Progressive Development of a Digital Cadastral Data Base

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and
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Quick and dirty capture

Main St

1
15
RP12562

3
16
RP12562
overshoot

5
171
RP12562

7
181
RP12562

gaps

9
183
RP12562

undershoot

182
RP12562

184
RP12562
Very Small Errors
Detected and Undetected Errors
Very Small Parcel

15 millimetres

4
RP77925
IS109590
IS156907

EMT E
0.1 m²

27°09' 29°09'
117°12'10" 24°99"5
27°09' 29°09'
117°12'10" 24°99"5

No O. Mk Screws pld in Conc NE Cor Blk Bldg 0.015NW SE Cor Blk Bldg 0.03NW 0.07NE O Screw

29/09/2013
Progressive Development

Conclusions:

- The removal of small errors is a non-trivial exercise.
- Therefore the data model and software should be robust enough to “live with” small errors, and provide the best possible functionality despite them.
Levels of Completion

Conclusions

- Not all parts of the database will be at the same level of completion, accuracy or validity.
  - (e.g. In Queensland, city parcels are generally ±0.1m while in the western regions may be ±100m)
LADM

Five levels of encoding allow a Cadastral Database at various levels of maturity

- Text Based
- Point Based
- Line Based
- Polygon Based
- Topology Based

Suggestion – develop a toolkit allowing the database to progress through the levels.
Text Based Encoding

- In 2D “From the shore line to the top of the ridge”
- But also in 3D “a unit consisting of floor 17 of … building”
- Sub-level of “image based” encoding.
Point Based Encoding
Cheap vectorisation of existing maps

Line Based Encoding
Polygon Based Encoding

Queensland Cadastre (but with variations)
Topology Based Encoding

Netherlands Kadaster (with variations)
# Expressiveness of Encoding Levels

<table>
<thead>
<tr>
<th></th>
<th>In</th>
<th>Text based</th>
<th>Point based</th>
<th>Line based</th>
<th>Polygon based</th>
<th>Topology based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td></td>
<td>Y</td>
<td>Y*</td>
<td>Y*</td>
<td>Y*</td>
<td>Y*</td>
</tr>
<tr>
<td>Point</td>
<td></td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Line</td>
<td></td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Polygon</td>
<td></td>
<td>N</td>
<td>N</td>
<td>V</td>
<td>Y</td>
<td>V</td>
</tr>
<tr>
<td>Topology</td>
<td></td>
<td>N</td>
<td>N</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
</tbody>
</table>

Web Map Service possible from Line Based or better, or from point based if a base image is available
Web Feature Service possible in Polygon/Topology levels.
Calculations of areas, volumes perimeters etc. in Polygon/Topology levels.
Adjacency can be determined in topological level, or in polygon based and line based if certain additional constraints are applied.
## Mixed Encoding Levels

<table>
<thead>
<tr>
<th>3D</th>
<th>2D</th>
<th>Text based x/y</th>
<th>Point based x/y</th>
<th>Line based x/y</th>
<th>Polygon based x/y</th>
<th>Topology based x/y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2D</td>
<td>Text based x/y</td>
<td>Point based x/y</td>
<td>Line based x/y</td>
<td>Polygon based x/y</td>
<td>Topology based x/y</td>
</tr>
<tr>
<td></td>
<td>3D</td>
<td>Text z</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Point z</td>
<td>N</td>
<td>Y</td>
<td>Y(^1)</td>
<td>Y(^1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Line z</td>
<td>N</td>
<td>N</td>
<td>Y(^2)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polygon z</td>
<td>N</td>
<td>N</td>
<td>Y(^3)</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Topology z</td>
<td>N</td>
<td>N</td>
<td>Y(^3)</td>
<td>Y(^4)</td>
</tr>
</tbody>
</table>

29/09/2013
Now compared with 2001
2001 to 2005
Tracking History of the Cadastre

Conclusions:

- The database should be capable of recording history of the Cadastre
- The best place to record history is within the database itself
- The “versioned object” is recommended as the mechanism for holding history.
- In a developing database, different levels of accuracy and encoding will occur within the historic record.
Secondary Interests – larger than a parcel

- Province
- Municipality
- Cadastral Municipality
- Cadastral Section
- Spatial Unit
- Complex

- Local Government
  - Locality
  - Spatial Unit
- County
  - Parish

Geographically defined regions
Secondary Interests – smaller

- Applied to a whole parcel (e.g. a Mortgage)
- Applied to a parcel but not fully defined (e.g. “pencilled notings”, reserved area).
- Defined as a subset of a parcel (2D or 3D)
- 2D or 3D networks crossing multiple parcels
- Combinations of these
Secondary Interests

Conclusion:

- Secondary interests exist and are an important part of a cadastre.
- They may be parts of parcels, whole parcels or multiple parcels, or not related to parcels at all.
- The encoding of secondary interests may be different from the encoding level of base parcels.
Data model – Proof of Concept
Summary – Requirements

- Progressive improvement of the database
- Support for different levels of accuracy and completeness in different places
- Provision for tracking history of the cadastre
- Support for differences in accuracy and encoding over history
- Support for secondary interests of different types
- Capability of moving into 3D (or 2D/3D mixture of parcels)
Summary – Requirements

- The data in the database can vary in accuracy, quality, and level of encoding, and can be a mixture of 2D and 3D.
- These variations can occur:
  - Geographically
  - Temporarily
  - Between primary and secondary interests
  - Between base 2D parcels and the Z values
Conclusions

- A data model based on the LADM is capable of supporting the progressive development of a cadastral database.

- There may be a case to be made for an open source development of a database based on such a model.

- Such a data model would fulfil the requirements of jurisdictions from initial uptake of a cadastral database through to highly sophisticated support for “4D Cadastre”.
Questions?