Progressive Development of a Digital Cadastral Data Base

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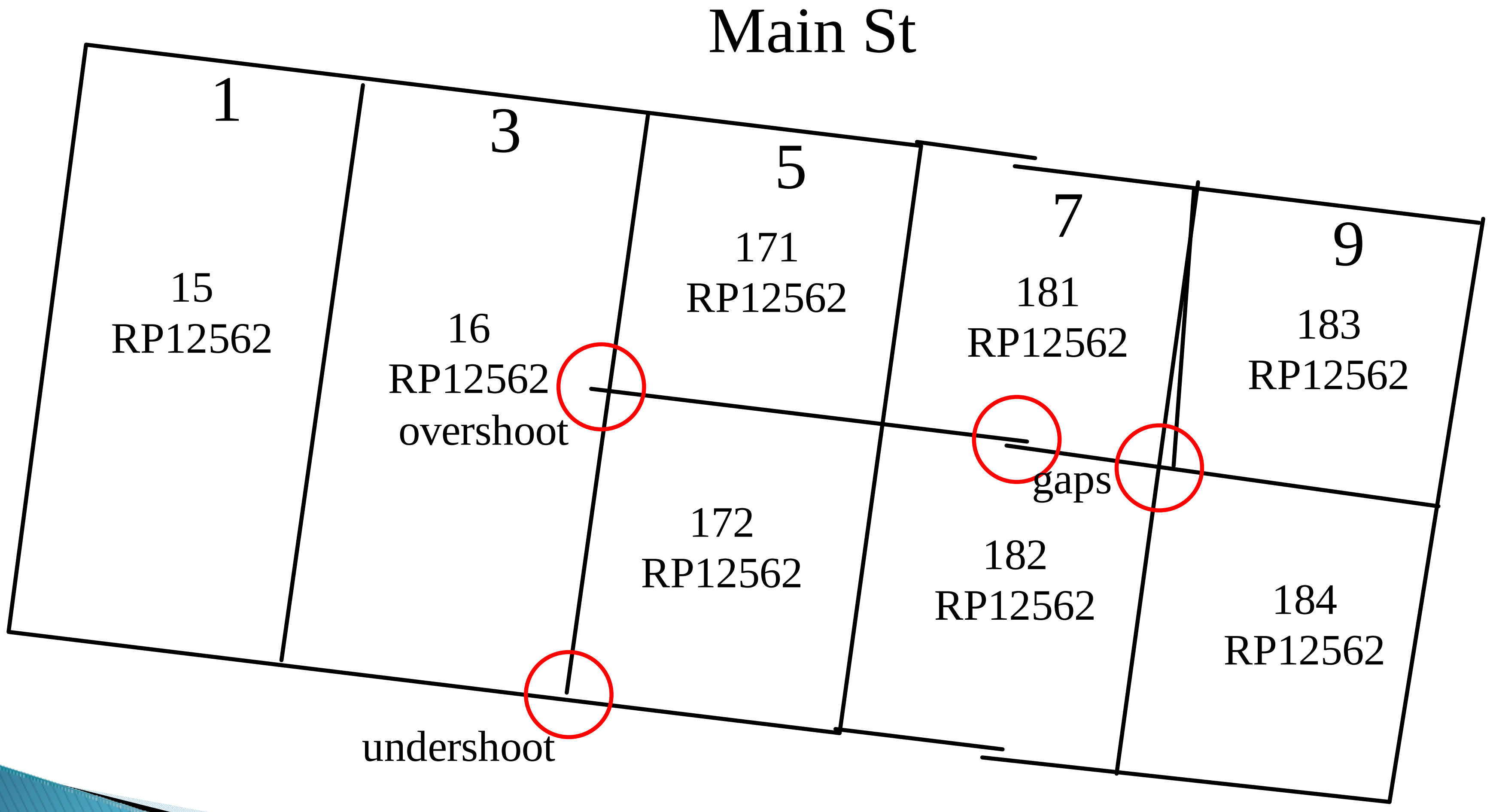
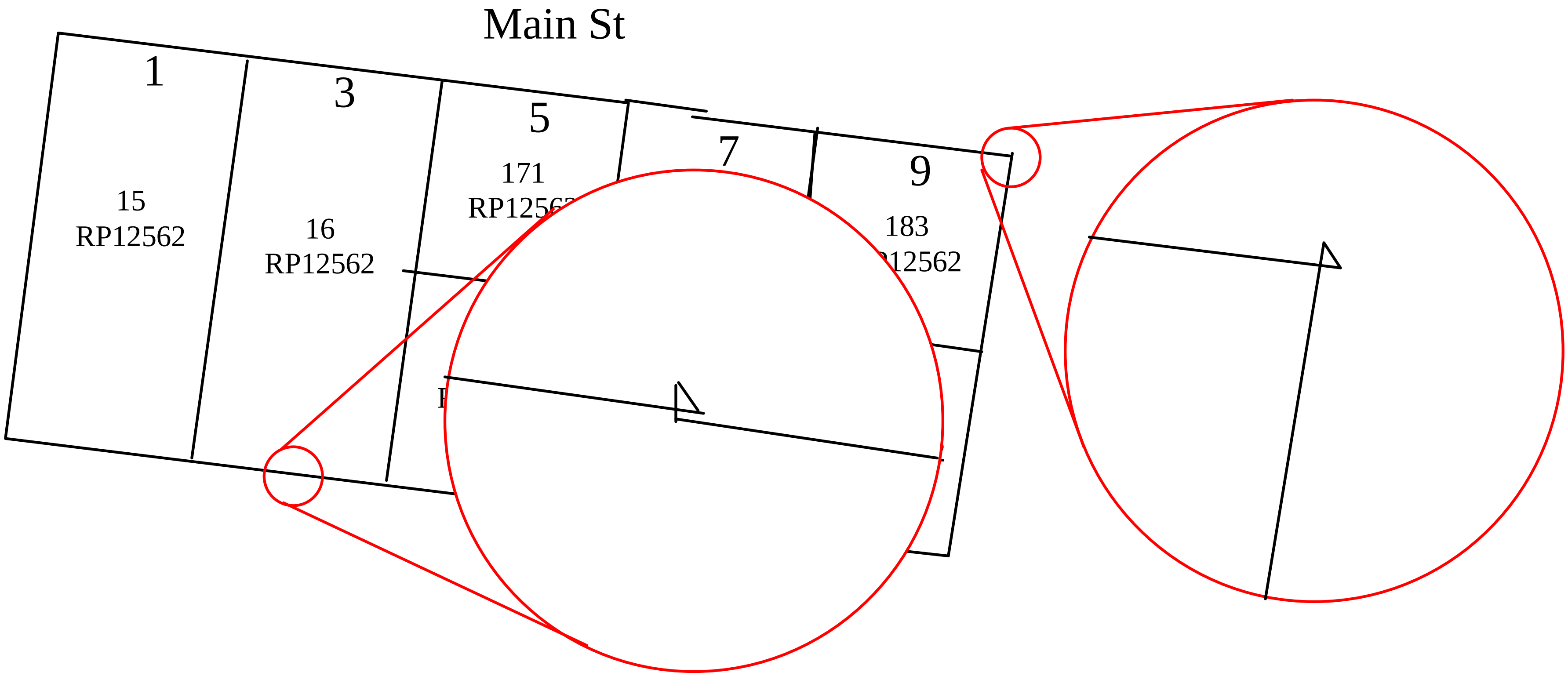
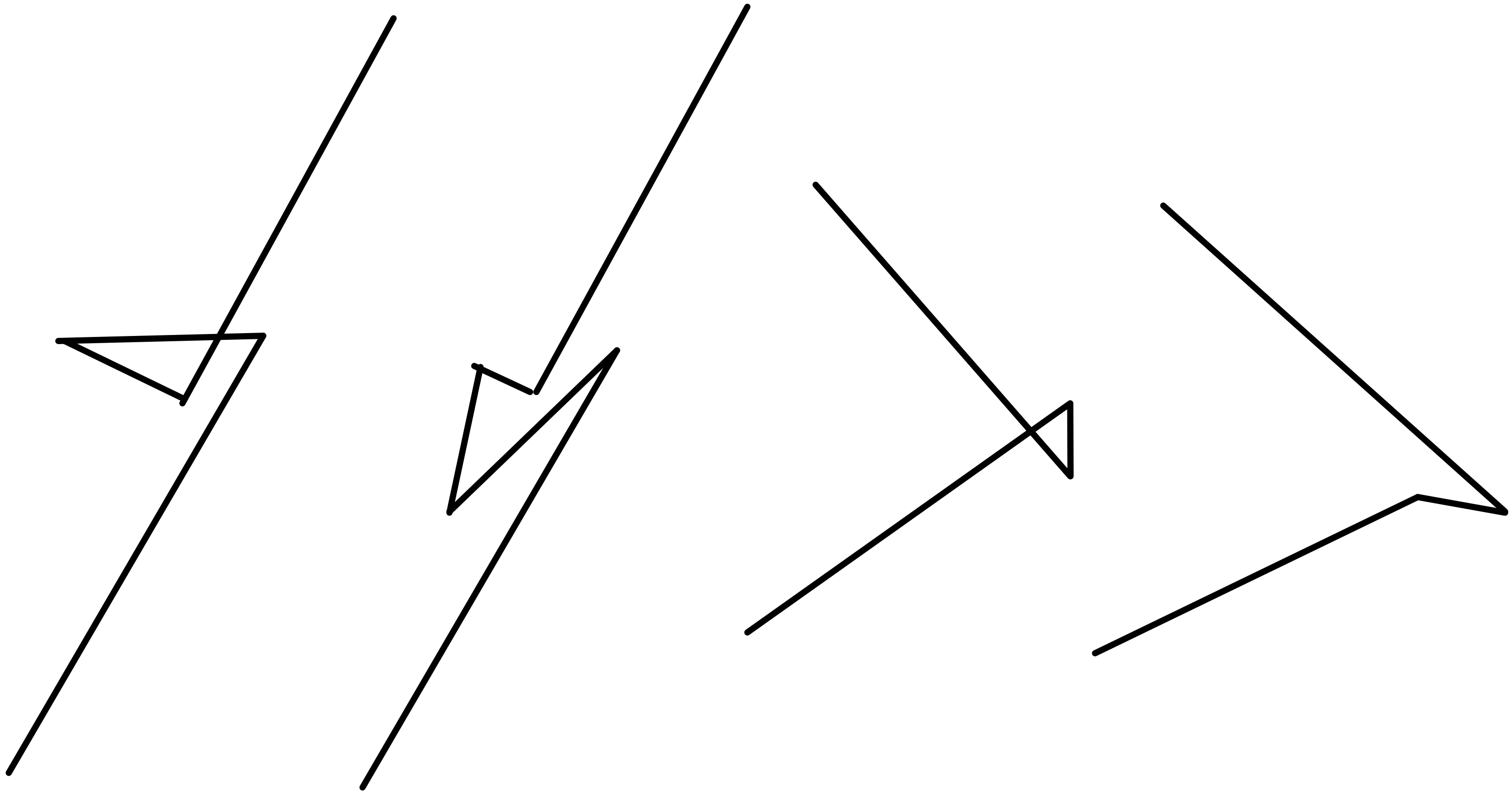
Quick and dirty capture


