Spatial aspects and multiple dimensions within LADM

16-7-2012

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(joint work Christiaan Lemmen, Rod Thompson, João Hespanha and Harry Uitermark)

LADM from Research to Implementation - Land Administration Domain Modelling at a threshold, 6 July 2012, Rotterdam, the Netherlands

TU Delft Delft University of Technology

Challenge the future

Content overview

1. Spatial Aspects LADM

2. Third Dimension

3. Adding Time

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Land Administration Domain Model ISO 19152 (LADM)

- Model includes:
  - Spatial part (geometry, topology)
  - Extensible frame for legal/admin parts

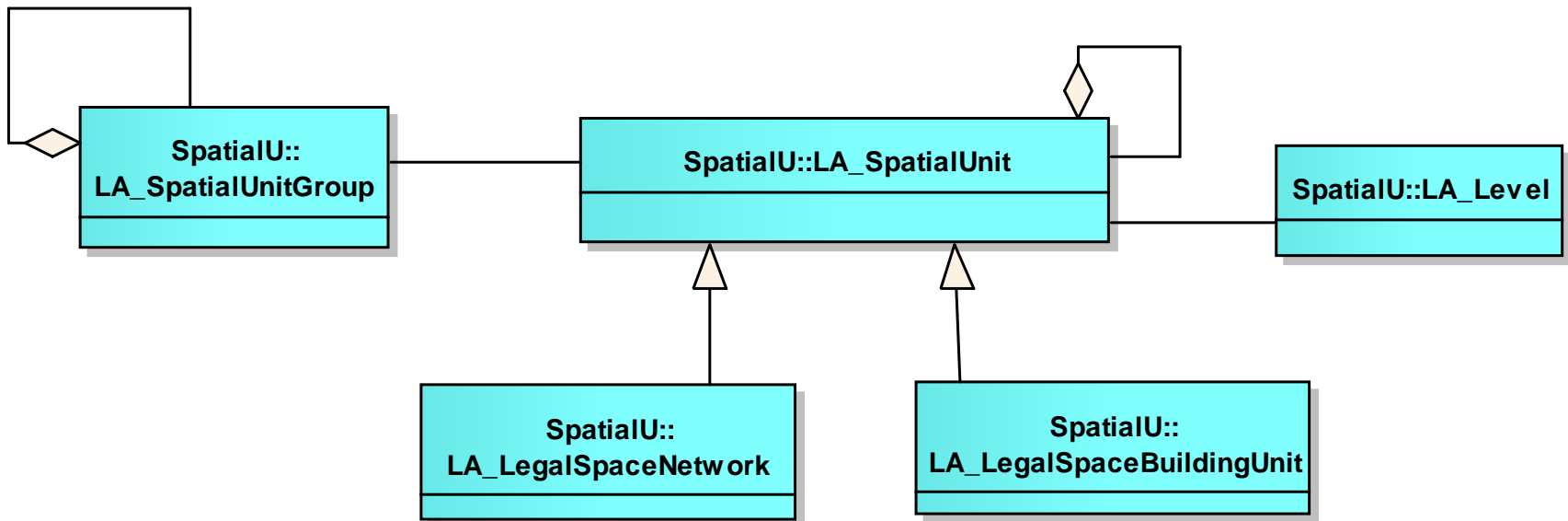LA_Party — LA_RRR — LA_BAUnit — LA_SpatialUnit
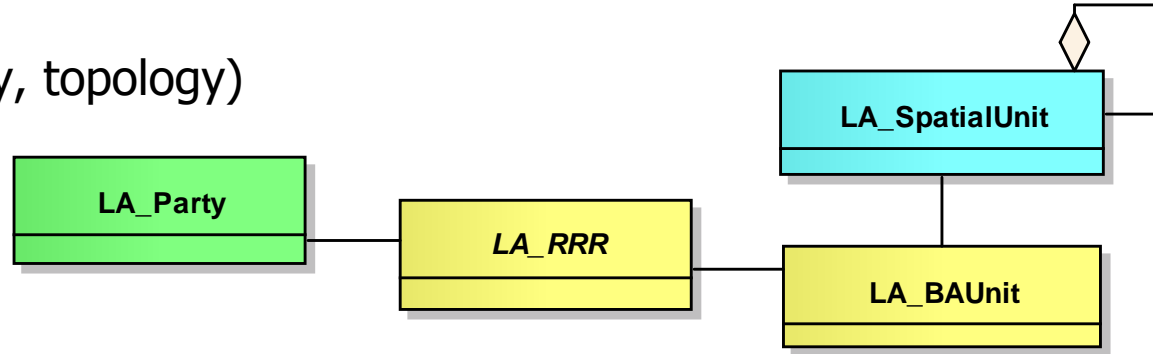
- Stared within the FIG in 2002 (International Federation of Surveyors, founded 1878 NGO)

- FIG proposed LADM to ISO/TC211, January 2008 (parallel voting in ISO TC211 and CEN TC287)

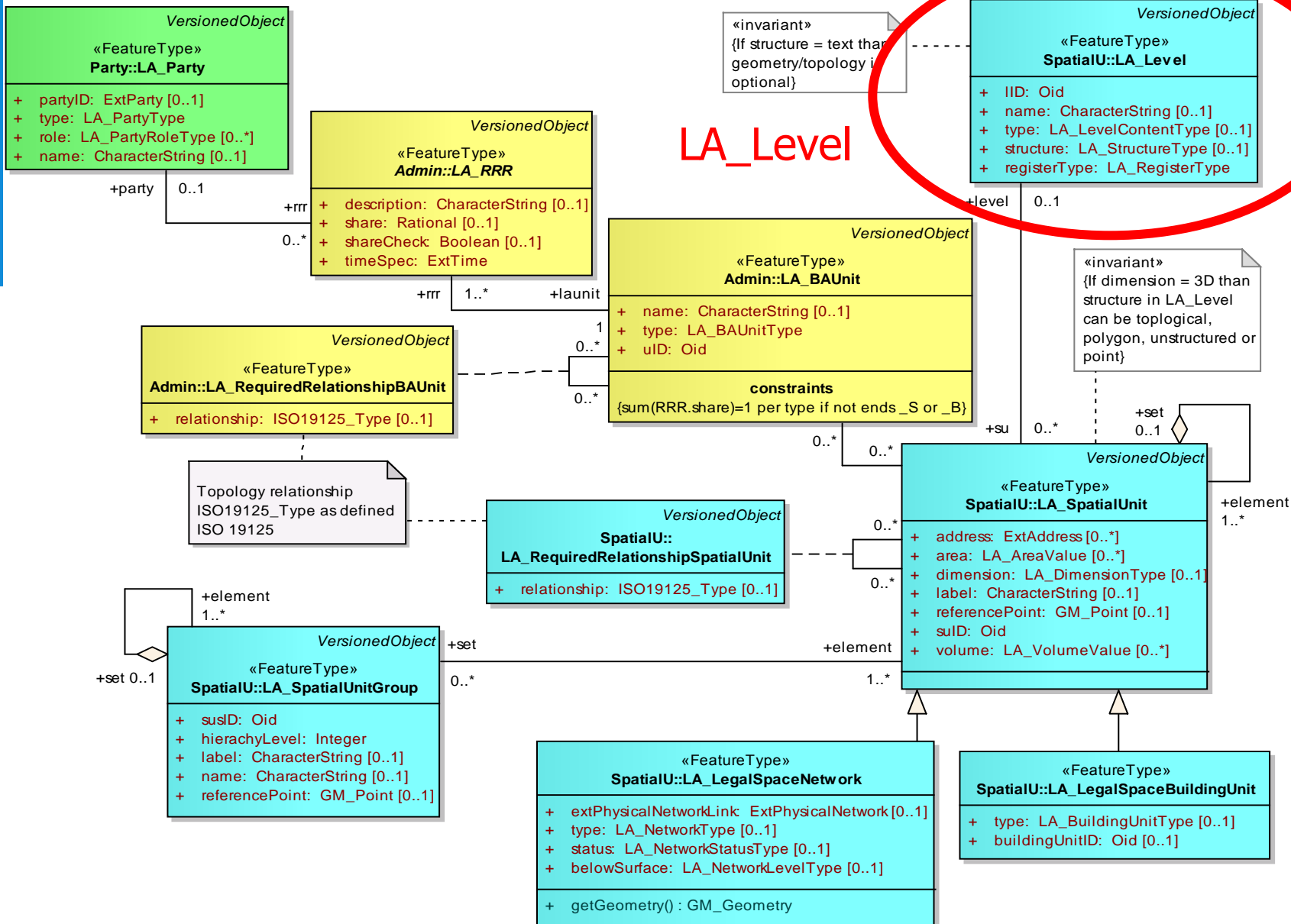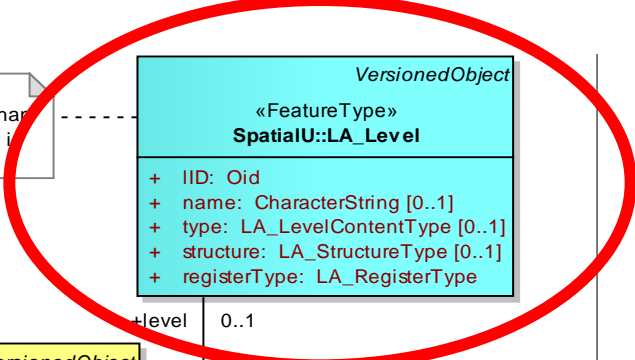- Includes integrated 2D and 3D support

