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| ICS 35.240.70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <div>Entwurf</div> | Einsprüche bis 2024-06-12<br>Vorgesehen als<br>teilweiser Ersatz für<br>DIN EN ISO 19152:2013-03 |
| <p><b>Geoinformation –<br/>Land Administration Domain Model (LADM) –<br/>Teil 2: Erfassung von Grundeigentum (ISO/DIS 19152-2:2024);<br/>Englische Fassung prEN ISO 19152-2:2024</b></p> <p>Geographic information –<br/>Land Administration Domain Model (LADM) –<br/>Part 2: Land registration (ISO/DIS 19152-2:2024);<br/>English version prEN ISO 19152-2:2024</p> <p>Information géographique –<br/>Modèle du domaine de l’administration des terres (LADM) –<br/>Partie 2: Enregistrement foncier (ISO/DIS 19152-2:2024);<br/>Version anglaise prEN ISO 19152-2:2024</p> <p><b>Anwendungswarnvermerk</b></p> <p>Dieser Entwurf mit Erscheinungsdatum 2024-04-12 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.</p> <p>Weil das beabsichtigte Dokument von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfs besonders zu vereinbaren.</p> <p>Stellungnahmen werden erbeten</p> <ul style="list-style-type: none"><li>– vorzugsweise online im Norm-Entwurfs-Portal von DIN unter <a href="http://www.din.de/go/entwuerfe">www.din.de/go/entwuerfe</a> bzw. für Norm-Entwürfe der DKE auch im Norm-Entwurfs-Portal der DKE unter <a href="http://www.entwuerfe.normenbibliothek.de">www.entwuerfe.normenbibliothek.de</a>, sofern dort wiedergegeben;</li><li>– oder als Datei per E-Mail an <a href="mailto:nabau@din.de">nabau@din.de</a> möglichst in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter <a href="http://www.din.de/go/stellungnahmen-norm-entwuerfe">www.din.de/go/stellungnahmen-norm-entwuerfe</a> oder für Stellungnahmen zu Norm-Entwürfen der DKE unter <a href="http://www.dke.de/stellungnahme">www.dke.de/stellungnahme</a> abgerufen werden;</li><li>– oder in Papierform an den DIN-Normenausschuss Bauwesen (NABau), 10772 Berlin oder Am DIN-Platz, Burggrafenstr. 6, 10787 Berlin.</li></ul> <p>Es wird gebeten, mit den Kommentaren zu diesem Entwurf jegliche relevanten Patentrechte, die bekannt sind, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.</p> <p>Gesamtumfang 161 Seiten</p> <p>DIN-Normenausschuss Bauwesen (NABau)</p> |                    |                                                                                                  |

## Nationales Vorwort

Dieses Dokument (prEN ISO 19152-2:2024) wurde vom Technischen Komitee ISO/TC 211 „Geographic information/Geomatics“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 287 „Geoinformation“ (Sekretariat BSI, Vereinigtes Königreich) erarbeitet.

Das zuständige nationale Normungsgremium ist der Arbeitsausschuss NA 005-03-03 AA „Geoinformation (SpA zu CEN/TC 287+ISO/TC 211)“ im DIN-Normenausschuss Bauwesen (NABau).

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die Englische Fassung von prEN ISO 19152-2:2024.

Für die in diesem Dokument zitierten Dokumente wird im Folgenden auf die entsprechenden deutschen Dokumente hingewiesen:

|                  |       |                            |
|------------------|-------|----------------------------|
| ISO 8601-1:2019  | siehe | DIN ISO 8601-1:2020-12     |
| ISO 19101-1:2014 | siehe | DIN EN ISO 19101-1:2015-03 |
| ISO 19105:2022   | siehe | DIN EN ISO 19105:2022-10   |
| ISO 19106:2004   | siehe | DIN EN ISO 19106:2006-05   |
| ISO 19107:2019   | siehe | DIN EN ISO 19107:2020-09   |
| ISO 19109:2015   | siehe | DIN EN ISO 19109:2016-05   |
| ISO 19110:2005   | siehe | DIN EN ISO 19110:2006-09   |
| ISO 19111:2019   | siehe | DIN EN ISO 19111:2020-09   |
| ISO 19115-1:2014 | siehe | DIN EN ISO 19115-1:2014-07 |
| ISO 19126:2009   | siehe | DIN EN ISO 19126:2010-03   |
| ISO 19131:2007   | siehe | DIN EN ISO 19131:2008-09   |
| ISO 19132:2007   | siehe | DIN EN ISO 19132:2009-01   |
| ISO 19135-1:2015 | siehe | DIN EN ISO 19135-1:2016-12 |
| ISO 19156:2023   | siehe | DIN EN ISO 19156:2023-12   |
| ISO 19157-1:2023 | siehe | DIN EN ISO 19157-1:2023-12 |
| ISO 20524-2:2020 | siehe | DIN EN ISO 20524-2:2023-04 |

Aktuelle Informationen zu diesem Dokument können über die Internetseiten von DIN ([www.din.de](http://www.din.de)) durch eine Suche nach der Dokumentennummer aufgerufen werden.

## Änderungen

Gegenüber DIN EN ISO 19152:2013-03 wurden folgende Änderungen vorgenommen:

- a) Aufteilung von ISO 19152 in sechs Teile;
- b) grundlegende Überarbeitung und Umbenennung des Dokuments in Geoinformation — Land Administration Domain Model (LADM) „Teil 1: Allgemeines konzeptionelles Modell“, „Teil 2: Eigentumssicherung“, „Teil 3: Georegulierung in Meeren“, „Teil 4: Bodenbewertungsinformationen“, „Teil 5: Räumliche Planung“, „Teil 6: Implementierungsaspekte“;
- c) redaktionelle Überarbeitung.

## Nationaler Anhang NA (informativ)

### Begriffe und Abkürzungen

Reihenfolge und Inhalt der folgenden Begriffe sind identisch mit denen im Abschnitt Begriffe der Englischen Fassung.

Für die Anwendung dieses Dokuments gelten die Begriffe nach ISO 19152-1 und die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- ISO Online Browsing Platform: verfügbar unter <https://www.iso.org/obp>
- IEC Electropedia: verfügbar unter <https://www.electropedia.org/>

#### NA.1 Begriffe

##### 3.1.1

##### **Verwaltungsquelle**

<LADM> mit der verwaltungsbezogenen Beschreibung (sofern zutreffend) der beteiligten Gruppen, der Rechte, Einschränkungen und Verantwortlichkeiten sowie der betroffenen Grundverwaltungseinheiten

BEISPIEL 1 Der Nachweis des Rechts einer Gruppe an einer Grundverwaltungseinheit.

BEISPIEL 2 Ein Dokument, das eine Transaktion beschreibt (Urkunden), oder ein Urteil des Registerinhabers.

##### 3.1.2

##### **Begrenzung**

Menge, die die Grenzen einer Entität darstellt

Anmerkung 1 zum Begriff: Der Begriff „Begrenzung“ wird am häufigsten im Kontext der Geometrie benutzt, bei der die Menge aus einer Sammlung von Punkten oder einer Sammlung von Objekten, die von diesen Punkten dargestellt wird, besteht. In anderen Bereichen wird der Begriff im übertragenen Sinne gebraucht, um den Übergang zwischen einer Entität und dem übrigen betroffenen Domain zu bezeichnen.

[QUELLE: ISO 19107:2019, 3.6]

##### 3.1.3

##### **Begrenzungsmasche**

Masche, die bei der dreidimensionalen Darstellung einer Begrenzung einer raumbezogenen Einheit verwendet wird

Anmerkung 1 zum Begriff: Begrenzungsmaschen werden verwendet, wenn die implizierten vertikalen und unbegrenzten Maschen eines Begrenzungssumrings nicht ausreichen, um dreidimensionale raumbezogene Einheiten zu beschreiben. Begrenzungsmaschen schließen Volumen in der Höhe (z. B. jedes Geschoss von Wohngebäuden) oder in der Tiefe (z. B. unterirdisches Parkhaus) oder in allen sonstigen Richtungen ab, um ein umgrenztes Volumen zu bilden. Die Volumen stellen den rechtlichen Raum dar (im Gegensatz zum physischen Raum).

[QUELLE: ISO 19152-1:2024, 3.22]

### 3.1.4

#### **Begrenzungsring**

Begrenzung, die Teil der äußeren Umgebung einer raumbezogenen Einheit ist

Anmerkung 1 zum Begriff: Begrenzungsringe werden verwendet, um die Begrenzungen von raumbezogenen Einheiten zweidimensional durch Linestrings darzustellen. Diese zweidimensionale Darstellung bedeutet in einem zweidimensionalen Landadministrationssystem eine zweidimensionale Begrenzung, in einem dreidimensionalen Landadministrationssystem eine Reihe vertikaler Begrenzungsflächen. In diesem Fall wird ein nicht umgrenztes Volumen vorausgesetzt, das von Begrenzungsflächen umgeben ist, die die Erdoberfläche schneiden (wie zum Beispiel traditionell in den Katasterkarten dargestellt).

### 3.1.5

#### **Masche**

<Topologie> zweidimensionales topologisches Primitiv

Anmerkung 1 zum Begriff: Die geometrische Realisierung einer Masche ist eine Fläche. Die Begrenzung einer Masche besteht aus einer Menge gerichteter Kanten innerhalb desselben topologischen Komplexes, die über die Grenzverhältnisse mit der Masche assoziiert sind. Diese können in Form von Ringen organisiert sein.

[QUELLE: ISO 19107:2019, 3.38]

### 3.1.6

#### **Ebene**

<LADM> Menge von raumbezogenen Einheiten mit geometrischer und/oder topologischer und oder thematischer Kohärenz

BEISPIEL 1 Eine Ebene von raumbezogenen Einheiten für ein städtisches Kataster und eine weitere Ebene für raumbezogene Einheiten für ein ländliches Kataster.

BEISPIEL 2 Eine Ebene von raumbezogenen Einheiten, um mit Rechten verbundenen Grundverwaltungseinheiten zu definieren und eine weitere Ebene von raumbezogenen Einheiten, um mit Einschränkungen verbundenen Grundverwaltungseinheiten zu definieren.

BEISPIEL 3 Eine Ebene von raumbezogenen Einheiten, um mit formellen Rechten verbundenen Grundverwaltungseinheiten zu definieren, eine zweite Ebene von raumbezogenen Einheiten, um mit informellen Rechten verbundenen Grundverwaltungseinheiten zu definieren und eine dritte Ebene von raumbezogenen Einheiten, um mit Wohnrechten verbundenen Grundverwaltungseinheiten zu definieren.

BEISPIEL 4 Eine Ebene mit auf Punkten basierenden raumbezogenen Einheiten, eine zweite Ebene mit auf Linien basierenden raumbezogenen Einheiten und eine dritte Ebene mit auf Polygonen basierenden raumbezogenen Einheiten.

### 3.1.7

#### **raumbezogene Schwelleneinheit**

<LADM> raumbezogene Einheit an der Schwelle zwischen zwei- und dreidimensionaler Darstellung

Anmerkung 1 zum Begriff: Eine grenzwertige räumliche Einheit wird durch eine räumliche Einheit an der Schwelle zwischen 2D- und 3D-Darstellungen dargestellt.

### 3.1.8

#### **Punkt**

0-dimensionales geometrisches Primitiv (3.1.31), das eine Position darstellt

Anmerkung 1 zum Begriff: Die Grenze eines Punkts ist die leere Menge.

Anmerkung 2 zum Begriff: Ein Punkt kann verwendet werden, um eine oder mehrere Begrenzungsflächen oder Begrenzungsringe zu definieren.

Anmerkung 3 zum Begriff: Punkte können z. B. durch terrestrische Vermessung, aber auch durch Fotointerpretation, Bildinterpretation oder Identifikation auf einer vorhandenen Karte erfasst werden.

[QUELLE: ISO 19136-1:2020, 3.1.47, modifiziert – Anmerkung 2 und Anmerkung 3 zum Begriff wurden hinzugefügt]

### 3.1.9

#### **Versorgungsnetz**

<LADM> Netz, das den rechtlichen Raum der Topologie einer Versorgungseinrichtung beschreibt

BEISPIEL Der rechtliche Raum, der erforderlich ist, um das Versorgungsnetz zu haben und dieses instand zu halten.

Anmerkung 1 zum Begriff: Ein Versorgungsnetz darf als Attribute Informationen zu seinem rechtlichen, protokollierten oder informellen Raum erhalten.

Anmerkung 2 zum Begriff: Ein Versorgungsnetz kann auch als eine Grundverwaltungseinheit modelliert werden.

## **NA.2 Abkürzungen**

|         |                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------|
| BAUnit  | Grundverwaltungseinheit (en: Basic Administrative Unit)                                                       |
| FIG     | Internationale Vereinigung der Vermessungsingenieure (en: International Federation of Surveyors)              |
| GNSS    | Global Navigation Satellite System                                                                            |
| GPR     | Bodenradar (en: Ground-penetrating radar)                                                                     |
| IHO     | Internationale Hydrographische Organisation (en: International Hydrographic Organization)                     |
| INSPIRE | Geodateninfrastruktur in der Europäischen Gemeinschaft (en: Infrastructure for Spatial Information in Europe) |
| LA      | Landadministrations (en: Land Administration)                                                                 |
| LAS     | Landadministrations-System (en: Land Administration System)                                                   |
| LADM    | Landadministrations-Domänenmodell (en: Land Administration Domain Model)                                      |
| MBES    | Ein Multibeam-Echolot (en: Multibeam Echosounder)                                                             |
| OGC     | Open Geospatial Consortium                                                                                    |
| RRR     | Recht, Einschränkung, Verantwortlichkeit (en: Right, Restriction, Responsibility)                             |
| SDI     | Geodateninfrastruktur (en: Spatial Data Infrastructure)                                                       |
| STDM    | Social Tenure Domain Model                                                                                    |
| TPS     | Terrestrisches Positionierungssystem (en: Terrestrial Positioning System)                                     |
| UML     | vereinheitlichte Modellierungssprache (en: Unified Modelling Language)                                        |

## Nationaler Anhang NB (informativ)

### Literaturhinweise

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DIN EN ISO 19156:2023-12, *Geoinformation — Erdbeobachtung und Erdmessung (ISO 19156:2023)*; Englische Fassung EN ISO 19156:2023

DIN EN ISO 19157-1:2023-12, *Geoinformation — Datenqualität — Teil 1: Allgemeine Anforderungen (ISO 19157-1:2023)*; Englische Fassung EN ISO 19157-1:2023

DIN EN ISO 20524-2:2023-04, *Intelligente Verkehrssysteme — Geografische Datendateien (GDF) GDF5.1 — Teil 2: Kartendaten, die in automatisierten Fahrsystemen, kooperativen ITS und multimodalem Transport verwendet werden (ISO 20524-2:2020)*; Englische Fassung EN ISO 20524-2:2022

DIN ISO 8601-1:2020-12, *Datum und Uhrzeit — Darstellung für den Informationsaustausch — Teil 1: Grundlegende Regeln (ISO 8601-1:2019)*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 287, *Geographic Information*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This edition of ISO 19152-2 together with ISO 19152-1 cancel and replace the first edition (ISO 19152:2012), which has been technically revised.

The main changes are as follows:

- This version of ISO 19152-2 defines the fundamental terms, basic components, relationships, attributes and constraints for land registration. A detailed overview of the model has been presented in its individual packages.
- The terms, although unchanged in principle, have been defined more rigorously (i.e., administrative source, liminal spatial unit), enriched with examples and notes. Updates in ISO/TC 211 standards (i.e., definitions, data types) have been reflected, and corresponding adjustments have been made where necessary.
- Requirements that a land registration system can conform been formulated in contrast to ISO 19152:2012. It is noted that the use of 'shall' only in requirements statements is mandatory according to ISO rules.
- While 3 new (featureType) classes different from ISO 19152:2012 have been introduced in ISO 19152-1 (i.e., LA\_RequiredRelationshipRRR, LA\_LegalSpaceCivilEngineeringElement, LA\_LegalSpaceParcel), 13 new (featureType) classes different from ISO 19152:2012 have been introduced in ISO 19152-2 (i.e., LA\_SurveySource, LA\_DesignSource, LA\_SurveyRelation, LA\_DistanceObservation, LA\_LevelObservation, LA\_AngularObservation, LA\_ImageObservation, LA\_TPSObservation, LA\_PointCloudObservation, LA\_GNSSObservation, LA\_GNSSCorrection, LA\_GPRObservation, LA\_MBESObservation). No (featureType) classes have been removed from 19152:2012.
- The surveying and representation subpackage have been refined with types of observation information, such as distance, level, angular, image, TPS, point cloud, GNSS and GPR.

