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May 6-11, 2018 in Istanbul, Turkey*

# 3D Cadastral Information Modelling FIG publication Best Practices 3D Cadastres - Extended version

XXVI FIG CONGRESS 2018

Istanbul, Turkey

8 May 2018

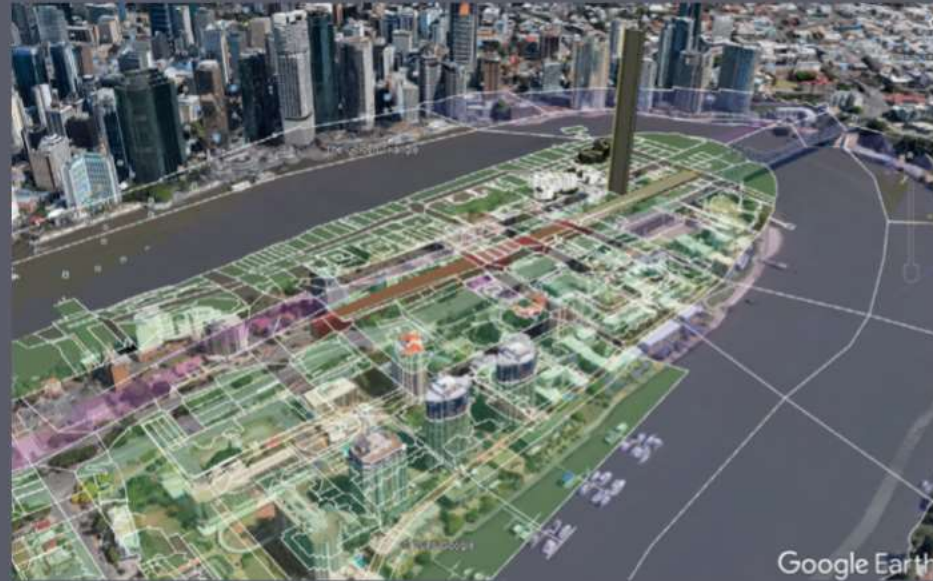
Peter van Oosterom, Christiaan Lemmen, Rod Thompson, Karel Janečka, Sisi Zlatanova and Mohsen Kalantari