LA_SpatialUnit (alias LA_Parcel)

- LA_SpatialUnit specializations: network, building unit
- organized in LA_Level based on structure or content
- 5 types: point, text (unstructured) line, polygon, and topology
- 2D and 3D integrated without complicating 2D

class Figure 4. Spatial Unit Package

| SpatialU:: LA_SpatialUnitGroup | — | SpatialU::LA_SpatialUnit | — | SpatialU::LA_Level |

SpatialU:: LA_LegalSpaceNetwork

SpatialU:: LA_LegalSpaceBuildingUnit

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LA_Level

Text-Based Spatial Unit

"beginning with a corner at the intersection of two stone walls near an apple tree on the north side of Muddy Creek road one mile above the junction of Muddy and Indian Creeks, north for 150 rods to the end of the stone wall bordering the road, then northwest along a line to a large standing rock on the corner of John Smith's place, thence west 150 rods to the corner of a barn near a large oak tree, thence south to Muddy Creek road, thence down the side of the creek road to the starting point."

(quoted from: http://en.wikipedia.org/wiki/Metes_and_bounds).

Point-Based Spatial Unit

"*a single coordinate of the centre of the dwelling unit could positively identify that unit, and this may be sufficient for basic recording purposes where the limits of the land holding are for the time being unimportant*".

- An early stage in a system of progressive title improvement, ending in a standard freehold system.
- Identifies a spatial unit, but does not delineate it.
- Provides an address reference point.
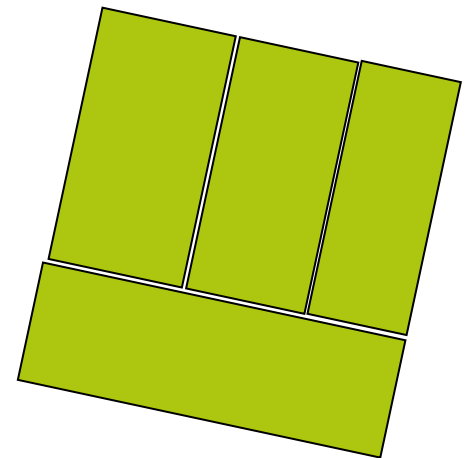
Line-Based Spatial Unit
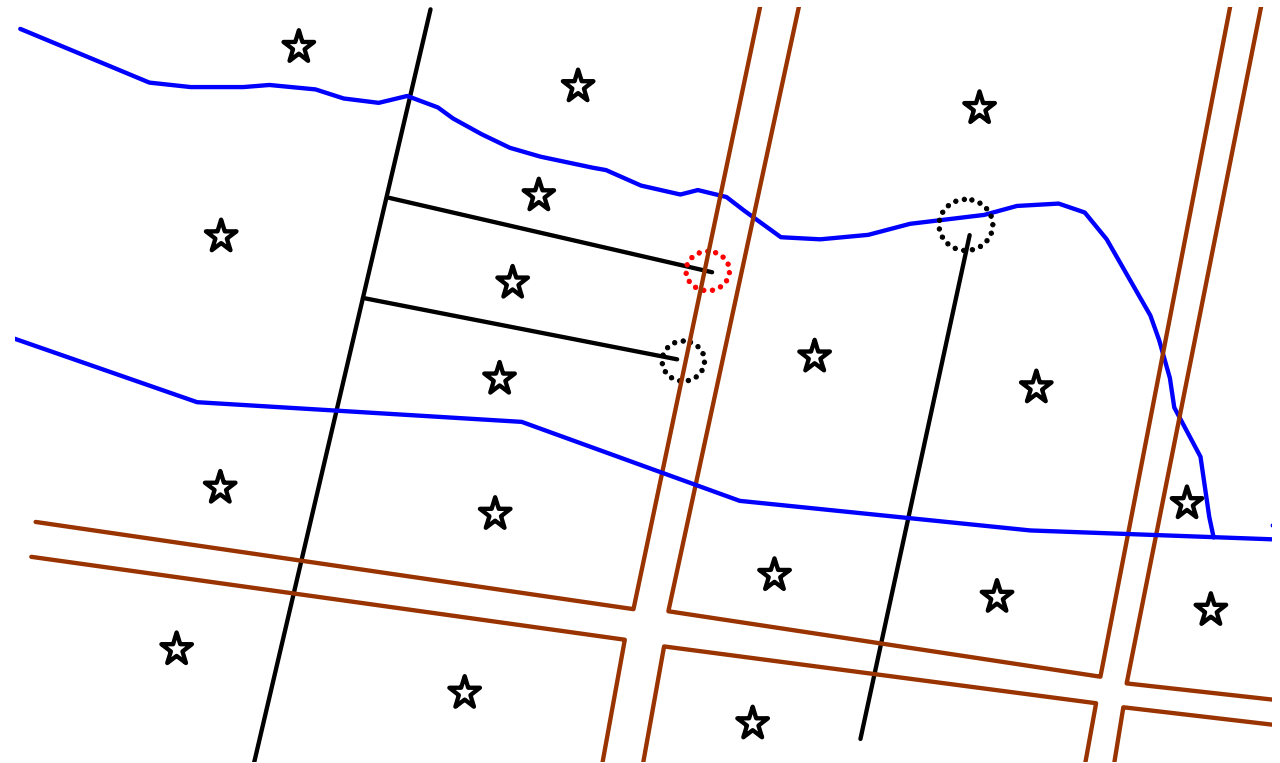
Likewise an early stage in development
Allows misses and overshoots
Still provides a useable "cadastral map" base
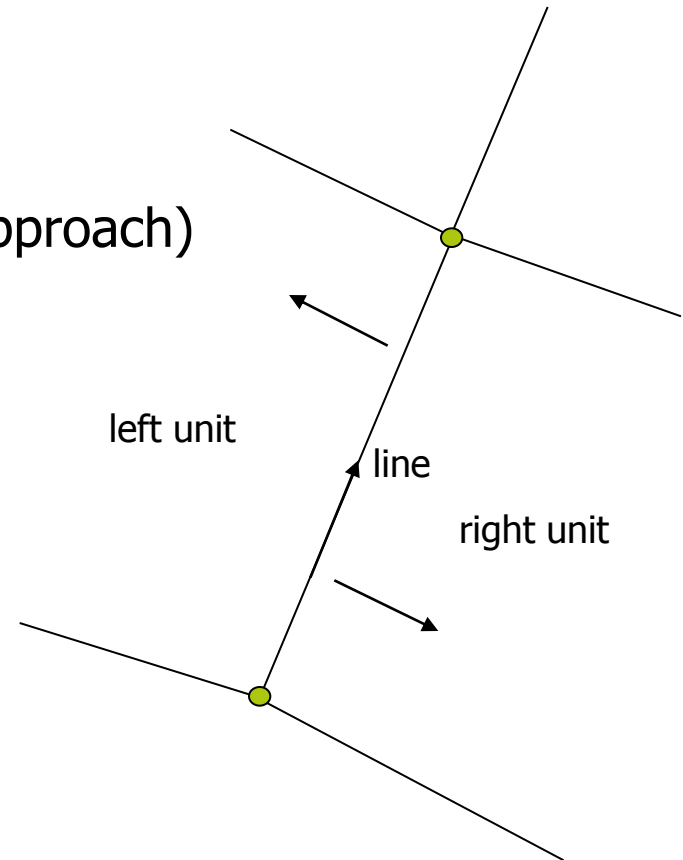
Polygon-Based Spatial Unit

Each spatial unit is recorded as a separate entity (a polygon in 2D).

