

Geographic information — Land Administration Domain Model

Information géographique — ?

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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Introduction

This International Standard (IS) defines the Land Administration Domain Model (LADM). Land administration is a large field; the focus of this standard is on the part of land administration that is mainly connected to real properties, land ownership, and the geometrical (spatial) components thereof. The LADM will serve at least two important goals: (1) avoid reinventing and re-implementing the same functionality over and over again, but provide a extensible basis for an efficient and effective land administration system development based on a Model Driven Architecture (MDA), and (2) enable involved parties, both within one country and between different countries, to communicate based on the shared vocabulary (an ontology) implied by the model. The second goal is very important for creating standardized information services in an international context, where land administration domain semantics have to be shared between countries (in order to enable necessary translations). Important conditions during the design of the model are: it should cover the common aspects of land administration all over the world, should be based on the conceptual framework of Cadastre 2014 ([Kaufmann & Steudler, 1998](#)), should follow international ISO standards, and at the same time the model should be as simple as possible in order to be useful in practice.

[Annex A](#) contains the abstract test suite in order to establish the conformance of a given model with the LADM. The Social Tenure Domain Model (STDM) is a specialization of the LADM. This model is an illustration of the use of the LADM standard in a specific context. The STDM is presented in the [Annex B](#). The functionality of the STDM is included in the LADM, but the terminology is adapted to specific needs. For every country something similar has to be done: specialize the model and adapt terminology to the local language. [Annex C](#) illustrates this using the LADM in a number of specific cases, by showing instance level UML object diagrams. [Annex D](#) contains an overview of all classes (including their attributes and operations) in the form of a feature catalogue (consistent with INSPIRE D2.6, annex C).

Until now, most countries (or states or provinces) have developed their own land administration system. In one country operates deeds registration, another title registration; some systems are centralized, and others decentralized. Some systems are based on a general boundaries approach, others on fixed boundaries. Some land administrations have a fiscal background, others a legal one. However, the separate implementation and systems maintenance of land administration systems is not cheap, especially if one considers the ever-changing requirements. Also, the different implementations (foundations) of the land administration systems do not make meaningful communication very easy, e.g. in an international context. Looking at it from a little distance one can observe that the systems are in principle mainly the same: they are all based on the relationships between parties and land, via (property) rights, and are in most countries influenced by developments in Information and Communication Technology (ICT). The two main functions of every land administration- and land registry are: (1) keeping the contents of these relationships up-to-date (based on legal transactions), and (2) providing information on this registry.

The UN Land Administration Guidelines ([UN/ECE, 2006](#)) speak about land administration as the 'process of determining, recording, and disseminating information on ownership, value and use of land when implementing land management policies'. If 'ownership' is understood as the mode in which rights to land are held, we could also speak about 'land tenure'. A main characteristic of land tenure is that it reflects a social relationship regarding rights to land, which means that in a certain jurisdiction the relationship between people and land is recognised as a legally valid one (either formal, or non-formal). These recognised rights are in principle eligible for registration, with the purpose to assign a certain legal meaning to the registered right (e.g. a title). Therefore land administration systems are not 'just handling only geographic information' as they represent a lawfully meaningful relationship amongst people, and between people and land. As the land administration activity on the one hand deals with huge amounts of data, which moreover are of a very dynamic nature, and on the other hand requires a continuous maintenance process, the role of information technology is of strategic importance. Without the availability of information systems it will be difficult to guarantee good performance with respect to meeting changing customer demands. Organisations are now increasingly confronted with rapid developments in the technology, a *technology push*: internet, (geo)databases, modelling standards, open systems, GIS, as well as a growing demand for new services, a *market pull*: e-governance, sustainable development, electronic conveyance,

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integration of public data and systems. Land administration modelling is considered as a basic tool facilitating appropriate system development and reengineering and in addition it forms the basis for meaningful communication between different (parts of the) systems.

Standardization has become a well-known subject since the establishment of land administration- and land registries. In both paper-based systems and computerized systems, standards are required to identify objects, transactions, relations between real estate objects (e.g. parcels) and parties (also called subjects, in some countries), classification of land use, land value, map representations of objects, etc. Computerized systems ask for further standardization when topology and identification of single boundaries are introduced ([Van Oosterom and Lemmen, 2001](#)). In existing land administration- and land registries, standardization is limited to the region or jurisdiction where the land administration- and land registry is in operation. Open markets, globalisation, and effective and efficient development and maintenance of flexible (generic) systems require further standardization.

Review history

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Geographic information — Land Administration Domain Model (LADM)

1 Scope

This International Standard defines a Land Administration Domain Model (LADM) covering all information-related components of Land Administration. The standard provides a conceptual schema with five basic packages related to 'parties', 'immovable objects', 'rights/responsibilities/restrictions', 'surveying', and 'geometry/topology'. The LADM is a terminology for land administration based on various national and international systems, and is as simple as possible in order to be useful in practice.

This helps in combining and understanding Land Administration information from different sources in a coherent way. The terminology allows a shared description of different practices and procedures in various jurisdictions, but is not meant to have any legal implications and interference with (national) land administration laws.

It is organised into packages to support its objectives.

2 Conformance

An abstract test suite for this International Standard is given in [Annex A](#).

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[ISO 19107](#), *Geographic Information -- Spatial schema*

[ISO 19108](#), *Geographic Information -- Temporal schema*

[ISO 19109](#), *Geographic Information -- Rules for application schema*

[ISO 19111](#), *Geographic information -- Spatial referencing by coordinates*

[ISO 19136](#), *Geographic information -- Geography Markup Language (GML)*

4 Terms, definitions, and abbreviations

4.1 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

4.1.1 Land Administration

The process of determining, recording and disseminating information about ownership, value and use of land when implementing land management policies (UN/ECE, 1996).

4.1.2 Registry

Information system on which a register is maintained (ISO 19135, 2005).

4.1.3 Register

Set of files containing identifiers assigned to items with descriptions of the associated items (ISO 19135, 2005).

Registration

Assignment of a permanent, unique and unambiguous identifier to an item ([ISO 19135, 2005](#)).

4.2 Abbreviations

GIS Geographical Information System

INSPIRE Infrastructure for spatial information in Europe

LADM Land Administration Domain Model

STD M Social Tenure Domain Model

UML Unified Modeling Language

5 Land Administration Domain Model

5.1 Concept of the LADM

In this section the LADM and related functionality is introduced. The classes, attributes and associations, including the draft (preliminary) definitions are introduced in subsections. The LADM is developed according to the rules for application schema as defined by [ISO 19109](#). It should be noted that although this is a land administration domain model, it is not intended to be complete for any particular country. It is likely that additional attributes, operators, associations and perhaps even complete new classes will be needed for a specific country or region; see for example the STD M in [Annex B](#). Further it has to be noted that it is possible to use only a subset of the LADM for a specific implementation; there are many options in implementing subsets.

