



Engaging Content  
Engaging People



# Serving Ireland's Geospatial as Linked Data on the Web

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The Web of Documents were created by humans for humans; the **links between documents bore little meaning for machines** and **documents provided little structured information.**

Structured information can be found on the Web – such as XML, CSV, etc. – but, ... **How do we link data rather than documents, and create a global “database” of information?**

Linked Data is a global initiative to **publish** and **interlink** structured (open) data on the Web using a combination of standardized technologies (HTTP, URI, RDF) such that ...

- any agent can explore the data and links ...
- that is fit for the agent (human or computer based) ...
- via a “protocol” and ...
- allowing one to build innovative applications.

- In 2014, the *Ordnance Survey Ireland* (OSi) delivered a newly developed spatial data storage model known as *Prime2*.
- With *Prime2*, OSi moved from a traditional map-centric model towards an object-oriented model from which various types of mapping and data services can be produced.
- OSi furthermore aims to adopt Linked Data to enable third parties to explore and consume some of OSi's *authoritative* datasets. *But how? Can Prime2 form the basis for that?*

**Goal:** To lay the foundations of a semantic architecture and Linked Data platform for the OSi taking into account best practices and guidelines in the domain of geospatial information and industry and OSi's current technology stack.

Starting from the boundaries dataset. These are open and already available on <http://data.gov.ie/>, but *not* as Linked Data.

- Requirements analysis included engagement the *Central Statistics Office* and the *Department of Public Expenditure and Reform* as stakeholders.
- Formulation of two use case scenarios from which requirements were distilled:
  1. Accessing the **same features with different geometric representations**, i.e., different generalizations or “resolutions”.
  2. Capturing the **provenance and evolution of features and their geometric representations**. E.g., Statutory Instruments to change boundaries.

## Ontologies

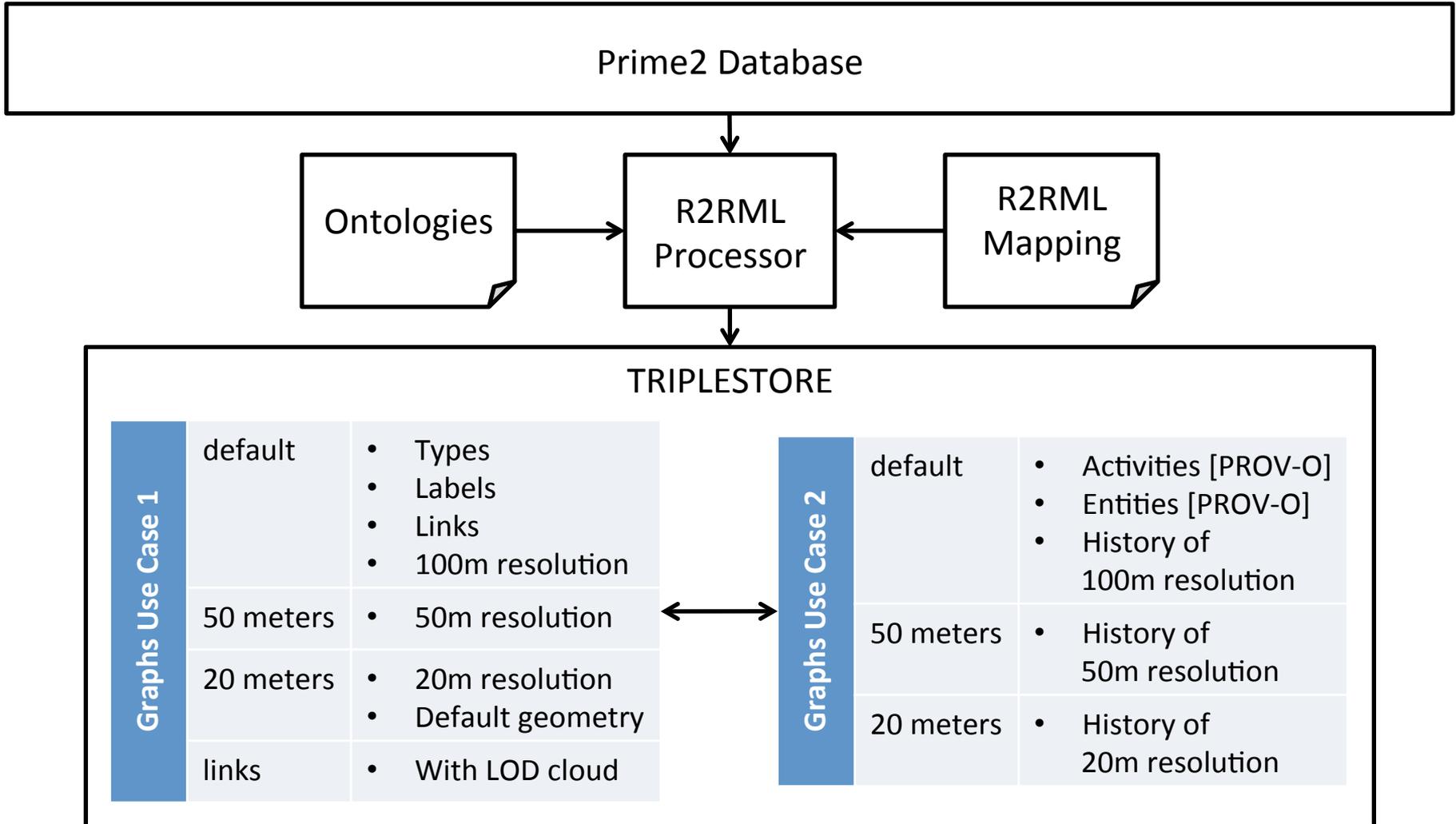
- Features and Geometries *based on* [GeoSPARQL](#)
- Provenance using Statute Instruments *based on* [PROV-O](#)
- Static and dynamic boundaries (and their relationships)
- Necessary ontologies developed and published

