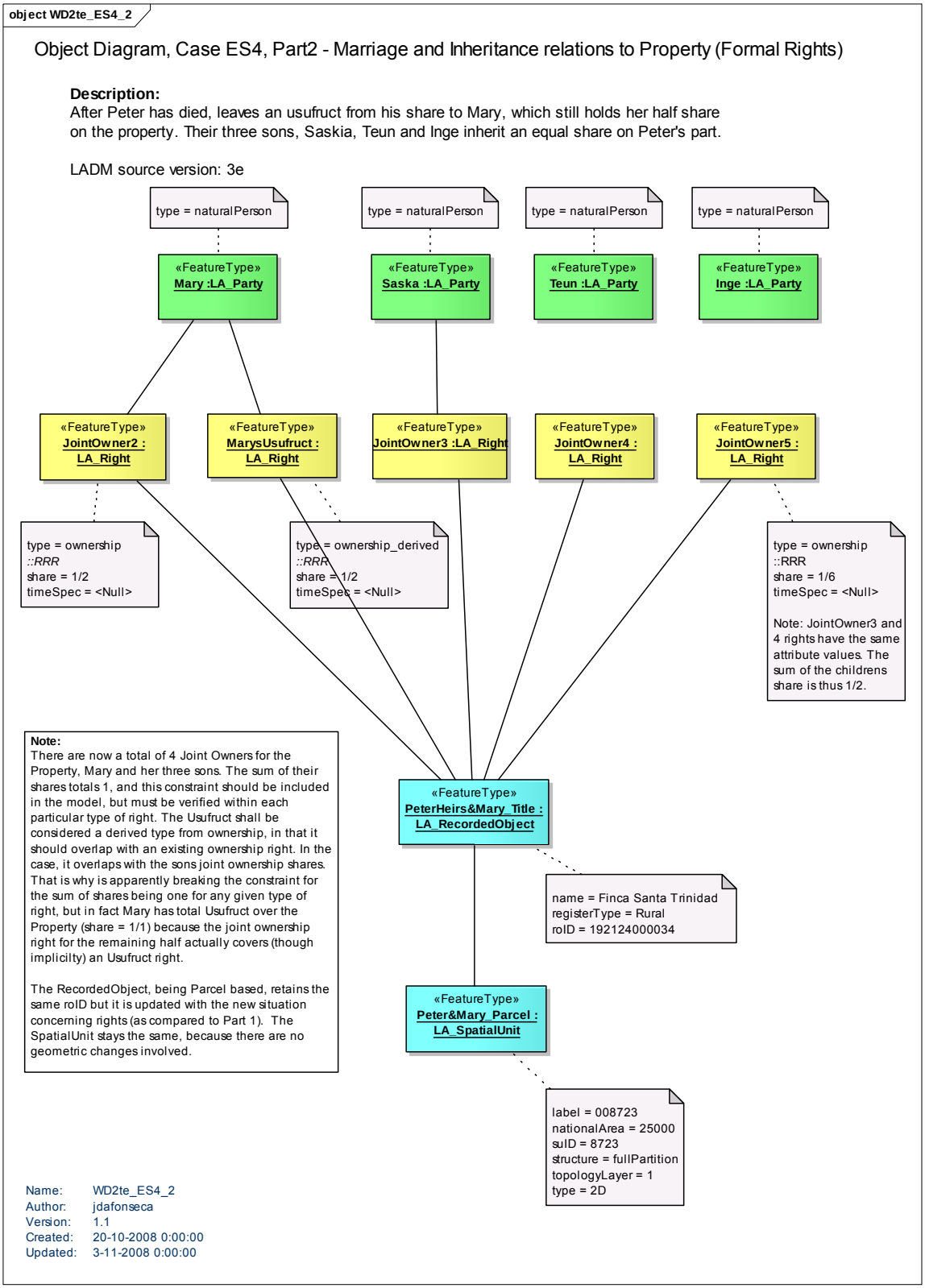


Case 30. Tax valuations on condominium rights in Spain

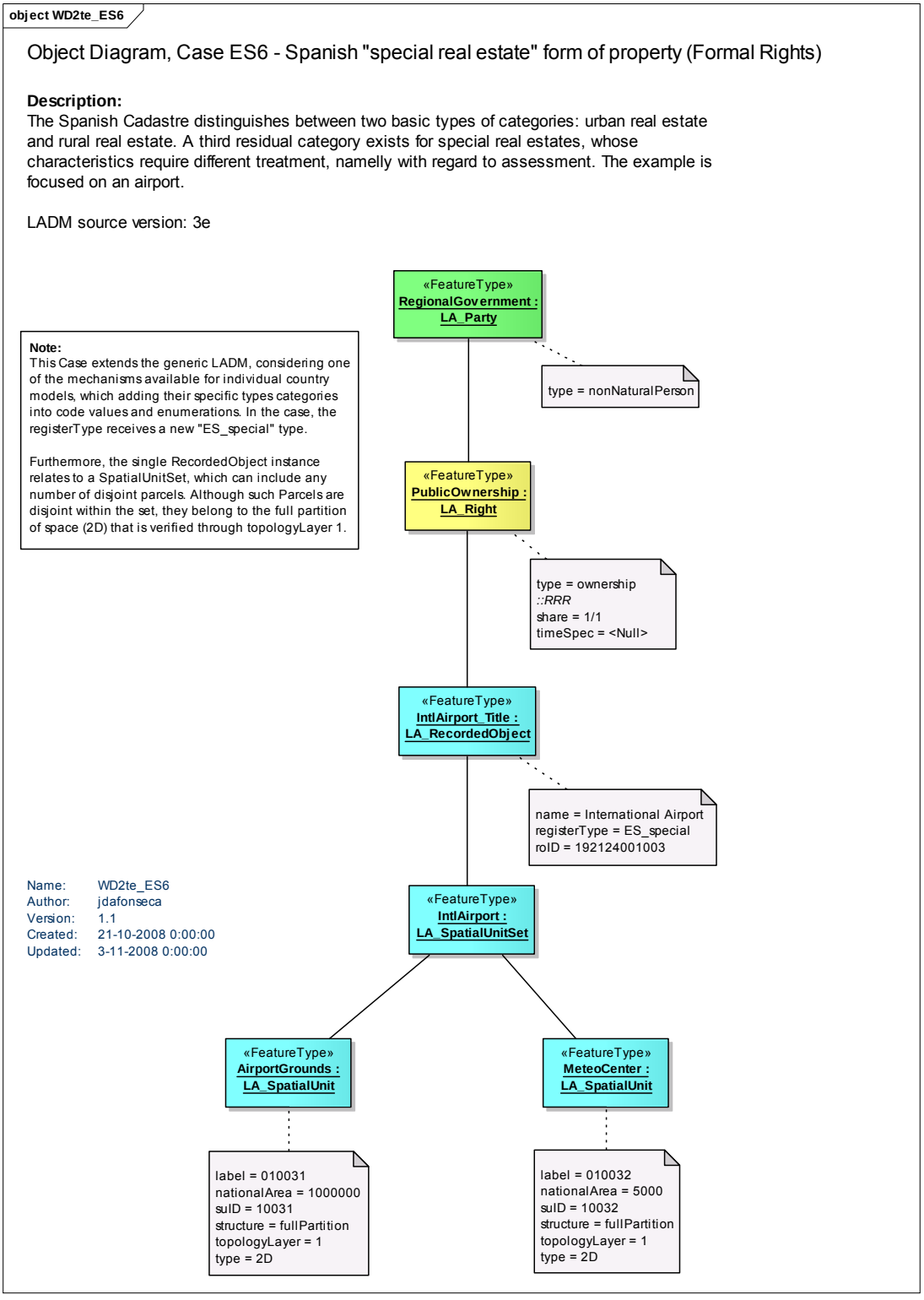
LADM source version: 3e



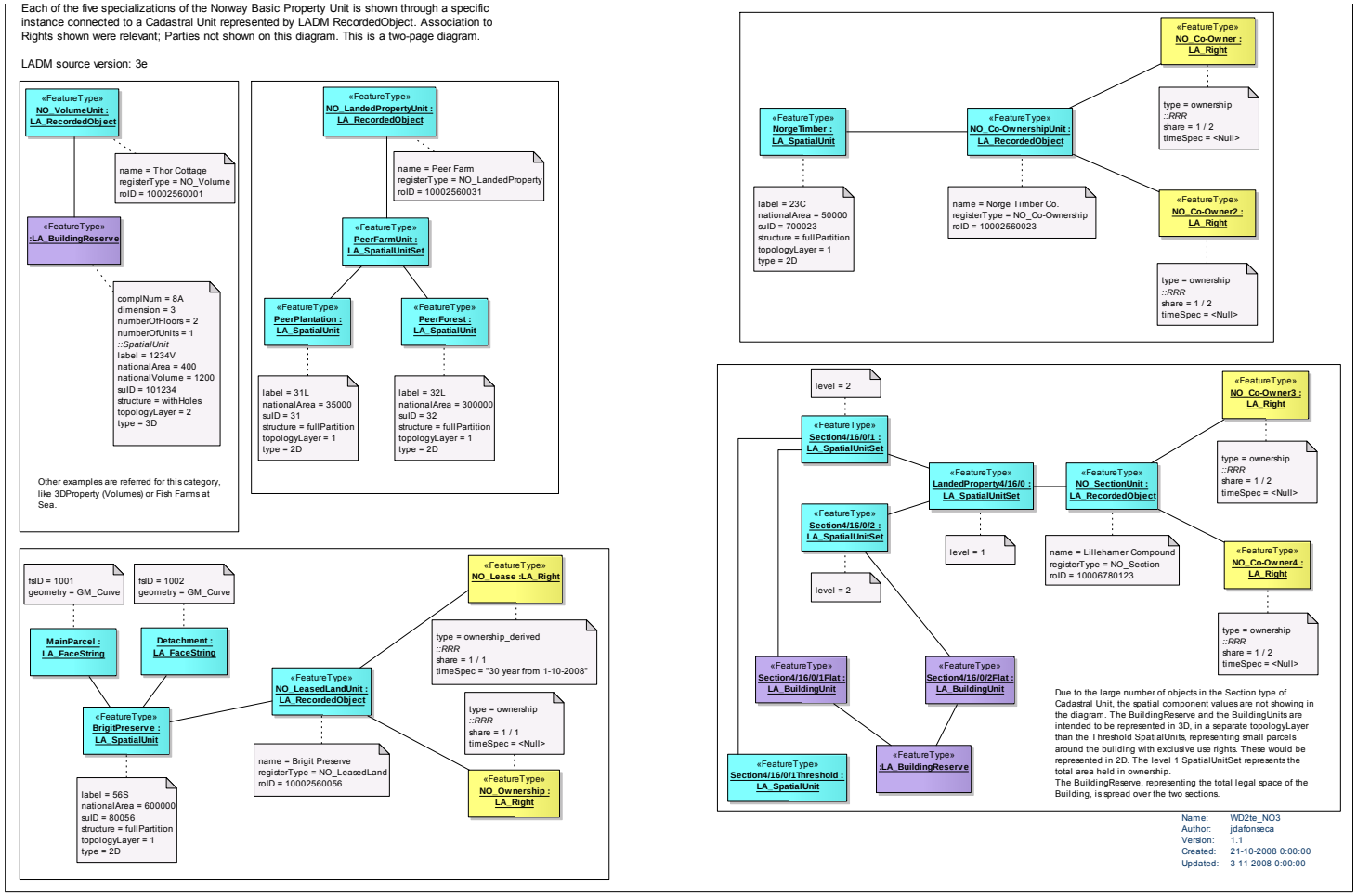
Case 31. Marriage and inheritance relationships to property (simple) in Spain



Case 32. Marriage and inheritance relationships to property (complex) in Spain



Case 33. Spanish '*real estate*' form of property



Case 34. Norwegian categories of basic properties

Annex D. Country examples

(informative)