The core of the model is based on the three classes:

1. SpatialUnit.
2. RRR (Right, Restriction, Responsibility), and
3. Party (including groups).

The model supports the temporal aspects of the involved classes: Party, RRR and SpatialUnit all inherit from VersionedObject (with temporal attributes based on [ISO 19108](#)), see also section [5.7](#) below. The model offers several types of SpatialUnit representation (depending on the data acquisition methods and the use of existing spatial data sources):

- with solids, faces, edges and nodes based on [ISO 19107](#)
- with geometry only

- with a single point, or
- with no coordinates, just a description.

The model is specified in a UML class diagrams (Booch et al, 1999), and it is indicated how this UML model can be converted into an GML schema, which can then be used for data exchange (Annex E).

In the model there is no direct relationship between Party and SpatialUnit, but only via RRR. . Figure 1 shows the core of the model in a UML class diagram, which also contains the interface object Folio; see section 5.8 for more details on this.

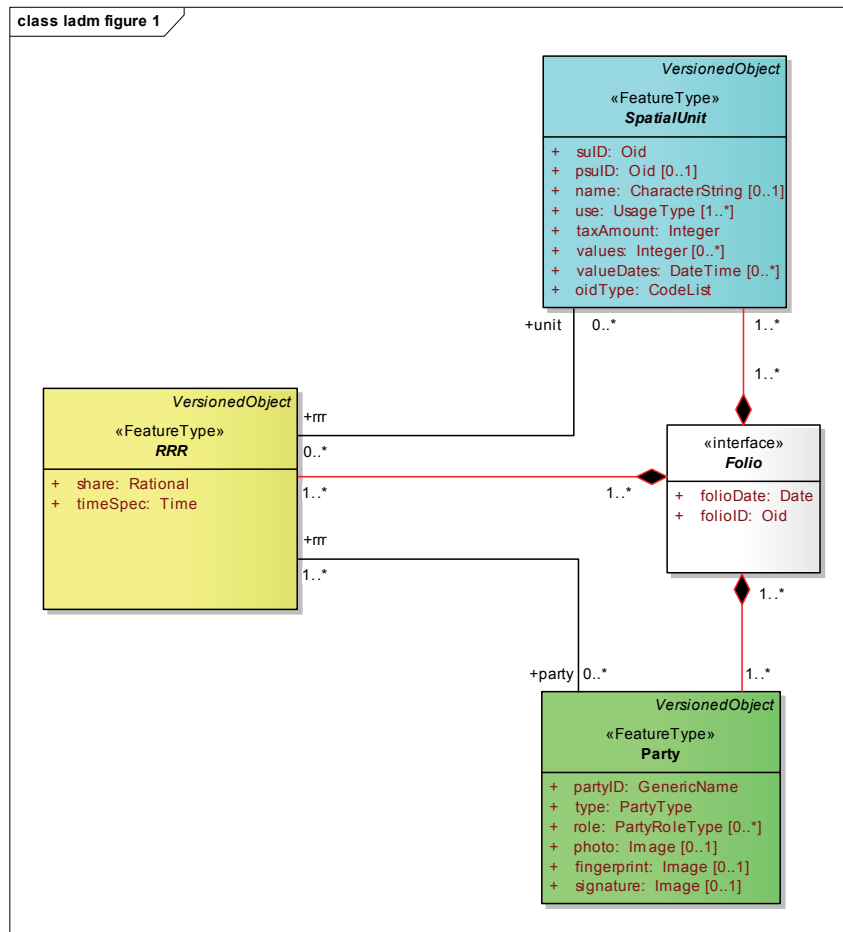


Figure 1. Core of the LADM: Party, RRR (Right, Restriction, Responsibility), and SpatialUnit

The LADM contains 'administrative' object classes for persons (parties), rights and the geographic description of real estate objects (spatial units). This means that data could be maintained by different organizations. The model can be implemented in a distributed set of (geo-) information systems, each supporting the maintenance activities and the information supply of parts of the data sets represented in this model (diagram), thereby using parts of the model. The model can also be implemented by one or more maintenance organization(s) operating at national, regional or local level. This underlines the relevance of the model: different organizations have their own responsibilities in data maintenance and supply, but can communicate on the basis of standardized legal, administrative and technical update processes.

One should not look at the whole model at once as the colours represent UML 'packages' or coherent parts of the model: spatial unit specializations (the "blue package", see section 5.2), surveying aspects (the "pink package", see section 5.3), geometric/topological aspects (the "purple package", see section 5.4), party (person) aspects (the "green package", see section 5.5) and legal/administrative aspects (the "yellow package", see section 5.6).

The advantages of distinguishing several packages are: being able to present the LADM in comprehensive parts, maintain and develop packages independently, and being able to use a package to implement one type of functionality.

5.1.1 VersionedObject

This class is re-used from [ISO 19108](#) and is introduced into the LADM to manage history in the database. Attributes are:

- beginValidityVersion: the start time (DateTime) of a specific object version
- endValidityVersion: the end time (DateTime) of a specific object version.

VersionedObject allows to keep and manage historical data in the data base, this implies that inserted and deleted data get a time-stamp in the data base.

In this way the contents of the data base as it was in a moment in the past can be reconstructed.

5.1.2 SpatialUnit

Spatial units are objects which are subject to registration by law, or 'recordation' (informal, or customary rights, and other social tenure relationships). Based on ([UN/ECE, 2004](#); [WG-CPI, 2006](#)): a spatial unit is a single area of land, or more particularly a volume of space, under homogeneous and unique real property or land use rights. By unique is meant that the ownership/use-right is held by one or several owners/users for the whole spatial unit. By homogeneous property/use-rights is meant that rights of ownership, use, social tenure, leases and mortgages affect the whole spatial unit. This does not apply to specific rights, which may only affect part of the spatial unit (e.g. encumbrances). SpatialUnit is a subclass of VersionedObject. SpatialUnit is associated with RRR ("Rights, Restrictions and Responsibilities").

SpatialUnit has as attributes:

- sulD: unique spatial unit identification
- psulD: preliminary spatial unit identification. This is an optional temporal spatial unit identifier, used between data acquisition and final acceptance of the data related to the spatial unit, including RRR
- name: the name of the the SpatialUnit
- use: that is the main use of the SpatialUnit, e.g. industry, housing, recreation, agriculture, nature. The value domain type is an enumeration type (CodeList).
- taxAmount: that is the amount of real estate tax in local currency for the SpatialUnit.
- values: this includes the result of valuation, value domain model is Array
- valueDates: the corresponding dates of the value array attribute (Array of DateTime)
- oidType: type of spatial unit identifier, e.g. based on the administrative subdivision of the land administration jurisdiction, or based on geographic coordinates

See [Figure 2](#).