## Workshops with DPER and CSO on a [URI Strategy](#)

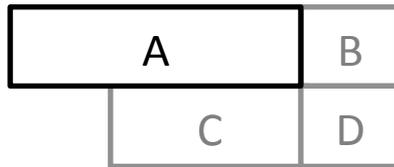
- Information Resources vs. Non-Information Resources
- Using Prime2's GUIDs and a hint of the instance's nature

Cleverly using [\(named\) graphs](#) to support both use cases

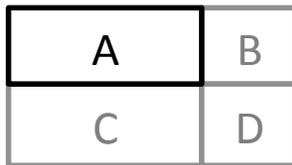
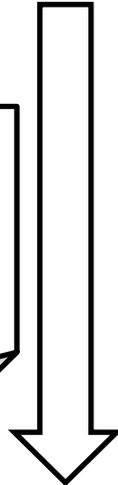
Mapping the Prime2 database to RDF with [R2RML](#)



# Example evolution of boundaries



Legal Instrument ordering change of A's boundary on 2000/01/01



```
<http://data.example.com/feature/A>
a geo:Feature ;
rdfs:label "A" ;
geo:hasGeometry
  [ a geo:Geometry ;
    geo:asWKT "MULTIPOLYGON (((0 1, 0 2, 3 2, 3 1, 0 1)))"^^geo:wktLiteral
  ] .
<http://data.example.com/feature/B> ... .
<http://data.example.com/feature/C> ... .
<http://data.example.com/feature/D> ... .

<http://data.example.com/feature/A>
a geo:Feature ; rdfs:label "A" ;
geo:hasGeometry
  [ a geo:Geometry ;
    geo:asWKT "MULTIPOLYGON (((1 1, 1 2, 3 2, 3 1, 1 1)))"^^geo:wktLiteral ;
    prov:wasGeneratedBy <http://data.example.com/change/1> ;
    prov:wasRevisionOf
      [ a geo:Geometry ;
        geo:asWKT "MULTIPOLYGON (((0 1, 0 2, 3 2, 3 1, 0 1)))"^^geo:wktLiteral
      ] .
  ] .
<http://data.example.com/feature/B> ... .
<http://data.example.com/feature/C> ... .
<http://data.example.com/feature/D> ... .

<http://data.example.com/change/1>
a prov:Activity ;
prov:endedAtTime "2000-01-01T12:00:00"^^xsd:dateTime ;
prov:startedAtTime "2000-01-01T12:00:00"^^xsd:dateTime ;
prov:used <http://data.example.com/instrument/1> .

<http://data.example.com/instrument/1>
a prov:Entity ;
<http://purl.org/dc/elements/1.1/date> "2000-01-01" ;
<http://purl.org/dc/elements/1.1/identifier> "1" ;
<http://purl.org/dc/elements/1.1/title> "Change A" .
```

Simplified example. Different graphs are used for different resolutions. Types for activities and entities omitted.