FIG publication

# Best Practices 3D Cadastres

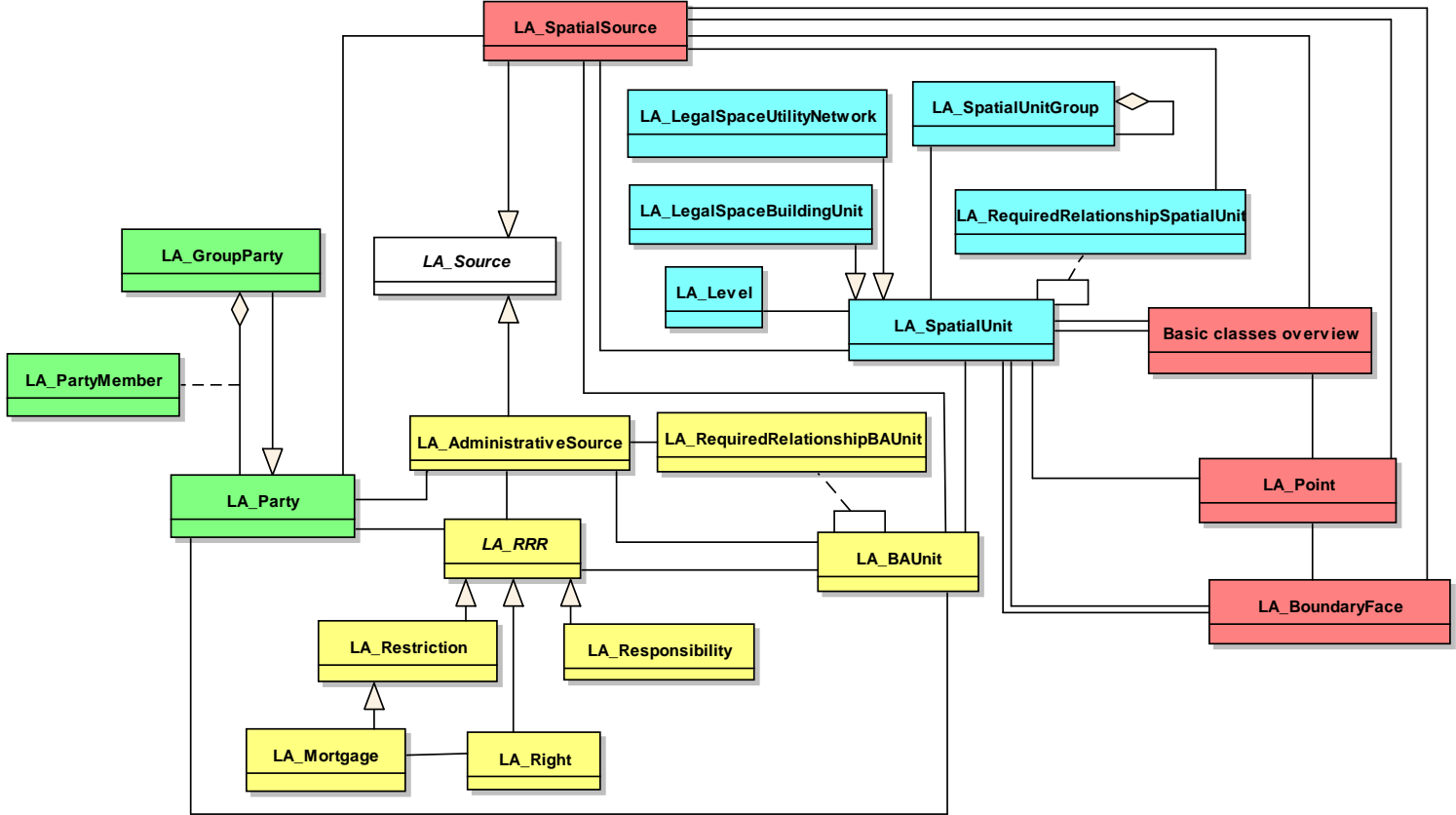
Extended version



Google Earth

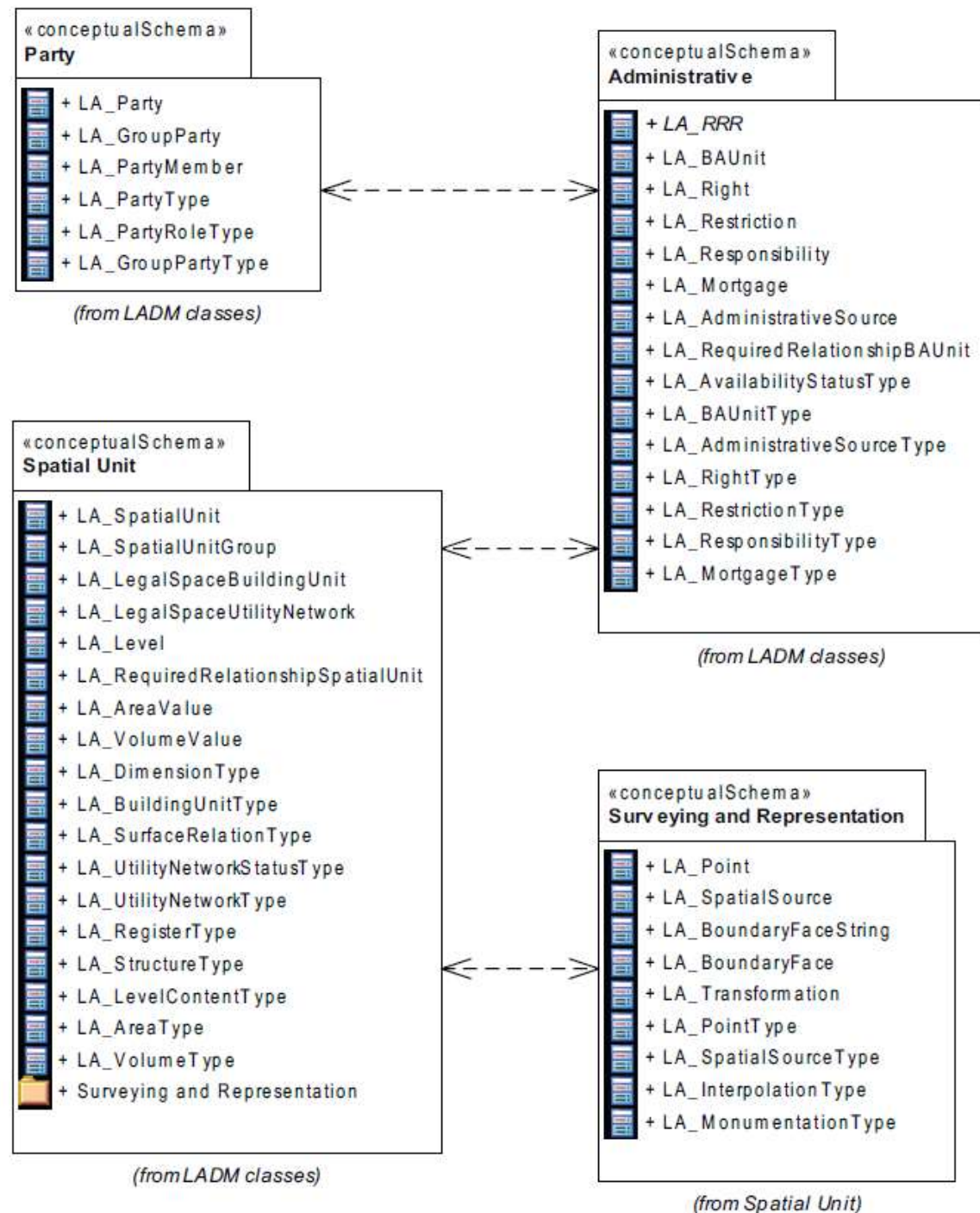
Editor: Peter van Oosterom

# LADM

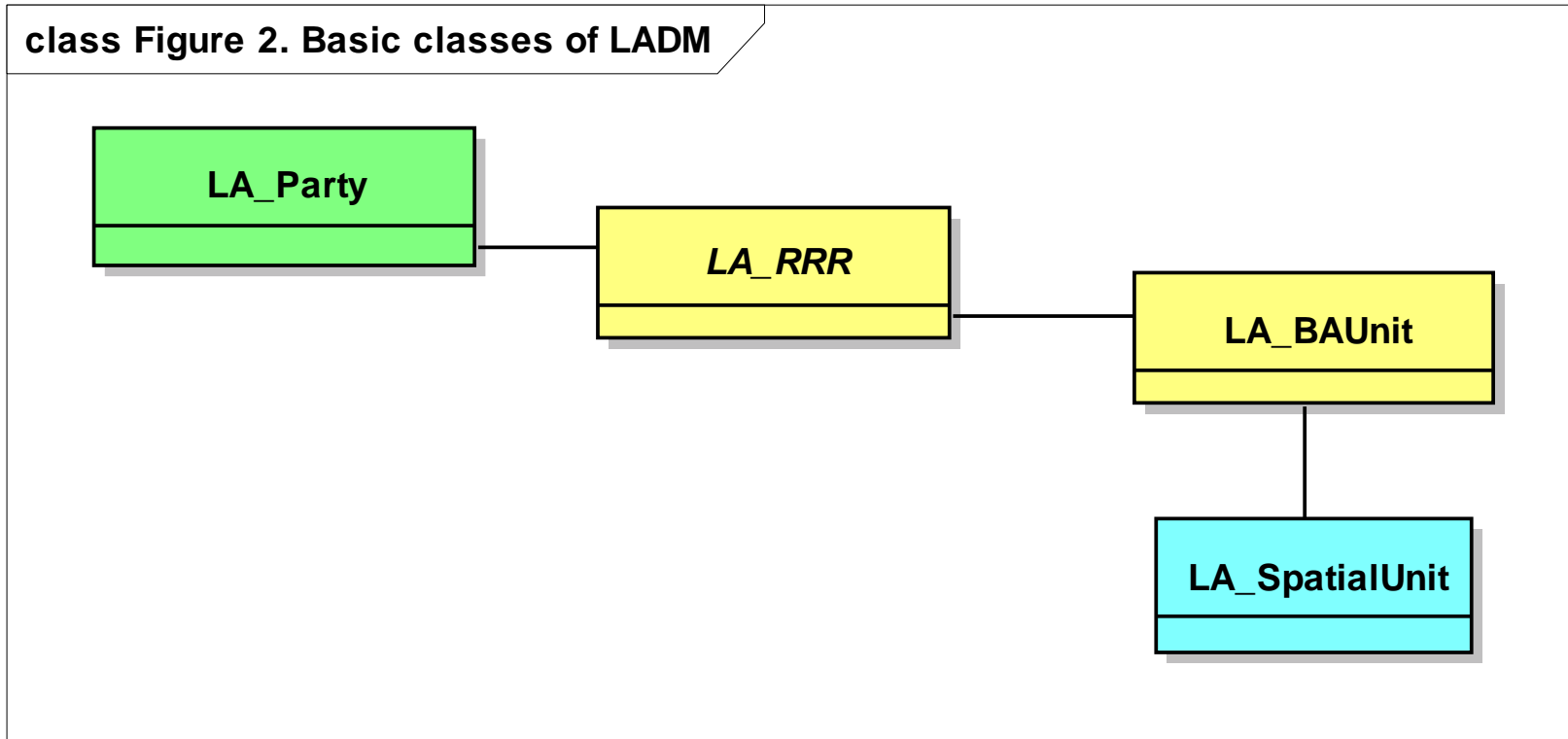