- No topological connection between neighbouring spatial units (and no boundaries shared),
- Constraints enforcing a complete coverage must be applied by the sending and receiving software
- All lines are represented twice (at least)
- Secondary interests difficult.

Topology-Based Spatial Unit

- Lines are stored once only
- Lines broken at nodes (unlike line-based approach)
- Fast for adjacency
- Tight validation
- Topology is built into the database

left unit

line

right unit

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http://wiki.tudelft.nl/bin/view/Research/ISO19152/WebH

Research/ISO19152

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TuDelft > ■ Research/ISO19152 Web > WebHome (08 Jun 2012, PeterVanOosterom)

Tags: [▼] + create new tag , view all tags

Land Administration Domain Model

Welcome to the LADM Wiki!

The collaborative environment for posting and discussing ISO/TC 211 Geographic Information - Land Administration D
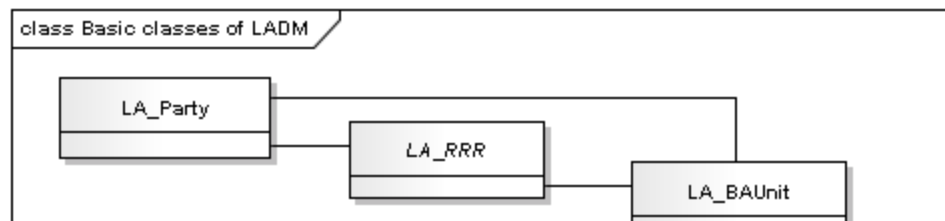
6 July 2012, Rotterdam, The Netherlands: International workshop Workshop_LADM_announchement_v4.pdf:
LADM from Research to Implementation – Land Administration Domain Modelling at a threshold

Available Information

- IsoDocuments
- UmlModels
- CountryProfiles
- LadmPublications
- ImplementationMaterial

If you want to add material (and do not have an account for this Wiki), send email to "P.J.M.vanOosterom@tudelft.nl".

class Basic classes of LADM

LA_Party

LA_RRR

LA_BAUnit

Content overview

1. Spatial Aspects LADM

2. Third Dimension

3. Adding Time

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Today's solution: Queensland Australia

Airspace sold

STATE cabinet has approved the sale of airspace over the South Bank rail corridor, which will allow planned offices to extend over the rail lines.

Premier Peter Beattie and Transport Minister Steve Bredhauer said the sale fuelled a new era in Brisbane city development.

"Mirvac and South Bank Corporation approached the Government proposing to buy this airspace because Mirvac wants extra floor space for offices it plans to build on an adjacent lot," Mr Beattie said.
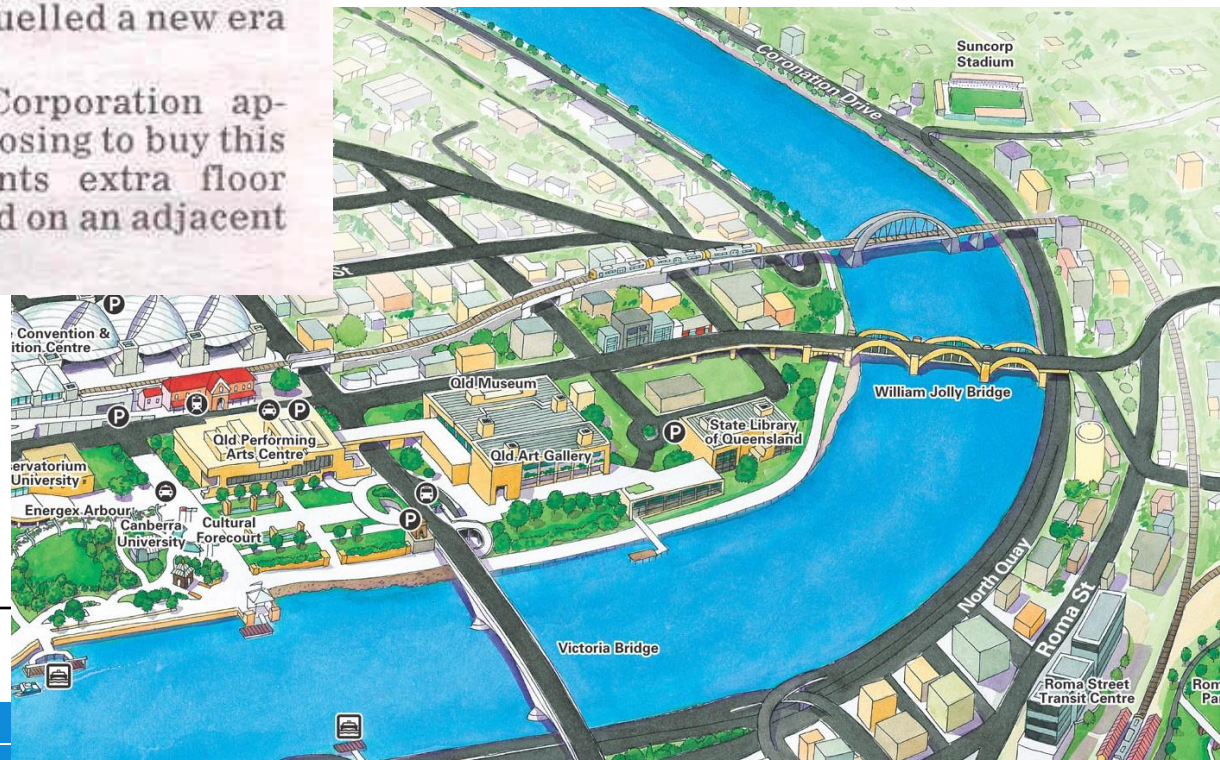
Dynamic 3D world
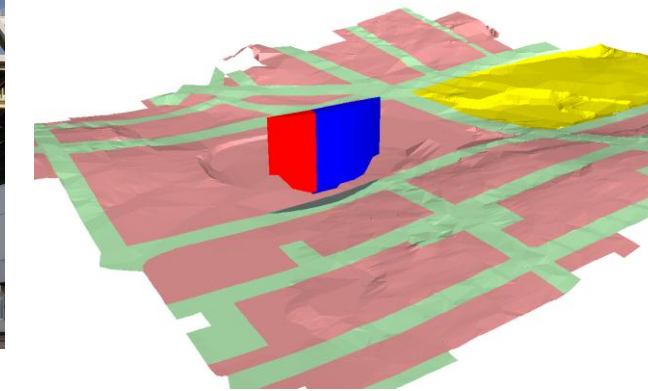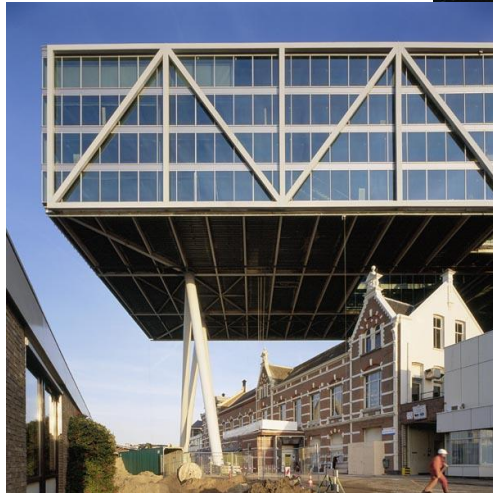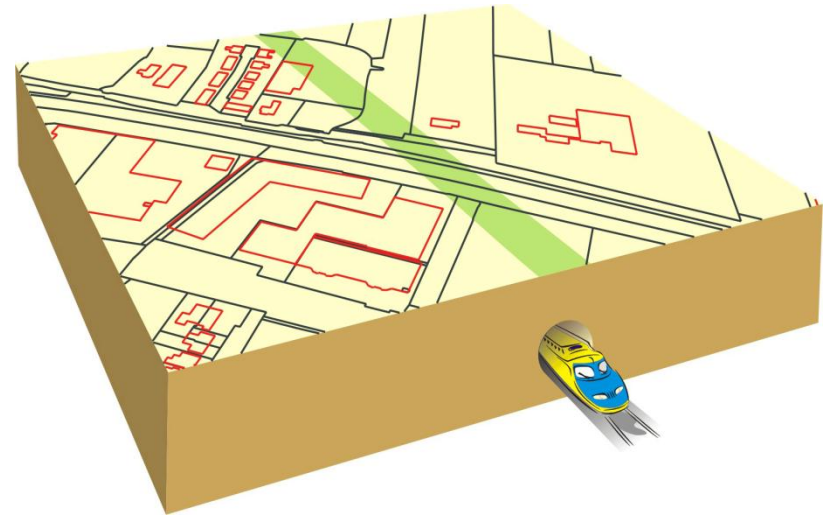
No country has 3D Cadastre

