

Linked Data Generation

Oscar Corcho, Asunción Gómez Pérez ({ocorcho, asun}@fi.upm.es)
Universidad Politécnica de Madrid

Credits: Raúl García Castro, Guillermo Alvaro, Oscar Muñoz, Jose Angel Ramos Gargantilla, María del Carmen Suárez de Figueroa, Boris Villazón, Alex de León, Víctor Saquicela, Luis Vilches, Miguel Angel García, Manuel Salvadores, Juan Sequeda, Carlos Ruiz Moreno and many others

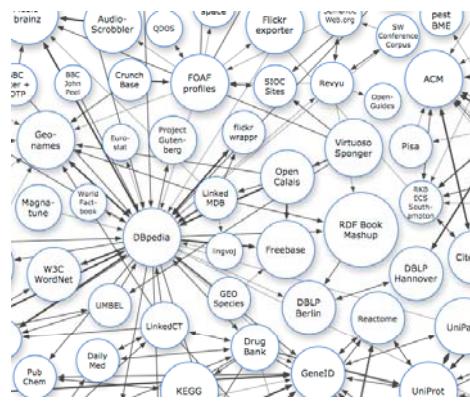
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Contents

- Introduction to Linked Data
- Linked Data publication
 - Methodological guidelines for Linked Data publication
 - RDB2RDF tools
 - Technical aspects of Linked Data publication
- [Linked Data consumption]

What is the Web of Linked Data?

- An extension of the current Web...
 - ... where data are given **well-defined** and **explicitly represented** meaning, ...
 - ... so that it can be **shared** and used by **humans and machines**, ...
 - ... better enabling them to work in cooperation
 - How?
 - Promoting information exchange by **tagging web content** with machine processable descriptions of its meaning.
 - And **technologies** and **infrastructure** to do this
 - And **clear principles** on how to publish data

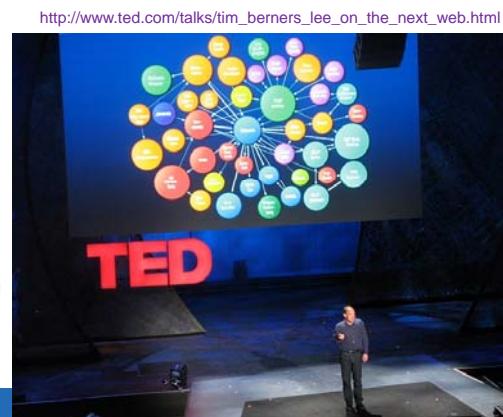


What is Linked Data?

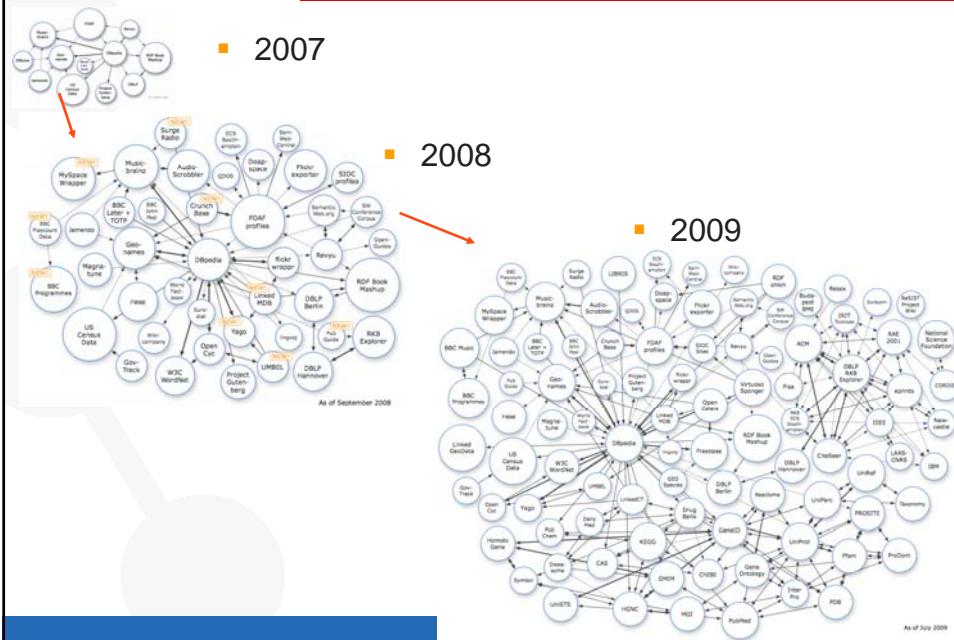
- Linked Data is a term used to describe a recommended **best practice** for exposing, sharing, and connecting pieces of data, information, and knowledge on the Semantic Web using URIs and RDF.
 - Part of the Semantic Web
 - Exposing, sharing and connecting data
 - Technologies: URIs and RDF (although others are also important)

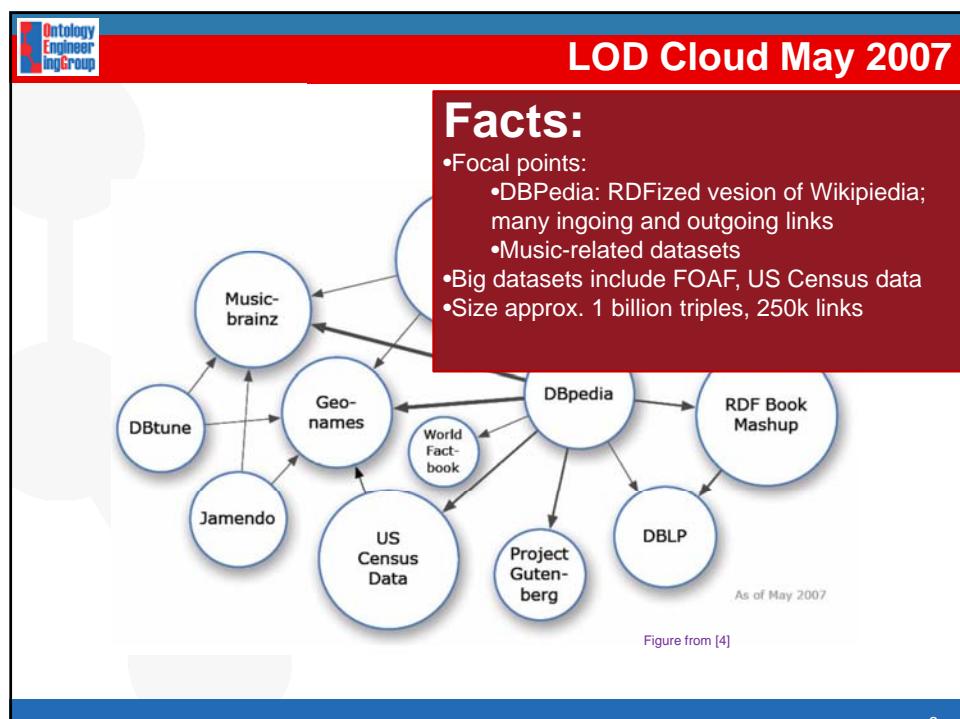
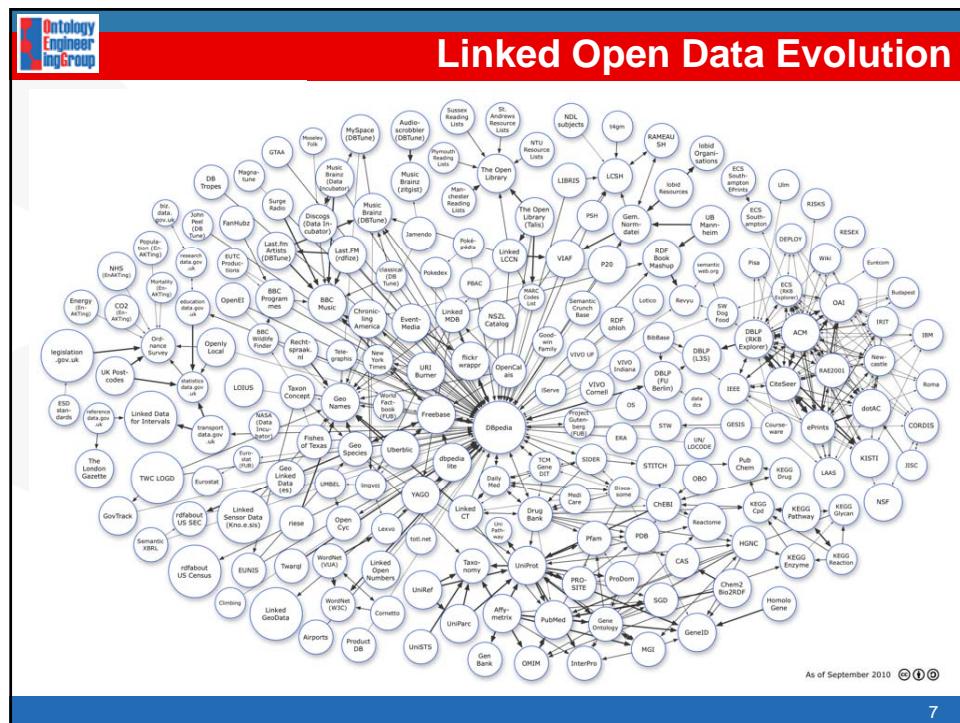
The four principles (Tim Berners Lee, 2006)

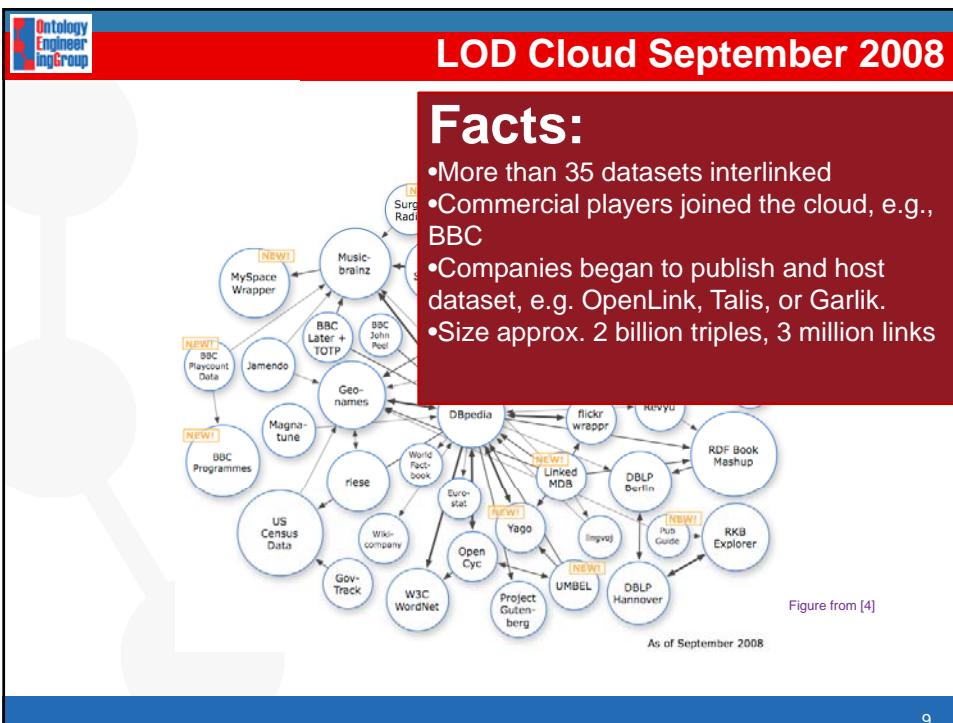
1. Use URIs as names for things
 2. Use HTTP URIs so that people can look up those names.
 3. When someone looks up a URI, provide useful information, using the standards (RDF*, SPARQL)
 4. Include links to other URIs, so that they can discover more things.
- <http://www.w3.org/DesignIssues/LinkedData.html>