Main St
1
3
5
7
9
15
RP12562
16
RP12562
overshoot
171
RP12562
181
RP12562
183
RP12562
gaps
172
RP12562
182
RP12562
184
RP12562
undershoot

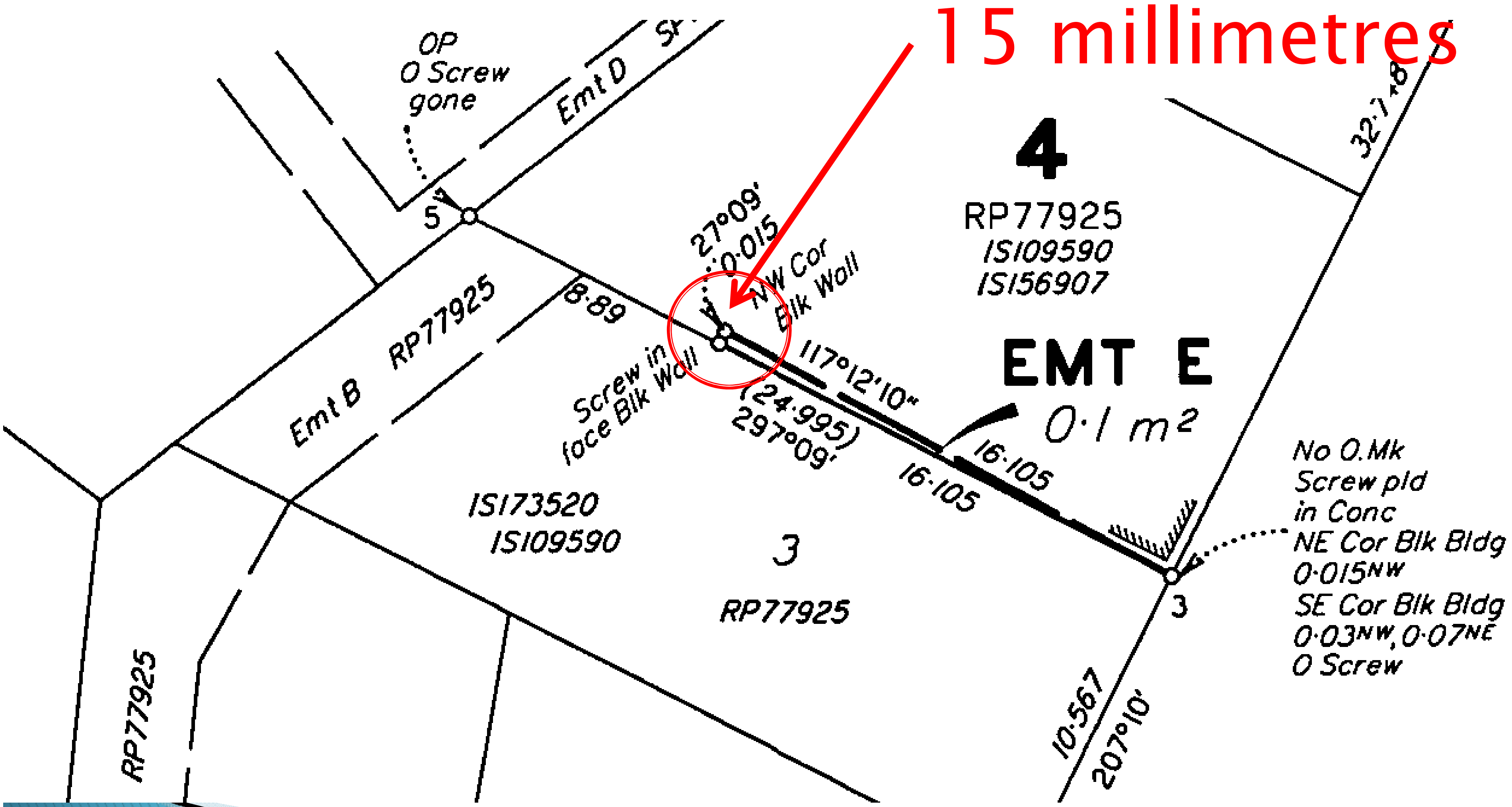
Very Small Errors


Main St
1
3
5
7
9
15
RP12562
16
RP12562
171
RP1256
183
12562

Detected and Undetected Errors



Very Small Parcel



15 millimetres

OP
O Screw
gone
Emt D
5
Emt B
RP77925
8·89
27°09'
0·015
NW Cor
Blk Wall
Screw in
face Blk Wall
117°12'10"
(24·995)
297°09'
4
RP77925
IS109590
IS156907
EMT E
0·1 m²
16·105
16·105
32·7+8
No O.Mk
Screw pld
in Conc
NE Cor Blk Bldg
0·015NW
SE Cor Blk Bldg
0·03NW, 0·07NE
O Screw
3
IS173520
IS109590
3
RP77925
10·567
207°10'
RP77925

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

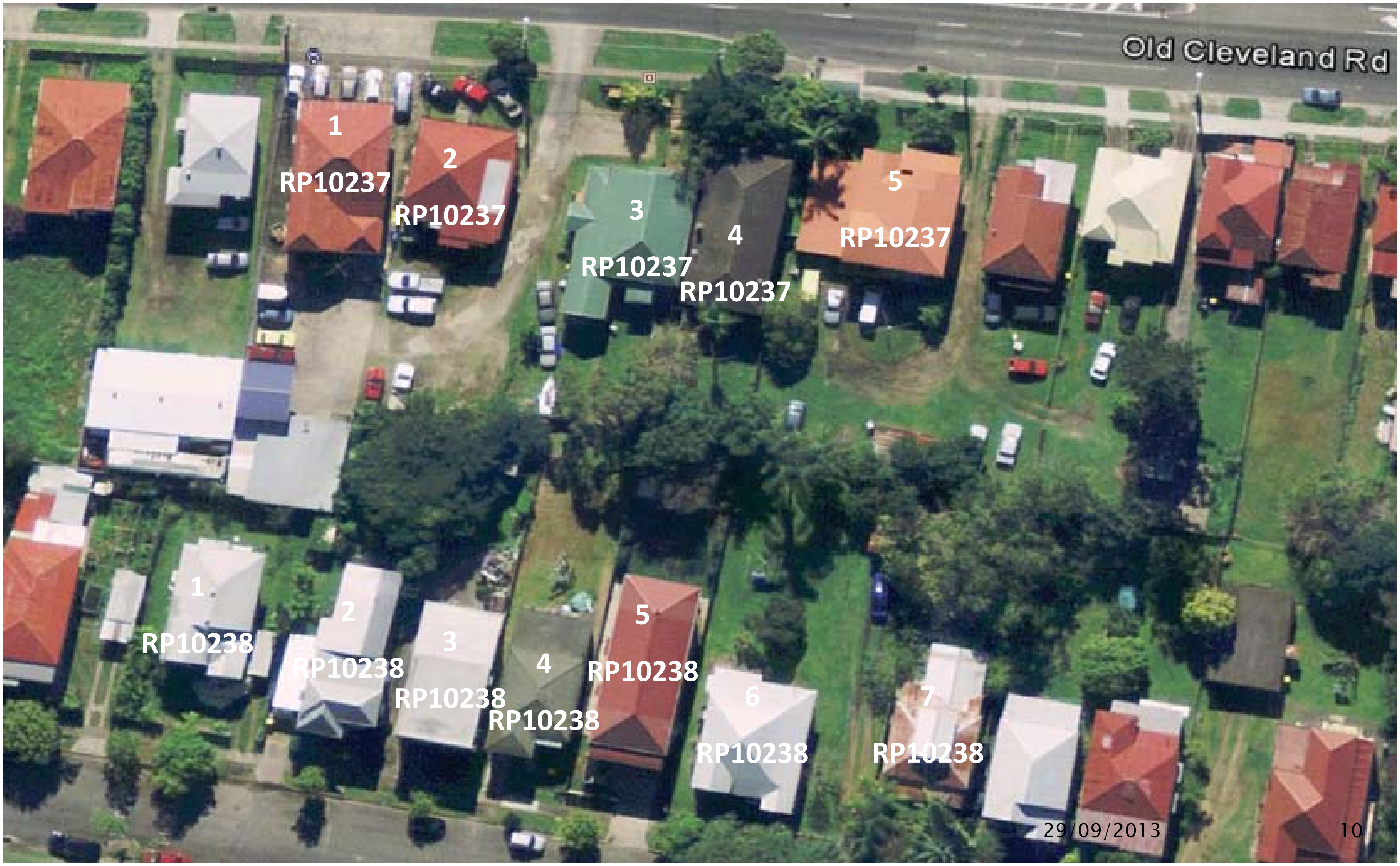
- Text Based
- Point Based
- Line Based
- Polygon Based
- Topology Based