Spatial Units in 3D
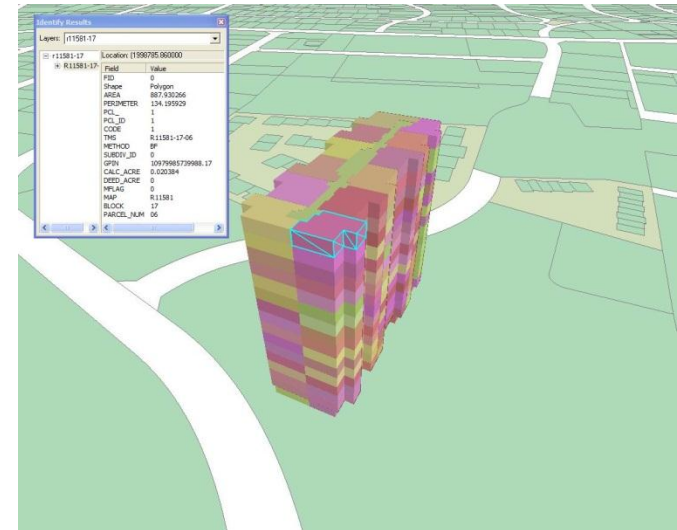
- Extend the equivalent concept from 2D to 3D
  → 3D parcels are in areas of highest land values

- Sharing of surfaces between 3D parcels
  where lines would be shared in 2D

- point-line-area becomes point-line-area-volume

- Challenges:
  1. Majority of parcels is in 2D and should not be lost
     → integrate 2D/3D
  2. 3D parcels can be unbounded (up/down) according to National law
     → does not fit in ISO 19107, so alternative needed

2D parcels and their 3D interpretation

- Observation: 2D description implies 3D prismatic volume
- 2D polyline (GM_curve) implies string of vertical faces
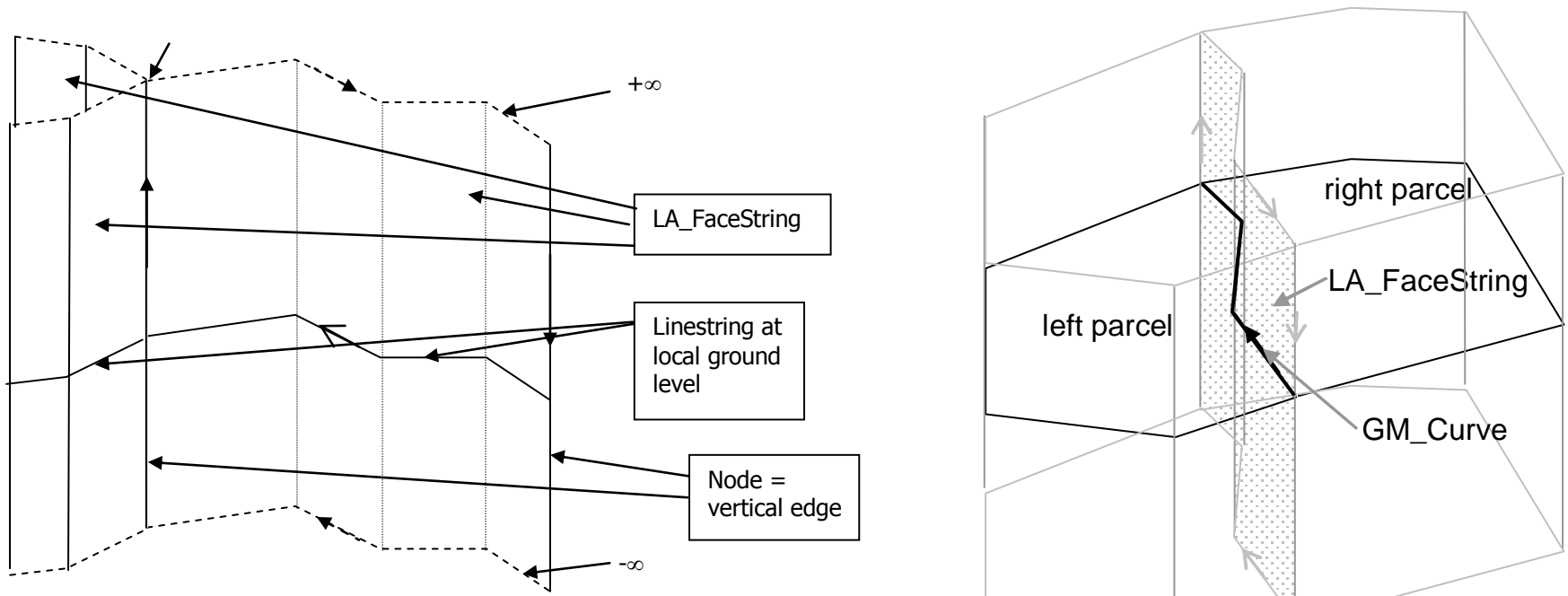
2D and 3D Integration

- between 2D and 3D spatial unit transition via liminal spatial units
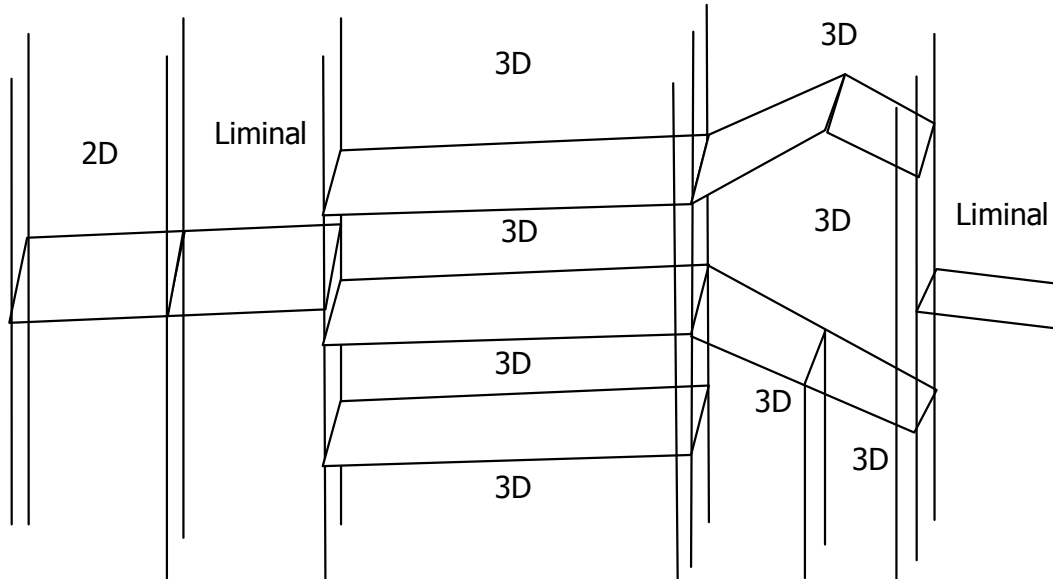
- Liminal spatial units are 2D parcels, but are stored as 3D parcels

- Liminal spatial units are delimited by a combination of LA_BoundaryFace and LA_BoundaryFaceString objects

Simple 2D spatial unit	Liminal 2D spatial unit	3D spatial units	3D spatial units	Liminal 2D spatial unit
			Liminal 2D spatial unit A	