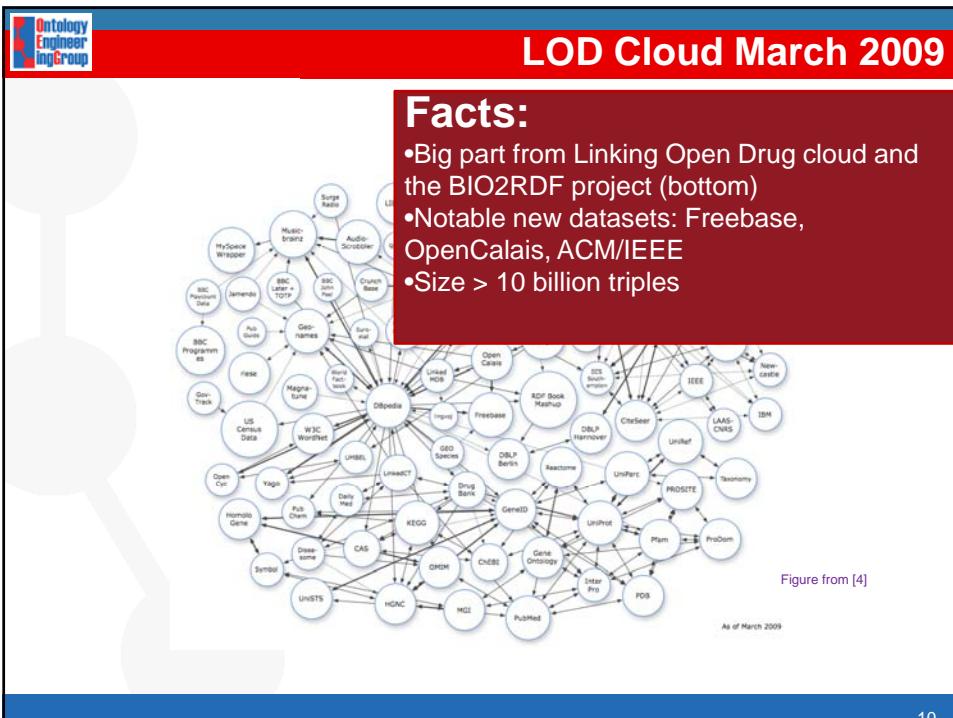
Linked Open Data evolution



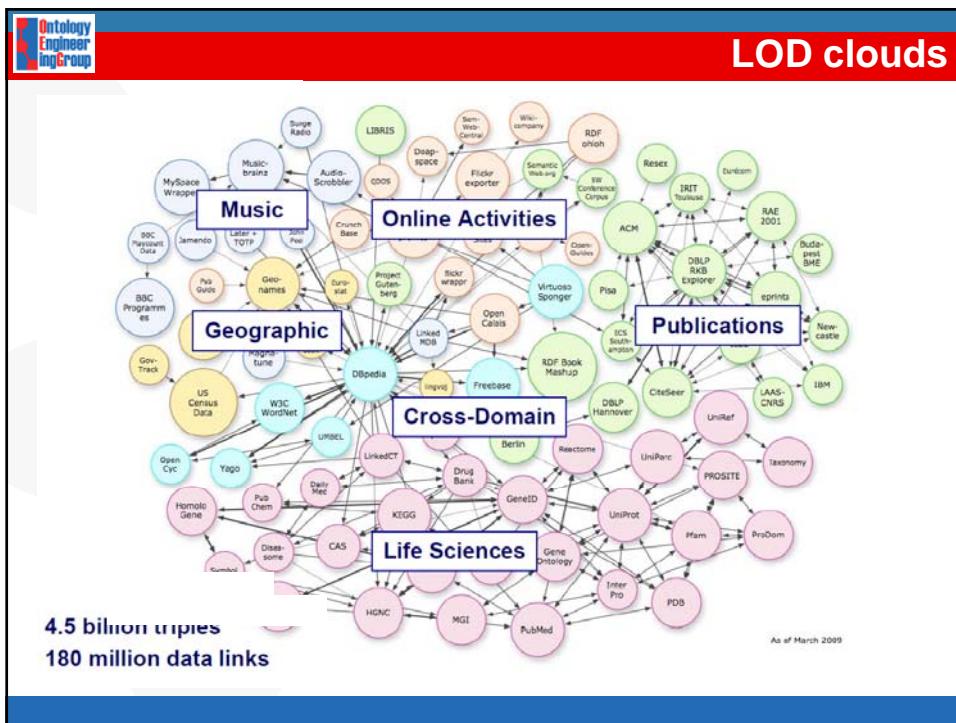




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- How should we publish data?**
- Formats in which data is published nowadays...
 - XML
 - HTML
 - DBs
 - APIs
 - CSV
 - XLS
 - ...
 - However, main limitations from a Web of Data point of view
 - Difficult to integrate
 - Data is not linked to each other, as it happens with Web documents.

How do we publish Linked Data?

1. Exposing Relational Databases or other similar formats into Linked Data
 - D2R
 - Triplify
 - R2O
 - NOR2O
 - Virtuoso
 - Ultrawrap
 - ...
2. Using native RDF triplestores
 - Sesame
 - Jena
 - OwlIM
 - Talis platform
 - ...
3. Incorporating it in the form of RDFa in CMSs like Drupal

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How do we consume Linked Data?

- Linked Data browsers
 - To explore things and datasets and to navigate between them.
 - Tabulator Browser (MIT, USA), Marbles (FU Berlin, DE), OpenLink RDF Browser (OpenLink, UK), Zitgist RDF Browser (Zitgist, USA), Disco Hyperdata Browser (FU Berlin, DE), Fenfire (DERI, Ireland)
- Linked Data mashups
 - Sites that mash up (thus combine Linked data)
 - Revyu.com (KMI, UK), DBtune Slashfacet (Queen Mary, UK), DBpedia Mobile (FU Berlin, DE), Semantic Web Pipes (DERI, Ireland)
- Search engines
 - To search for Linked Data.
 - Falcons (IWS, China), Sindice (DERI, Ireland), MicroSearch (Yahoo, Spain), Watson (Open University, UK), SWSE (DERI, Ireland), Swoogle (UMBC, USA)

Linked Data browsers (Disco)

The screenshot shows a Windows Internet Explorer window displaying a resource page from the Disco linked data browser. The URL is <http://www4.wiwiss.fu-berlin.de/dbp/resource/person/315759>. The page title is "Christian Bizer". The interface includes:

- Label of the displayed resource:** "Christian Bizer"
- Navigation box:** A sidebar on the left containing links like "Home", "About", "Logout", and "Help".
- Resource description:** A table showing properties and values for the resource.
- List of all source graphs:** A table showing the sources of each piece of information.
- Sources:** A list of RDF graphs that contributed to the displayed information.
- Session Cache:** A link to display all RDF graphs currently in the session cache.
- Go to URI button:** A button to go to the specified URI.
- Sources of each piece of information:** A list of sources for each piece of information.

Linked Data Mashup (LinkedGeoData)

The screenshot shows a web application for LinkedGeoData. It features a map of a city area with various geographical features and data overlays. The interface includes:

- Search:** A search bar at the top with the placeholder "Search" and a "powered by Planlayer" logo.
- Map:** A detailed map of a city street layout with red markers indicating specific locations or entities.
- Details:** A modal dialog box showing details for a selected location, including "Name", "Description", and "Source ref".
- Facets:** On the left, there are two sections: "Class hierarchy" and "Properties".
- Instances:** A table showing instances of classes, with columns for "Name", "Description", and "Source ref".
- Search results:** A list of search results on the right side of the map.
- Legend:** A legend at the bottom left showing icons for different geographical features like roads, parks, and buildings.

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Linked Data Mashup (DBpedia Mobile)

<http://wiki.dbpedia.org/DBpediaMobile>

- Displays Wikipedia data on a map
- Smushes the data with data from other sources

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Linked Data Search Engines (Sindice and SIG.MA)

- Entity lookup service. Find a document that mentions a URI or a keyword.

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Linked Data Search Engines (NYT)

- The New York Times: Alumni In The News
 - <http://data.nytimes.com/schools/schools.html>

The screenshot shows the NYTimes Linked Open Data search interface. At the top, there's a navigation bar with 'The New York Times' logo, 'Linked Open Data BETA', and a 'View Application Source' link. Below the bar, the main title is 'Alumni In The News'. A search input field contains 'Stanford University'. To the right, there's a thumbnail of the Stanford University building. The main content area displays a grid of news articles. One article for '2008 Stanford Cardinal football team' is highlighted, showing details like 'Born: December 23, 1963'. Another article for 'John Elway' is also shown with his photo and birth date 'Born: June 28, 1960'. The interface features a complex network graph on the left side, illustrating the interconnectedness of various data sources.

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Linked Data Search Engines (NYT)

- The New York Times: Source code is available

```
// SPARQL query that retrieves the Freebase ID(s) associated with an item
// in DBpedia
var sparql =
"SELECT ?freebaseUri WHERE {" +
"?s" + schoolUri + "> owl:sameAs ?freebaseUri FILTER regex(?freebaseUri,'http://rdf\\\\\\\.freebase\\\\\\\.com/.+') " +
"}";

// DBpedia URI for executing the sparql query.
var dbpediaUrl =
"http://dbpedia.org/sparql?default-graph-uri=http%3A%2F%2Fdbpedia.org&query=" +
escape(sparql) +
"&format=json";
```

- ... and is based on SPARQL queries

One additional motivation: Open Government

- Government and state administration should be opened at all levels to effective public scrutiny and oversight
- Objectives:
 - Transparency
 - Participation
 - Collaboration
 - Inclusion
- Cost reduction
 - Interoperability
 - Reusability
- Leadership
 - Market & Value

Some Links:

- B. Obama - [Transparency and Open Government](#)
- T. Berners-Lee - [Raw data now!](#)
- J. Manuel Alonso - [¿Qué es Open Data?](#)
- [Open Government Data](#)
- [8 Principles of Open Government Data](#)

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Open Government. USA and UK

HM Government

Unlocking innovation
Working with UK Public Sector Information and data

Latest datasets

2 July Public sector savings over £100,000 now also covers NDPRs
 25 June Costs and other data about central government websites
 18 June Estimated government workforce including consultants
 14 June More COINS public spending data now covers 2005 to 2010

What we do

data.gov.uk is a key part of the Government Transparency programme. It is the public-facing side of a wider initiative with Sir Tim Berners-Lee, Professor Mark Weitzman and Tim Berners-Lee and others from the Cabinet Office Ministers new Public Sector Transparency Board. The site seeks to give a very easy into the wealth of government data becoming available. It's under constant development and we want to work with you to make it better.

TOP-DOWN

DATA.GOV
A CLOUD COMPUTING SERVICE

HAPPY 1ST ANNIVERSARY DATA.GOV
data.gov.uk

Community Log in / Sign up **Local Data Panel**

What is the Semantic Web? Contact us if you have any questions, but the Semantic Web is a distributed network of knowledge that can be used by people and machines to find, use and reuse data in meaningful ways.

SEARCH OUR CATALOGS Search our catalog... SEARCH

Most Popular Datasets

1. U.S. Overseas Loans and Grants (Greenbook)
2. Worldwide Min+Earthquakes, Past 7 Days
3. Latest Volumes of Foreign Relations of the...
4. Local Area Unemployment Statistics
5. Personal Trends by Gender/Race

COMMUNITY **SEMANTIC WEB**

Data.gov is leading the way in democratising public sector data and driving innovation. The open data movement is about making the Government data stores available to researchers to perform their own analysis. Developers can use the data to build their own applications, providing interesting and useful services that connect new ideas and

As the Web of linked documents moves to the semantic web, it's not just about linking limited data, we're working to maximize the potential of the semantic web. We're beginning to realize the promise of

BOTTOM-UP

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Linked Data Mashup (data.gov)

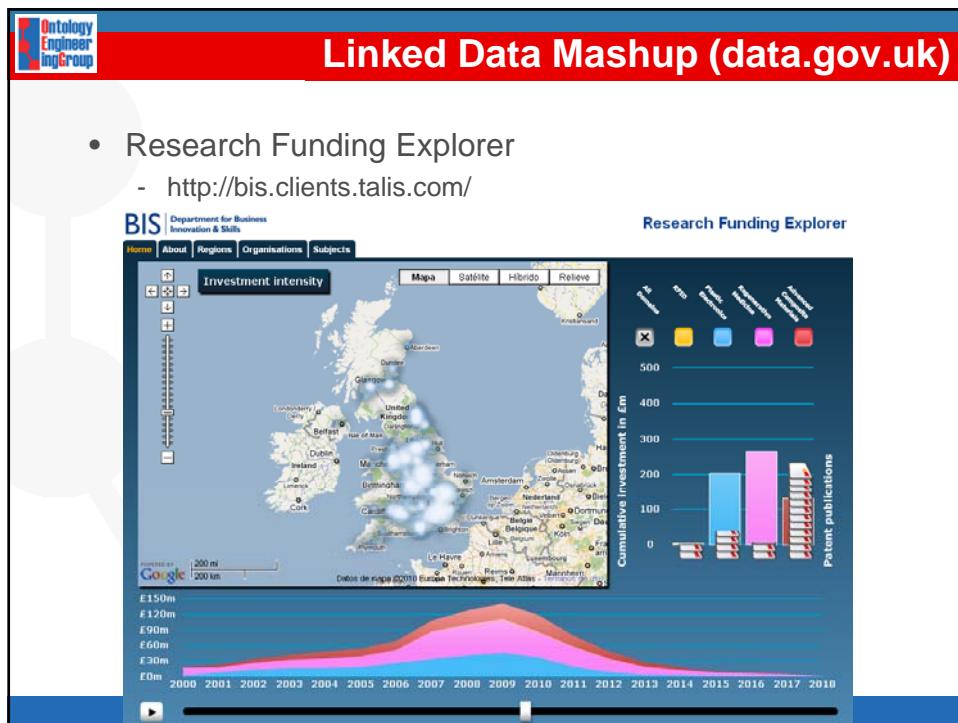
- Clean Air Status and Trends (CASTNET)
 - <http://data-gov.tw.rpi.edu/demo/exhibit/demo-8-castnet.php>

The screenshot displays three distinct web applications side-by-side:

- Clean Air Status and Trends Network (CASTNET):** A map of the western United States showing various air monitoring stations. A legend indicates Land Use (Agric, Coastal/Marsh, Desert, Forest) and Terrain (Ridge, MountainTop, Flat/Water, Flat). An Agency legend shows EPA and NPS.
- employment market explorer:** A map of San Francisco Bay Area showing unemployment rates across different neighborhoods.
- National obesity comparison tool:** A map of California showing obesity rates by county. A legend indicates Obesity (% of pop) from 0% to 40%. A scatter plot below shows Obesity (% of pop) on the Y-axis versus another metric on the X-axis, with points clustered around a diagonal line labeled "National Av.".