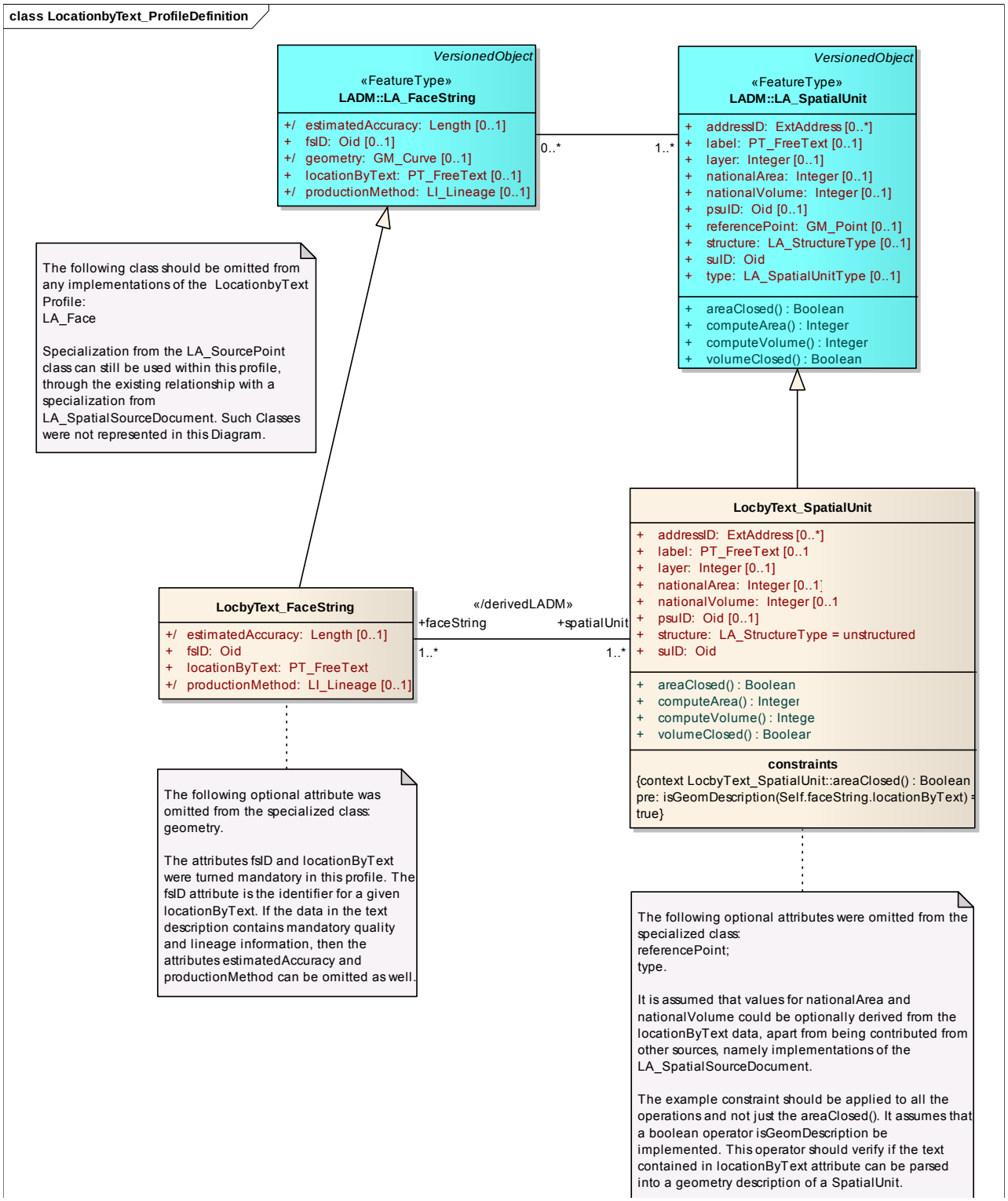
Under construction, possible candidates are Portugal, Canada, Korea, …

Annex E. Spatial Profiles

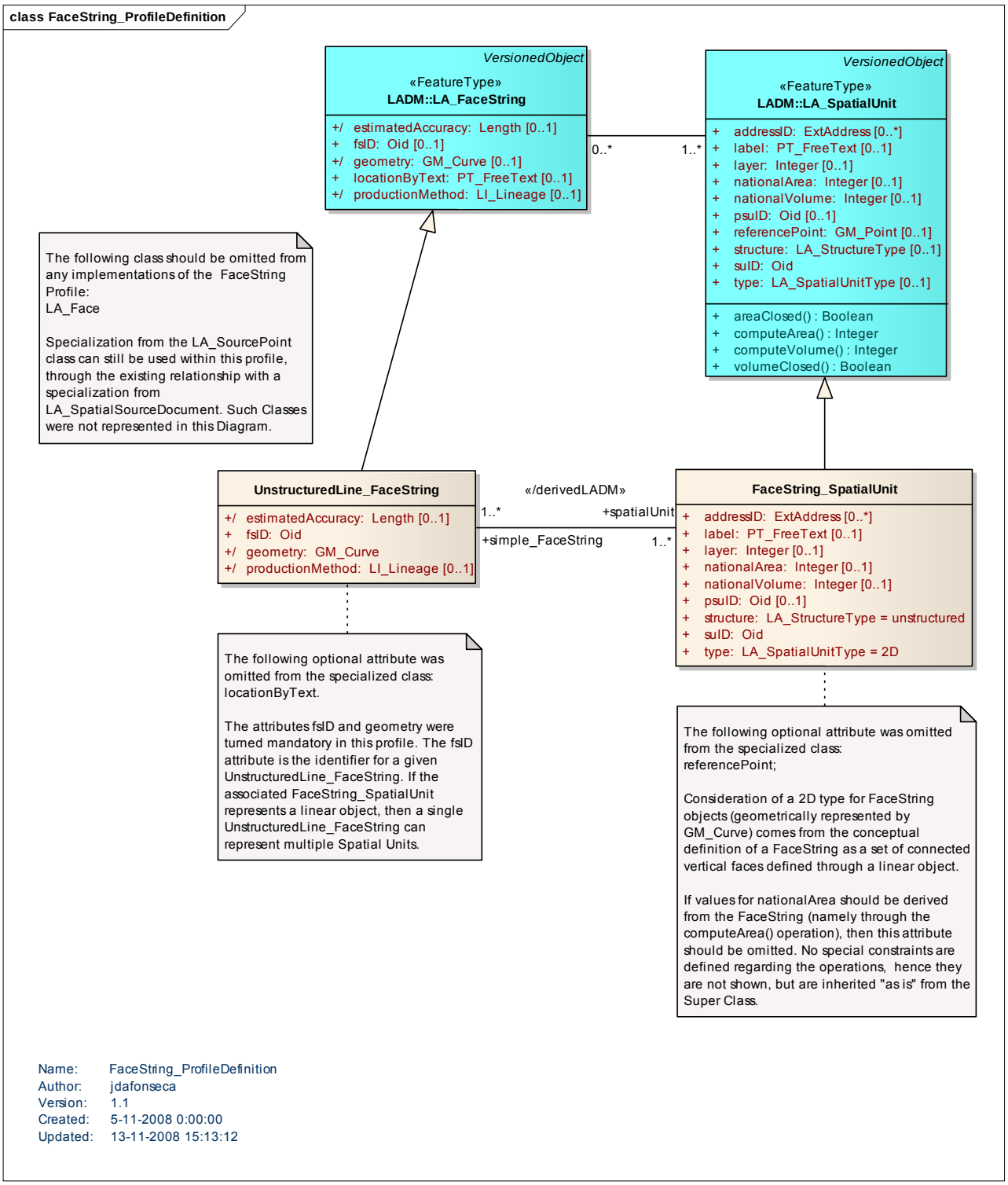
(informative)