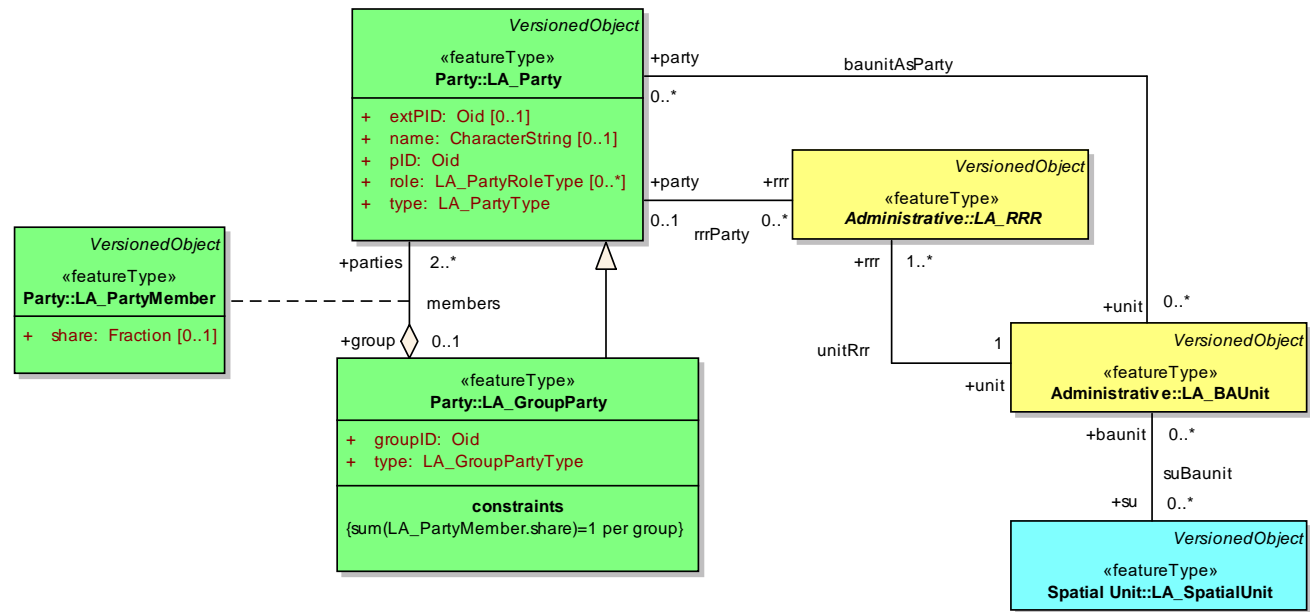
# LADM Packages

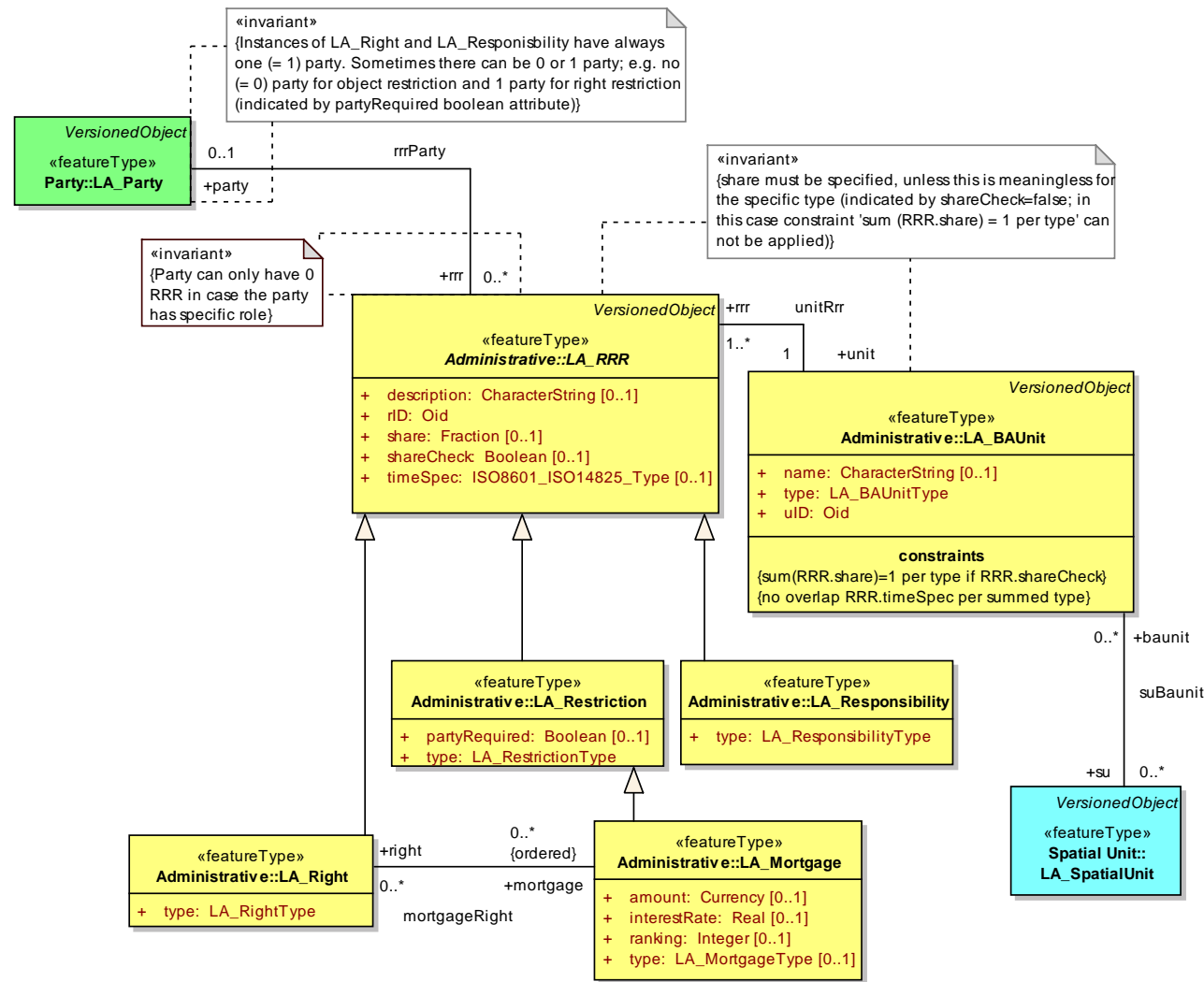
- Party Package
- Administrative Package
- Spatial Unit Package – with sub-package Surveying and Representation