Linked Data in the UK

- Education
 - <http://education.data.gov.uk/id/school/106661>
- Parliament
 - <http://parliament.psi.enacting.org/id/member/1227>
- Maps
 - E.g., London:
 - <http://data.ordnancesurvey.co.uk/id/7000000000041428>
 - <http://map.psi.enacting.org>
- Transport
 - <http://www.dft.gov.uk/naptan/>
- SameAs service
 - <http://www.sameas.org>
- Challenges
 - <http://gov.tso.co.uk/openup/sparql/gov-transport>



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Open Government Spain. Abredatos

The infographic features a smartphone displaying the Infocarretera app interface, which shows traffic information for different roads. To the right of the phone is a stylized road with three cars (a purple bus, a blue car, and a red car) and a yellow and black striped barrier. The background is a green landscape with white clouds. The Infocarretera logo is prominently displayed in the center. Below the logo, there's a small badge for 'PRIMER PREMIO AbreDatos'.

infocarretera toda la información de la red carreteras de euskadi en tu bolígrafo

infocarretera te acerca el estado de las

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Open Government Spain. Zaragoza

The screenshot shows the official website of the City of Zaragoza. At the top, there's a navigation bar with links for 'AYUNTAMIENTO', 'LA CIUDAD', 'CULTURA', 'PASAR AL CONTE', 'TURISMO', 'Todo', and 'Buscar'. Below the navigation, there's a search bar and a 'SERVICIOS' section. Under 'SERVICIOS', there's a 'CONJUNTO DE DATOS' section titled 'infocarretera'. A detailed note in this section explains the legal basis for the provision of data under Article 27(2)(b) of the LOPD, stating that the data is provided to facilitate the execution of public services and the implementation of the citizen's right to access and obtain information from the public administration. It also mentions the processing of personal data in accordance with Article 22(1) of the LOPD. A table below lists the services and their formats: 'Agenda de actividades' (PDF, RSS, HTML), 'Oficina de Empleo' (PDF, RSS), and 'Centro de Atención Ciudadana' (GeotRSS).

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Open Government Spain. Asturias

Catálogo de Datos de Asturias

En la siguiente tabla se enumeran los conjuntos de datos de Asturias, los cuales están representados por filas. Cada conjunto de datos puede estar representado en los diversos formatos que aparecen en la tabla y se puede obtener más información sobre cada uno de ellos (detalles técnicos, licencia, etc.) en las fichas asociadas a cada uno.

Consulta más sobre los [formatos disponibles](#) o sobre los [términos de uso](#) de los datos.

Nombre	Actualización	HTML	SPARQL/XML	SPARQL/JSON	RDF/XML	RDF/N3	TURTLE
Oferta Formativa del Servicio Público de Empleo del Principado de Asturias	17/02/2010	✓	✓	✓	✓	✓	✓
Organograma de las Consejerías del Principado de Asturias	17/02/2010	✓	✓	✓	✓	✓	✓
Plataforma de acceso a la documentación del Principado de Asturias	17/02/2010	✓	✓	✓	✓	✓	✓

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Linked Data Mashup (Water quality)

- Water quality in Asturias' beaches
 - <http://datos.fundacionctic.org/sandbox/asturias/playas/>

The screenshot displays a map of the Asturias coastline with various colored dots representing different beach locations. A specific beach, 'Playa de Borizo', is highlighted with a callout box containing the following information:

Playa de Borizo

Calor: 20°C

Palo	Biove
Condiciones	Vigilancia
advisory	Advertida
Comarca	Urgente
Corriente	Clara

- Introduction to Linked Data
- **Linked Data publication**
 - Methodological guidelines for Linked Data publication
 - RDB2RDF tools
 - Technical aspects of Linked Data publication
- [Linked Data consumption]

- Motivation
- Related Work
- GeoLinkedData
 - Identification of the data sources
 - Vocabulary Development
 - Generation of the RDF data
 - Publication of the RDF data
 - Data cleansing
 - Linking the RDF data
 - Enable effective discovery
- Future Work

GeoLinkedData

- It is an open initiative whose aim is to enrich the Web of Data with Spanish geospatial data.
- This initiative has started off by publishing diverse information sources, such as National Geographic Institute of Spain (IGN-E) and National Statistics Institute (INE)

GeoLinked Data

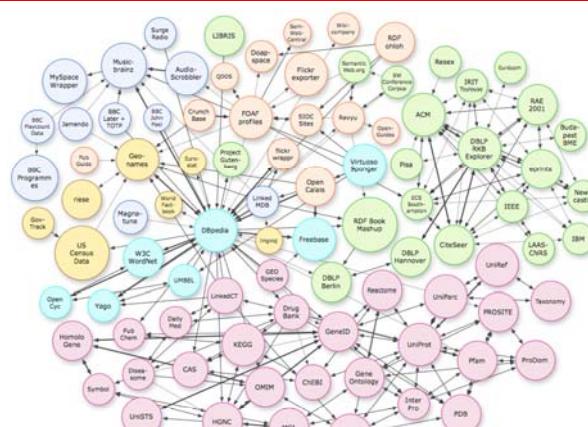


- <http://geo.linkeddata.es>

Motivation

The Web of Data is mainly for English speakers
Poor presence of Spanish

Total	3182428709
Non-literals	1494635231
Literals	1687793478
Literals without Lang tag	1282062417
Literals - en	99.171 %
Literals - ja	0.463 %
Literals - fr	0.054 %
Literals - de	0.034 %
Literals - pl	0.025 %
Literals - it	0.021 %
Literals - es	0.019 %
Literals - ru	0.018 %
Literals - nl	0.018 %



As of March 2009

» 99.171 % English
» 0.019 % Spanish

Source: Billion Triples dataset at <http://km.aifb.kit.edu/projects/btc-2010/>
Thanks to Aidan and Richard

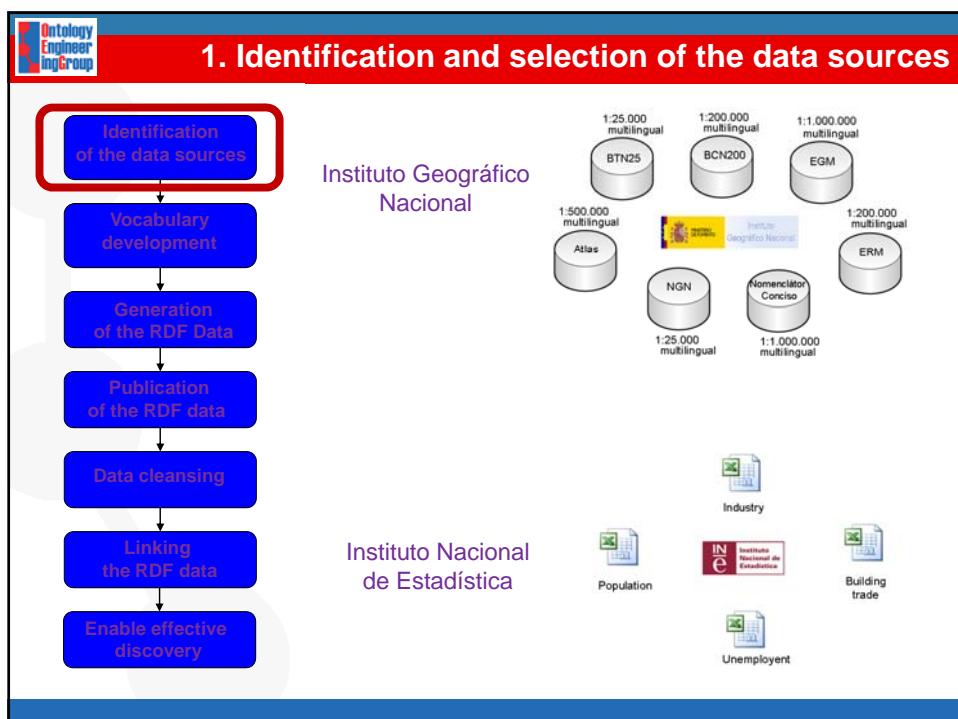
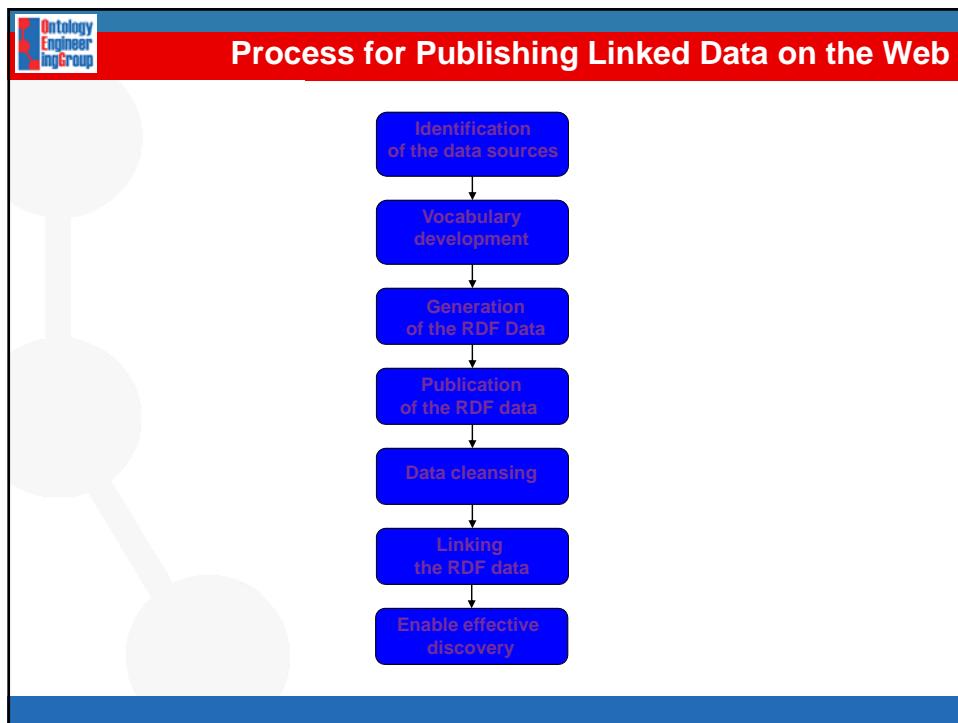
Related Work

Provider	Provenance data	Triple store	Topics	Datasets	RDF generation	URI pattern	Vocabulary	Geometry	Lang.
Ordnance survey	Ordnance survey	Talis	Administrative units	A Gazetteer (1:50,000) and administrative gazetteer for Great Britain	-	http://data.ordnancesurvey.co.uk/id/+	Spatial Relations Ontology, Administrative Geography Ontology, WGS84 Geo Positioning FOAF, OWL, and Gazetteer Ontology	Point	en
Linked GeoData	OpenStreet Map	Virtuoso	Points-of-interest	OpenStreetMap database (post offices, traffic lights, bus stops)	Triplify	http://linkedgeo data.org/triplify /+	LGD ontology, WGS84 Geo Positioning	Point	en
GeoNames	GeoNames	RDF dump	Toponyms	Datasources used by GeoNames	-	http://sws.geon ames.org/id/	GeoNames Ontology, WGS84 Geo Positioning	Point	en, es, de, ca, nb, it, da, fr.
DBpedia	Wikipedia	Virtuoso	General knowledge	Wikipedia	D2R Server	http://dbpedia.o rg/resource/+	Dbpedia ontology, WGS84 Geo Positioning	Point	92 lang.

Impact of Geo.linkeddata.es

- Número de tripletes en Español (July): 1.412.248
- Número de tripletas en Español (End august): 21.463.088

Before	geo.linkeddata.es	After	geo.linkeddata.es
en	99,1712875	en	94,18744941
ja	0,463849377	es	5,044085342
fr	0,05447229	ja	0,440538697
de	0,034225134	fr	0,051734793
pl	0,02532934	de	0,032505155
it	0,021982542	pl	0,024056418
es	0,019584648	it	0,020877812





1. Identification and selection of the data sources

- Instituto Geográfico Nacional (Geographic Spanish Institute)
 - Multilingual (Spanish, Vasc, Galician, Catalan)
 - Conceptualization mismatches
 - Granularity (scale concept)
 - Textual information
 - Particularities
 - Longitude
 - latitude
- Instituto Nacional de Estadística (Statistic Spanish Institute)
 - Monolingual
 - Numerical information
 - Particularities
 - Geo (textual level)
 - Temporal