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- In order to support all types of spatial units two new subclasses for LA\_SpatialUnit have been introduced in ISO 19152-2: LA\_LegalSpaceCivilEngineeringElement and LA\_LegalSpaceParcel. An optional geometry attribute has been added to LA\_SpatialUnit.
- The LA\_LegalSpaceUtilityNetwork (featureType) class has been renamed to LA\_LegalSpaceUtilityNetworkElement. LA\_UtilityNetworkType code list has been renamed to LA\_UtilityNetworkElementType.
- In order to represent topological relationships between spatial units, two new (dataType) classes (i.e., TopoRelation and IntersectionPatternMatrix) have been created based on the definition given in 19107:2019 and have been introduced in ISO 19152-2. In addition, 3 code lists (i.e., TopoRelationType, DimensionExtension and SetMask) have been created based on the definition given in 19107:2019 and have been introduced in ISO 19152-2.
- Only one multiplicity of an association has been changed: A point may now be associated to zero or more [0..\*] spatial units, not [0..1] spatial unit.
- The Annex I (informative) – Social Tenure Domain Model (STDM) of ISO 19152:2012 has been refined and moved to the Annex B (formative) of ISO 19152-2.
- Annex A (normative) – Abstract Test Suite has been redesigned using the requirements introduced the main part of ISO 19152-2.
- Annex C (informative) – 2D and 3D Representations of Spatial Units has been refined and extended in order to support all types of spatial unit representation.
- Annex G (informative) – Code Lists has been refined and extended to support semantically enriched code list values. Generic definitions for code list values have been provided. Existing code lists have been refined with new values and 24 new code lists have been introduced (i.e., LA\_CivilEngineeringType, LA\_ParcelUseType, LA\_SurveyPurposeType, LA\_AutomationLevelType, LA\_PlatformType, LA\_SurveyMethodType, LA\_ObservationsAccuracyType, LA\_LifecyclePhaseType, LA\_DesignFileCreatorRoleType, LA\_DesignObjectType, LA\_SourceFileType, LA\_SpatialTransactionType, LA\_DistanceType, LA\_AngleType, LA\_SatelliteSystemType, LA\_GNSSSurveyType, LA\_GNSSReferenceStationsNetworkType, LA\_GNSSReferenceStationsNetworkScale, LA\_CorrectionServiceType, LA\_GNSSFrequencyType, LA\_SSR\_Error\_Components, TopoRelationType, DimensionExtension and SetMask) in ISO 19152-2.
- Annex H (informative) – The LADM and LPIS, Annex M (informative) – Modelling land administration processes and Annex N (informative) – History and dynamic aspects of ISO 19152:2012 have not been included in ISO 19152-2. Annex K (informative) – LADM and IndoorGML and Annex L (informative) – LADM and legal spaces in buildings have been introduced in ISO 19152-2. All the other not mentioned annexes has been updated and refined.
- The bibliography has been revised to include additional references and has been reformatted.

A list of all parts in the ISO 19152 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

This document defines the Land Administration Domain Model (LADM). The LADM is a conceptual model, and not a data product specification (in the sense of ISO 19131).

The purpose of the LADM is not to replace existing systems, but rather to provide a formal language for describing them, so that their similarities and differences can be better understood. This is a descriptive standard, not a prescriptive standard.

Land administration / geo-regulation is a large field; the focus of this document is on that part of land administration that is interested in rights, responsibilities and restrictions affecting land, and the geometrical (geospatial) components thereof. The LADM provides a reference model which will serve two goals:

- a) to provide an extensible basis for the development and refinement of efficient and effective land administration systems, based on a Model Driven Architecture (MDA); and
- b) to enable involved parties, both within one country and between different countries, to communicate, based on the shared vocabulary (that is, an ontology), implied by the model.

The second goal is relevant for creating standardized information services in a national and international context, where land administration / geo-regulation domain semantics have to be shared between regions, or countries, in order to enable necessary translations. Four considerations during the design of the model were:

- it will cover the common aspects of land administration / geo-regulation worldwide;
- it will be based on the conceptual framework of ‘Cadastre 2014’ of the International Federation of Surveyors (FIG);
- it will be as simple as possible to be useful in practice;
- the geospatial aspects follow the ISO/TC 211 conceptual model.

The first edition of this standard, ISO 19152:2012 concentrated on Land Administration, Land Registration and Cadastre. This information is about the relationship between people and land. This is now included in Part 2 with a more refined survey model, namely by this standard. Part 1 of this standard provides the general reference model for all aspects of regulation in a geospatial environment. Part 3 is Marine georegulation, Part 4 Valuation information and Part 5 Spatial plan information. Part 6 provides an overview of relevant aspects in implementations.

Until now, most countries (or states, provinces) have developed their own Land Administration System. Some systems are centralized, and others decentralized, while some are based on a general boundaries approach, others on fixed boundaries. Some systems have a fiscal background, others a legal one. The different implementations (foundations) of the various Land Administration Systems do not facilitate meaningful communication across borders. However, looking from a distance, one will observe that the different systems are in principle largely the same: they are all based on the relationships between people and land, linked by (ownership or use) rights, and are in most countries influenced by developments in Information and Communication Technology (ICT). Furthermore, the two main functions of every land administration (including cadastre and/or land registry) are:

- i) keeping the contents of these relationships up-to-date (based on regulations and related transactions); and
- ii) providing information from the (national) registers.

Land administration is described as the process of determining, recording and disseminating information about the relationship between people and land. If ownership is understood as the mechanism through which rights to land are held, then it can be viewed as a type of 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. These recognised rights are in

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principle eligible for registration, with the purpose being to assign a certain legal meaning to the registered right (e.g., a title). Therefore, land administration systems are not just 'handling geographic information', as they represent a lawfully meaningful relationship amongst people, and between people and land.

As land administration activity on the one hand deals with huge amounts of data, which moreover are of a dynamic nature, and on the other hand requires a continuous maintenance process, then the role of ICT 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. Organizations are now increasingly confronted with rapid developments in technology, a technology push (the Internet, geospatial databases, modelling standards, open systems, BIM and GIS), as well with a growing demand for new services, a market pull (e-governance, sustainable development, electronic conveyance, and the integration of public data and systems). Modelling is a basic tool, facilitating appropriate system development and reengineering and, in addition, it forms the basis for meaningful communication between different systems.

Standardization has become a well-known process in the work of land administrations and land registries. In both paper-based systems and computerized systems, standards are required to identify objects, transactions, relationships between objects (e.g., parcels, generally referred to as spatial units) and persons (e.g., citizens and generally referred to as parties), classification of land use, land value, map representations of spatial units, and so on. Computerized systems require further standardization when topology and the identification of single boundaries are introduced. In existing land administration systems and land registries, standardization is generally limited to the region, or jurisdiction, where the land administration (including cadastre and/or land registry) is in operation. Open markets, globalization, and effective and efficient development and maintenance of flexible (generic) systems, require further standardization.

The scope of this document is provided in Clause 1. Conformance in relation to this document is given in Clause 2, and a conformance test is specified in Annex A. Normative references are presented in Clause 3 and the used terms, definitions and abbreviations in Clause 4. Clause 5 provides the notation and context. Clause 6 gives a global overview of packages. Clause 7 introduces the classes, attributes and associations in detail. Annex B gives an overview of Social Tenure Domain Model (STDM). Annex C explains the 2D and 3D representations of spatial units, spatial unit profiles and refined survey model. A comprehensive set of informative examples (using instance level cases) is available in Annex D.

It must be noted that this is a generic domain model. It is expandable and it is likely that additional attributes, operators, associations, and perhaps even additional classes, will be needed for a specific region or country. Code list values in the main text are informative (not normative) and can only be considered as examples. Specific parts of the LADM are further detailed in the legal profiles in Annex E. Some examples of using the LADM in a specific context are: the INSPIRE cadastral parcels in Annex F. It is possible to use only a subset, or profile, of the LADM for a specific implementation. Annex G presents the LADM code lists as a basis for describing a flexible enumeration, and gives an overview of semantic technologies for representing code list values.

The construction of external databases with party data, address data, taxation data, land cover data, physical utility network data, and archive data, is outside the scope of the LADM. However, the LADM provides stereotype classes for these data sets (if available), see Annex H. Interface classes are in Annex I. Annex J explains the link to other ISO international standards. Annex K presents a framework for the integration of the LADM and IndoorGML. Annex L proposes a framework for representing legal spaces in building.

# Geographic information — Land Administration Domain Model (LADM) —

## Part 2: Land registration

### 1 Scope

This document:

- a) defines a reference Land Administration Domain Model (LADM) covering basic information-related components of Land Administration (including elements above and below the surface of the earth);
- b) provides an abstract, conceptual model with three packages and one sub-package related to
  - 1) parties (people and organizations) [19152-2];
  - 2) basic administrative units, rights, responsibilities, and restrictions (ownership rights) [19152-2];
  - 3) spatial units (parcels, and the legal space of buildings and utility networks and other geometry) with a sub-package on surveying and spatial representation (geometry and topology) [19152-2];
- c) provides terminology for land administration, based on various national and international systems, that is as simple as possible in order to be useful in practice. The terminology allows a shared description of different formal or informal practices and procedures in various jurisdictions;
- d) provides a platform for comparison and monitoring that is based on indicators;
- e) provides a basis for national and regional profiles; and
- f) enables the combination of land administration information from different sources in a coherent manner.

The following is outside the scope of this document:

- interference with (national) land administration laws that may have any legal implications; and
- construction of external databases with party data, address data, land cover data, physical utility network data, archive data and taxation data. However, the LADM provides stereotype classes for these data sets to indicate which data set elements the LADM expects from these external sources, if available.

This document provides the concepts and the detailed structure for standardization in the land administration domain.

### 2 Normative references

The following documents are referred to in the main text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 5218:2022, *Information technology — Codes for the representation of human sexes*

ISO 19103:2015, *Geographic information — Conceptual schema language*

ISO 19105:2022, *Geographic information — Conformance and testing*

ISO 19107:2019, *Geographic information — Spatial schema*

ISO 19109:2015, *Geographic information — Rules for application schema*

ISO 19111:2019, *Geographic information — Referencing by coordinates*

ISO 19115-1:2014, *Geographic information — Metadata — Part 1: Fundamentals*

ISO 19152-1:2024, *Geographic information — Land Administration Domain Model (LADM) — Part 1: Generic conceptual model*

ISO 19156:2023, *Geographic information — Observations, measurements and samples*

OGC *Land and Infrastructure Conceptual Model Standard (LandInfra)*

### 3 Terms, definitions and abbreviations

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19152-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

##### 3.1.1

##### **administrative source**

<LADM> source comprised of the administrative description (where applicable) of the parties involved, the rights, restrictions and responsibilities created and the basic administrative units affected

EXAMPLE 1 The evidence of a party's right to a basic administrative unit.

EXAMPLE 2 A document describing a transaction (a deed), or a judgement of the register holder.

##### 3.1.2

##### **boundary**

set that represents the limit of an entity

Note 1 to entry: Boundary is most commonly used in the context of geometry, where the set is a collection of points or a collection of objects that represent those points. In other arenas, the term is used metaphorically to describe the transition between an entity and the rest of its domain of discourse.

[SOURCE: ISO 19107:2019, 3.6]

##### 3.1.3

##### **boundary face**

face that is used in the 3-dimensional representation of a boundary of a spatial unit

Note 1 to entry: Boundary faces are used when the implied vertical and unbounded faces of a boundary face string are not sufficient to describe 3D spatial units. Boundary faces close volumes in height (e.g., every apartment floor), or in depth (e.g. an underground parking garage), or in all other directions to form a bounded volume. The volumes represent legal space (in contrast with physical space).

[SOURCE: ISO 19152-1:2024, 3.22]

### 3.1.4

#### **boundary face string**

boundary forming part of the outside of a spatial unit

Note 1 to entry: Boundary face strings are used to represent the boundaries of spatial units by means of linestrings in 2D. This 2D representation is a 2D boundary in a 2D land administration system. In a 3D land administration system, it represents a series of vertical boundary faces where an unbounded volume is assumed, surrounded by boundary faces which intersect the earth's surface (such as traditionally depicted in the cadastral map).

### 3.1.5

#### **face**

<topology> 2-dimensional topological primitive

Note 1 to entry: The geometric realization of a face is a surface. The boundary of a face is the set of directed edges within the same topological complex that are associated to the face via the boundary relations. These can be organized as rings.

[SOURCE: ISO 19107:2019, 3.38]

### 3.1.6

#### **level**

<LADM> set of spatial units, with a geometric, and/or topologic, and/or thematic coherence

EXAMPLE 1 One level of spatial units for an urban cadastre and another for spatial units for a rural cadastre.

EXAMPLE 2 One level of spatial units to define basic administrative units associated with rights and another level of spatial units to define basic administrative units associated with restrictions.

EXAMPLE 3 One level of spatial units to define basic administrative units associated with formal rights, a second level for spatial units to define basic administrative units associated with informal rights and a third level for spatial units to define basic administrative units associated with customary rights.

EXAMPLE 4 One level with point based spatial units, a second level with line based spatial units, and a third level with polygon based spatial units.

### 3.1.7

#### **liminal spatial unit**

<LADM> spatial unit with a geometry represented as a combination of boundary face strings (2D) and boundary faces (3D)

Note 1 to entry: A liminal spatial unit is represented by a spatial unit on the threshold between 2D and 3D representations.

### 3.1.8

#### **point**

0-dimensional geometric primitive, representing a position

Note 1 to entry: The boundary of a point is the empty set.

Note 2 to entry: A point may be used to define one or more boundary faces or boundary face strings.

Note 3 to entry: Points can be observed by e.g., terrestrial surveying, but also by photo interpretation, image interpretation, or identification on an existing map.

[SOURCE: 19136-1:2020, 3.1.47, modified —Note 2 and 3 to entry to entry have been added.]

### 3.1.9

#### **utility network**

<LADM> network describing the legal space of the topology of a utility

EXAMPLE The legal space needed to locate and maintain the network.

Note 1 to entry: A utility network may be attributed with information about its legal, recorded or informal space.

Note 2 to entry: A utility network can also be modelled as a basic administrative unit.

## 3.2 Abbreviations

|         |                                                  |
|---------|--------------------------------------------------|
| BAUnit  | Basic Administrative Unit                        |
| FIG     | International Federation of Surveyors            |
| GNSS    | Global Navigation Satellite System               |
| GPR     | Ground-penetrating radar                         |
| IHO     | International Hydrographic Organization          |
| INSPIRE | Infrastructure for Spatial Information in Europe |
| LA      | Land Administration                              |
| LAS     | Land Administration System                       |
| LADM    | Land Administration Domain Model                 |
| MBES    | Multibeam Echosounder                            |
| OGC     | Open Geospatial Consortium                       |
| RRR     | Right, Restriction, Responsibility               |
| SDI     | Spatial Data Infrastructure                      |
| STDM    | Social Tenure Domain Model                       |
| TPS     | Terrestrial Positioning System                   |
| UML     | Unified Modelling Language                       |

## 4 Conformance

### 4.1 Conformance requirements and testing

Conformance to this part of the ISO 19152 series on Land Administration Domain Model (LADM) (Part 2 – Land registration) consists of alignment with the requirements established in Clauses 4.2 and 7 in this document. The Abstract Test Suite given in Annex A describes a methodology for testing conformance to these requirements.

### 4.2 Conformance classes

#### 1) ‘Based on Generic Conceptual Model’

<https://standards.isotc211.org/19152/-2/1/req/basedongenericconceptualmodel>

**Requirement 1:** This part of the standard is based on Part 1 – Generic Conceptual Model. All requirements contained in 19152-1 shall apply to this part of the standard.

#### 2) ‘Continuum of Rights’

<https://standards.isotc211.org/19152/-2/1/req/continuumofrights>

**Requirement 2:** The continuum of land rights shall be supported. This includes the recognising, recording, administering a variety of appropriate and legitimate land tenure forms, such as registered freehold, lease, group tenure, adverse possession, occupancy, customary.

3) ‘Grouping People Land’

<https://standards.isotc211.org/19152/-2/1/req/groupingpeopleland>

**Requirement 3:** Groupings of people and land shall be supported. The flexibility of LA model can be based on the recognition that people to land relationships appear in many different ways, depending on local tradition, culture, religion and behaviour.

4) ‘Different Organisations’

<https://standards.isotc211.org/19152/-2/1/req/differentorganisations>

**Requirement 4:** LA data can be maintained by different organisations. And within one organisation at many sites. Administrative territories for organisations can be completely different. The LADM based systems shall be implemented as a distributed set of (geo-) information systems, each supporting the maintenance processes (transactions in land rights, establishment of rights, restrictions and responsibilities) and the information supply of parts of the data set, represented in this model.

5) ‘Keep Data to Source’

<https://standards.isotc211.org/19152/-2/1/req/keepdatatosource>

**Requirement 5:** LA data shall be kept to the source within Spatial Data Infrastructure (SDI). Today all data (spatial and thematic) can be stored in a Data Base Management System (DBMS). Information products are becoming flexible combinations of digital data components and additional facilities and services. This can replace the exchange of copies of data sets between organisations. Multi source information products require avoidance of redundancy and good standardisation protocols.

## 5 Notation

The conceptual schema specified in this part of ISO 19152 is described using the Unified Modelling Language (UML), following the guidance of ISO 19103:2015.

Several model elements used in this schema are defined in other ISO geographic information standards. By convention within some ISO/TC 211 standards, names of UML classes, with the exception of basic data type classes, include a two-letter prefix that identifies the standard and the UML package in which the class is defined. This provides a global unique name for the class. UML classes defined in this part of ISO 19152 have the two-letter prefix of LA. Table 1 lists the prefixes as defined for some of the other parts of ISO 19152. Same prefix is used for Part 1 and Part 2 to support backward compatibility. Table 2 lists the prefixes used by LADM.

**Table 1 — Sources of internally defined UML classes**

| Prefix | Standard | Part                     |
|--------|----------|--------------------------|
| LA     | 19152-1  | Generic conceptual model |
| LA     | 19152-2  | Land registration        |
| MG     | 19152-3  | Marine georegulation     |
| VM     | 19152-4  | Valuation information    |
| SP     | 19152-5  | Spatial plan information |

Table 2 — External sources used by LADM

| Prefix | Standard | Part                          |
|--------|----------|-------------------------------|
| CI, LI | 19115-1  | Metadata Part 1: Fundamentals |
| OM     | 19156    | Observations and measurements |

## 6 Overview of the LADM conceptual information model

### 6.1 General

LADM, as a product, is a conceptual schema. The LADM is organized into three packages, and one subpackage. A (sub)package is a group of classes, with a certain degree of cohesion. Each (sub)package has its own namespace. (Sub)packages facilitate the maintenance of different data sets by different organizations. The complete model may therefore be implemented through a distributed set of (geo-) information systems, each supporting data maintenance activities and the provision of elements of the model. The model may also be implemented by one or more maintenance organizations (national, regional or local). This underlines the relevance of the model: different organizations have their own responsibilities in data maintenance and supply but may communicate on the basis of standardized administrative and technical update processes.