The Spatial Representation package of the LADM allows a large number of possible representations of spatial units in 2D or 3D (or mixed). For one specific type of spatial representation, there are often just a limited number of classes and attributes needed. This annex shows per spatial profile the needed classes and attributes. The 3D cases also cover mixed 2D and 3D configuration. Further, in a specific country profile it is possible to combine several spatial profiles; e.g. parcels with 2D topology based spatial units and building reserves with 2D polygons.

- 2D Point based (under construction)
- 2D Text based (profile 2)
- 2D Unstructured (Line) based (profile 3)
- 2D Polygon based (under construction)
- 2D Topological based (under construction)
- 3D Point based (under construction)
- 3D Text based (under construction)
- 3D Unstructured (Surface) based (under construction)
- 3D Polyhedron based (under construction)
- 3D Topological based (under construction)



Profile 2. 2D Text based



Profile 3. 2D Unstructured (Line) based

Annex F. LADM and LPIS

(informative)

1 The integration of LADM with Land Parcel Identification Systems (LPIS)

One of the aspects of the Common Agricultural Policy (CAP) of the European Union is to focus on the management of subsidies to the farmers. For this purpose, member states have established an Integrated Administration and Control System (IACS), including a Land Parcel Identification System (LPIS) as the spatial component of IACS. The LPIS as a concept was developed already in 1992, when the need for identification of the agriculture parcels to support IACS emerged. At that time, the data model was purely alphanumerical without any geospatial reference. It was in the Council Reg. No 1593 (2000) that the spatial LPIS based on Geographic Information System (GIS) was promoted. Five years have been given to the member states to establish LPIS in digital and geo-referenced format. Thus, the first year of operational GIS-based LPIS was 2005. Although the regulatory requirements were unique across the sector, the particular implementations were a subject of the member states. In fact, during the development stages of different LPISs in different member states, the use of Land Administration (LA, or Cadastre) data, as well as large scale topography data, were on the agenda for a considerable while (UN/ECE,1996). In the following example a data model is designed that implies the collaboration or integration of LADM and LPIS. The standardization initiative in the area of LPIS (Sagris and Devos, 2008) by the Joint Research Centre (JRC) of the European Commission is used in this example in order to represent potentials for integration/collaboration between LADM and LPIS.

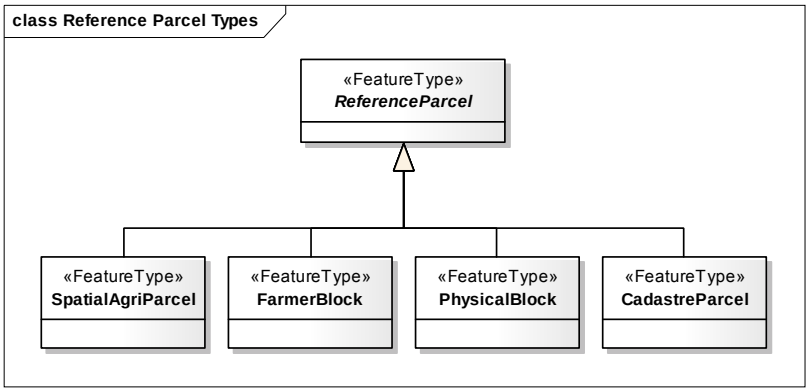


Figure 7. Reference parcel types.

A declared agricultural parcel is a key concept applied in relation to area-based payments, which determines the subject of the aid application, geographic location and extent (area) of agricultural activity. The declared agricultural parcel is a subject of the payment calculation as well as for administrative control. Due to the dynamic nature of agricultural activities, declared agricultural parcel can be unstable over time and space (crop rotation, out of use, aggregation or subdivision of fields, different extent of use, conditions for eligibility for payments etc.). Therefore, the reference parcel (RP) is used as basic unit of LPIS for purpose of identification of the declared agricultural parcels where one RP can contain 1..* declared agricultural parcels. The EU regulations specify that reference parcel can be either cadastral parcel or production block (see Figure 7). In the end some member states decided to build their systems as close to declared agricultural practice as it possible and use reference unit which contains only one spatial agricultural parcel.

The main difficulties of Cadastral parcel as reference for subsidies' application are that a part from other systems (i) it contains non-agricultural land, so area eligible for payment can not directly determined, and (ii) that boundaries of agricultural activity are out of LA scope and their maintenance via cadastral update cycle is very complicated. Therefore in section 2 the concept of SubParcel is introduced, which plays the role of a reference parcel (and as glue between LADM and IACS/LPIS).