Asunción Gómez Pérez

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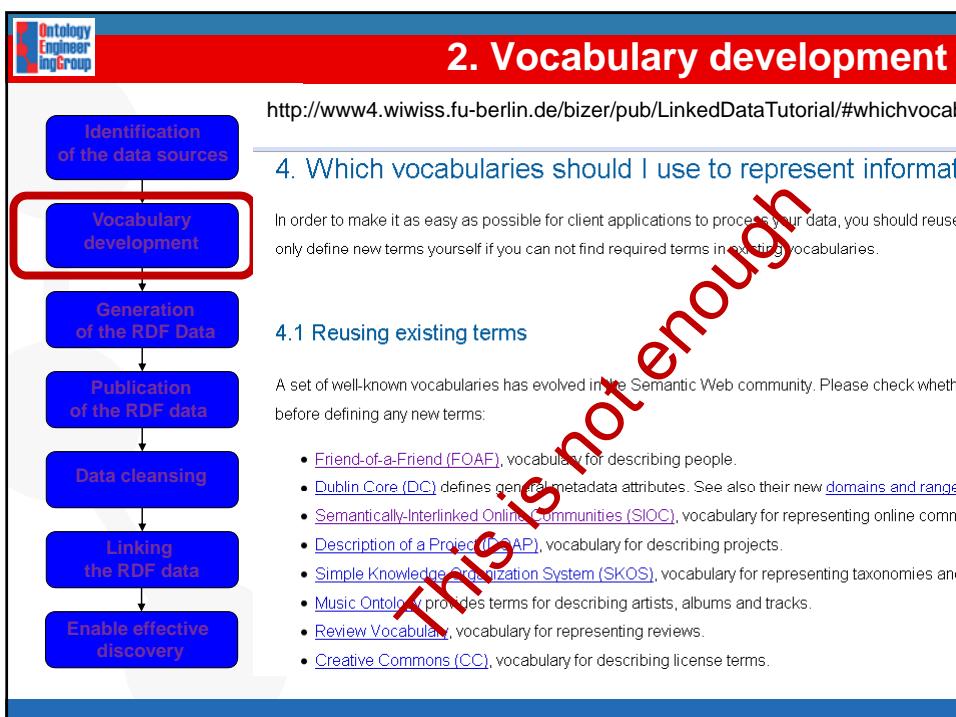
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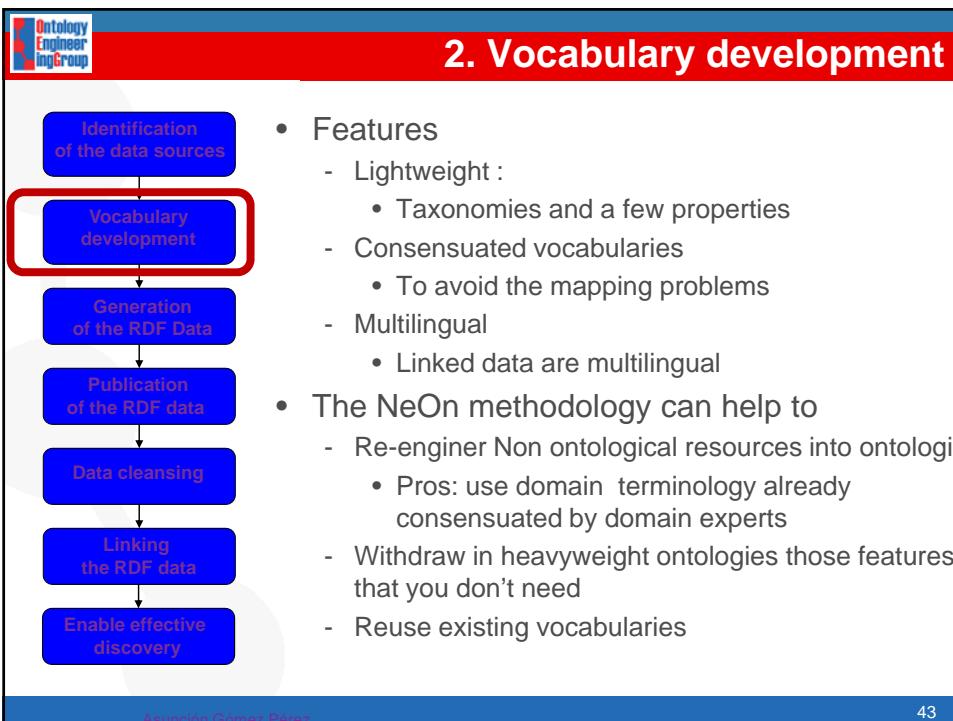
1. Identification and selection of the data sources												
NOMBRE	ENTIDAD	CON	PROV	CODINE	XUTM	YUTM	HUSO	HOJA25	LongitudG	LatitudG	LongitudGMS	LatitudGMS
Abejuela, Olivar de / Oli	Lugar/Paraje	0	02	02042	584300	246500	30	0867-3	-2,03512445814873	38,3620693572292	-02°02'06.44	38°21'
Abejuela, Rambla de	Corriente fluvial	0	04	04053	397560	152000	30	0974-4	-1,89618811907142	37,509177056304	-01°53'46.37	37°30'
Abejuela, Rambla de la	Corriente fluvial	1	46	46262	379190	123000	30	0638-2	-0,9028553170738	39,9374839997029	-00°54'10.27	39°56'
Abejuela, Rambla de la	Corriente fluvial	1	44	44002	378800	742000	30	0638-2	-0,907142388290964	39,9465700679236	-00°54'25.71	39°56'
Abelá, A	Población	0	27	27025	521500	336500	29	0003-3	-7,49293473672413	43,670782491816	-07°29'34.56	43°40'
Abeladaira	Población	0	27	27039	522000	774030	29	0073-1	-7,5006276897665	43,1084031553505	-07°30'02.38	43°06'
Abeladaira	Lugar/Paraje	0	27	27039	521550	774290	29	0073-1	-7,50615694547912	43,1100057447368	-07°30'22.15	43°06'
Abelaedo	Lugar/Paraje	0	27	27005	548100	321300	29	0010-3	-7,16730269277051	43,5291689758955	-07°10'02.28	43°31'
Abelaedo, Chao do	LLanura/Raso	0	27	27013	525500	330200	29	0009-1	-7,4448008623332	43,613414717808	-07°26'41.28	43°36'
Abelaedo, Monte do	Lugar/Paraje	0	27	27064	509000	341000	29	0002-4	-7,647027151208	43,7132267373192	-07°38'49.29	43°42'
Abelaedo, O	Población	0	27	27064	508500	340500	29	0002-4	-7,65333254552948	43,708799463333	-07°39'11.99	43°42'
Abelaedo, Rego do	Corriente fluvial	0	27	27064	509000	340540	29	0002-4	-7,64712030731384	43,7090862344245	-07°38'49.63	43°42'
NOMBRE								GML/GEOMETRY				
Abengibre								(HUGECLOB)				
Alatoz								(HUGECLOB)				
Albatana												
Balsa de Ves								 <gml:Polygon srsName="#SDO:8223" xmlns:gml="http://www.opengis.net/gml">				
Ralletern, FI								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,48374108,39,23127677,0-1,4848490765,39,22531695,0-1,48544493,39,2231538,0-1,48588725,39,22212319,0-1,48680465,39,22141415,0-1,486050				
Albreca								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,48421128,39,21319056,0-1,48390069,39,21064575,0-1,48429166,39,2045424,0-1,48592926,39,20406290,0-1,49250				
Alcadizo								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,49590016,39,20836339,0-1,49005691,39,20405732,0-1,50256676,39,20446292,0-1,50338941,39,20465364,0-1,5040				
Alcalá del Júcar								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,51378498,39,2047147,0-1,51398161,39,20472622,0-1,5171434,39,20471246,0-1,51894734,39,20373528,0-1,51962				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,52344981,39,20108038,0-1,52693907,39,19901681,0-1,52849033,39,19815278,0-1,5315167,39,19819073,0-1,5320				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,5329951,39,19477493,0-1,53388695,39,19603246,0-1,53537021,39,19852841,0-1,5367317,39,19844615,0-1,5369				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,53953498,39,19602121,0-1,54099994,39,19629185,0-1,54110394,39,19630216,0-1,54231647,39,19646151,0-1,5441				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,54597924,39,19635592,0-1,55131402,39,1964386,0-1,55382203,39,19667799,0-1,55798564,39,19690882,0-1,5598				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,56633376,39,19750743,0-1,5703604,39,19766503,0-1,57231502,39,19777111,0-1,5728711,39,19790204,0-1,5736				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,57633378,39,1982863,0-1,57807687,39,20087703,0-1,57814542,39,20092292,0-1,57871557,39,20132037,0-1,5791				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,5805024,39,20233924,0-1,58088715,39,2027543,0-1,58107794,39,20313014,0-1,58122865,39,20365457,0-1,5814				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,58195139,39,20563864,0-1,58191475,39,20581637,0-1,58194513,39,20630299,0-1,58256235,39,20567667,0-1,5842				
								<gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="" ts="">-1,58516216,39,21675162,0-1,58549894,39,21657712,0-1,58739734,39,2174126,0-1,5877698,39,2174176,0-1,58924				

Ontology Engineer IngGroup

1. Identification and selection of the data sources

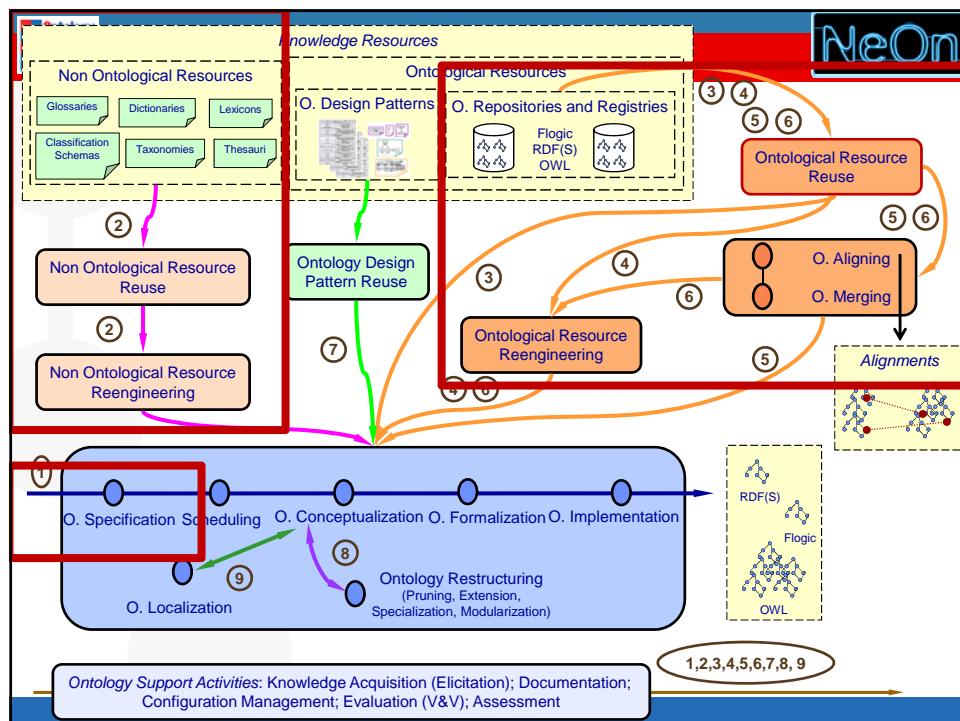
Province	Year							Industry Production Index	
	2009	2008	2007	2006	2005	2004	2003		
Total Nacional	3355830	342239	3338657	3174393	3064129	2942583	2813159		
Alava	21988	22318	20676	20349	19838	19779	19638		
Albacete	27380	27647	27068	25531	24685	23550	22547		
Alicante	136239	142307	140145	133016	123333	113852	111805		
Almería	43601	45130	43970	40871	38768	36260	33947		
Asturias	71863	73124	72276	70116	69178	67039	65082		
Ávila	11455	11708	11434	10940	10611	10319	10211		
Badajoz	40674	41358	40168	38645	37052	34972	34866		
Illes Balears	91826	93335	91254	88027	87024	85425	75951		
Barcelona	467385	477942	469432	444410	436294	417425	397693		
Burgos	25567	25891	25372	24504	23733	22882	22159		
Cáceres	26307	26494	26064	25039	24465	20598	23440		
Cádiz	62817	64505	63338	61691	58868	57138	54462		
Cantabria	39611	40333	39560	37690	36561	35649	34017		
Castellón	42122	43855	42476	39749	37685	37214	34213		
Ciudad Real	32046	33011	31881	30446	29521	29011	26778		
Córdoba	48979	50057	49302	47155	45405	43394	41964		
Coruña, A	83748	84220	82873	79170	77023	74809	71748		
Cuenca	14747	14928	14741	13822	13336	12829	12546		
Girona	58404	51467	50108	47169	46827	45145	52482		
Granada	60016	62269	61055	57223	54341	50508	49662		
Guadalajara	13507	13735	12874	11825	10438	10120	9422		
Guipúzcoa	62034	63569	59546	58486	57193	56498	55983		
Huelva	26783	27463	27063	25487	24777	24270	22547		
Huesca	18837	17109	16694	16025	15390	15078	14283		
Jaén	36557	37368	36962	35383	34675	33157	32444		
León	33564	34012	33563	32359	31664	30992	30256		
Lleida	36920	37638	36065	33956	32739	31515	29605		
Lugo	24861	25035	24609	23780	23122	22479	22396		
Madrid	511804	519307	503000	478202	456175	436074	407655		
Málaga	113362	116683	114547	108713	102382	96587	88257		
Murcia	95636	100075	97374	90698	85110	82484	75973		
Navarra	43282	43847	43142	41083	40730	39679	38936		
Ourense	23304	23711	23520	22843	22452	22118	21560		
Palencia	10954	11111	11060	10594	10575	10399	10297		