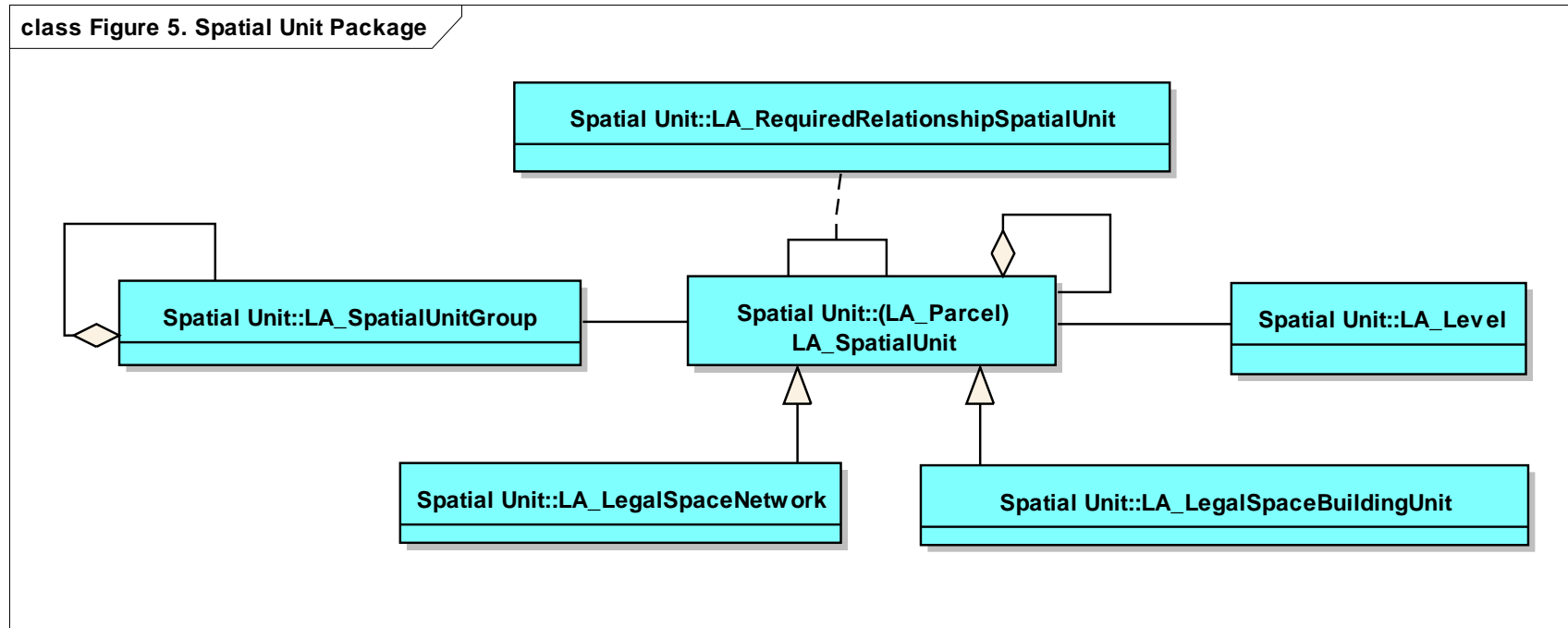
# Core Classes of LADM



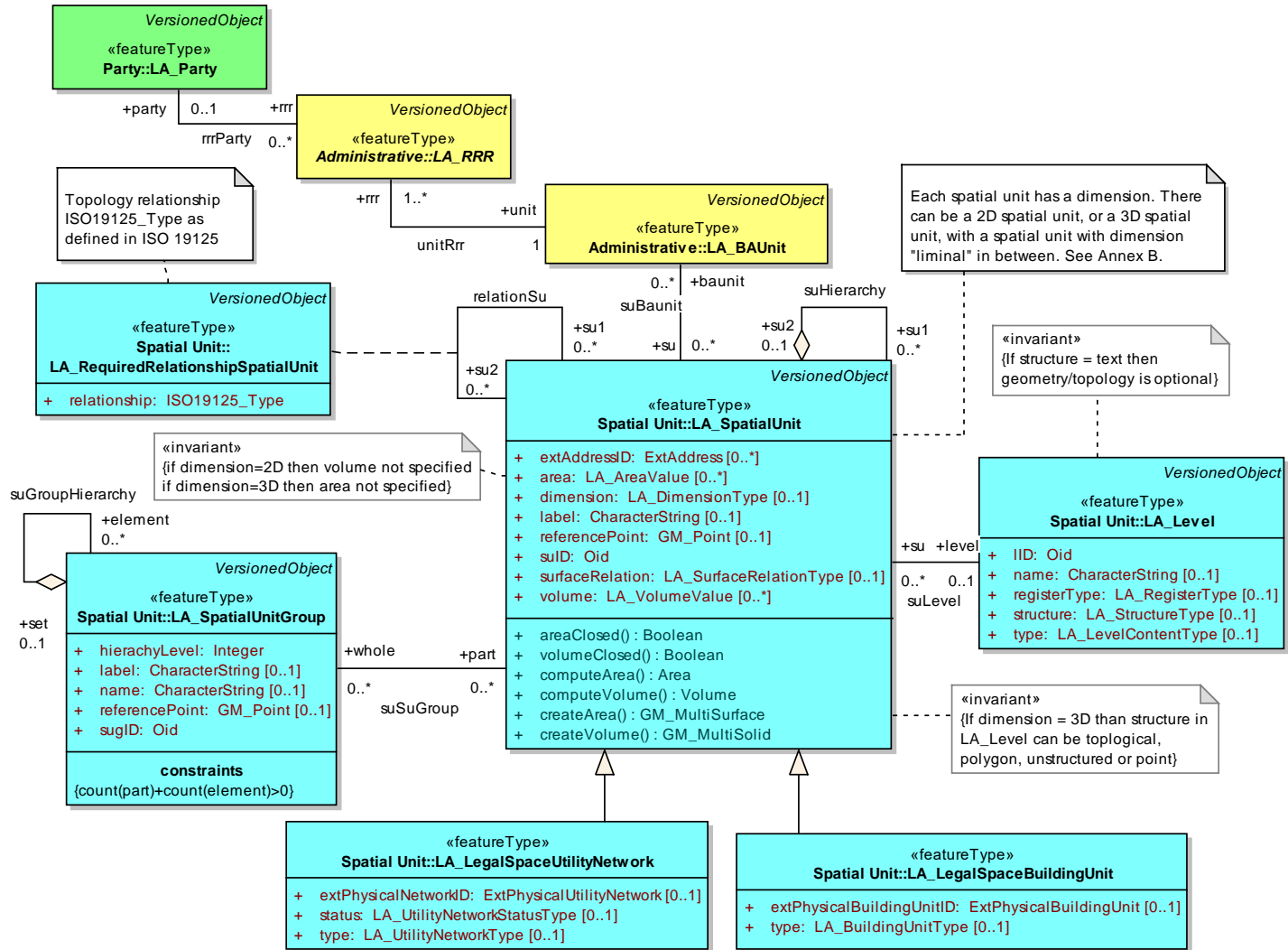




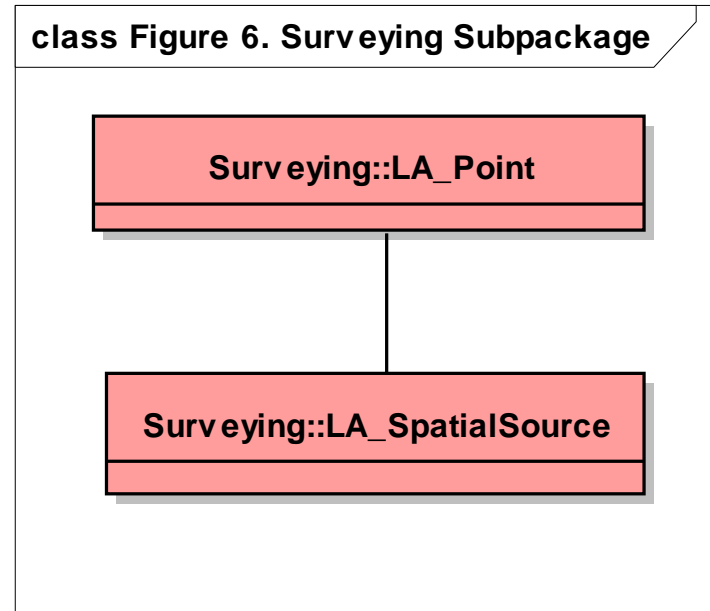
# LADM Spatial Unit Classes



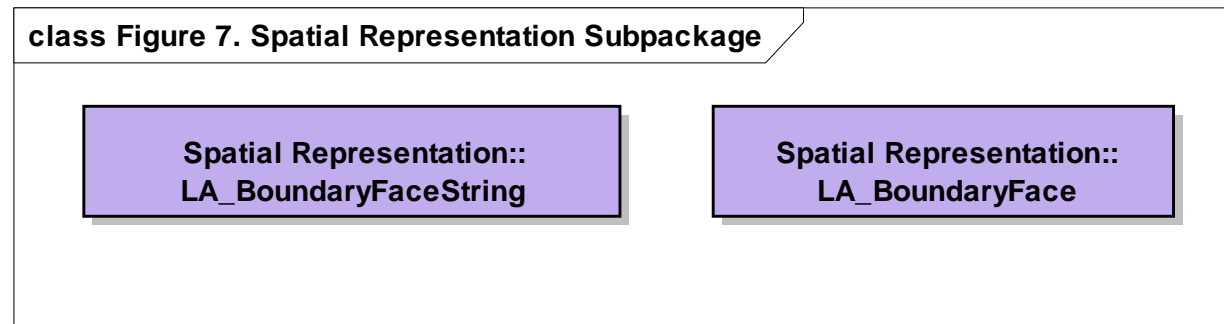




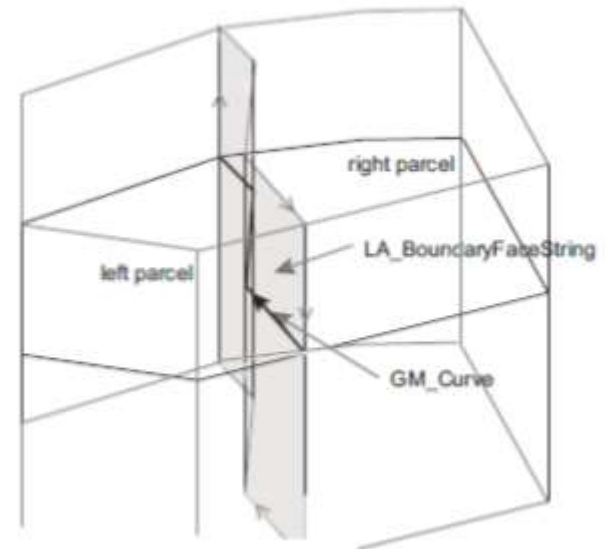
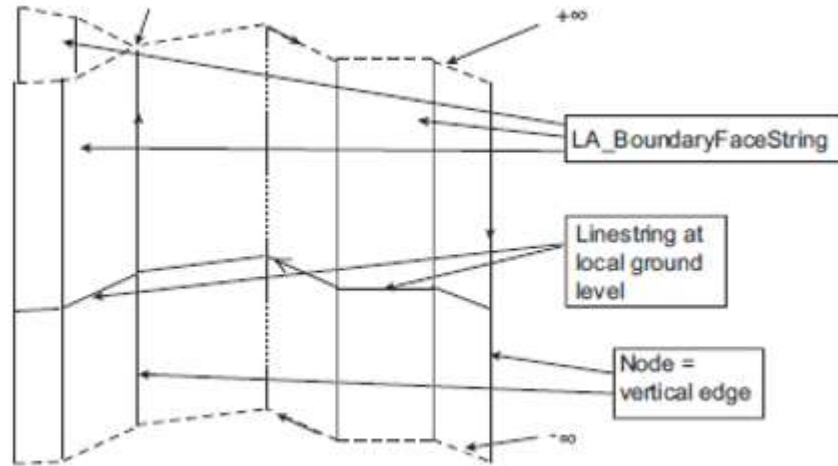
# LADM Surveying Classes