2 A Data Model for the Integration of LADM and LPIS

In the UML class diagrams, current LADM classes are used with or without small changes in their attributes or they are extended with new classes, and IACS/LPIS classes are shown in a single colour (grey).

2.1 Basics of LPIS Core Model (LCM)

LPIS Core Model (LCM) has been developed by the Agriculture unit of the EC Joint Research Center (JRC). The intention with this model is extract general classes from functional LPIS system and test them for conformance with the EU Regulations; therefore model does not cover every aspect of the LPIS. MS experts could extend the boundaries of the LCM to fit for particular needs of national implementations. Figure 8 represents the logical business model of the main concepts of the LCM. All basic concepts are represented as classes.

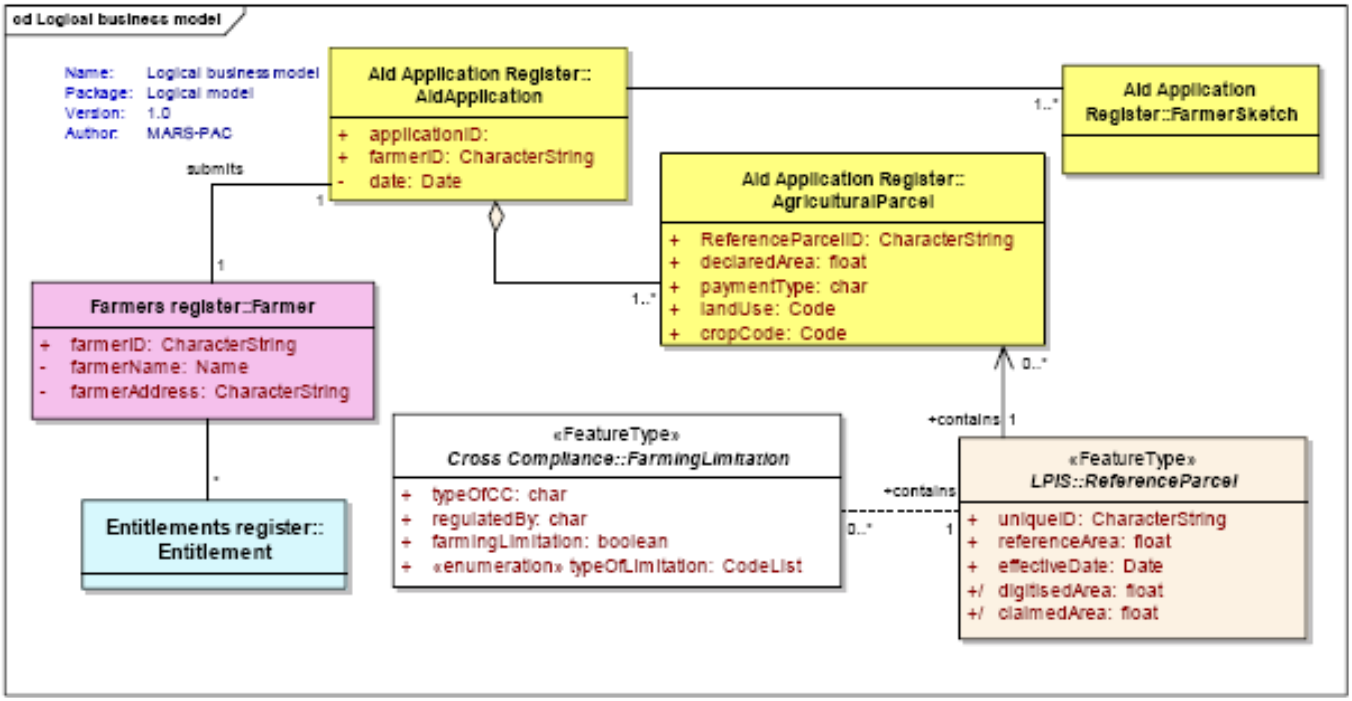


Figure 8. The Core (classes) of the LCM

2.2 Integration of LCM and LADM Basic Classes

2.2.1 Spatial Classes

The class LA_SpatialUnit is one of the core classes of LADM. LADM also provides the functionality of grouping the LA_SpatialUnits with the class LA_RecordedObject through which the legal facts (right, restrictions, responsibilities in LA_RRR) are attached. The specialized classes of LA_SpatialUnit are outside of the scope of cadastral parcel (LA_BuildingReserve, LA_BuildingUnit, LA_NetworkReserve) as is the hierarchical grouping in LA_SpatialUnitSets (sections, municipalities, etc.); see Figure 9. For a meaningful, comparable and standardized classification of land, at least for the case of cadastral parcels as reference parcel, SubParcel class is designed as a part of cadastral parcels in the model. SubParcel has composition association with LA_RecoredObject. In the SubParcel class, the attribute typeSubParcel is designed to store different types of SubParcel. These are defined in the code list SubParcelType (Figure 9). One important consideration is that the boundaries of the defined classes should be stable over time. Otherwise, the update and maintenance procedures will definitely be a burden.