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2D and 3D integration

- 2D polyline (GM_curve) implies string of vertical faces: LA_BoundaryFaceString
- true 3D described with arbitrary oriented faces: LA_BoundaryFace
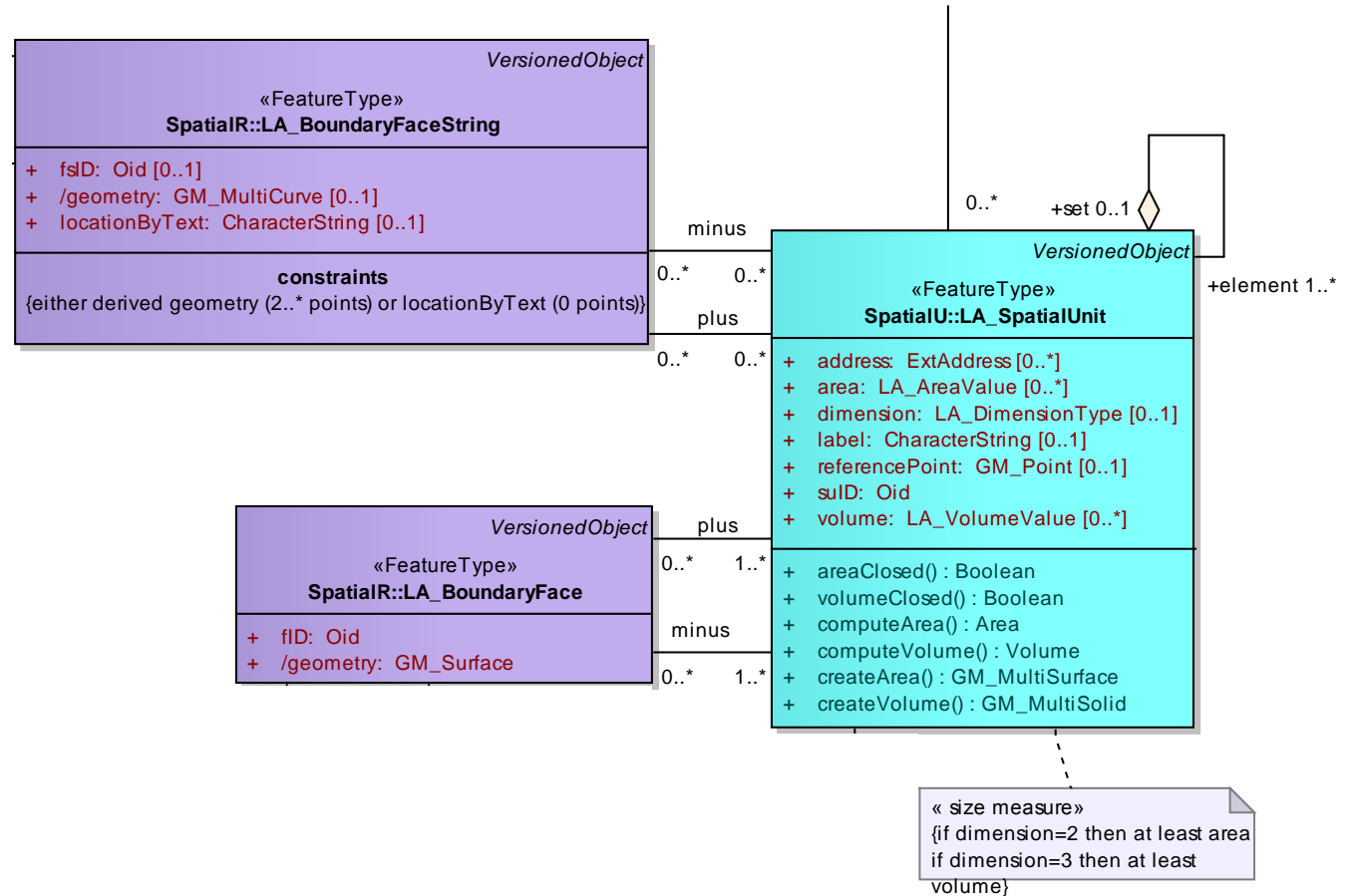
The 3D use of LA_Level

- organization based on content or structure:
  - example 1, content-based: one layer with 'primary' (strongest) rights, another layer with rights that can be added/subtracted (e.g. restrictions)
  - example 2, structure-based: one layer with topologically structured parcels (one part of the country), another layer with (unstructured) line based parcels (other part of country)

- can also be used in 3D context: one layer 'normal' parcels, another layer with subtracted 3D parcels

- based on independence principle

- each country design own levels

+∞

closed
GM_curve

Z=0, or
local

3D LA_SpatialUnit in layer 2 not broken
by layer 1 boundaries (LA_FaceStrings)

−∞

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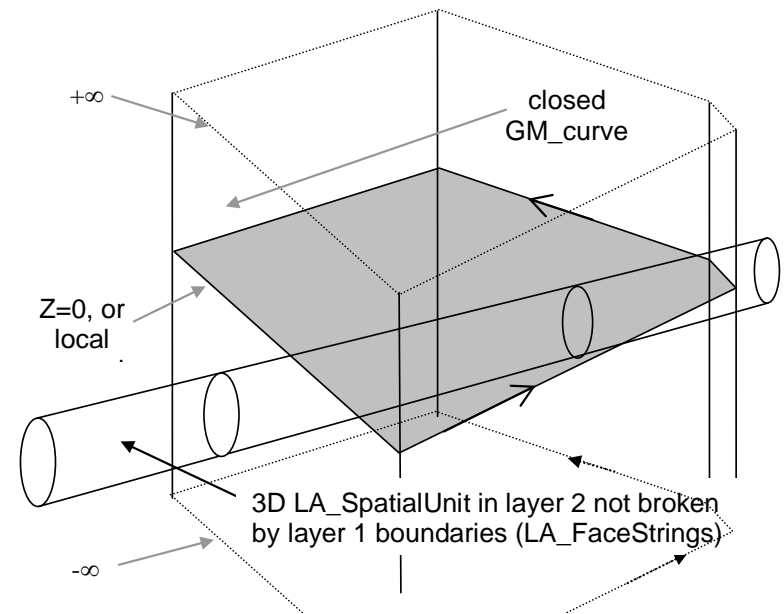
Integration of 3D+time: 4D Cadastre

- In addition to spatial (3D) aspect, rights, restrictions and responsibilities include a temporal aspect

- To be able to manage the dynamics in land administration the time (fourth) dimension must be handled as well

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Conceptual Cadastre Basis

Partition: no gaps or overlaps in the parcelation on which the rights are based

2D: a planar partition of the surface

3D: a partition of space with no overlaps or gaps

4D: no overlaps or gaps in the rights, not only in space but also in parallel the time dimension

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3D Tunnel registration in Queensland

DIAGRAM K
Isometric of Lot 837
1: 400

River is moving over time and legal Boundary follows (true 4D)

Db
RL −38·381
RL −38·404
RL −38·307
RL −38·4

RL −38·371
146b
RL −38·121
Da
RL −55·381

Cb
RL −38·342
RL −55·404
16a
RL −55·307

17b
RL −36·72

10b
RL −38·113

RL −55·4

142b
RL −36·715

RL −55·371

Ca
RL −55·342
146a
RL −55·121

17a
RL −53·72

10a
RL −55·113

142a
RL −53·715

20b
RL −35·634

RL −35·629
140b
22b
RL −35·143

837
45,258 m³

139b
RL −35·138

20a
RL −52·634

136b
RL −34·654

RL −52·629
140a
22a
RL −52·143

RL −34·649
134b

139a
RL −52·138

136a
RL −51·654

RL −51·649
134a

Lots 837 is bounded by vertical planes.
Datum of Levels: PM131362 RL 5·426 AHD Der

Scale 1:400 − Lengths are in Metres.