Asunción Gómez Pérez

43

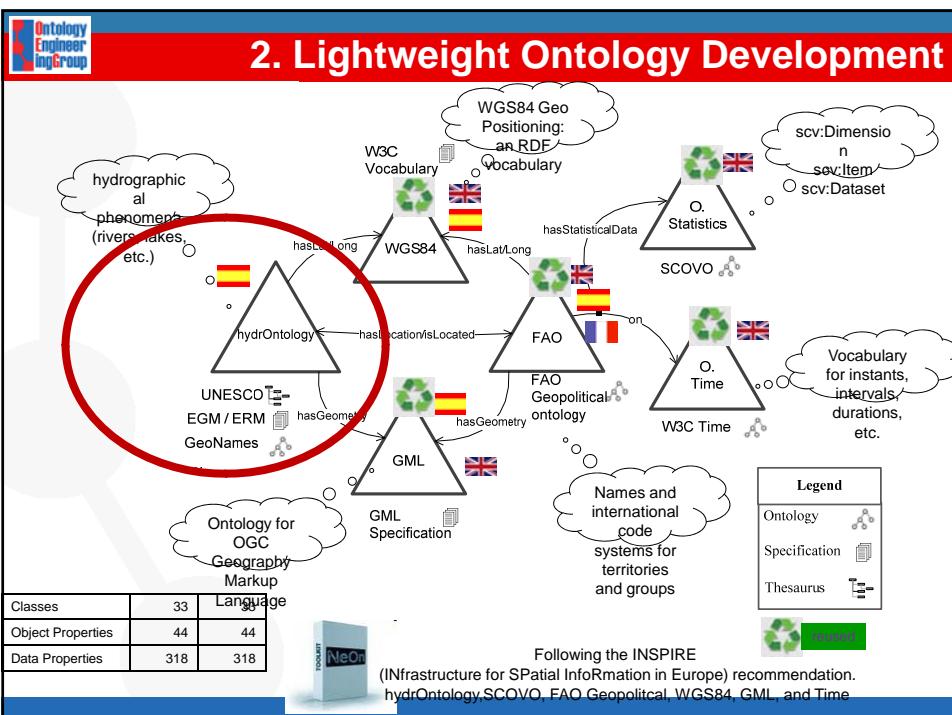


Vocabulary development: Specification

- Content requirements: Identify the set of questions that the ontology should answer
 - Which one are the provinces in Spain?
 - Where are the beaches?
 - Where are the reservoirs?
 - Identify the production index in Madrid
 - Which one is the city with higher production index?
 - Give me Madrid latitude and altitude
 -
- Non-content requirements
 - The ontology must be in the four official Spanish languages

Asunción Gómez Pérez

45



Contexto – Directiva INSPIRE

- **Objetivos:**

- INSPIRE intenta conseguir fuentes armonizadas de Información Geográfica para dar soporte a la formulación, implementación y evaluación de políticas comunitarias (Medio Ambiente, etc).
- Fuentes de Información Geográfica: Bases de datos de los Estados Miembros (UE) a nivel local, regional, nacional e internacional.



European Environment Agency

Luis Manuel Vilches Blázquez

INSPIRE - Anexos

Datos de Referencia

(Armonizados y Compartidos)

Consistencia
geométrica,
topológica,
semántica y lógica

Anexo I (INSPIRE)

Sistema de Ref. de Coordenadas
Cuadrículas geográficas
Nombres Geográficos
Unidades Administrativas
Redes de Transporte
Hidrografía
Lugares protegidos

Modelos de Elevación

Direcciones y Áreas Postales

Parcelas Catastrales

Ocupación del suelo

Ortofotos

Anexo II (INSPIRE)

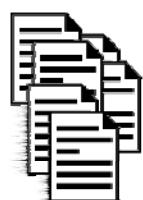


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- Existencia de gran diversidad de problemas (múltiples fuentes, heterogeneidad de contenido y estructuración, ambigüedad del lenguaje natural, etc.) en la información geográfica.
- Necesidad de un modelo compartido para solventar los **problemas de armonización y estructuración** de la información hidrográfica.
- *hydrOntology* es una ontología global de dominio desarrollada conforme a un acercamiento *top-down*.
 - Recubrir la mayoría de los fenómenos representables cartográficamente asociados al dominio hidrográfico.
 - Servir como marco de armonización entre los diferentes productores de información geo-espacial en el entorno nacional e internacional.
 - Comenzar con los pasos necesarios para obtener una **mejor organización y gestión** de la información geográfica (hidrográfica).

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Fuentes



Catálogos de fenómenos



BCN25
EGM & ERM



CC.AA.



Tesauros y Bibliografía



GEMET



FTT ADL



Getty



WFD



Diccionarios y Monografías

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Criterios de estructuración

- Directiva Marco del Agua
 - Propuesta por Parlamento y Consejo de la UE
 - Lista de definiciones de fenómenos hidrográficos
- Proyecto SDIGER
 - Proyecto piloto INSPIRE
 - Dos cuencas, países e idiomas
- Criterios semánticos
 - Diccionarios geográficos
 - Diccionario de la Real Academia de la Lengua
 - WordNet
 - Wikipedia
 - Bibliografía de varias áreas de conocimiento
- Herencia: Estructuración actual de catálogos
- Asesoramiento expertos en toponimia del IGN

Luis Manuel Vilches Blázquez

Nivel su

Nivel inferior

Luis Manuel Vilches Blázquez

Implementación & Formalización

protégé + Pellet

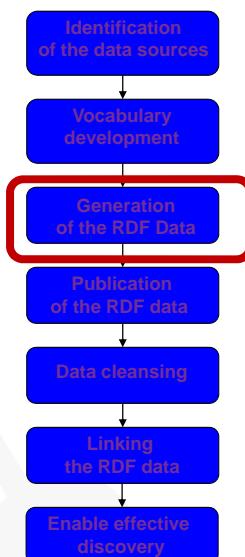
+ 150 conceptos (*classes*) , 47 tipos de relaciones (*properties*)
y 64 tipos de atributos (*attribute types*)

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2. Vocabulary development: HydrOntology

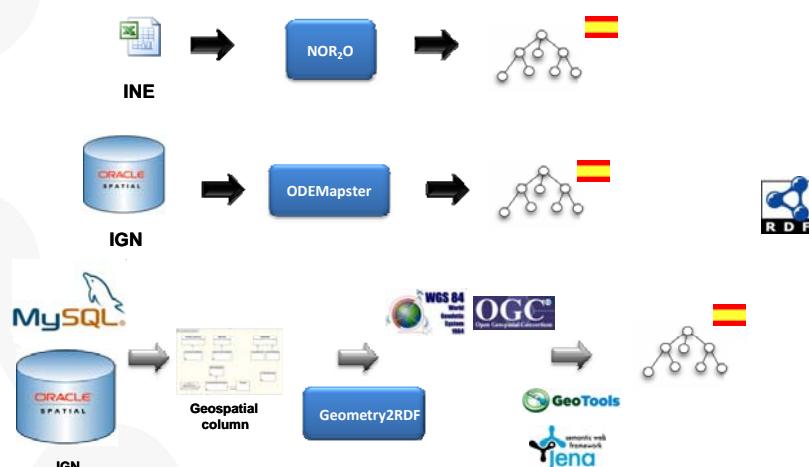
http://geo.linkeddata.es/ontology/Surgencia	http://geo.linkeddata.es/ontology/Lucio
http://geo.linkeddata.es/ontology/Marisma	http://geo.linkeddata.es/ontology/Rambla
http://geo.linkeddata.es/ontology/Desembocadura	http://geo.linkeddata.es/ontology/Esterero
http://geo.linkeddata.es/ontology/Albufera	http://geo.linkeddata.es/ontology/Regato
http://geo.linkeddata.es/ontology/Brazo	http://geo.linkeddata.es/ontology/Balsa
http://geo.linkeddata.es/ontology/Oio	http://geo.linkeddata.es/ontology/Charca
http://geo.linkeddata.es/ontology/Caz	http://geo.linkeddata.es/ontology/Azarbe
http://geo.linkeddata.es/ontology/Chorrera	http://geo.linkeddata.es/ontology/Garganta
http://geo.linkeddata.es/ontology/Lavajo	http://geo.linkeddata.es/ontology/Madre
http://geo.linkeddata.es/ontology/Reguero	http://geo.linkeddata.es/ontology/Estanque
http://geo.linkeddata.es/ontology/Ribera	http://geo.linkeddata.es/ontology/R%C3%A9tulo
http://geo.linkeddata.es/ontology/Embalse	http://geo.linkeddata.es/ontology/Fa%C3%ADa
http://geo.linkeddata.es/ontology/Laguna	http://geo.linkeddata.es/ontology/Ca%C3%B3n
http://geo.linkeddata.es/ontology/Nava	http://geo.linkeddata.es/ontology/Ca%C3%B3nB1
http://geo.linkeddata.es/ontology/Arroyo	http://geo.linkeddata.es/ontology/Ca%C3%B3nB1da
http://geo.linkeddata.es/ontology/Canal	http://geo.linkeddata.es/ontology/Oc%C3%A1n
http://geo.linkeddata.es/ontology/Acequia	http://geo.linkeddata.es/ontology/Captaci%C3%B3n
http://geo.linkeddata.es/ontology/Rivera	http://geo.linkeddata.es/ontology/A%C3%81rea
http://geo.linkeddata.es/ontology/Torrente	http://geo.linkeddata.es/ontology/Organizaci%C3%B3n
http://geo.linkeddata.es/ontology/Colector	http://geo.linkeddata.es/ontology/Humedal

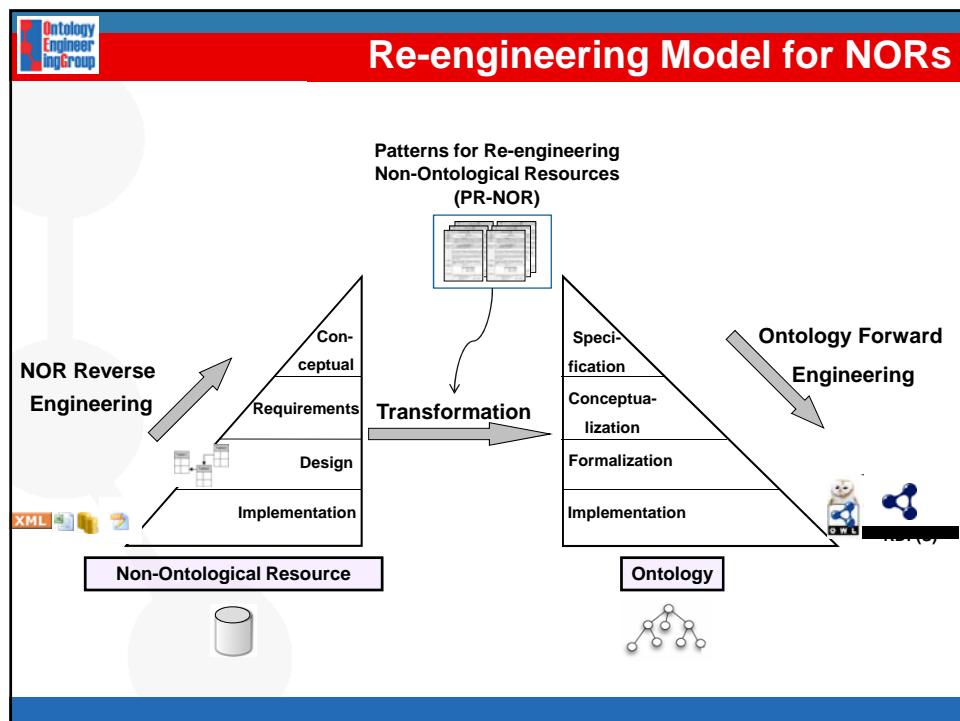
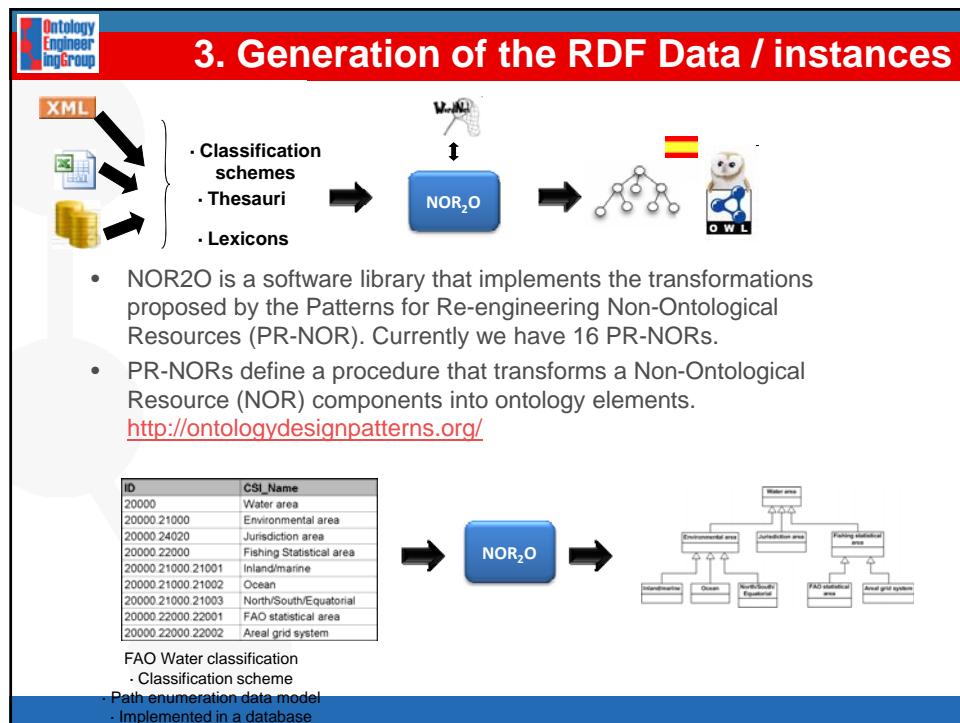
3. Generation of RDF



- From the Data sources
 - Geographic information (Databases)
 - Statistic information (.xsl)
 - Geospatial information
- Different technologies for RDF generation
 - Reengineering patterns
 - R2O and ODEMapster
 - Annotation tools
 - Geometry generation

3. Generation of the RDF Data





Technological support

PR-NOR library at the ODP Portal

submissions:congress:ingdpd discussion view source history

Submissions:ReengineeringODPs

Below you find the currently proposed Re-engineering OPs (RPs).