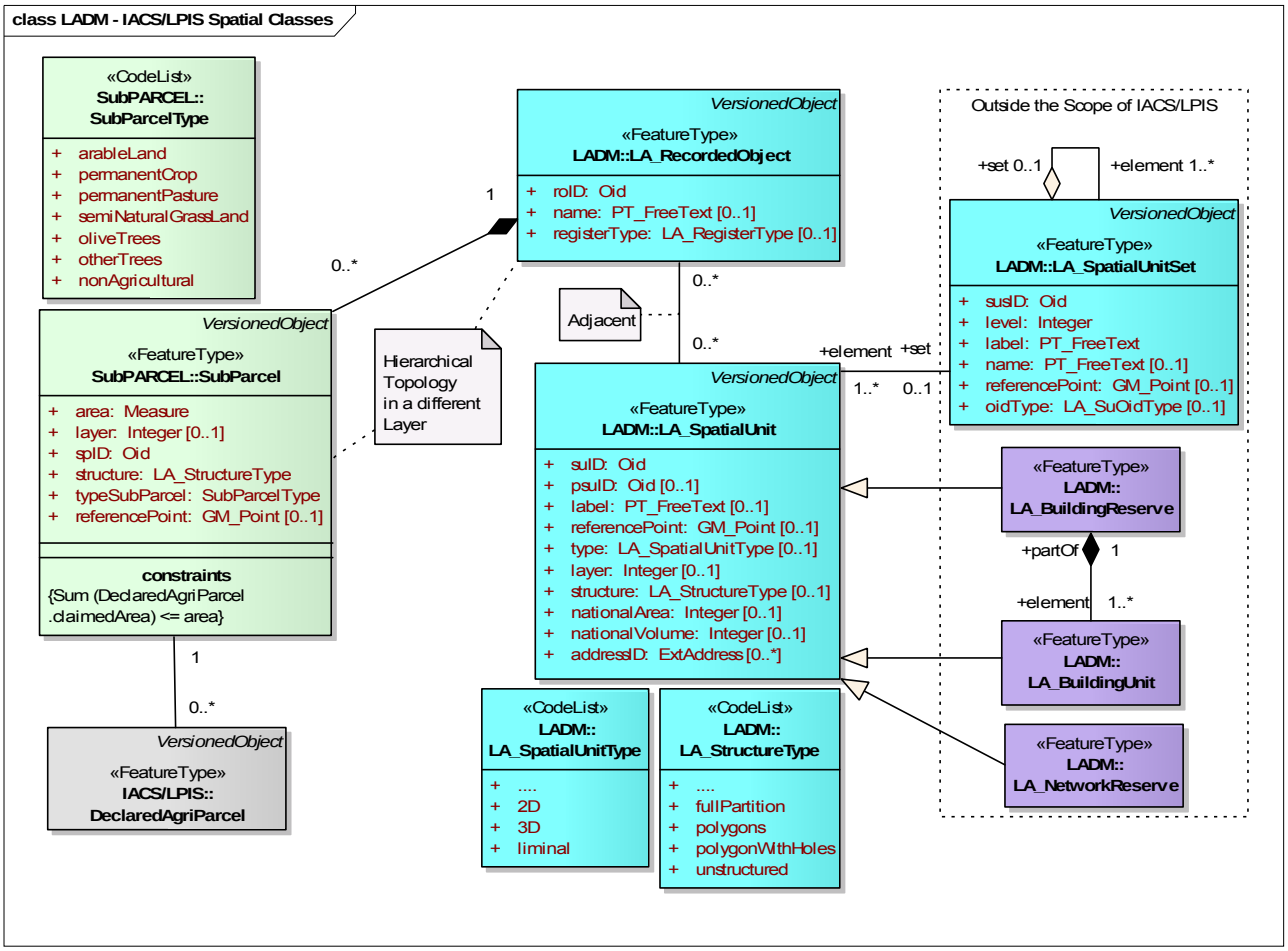


Figure 9. Spatial classes for LADM – IACS/LPIS collaboration

2.2.2 Administrative Classes

LA_Party (person), Farmer, Right/Restriction/Responsibility (LA_RRR), YearlyAidApplication, YearlyFarmerSketch, DeclaredAgriParcel are the basic classes designed to manage administrative data in the model (Figure 10). LA_Party and LA_RRR are two core classes coming from the LADM. Other classes are designed for the representation of LPIS administrative data.