5.1.3 RRR (RightRestrictionResponsibility)

RRR is the real property right, or social tenure relationship, between Party and SpatialUnit, including restrictions and responsibilities. RRR is a subclass of VersionedObject. RRR is also associated with LegalDocument. Attributes are:

- share: this is a share in a RRR (data type is a fraction, with the constraint that the total of all fractions related to a single RRR is equal to 1). Example: two parties each holding a share of $\frac{1}{2}$ in a right of ownership; or, one party holding $\frac{1}{4}$ and another holding $\frac{3}{4}$
- timeSpec: operational use of a Right in time sharing; this attribute is capable of handling also other temporal representation, such as reoccurring patterns (every week-end, every summer, etc.). This means

for example that a party can hold a right to use an apartment each year in March. Or a group of pastoralists has the right to cross a field each summer.

5.1.4 Party

Party is a human being or legal person holding a RRR, or social tenure relation. Party is a subclass of VersionedObject. It is also associated with Mortgage and GroupPerson. Attributes are:

- partyID
- type, this is the type of Party (with a value domain type enumeration: naturalPerson, nonNaturalPerson)
- role, this is the role of a Party in the data maintenance and update process: conveyor, notary, writer, surveyor, certified surveyor, bank, money provider, employee, etc, etc
-
- photo
- fingerprint
- signature.

5.2 Spatial Unit Package ('Blue Package')

Before the classes are introduced in subsections, an overview of the specializations of SpatialUnit is presented. The spatial units are refined into three main categories: land (2D)/space (3D), buildings, and others.

The different types of land (2D)/space (3D) spatial units include: TopologicalSpatialUnit, LineBasedSpatialUnit, PointSpatialUnit, and TextSpatialUnit. Land (2D)/space (3D) spatial units may be urban, rural, or special.

A TopologicalSpatialUnit has a consistent topological structure (and includes the boundaries). A LineBased-SpatialUnit is represented by a set of lines, which can be collected from different sources. This set of lines is not topologically structured, so that area calculation is not possible. A PointSpatialUnit only contains the coordinates of the centroid. A TextSpatialUnit is not represented by coordinates, but has a spatial description in words, e.g. bouds and metes system.

The different types of building spatial units include: Building, and BuildingUnit.. All these specializations of SpatialUnit have associations with zero, or more parties via the RRR class. It is possible that a spatial unit is only associated with a RRR and not with Party (via RRR). In this way land with joint ownership, and other types of common lands, are modelled. This is expressed by the multiplicity [0...*] from RRR to Party.

Spatial units can be aggregated to SpatialUnitSet, e.g. a section, a municipality, a planning area. A SpatialUnitSet can be an aggregation of other SpatialUnitSet's. In implementations of the LADM this can be related to spatial units identifiers; when a spatial unit identifier is composed out of e.g. country id/department id/county id/municipality id/etc.. Further, it is possible that a RRR is associated to a group of spatial units. This is modelled by the multiplicity [0...*] from RRR to SpatialUnit.

In the UML class diagram the topologically structured spatial unit is named TopologicalSpatialUnit, which all-together form the partition (subdivision without gaps and overlaps) of the region where land administration applies.

A spatial unit may change its representation over time from TextSpatialUnit to PointSpatialUnit to LineBasedSpatialUnit to TopologicalSpatialUnit.

As mentioned above, the different types of building spatial units include: Building and BuildingUnit A Building (the representation of the legal, registered or informal space, not the physical space) is composed out of several BuildingUnits. Note that a BuildingUnit is intended in the general sense, not only for living purposes, but also for other purposes, e.g. commercial. Further note that SpatialUnitSet allows the relating of one right to, for instance, a combination of an apartment, a parking place and another unit in the building.

A BuildingUnit has *type* as attribute. This can be used to represent *shared units* or *individual units*. In this way an apartment could be represented as an individual unit, the common areas (threshold, stairs, corridors, elevator, roof,...) as a shared unit. For all types there can be separate RRRs and Party's. A BuildingUnit is associated to SurveyPoint via a Building.

In most land administration systems a restriction is associated to a complete spatial unit, and this is also reflected in the presented model: a Party can have a Restriction (specialization of RRR) on a SpatialUnit.

It is possible that no spatial unit exist to a RRR. E.g. in case of a right to fish in a commonly held area, where the holder of the fishing right does not (or no longer) hold rights to a spatial unit in the area. This is modelled by the multiplicity [0...*] from RRR to SpatialUnit.

5.2.1 TopologicalSpatialUnit

Attributes are:

- urban: is Urban,Rural, or Special
- computedSize: calculated area based on the co-ordinates of the boundary points. This area is most of the time not exactly equal to the legalSize of SpatialUnit. Data type is Real; other data types (Area: ha.are.ca or integer: in square metres) as they can be in local use can be derived from this
- dimension: dimension of of the coordinate system, this can be surface or volume (2D or 3D)
- spatialDescription: this is the spatial representation ([ISO 19107](#)).

See [Figure 3](#).

5.2.2 TextSpatialUnit

For a TextSpatialUnit the location of the spatial unit is described in words.. Attribute are:

- estimatedSize, this is the estimated area of a TextSpatialUnit. Data type is real; other data types (Area: ha.are.ca or integer: in square metres) as they can be in local use can be derived from this
- urban: is Urban,Rural, or Special.

5.2.3 PointSpatialUnit

For a PointSpatialUnit the location of the spatial unit is described by one single point (inside) the spatial unit. Attribute are:

- estimatedSize, this is the estimated area of a PointParcel. Data type is real; other data types (Area: ha.are.ca or integer: in square metres) as they can be in local use can be derived from this
- urban: is Urban,Rural, or Special.

5.2.4 LineBasedSpatialUnit

For a LineBasedSpatialUnit the location is defined by a set of boundary lines, which can be incomplete, or not topologically structured. Attribute are:

- legalSize, this is the estimated Area of a SpaghettiParcel. Data type is real; other data types (Area: ha.are.ca or integer: in square metres) as they can be in local use can be derived from this
- urban: is Urban,Rural, or Special.

5.2.5 OtherSpatialUnit

This is an object, other then spatial unit or building, subject for registration.

5.2.6 Building

This is a legal space or a legal surface around a building. Building is a subclass of SpatialUnit and it is a composition of BuildingUnits. Attributes are:

- complNum: the identification of the building
- dimension (derived): the dimension of the coordinate system.

5.2.7 BuildingUnit

A BuildingUnit is a subdivision of a Building and can be a common (shared) area in a Building or an individual property (apartment). Is associated with Building. Attributes are:

- extAddressId, this is the Identifier of the postal address (in an external address register) of a BuildingUnit. The value type of address is outside the scope of the LADM.
- unitNum, this is the identifier of a BuildingUnit. The value data type depends on the local structure of identifiers.
- type, this is the type of BuildingUnit, the value domain type is enumeration type (code list: shared or individual).