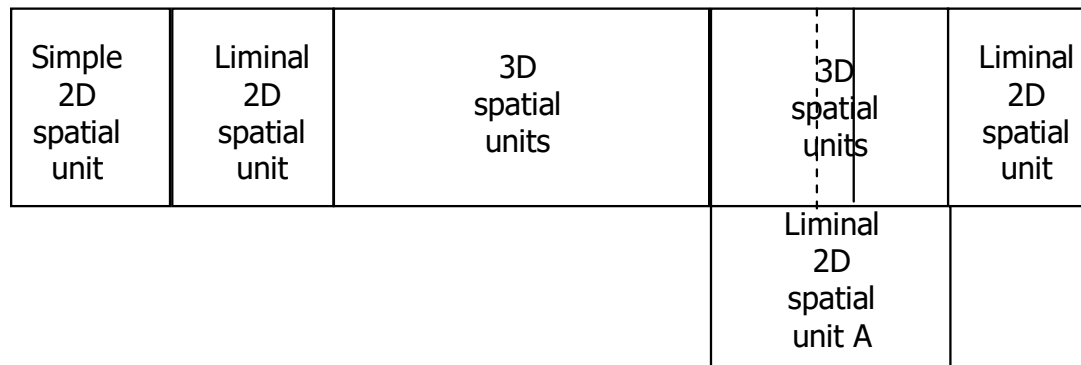
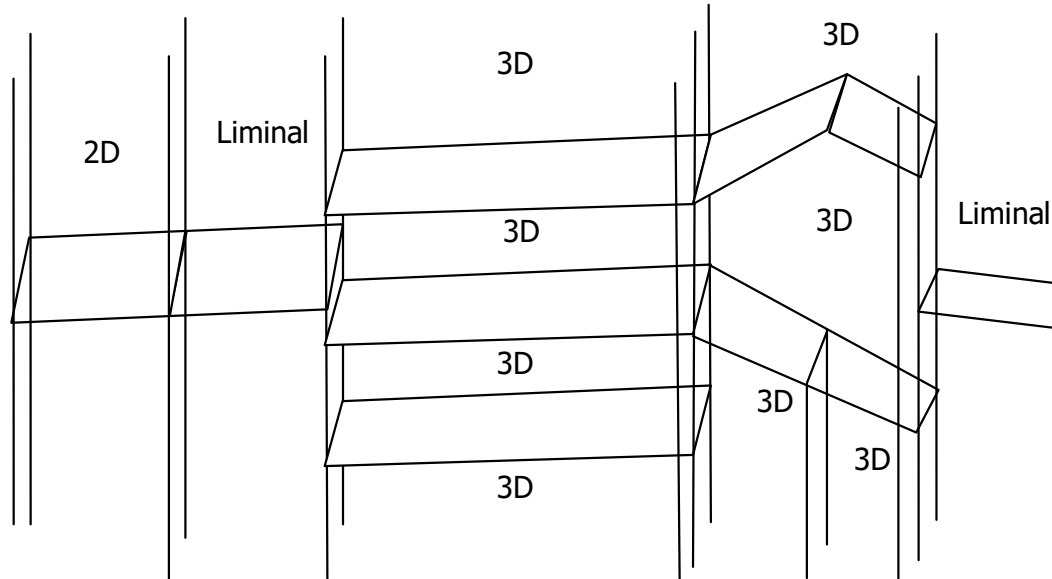
# LADM Spatial Representation Classes



# Boundary Face Strings



# 2D and 3D Integration

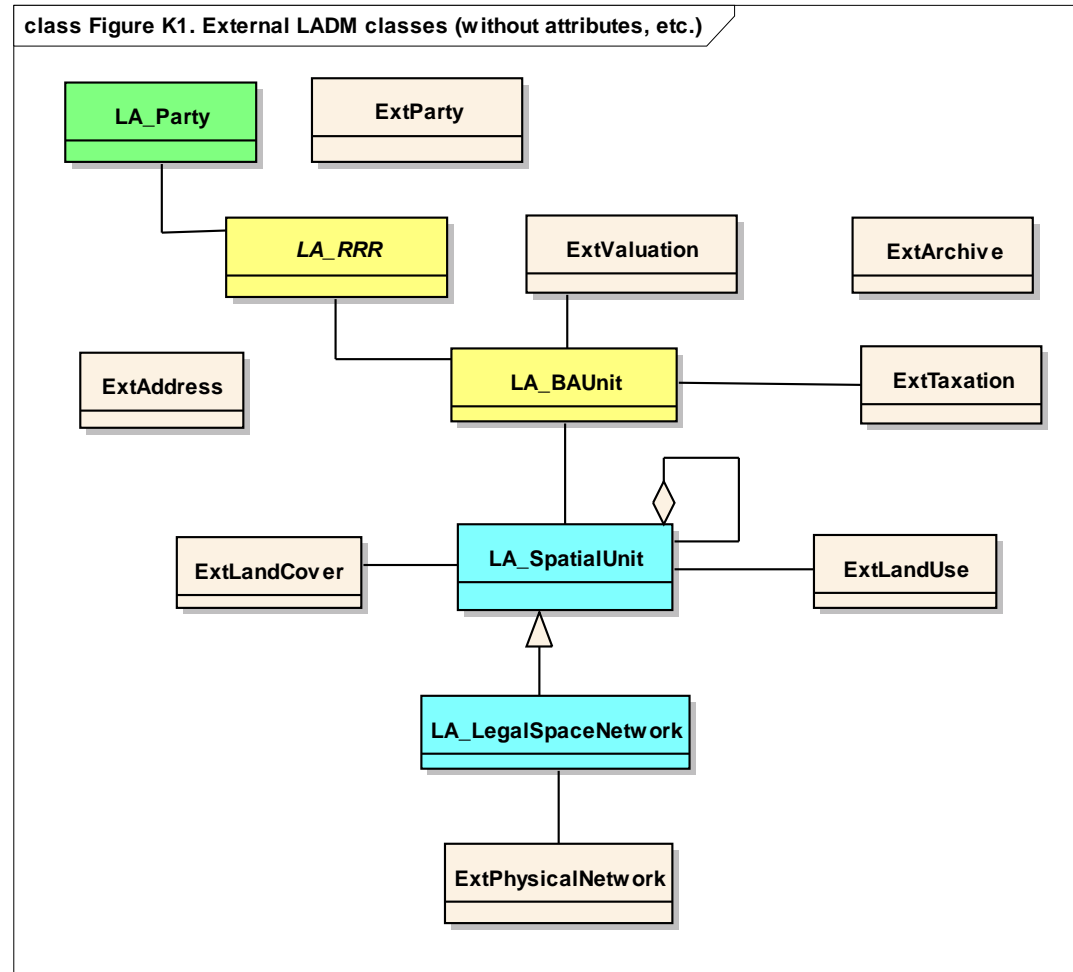


- between 2D and 3D spatial unit transition via liminal spatial units
- Liminal spatial units are 2D parcels, but are stored as 3D parcels
- Liminal spatial units are delimited by a combination of LA\_BoundaryFace and LA\_BoundaryFaceString objects

# LADM External Links

## External links

- Addresses
- Persons
- Valuation
- Taxation
- Land cover
- Land use
- Documents
- Utility networks