The standards addressing land administration and geo-regulation makes use of the generic General Feature Model as described in ISO standard 19109 Rules for application schema. It describes a feature oriented approach where a feature may have thematic, temporal, spatial, quality, etc. attributes. The spatial geometries derive directly from this structure.

### 6.2 Packages and subpackages of the LADM

The LADM is organized into a set of packages, and subpackages (see Figure 1). A (sub)package is a group of classes, with a certain degree of cohesion. Each (sub)package has its own namespace. (Sub)packages facilitate the maintenance of different data sets by different organizations. The complete model may therefore be implemented through a distributed set of (geo-) information systems, each supporting data maintenance activities and the provision of elements of the model. The model may also be implemented by one or more maintenance organizations, 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 may communicate on the basis of standardized administrative and technical update processes.

LADM Part 1 – Generic conceptual model and LADM Part 2 – Land registration together form an application schema. Figure 1 shows all classes of Part 1 and Part 2.

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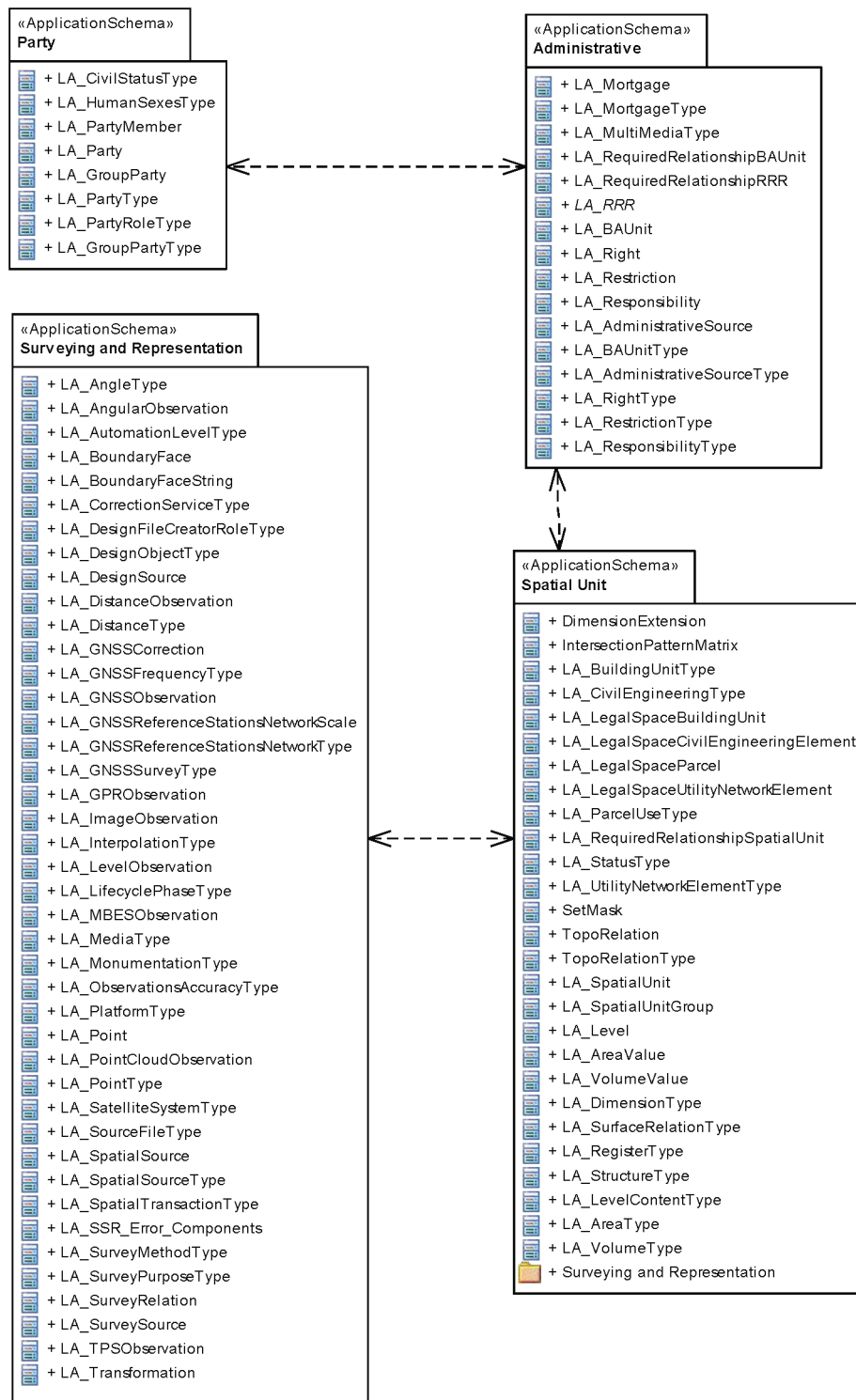


**Figure 1 — Packages of the core LADM (with their respective classes)**

Table 3 shows which packages and classes are defined in which part of the standard.

Table 4 shows which packages and code lists are defined in which part of the standard.

It is important to note that no attributes are available in Part 1, except for the special classes. This part of the standard gives detailed descriptions about the classes introduced in Part 1 and the classes introduced in this part of the standard. Table 4

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**Table 3 — Packages and classes of Part 1 and Part 2**

| (Sub)Package name            | Class name                                                                                                                                                                                                                                                                                                                                                             | Defined part |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Special classes              | LA_Source, VersionedObject, Oid, Fraction                                                                                                                                                                                                                                                                                                                              | Part 1       |
|                              | —                                                                                                                                                                                                                                                                                                                                                                      | Part 2       |
| Party                        | LA_Party, LA_GroupParty, LA_PartyMember                                                                                                                                                                                                                                                                                                                                | Part 1       |
|                              | —                                                                                                                                                                                                                                                                                                                                                                      | Part 2       |
| Administrative               | LA_BAUnit, LA_RRR, LA_Right, LA_Restriction, LA_Responsibility, LA_AdministrativeSource, LA_RequiredRelationshipBAUnit, LA_RequiredRelationshipRRR                                                                                                                                                                                                                     | Part 1       |
|                              | LA_Mortgage                                                                                                                                                                                                                                                                                                                                                            | Part 2       |
| Spatial unit                 | LA_SpatialUnit, LA_SpatialUnitGroup, LA_Level, LA_RequiredRelationshipSpatialUnit                                                                                                                                                                                                                                                                                      | Part 1       |
|                              | LA_LegalSpaceParcel, LA_LegalSpaceBuildingUnit, LA_LegalSpaceUtilityNetworkElement, LA_LegalSpaceCivilEngineeringElement, LA_AreaValue, LA_VolumeValue                                                                                                                                                                                                                 | Part 2       |
| Surveying and representation | —                                                                                                                                                                                                                                                                                                                                                                      | Part 1       |
|                              | LA_Point, LA_BoundaryFace, LA_BoundaryFaceString, LA_SpatialSource, LA_SurveySource, LA_DesignSource, LA_AngularObservation, LA_DistanceObservation, LA_GNSSObservation, LA_GNSSCorrection, LA_GPRObservation, LA_ImageObservation, LA_LevelObservation, LA_MBESObservation, LA_PointCloudObservation, LA_TPSPSObservation, LA_SSR_Error_Components, LA_Transformation | Part 2       |

**Table 4 — Packages and code lists of Part 1 and Part 2**

| (Sub)Package name            | Code list name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Defined part |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Special classes              | LA_AvailabilityStatusType                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Part 1       |
|                              | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Part 2       |
| Party                        | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Part 1       |
|                              | LA_PartyType, LA_PartyRoleType, LA_HumanSexesType, LA_CivilStatusType, LA_GroupPartyType                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Part 2       |
| Administrative               | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Part 1       |
|                              | LA_BAUnitType, LA_AdministrativeSourceType, LA_RightType, LA_RestrictionType, LA_ResponsibilityType, LA_MortgageType, LA_MultiMediaType                                                                                                                                                                                                                                                                                                                                                                                                                         | Part 2       |
| Spatial unit                 | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Part 1       |
|                              | LA_DimensionType, LA_SurfaceRelationType, LA_RegisterType, LA_StructureType, LA_LevelContentType, LA_AreaType, LA_VolumeType, LA_BuildingUnitType, LA_CivilEngineeringType, LA_ParcelUseType, LA_StatusType, LA_UtilityNetworkElementType, TopoRelation, DimensionExtension, SetMask, TopoRelationType                                                                                                                                                                                                                                                          | Part 2       |
| Surveying and representation | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Part 1       |
|                              | LA_AngularType, LA_AutomationLevelType, LA_CorrectionServiceType, LA_DesignFileCreatorRoleType, LA_DesignObjectType, LA_DistanceType, LA_GNSSCorrection, LA_GNSSFrequencyType, LA_GNSSReferenceStationsNetworkScale, LA_GNSSReferenceStationsNetworkType, LA_GNSSSurveyType, LA_InterpolationType, LA_LifecyclePhaseType, LA_MediaType, LA_MonumentationType, LA_ObservationsAccuracyType, LA_PlatformType, LA_PointType, LA_SatelliteSystemType, LA_SourceFileType, LA_SpatialSourceType, LA_SpatialTransactionType, LA_SurveyMethodType, LA_SurveyPurposeType | Part 2       |

### 6.3 Basic classes of the LADM

The core LADM is based on six basic classes:

- a) Class *LA\_Source*. Instances of this class are sources;
- b) Class *VersionedObject*. Instances of subclasses of *VersionedObject* are all LADM classes except for *LA\_Source*.
- c) Class *LA\_Party*. Instances of this class are parties;
- d) Class *LA\_RRR*. Instances of subclasses of *LA\_RRR* are Rights, Restrictions or Responsibilities;
- e) Class *LA\_BAUnit*. Instances of this class are basic administrative units;
- f) Class *LA\_SpatialUnit*. Instances of this class are spatial units;

Figure 2 shows the basic classes of the LADM. The details of these first four basic classes, and all other LADM classes, are presented in Clause 7. The details of *LA\_Source* and *VersionedObject* are presented in Part 1. The informative Annex C of Part 1 includes an overview how LADM parts are related to each other including Part 2.

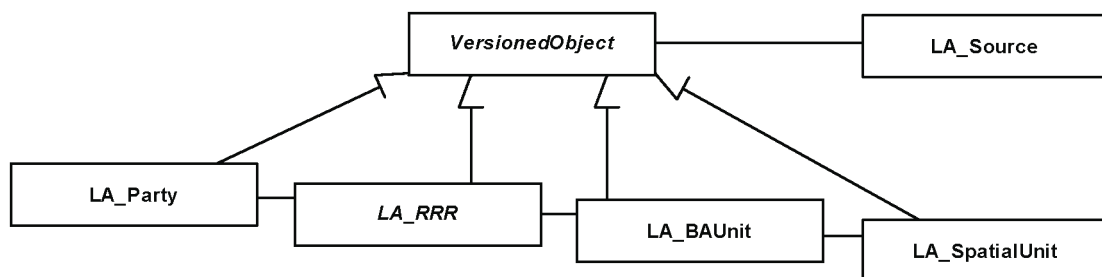


Figure 2 — Basic classes of the core LADM

### 6.4 Surveying and Representation Subpackage

The sixteen classes of the Surveying and Representation Subpackage are *LA\_Point*, *LA\_BoundaryFaceString*, *LA\_BoundaryFace*, *LA\_SpatialSource*, *LA\_DesignSource*, *LA\_SurveySource*, *LA\_DistanceObservation*, *LA\_LevelObservation*, *LA\_ImageObservation*, *LA\_AngularObservation*, *LA\_GNSSObservation*, *LA\_TPSObservation*, *LA\_GPRObservation*, *LA\_MBESObservation*, *LA\_PointCloudObservation*, and *LA\_GNSSCorrection*, see Figure 3. Except for the first four classes, which are also included in ISO 19152:2012, all classes are introduced in this part of the standard.

Points, as instances of *LA\_Point*, lines, surfaces and volumes can be acquired in the field (with classical topographic surveys, or with satellite navigation systems), in an office (reusing input from design), or compiled from various sources, for example using forms, field sketches or orthophotos. The acquisition of points, lines, surfaces or volumes (through a topographic survey) may concern the identification of spatial units on a photograph, on an image (orthophoto), or on a topographic map, while cycloramas or pictometry methods (multiple images from different angles) may also be used for that purpose.

The *LA\_SpatialSource* class as defined in ISO 19152:2012 LADM, is being updated and extended. There are two subclasses of *LA\_SpatialSource*; *LA\_SurveySource* and *LA\_DesignSource*, to provide more insights at the spatial source registered at the system. A survey is documented with survey sources, instances from class *LA\_SurveySource*. This may be the final (sometimes formal) documents, or all documents related to a survey. Sometimes, several documents are the result of a single survey. A design document (e.g., BIM/IFC, DXF) is documented with design sources, instances from class *LA\_DesignSource*. A spatial source (survey or design) may be official, or not (i.e., a registered survey plan, or an aerial photograph). Paper based documents (which may be scanned) can be considered as an integral part of the land administration system.

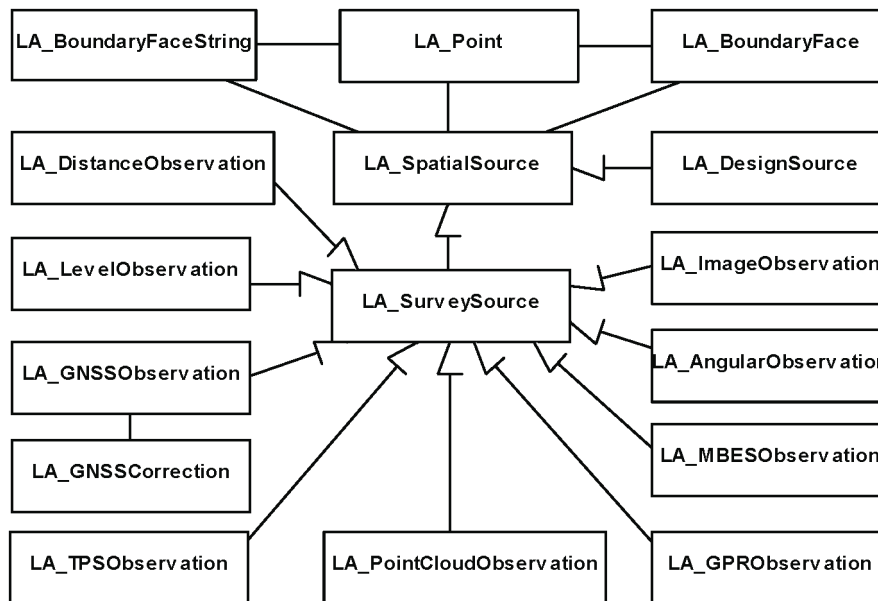


Figure 3 — Classes of the Surveying and Representation Subpackage

The subclasses of the LA\_SurveySource relate to the various survey acquisition methods that could be used during a survey, specifically: distance observations, angular observations, level observations, image-based methods, GPS, GNSS and/or using Galileo High Accuracy Services, classic total station, GPR observations, MBES observations and point-clouds observations (LiDAR is a common survey technique for point cloud observation).

The subclasses of LA\_SurveySource are extendable based upon sensor characteristics. Specifically in certain countries (countries that follow fixed boundary approach) refined survey model is added to Part 2 to meet the requirements of the cadastral survey community.

The individual points are instances of class LA\_Point, which is associated to LA\_SpatialSource. While it is not required that the complete spatial unit is represented, a spatial source may be associated to several points. Geodetic control points, including multiple sets of coordinates for points, and with multiple reference systems, are all supported in the LADM.

2D and 3D representations of spatial units use boundary face strings as instances of class LA\_BoundaryFaceString, and boundary faces as instances of class LA\_BoundaryFace.

Coordinates themselves either come from points or are captured as linear geometry.

The LADM supports the increasing use of 3D representations of spatial units, without putting an additional burden on the existing 2D representations. Another feature of the spatial representation within the LADM is that there is no mismatch between spatial units that are represented in 2D and spatial units that are represented in 3D.

## 7 Content of classes of the LADM and their association

### 7.1 General

The detailed content of the core LADM packages is given in this part.

### 7.2 Introduction

All LADM classes adhere to ISO 19103:2015 stereotype class featureType (a feature type is a class of features, i.e., abstractions of real-world phenomena, having common properties). Many LADM classes are subclasses of class VersionedObject (see 19152-1:2024).

The LADM presupposes stereotype classes, with a minimal number of attributes, to address the situation where an LADM class refers to external sources for parties, addresses, taxation, land cover, building units, utility networks, or archives. See Annex H.

### 7.3 Special classes

#### 6) ‘Authentic Source Documents’

<https://standards.iso/211.org/19152/-2/1/req/authenticsourcesdocuments>

**Requirement 6:** Inclusion of new data and data updates shall be documented. This concerns legal administrative data, spatial data and/or technical data.

#### 7.3.1 LA\_Source

In the LADM, administrative sources and spatial sources are modelled, starting with a concrete class LA\_Source (ISO 19152-1:2024). LA\_Source has two subclasses:

- a) LA\_AdministrativeSource (see 7.5.7);
- b) LA\_SpatialSource (see 7.7.4).