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

Text Based Encoding

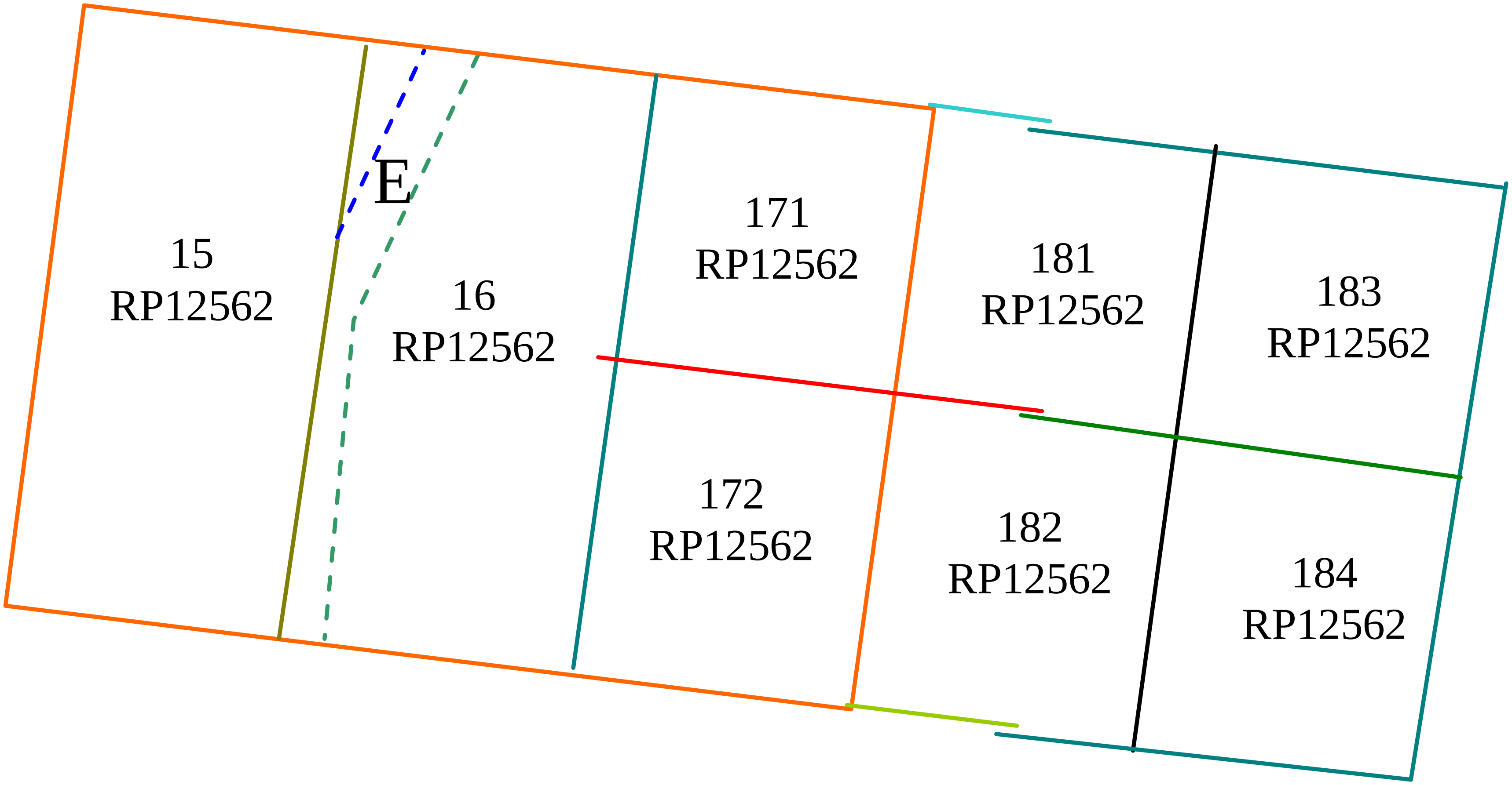
- In 2D “From the shore line to the top of the ridge”
- But also in 3D “a unit consisting of floor 17 of … building”
- Sub-level of “image based” encoding.

Point Based Encoding



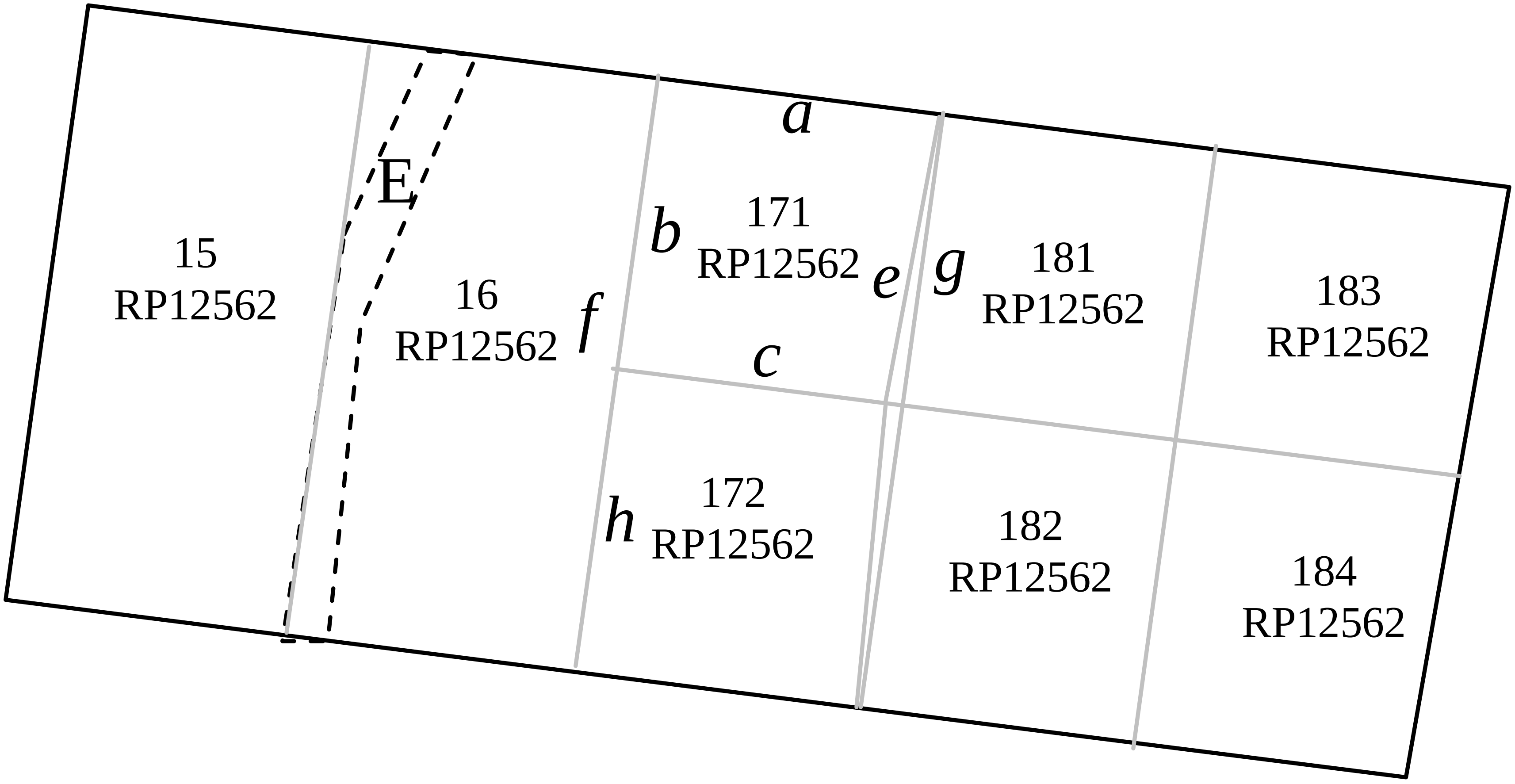
Old Cleveland Rd
1
RP10237
2
RP10237
3
RP10237
4
RP10237
5
RP10237
1
RP10238
2
RP10238
3
RP10238
4
RP10238
5
RP10238
6
RP10238
7
RP10238