# New Working Item Proposal

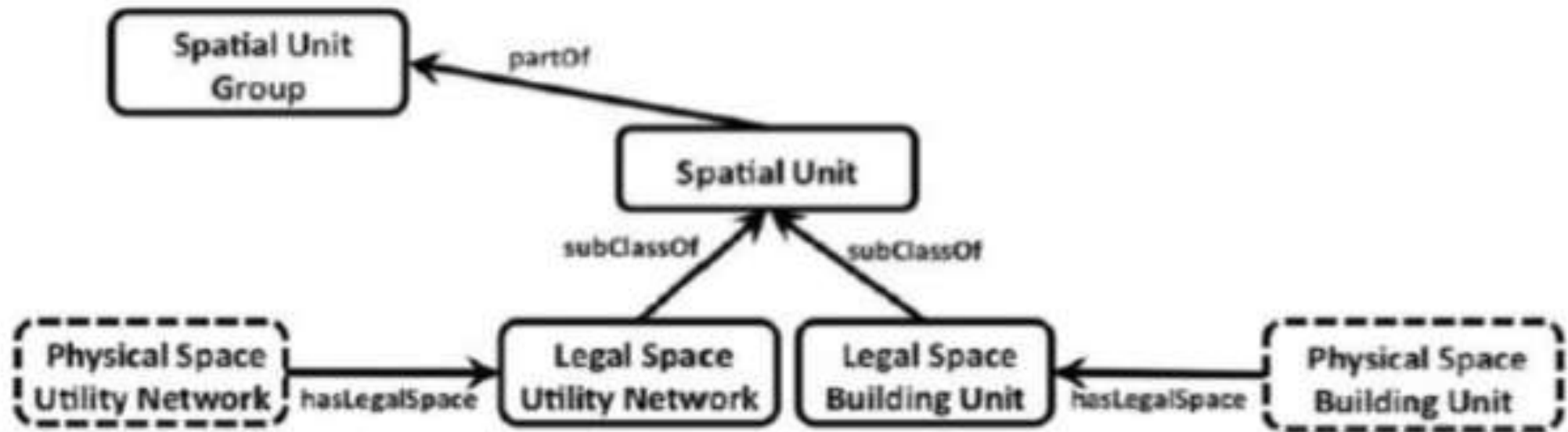
- more functionality for a complete partition of space: more explicit 3D+time profiles
- extended survey model and legal model is needed (adjustments, quality labels)
- encodings/technical models for integration of LADM with existing standards: BIM/IFC, GML, CityGML, LandXML, LandInfra, IndoorGML, RDF/linked data, GeoJSON
- BIM is very important in order to establish a link between BIM and land administration in relation to spatial planning and lifecycles of buildings
- Open data is about Coding of Rights, Right holders, Spatial Unit Types, etc. See Informative Annex J of (ISO 19152, 2012) – W3C.

# 3D

- Develop and register zoning plans
- Register (public law) restrictions
- Design new spatial units/objects
- Acquire appropriate land/space
- Request and provide (after appropriate checks) permits
- Obtain and register financing (mortgage) for future objects
- Survey and measure spatial units/objects (after construction)
- Submit associated rights (RRR)/parties and their spatial units
- Validate and check submitted data (and register if accepted)
- Store and analyze the spatial units
- Disseminate, visualize and use the spatial units

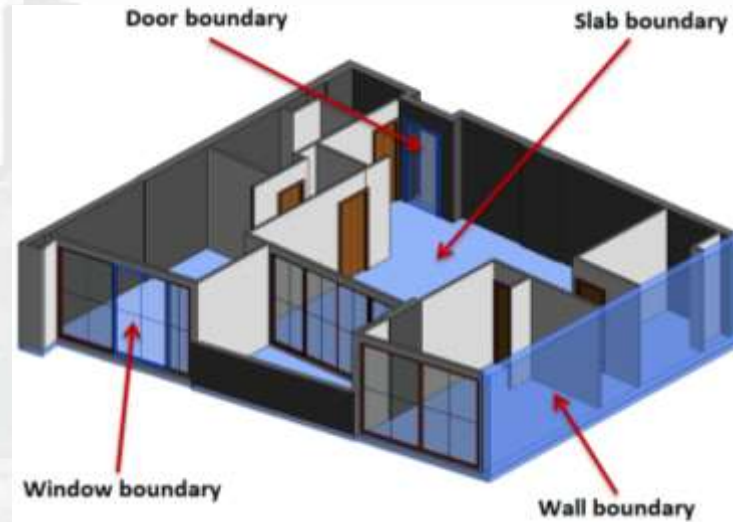


# Legal and Physical



# BIM for Land Administration

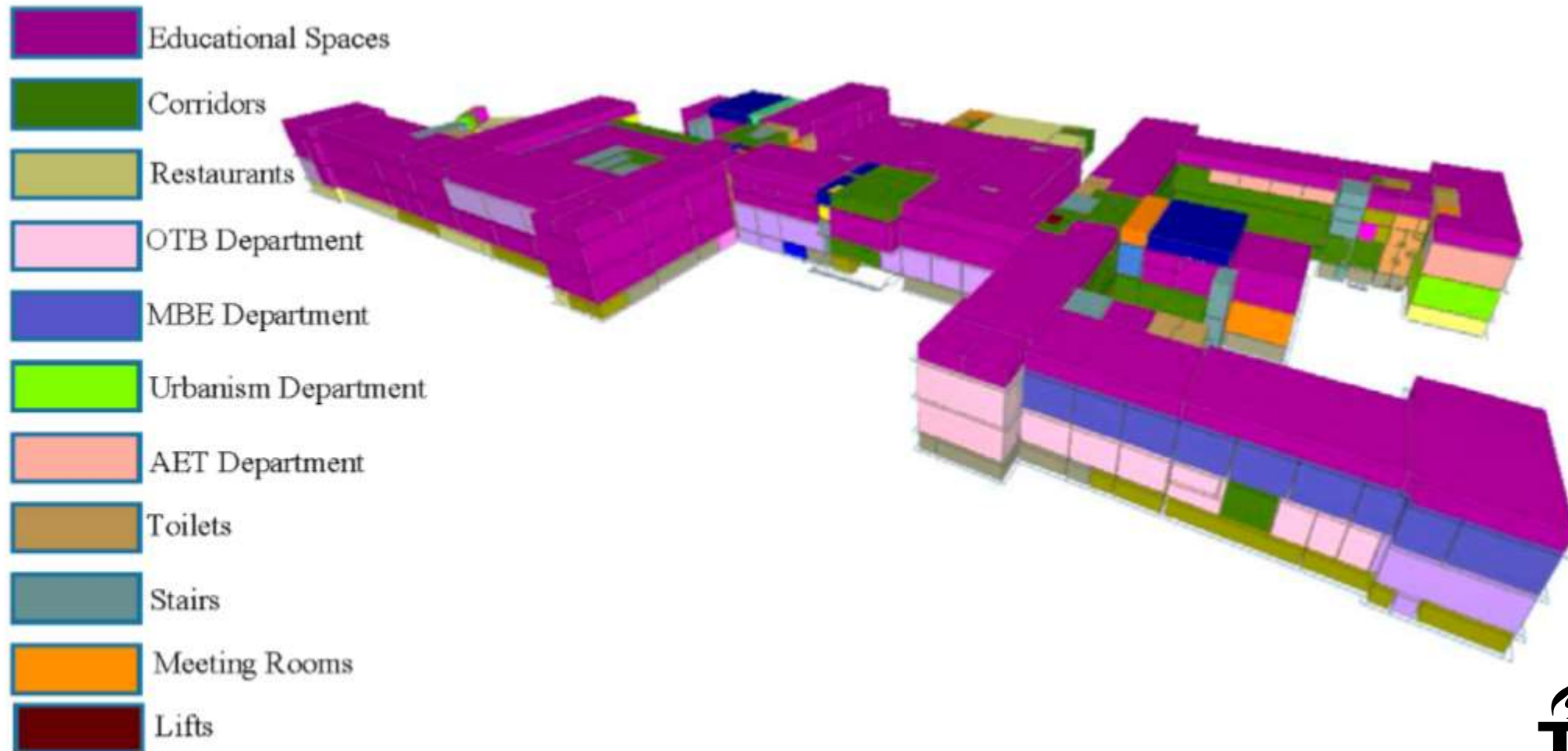
- Given that land administration information about high-rise buildings is mostly derived from the physical aspects of the building, BIM models could potentially offer a feasible solution for the 3D digital management of ownership rights.