New proposals of RPs are very welcome. Please post a new proposal if you want to contribute.

Proposed Re-engineering ODPs

submissions:pattern for re-engineering a term-based thesaurus, which follows the recordbased data model, into an ontology schema discussion view form history

Pattern for re-eng schema, which fol data model, into a

Pattern for re-eng schema, which fol data model, into an on

Pattern for re-eng schema, which fol enumeration data schema

Pattern for re-eng schema, which fol data model, into an on

Pattern for re-eng schema, which fol data model, into an on

If you are a member of quality committee please visit the evaluation section.

If you are author of this proposal or you want to contribute to this pattern's review, you can:

- ask for a review [post your open review](#)
- specify if this revision takes in account any of the review(s) [Add a new scenario for Pattern for re-engineering a term-based thesaurus, which follows the recordbased data model, into an ontology schema](#)

In general, it could be useful to visit the [evaluation section](#) to have informations about the evaluation process of this proposal

Current revision ID: 8956

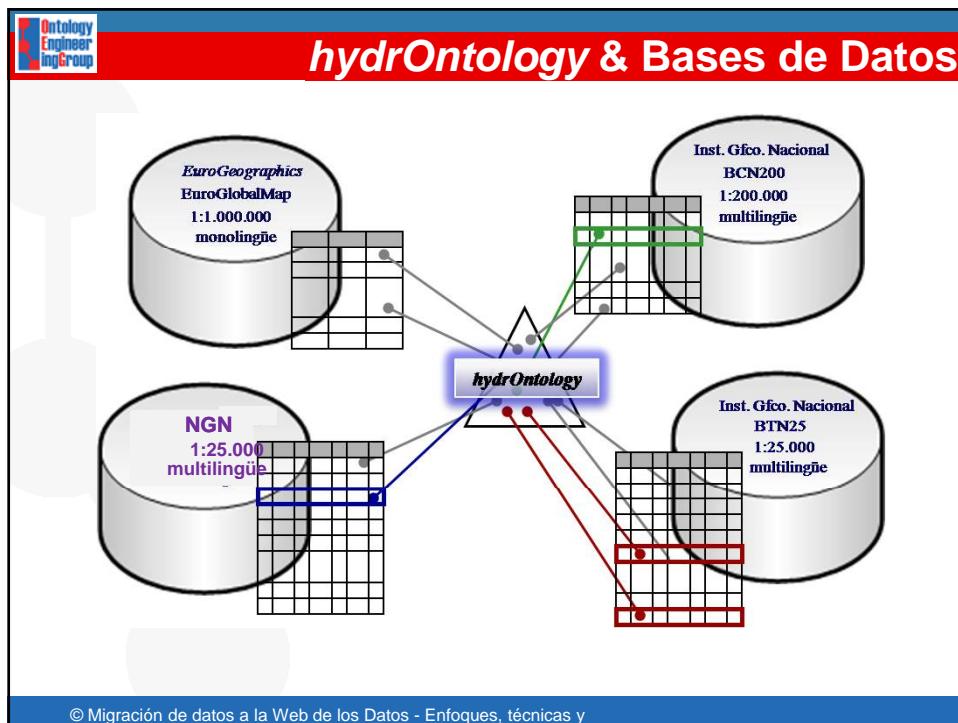
General information

Name	Pattern for re-engineering a term-based thesaurus, which follows the recordbased data model, into an ontology schema
Problem	Re-engineering a term-based thesaurus which follows the record-based model to design an ontology schema.

Non-Ontological Resource

Description	A non-ontological resource holds a term-based thesaurus which follows the record-based model. A thesaurus represents the knowledge of a domain with a collection of terms and a limited set of relations between them. The record-based data model is a denormalized structure, uses a record for every term with the information about the term, such as synonyms, broader, narrower and
--------------------	--

<http://ontologydesignpatterns.org/wiki/Submissions:ReengineeringODPs>



3. Generation of the RDF Data – R2O & ODEMapster

- Creation of the R2O Mappings

3. Generation of the RDF Data – Geometry2RDF

NOMBRE	GMLGEOMETRY
Abengibre	(HUGELOB)
Alatoc	(HUGELOB)
Albatana	(HUGELOB)
Balsa de Ves	(HUGELOB)
Ballesteros, El	(HUGELOB)
Alborea	(HUGELOB)
Alcadoco	(HUGELOB)
Alcalá del Júcar	(HUGELOB)

Oracle STO UTIL package

```
SELECT TO_CHAR(SDO_UTIL.TO_GML311GEOMETRY(geometry))
AS Gml311Geometry
FROM "BCN200"."BCN200_0301L_RIO" c
WHERE c.Etiqueta='Arroyo'
```

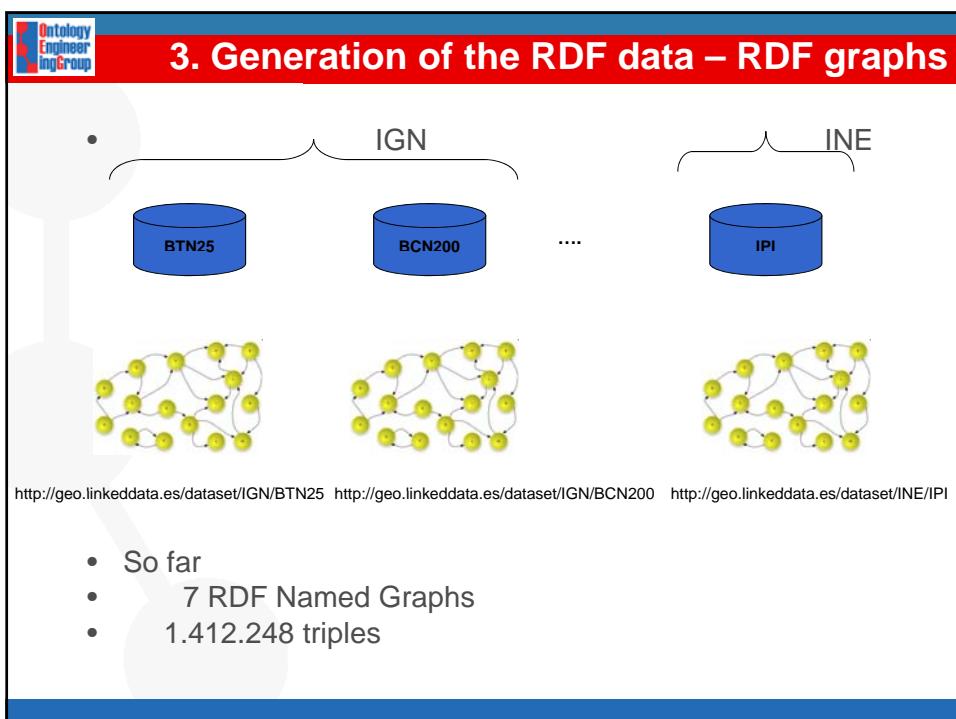
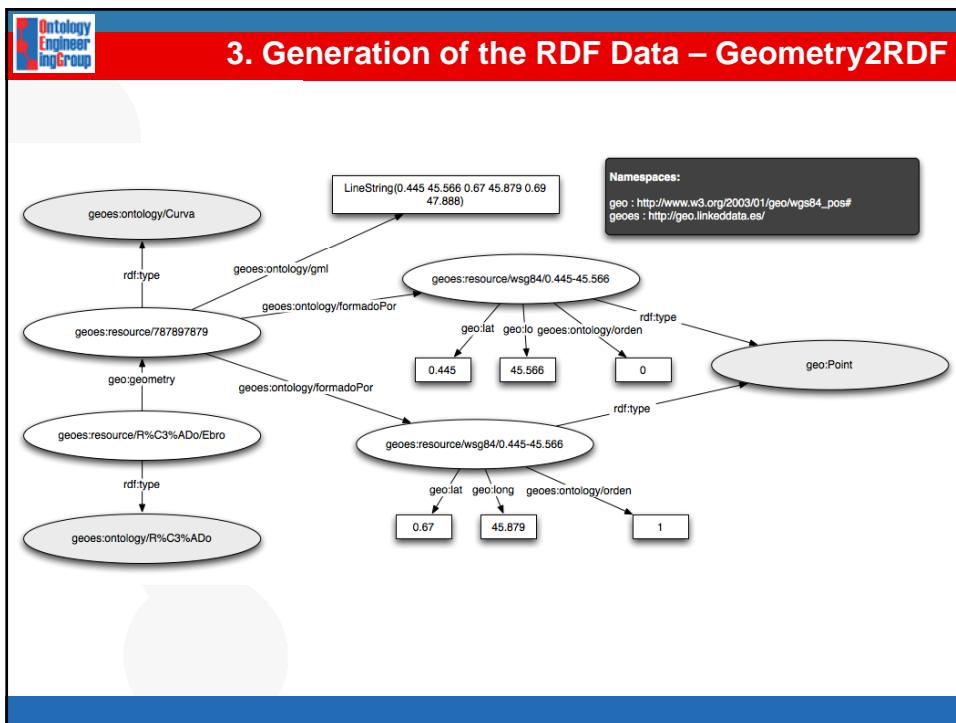


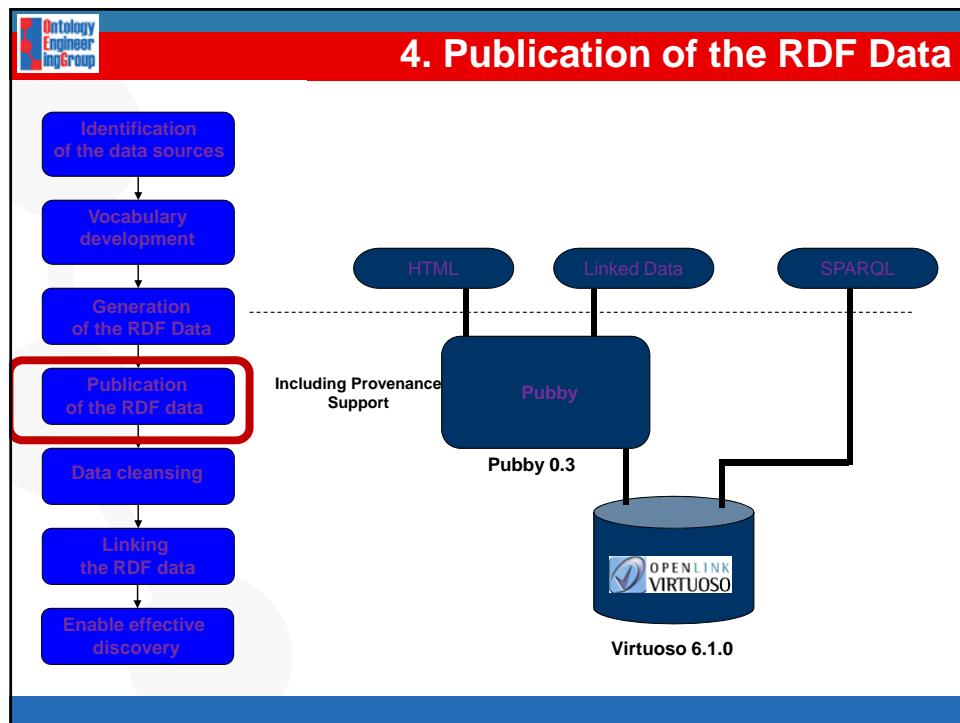
```
<gml:Polygon srsName="SDO:8223" xmlns:gml="http://www.opengis.net/gml">
  <gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="," ts=" ">-1.48374108,39.23127677,-0.1,48404
  -1.48460765,39.22531695,0,-1.48544493,39.2231538,0,-1.4858725,39.22212319,0,-1.48608465,39.22141415,0,-1.4860584,
  -1.48421128,39.2131905,0,-1.48390698,39.21064575,0,-1.48429166,39.2094524,0,-1.48529268,39.20490629,0,-1.4925061
  -1.49590016,39.20383639,0,-1.49905681,39.20405732,0,-1.50256676,39.2046292,0,-1.50338941,39.20453654,0,-1.504833
  -1.51378498,39.2047147,0,1.51398161,39.20472622,0,1.5171434,39.20471246,0,1.51894734,39.20373528,0,1.5196271
  -1.5234981,39.20108039,0,1.52699007,39.19901681,0,1.5284903,39.19815278,0,-1.53151887,39.19619073,0,-1.5320861
  -1.5329951,39.19474973,0,-1.53398595,39.19503246,0,-1.53537021,39.19528414,0,-1.53607317,39.1954615,0,-1.536914
  -1.53534998,39.19602121,0,-1.54099994,39.19629185,0,-1.54110394,39.19630216,0,-1.5423164,39.1964615,0,-1.54461
  -1.54957924,39.19633592,0,-1.55131402,39.1964366,0,-1.55382202,39.19668799,0,-1.55798564,39.19690882,0,-1.559809
  -1.56633376,39.19750743,0,-1.5703604,39.19765603,0,-1.57231502,39.19777011,0,-1.57278711,39.19790204,0,-1.573636
  -1.57633787,39.19982863,0,-1.57807687,39.20087703,0,-1.57814542,39.20092292,0,-1.57871557,39.20136237,0,-1.57915
  -1.5805024,39.20233924,0,-1.58068715,39.20278543,0,-1.58107708,39.20313014,0,-1.58122865,39.20365457,0,-1.581447
  -1.5819531,39.20563664,0,-1.58191475,39.20581637,0,-1.58194513,39.20603299,0,-1.5828652,39.20756767,0,-1.584270
```

The screenshot shows the GeoTools Jena interface. At the top, there's a navigation bar with links like 'Home', 'GeoTools', 'Jena', 'GeoServer', 'GeoNetwork', 'GeoNetwork', 'GeoNetwork', and 'GeoNetwork'. Below the navigation bar, the main title is '3. Generation of the RDF Data – Geometry2RDF'. The interface has several sections:

- Input:** A 'Geometry' section containing a large black arrow pointing downwards.
- Output:** A 'RDF' section showing a table of generated RDF triples. The first few rows are as follows:

URI	Predicate	Object
<http://geo.linkeddata.es/resource/wgs84/39.158523176194414>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>	<http://www.w3.org/ns/rdf#Resource>
<http://geo.linkeddata.es/resource/wgs84/39.158523176194414>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#subject>	<http://www.w3.org/ns/rdf#Resource>
<http://geo.linkeddata.es/resource/wgs84/39.158523176194414>	<http://www.w3.org/1999/02/22-rdf-syntax-ns#object>	<http://www.w3.org/ns/rdf#Resource>
- GeoTools Jena Version:** Shows 'GeoTools 6.13.0', 'Jena 3.13.0', and 'Apache Jena 3.13.0'.
- Help:** Includes links to 'GeoTools API', 'GeoTools Examples', 'GeoTools Tutorials', 'GeoTools Documentation', and 'GeoTools Wiki'.