Line Based Encoding


E
15
RP12562
16
RP12562
171
RP12562
172
RP12562
181
RP12562
182
RP12562
183
RP12562
184
RP12562

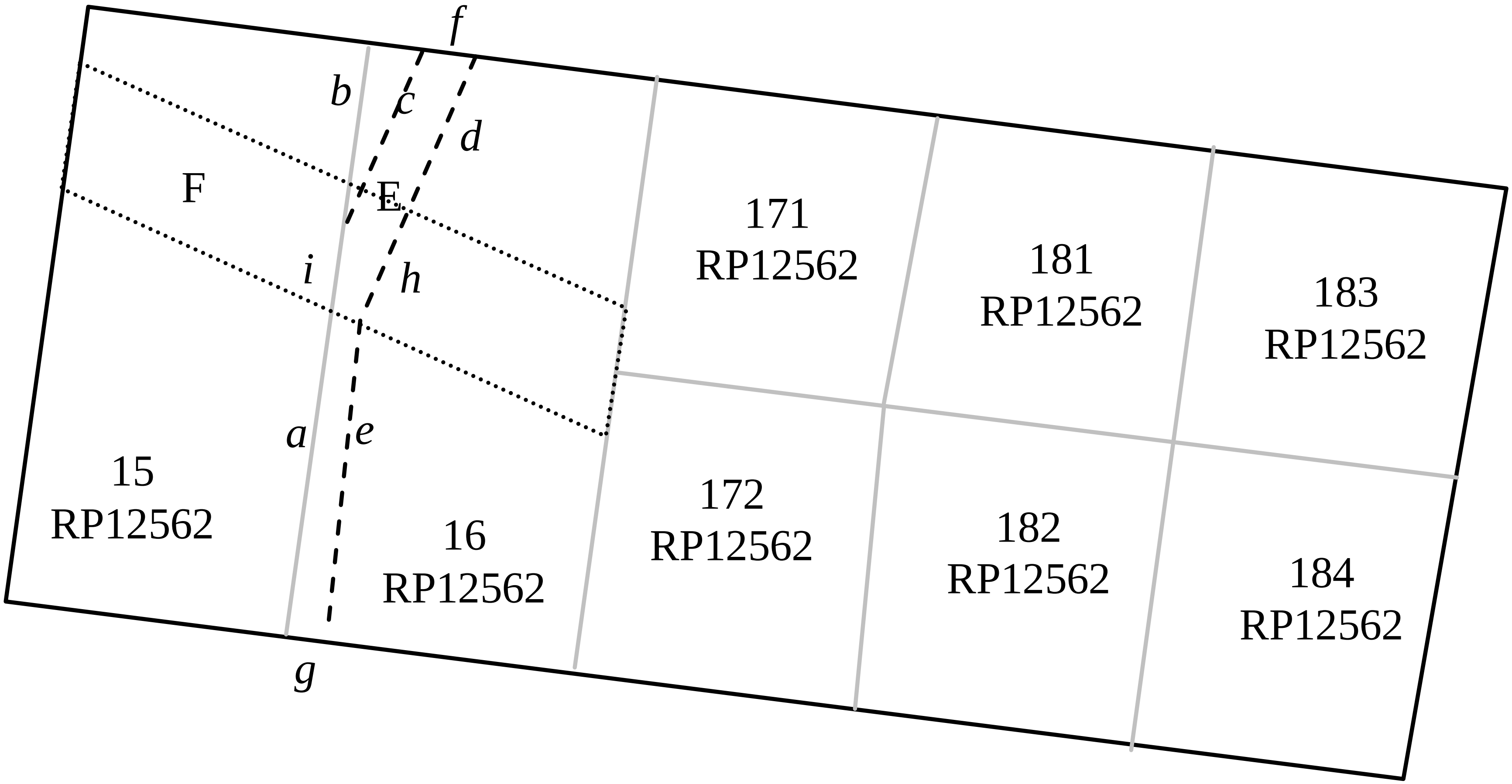
Cheap vectorisation of existing maps

Polygon Based Encoding


a
E
b
171
RP12562
e
g
181
RP12562
183
RP12562
15
RP12562
16
RP12562
f
c
h
172
RP12562
182
RP12562
184
RP12562

Queensland Cadastre (but with variations)

Topology Based Encoding


f
b
c
d
F
E
171
RP12562
181
RP12562
183
RP12562
i
h
a
e
15
RP12562
16
RP12562
172
RP12562
182
RP12562
184
RP12562
g

Netherlands Kadaster (with variations)

Expressiveness of Encoding Levels

In Out	Text based	Point based	Line based	Polygon based	Topology based
Text	Y	Y*	Y*	Y*	Y*
Point	N	Y	Y	Y	Y
Line	N	N	Y	Y	Y
Polygon	N	N	V	Y	V
Topology	N	N	V	V	Y

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.

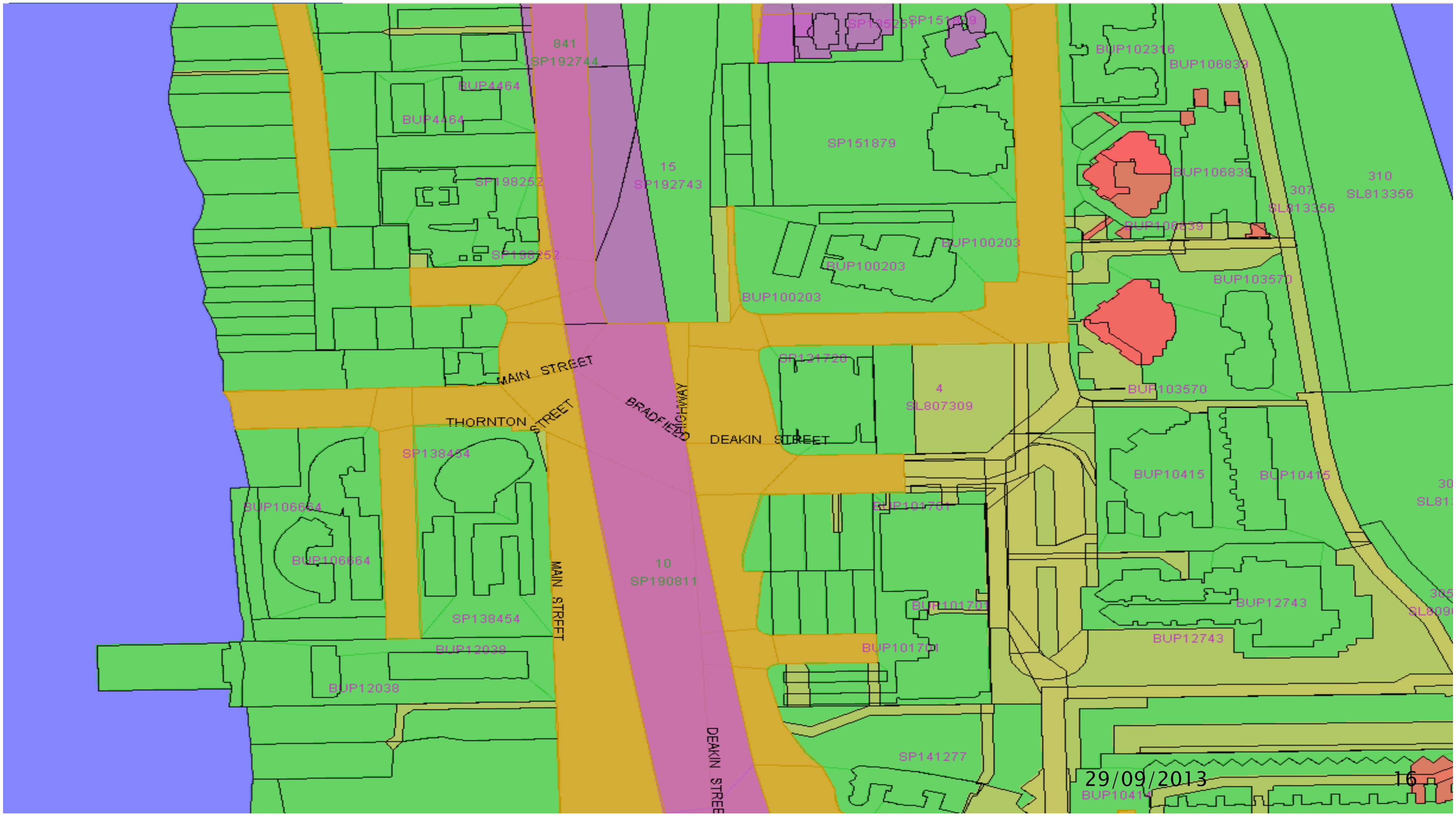
Adjacency can be determined in topological level, or in polygon based and line based if certain additional constraints are applied.