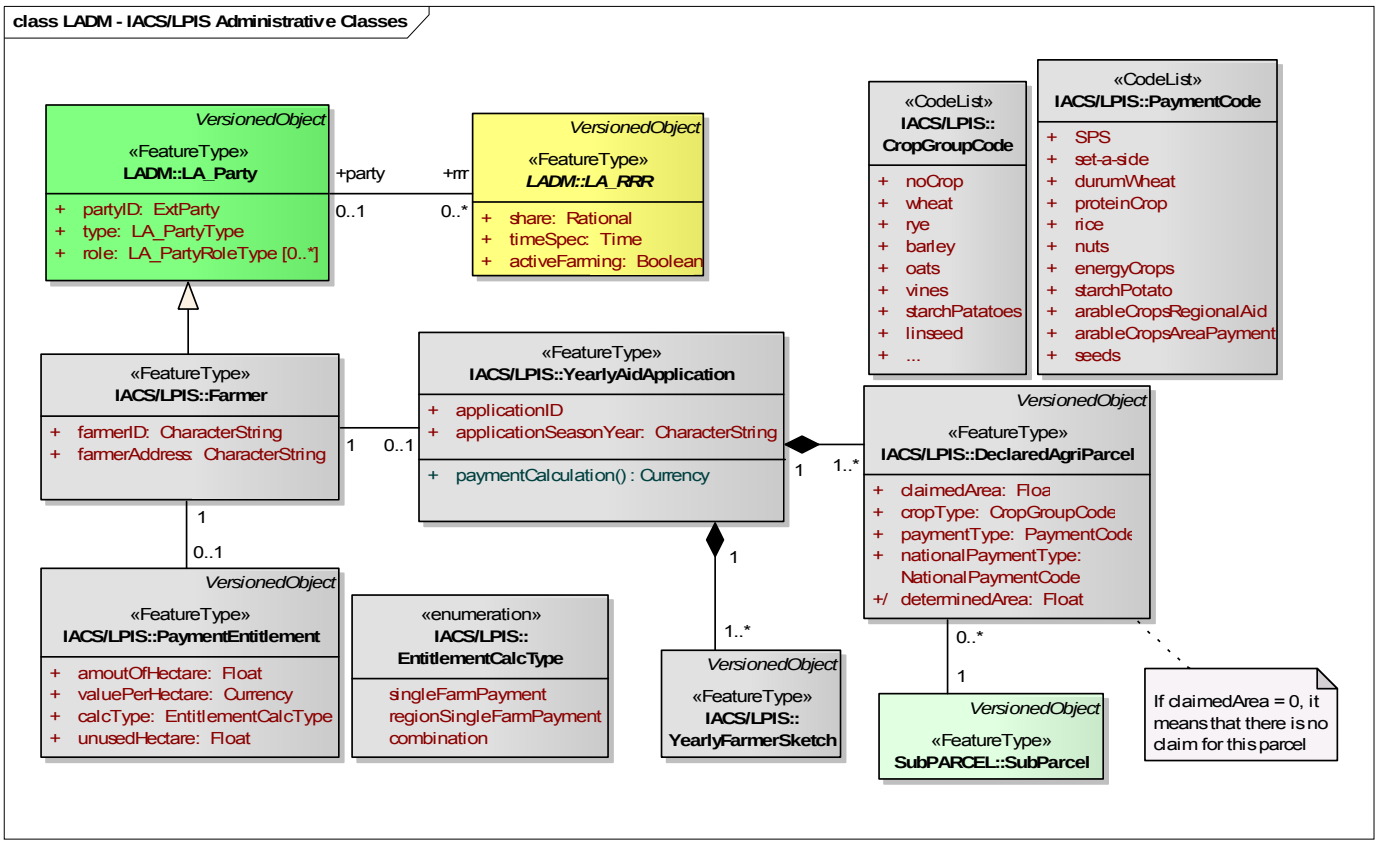


Figure10. Administrative classes for LADM – LPIS integration

Farmer class is designed as a specialization of LA_Party class in order to handle the attributes specific to farmers. Farmers may apply for agricultural subsidies every year. To handle the application information of farmers, YearlyAidApplication class is designed. Farmers have to have some payment entitlement rights to be able to get aid as a result of the application. Aid applications submitted by farmers must be accompanied by farmer declarations which describe each piece of land used by farmer for agricultural activities and farmers' sketch. Therefore there are two corresponding classes (DeclaredArgiParcel and YearlyFarmerSketch) composing the YearlyAidApplication (a LA_SourceDocument) in the model. To represent their entitlement rights, PaymentEntitlement class is introduced in the model. In the skech which farmers must provide together with their applications, they indicate the boundaries of their agricultural parcels. They may use one single agricultural parcel or many of them. They may draw the boundaries of their land in separate sketches for each piece of land. Some grouping is also possible depending on their location and the scale of the sketch. Aid applications submitted by farmers must be accompanied by farmer declarations which describe each piece of land used by farmer for agricultural activities. These declarations are subject to agricultural subsidies after some control processes are carried out. Farmer declarations are represented by DeclaredAgriParcel in the model. It is designed as a part of YearlyAidApplication class because this class can not be without any aid application.

3 Special Issues for the Integration of LADM and LPIS

Farmer is defined in article two of the Regulation EC No 1782/2003 as a natural or legal person or a group of natural or legal persons. This definition of person can be represented by LA_Party classes designed for LADM. In Figure 11, the classes in green are LADM person classes. LA_Party is the main class which represents natural person and non natural person, and also groups of natural and non natural persons via LA_GroupPerson class. So, LADM person classes have the functionality of representing farmers as all kinds of persons. However, a new class Farmer is designed to represent the attributes which are specific only to farmers. Currently in the model, only two specific attributes. One is farmerID which indicates that the person is a farmer. The other is farmerAddress which includes up-to-date address information.