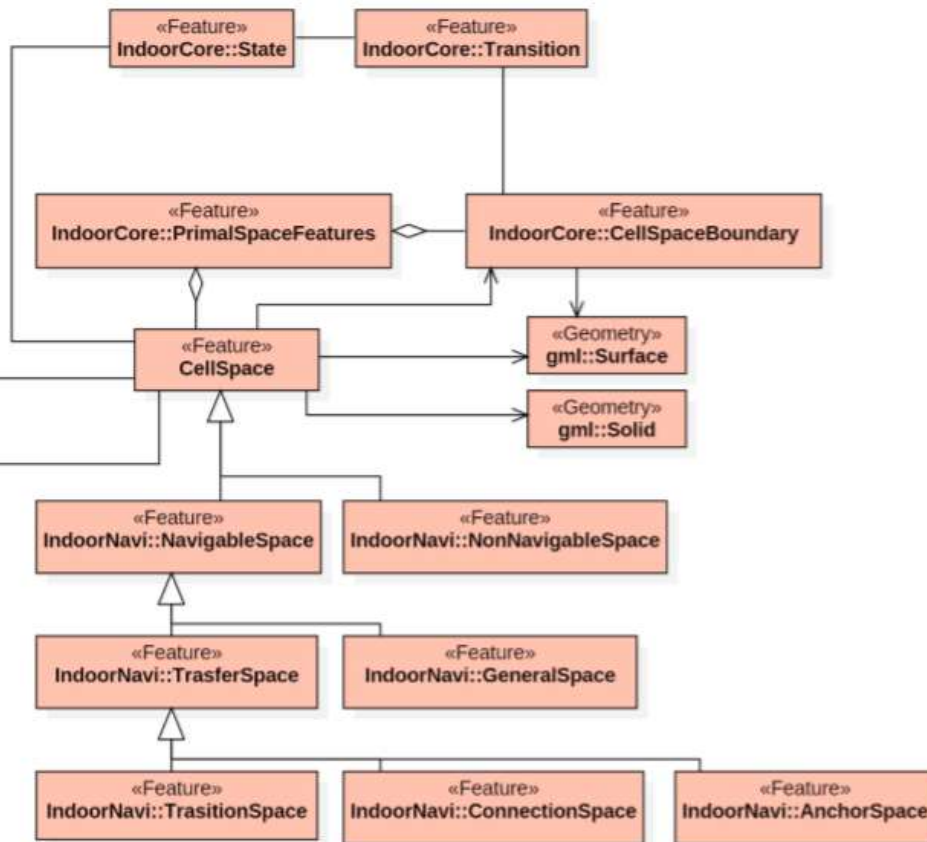
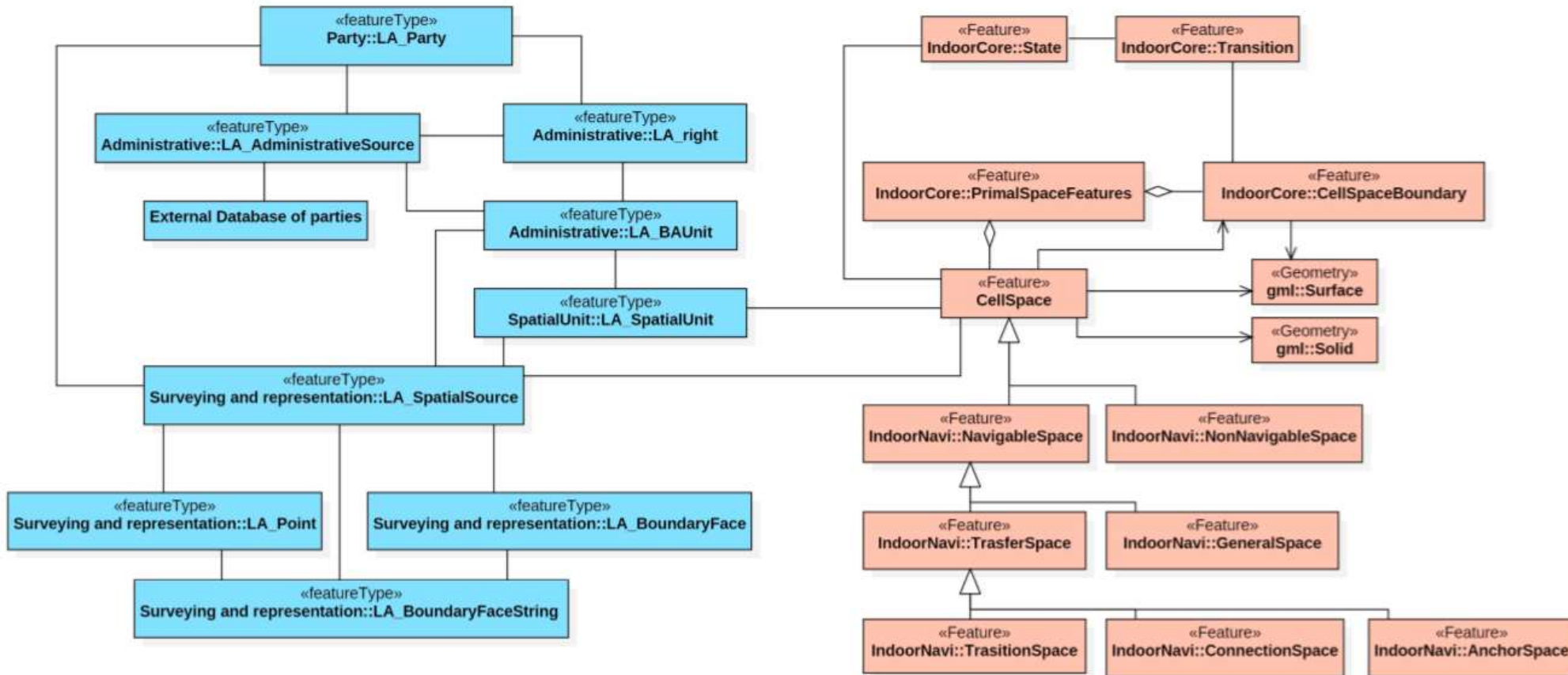
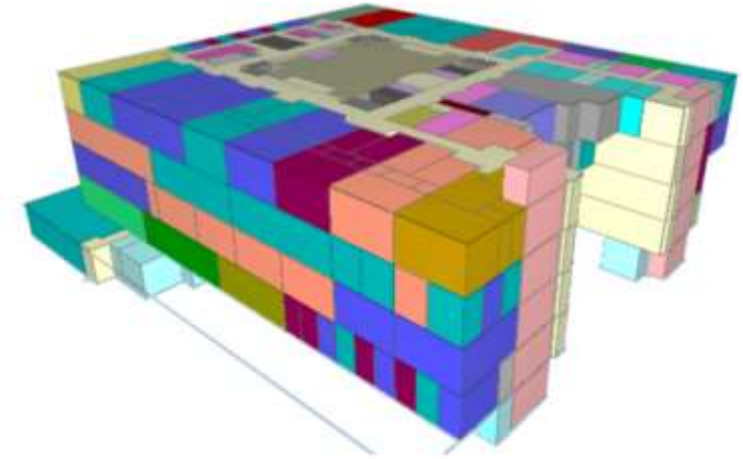
# List of wishes/challenges