5 0 5 10 15 20 25 30 35 40 45 50 55

Land Title Act 1994 : Land Act 1994
Form 21A Version 1

ADDITIONAL SHEET
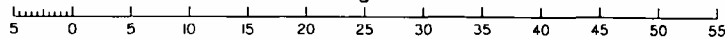
Insert Plan Number
SP192733

Sheet 5 of 5

More cases: Timesharing

- 3D volumetric survey plan (apartments)
- Timesharing of 40 units/week: 40*52 shares
- Timeshare can be traded, mortgaged, etc.
- 3D+time=4D
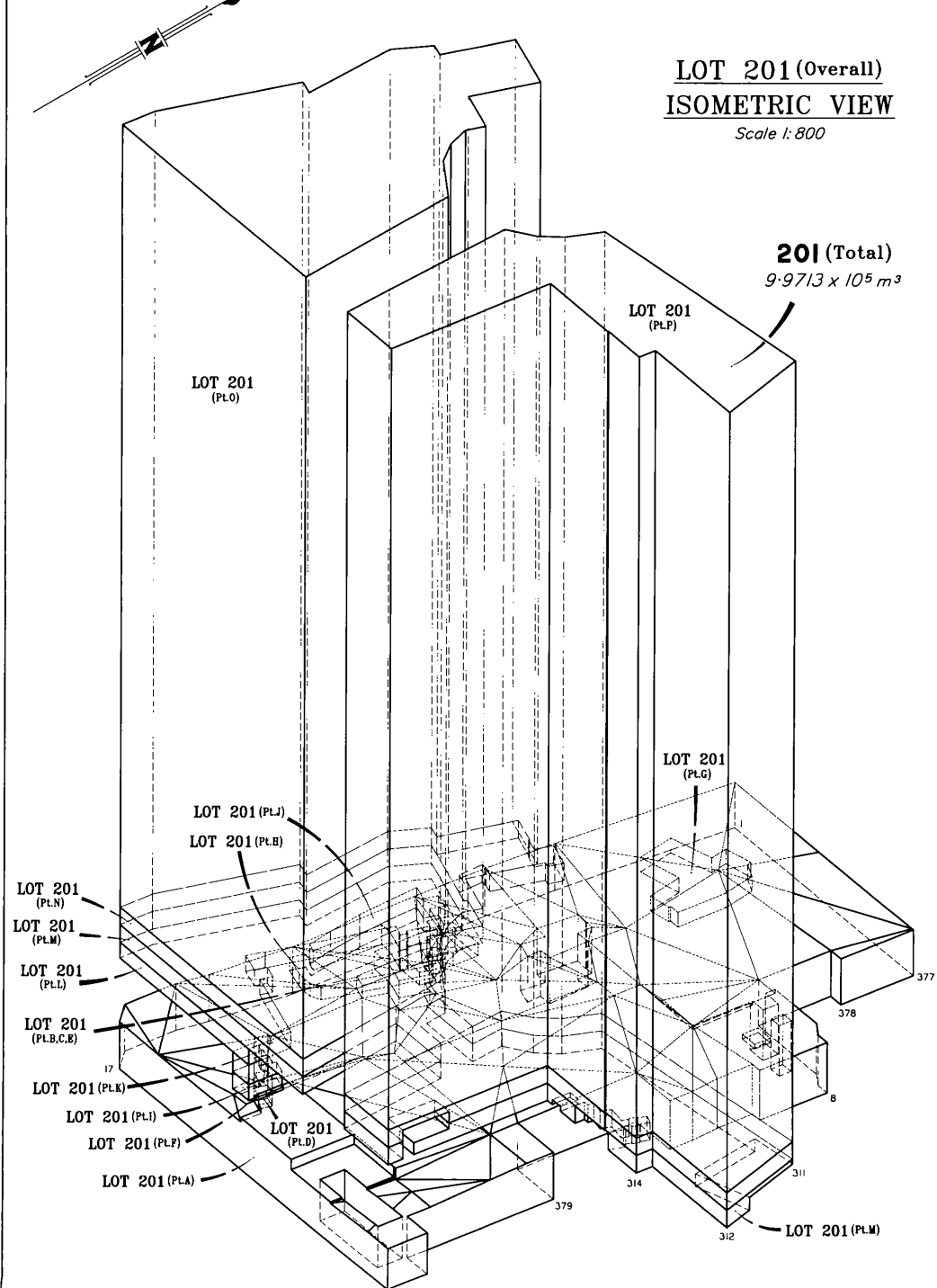
4D cadastre: separate space and time or an integrated attribute?

- Advantages of separate attributes:
  1. Already able to represent all cases
  2. Supported by state-of-the art technology
  3. Temporal aspect is more than just one dimension

- Advantages of integrated 4D data type:
  1. optimal efficient 4D searching
  2. Parent-child becomes topology neighbor query in time

Subdivision of parcels
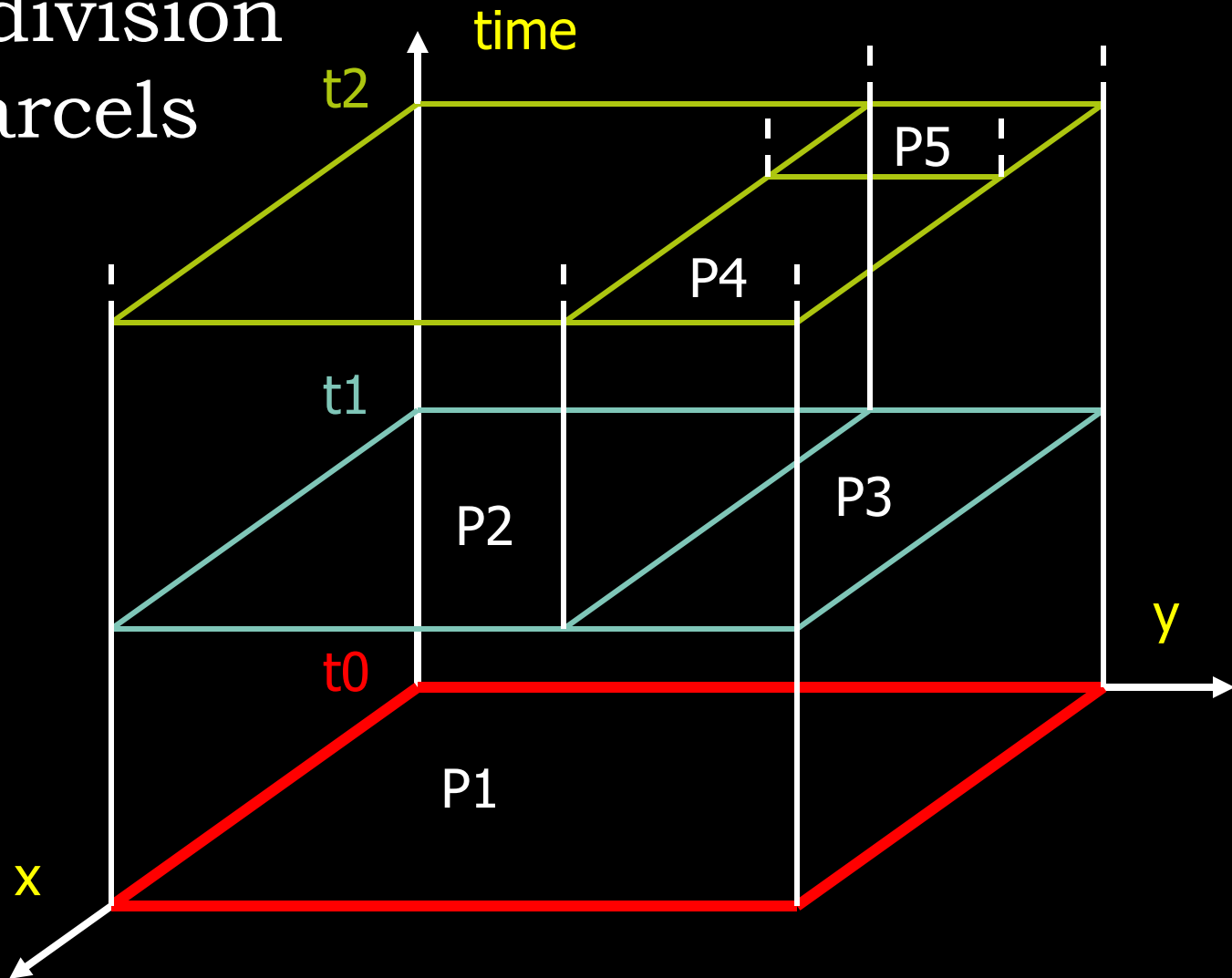
4D data type advantages (cont.)

