The Modelling of Spatial Units (Parcels) in the Land Administration Domain Model (LADM, ISO 19152)

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- Introduction
- 5 Encodings
- 3D Encoding
- Combining 2D / 3D
- Conclusion

LA_SpatialUnit (alias LA_Parcel)

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

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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."

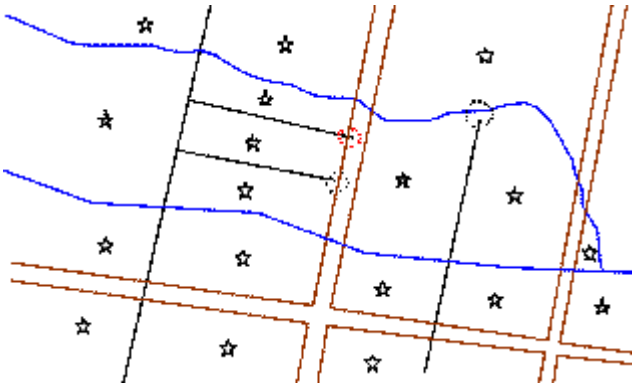
(quoted from: http://en.wikipedia.org/wiki/Metes_and_bounds).

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.

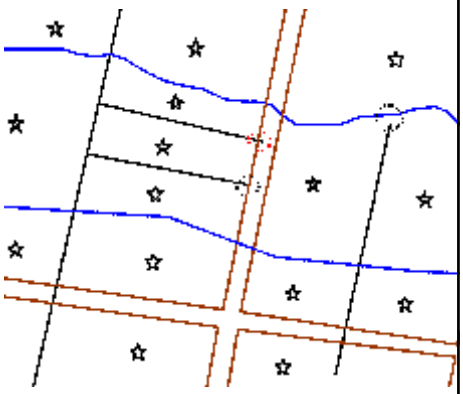
Line-Based Spatial Unit



Likewise an early stage in development
Allows misses and overshoots
Still provides a useable “cadastral map” base

Line-Based Spatial Unit

- Compared to more sophisticated encodings, missing some functionality.
- But – allows the construction of a cadastral database with the available data (rather than waiting for a topologically “pure” form to be available)
- Lines stored once only

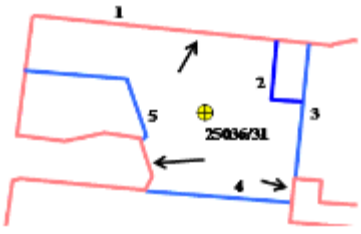


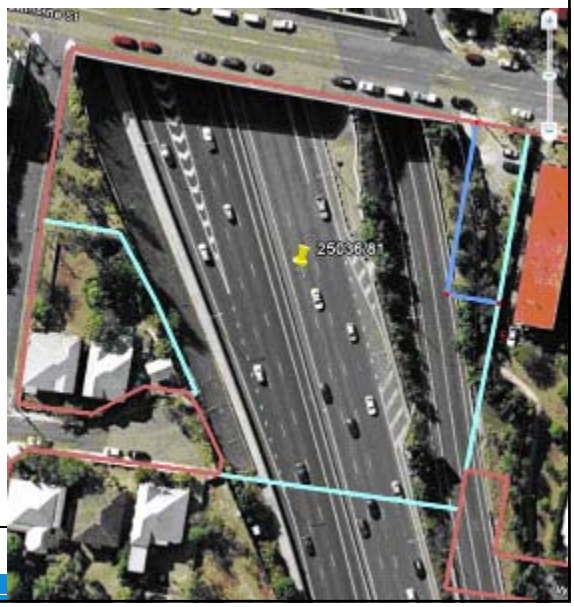
Example from Queensland DCDB

- Lines are part of definition of more than one parcel
- Road boundaries join to define a “block”