5.2.8 SpatialUnitSet

is an association with the next higher , of which the current SpatialUnitSet is one of the members. This is a class where the link with the administrative subdivision of a region (country) can be made. Attributes are:

- hierarchicalLevel, the level in the hierarchy of the administrative subdivision. The data type is a positive Integer.
- name, the name of the aggregated unit. The data type is CharacterString.

5.2.9 Network

Network is the legal area/space around a utility network, which can be registered. Is a subclass of OtherSpatialUnit. Attributes are:

- belowSurface, is it an underground network or above the ground, data type is Boolean
- dangerous, Boolean: dangerous or not
- exPhysicalNetwork, reference to the physical (technical) description of the utility network in an external information source (of the organization responsible for the network)
- geometricQuality, precision of geometric data
- networkType, value domain is enumeration type (code list)
- status, value domain is enumeration type (code list).

5.3 Surveying Package ('Pink Package')

A land administration survey is documented on a SurveyDocument, which is a source document made up in the field – this can be the final (sometimes legal) document or all documents related to a survey. Survey documents may be established in the field, and can be finished in the office. Sometimes, several documents are the result of a single terrestrial survey. This document may contain signatures; in a full digital surrounding a field office may be required to support this under the condition that digital signatures have legal support. Otherwise paper based documents (which may be scanned, in the office or in the field) should be considered as an integral part of the land administration system. Files with terrestrial observations - distances, bearings, and referred geodetic control- on points are attributes of SurveyDocument: the Measurements. The individual survey points are associated with SurveyDocument. One SurveyDocument can be associated with several SurveyPoints. The SurveyPoints form the measured foundation of both the topology-based spatial units and the non topology-based spatial units.

If a SurveyPoint is observed at different surveys there will be different SurveyDocuments. If a SurveyPoint is observed from different positions during a measurement, there is only one association with a SurveyDocument. One of the attributes of a SurveyPoint is the *pointType*, which indicates the type of SurveyPoint; this could for example be a Geodetic Control Point (GCP). Further, there might be reasons for changing coordinates, for example map improvement, or switching to a different coordinate reference system (as defined in [ISO 19111](#)), or new calculation of the same reference system. Geodetic control points, possible multiple coordinates for points, supporting multiple reference systems are supported in the LADM.

Apart from field surveying there might be aerial photographs, satellite images, existing topographic maps used as a survey document. This is an approach in case of initial data collection, related to adjudication (observation of the existing situation where relationships between people and land are concerned).

5.3.1 SurveyPoint

A SurveyPoint is an observed point of a SpatialUnit in the field. See [Figure 5](#) for the spatial representation. Attributes are (all optional):

- locationOrig: calculated co-ordinates based on observations
- transformation: transformation used (from calculated co-ordinates in a local reference system to transformed co-ordinates)
- dimension (derived): 2D, or 3D
- quality; quality label related to survey method ([ISO 19115](#))
- pointType: type of monumentation in the field, this has as value domain type enumeration (code list)
- locationTransf: shift in co-ordinates after a new survey (with a new SurveyDocument) of the same point.

5.3.2 SurveyDocument

This is a document providing the spatial description of the SpatialUnit, associated with SurveyPoint and a subclass of SourceDocument (see [Figure 5](#) and section 5.6.3).

Data acquisition can be done digital with a field office, or can be done using forms and field sketches, or enlarged satellite images, aerial photographs, or existing topographic maps. In case of traditional land surveying a sketch will be used where the surveyed points are identified. A further option is data acquisition based on GPS, or a combined GPS/Images approach. The forms are used to write administrative data about Parties, RRR, social tenure relations and spatial units. The enlarged satellite images or aerial photographs can be used to draw the identifiers of spatial units, possibly with boundaries. The same can be done for Buildings. If no satellite images or aerial photographs are available a field sketch (SurveyDocument) can be made with a sketch of the spatial units and buildings, including the identifiers - which shows the neighbor relations. It can happen that a spatial unit is incomplete. An alternative field sketch is a (digital) photograph of a sketch drawn on a wall – again showing the spatial unit identifiers and neighbor relations. One more option is to include a description in words to the data on spatial units. Finally it may happen that there is no spatial reference at all, except the village name. It may happen that the senior data collector collects all the data and/or that junior spatial data collector and junior administrative data collector are involved. Normally this means that the junior spatial data collector will start, will produce the spatial data and identify the spatial units and buildings – organized in blocks which can be overseen.

Attributes:

- measurements: observations and measurements as a basis for mapping and as a basis for later reconstruction of the location of (parts of) the SpatialUnit in the field. Value data types are: gon, meters, coordinates.
- number: identifier of the SurveyDocument, data type depends on the local approach in document identification
- surveyDate: date of survey in the field

- quality: precision of observation (value type; enumeration (code list))
- type: type of SurveyDocument (value type; enumeration (code list)).

5.4 Geometry and Topology Package ('Purple Package')

The LADM is based on already accepted and available standards *on geometry and topology* published by ISO. *Geometry* itself is based on SurveyPoints (mostly after geo referencing, depending on data collection mode: survey-tape, total station, GPS, image based data collection, etc) and is associated with the classes TP_node (topology node), TP_edge (topology edge) and TP_face (topology face, only in 3D case) to describe intermediate 'shapes' points between nodes, metrically based on SurveyPoints (*Remark:INSPIRE may change this*).

Spatial units have a 2D or 3D geometric description. In 2D a geometry area is defined by at least three SurveyPoints, which all are situated in the same horizontal plane (of the earth surface). In 3D a geometry area is defined by at least four non-partition SurveyPoints; this would result in a tetrahedron, the simplest 3D volume object.

The 2D or 3D (ISO) topology structures must be valid at every moment in time. In case of topological spatial units there are never gaps or overlaps in the partition. However, edges belonging to different time spans (defined by versions) may cross without a node. The temporal topology must also be maintained: that is, no time gaps or overlaps in the representations. Therefore the structure is based on spatio-temporal topology. Current land administration registration systems, based on 2D topological and geometrically described spatial units, have shown limitations in defining the (2D and 3D) location of 3D constructions (e.g. pipelines, tunnels, building complexes) and in the vertical dimension (depth and height) of rights established for 3D constructions ([Stoter, 2004](#)). 2D and 3D are treated in the same manner throughout the model;. It is important to realize that there is a difference between the 3D physical object itself and the legal space related to this object. The LADM only covers the 'legal space'. That is, the space that is relevant for the land administration (bounding envelope of the object), which is usually larger than the physical extent of the object itself (for example including a safety zone).

5.5 Party Package ('Green Package')

Party can be of type natural person, or non-natural person, like organizations, companies, co-operations, and other entities representing social structures. Further there can be a specialization: GroupPerson. The difference between the non-natural person and the GroupPerson is that the first is intended to represent instances such as organizations, companies, government institutes , while the second is intended to represent communities, cooperatives and other entities representing social structures. Note that a GroupPerson in itself can consist of all kinds of parties: natural persons, non-natural persons, but also of other GroupPersons. In case of more informal situations the explicit association with the class Member is optional. Further, a Party can be a member of 0 or more GroupPersons.