- Advantages of integrated 4D data type:
  1. optimal efficient 4D searching
  2. Parent-child becomes topology neighbor query in time
  3. Foundation of full (4D) partition: no overlaps or gaps in space and/or time
  4. 4D analysis: do two moving cattle rights have spatio-temporal overlap/touch

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Moving cattle
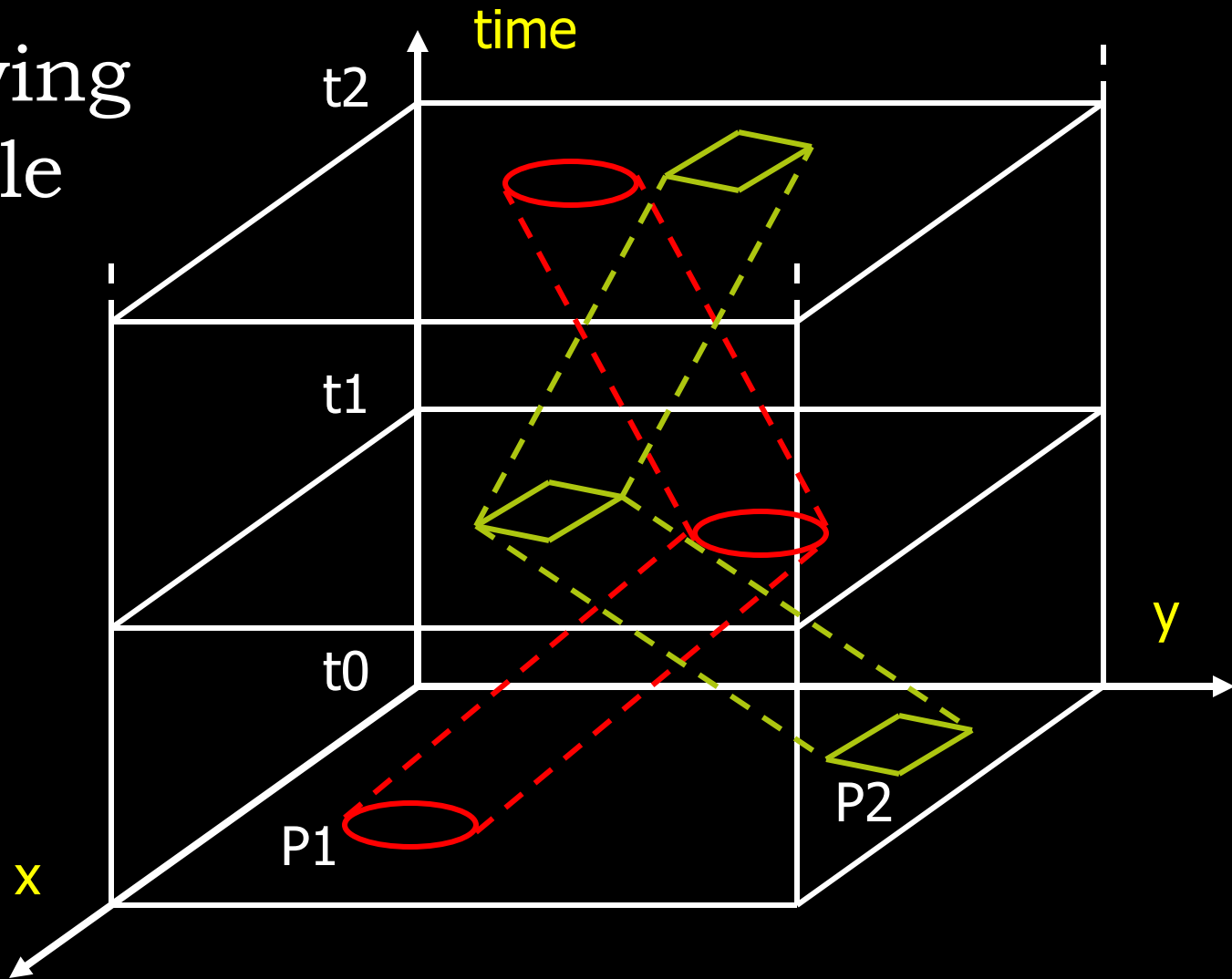
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→ FIG 3D-Cadastres working group

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International Federation of Surveyors (FIG) 3D-Cadastres working group

- Common understanding of terms and issues involved;
  ISO 19152 Land Administration Domain Model: LADM with 3D

- Guidelines/checklist for implementation of 3D-Cadastres:
  'best practices' legal, institutional and technical aspects

Note: 3D Parcels in
broadest sense:
land & water spaces,
both above & below
surface.

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www.cadastre2012.org/eAccommodation.aspx   cesun 2012
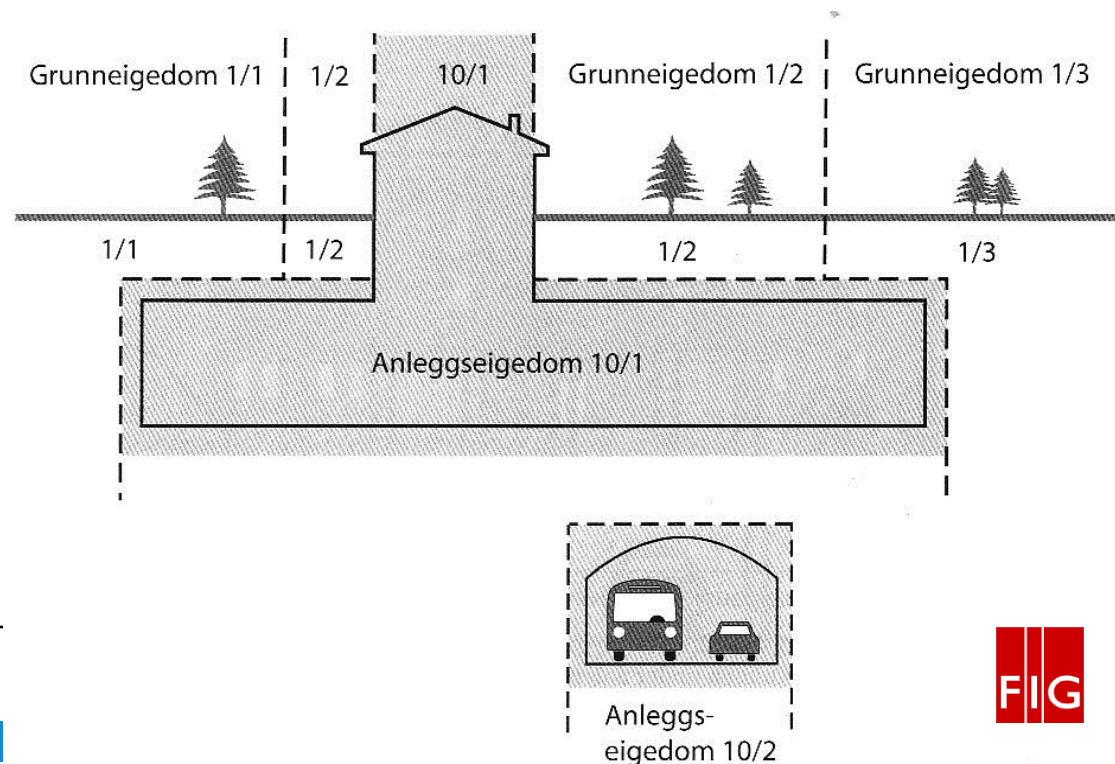
Third International FIG Workshop on 3D Cadastres
Developments and Practices • Shenzhen, China
25 - 26 Oct, 2012

Home   Committees   Programme   Important Dates   Submission   Registration   Venue   Contact   中文

深圳市规划和国土资源委员会
Urban Planning,Land and Resources Commission of Shenzhen Municipality

PALRC

WUHAN UNIVERSITY

3D Cadastres

FIG

Venue & Accommodation

The workshop will take place in Shenzhen, one of the moden and developed cities of P.R.China.
The venue of the workshop will be the Pavilion Hotel in Futian District, Shenzhen (see Google map).