LA\_SpatialSource has two subclasses:

- LA\_SurveySource (see 7.7.5);
- LA\_DesignSource (see 7.7.6), see Figure 4.

Integrated Source is modelled as an association between the Administrative and the Spatial source classes. Different source types are represented via assignment of multiplicity, where “0” represents a case of a pure Administrative or Spatial source, whereas “1” illustrates a situation where a document contains both attributes from LA\_AdministrativeSource as well as from the LA\_SpatialSource.

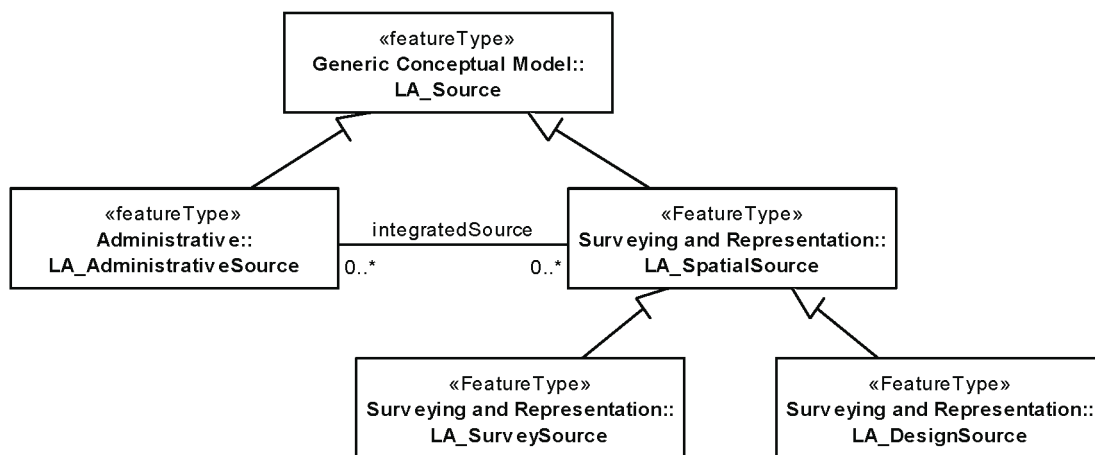


Figure 4 — Class LA\_Source (with subclasses)

#### 7) ‘Transparency’

<https://standards.iso/211.org/19152/-2/1/req/transparency>

**Requirement 7:** All updates shall be traceable in LADM compliant LASSs.

#### 7.3.2 VersionedObject

Class VersionedObject is introduced in the LADM to manage and maintain historical data in the database. History requires, that inserted and superseded data, are given a timestamp. In this way, database content

can be reconstructed as it was at any historical moment, in addition all events can be recollected (see Section 6.3.1 of Part 1)

Classes LA\_Party, LA\_PartyMember, LA\_RRR, LA\_BAUnit, LA\_SpatialUnit, LA\_SpatialUnitGroup, LA\_RequiredRelationshipSpatialUnit, LA\_RequiredRelationshipBAUnit, LA\_RequiredRelationshipRRR, LA\_Level, LA\_SurveyRelation, LA\_BoundaryFaceString, LA\_BoundaryFace, and LA\_Point are all subclasses of class VersionedObject, see Figure 5.

Classes LA\_GroupParty, LA\_Right, LA\_Restriction, LA\_Responsibility, LA\_Mortgage (via LA\_Restriction), LA\_LegalSpaceParcel, LA\_LegalSpaceUtilityNetworkElement, LA\_LegalSpaceBuildingUnit and LA\_LegalSpaceCivilEngineeringElement inherit VersionedObject through the above classes.

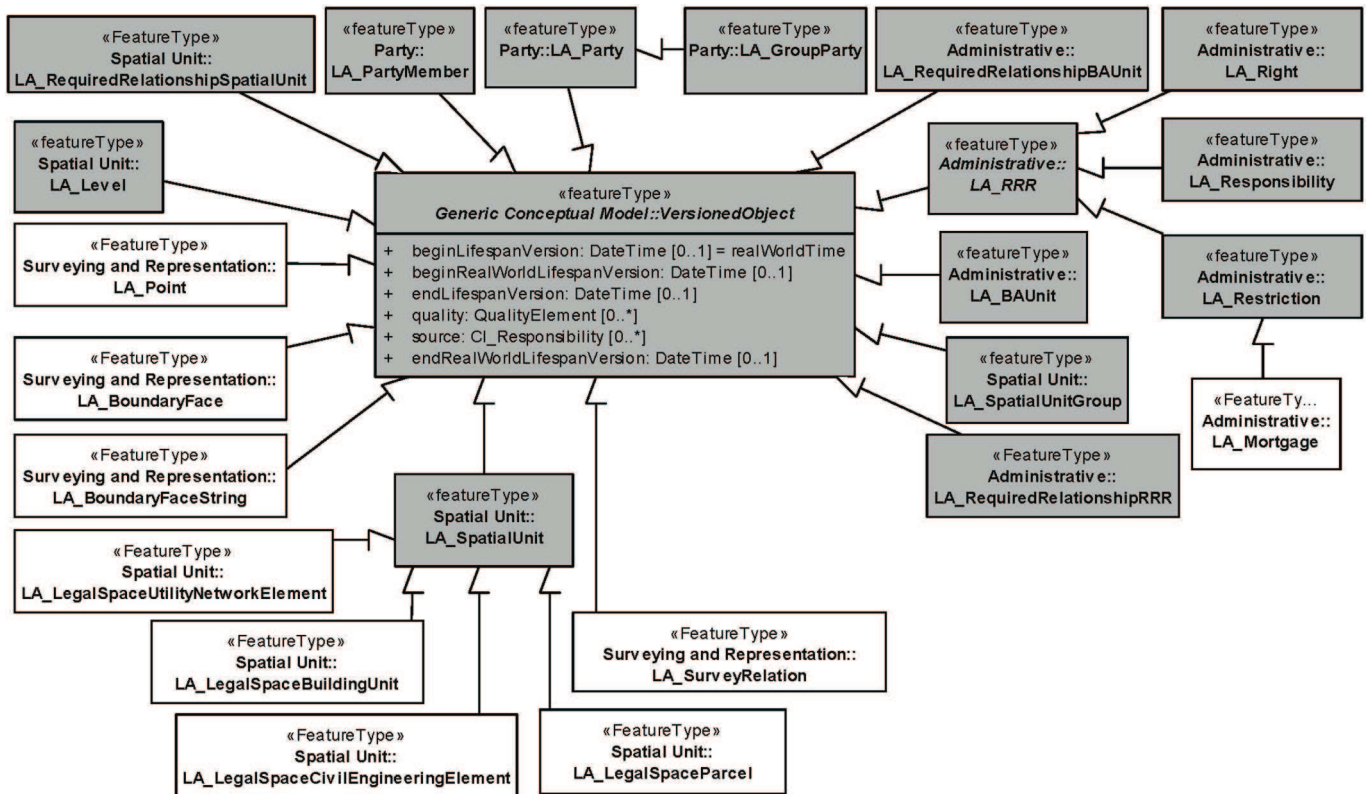


**Figure 5 — Classes VersionedObject (with subclasses)**

## 7.4 Classes of Party Package

### 8) 'Responsible Person'

<https://standards.isotc211.org/19152/-2/1/req/responsibleperson>

**Requirement 8:** The names of persons responsible for transactions shall be part of the source data set (conveyors, surveyors, registrars, etc.). This is one reason for management of history and for documentation of all updates.

### 9) 'Continuum of Right Parties'

<https://standards.isotc211.org/19152/-2/1/req/continuumofrightparties>

**Requirement 9:** Efficient and effective LAS using this part of ISO 19152 LADM shall support all types of parties. Parties can be persons, or groups of persons, or non-natural persons, that compose an identifiable single entity. A non-natural person may be a tribe, a family, a village, a company, a municipality, the state, a farmer's community/co-operation, a slum dwellers group/organisation, a religious community, and so on. This list may be extended, and it can be adapted to local situations, based on community needs.

### 7.4.1 LA\_Party

An instance of class LA\_Party is a party. A party is associated to zero or more [0..\*] instances of a subclass of LA\_RRR. LA\_Party is also associated to LA\_BAUnit, to cater for the fact that a basic administrative unit can be a party (e.g., a basic administrative unit holding an easement on another basic administrative unit). A party may be associated to zero or more [0..\*] administrative sources. A party may be associated to zero or more [0..\*] spatial sources, depicting explicit relations between the LA\_Party class and the Administrative and/or Spatial classes. Third party that does not necessarily associated with the source documents, is portrayed via role attribute in the LA\_Party class itself; see Figure 6.

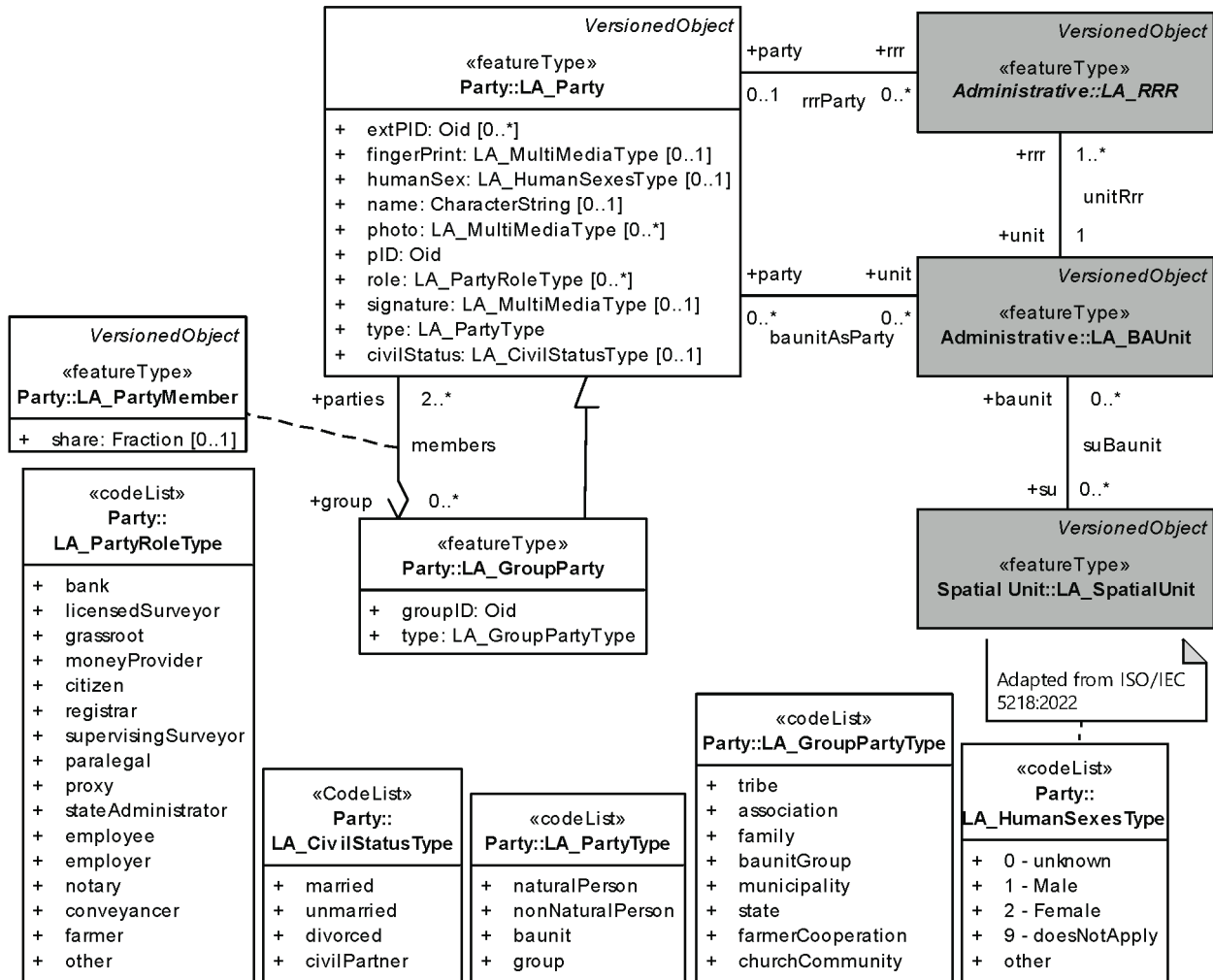


**Figure 6 — Content of Party Package and associations to other basic classes**

The attributes of LA\_Party are shown in Table 5.

**Table 5 — Attributes of LA\_Party**

| Attribute name | Type             | Cardinality | Description                                                  |
|----------------|------------------|-------------|--------------------------------------------------------------|
| extPID         | Oid              | 0..*        | The identifier of party in an external register              |
| name           | CharacterString  | 0..1        | The name of party                                            |
| pID            | Oid              | 1           | The identifier of party                                      |
| role           | LA_PartyRoleType | 0..*        | The role of party in the data update and maintenance process |
| type           | LA_PartyType     | 1           | The type of party                                            |

**Table 5 (continued)**

| Attribute name | Type               | Cardinality | Description                                          |
|----------------|--------------------|-------------|------------------------------------------------------|
| photo          | LA_MultiMediaType  | 0..*        | The photo of party                                   |
| fingerprint    | LA_MultiMediaType  | 0..1        | The fingerprint of party (natural person only)       |
| signature      | LA_MultiMediaType  | 0..1        | The signature of party                               |
| humanSex       | LA_HumanSexesType  | 0..1        | The human sex type of party (natural person only)    |
| civilStatus    | LA_CivilStatusType | 0..1        | The civil status type of party (natural person only) |

NOTE 1 If ‘role’ has a specific value (e.g. conveyancer) then it is possible that no subclasses of LA\_RRR are associated to the party, hence [0..\*] multiplicity, 0 indicating that e.g. this conveyancer is not involved in any subclass of LA\_RRR.

NOTE 2 Party with defined membership is a group party.

NOTE 3 Human sex types are adapted from ISO/IEC 5218:2022. Additional attributes may be added, for example to specify any indicators used in support of the United Nations’ Sustainability Goals.

NOTE 4 This part of 19152 is flexible enough to collect statistics about civil status and human sexes in order to support United Nations’ Sustainable Development Goal 5 Gender Equality.

EXAMPLE Parties are demonstrated in instance level cases, see Annex D, Figures D.3, D.4 and D.13.

#### 7.4.2 LA\_GroupParty

An instance of class LA\_GroupParty is a group party. Class LA\_GroupParty is a subclass of LA\_Party, thus allowing instances of class LA\_GroupParty to have an association with instances of class LA\_RRR (and thereby also to class LA\_BAUnit). A group party consists of two or more [2..\*] parties, but also of other group parties (that is to say, a group party of group parties). Conversely, a party is a member of zero or more [0..\*] group parties, see Figure 6.

The attributes of LA\_GroupParty are shown in Table 6.

**Table 6 — Attributes of LA\_GroupParty**

| Attribute name | Type              | Cardinality | Description                     |
|----------------|-------------------|-------------|---------------------------------|
| groupID        | Oid               | 1           | The identifier of a group party |
| type           | LA_GroupPartyType | 1           | The type of a group party       |

LA\_GroupParty has a constraint requiring that the sum of the shares of the group party members must be equal to 1. This constraint is only enforced if a class LA\_PartyMember exists (see 7.3.2)."

EXAMPLE Group parties are demonstrated in instance level cases, see Annex D, Figures D.3, D.4, D.5 and D.13.

#### 7.4.3 LA\_PartyMember

An instance of class LA\_PartyMember is a party member. Class LA\_PartyMember is an optional association class between LA\_Party and LA\_GroupParty, see Figure 6.

The attribute of LA\_PartyMember is shown in Table 7.

**Table 7 — Attributes of LA\_PartyMember**

| Attribute name | Type     | Cardinality | Description               |
|----------------|----------|-------------|---------------------------|
| share          | Fraction | 0..1        | The fraction of the whole |

## 7.5 Classes of Administrative Package

### 10) 'Basic Administrative Unit'

<https://standards.iso/211.org/19152/-2/1/req/basicadministrativeunit>

**Requirement 10:** In combination to the Triple (1. LA\_Party – 2. LA\_RRR and/or LA\_AdministrativeSource – 3. LA\_BAUnit/LA\_SpatialUnit) the constellation of basic administrative units shall be supported. The purpose of a BAUnit is the grouping of spatial units, which have the same rights, etc. attached. A BAUnit can play the role of a party: a BAUnit may be owned by one or more other BAUnit.

#### 7.5.1 LA\_BAUnit

An instance of class LA\_BAUnit is a basic administrative unit. LA\_BAUnit is associated to class LA\_Party (a party may be a basic administrative unit). A basic administrative unit is associated to zero or more [0..\*] spatial units. A basic administrative unit can be associated to one or more [1..\*] instances of right, restriction or responsibility (i.e. a basic administrative unit cannot exist if there is not at least one right, restriction or responsibility associated to it). A basic administrative unit can be spatially related, through a required relationship, to zero or more [0..\*] other basic administrative units (i.e. create an explicit spatial relationship between two basic administrative units when the geometry is missing or inaccurate to provide reliable implicit results). Basic administrative units do not need to be related explicitly. However, if an explicit required relationship is specified, a basic administrative unit can be associated to one or more [1..\*] other basic administrative units. A basic administrative unit can be associated to zero or more [0..\*] administrative sources (i.e. the basic administrative unit is usually described as the object affected by the right, restriction or responsibility in the administrative source). A basic administrative unit can be associated to zero or more [0..\*] spatial sources (i.e. the extent – part of – of a basic administrative unit can be described on a spatial source). See Figure 7.