5.5.1 GroupPerson

This can be a community, co-operative and other entities representing social structures. Associated with and subclass of Party.

5.5.2 Member

This is an optional association class between Party and GroupPerson. Attributes are:

- name
- share, that is a fraction of the whole (with the constraint that the total is 1).

5.6 Administrative Package ('Yellow Package')

The main class in this package is the abstract class RRR with specializations Right, Restriction and Responsibility (note: social tenure relationships are considered to be RRRs). In principle, all RRRs are based on a LegalDocument as source. The essential data, for example names or transaction dates, which can be

derived from a LegalDocument, can be represented in the classes RRR and Mortgage. A single legal document may even create a mix of these types. In the other direction, an instance of RRR or Mortgage is always associated with exactly one instance of LegalDocument as its source. It is possible to describe more than one mortgage in one legal document.

Each jurisdiction has a different 'land tenure system', reflecting the social relationships regarding rights (restrictions, and responsibilities) to land in that area. The variety of rights is quite large within most jurisdictions and the exact meaning of similar rights still differs considerably between jurisdictions (which could be areas with customary tenures). The aforementioned rights are primarily in the domain of private, or customary law. Usually the rights are created after an agreement between the person obtaining the right and the person (e.g. the land owner) who restricts his right by the newly created right. The rights and restrictions usually 'run with the land', which means that they remain valid even when the land is transferred after the right was created (and registered). Because property and ownership rights are based on (national) legislation, 'lookup tables' can support in this. 'Customary Right' related to a region or 'Informal Right' can be included; from modelling perspective this is not an item for discussion. Of course, for the actual implementation in a given country or region, this is very important.

In addition to those private law restrictions, many countries also have public law restrictions, which are usually imposed by a (local) government body. The 'holder' of the right is a Party (either 'the government' or 'society-at-large') and usually they are primarily seen as restrictions. Some of them apply to a specific SpatialUnit (or right therein) or a small group of them, or the duty to pay a certain tax for improvements on the road, or the duty to repair damage or perform belated maintenance. Each non-ownership Right by a third part (be it government or a private Party) causes a Restriction. These Restrictions have their own place in the LADM: they are modelled as views. That is, not intended to be stored in the LADM, but to be derived on demand when needed. Right (a specialization of the abstract super class RRR) is compulsory association between SpatialUnit and Party, where this is not compulsory in case of 'Restriction' and Responsibility (the other specializations of RRR). The class RRR allows for the introduction of 'shares of rights' in case where more than one Party holds an undivided part of a 'complete' Right (or Restriction or Responsibility).

A restriction means that you have to allow someone to do something or that you have to refrain from doing something yourself. Restrictions can both be within private law, especially in the form of servitudes, as within public law, through zoning and other planning restrictions as well as environmental limitations. Responsibilities mean that one has actively to do something. Not all legal systems allow such mandated activities as property rights, and this will also effect the question if they can (and have to be) registered. Their impact can be substantial and their registration is therefore preferable.

The class RRR has associations to both Party and SpatialUnit ([Zevenbergen, 2004](#); [Paasch, 2005](#)). It is still possible that one SpatialUnit is related to several parties (via RRR associations) and reversibly, that one party is related to several SpatialUnits (again via RRR associations). There is always at least one instance of Right (subclass of RRR) in which the type of right represents the strongest (or primary) right, for instance customary or statutory ownership, freehold or leasehold. Connected to this strongest right certain interests can be added, or subtracted from this strongest right. A point of discussion is how to represent the subtractions (Restrictions) as they are already implied by a non-primary right of a third party. The fact a neighbour is allowed to walk over your spatial unit is an additional Right (appurtenance, positive-side) to the ownership of his property, whereas it is a Restriction (encumbrance, negative-side) to your property. In the present model both sides are represented, but it is the intention only to store the positive-side and derive (compute) the negative side when needed (compare [Zevenbergen, 2004](#)).

One or several mortgage(s) is always vested on a (set of) Right(s), and should never be seen as a separate relation between Party and SpatialUnit. On the other hand a Mortgage is usually vested as collateral for loan. Therefore the mortgagee is connected to the Mortgage as MoneyProvider; one of the specializations of Person. Mortgage is associated to a Right.

The fact that all the different (public law and private law) RRRs find their base in some kind of establishing or transacting document is represented by connecting them to LegalDocument which is a specialization of the abstract class SourceDocument (as is SurveyDocument). The one responsible for drafting the document is connected to this as Conveyer.

The legal/administrative part of the LADM as just described is based on the notion of one strongest (primary) right, with other limited rights derived from it. This notion can be found in most continental European countries, but it also fits to the different approach found in Anglo-American law. That starts from the concept of property rights as 'estates' held in the land. Ownership in this approach is often seen as a 'bundle of sticks'. Separate 'sticks' of the bundle can be acquired in different ways, can be held by different persons for different periods. When a person owns all the rights, he is said to own the fee simple title. When he owns only some of the rights, he has a partial interest. This approach is also used in ([Paasch, 2005](#)). Land administration systems that underpin customary land tenure systems, informally arranged land use or conflicting claims to rights, and whose objects might not be clearly identifiable (fuzzy), not (yet) clearly identified or whose areas overlap are in need of other classes to allow for those type of situations ([Van Oosterom et al, 2005](#)). Often in such countries or jurisdictions both types of situations (strictly legal and formalized and more fuzzy and informal) are to be found in the same area, and should therefore be able to co-exist in the land administration system, and thus in the LADM.

5.6.1 Right

This is the real property right based on legislation or the social tenure relationship between SpatialUnit and Party. A social tenure relationship can be informal, traditional or customary type of right. Right is a subclass of RRR and is associated to Mortgage. Attributes:

- rightType, this is the type of right or social tenure relationship. Value domain type is enumeration (code list).

5.6.2 Restriction

This is a legal restriction to a (property) right. Restriction is a subclass of RRR. Attribute:

- restrictionType, this is the type of restriction. Value domain type is enumeration (code list).

5.6.3 Responsibility

Responsibility to perform maintenance. Subclass of RRR. Attribute:

- responsibilityType, this has a value domain enumeration (code list).

5.6.4 Mortgage

A Mortgage on a Right. Mortgage is associated to Right, Person and LegalDocument. Attributes are:

- amount, the amount of money of the mortgage in local currency
- interest, interest
- ranking, this is the ranking order in case more the one mortgage applies to a right.