4. Publication of the RDF Data

The screenshot shows the GEOLINKEDDATA ES interface. On the left, there is a linked data view for the entity 'Granada'. The properties listed include:

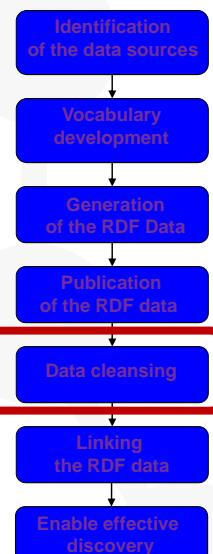
- Property**: [http://geodata.es/resource/ProvinciaGranada](#)
- Value**: [http://geodata.es/resource/CapitalGranada](#), [http://geodata.es/resource/ComunidadAutonomaAndalucia](#), [http://geodata.es/resource/ID_17920200003_3895439519E1](#), [Granada](#) (rdfs:label)
- Metadata**: [http://geodata.es/resource/ProvinciaGranada](#)
- Value**: [http://www.w3.org/2004/02/skos.rdf#Graph](#), [http://geodata.es/resource/ProvinciaGranada](#)
- dc:title**: [http://geodata.es/resource/ProvinciaGranada](#)
- dc:publisher**: [http://geodata.es/resource/ProvinciaGranada](#)
- dc:rights**: La información geográfica digital comprendida en el Equipoamiento Geográfico de Referencia Nacional (artículo 1.1 de la Orden FOM/96/2000) así como los Metadatos de los datos geográficos y servicios del IGN-CNDI, no requieren la aceptación de licencia y su uso será, en cualquier caso, libre y gratuito, siempre que se mencione al Instituto Geográfico Nacional como proveedor de los datos.
- dc:spatial**: [http://geodata.es/resource/EspacioGeografico](#)
- processedBy**: [Anon_O_Geo](#)

On the right, there is a map of Spain with numerous red location markers. A sidebar on the left shows a legend for 'Feature' types: 'boundary', 'capital', and 'iso'.

4. Publication of the RDF Data - License

- License for GeoLinkedData
 - Creative Commons Attribution-ShareAlike 3.0
 - GNU Free Documentation License
- Each dataset will have its own specific license, IGN, INE, etc.

5. Data cleansing

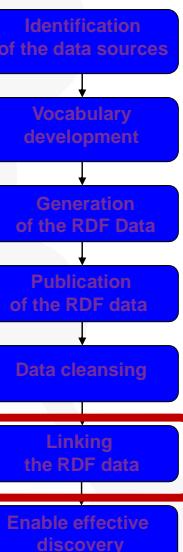


- Lack of documentation of the IGN datasets
- Broken links: Spain, IGN resources
- Lack of documentation of the ontology
- Missing english and spanish labels
- Building a spanish ontology and importing some concepts of other ontology (in English):
 - Importing the English ontology. Add annotations like a Spanish label to them.
 - Importing the English ontology, creating new concepts and properties with a Spanish name and map those to the English equivalents.
 - Re-declaring the terms of the English ontology that we need (using the same URI as in the English ontology), and adding a Spanish label.
 - Creating your own class and properties that model the same things as the English ontology.

5. Data cleansing

- URIs in Spanish
 - http://geo.linkeddata.es/ontology/Río
 - RDF allows UTF-8 characters for URIs
 - But, Linked Data URIs has to be URLs as well
 - So, non ASCII-US characters have to be %code
 - http://geo.linkeddata.es/ontology/R%C3%A9o

6. Linking of the RDF Data



- Silk - A Link Discovery Framework for the Web of Data
 - First set of links: Provinces of Spain
 - 86% accuracy
- 
- A diagram illustrating the linking of three datasets: DBpedia (cyan circle), GeoLinkedData (blue circle), and Geonames (yellow circle). They are interconnected by double-headed arrows, indicating bidirectional links between them.

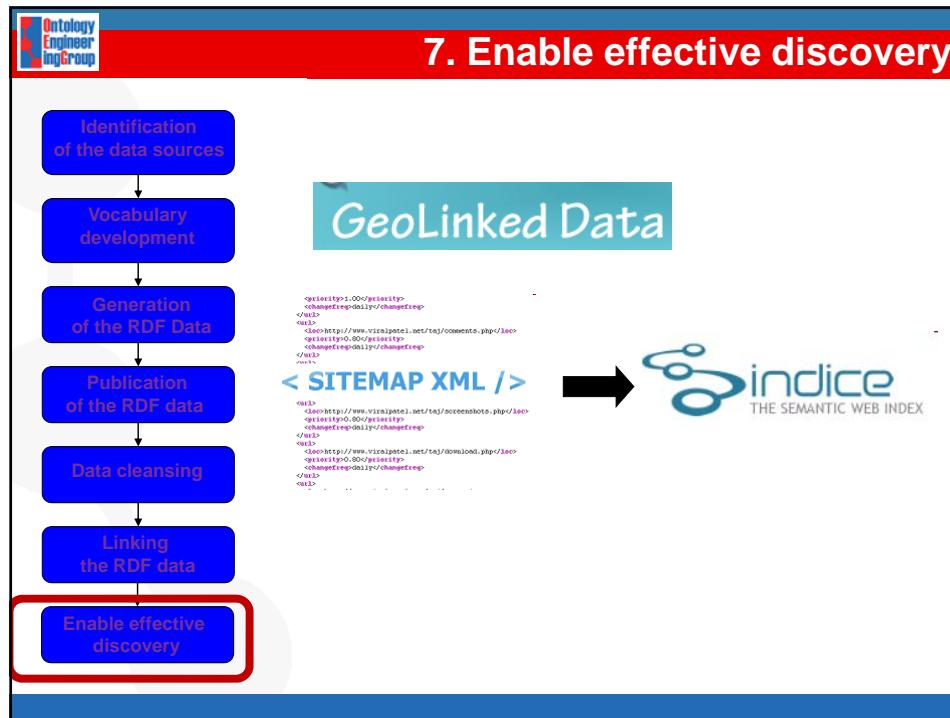
6. Linking of the RDF Data

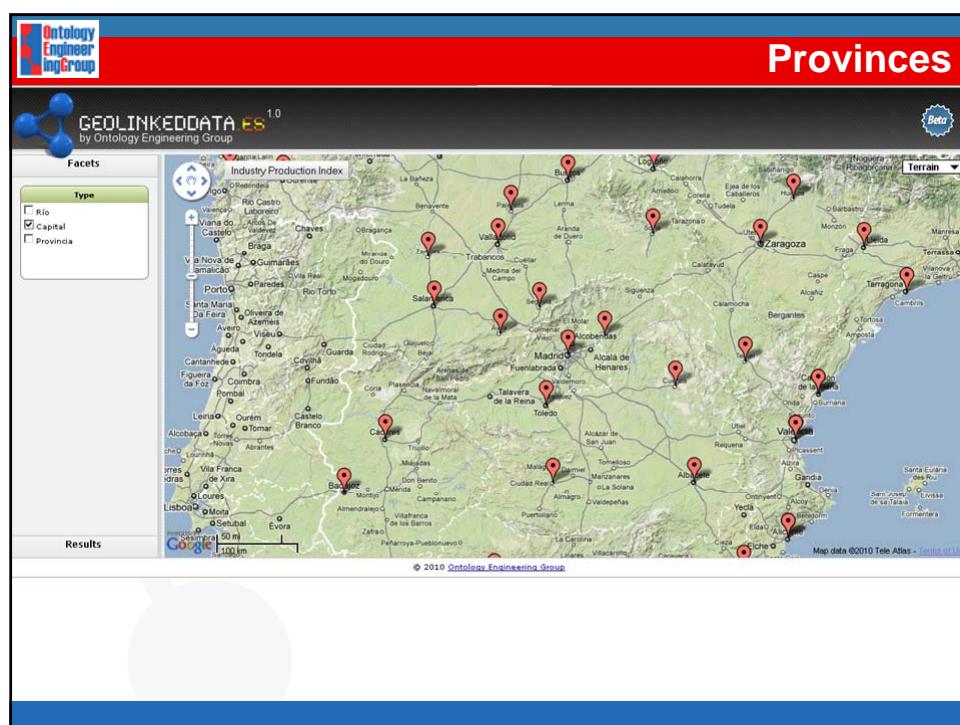
- <http://geo.linkeddata.es/page/Provincia/Granada>

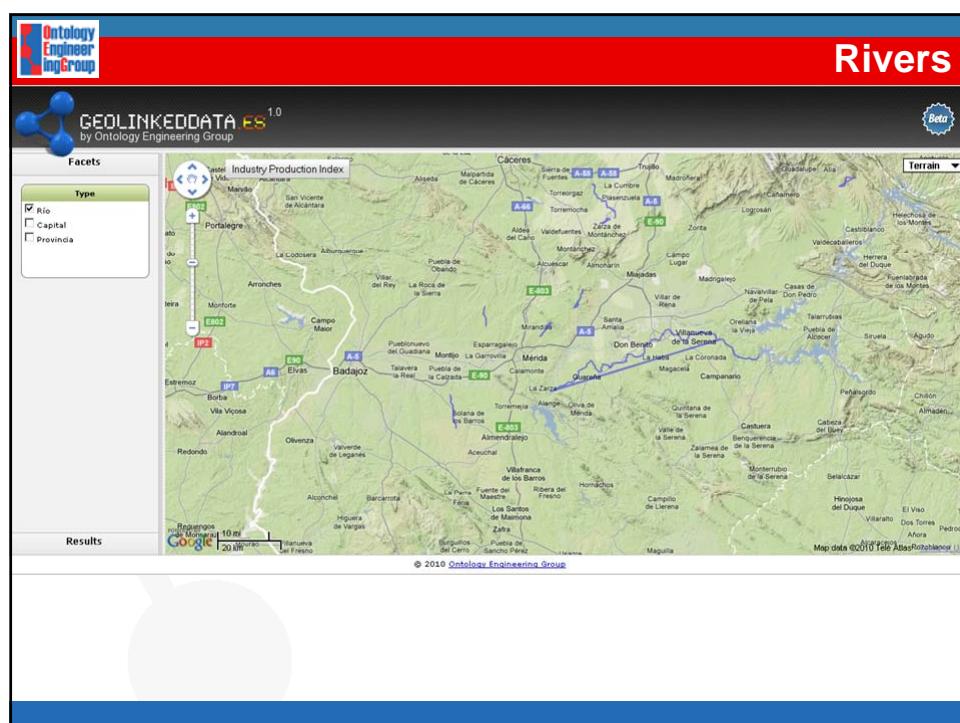
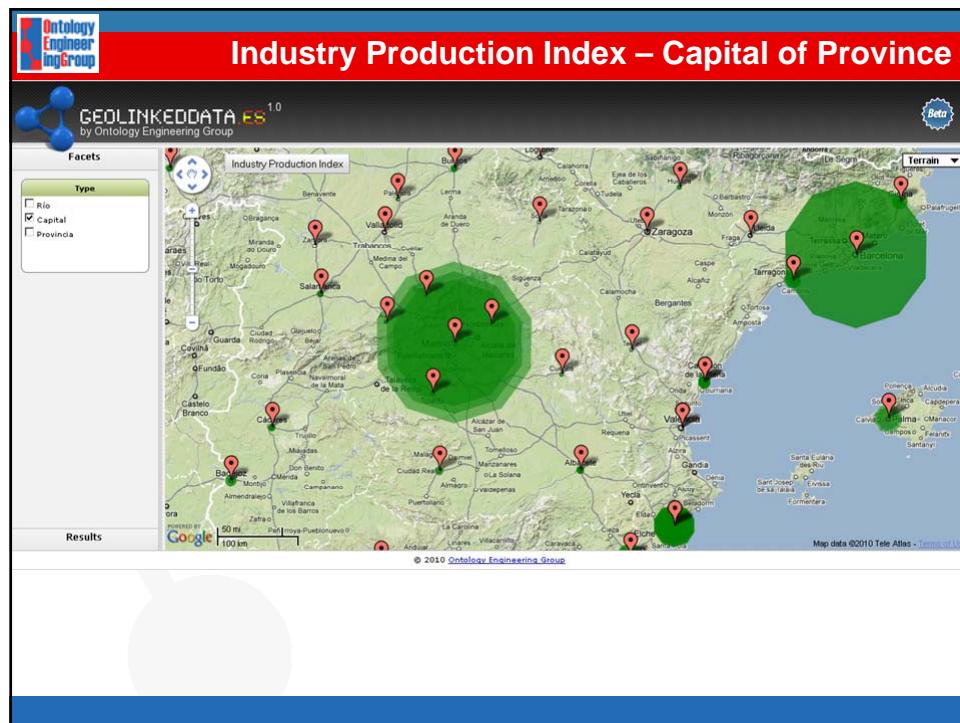
	<ul style="list-style-type: none"> ■ <http://geo.linkeddata.es/resource/Municipio/0g%C3%ADjares> ■ <http://geo.linkeddata.es/resource/Municipio/Otura> ■ <http://geo.linkeddata.es/resource/Municipio/Padul> ■ <http://geo.linkeddata.es/resource/Municipio/Peligros> ■ <http://geo.linkeddata.es/resource/Municipio/Pinos%20Puentecillas> ■ <http://geo.linkeddata.es/resource/Municipio/Puebla%20de%20Don%20Fadrique> ■ <http://geo.linkeddata.es/resource/Municipio/Pulianas> ■ <http://geo.linkeddata.es/resource/Municipio/Purullena> ■ <http://geo.linkeddata.es/resource/Municipio/Salar> ■ <http://geo.linkeddata.es/resource/Municipio/Salobre%C3%B1a> ■ <http://geo.linkeddata.es/resource/Municipio/Santa%20Fe> ■ <http://geo.linkeddata.es/resource/Municipio/Ug%C3%A9z%C3%ADjar> ■ <http://geo.linkeddata.es/resource/Municipio/V%C3%A9lez%20de%20Benaudalla> ■ <http://geo.linkeddata.es/resource/Municipio/Villanueva%20Mes%C3%ADa> ■ <http://geo.linkeddata.es/resource/Municipio/Z%C3%BAjar> ■ <http://geo.linkeddata.es/resource/Municipio/Zubia%2C20La>
geo:geometry	<ul style="list-style-type: none"> ■ <http://geo.linkeddata.es/resource/wgs84/37_1666666666667> -3.58333333333333> ■ <http://geo.linkeddata.es/resource/wgs84/37_1793252820524> -3.59704135514161>
rdfs:label	<ul style="list-style-type: none"> ■ Granada (es) ■ Granada (xsd:string)
owl:sameAs	<ul style="list-style-type: none"> ■ <http://dbpedia.org/resource/Province_of_Granada> ■ <http://sws.geonames.org/2517115/>
geos:tieneCapital	<ul style="list-style-type: none"> ■ <http://geo.linkeddata.es/resource/Municipio/Granada>
rdf:type	<ul style="list-style-type: none"> ■ geos:Provincia