Example from the Queensland DCDB

- Lines can occur more than once in the same parcel





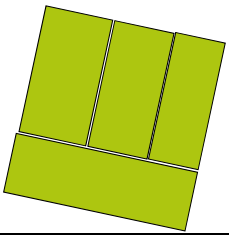
Line-Based Spatial Unit

- Very efficient for web map services and map production
- Good for metadata on (variable quality) line work.
- Small storage requirements (lines stored once only).
- Forgiving validation requirements.
- Good for storage of secondary interests

Polygon-Based Spatial Unit

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

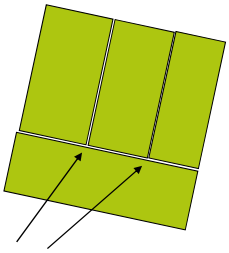
- No topological connection between neighbouring spatial units (and no boundaries shared),
- Constraints enforcing a complete coverage must be applied by the sending and receiving software
- All lines are represented twice (at least)
- Secondary interests difficult.



Polygon-Based Spatial Unit

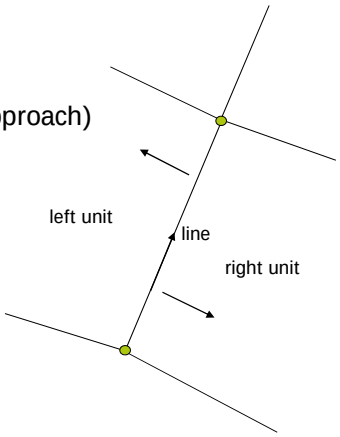
(Used in the Queensland DCDB)

- Very fast if well indexed.
- Calculation of area, perimeter etc.
- Web map servers and map production are efficient.
- Each land parcel is self-contained – easy to extract regions.
- Neighbor searches must use the spatial index.
- "Polygon Dissolve" operation is possible only if adjacency constraint is enforced.
- Redundant points inserted in lines to ensure adjacency



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
- Often seen as the "ideal"



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3D Cadastre

- Text-Based Spatial Units (e.g. a unit defined by the building walls)
- Point-Based Spatial Units

Both can be used to describe 3D cadastral parcels, but it is likely that the more explicit representations will be used.

But note that the issuing of 3D property rights may not wait for the registering authority to get its act together.

- Extend the equivalent concept from 2D to 3D
- Sharing of faces or surfaces between parcels
- Point-line-polygon becomes point-line-surface-polyhedron.

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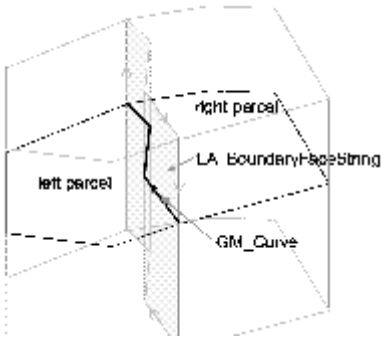
2D and 3D integration

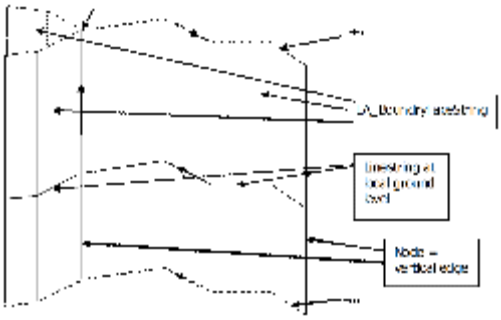
- The vast majority of property parcels in most jurisdictions are 2D
- The 3D parcels are in areas of highest land values and densest subdivision
- Some 2D parcels are orders of magnitude larger than the largest 3D parcel (footprint).
- Some 2D parcels have a large number of corners
- Most 3D parcels are prismatic slabs – not really complex shapes

So – rather than assume a full 3D, LADM makes provision for a mixture of 2D and 3D property parcels (spatial units).