5.6.5 SourceDocument

This is a document providing facts. Attributes:

- submission; date of submission of the document by Person
- acceptance; date of acceptance of the document by an authority
- registration; date of registration of the document by registering authority
- electrSignature: data in electronic form which are attached to or logically associated with other electronic data and which serve as a method of authentication (DIRECTIVE 1999/93/EC)

See [Figure 5](#).

5.6.6 LegalDocument

Document providing legal facts: evidence of a Party's rights to land ([UN/ECE, 2004](#)). Associated with RRR and Mortgage

Note: LegalDocument does not inherit from VersionedObject, so there is no history management of versions here. All temporal attributes are inherited from SourceDocument (acceptance, registration and submission DateTimes).

Attributes:

- number: identifier of the LegalDocument
- text: contents of the LegalDocument
- type: type of LegalDocument, value domain type is enumeration (code list)
- salePrice: Purchase price of the SpatialUnit in relation to a transaction (buying, selling etc).

5.7 History and dynamic aspects

There are two different approaches when modelling the result of dynamic systems (discrete changes in the state of the system): event and state based modelling:

- In event based modelling, transactions are modelled as separate entities within the system (with their own identity and set of attributes). When the start state is known and all events are known, it is possible to reconstruct every state in the past by traversing the whole chain of events. It is also possible to represent the current state, and not to keep the start state (and go back in time via the 'reversal' of events).
- In state based modelling, the states (that is the results) are modelled explicitly: every object gets (at least) two dates/times, which indicate the time interval during which this object is valid. Via the comparison of two succeeding states it is possible to reconstruct what happened as a result of one specific event. It is very easy to obtain the state at a given moment in time, by selecting the object based on their time interval (tmin-tmax). The temporal aspect is inherited from the VersionedObject with its attributes: beginValidityVersion and endValidityVersion. The class RRR has an additional temporal attribute called timeSpec, which is capable of handling other temporal representations, such as a recurring pattern (every week-end, every summer, etc.) Note that nearly every object inherits the temporal attributes via either SpatialUnit, RRR or Party – or directly via VersionedObject (e.g. in the case of Parcel as this is not a subclass of SpatialUnit).

The LADM covers both event (via the SourceDocuments) and state based temporal modelling (via VersionedObject). In addition to the event and state modelling, it is also possible that the explicit 'parent/child' associations between the Immovables (SpatialUnit) are modelled (lineage); e.g. when a land administration parcel is subdivided. However, as these associations can also be derived from a spatio-temporal overlay, it was decided to not further complicate the model with the explicit parent-child relationships.

Besides the data modelling aspect of the dynamic processes within the LADM, one could question how are the functions and processes related to each other? The UML class diagram should further be completed by diagrams covering other aspects, e.g. via state (use case, sequence, collaboration, state or activity) diagrams. Activity diagrams show how processes are related to the information (data) and how one 'flows' from on to the other. In all the other mentioned types of UML diagrams, actors or organizations play an important role and this may be quite dependent on the (national) set-up. The introduction of different 'stages' of a parcel (onepoint, image, surveyed), a right (start, landhold, freehold) and a person could further reflect the dynamic nature of the system.

5.8 Interface objects

The interface objects Map and Folio support the generation and the management of products and services. Those classes do not contain attributes in itself but they allow the option to relate e.g. customer (identifier), date etc. This can be useful in the link to Customer Relation Management, Workflow Management and financial systems.