Mixed Encoding Levels

2D 3D	Text based x/y	Point based x/y	Line based x/y	Polygon based x/y	Topology based x/y
Text z	Y	Y	Y	Y	Y
Point z	N	Y	Y[1]	Y[1]	Y[1]
Line z	N	N	Y[2]	N	N
Polygon z	N	N	Y[3]	Y	Y
Topology z	N	N	Y[3]	Y[4]	Y

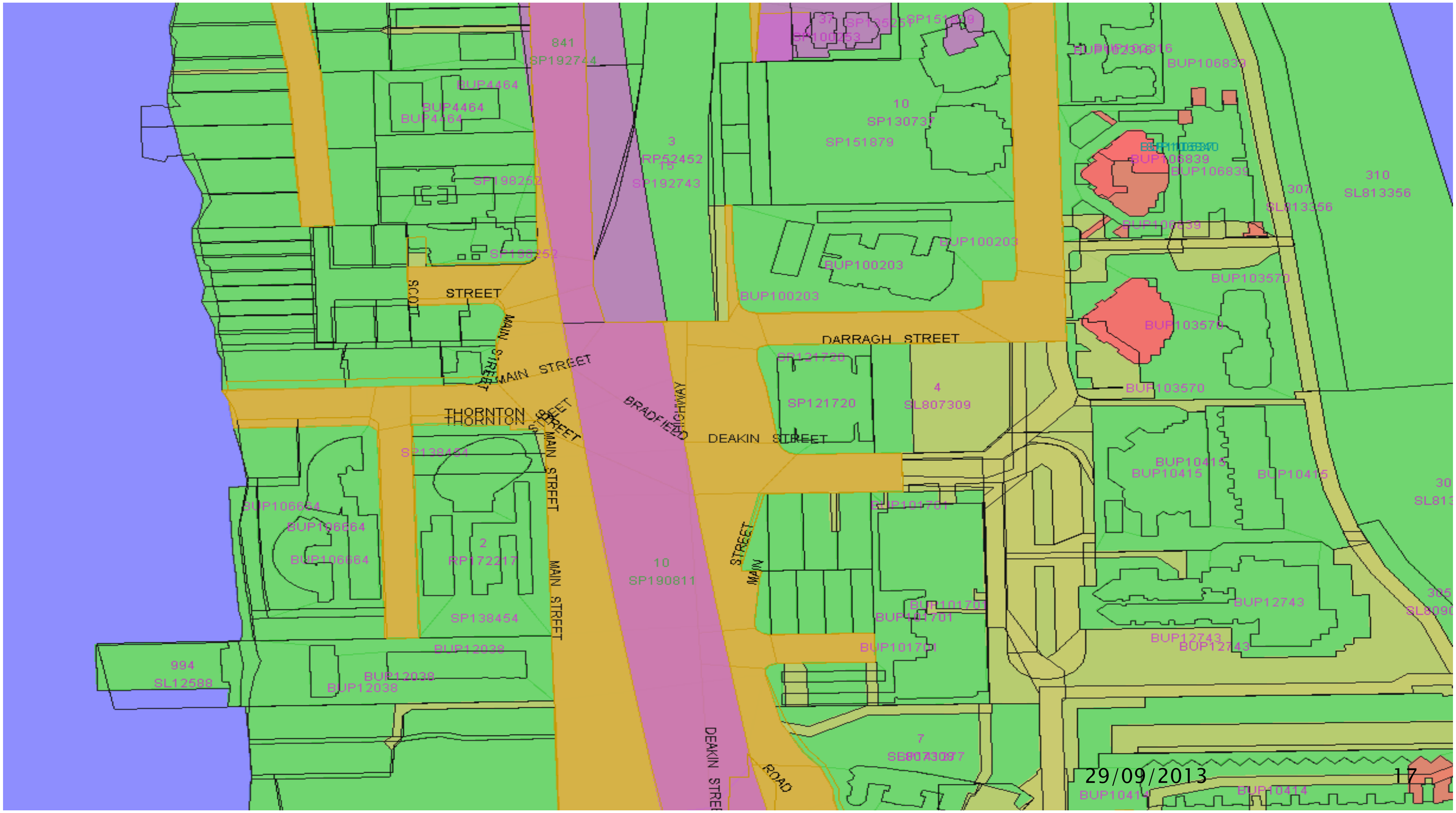
History in Developing Database

Now



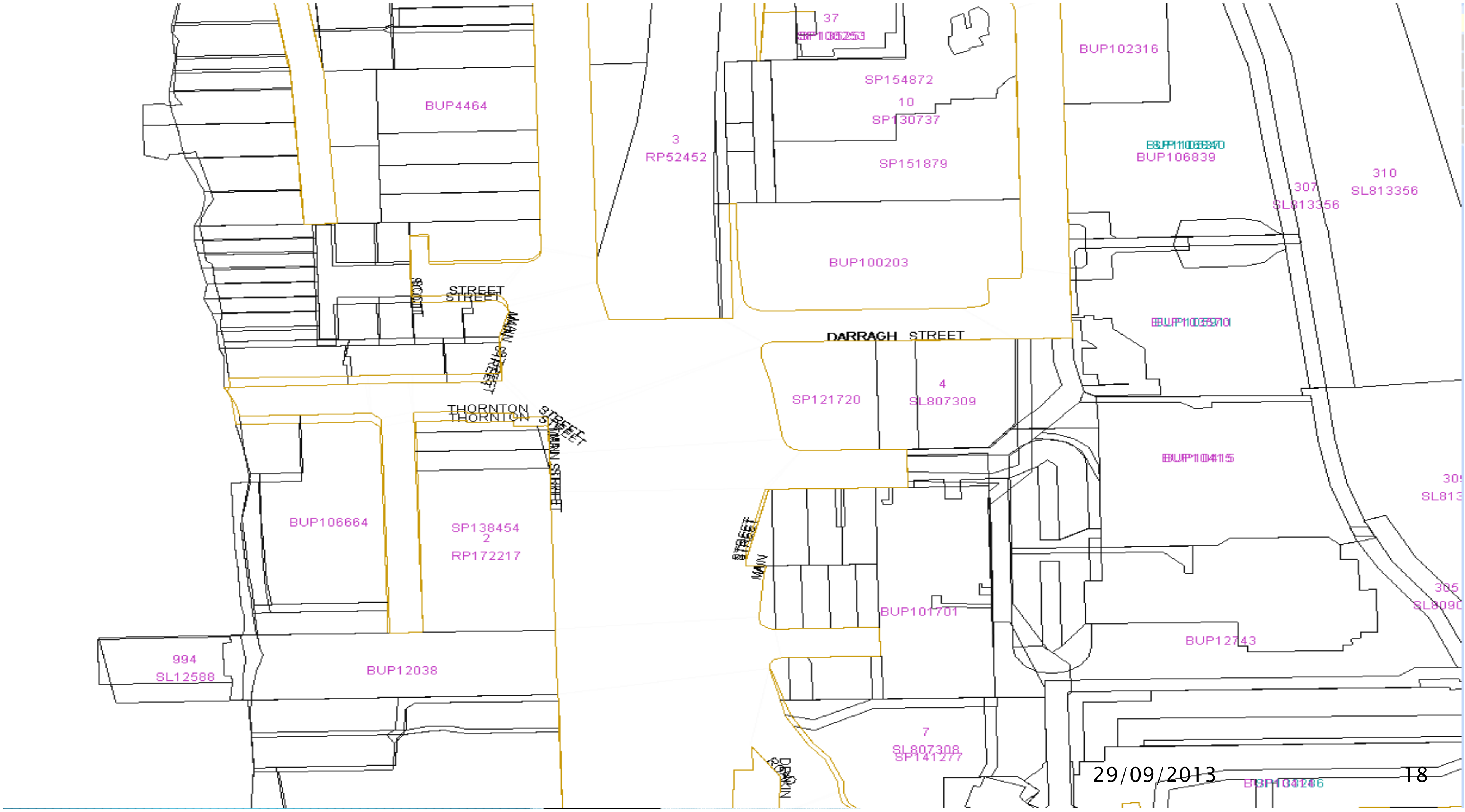
841
SP192744
BUP4464
BUP4464
SP135257
SP151879
BUP102316
BUP106839
SP198252
15
SP192743
BUP106839
310
SL813356
307
SL813356
BUP106839
SP198252
BUP100203
BUP100203
BUP100203
BUP103570
SP121720
4
SL807309
BUP103570
MAIN STREET
THORNTON STREET
BRADFIELD HIGHWAY
DEAKIN STREET
SP138454
BUP10415
BUP10415
BUP106664
BUP101701
BUP106664
10
SP190811
MAIN STREET
BUP12743
BUP101701
SP138454
BUP12743
BUP12038
BUP101701
BUP12038
DEAKIN STREET
SP141277
BUP10414

Now compared with 2001



841
SP192744
BUP4464
BUP4464
BUP4464
SP198252
SP198252
3
RP52452
15
SP192743
10
SP130737
SP151879
SP151