The attributes of LA\_BAUnit are shown in Table 8.

**Table 8 — Attributes of LA\_BAUnit**

| Attribute name | Type            | Cardinality | Description                                     |
|----------------|-----------------|-------------|-------------------------------------------------|
| name           | CharacterString | 0..1        | The name of the basic administrative unit       |
| type           | LA_BAUnitType   | 1           | The type of the basic administrative unit       |
| uID            | Oid             | 1           | The identifier of the basic administrative unit |

LA\_BAUnit has a constraint requiring that the sum of all the shares for one basic administrative unit must equal 1 for the same subclass of class LA\_RRR, unless 'share' is meaningless with regard to the type of right, restriction or responsibility. The constraint can be applied only to instances valid at the same moment in time (life span).

LA\_BAUnit has a constraint requiring that no overlap be allowed between timeSpecs for the same RRR type and the same basic administrative unit (share must be specified, unless this is meaningless for the specific type (indicated by shareCheck=false; in this case constraint 'sum (RRR.share) = 1 per type' cannot be applied))."

NOTE 1 LA\_BAUnit allows the association of one right to a combination of spatial units (e.g., an apartment and a parking place).

NOTE 2 It is possible that no spatial unit exists for a basic administrative unit, thus allowing for the support of special administrative situations (e.g., deeds registration without mapping).

NOTE 3 A (group of) BAUnit may be a party.

EXAMPLE Basic administrative units (BAUnit's) are demonstrated in instance level cases, see Annex D, Figures D.1, D.17, D.23, D.24, D.25, D.27, D.28, D.29, D.31, D.32 and D.33.

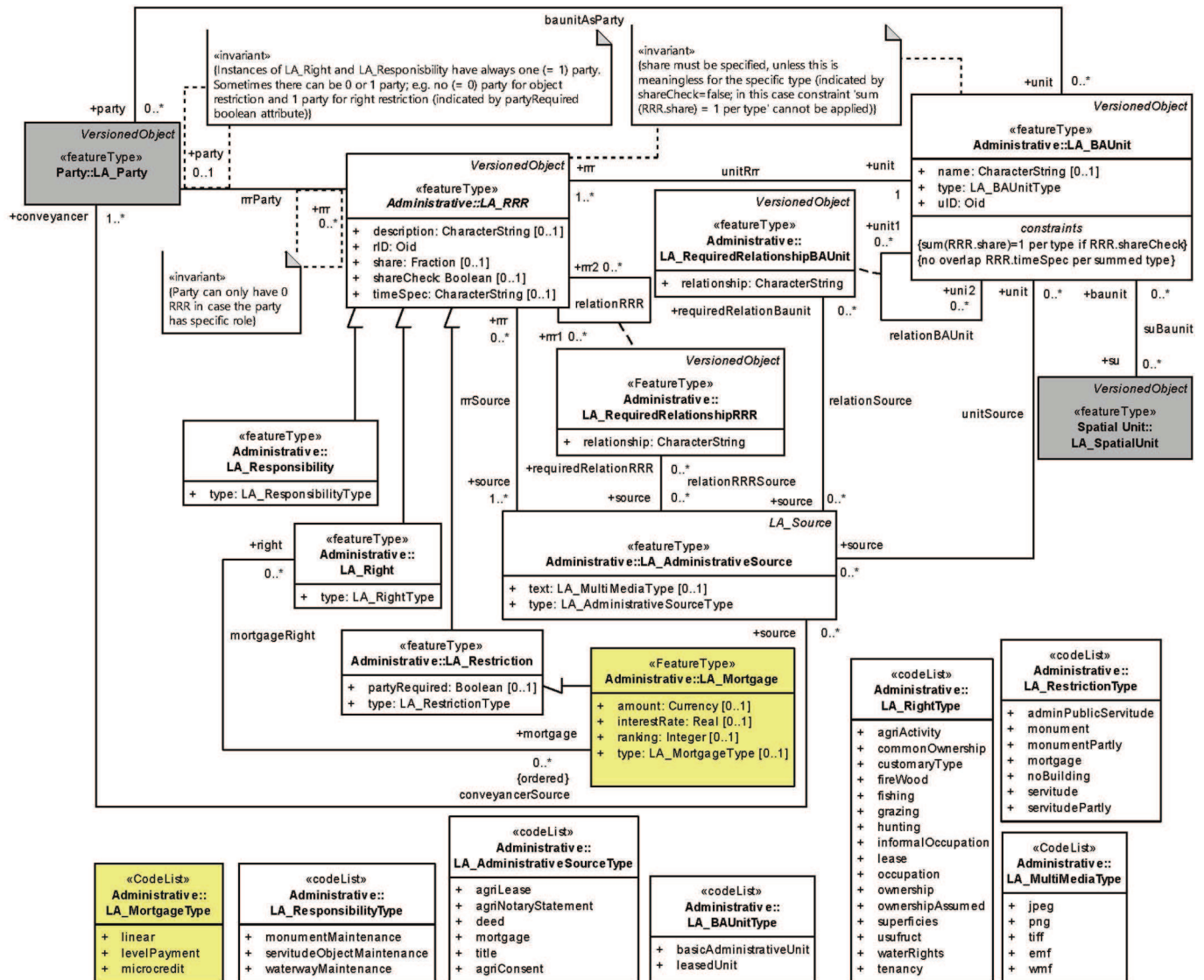


**Figure 7 — Content of Administrative Package with associations to other basic classes**

## 11) 'Shares In RRR'

<https://standards.iso/211.org/19152-2/1/req/sharesinRRR>

**Requirement 11:** Holding shares in rights, restrictions, responsibilities shall be supported.

### 7.5.2 LA\_RRR

Class LA\_RRR is an abstract class. An instance of a subclass of LA\_RRR is a right (or social tenure relationship), a restriction, or a responsibility. If it is a right or responsibility, then it is associated to exactly one [0..1] party, and exactly one<sup>[1]</sup> basic administrative unit. If it is a restriction, then it is associated to zero or one [0..1] parties, and exactly one<sup>[1]</sup> basic administrative unit. The latter allows for the registration of restrictions (e.g., right-of-way, right-to-harvest-fruit), with, or without an association to LA\_Party.

An instance of a subclass of LA\_RRR can be associated to one or more [1..\*] administrative sources (i.e. the right, restriction or responsibility affecting a basic administrative unit can be supported by at least one administrative source); see Figure 7.

The attributes of LA\_RRR are shown in Table 9.

Table 9 — Attributes of LA\_RRR

| Attribute name | Type            | Cardinality | Description                                                       |
|----------------|-----------------|-------------|-------------------------------------------------------------------|
| description    | CharacterString | 0..1        | Description regarding the right, restriction or responsibility    |
| rID            | Oid             | 1           | The RRR identifier                                                |
| share          | Fraction        | 0..1        | A share in an instance of a subclass of LA_RRR                    |
| shareCheck     | Boolean         | 0..1        | Indicates whether the constraint in class LA_BAUnit is applicable |
| timeSpec       | CharacterString | 0..1        | Operational use of a RRR in time sharing                          |

NOTE 1 Attribute timeSpec is capable of handling other temporal descriptions, such as recurring patterns (every weekend, every summer, etc.). This means, for example, that a party can hold a right to use an apartment each year in March, or that a group of pastoralists has the right to cross a field each summer (for fuzzy time range specifications, see ISO 20524-2:2020 and ISO 8601-1:2019).

NOTE 2 Attribute timeSpec can be related to a single time interval with limited duration (e.g., long lease of 25 years), see Annex D, Figures D.1, D.31.

NOTE 3 Additional attributes may be added, for example to specify legal property owner rights, restrictions and responsibilities in a particular jurisdiction.

EXAMPLE There can be parties without an RRR, for example surveyor, and there can also be RRR without parties, especially for public law restrictions.

### 7.5.3 LA\_Right

An instance of class LA\_Right is a right. LA\_Right is a subclass of class LA\_RRR. A right may be associated to zero or more [0..\*] mortgages (i.e. a mortgage is associated to the affected basic administrative unit but it may also be specifically associated to the right which is the object of the mortgage); see Figure 7.

The attribute of LA\_Right is shown in Table 10.

Table 10 — Attribute of LA\_Right

| Attribute name | Type         | Cardinality | Description           |
|----------------|--------------|-------------|-----------------------|
| type           | LA_RightType | 1           | The type of the right |

EXAMPLE Rights are demonstrated in instance level cases, see Annex D, Figures D.1, D.8, D.11, D.28 and D.29.

### 7.5.4 LA\_Restriction

An instance of class LA\_Restriction is a restriction. LA\_Restriction is a subclass of class LA\_RRR. LA\_Mortgage (8.4.6) is a specialization of LA\_Restriction; see Figure 7.

The attributes of LA\_Restriction are shown in Table 11.

Table 11 — Attributes of LA\_Restriction

| Attribute name | Type               | Cardinality | Description                                                                                                  |
|----------------|--------------------|-------------|--------------------------------------------------------------------------------------------------------------|
| partyRequired  | Boolean            | 0..1        | Indicates whether a party is required for the registration of the restriction in the association to LA_Party |
| type           | LA_RestrictionType | 1           | The type of the restriction                                                                                  |

NOTE Attribute partyRequired is set to TRUE (by default), if for the registration of the restriction a party is required, and to FALSE, if the restriction is considered as a spatial unit restriction. The spatial unit restriction is always via a BAUnit.

EXAMPLE Restrictions are demonstrated in instance level cases, see Annex D, Figures D.9, D.16, D.20, D.21 and D.22.

### 7.5.5 LA\_Responsibility

An instance of class LA\_Responsibility is a responsibility. LA\_Responsibility is a subclass of class LA\_RRR. See Figure 7.

The attribute of LA\_Responsibility is shown in Table 12.

**Table 12 — Attribute of LA\_Responsibility**

| Attribute name | Type                  | Cardinality | Description                    |
|----------------|-----------------------|-------------|--------------------------------|
| type           | LA_ResponsibilityType | 1           | The type of the responsibility |

EXAMPLE Responsibilities are demonstrated in instance diagrams, see Annex D, Figure D.19.

### 7.5.6 LA\_Mortgage

An instance of class LA\_Mortgage is a mortgage. LA\_Mortgage is a subclass of LA\_Restriction. LA\_Mortgage is associated to class LA\_Right (the right that is the basis for the mortgage). A mortgage can be associated to zero or more [0..\*] rights (i.e. a mortgage can be associated specifically to the right which is the object of the mortgage). In all cases, the mortgage is associated, through LA\_Restriction and LA\_RRR, to the basic administrative unit which is affected by the mortgage; see Figure 7.

The attributes of LA\_Mortgage are shown in Table 13.

**Table 13 — Attributes of LA\_Mortgage**

| Attribute name | Type            | Cardinality | Description                                                                 |
|----------------|-----------------|-------------|-----------------------------------------------------------------------------|
| amount         | Currency        | 0..1        | The amount of money of the mortgage                                         |
| interestRate   | Real            | 0..1        | Interest rate of the mortgage (percentage)                                  |
| ranking        | Integer         | 0..1        | The ranking order, if more than one mortgage applies to a right (or rights) |
| type           | LA_MortgageType | 0..1        | The type of the mortgage                                                    |

NOTE ISO 4217 may be used for the list of currencies in the ISO 19103:2015 measure.

EXAMPLE Mortgages are demonstrated in instance level cases, see Annex D, Figures D.10, D.11 and D.15.

### 7.5.7 LA\_AdministrativeSource

An instance of class LA\_AdministrativeSource is an administrative source. LA\_AdministrativeSource is a subclass of class LA\_Source. An administrative source can be associated to one or more [1..\*] parties (i.e. as a minimum the party playing the role of conveyancer must be specified). An administrative source may be associated to zero or more [0..\*] basic administrative units (i.e. the administrative source may describe the objects of the right, restriction or responsibility). An administrative source may be associated to zero or more [0..\*] instances of specializations (right, restriction/mortgage, and responsibility) of LA\_RRR (i.e. the administrative source may describe the rights, restrictions or responsibilities hold by a party and affecting a basic administrative unit); see Figures 7.

The attributes of LA\_AdministrativeSource are shown in Table 14.

**Table 14 — Attributes of LA\_AdministrativeSource**

| Attribute name | Type                        | Cardinality | Description                           |
|----------------|-----------------------------|-------------|---------------------------------------|
| text           | LA_MultiMediaType           | 0..1        | The multimedia of the source document |
| type           | LA_AdministrativeSourceType | 1           | The type of document                  |

NOTE 1 An availability status for an administrative source is required, because it may be lost, e.g., by a disaster.

NOTE 2 Archives can be internal or external to the LA organization. If internal then text attribute can be used; if external then extArchiveID of administrative source.

### 7.5.8 LA\_RequiredRelationshipBAUnit

An instance of association class LA\_RequiredRelationshipBAUnit is a required relationship between basic administrative units, see Figure 7. A required relationship between basic administrative units can be associated to zero or more [0..\*] administrative sources to provide supporting documentation for the explicit relationship.

The attribute of LA\_RequiredRelationshipBAUnit is shown in Table 15.

Table 15 — Attribute of LA\_RequiredRelationshipBAUnit

| Attribute name | Type            | Cardinality | Description                                  |
|----------------|-----------------|-------------|----------------------------------------------|
| relationship   | CharacterString | 1           | The description of the required relationship |

NOTE 1 Instances of LA\_RequiredRelationshipBAUnit override implicit relationships, established through geospatial overlaying techniques.

NOTE 2 Even if the geometry of spatial units is accurate, there may be legal reasons to establish required relationships between BAUnit.

NOTE 3 LA\_RequiredRelationshipBAUnit is a versioned object class. Different life cycle attributes than the versioned object ones, can be added using the attribute ‘relationship’.

EXAMPLE Two historic versions of BAUnits may be connected in time when related to the same change, e.g., when a part of a spatial unit is sold.

### 7.5.9 LA\_RequiredRelationshipRRR

An instance of association class LA\_RequiredRelationshipRRR is a required relationship between RRRs, see Figure 7. A required relationship between RRRs can be associated to zero or more [0..\*] administrative sources to provide supporting documentation for the explicit relationship.

The attribute of LA\_RequiredRelationshipRRR is shown in Table 16.

Table 16 — Attribute of LA\_RequiredRelationshipRRR

| Attribute name | Type            | Cardinality | Description                                  |
|----------------|-----------------|-------------|----------------------------------------------|
| relationship   | CharacterString | 1           | The description of the required relationship |

## 7.6 Classes of Spatial Unit Package

### 12) ‘Continuum of Spatial Units’

<https://standards.isotc211.org/19152/-2/1/req/continuumofspatialunits>

**Requirement 12:** Representation of a broad range of spatial units, with a clear quality indication, shall be supported by an LADM compliant LAS. Spatial units are the areas of land (or water – e.g., water rights and the marine environment) where the rights and social tenure relationships apply. Spatial units can be represented as a text (“from this tree to that river”), as a sketch, as a single point, as a set of unstructured lines, as a surface, or as a 3D volume.

### 13) ‘Spatial Unit Identifiers’

<https://standards.isotc211.org/19152/-2/1/req/spatialunitidentifiers>

**Requirement 13:** Spatial units shall have a unique identifier. A key component in LASs is the spatial unit identifier, the parcel identifier or the unique parcel reference number. This acts as a link between the parcel

itself and all record related to it. It facilitates data input and data exchange. There can be a need to change identifiers during data collection.

### 7.6.1 LA\_SpatialUnit

An instance of class LA\_SpatialUnit is a spatial unit. A spatial unit may be associated to zero or more [0..\*] basic administrative units (i.e. the spatial unit may be used to describe the extent – part of – a basic administrative unit. A spatial unit may be associated to zero or one [0..1] levels (i.e. a spatial unit can be associated to a level). A spatial unit cannot be associated to more than one level. A spatial unit may be associated to zero or more [0..\*] spatial unit groups (i.e. a spatial unit can be associated to a subdivision and also to school district). A spatial unit can be spatially related, through a required relationship, to zero or more [0..\*] other spatial units (i.e. creates an explicit spatial relationship between two spatial units when the geometry is missing or inaccurate to provide reliable implicit results). Spatial units do not need to be related explicitly. A spatial unit need to be associated to one or more [1..\*] spatial sources (i.e. the spatial unit need to be supported by at least one spatial source). A spatial unit can form part of 0..1 other spatial unit. A spatial unit can include 0..\* other spatial units. Spatial units can be further specialized into building units (7.5.3), utility networks (7.5.4), infrastructure (7.5.5) or parcel (7.5.6); see Figure 8. Spatial units can be extended by subtyping in country profiles.

The attributes of LA\_SpatialUnit are shown in Table 17.

**Table 17 — Attributes of LA\_SpatialUnit**

| Attribute name  | Type                   | Cardinality | Description                                                    |
|-----------------|------------------------|-------------|----------------------------------------------------------------|
| area            | LA_AreaValue           | 0..*        | The area of the 2D spatial unit                                |
| dimension       | LA_DimensionType       | 0..1        | The dimension of the spatial unit                              |
| extAddressID    | Oid                    | 0..*        | The link to external address(es) of the spatial unit           |
| label           | CharacterString        | 0..1        | Short textual description of the spatial unit                  |
| geometry        | Geometry               | 0..1        | The geometry of the spatial unit                               |
| referencePoint  | Point                  | 0..1        | The coordinates of a point inside the spatial unit             |
| suID            | Oid                    | 1           | The spatial unit identifier                                    |
| surfaceRelation | LA_SurfaceRelationType | 0..1        | Indicates whether a spatial unit is above or below the surface |
| volume          | LA_VolumeValue         | 0..*        | The volume of the 3D spatial unit                              |

**NOTE** The method 'createArea()' constructs geometric primitive of type Collection(Surface) based on associated spatial representation (2D). The method 'areaClosed()' checks if associated spatial representation is closed (2D). The method 'computeArea()' computes area of associated spatial representation (2D). The method 'computeVolume()' computes volume of associated spatial representation (3D). The method 'createVolume()' constructs geometric primitive of type Collection(Solid) based on associated spatial representation (3D). The method 'volumeClosed()' checks if associated spatial representation is closed (3D). These methods define meaning of class at conceptual level, and are not inherited from other classes, nor defined in other ISO standards. Not all methods are meaningful in all situations; e.g. computeVolume() in case of 2D.