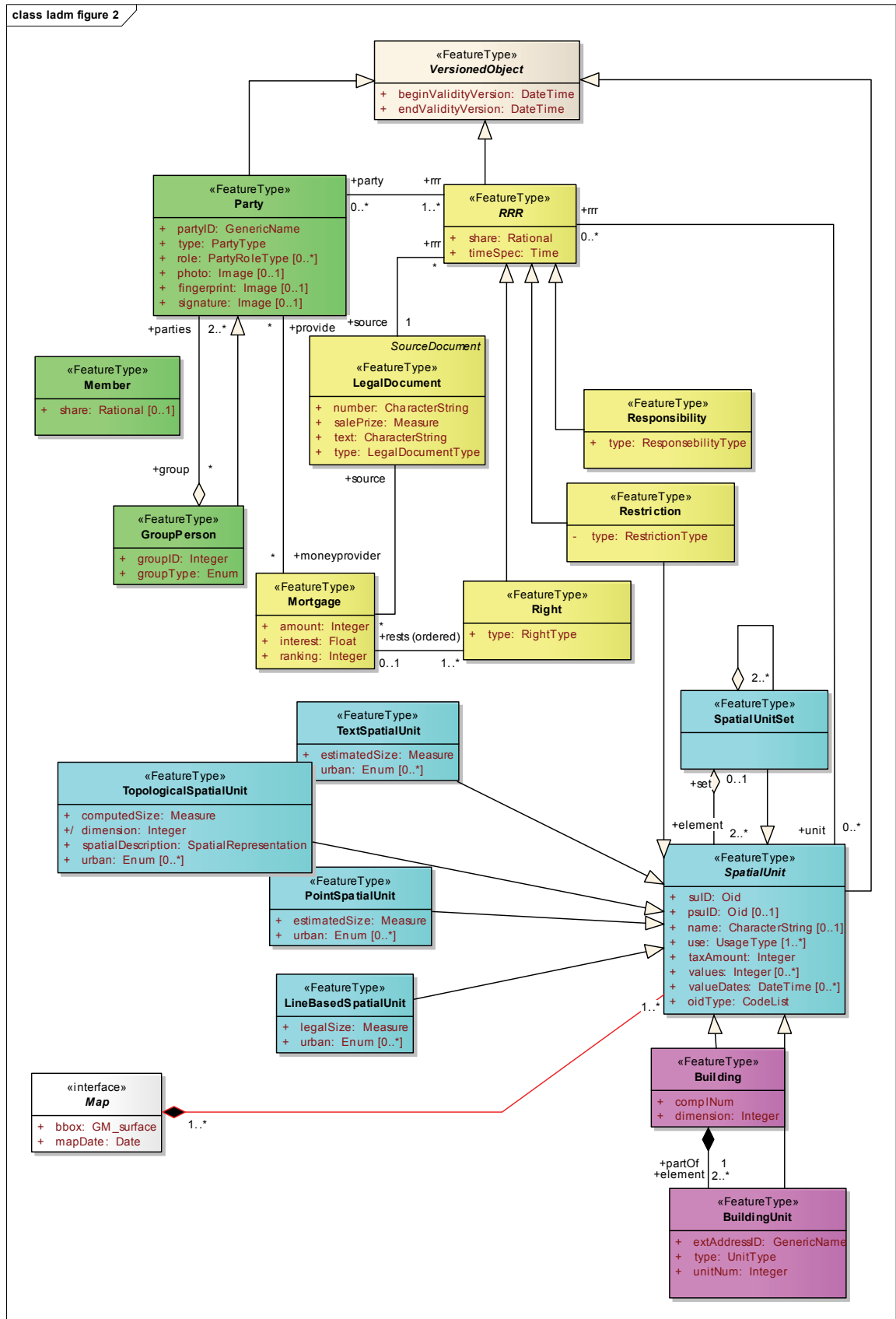


Figure 2 —RRR, parties and spatial units

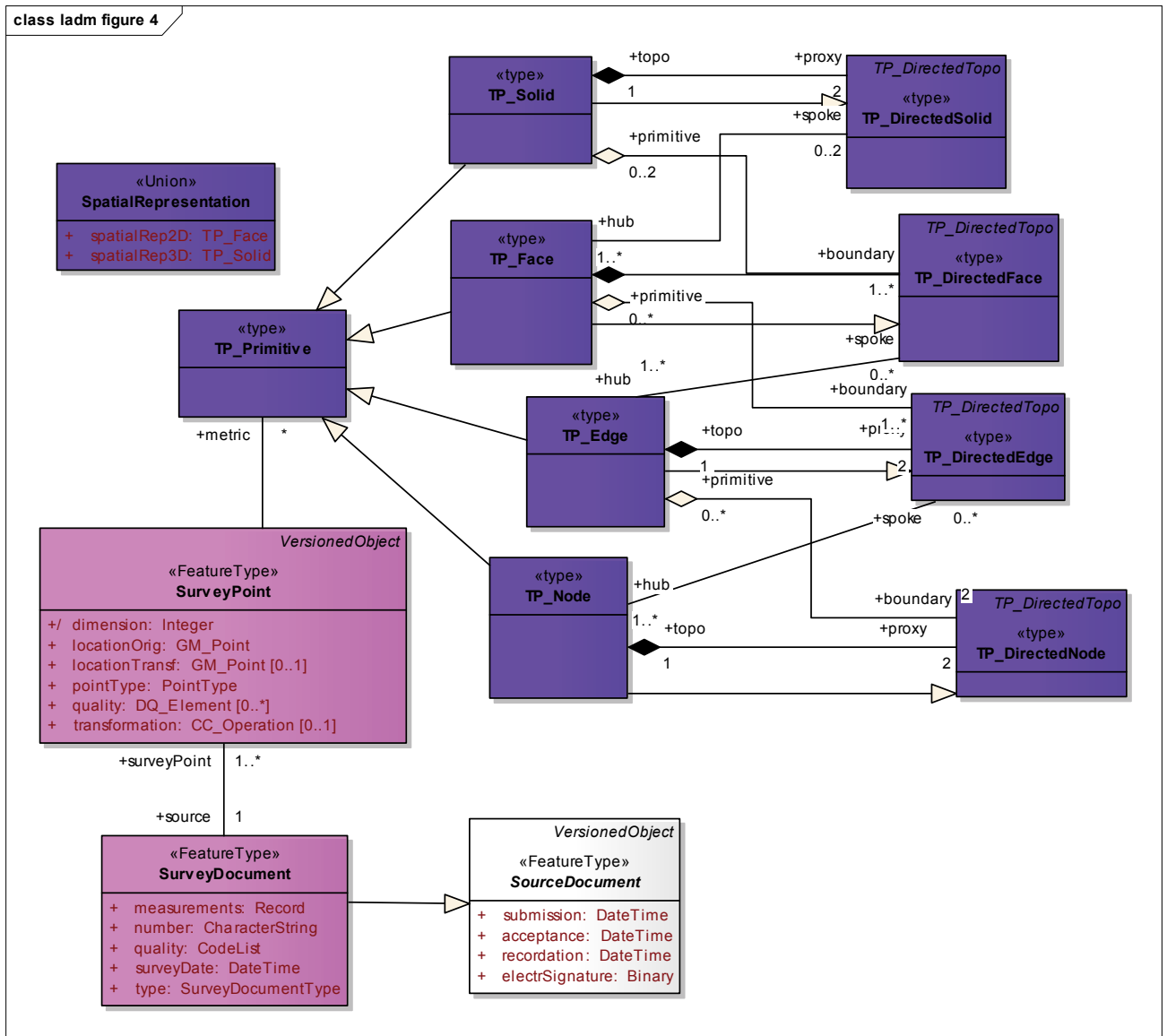


Figure 4 — Spatial representation of spatial units and survey points (ISO 19107)