SP100253
BUP106839
BUP106839
BUP106839
BUP106839
310
SL813356
307
SL813356
BUP100203
BUP100203
BUP100203
BUP103570
BUP103570
BUP103570
DARRAGH STREET
SCOTT STREET
MAIN STREET
MAIN STREET
THORNTON STREET
BRADFIELD HIGHWAY
DEAKIN STREET
SP121720
SP121720
4
SL807309
SP138454
BUP106664
BUP106664
BUP106664
2
RP172217
SP138454
10
SP190811
BUP10415
BUP10415
BUP10415
BUP101701
BUP101701
BUP101701
BUP101701
STREET MAIN
MAIN STREET
BUP12743
BUP12743
BUP12743
BUP12038
BUP12038
BUP12038
994
SL12588
7
SL807307
DEAKIN STREET
ROAD
BUP10414
BUP10414

2001 to 2005

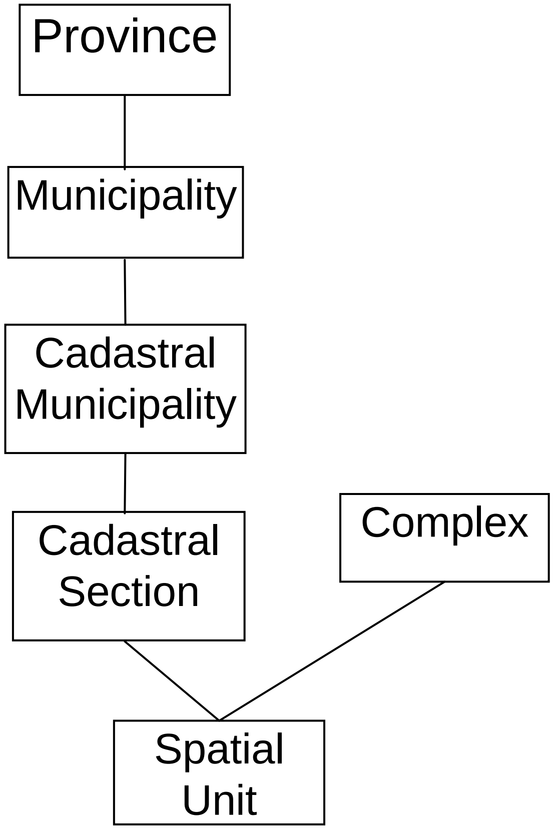

37
SP106253
BUP102316
SP154872
10
SP130737
BUP4464
3
RP52452
SP151879
BUP106839
310
SL813356
307
SL813356
BUP100203
SCOTT
STREET
MAIN STREET
DARRAGH STREET
4
SL807309
SP121720
THORNTON
STREET
MAIN STREET
BUP10415
BUP106664
SP138454
2
RP172217
STREET
MAIN
BUP101701
BUP12743
305
994
SL12588
BUP12038
7
SL807308
SP141277
DEAN ROBIN