2D and 3D Integration

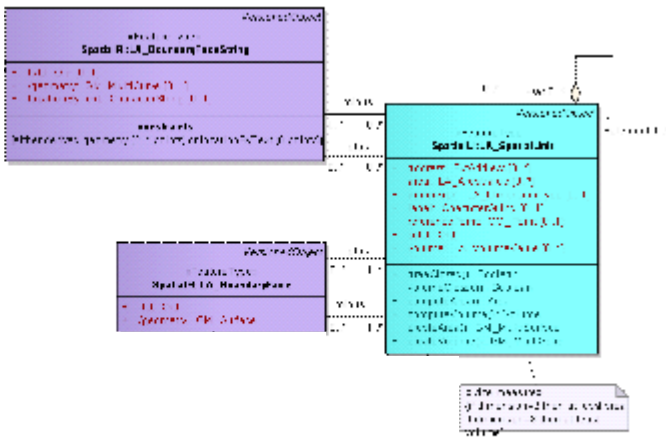
- observation: 2D description implies 3D prismatic volume
- 2D polyline (GM_curve) implies string of vertical faces





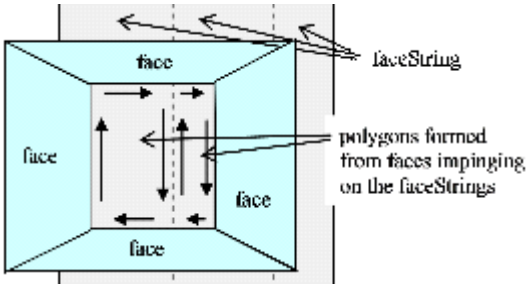
2D and 3D integration

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



2D and 3D Integration using Line-Based Spatial Units

- 2D parcels delimited by LA_BoundaryFaceString objects
- 3D parcels by a combination of LA_BoundaryFace and LA_BoundaryFaceString objects



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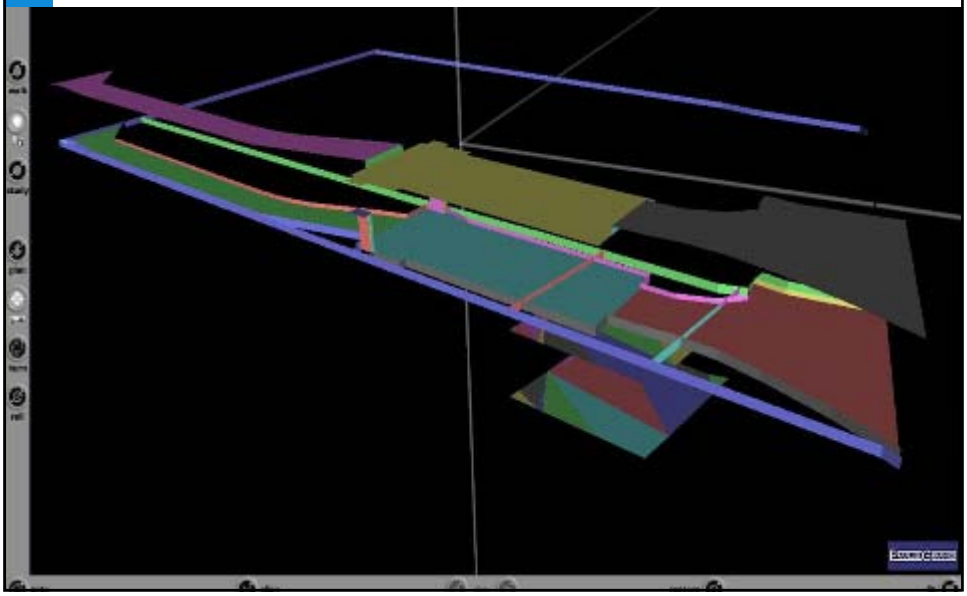