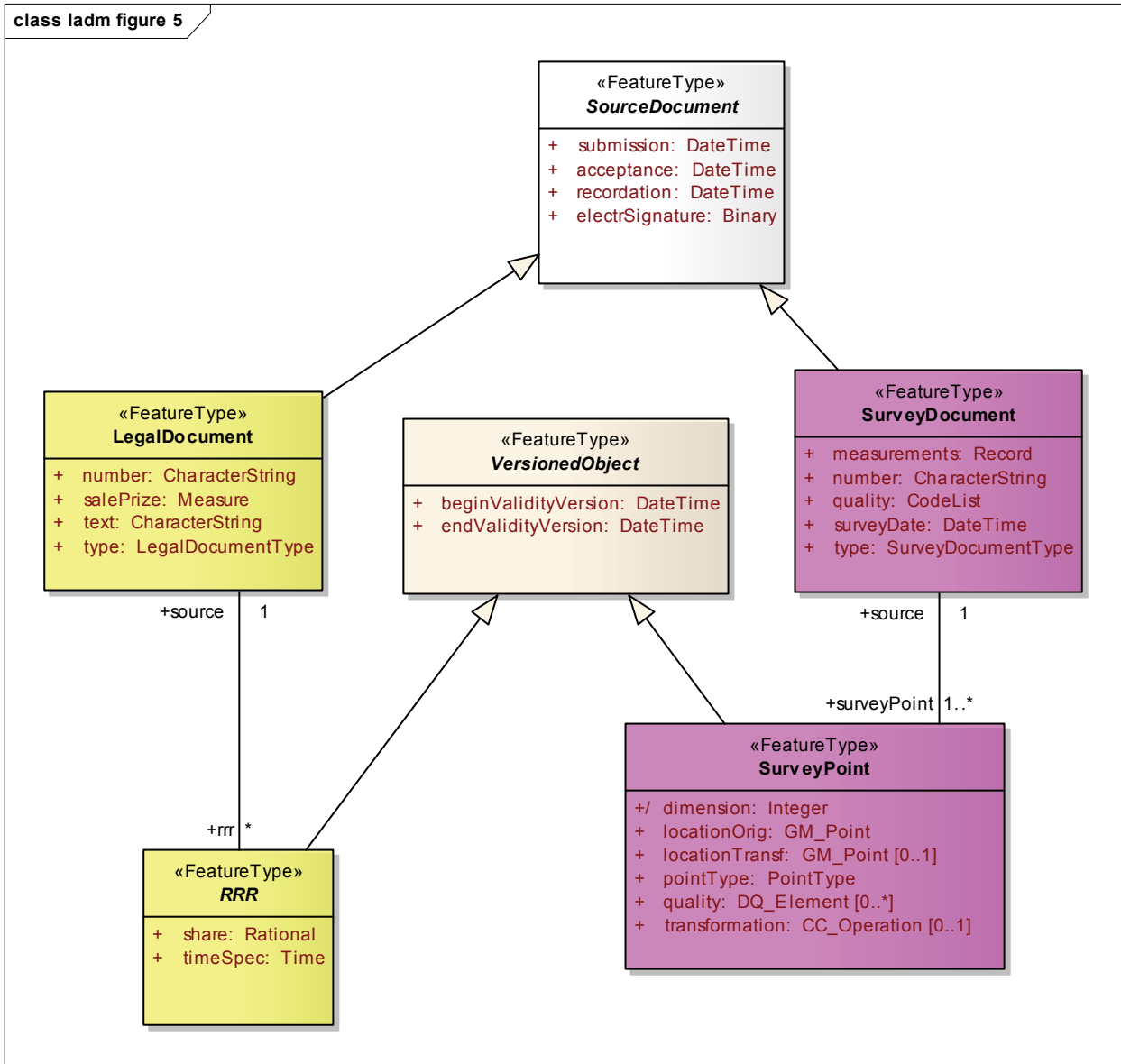


Figure 5 — Documents

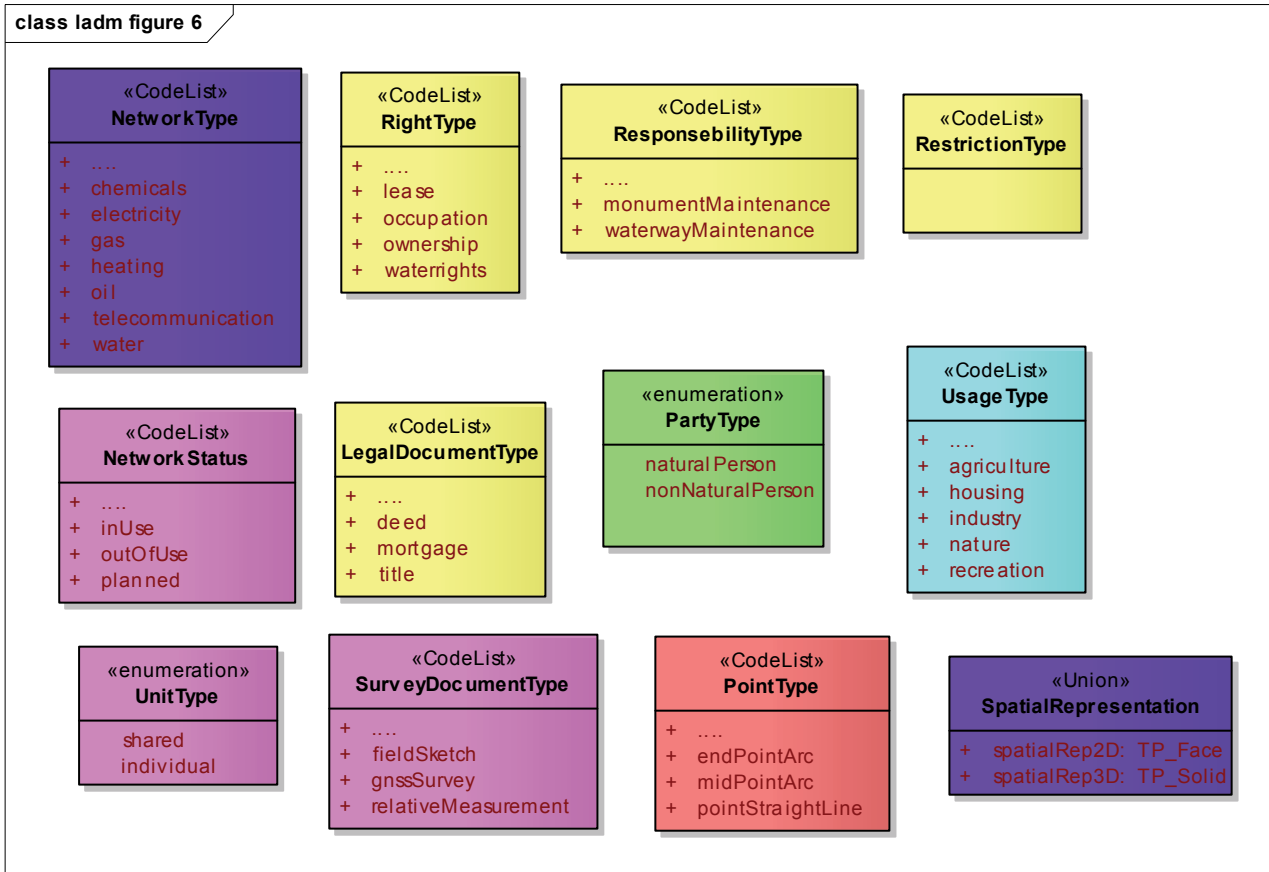


Figure 6 — Types (basic types and code lists)

Annex A
(normative)

Abstract Test Suite

To be included.

Annex B
(normative)

Social Tenure Domain Model (STDM)

To be included.

Annex C

(informative)

Land administration cases, instance level UML object diagrams

Remark: 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.

- 1 natural person is leaseholder another non-natural person is owner, ownership and lease hold based on civil code for one country
- 1 spatial unit with a customary right
- 2 persons hold a share in a right (e.g. one person a share 1/2 and the other person a share 1/2 , or 2/3 and 1/3)
- A serving parcel provides access to 4 parcels, and the serving parcel is not public
- A group person holds property right on a spaghetti parcel
- A legal space building contains individual units (apartments) and a shared unit, with one common threshold on 1 ground parcel
- A 3D volume parcel with 1 owner
- A timeshare ownership for the month of February
- A restriction not to change a building because of its monumental status
- Mortgage on ownership, bank included as person
- Mortgage on usufruct on ownership, money provider included as person
- Informal right by a person on a text parcel
- Informal right by a group on a point parcel
- Informal right on a spatial unit
- A conflicting claim on a spatial unit
- A utility network with 1 owner and a mortgage (bank included as person)
- A pastoralist group with an access right for a certain period
- Parcel with 1 owner, building on it with other owner
- Farmer owning several parcels (rural)
- Value as basis for taxation valid for 5 years
- A milk right to a parcel
- A responsibility to clean the ditches
- A right of use a road on a property of somebody else
- A restriction area with its own geometry: not allowed to built 200 meters around a fuel station
- Parcel complex with one owner
- Complex of parcels and building with one owner
- Complex of several parcels with two owners
- Spatial unit in conflict
- Spatial unit with micro credit

Annex D
(informative)
Feature catalogue

summary of Chapter 5 and presented in form similar to INSPIRE D2.6, annex C

Annex E

(informative)

GML application schema (p.m.)

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