**EXAMPLE** Spatial units are demonstrated in instance level cases, see Annex D, Figures D.6, D.7, D.16, D.17, D.21, D.27 and D.33.

### 7.6.2 LA\_SpatialUnitGroup

An instance of class LA\_SpatialUnitGroup is a spatial unit group. A spatial unit group is made of one or more [1..\*] parts/elements (which can be spatial units, or spatial unit groups, or a combination of spatial units and spatial unit groups). A spatial unit group is part of zero or one [0..1] larger spatial unit group, which again can even be part of zero or one [0..1] larger spatial unit group, and so on. See Figure 8.

The attributes of LA\_SpatialUnitGroup are shown in Table 18.

Table 18 — Attributes of LA\_SpatialUnitGroup

| Attribute name | Type            | Cardinality | Description                                                            |
|----------------|-----------------|-------------|------------------------------------------------------------------------|
| hierarchyLevel | Integer         | 1           | The level in the hierarchy of an administrative, or zoning subdivision |
| label          | CharacterString | 0..1        | Short textual description of the spatial unit group                    |
| name           | CharacterString | 0..1        | The name of the spatial unit group                                     |
| referencePoint | Point           | 0..1        | The coordinates of a point within the spatial unit group               |
| sugID          | Oid             | 1           | The identifier of the spatial unit group                               |

NOTE The highest level in the hierarchy of a subdivision (country) is 1; lower levels are incremented by 1.

### 7.6.3 LA\_LegalSpaceBuildingUnit

An instance of class LA\_LegalSpaceBuildingUnit is a building unit. LA\_LegalSpaceBuildingUnit is a subclass of class LA\_SpatialUnit, see Figure 8.

The attributes of LA\_LegalSpaceBuildingUnit are shown in Table 19.

Table 19 — Attributes of LA\_LegalSpaceBuildingUnit

| Attribute name            | Type                    | Cardinality | Description                         |
|---------------------------|-------------------------|-------------|-------------------------------------|
| extPhysicalBuildingUnitID | ExtPhysicalBuildingUnit | 0..1        | The identifier of the building unit |
| type                      | LA_BuildingUnitType     | 0..1        | The type of the building unit       |

NOTE The extBuildingUnitID is optional as in most cases the suID inherited from LA\_SpatialUnit is sufficient to uniquely identify instances of LA\_LegalSpaceBuildingUnit.

EXAMPLE Building units are demonstrated in instance level cases, see Annex D, Figures D.6, D.22, D.24, D.27, D.32 and D.33.

### 7.6.4 LA\_LegalSpaceUtilityNetworkElement

An instance of LA\_LegalSpaceUtilityNetworkElement is a utility network element. LA\_LegalSpaceUtilityNetworkElement is a subclass of class LA\_SpatialUnit, see Figure 8.

The attributes of LA\_LegalSpaceUtilityNetworkElement are shown in Table 20.

Table 20 — Attributes of LA\_LegalSpaceUtilityNetworkElement

| Attribute name              | Type                         | Cardinality | Description                                                                        |
|-----------------------------|------------------------------|-------------|------------------------------------------------------------------------------------|
| extPhysicalUtilityNetworkID | ExtPhysicalUtilityNetwork    | 0..1        | A reference to the physical (technical) description of the utility network element |
| status                      | LA_StatusType                | 0..1        | The status of the utility network element                                          |
| type                        | LA_UtilityNetworkElementType | 0..1        | The type of the utility network element                                            |

NOTE Networks are implicitly connected. One is only interested in a part of the network, not a network as whole.

EXAMPLE Utility networks are demonstrated in instance level cases, see Annex D, Figure D.15.

### 7.6.5 LA\_LegalSpaceCivilEngineeringElement

An instance of LA\_LegalSpaceCivilEngineeringElement is an infrastructure. LA\_LegalSpaceCivilEngineeringElement is a subclass of class LA\_SpatialUnit, see Figure 8.

The attributes of LA\_LegalSpaceCivilEngineeringElement are shown in Table 21.

**Table 21 — Attributes of LA\_LegalSpaceCivilEngineeringElement**

| Attribute name              | Type                      | Cardinality | Description                                                                      |
|-----------------------------|---------------------------|-------------|----------------------------------------------------------------------------------|
| extPhysicalInfrastructureID | ExtPhysicalInfrastructure | 0..1        | A reference to the physical (technical) description of civil engineering element |
| status                      | LA_StatusType             | 0..1        | The status of civil engineering element                                          |
| type                        | LA_CivilEngineeringType   | 0..1        | The type of civil engineering element                                            |

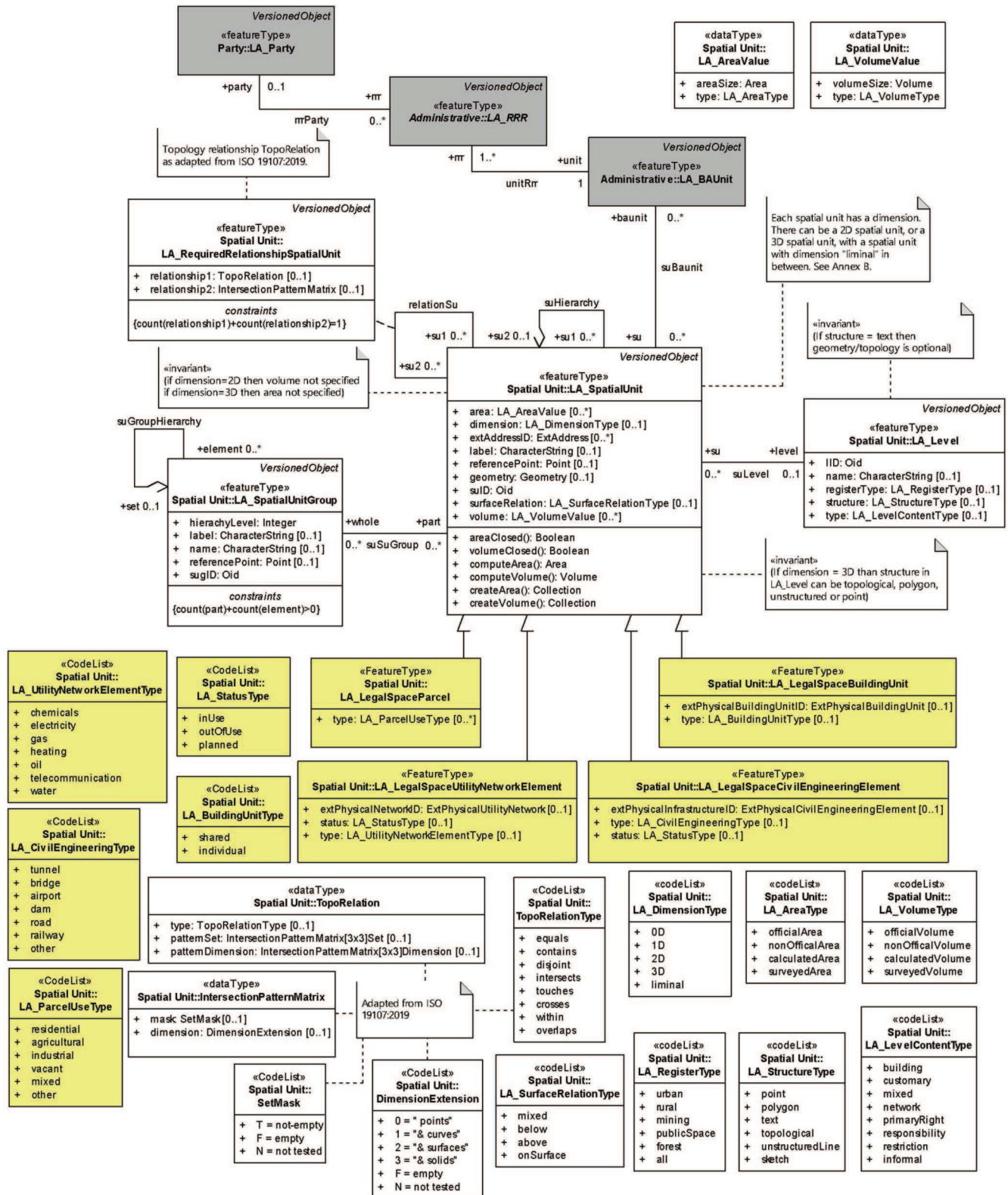


Figure 8 — Content of Spatial Unit Package with associations to other basic classes

### 7.6.6 LA\_LegalSpaceParcel

An instance of **LA\_LegalSpaceParcel** is a parcel. **LA\_LegalSpaceParcel** is a subclass of class **LA\_SpatialUnit**, see Figure 8. The attribute of **LA\_LegalSpaceParcel** **Parcel** is shown in Table 22.

Table 22 — Attributes of LA\_LegalSpaceParcel

| Attribute name | Type             | Cardinality | Description                |
|----------------|------------------|-------------|----------------------------|
| type           | LA_ParcelUseType | 0..*        | The use type of the parcel |

### 7.6.7 LA\_Level

An instance of class LA\_Level is a level. LA\_Level is associated to class LA\_SpatialUnit, see Figure 8.

The attributes of LA\_Level are shown in Table 23.

Table 23 — Attributes of LA\_Level

| Attribute name | Type                | Cardinality | Description                                   |
|----------------|---------------------|-------------|-----------------------------------------------|
| IID            | Oid                 | 1           | The identifier of the level                   |
| name           | CharacterString     | 0..1        | The name of the level                         |
| registerType   | LA_RegisterType     | 0..1        | The register type of the content of the level |
| structure      | LA_StructureType    | 0..1        | The structure of the level geometry           |
| type           | LA_LevelContentType | 0..1        | The type of the content of the level          |

EXAMPLE Levels are demonstrated in instance level cases, see Annex D, Figures D.2, D.14, D.16, D.21, D.23, D.24, D.25 and D.32.

### 7.6.8 LA\_RequiredRelationshipSpatialUnit

An instance of association class LA\_RequiredRelationshipSpatialUnit is a required relationship between spatial units, see Figures 8.

The attribute of LA\_RequiredRelationshipSpatialUnit is shown in Table 24.

Table 24 — Attributes of LA\_RequiredRelationshipSpatialUnit

| Attribute name | Type                      | Cardinality | Description                                                                |
|----------------|---------------------------|-------------|----------------------------------------------------------------------------|
| relationship1  | TopoRelation              | 0..1        | The description of the required relationship via TopoRelation              |
| relationship2  | IntersectionPatternMatrix | 0..1        | The description of the required relationship via IntersectionPatternMatrix |

NOTE The cardinality of TopoRelation or IntersectionPatternMatrix must equal to 1.

### 7.6.9 Data types for Spatial Unit Package

The Spatial Unit Package has two data types: LA\_AreaValue and LA\_VolumeValue. The generic data type LA\_AreaValue is introduced in LADM to provide support for registering the various types of area values (see Annex G).

The attributes of LA\_AreaValue are shown in Table 25.

Table 25 — Attributes of LA\_AreaValue

| Attribute name | Type        | Cardinality | Description                         |
|----------------|-------------|-------------|-------------------------------------|
| areaSize       | Area        | 1           | Area of the 2D spatial unit         |
| type           | LA_AreaType | 1           | Indicates the type of area provided |

The generic data type LA\_VolumeValue is introduced in LADM to provide support for various types of volume values (see Annex G). The attributes of LA\_VolumeValue are shown in Table 26.

**Table 26 — Attributes of LA\_VolumeValue**

| Attribute name | Type          | Cardinality | Description                           |
|----------------|---------------|-------------|---------------------------------------|
| volumeSize     | Volume        | 1           | Volume of the 3D spatial unit         |
| type           | LA_VolumeType | 1           | Indicates the type of volume provided |

The generic data type TopoRelation is introduced in LADM to provide support for topographical relationships (see Annex G). The attributes of TopoRelation are shown in Table 27.

**Table 27 — Attributes of TopoRelation**

| Attribute name   | Type                                    | Cardinality | Description                                               |
|------------------|-----------------------------------------|-------------|-----------------------------------------------------------|
| type             | TopoRelationType                        | 0..1        | The type of topological relationships, see ISO 19107:2019 |
| patternSet       | IntersectionPatternMatrix[3x3]Set       | 0..1        | The pattern set matrix, see ISO 19107:2019                |
| patternDimension | IntersectionPatternMatrix[3x3]Dimension | 0..1        | The pattern dimension of matrix, see ISO 19107:2019       |

The generic data type IntersectionPatternMatrix is introduced in LADM to provide support for topographical relationships (see Annex G). The attributes of IntersectionPatternMatrix are shown in Table 28.

**Table 28 — Attributes of IntersectionPatternMatrix**

| Attribute name | Type               | Cardinality | Description                                                                |
|----------------|--------------------|-------------|----------------------------------------------------------------------------|
| mask           | SetMask            | 0..1        | The set mask of intersection pattern matrix, see ISO 19107:2019            |
| dimension      | DimensionExtension | 0..1        | The dimension extension of intersection pattern matrix, see ISO 19107:2019 |

## 7.7 Classes of Surveying and Representation Subpackage

### 7.7.1 LA\_Point

An instance of class LA\_Point is a point. A point may be associated to zero or more [0..\*] spatial units (i.e. the point may be used as the reference point to describe the position of a spatial unit). A point may be associated to zero or more [0..\*] boundary faces (i.e. a point may be used to define a vertex of the side of a 3D parcel). A point may be associated to zero or more [0..\*] boundary face strings (i.e. a point can be used to define the start, end or vertex of a boundary). A point need to be associated to zero or more [0..\*] spatial sources, see Figure 9.

The attributes of LA\_Point are shown in Table 29.

**Table 29 — Attributes of LA\_Point**

| Attribute name    | Type                       | Cardinality | Description                                                        |
|-------------------|----------------------------|-------------|--------------------------------------------------------------------|
| estimatedAccuracy | AbsolutePositionalAccuracy | 0..1        | The estimated accuracy of the point                                |
| interpolationRole | LA_InterpolationType       | 1           | The role of the point in the structure of a straight line or curve |
| monumentation     | LA_MonumentationType       | 0..1        | The type of monumentation                                          |
| originalLocation  | Point                      | 1           | The calculated coordinates, based on measurements and observations |
| pID               | Oid                        | 1           | The point identifier                                               |

Table 29 (continued)

| Attribute name   | Type              | Cardinality | Description                             |
|------------------|-------------------|-------------|-----------------------------------------|
| pointType        | LA_PointType      | 1           | The type of point                       |
| productionMethod | LI_Lineage        | 0..1        | The lineage (19115-1:2014)              |
| transAndResult   | LA_Transformation | 0..*        | Transformation and transformed location |

NOTE The method 'getTransResult( )' returns the transformed point (Point), and is not inherited from other classes, nor defined in other ISO standards.

### 7.7.2 LA\_BoundaryFaceString

An instance of class LA\_BoundaryFaceString is a boundary face string. LA\_BoundaryFaceString is associated to class LA\_Point and class LA\_SpatialSource to document the origin of the geometry. In the case of a location by text, a boundary face string would not be defined by points. However, in all other cases, a boundary face string need to be defined by two or more [2..\*] points (i.e. as a minimum a boundary starts and ends at a point, i.e. a straight line).

NOTE In case the boundary face string is defined by text, then no points are associated; in case the boundary face string is not defined by text, then at least two points are associated (defining the boundary face string).

In the association between LA\_BoundaryFaceString and LA\_SpatialUnit, a + (plus) means that the associated boundary face string has the same orientation within the spatial unit, and a – (minus) means that the associated boundary face string has the opposite orientation within the spatial unit. A boundary face string may be associated to zero or more [0..\*] spatial sources (i.e. the boundary of a spatial unit can be described on one or more spatial sources (on the spatial source creating the spatial unit and on the spatial source creating the neighbouring spatial unit); see Figure 9.

The attributes of LA\_BoundaryFaceString are shown in Table 30.

Table 30 — Attributes of LA\_BoundaryFaceString

| Attribute name | Type            | Cardinality | Description                                          |
|----------------|-----------------|-------------|------------------------------------------------------|
| bfsID          | Oid             | 1           | The boundary face string identifier                  |
| geometry       | Curve           | 0..*        | The boundary represented via a curve at ground level |
| locationByText | CharacterString | 0..1        | The boundary represented in text                     |

NOTE The geometry is either derived from associated class LA\_Point, or based on captured linear geometry.

EXAMPLE Boundary face strings is demonstrated in instance level case, see Annex D, Figure D.31.