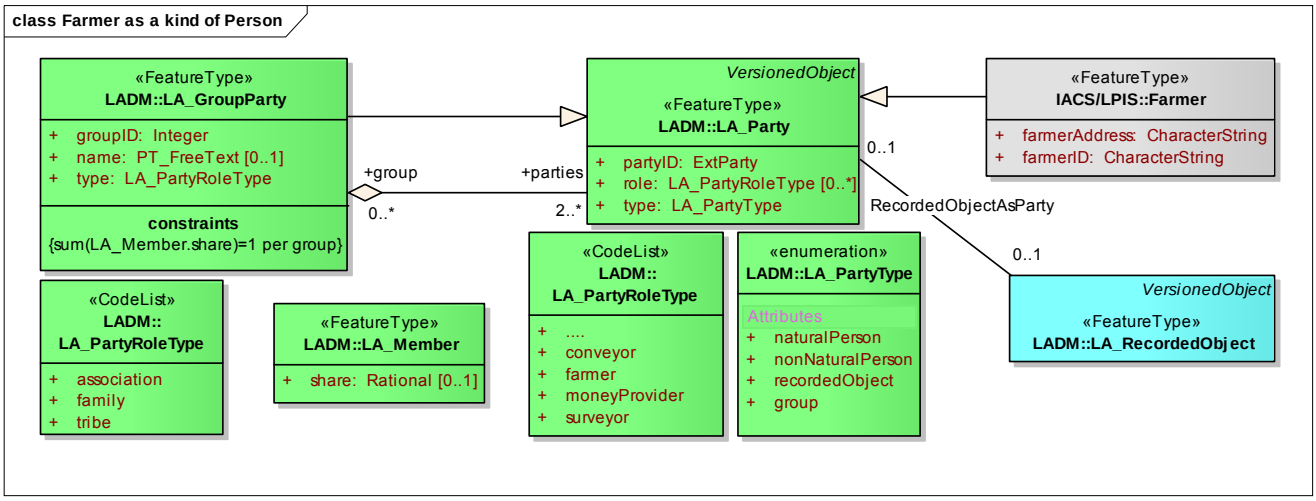


Figure 11. Person classes: LA_Party, LA_GroupPerson and Farmer

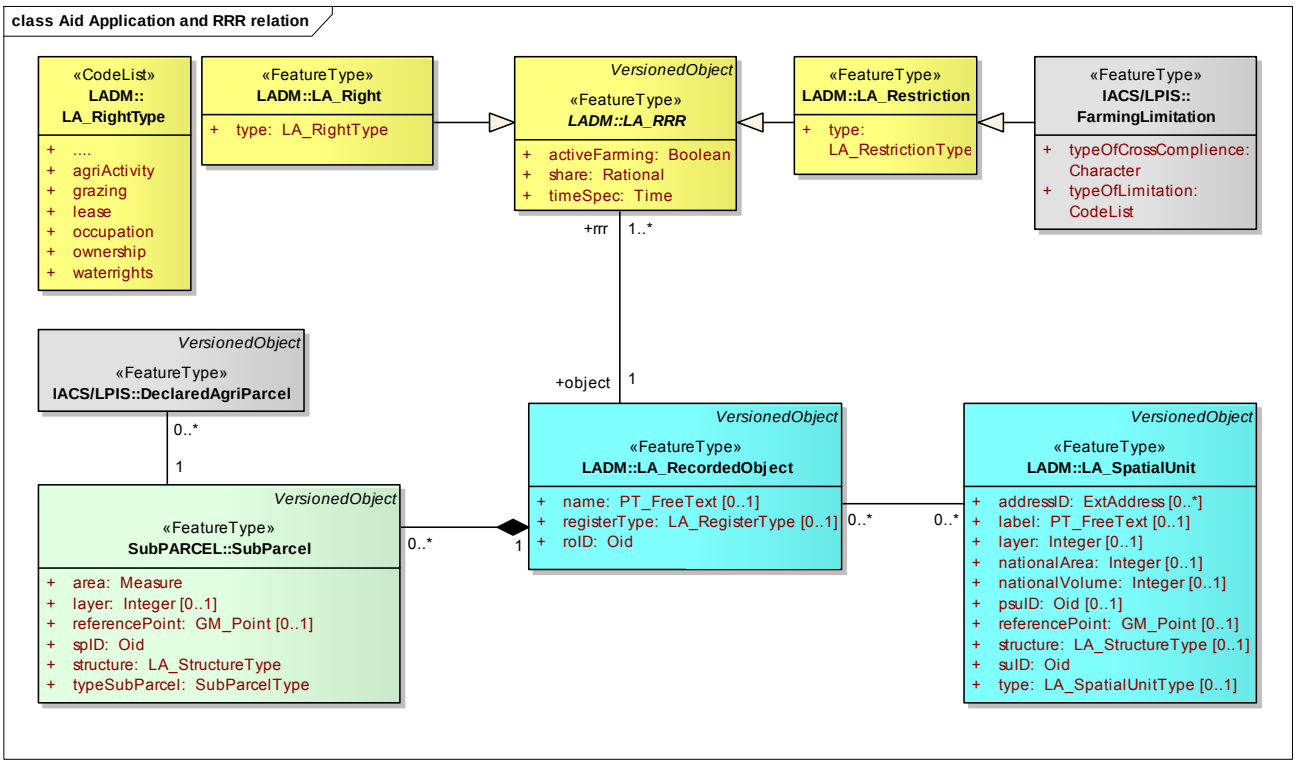


Figure 12. Association of rights and restrictions to DeclaredAgriParcel class

In the LADM, LA_RRR class has three main types of specialization classes – LA_Right, LA_Restriction, and LA_Responsibility. In the collaboration model for LPIS integration, farming rights are represented by LA_Right class and some of farming limitations are represented by FarmingLimitation class as a specialization of LA_Restriction class (Figure 12). The only right IACS/LIPS is about it is right to be paid (entitlement). It is associated with Farmer and via YearlyAidApplication and DecalredAgriParcel to SubParcel. It is not related directly to the whole LA_RecordedObject (with LA_SpatialUnit's).

4 Discussion

This annex shows that several aspects of LADM can be used in the integration of different LPIS set-ups in different member states of the European Union. Several other important aspects are not mentioned here but can be found in (Inan et al, 2008).

There has been a common understanding that the LPIS deals with farmers (users of land) and the Cadastre (or the LAS) deals with owners and they may not be the same person. Unlike such kind of common understanding, LASs, by definition, deal with a wide range of information related to land including ownership, land use rights (right holders of registered properties), farming rights, restrictions, responsibilities etc. We can also call such kind of a LAS as multi purpose cadastre. However, it is a fact that conventional LASs as legacy systems are currently not always capable of administering all kinds of land related rights. This is why LASs are generally underestimated by third parties. Therefore, registration of farmers and farming rights in a LAS has been regarded as an obstacle when compared with LPIS. In fact, a farmer is a person who does some kind of agricultural activity on some piece of land. Farmers may own some land for their activities. They may lease and/or get some kind of consent from others for another piece of land.

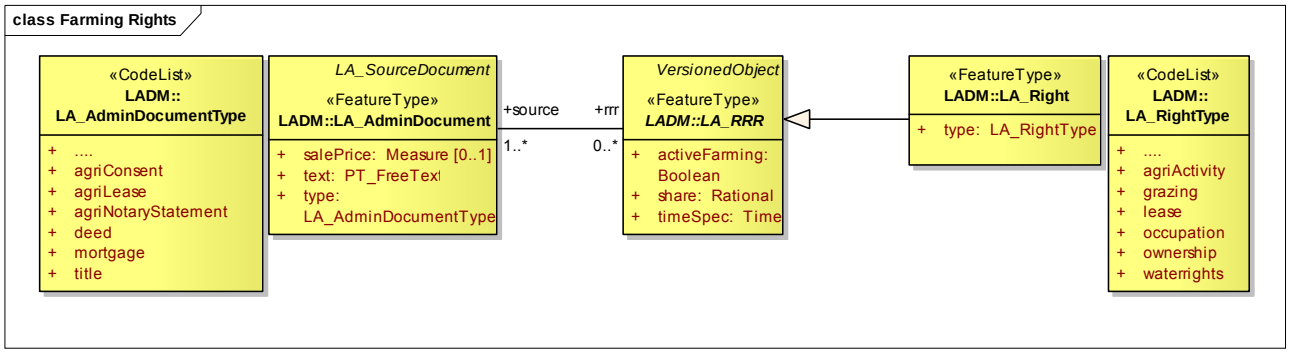


Figure 13. Registration of farming rights with the LADM classes

In this example, farming rights are designed as part of LAS with a few extensions in code lists (LA_RightType and LA_AdminDocumentType) with attribute values for attributes of some LADM classes (see Figure 13). The idea is that this will enable the application of an integrated solution for the management of land use rights both for LAS and LPIS applications.

In order to try to design and test properly the model presented above, a modeling of the use cases (from the business and system point of view) should be elaborated, including Activity diagrams of the processes and workflows.

Annex G. LADM and INSPIRE

(informative)

To be included: a LADM-based version of INSPIRE cadastral parcels, showing that the INSPIRE development fits within the LADM and that there are no inconsistencies. When the implementing rule and guidance material for INSPIRE cadastral parcels are published (target date 15 may 2009), then this annex will be completed.