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

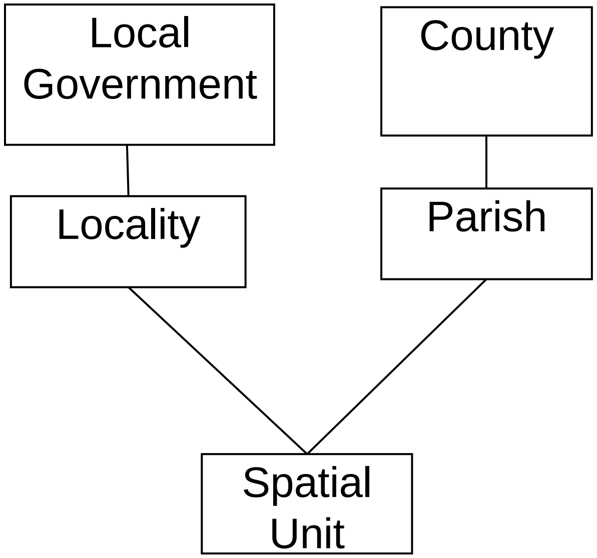
Municipality

Cadastral Municipality

Cadastral Section

Complex

Spatial Unit



Local Government

County

Locality

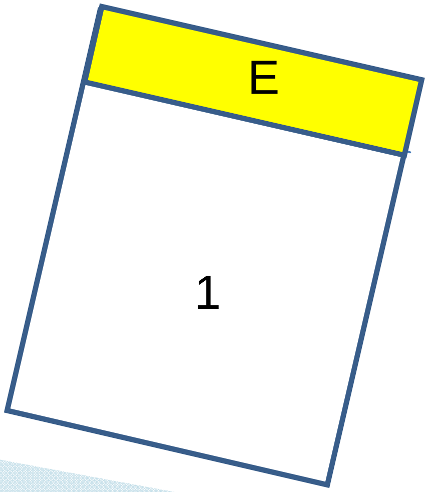
Parish

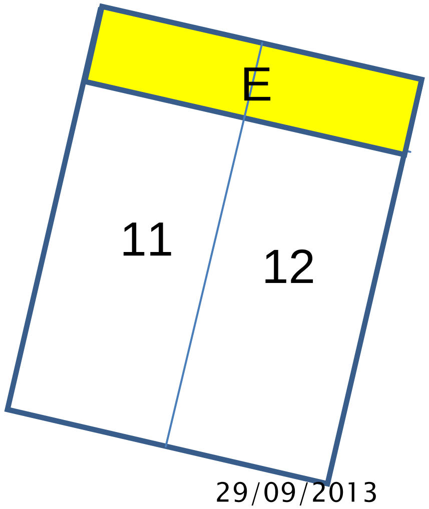
Spatial Unit

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



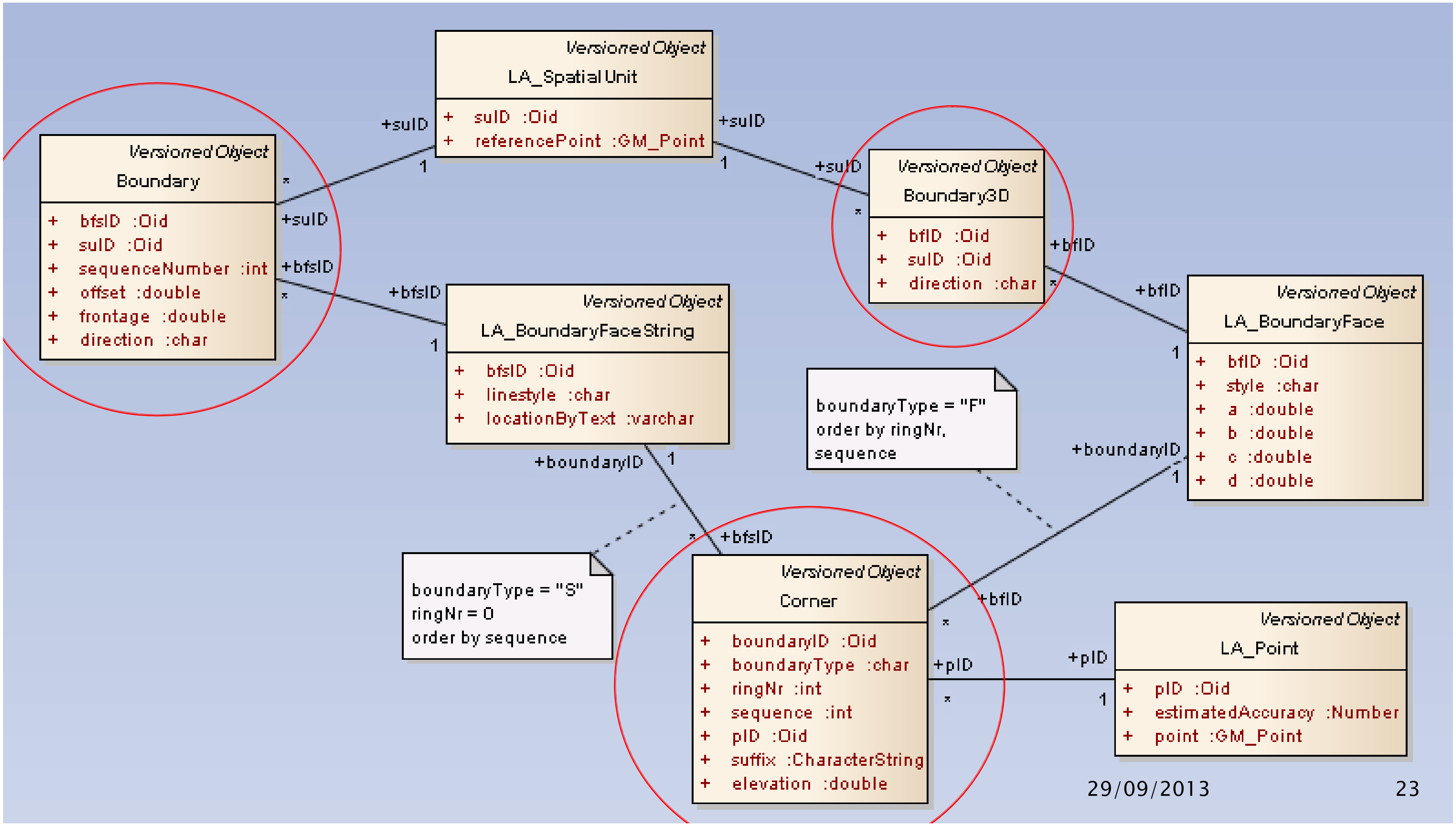


Secondary Interests

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



Versioned Object
LA_Spatial Unit
+ suID :Oid
+ referencePoint :GM_Point

Versioned Object
Boundary
+ bfsID :Oid
+ suID :Oid
+ sequenceNumber :int
+ offset :double
+ frontage :double
+ direction :char

Versioned Object
Boundary3D
+ bfID :Oid
+ suID :Oid
+ direction :char

Versioned Object
LA_BoundaryFaceString
+ bfsID :Oid
+ linestyle :char
+ locationByText :varchar

Versioned Object
LA_BoundaryFace
+ bfID :Oid
+ style :char
+ a :double
+ b :double
+ c :double
+ d :double

Versioned Object
Corner
+ boundaryID :Oid
+ boundaryType :char
+ ringNr :int
+ sequence :int
+ pID :Oid
+ suffix :CharacterString
+ elevation :double

Versioned Object
LA_Point
+ pID :Oid
+ estimatedAccuracy :Number
+ point :GM_Point

boundaryType = "F"
order by ringNr,
sequence

boundaryType = "S"
ringNr = 0
order by sequence

+suID
1
*
+suID
+bfsID
*
+bfsID
1
+suID
1
+suID
*
+bfID
*
+bfID
1
+boundaryID
1
+boundaryID
1
*
+bfsID
+bfID
*
+pID
*
+pID
1

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?