- Just conceptual model gives no system interoperability
- At least two steps in implementation
  1. Country profile → need methodology (best practices)
  2. Encoding → which/how
- Connecting legal spaces and real world physical objects
- Having constraints in the technical model
- Tech encoding of both schema and the data (not relevant for RDF)?
- O&M part of model is not optimal for cadastral survey, will this change?
- Same encoding for different parts of model: survey, legal, party? (alternative options for survey InfraGML, LandXML,...)
- What about code lists, language used...
- Our encoding should fit into the (international) SDI.
- Issues in converting conceptual model to tech model (whatever approach/tools used: Enterprise architect, INTERLIS tools,...)
- Encoding for use with at least data storage/exchange, but much more needed for full system implementation

# Functional Use Rights



# LADM-IndoorGML combined use model



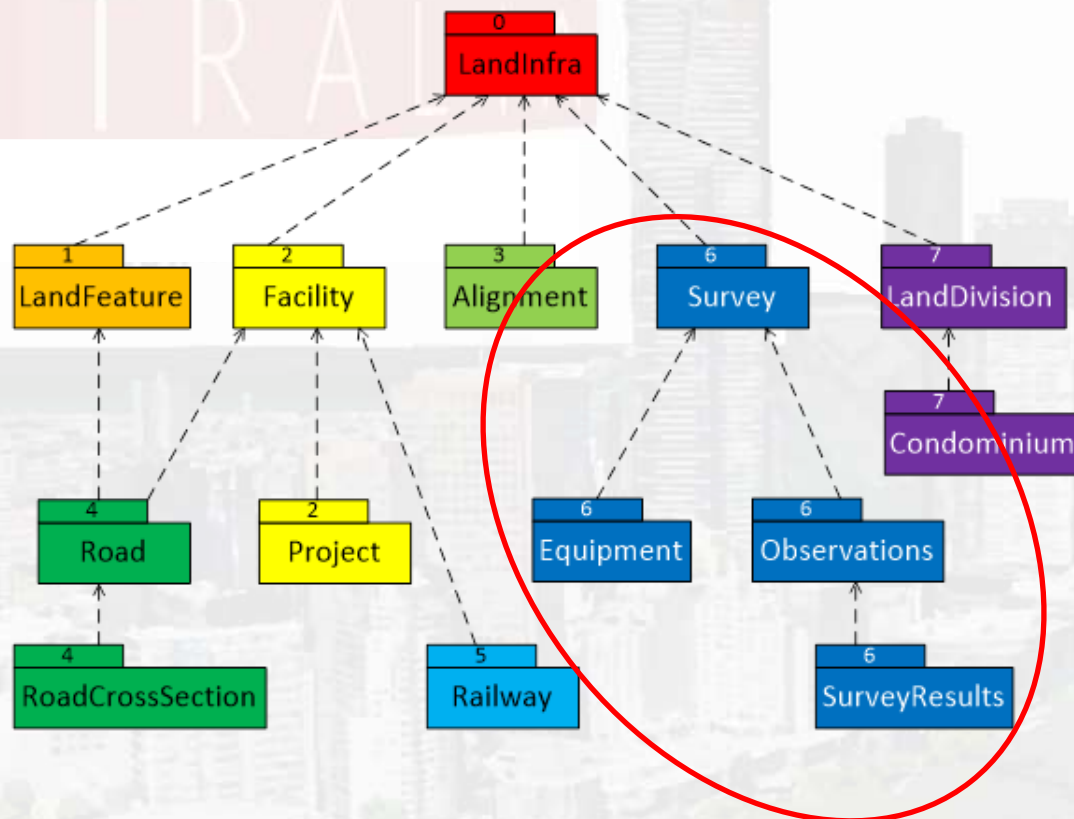
- Annex describing a methodology for developing country profile models
- Create toy data set/use cases to be expressed in different encodings and in instance level diagrams compared to Annex C
- Annexes with different encodings:
  1. Make a complete mapping of LADM concepts to **IFC** eg including group party which works with current reality (Dutch 'Basis ILS' could starting point) Include geo coordinates. Concurrently, define a domain layer within IFC (.ifc) in co operation with Building Smart, OGC, ISO,... (resulting in software support/implementations)
  2. Make a stable & complete schema in **INTERLIS** version 2 for use in the annex which includes the imported schemas from other ISO standards eg ISO19107 (.ili) The use of constraints should be emphasized (and perhaps constraints should be more formal in LADM core; e.g. UML/OCL)

3. Begin with a schema based on LADM and then express it in **RDF**. Work with existing code lists for semantics. Collaborate with INSPIRE SDI Joint Research Centre Linked Data research. Specify of 3D GeoSPARQL Endpoints. Consult ISO TS 19150 (Geographic Information Ontology) for guidelines on how to convert application schemas to .rdf
4. **InfraGML** (xml encoding), Try to cover RRR's, parties, group parties
5. **CityGML** and make an Application Domain Extension (ADE).

*We are concerned about the Survey Package, because from experience it does not seem optimal (maybe InfraGML is better here).*

*We are also concerned about the meta data in the conceptual model. This could be addressed better, more refined through the use of profiles – meta data at instance level, single object, group of objects*

## InfraGML Requirements Classes match LandInfra

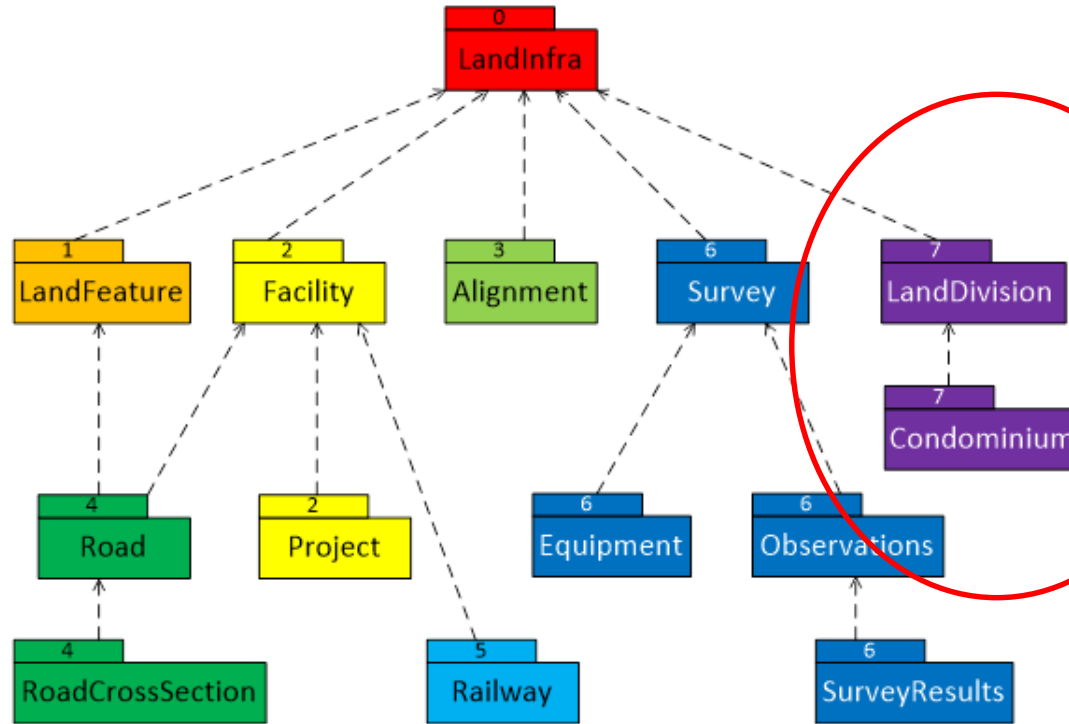


- Part 0 is the (concrete) Core RC which shall be supported by all conforming applications
- Then an application can select from
- Part 1 Land Features
- Part 2 Facilities (with optional Projects)
- Part 3 Alignments
- **Part 6 Survey (with optional Equipment, Observations, and SurveyResults)**
- Part 7 (2017) Land Division (with optional Condominiums)
- or any combination of these

Note: InfraGML Parts 0-6 have completed RFC March 3, 2017, with a TC vote soon to follow



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Thanks