The Pavilion Hotel (Shenzhen)
4002 Huaqiang Road North, Shenzhen, China
Phone: +86-755-82078888
http://www.pavilionhotel.com/en/

Topics

- 3D-Cadastres and models: role of earth surface, 3D parcels open at top and bottom, topology structure, relative height,…

- 3D-Cadastres and SII: legal objects (cadastral parcels and associated rights) and their physical counterparts (buildings or tunnels) result into two different, but related registrations

- 3D-Cadastres and time: partition of legal space into 4D parcels: no overlaps or gaps in space of time

- 3D-Cadastres and usability: graphic user interface (GUI) for interacting with 3D cadastral data; e.g. Google Earth
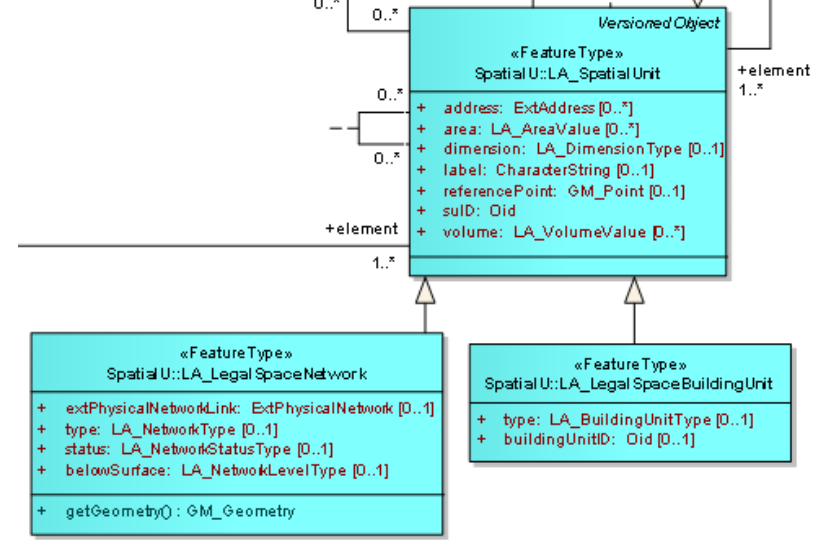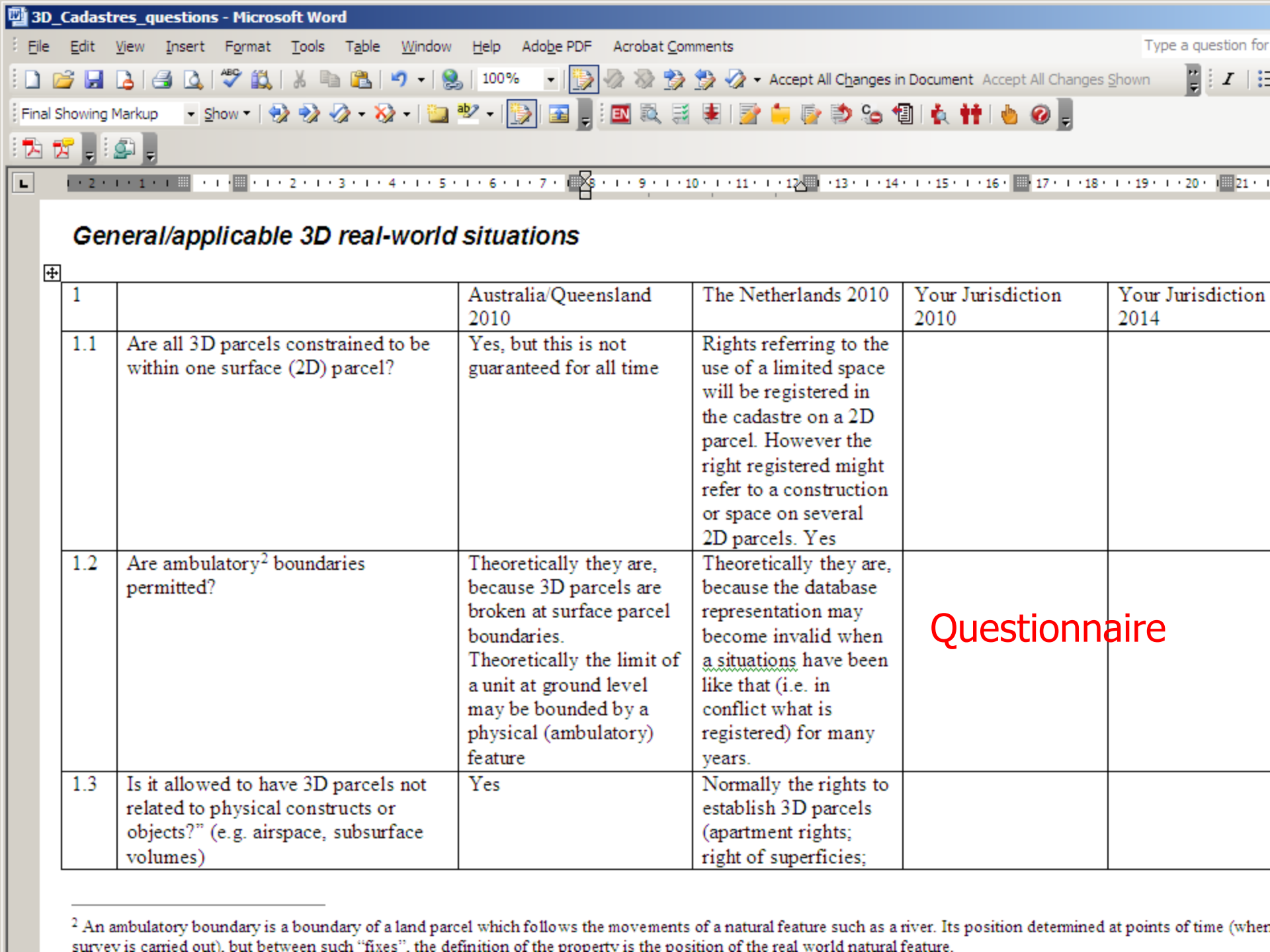
General/applicable 3D real-world situations

1		Australia/Queensland 2010	The Netherlands 2010	Your Jurisdiction 2010	Your Jurisdiction 2014
1.1	Are all 3D parcels constrained to be within one surface (2D) parcel?	Yes, but this is not guaranteed for all time	Rights referring to the use of a limited space will be registered in the cadastre on a 2D parcel. However the right registered might refer to a construction or space on several 2D parcels. Yes		
1.2	Are ambulatory[2] boundaries permitted?	Theoretically they are, because 3D parcels are broken at surface parcel boundaries. Theoretically the limit of a unit at ground level may be bounded by a physical (ambulatory) feature	Theoretically they are, because the database representation may become invalid when a situations have been like that (i.e. in conflict what is registered) for many years.		
1.3	Is it allowed to have 3D parcels not related to physical constructs or objects?" (e.g. airspace, subsurface volumes)	Yes	Normally the rights to establish 3D parcels (apartment rights; right of superficies;		

Questionnaire

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[2] An ambulatory boundary is a boundary of a land parcel which follows the movements of a natural feature such as a river. Its position determined at points of time (when survey is carried out), but between such "fixes", the definition of the property is the position of the real world natural feature.

3D Cadastres

FIG

FIG joint commission 3 and 7 Working Group on 3D Cadastres - Work plan 2010-2014

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Objectives
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Timetable
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Literature

Workshop 2012
Workshop 2011
Workshop 2001

Questionnaire
Please fill in

Literature

This page lists a number of (important) publications and other documents related to 3D Cadastres.
Click on the title to download or view the corresponding PDF file.

2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001

2012

Diego Alfonso Erba
Application of 3D Cadastres as a Land Policy Tool
In: Land Lines, the quarterly journal of the Lincoln Institute of Land Policy, April 2012, pp. 8-14

FIG Working Week 2012, Rome, Technical Programme
3D (Cadastre): p. 12, p. 14, p. 19

Chengxi Bernad Siew and Alias Abdul Rahman
Compression Techniques for 3D SDI
FIG Working Week 2012, Rome, 18 p.

Working group organisation

- Position within FIG:
  inter-commission activity between commissions 3 and 7

- Interested in participation?

- Contact chair WG 3D-cadastres: Peter van Oosterom, TU Delft
  P.J.M.vanOosterom@tudelft.nl
  tel (+31) 15 2786950, fax (+31) 15 2784422