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**ISO/DIS 19152-2:2024(en)**

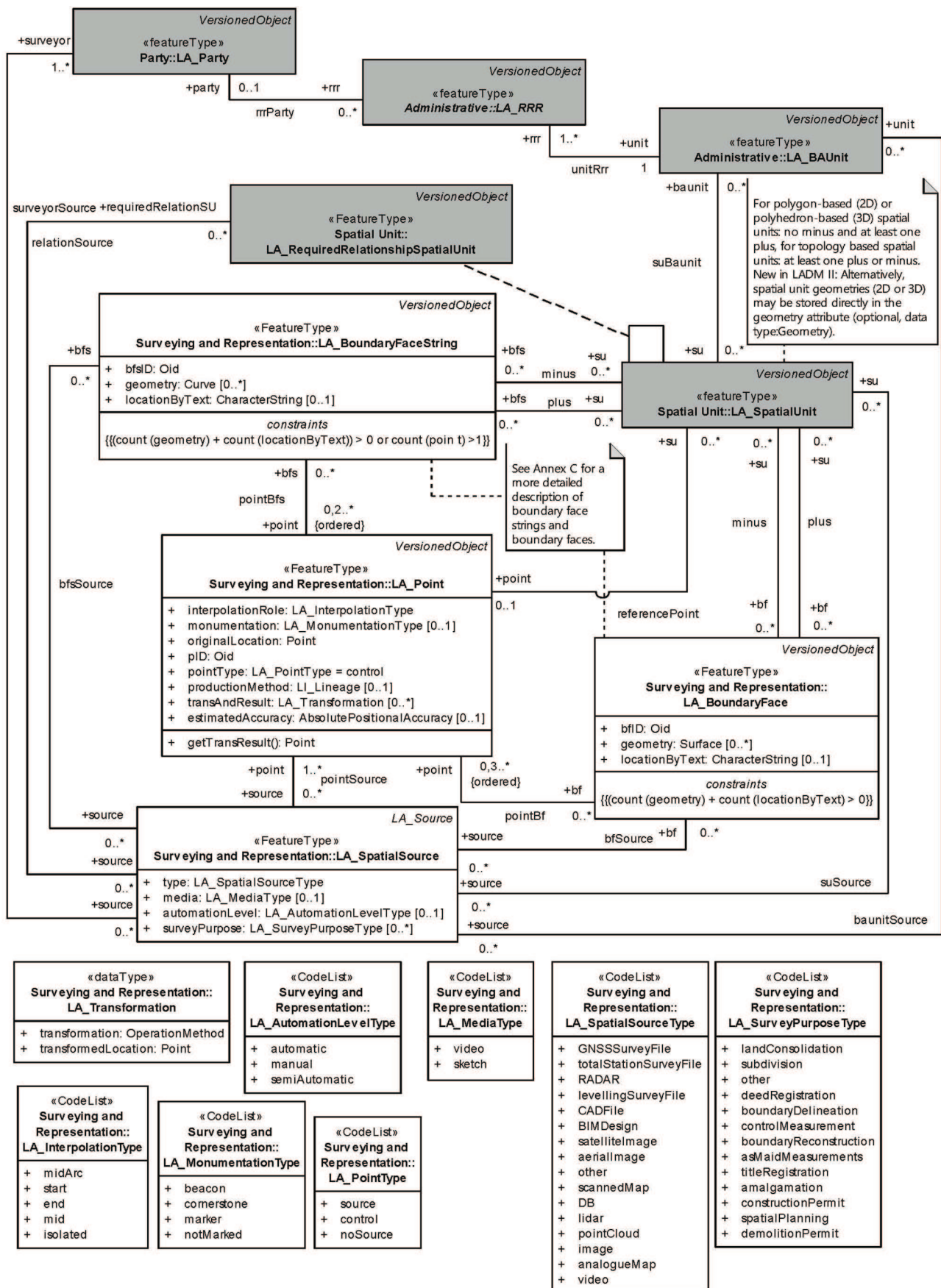


**Figure 9 — Basic Classes of the Surveying and Representation Subpackage (1)**

### 7.7.3 LA\_BoundaryFace

An instance of class LA\_BoundaryFace is a boundary face. LA\_BoundaryFace is associated to class LA\_Point and class LA\_SpatialSource to document the origin of the geometry. In the case of a location by text, a boundary face will not be defined by points. However, in all other cases, a boundary face need to be defined by three or more [3..\*] points, i.e. as a minimum, a triangle face is defined by three points. A boundary face may be associated to zero or more [0..\*] spatial sources, i.e. the face of a 3D spatial unit can be described on one or more spatial sources (on the spatial source creating the spatial unit and the spatial source creating the neighbouring spatial unit). The orientation of the boundary that is equal to the orientation of the spatial unit is the "+" association, otherwise "-", see Figure 9.

The attributes of LA\_BoundaryFace are shown in Table 31.

**Table 31 — Attributes of LA\_BoundaryFace**

| Attribute name | Type            | Cardinality | Description                                  |
|----------------|-----------------|-------------|----------------------------------------------|
| bfID           | Oid             | 1           | The boundary face identifier                 |
| geometry       | Surface         | 0..*        | The boundary represented via a surface in 3D |
| locationByText | CharacterString | 0..1        | The boundary represented in text             |

NOTE The geometry is either derived from associated class LA\_Point, or based on captured surface geometry.

EXAMPLE Boundary faces is demonstrated in instance level case, see Annex D, Figure D.7.

#### 14) 'Spatial Source Based Maps'

<https://standards.isotc211.org/19152/-2/1/req/spatialsourcebasedmaps>

**Requirement 14:** Cadastral maps shall be based on spatial sources, such as surveys, design sources, topographic maps, etc.

### 7.7.4 LA\_SpatialSource

An instance of class LA\_SpatialSource is a spatial source. LA\_SpatialSource is a subclass of class LA\_Source. A spatial source need to be associated to one or more [1..\*] points (i.e. the spatial source describes in all cases one or more points). If the spatial source does not describe at least one point, it would not be a spatial source. A spatial source may be associated to zero or more [0..\*] boundary face strings (i.e. the spatial source describes the boundary of a 2D spatial unit). A spatial source may be associated to zero or more [0..\*] boundary faces (i.e. the spatial source describes the face of a 3D spatial unit). A spatial source may be associated to zero or more [0..\*] spatial units (i.e. the spatial source describes the extent of a spatial unit). A spatial source may be associated to zero or more [0..\*] basic administrative units (i.e. the spatial source describes the extent of a property). A spatial source need to be associated to one or more [1..\*] parties (i.e. as a minimum the party playing the role of author of the spatial source, the surveyor, need to be specified). See Figures 8.

The optional association class connecting LA\_Party and LA\_SpatialSource denotes the different roles of a survey executor, see Figure 9.

The attributes of LA\_SpatialSource are shown in Table 32.

**Table 32 — Attributes of LA\_SpatialSource**

| Attribute name  | Type                   | Cardinality | Description                          |
|-----------------|------------------------|-------------|--------------------------------------|
| type            | LA_SpatialSourceType   | 1           | The technique of the survey used     |
| media           | LA_MediaType           | 0..1        | The source media type                |
| automationLevel | LA_AutomationLevelType | 0..1        | The process type of automation level |
| surveyPurpose   | LA_SurveyPurposeType   | 0..*        | The purpose of survey                |

NOTE 1 Measurements are the basis for mapping, and for historical reconstruction of the location of (parts of) the spatial unit in the field.

NOTE 2 The relationship to LA\_BAUnit can be obtained via LA\_SpatialUnit.

#### 15) 'Data Acquisition Methods'

<https://standards.isotc211.org/19152/-2/1/req/dataacquisitionmethods>

**Requirement 15:** Surveying of boundaries shall be supported. Surveys may concern the identification of boundaries of spatial units on a photograph, an image, or a topographic map. Surveys can be conventional land surveys, based on hand-held GPS. In all cases the representation of 'legal' reality is differentiated from the 'physical' reality. There may be sketch maps drawn up locally. Depending on the local situation, different registrations or recordings of land rights are possible.

#### 16) 'Cadastral Reference System'

<https://standards.isotc211.org/19152/-2/1/req/cadastralreferencesystem>

**Requirement 16:** Efficient LASSs compliant with this part of LADM shall be capable of producing co-ordinates, forming an essential component of cadastral systems. Provisions may be made to accommodate future changes in the reference system that may occur as a result of technical improvements. These may affect all co-ordinate-based systems. Imagery can be used depending on the user requirements, cost, and timing among other factors. It can be possible to include all documentation on data collected as evidence from the field.

#### 17) 'Data Quality'

<https://standards.isotc211.org/19152/-2/1/req/dataquality>

**Requirement 17:** The cadastral information shall be as complete as possible, reliable (which means ready when required), and rapidly accessible. Users of cadastral information need clarity, simplicity and speed in the registration process. Consistency between spatial and legal administrative data is important. Topology integrated with geometry and other attributes is relevant. The system must be ready to keep the information up to date. Data quality of spatial data may be improved in a later stage of development of a LAS, this has to be documented. For combined data products from different sources the quality descriptions and meta data related to the original data are relevant in relation to liability and information assurance.

### 7.7.5 LA\_SurveySource

An instance of class LA\_SurveySource is a survey source. A set of measurements such as: distances, bearings, GNSS observations etc. which may be obtained via various survey techniques and stored on designated media. LA\_SurveySource is subclass of class LA\_SpatialSource. See Figure 10.

The attributes of LA\_SurveySource are shown in Table 33.

**Table 33 — Attributes of LA\_SurveySource**

| Attribute name | Type                        | Cardinality | Description                                 |
|----------------|-----------------------------|-------------|---------------------------------------------|
| platform       | LA_PlatformType             | 0..1        | The platform used for the survey            |
| surveyMethod   | LA_SurveyMethodType         | 0..1        | The status of the survey                    |
| siteSketchMap  | LA_MultiMediaType           | 0..1        | The survey sketch map designed on the site  |
| procedure      | OM_Process                  | 0..1        | The survey method used (ISO 19156:2023)     |
| accuracyLevel  | LA_ObservationsAccuracyType | 0..1        | The level of observation accuracy expected  |
| equipmentID    | ExtEquipment                | 0..1        | The information on equipment used in survey |

NOTE The class survey LA\_SurveySource and some of its subclasses are adapted/inspired from OGC's LandInfra/InfraGML. There is additional functionality added here to the LandInfra model; for example LA\_GNSSCorrection, LA\_MBESObservation, LA\_GPRObservation and code list values.

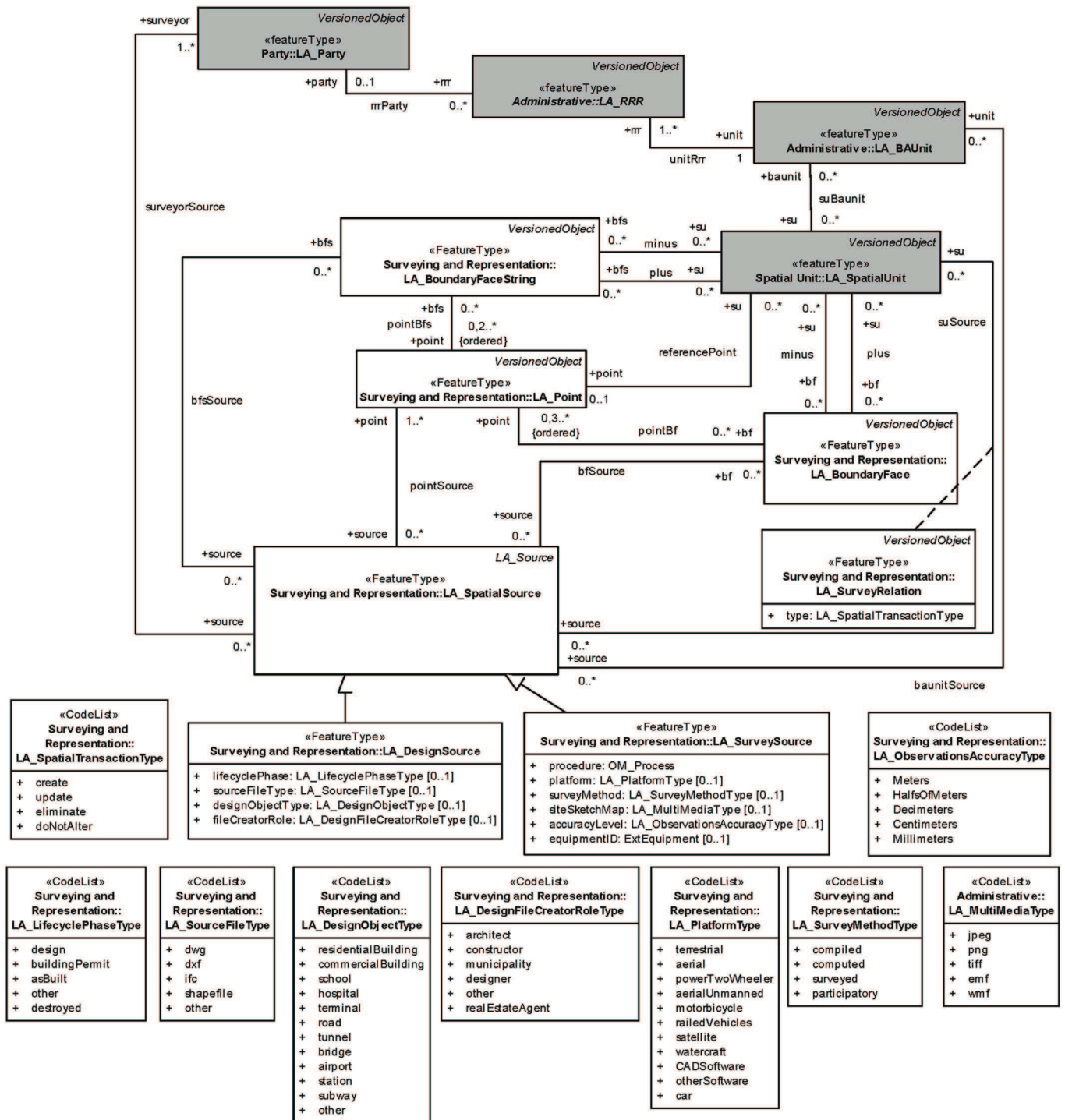


**Figure 10 — Basic Classes of the Surveying and Representation Subpackage (2)**

### 7.7.6 LA\_DesignSource

An instance of class LA\_DesignSource is a source from the design phase of the lifecycle that enables information reuse. LA\_DesignSource is subclass of class LA\_SpatialSource. See Figure 10.

The attributes of LA\_DesignSource are shown in Table 34.

**Table 34 — Attributes of LA\_DesignSource**

| Attribute name   | Type                   | Cardinality | Description                                                |
|------------------|------------------------|-------------|------------------------------------------------------------|
| lifecyclePhase   | LA_LifecyclePhaseType  | 0..1        | The object's lifecycle phase                               |
| sourceFileType   | LA_SourceFileType      | 0..1        | The format type of the source file                         |
| designObjectType | LA_DesignObjectType    | 0..1        | The type of object/ spatial unit that the design refers to |
| fileCreatorRole  | LA_FileCreatorRoleType | 0..1        | The role of the design file creator                        |

#### 7.7.7 LA\_SurveyRelation

An instance of the association class LA\_SurveyRelation is a survey relation. Association class LA\_SurveyRelation is an association class between LA\_SpatialSource and LA\_SpatialUnit, see Figure 10.

The attribute of LA\_SurveyRelation is shown in Table 35.

**Table 35 — Attributes of LA\_SurveyRelation**

| Attribute name | Type                      | Cardinality | Description                     |
|----------------|---------------------------|-------------|---------------------------------|
| type           | LA_SpatialTransactionType | 1           | The type of spatial transaction |

LADM refers to O&M, but in a very generic form therefore, a refined model for different survey techniques, which addresses survey related aspects is required. Furthermore, in order to explicitly express the purpose of the survey, an association class between the LA\_SpatialSource and LA\_SpatialUnit is added to the model, see Figure 10.

#### 7.7.8 LA\_DistanceObservation

An instance of class LA\_DistanceObservation is a survey source obtained by distance observation between the InstrumentPoint and the TargetPoint. LA\_DistanceObservation is subclass of class LA\_SurveySource. See Figure 11.

The attributes of LA\_DistanceObservation are shown in Table 36.

**Table 36 — Attributes of LA\_DistanceObservation**

| Attribute name | Type            | Cardinality | Description                                       |
|----------------|-----------------|-------------|---------------------------------------------------|
| distance       | Real            | 0..1        | The result of the observation                     |
| distanceType   | LA_DistanceType | 0..1        | The type of the distance used for the observation |
| description    | CharacterString | 0..1        | Information about the distance observation        |

#### 7.7.9 LA\_LevelObservation

An instance of class LA\_LevelObservation is a survey source obtained by level observation. LA\_LevelObservation is subclass of class LA\_SurveySource. See Figure 11.

The attributes of LA\_LevelObservation are shown in Table 37.

**Table 37 — Attributes of LA\_LevelObservation**

| Attribute name | Type            | Cardinality | Description                                 |
|----------------|-----------------|-------------|---------------------------------------------|
| deltaHeight    | Real            | 0..1        | The result of the observation               |
| description    | CharacterString | 0..1        | The information about the level observation |

#### 7.7.10 LA\_AngularObservation

An instance of class LA\_AngularObservation is a survey source obtained by angular observation. LA\_AngularObservation is subclass of class LA\_SurveySource. See Figure 11.

The attributes of LA\_AngularObservation are shown in Table 38.

**Table 38 — Attributes of LA\_AngularObservation**

| Attribute name | Type            | Cardinality | Description                                       |
|----------------|-----------------|-------------|---------------------------------------------------|
| angle          | Real            | 0..1        | The result of the observation                     |
| angularType    | LA_AngleType    | 0..1        | The type of angle measured during the observation |
| description    | CharacterString | 0..1        | The information about the angular observation     |

#### 7.7.11 LA\_ImageObservation

An instance of class LA\_ImageObservation is a survey source obtained by image-based observation. LA\_ImageObservation is subclass of class LA\_SurveySource. See Figure 11.