DUBLIN >>> geo.defaultGeometry at OSI Geohive

Back to DUBLIN

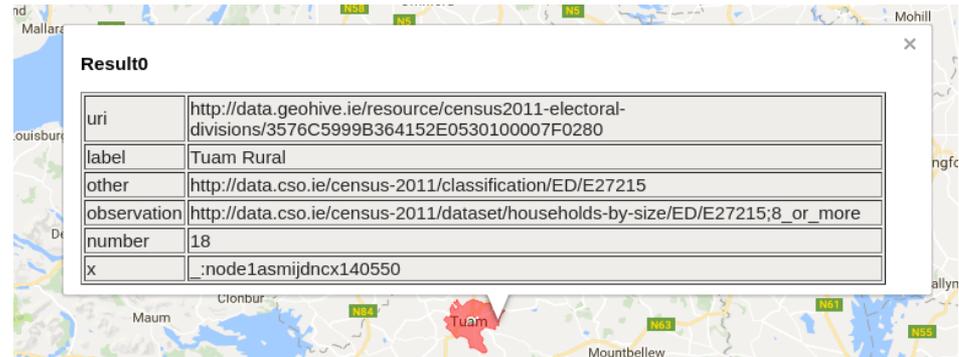
Geometrical Representation #20m

Property	Value
geo:asWKT	MULTIPOLYGON (((-6.17322835071853 53.4550587605824, -6.17324345299026 53.4550707210097, -6.17324216254192 53.4550537767041, -6.17322835071853 53.4550587605824)), ...>more- (geo:wktLiteral)
is geo.defaultGeometry of	<http://data.geohive.ie/resource/county/2AE19629144F13A3E05500000000001>
is geo.hasGeometry of	<http://data.geohive.ie/resource/county/2AE19629144F13A3E05500000000001>
rdftype	geo:Geometry

As Turtle | As RDF/XML

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- Publication of boundary data used by CENSUS 2011
  - EDs, Towns, Settlements, etc. published as Linked Data and linked with <http://data.cso.ie/>
  - Dynamic vs. Static boundary datasets
  - Merge of North and South Tipperary
- Creation of links with DBpedia, GeoNames, TCD Library, etc.
- Creation of a spatial component to a pollution dataset



The image shows a map interface with a search result window titled 'Result0'. The window contains a table with the following data:

uri	http://data.geohive.ie/resource/census2011-electoral-divisions/3576C5999B364152E0530100007F0280
label	Tuam Rural
other	http://data.cso.ie/census-2011/classification/ED/E27215
observation	http://data.cso.ie/census-2011/dataset/households-by-size/ED/E27215;8_or_more
number	18
x	_:node1asmjdnxc140550

The map in the background shows the location of Tuam Rural in Tipperary, Ireland, with various roads and landmarks labeled.

We have used OSi's Prime2 dataset to publish their authoritative geospatial data as Linked Data on the Web by creating R2RML mappings using ontologies that extend GeoSPARQL, and PROV-O.

Future directions include:

- Transforming the geometries of **buildings**, the evolution thereof, and how to link with the documents that inform the OSi of these changes (“**closed**” Linked Data)
- **Access control mechanisms** for such “Closed” Linked Data

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## References

Christophe Debruyne, Eamonn Clinton, Lorraine McNerney, Atul Nautiyal, Declan O'Sullivan: Serving Ireland's Geospatial Information as Linked Data. International Semantic Web Conference (Posters & Demos) 2016

Christophe Debruyne, Declan O'Sullivan: R2RML-F: Towards Sharing and Executing Domain Logic in R2RML Mappings. LDOW@WWW 2016

Prime2: Data Concepts and Data Model Overview. Tech. rep., Ordnance Survey Ireland (2014), <http://www.osi.ie/wp-content/uploads/2015/04/Prime2-V-2.pdf>