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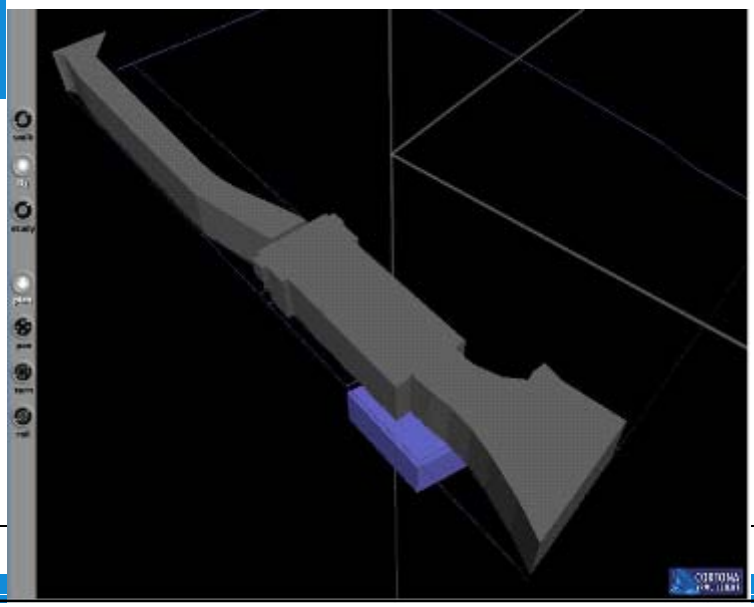
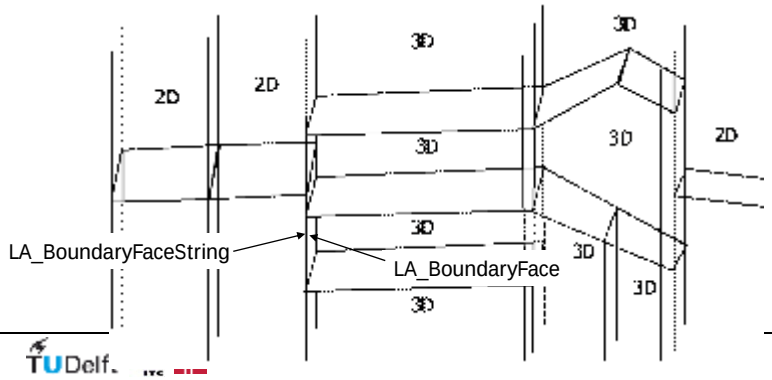


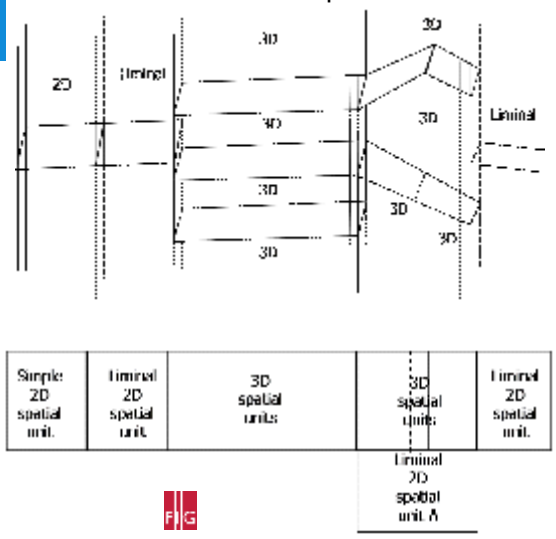
2D and 3D Integration using Polygon-Based Spatial Units

- 2D parcels delimited by LA_BoundaryFaceString objects
- 3D parcels by LA_BoundaryFace objects
- Faces that separate two spatial units will be stored twice (as will boundary face strings)
- Can have a LA_BoundaryFace co-incident with a LA_BoundaryFaceString



2D and 3D Integration using Topology_Based Spatial Units

- 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 LS_BoundaryFaceString objects

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Conclusion

- Spatial Units are the “glue” joining the spatial description of land to the RRR aspects
- Spatial Units are universal in their land administration application (ownership, easement, utilities, building,..)
- Range of representations: text → 3D topology
- Based on other ISO standards ISO19107 and ISO19156
- Integrate 2D and 3D representations