The attributes of LA\_ImageObservation are shown in Table 39.

**Table 39 — Attributes of LA\_ImageObservation**

| Attribute name | Type            | Cardinality | Description                                       |
|----------------|-----------------|-------------|---------------------------------------------------|
| image          | Image           | 0..1        | The result of the observation                     |
| name           | CharacterString | 0..1        | The name of the image                             |
| description    | CharacterString | 0..1        | The information about the image-based observation |

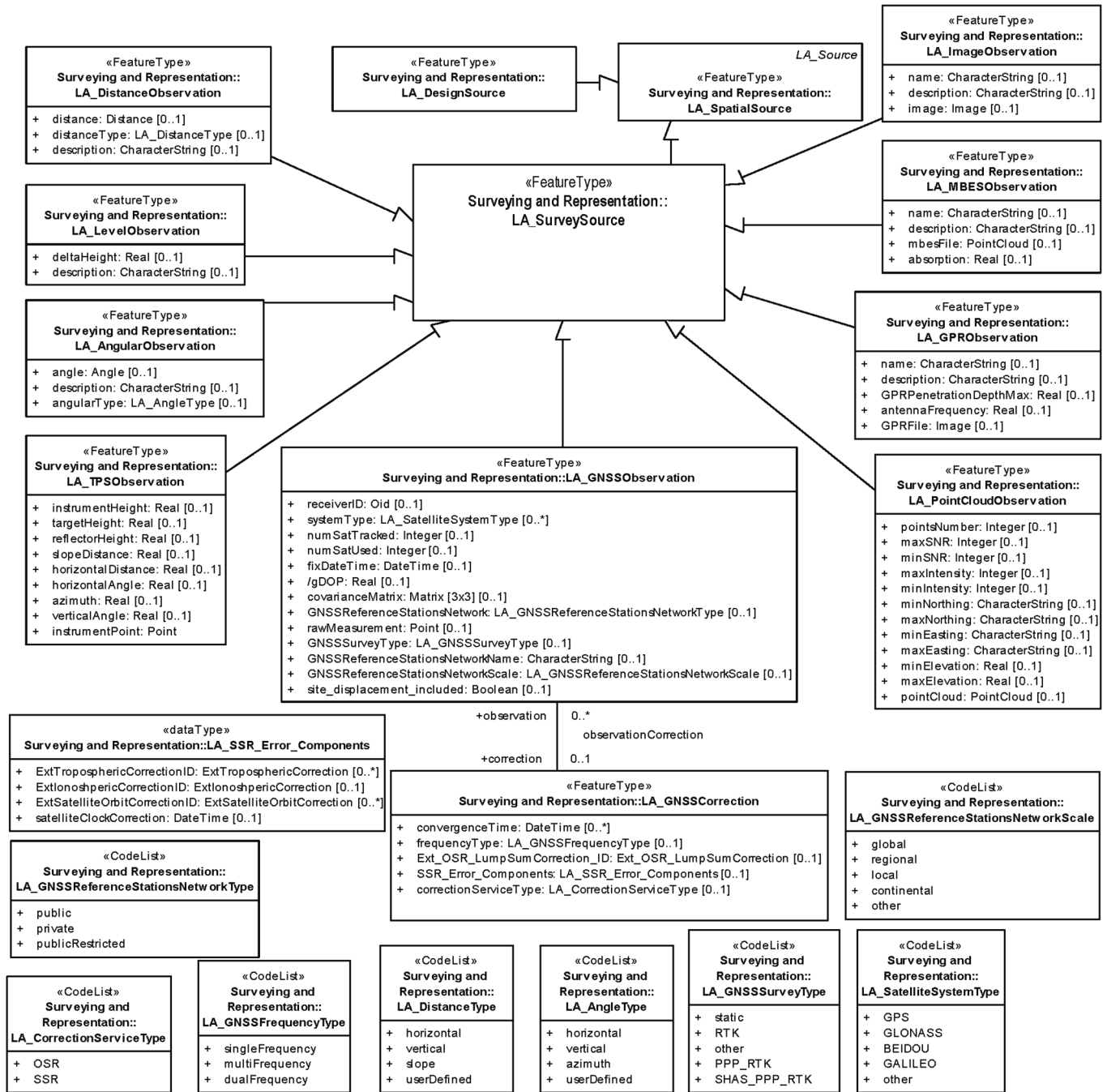


**Figure 11 — Basic Classes of the Surveying and Representation Subpackage (3)**

### 7.7.12 LA\_TPSObservation

An instance of class LA\_TPSObservation is a survey source obtained by using total-station. A TPSSource contains angular and distance observation from the InstrumentPoint to the TargetPoint. LA\_TPSObservation is subclass of class LA\_SurveySource. Figure 11.

The attributes of LA\_TPSObservation are shown in Table 40.

Table 40 — Attributes of LA\_TPSObservation

| Attribute name     | Type  | Cardinality | Description                                                              |
|--------------------|-------|-------------|--------------------------------------------------------------------------|
| instrumentHeight   | Real  | 0..1        | The vertical distance between instrument location and InstrumentPoint    |
| targetHeight       | Real  | 0..1        | The height of the target                                                 |
| reflectorHeight    | Real  | 0..1        | The vertical distance between the reflector and the TargetPoint          |
| slopeDistance      | Real  | 0..1        | The slope distance between the InstrumentPoint and the TargetPoint       |
| horizontalDistance | Real  | 0..1        | The horizontal distance between the InstrumentPoint and the TargetPoint  |
| horizontalAngle    | Real  | 0..1        | The horizontal angle reading from the InstrumentPoint to the TargetPoint |
| azimuth            | Real  | 0..1        | The azimuth from the InstrumentPoint to the TargetPoint                  |
| verticalAngle      | Real  | 0..1        | The vertical angle reading from the telescope axis to the reflector      |
| instrumentPoint    | Point | 0..1        | The point used for instrument set-up                                     |

### 7.7.13 LA\_PointCloudObservation

An instance of class LA\_PointCloudObservation is a survey source obtained by point clouds observation. LA\_PointCloudObservation is subclass of class LA\_SurveySource. See Figure 11.

The attributes of LA\_PointCloudObservation are shown in Table 41.

Table 41 — Attributes of LA\_PointCloudObservation

| Attribute name | Type            | Cardinality | Description                                                     |
|----------------|-----------------|-------------|-----------------------------------------------------------------|
| pointsNumber   | Integer         | 0..1        | The number of points included in the point cloud observation    |
| maxSNR         | Integer         | 0..1        | The maximum value of the quality index of signal to noise ratio |
| minSNR         | Integer         | 0..1        | The minimum value of the quality index of signal to noise ratio |
| maxIntensity   | Integer         | 0..1        | The maximum intensity value in the cloud                        |
| minIntensity   | Integer         | 0..1        | The minimum intensity value in the cloud                        |
| minNorthing    | CharacterString | 0..1        | The minimum Northing                                            |
| maxNorthing    | CharacterString | 0..1        | The maximum Northing                                            |
| minEasting     | CharacterString | 0..1        | The minimum Easting                                             |
| maxEasting     | CharacterString | 0..1        | The maximum Easting                                             |
| minElevation   | Real            | 0..1        | The minimum elevation                                           |
| maxElevation   | Real            | 0..1        | The maximum elevation                                           |
| poinCloud      | PointCloud      | 0..1        | The result of the observation                                   |

### 7.7.14 LA\_GNSSObservation

An instance of class LA\_GNSSObservation is a survey source obtained by using GNSS receivers. A LA\_GNSSObservation contains all the data related to the GNSS observation. It is subclass of class LA\_SurveySource. See Figure 11.

The attributes of LA\_GNSSObservation are shown in Table 42.

**Table 42 — Attributes of LA\_GNSSObservation**

| Attribute name                    | Type                                 | Cardinality | Description                                                                                      |
|-----------------------------------|--------------------------------------|-------------|--------------------------------------------------------------------------------------------------|
| receiverID                        | Oid                                  | 0..1        | The unique identifier of the receiver used for the observation                                   |
| systemType                        | LA_SatelliteSystem-Type              | 0..*        | The type of satellite system that was used for the position calculation                          |
| numSatTracked                     | Integer                              | 0..1        | The number of satellites that has been tracked from the rover position                           |
| numSatUsed                        | Integer                              | 0..1        | The number of satellites that has been used for the position calculation                         |
| /gDOP                             | Real                                 | 0..1        | The Geometric Dilution of Precision (GDOP), derived value from the Matrix                        |
| covarianceMatrix                  | Matrix [3x3]                         | 0..1        | The covariance matrix of the observation                                                         |
| fixDateTime                       | DateTime                             | 0..1        | The date and time of GPS signal                                                                  |
| GNSSSurveyType                    | LA_GNSSSurvey-Type                   | 0..1        | The type of GNSS techniques used                                                                 |
| GNSSReferenceStationsNetwork      | LA_GNSSReferenceStationsNetworkType  | 0..1        | The type of reference stations used                                                              |
| GNSSReferenceStationsNetworkName  | CharacterString                      | 0..1        | The name of reference stations' network used                                                     |
| GNSSReferenceStationsNetworkScale | LA_GNSSReferenceStationsNetworkScale | 0..1        | The scale of reference stations' network used                                                    |
| site_displacement_included        | Boolean                              | 0..1        | if the site displacement to be applied to a SSR position (e.g., Earth tides) is already included |
| rawMeasurement                    | Point                                | 0..1        | The raw result of the observation                                                                |

### 7.7.15 LA\_GNSSCorrection

An instance of class LA\_GNSSCorrection is a survey source obtained by implementing the corrections to correct the GNSS observations. A LA\_GNSSCorrection contains all the data related to the corrections of GNSS observation. It is subclass of class LA\_GNSSObservation. See Figure 11.

The attributes of LA\_GNSSCorrection are shown in Table 43.

**Table 43 — Attributes of LA\_GNSSCorrection**

| Attribute name               | Type                      | Cardinality | Description                                   |
|------------------------------|---------------------------|-------------|-----------------------------------------------|
| correctionServiceType        | LA_CorrectionService-Type | 0..1        | The category of the corrections' concept used |
| convergenceTime              | DateTime                  | 0..*        | The convergence time of GNSS observation      |
| frequencyType                | LA_GNSSFrequency-Type     | 0..1        | The frequency range of GNSS correction        |
| Ext_OSR_LumpSumCorrection_ID | Ext_OSR_LumpSumCorrection | 0..1        | The lump sum of corrections of OSR            |
| SSR_Error_Components         | LA_SSR_Error_Components   | 0..1        | The components of corrections of SSR          |

### 7.7.16 LA\_GPRObservation

An instance of class LA\_GPRObservation is a survey source obtained by GPR observation.

The attributes of LA\_GPRObservation are shown in Table 44.

Table 44 — Attributes of LA\_GPRObservation

| Attribute name         | Type            | Cardinality | Description                                      |
|------------------------|-----------------|-------------|--------------------------------------------------|
| name                   | CharacterString | 0..1        | The name of GPR observation                      |
| description            | CharacterString | 0..1        | The information about the GPR observation        |
| GPRPenetrationDepthMax | Real            | 0..1        | The maximum depth penetration of GPR observation |
| antennaFrequency       | Real            | 0..1        | The antenna frequency of GPR observation         |
| GPRFile                | Image           | 0..1        | The result file of the observation               |

#### 7.7.17 LA\_MBESObservation

An instance of class LA\_MBESObservation is a survey source obtained by MBES observation.

The attributes of LA\_MBESObservation are shown in Table 45.

Table 45 — Attributes of LA\_MBESObservation

| Attribute name | Type            | Cardinality | Description                                |
|----------------|-----------------|-------------|--------------------------------------------|
| name           | CharacterString | 0..1        | The name of GPR observation                |
| description    | CharacterString | 0..1        | The information about the MBES observation |
| MBESFile       | PointCloud      | 0..1        | The result file of the observation         |
| absorption     | Real            | 0..1        | The absorption amount of the observation   |

#### 7.7.18 Data types for Surveying and Representation Subpackage

The Surveying and Representation Subpackage has two data type: LA\_Transformation and LA\_SSR\_Error\_Components. The generic data type LA\_Transformation is introduced in LADM to provide support for transformations of coordinates between two reference systems, while the generic data type LA\_SSR\_Error\_Components to provide all the information regarding State Space Representation corrections.

The attributes of LA\_Transformation are shown in Table 46.

Table 46 — Attributes of LA\_Transformation

| Attribute name      | Type            | Cardinality | Description                                                                                 |
|---------------------|-----------------|-------------|---------------------------------------------------------------------------------------------|
| transformation      | OperationMethod | 1           | The description of transformation method used to associated location value (ISO 19111:2019) |
| transformedLocation | Point           | 1           | The location obtained from the transformation operation method                              |

The attributes of LA\_SSR\_Error\_Components are shown in Table 47.

Table 47 — Attributes of LA\_SSR\_Error\_Components

| Attribute name                | Type                        | Cardinality | Description                                   |
|-------------------------------|-----------------------------|-------------|-----------------------------------------------|
| satelliteClockCorrection      | DateTime                    | 0..1        | The clock correction of the satellite used    |
| ExtTroposphericCorrectionID   | ExtTroposphericCorrection   | 0..*        | The parameters of the tropospheric correction |
| ExtSatelliteOrbitCorrectionID | ExtSatelliteOrbitCorrection | 0..*        | The parameters of the orbit correction (3D)   |
| ExtIonosphericCorrectionID    | ExtIonosphericCorrection    | 0..1        | The parameters of the ionospheric correction  |

## **7.8 Associations between classes**

In this clause, three tables summarize all the relationships between the LADM classes:

- a) for associations between classes, see Table 48;
- b) for generalizations between classes, see Table 49;
- c) for aggregations between classes, see Table 50.

The information in these tables is included to assist the readability of the standard and are based on the models.

**Table 48 — Associations between the LADM classes**

| <b>Class 1<sup>a</sup></b> | <b>Class 2<sup>a</sup></b>       | <b>Association name</b> | <b>Role name End 1</b> | <b>Multiplicity</b> | <b>Role name End 2</b> | <b>Multiplicity</b> |
|----------------------------|----------------------------------|-------------------------|------------------------|---------------------|------------------------|---------------------|
| AdministrativeSource       | BAUnit                           | -                       | source                 | 0..*                | unit                   | 0..*                |
| AdministrativeSource       | Party                            | conveyancer-Source      | source                 | 0..*                | conveyancer            | 1..*                |
| AdministrativeSource       | RRR                              | -                       | source                 | 1..*                | rrr                    | 0..*                |
| AdministrativeSource       | RequiredRelationship-BAUnit      | relationSource          | source                 | 0..*                | requiredRelationBAUnit | 0..*                |
| AdministrativeSource       | SpatialSource                    | integrated-Source       | -                      | 0..*                | -                      | 0..*                |
| BAUnit                     | BAUnit                           | relationBAUnit          | unit1                  | 0..*                | unit2                  | 0..*                |
| BAUnit                     | RRR                              | -                       | baunit                 | 1                   | rrr                    | 1..*                |
| BoundaryFace               | SpatialSource                    | -                       | -                      | 0..*                | source                 | 0..*                |
| BoundaryFace               | SpatialUnit                      | minus, plus             | -                      | 0..*                | -                      | 0..*                |
| BoundaryFaceString         | Point                            | -                       | -                      | 0..*                | -                      | 0,2..*              |
| BoundaryFaceString         | SpatialSource                    | -                       | -                      | 0..*                | source                 | 0..*                |
| GNSSObservation            | GNSSCorrection                   | observation-Correction  | observation            | 0..*                | connection             | 0..1                |
| Mortgage                   | Right                            | -                       | -                      | 0..*                | -                      | 0..*                |
| Party                      | BAUnit                           | baunitAsParty           | -                      | 0..1                | -                      | 0..1                |
| Point                      | BoundaryFace                     | -                       | point                  | 0,3..*              | -                      | 0..*                |
| Point                      | BoundaryFaceString               | -                       | -                      | 0,2..*              | -                      | 0..*                |
| RRR                        | Party                            | -                       | rrr                    | 0..*                | party                  | 0..1                |
| RRR                        | RequiredRelationship-RRR         | relationRRR             | rrr1                   | 0..*                | rrr2                   | 0..*                |
| Source                     | Party                            | -                       | -                      | 0..*                | represented by         |                     |
| SpatialSource              | BAUnit                           | -                       | -                      | 0..*                | -                      | 0..*                |
| SpatialSource              | Party                            | conveyancer-Source      | source                 | 0..*                | surveyor               | 1..*                |
| SpatialSource              | RequiredRelationship-SpatialUnit | source                  |                        | 0..*                |                        | 0..*                |
| SpatialSource              | Point                            | -                       | source                 | 0..*                | sourcePoint            | 1..*                |
| SpatialUnit                | BAUnit                           | -                       | -                      | 0..*                | -                      | 0..*                |
| SpatialUnit                | Level                            | -                       | su                     | 0..*                | level                  | 0..1                |
| SpatialUnit                | Point                            | referencePoint          | -                      | 0..1                | -                      | 0..1                |
| SpatialUnit                | SpatialSource                    | -                       | -                      | 0..*                | -                      | 0..*                |
| SpatialUnit                | SpatialUnit                      | -                       | element                | 0..*                | set                    | 0..1                |
| SpatialUnit                | SpatialUnitGroup                 | -                       | part                   | 0..*                | whole                  | 0..*                |

<sup>a</sup> The LA prefix of class names has been omitted due to space reasons.