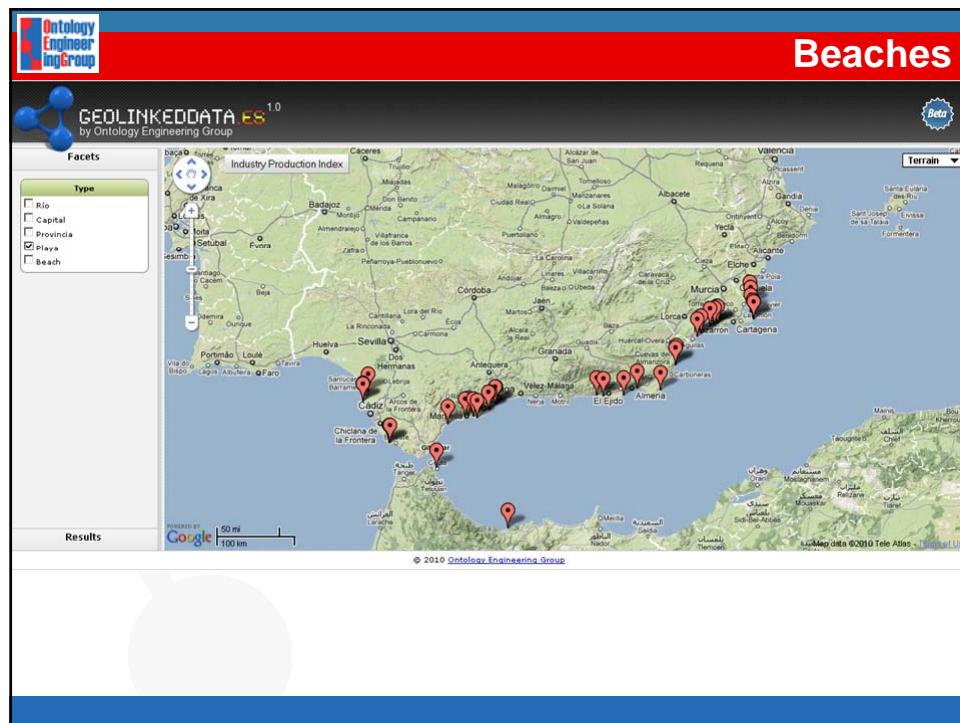
Asunción Gómez Pérez

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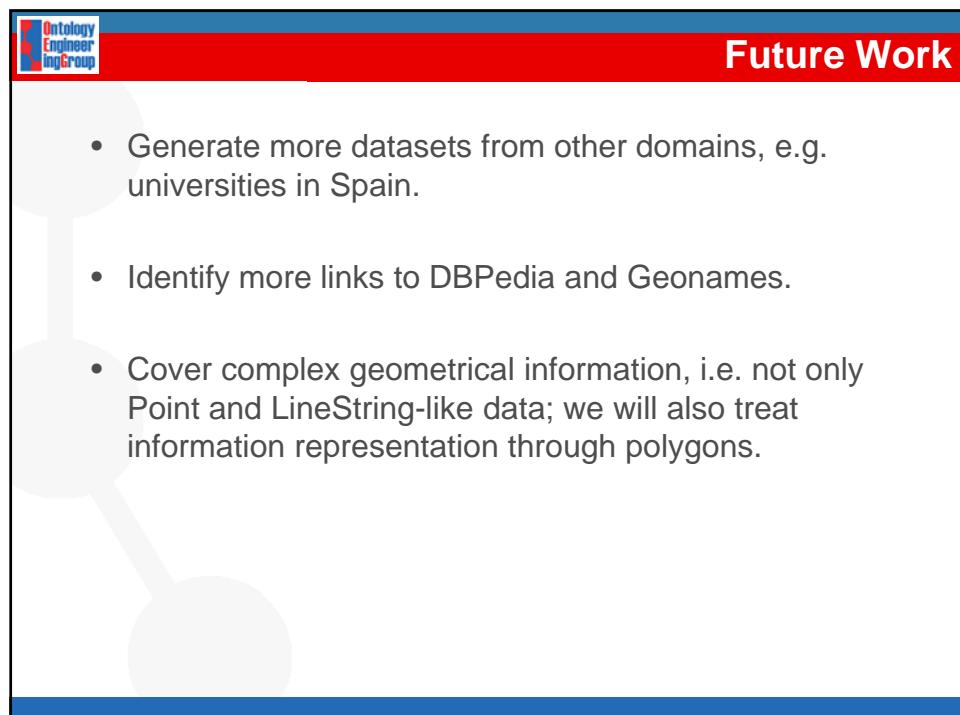








Beaches



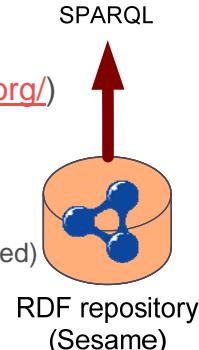
Future Work

- Generate more datasets from other domains, e.g. universities in Spain.
- Identify more links to DBpedia and Geonames.
- Cover complex geometrical information, i.e. not only Point and LineString-like data; we will also treat information representation through polygons.

- Introduction to Linked Data
- Linked Data publication
 - Methodological guidelines for Linked Data publication
 - RDB2RDF tools
 - Technical aspects of Linked Data publication
- [Linked Data consumption]

Using an RDF repository

- It allows storing and accessing RDF data
- For example, SESAME (<http://www.openrdf.org/>)
- Download it from
<http://www.openrdf.org/download.jsp>
 - openrdf-sesame-2.3.0-sdk.zip
 - Deploy the .war in Tomcat (JDK and Tomcat needed)
- Create a repository at
 - <http://localhost:8080/openrdf-sesame>
- Check:
 - <http://localhost:8080/openrdf-sesame/repositories/XXXX>
 - <http://localhost:8080/openrdf-sesame/repositories/XXX/statements>



RDF repository
(Sesame)

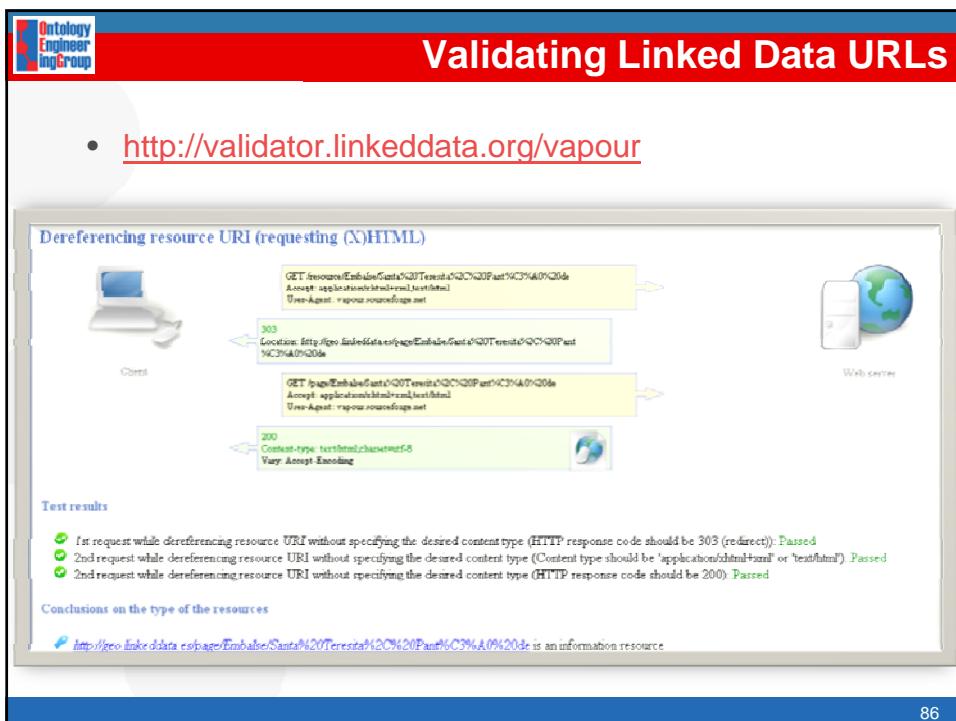
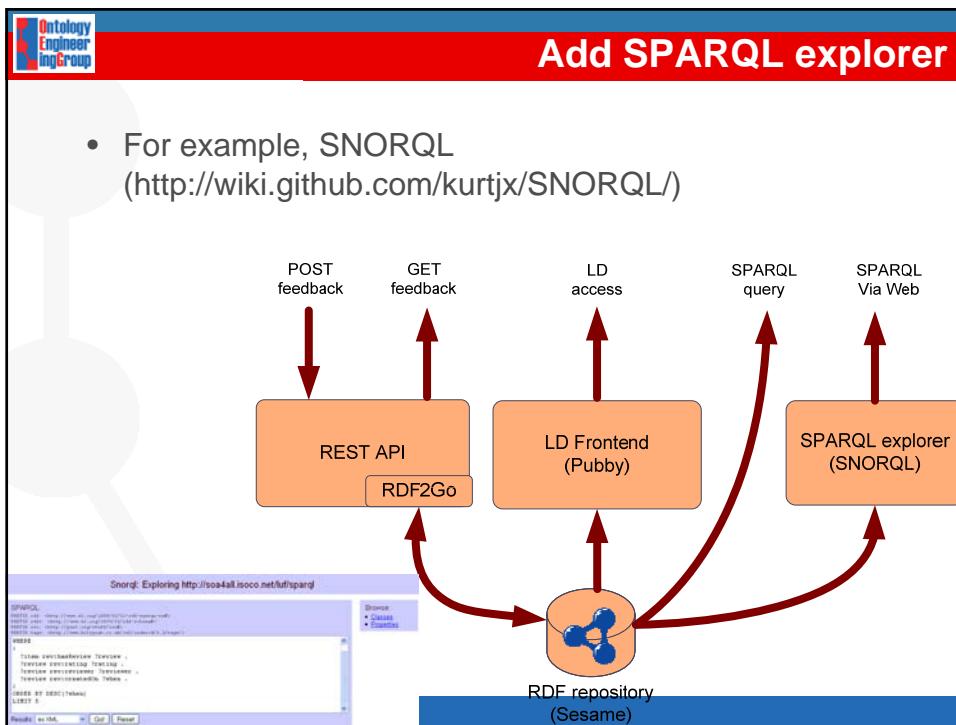


Linked Data frontend

- To expose data as Linked Data
 - Including content negotiation, etc.
- For example, Pubby
 - <http://www4.wiwiss.fu-berlin.de/pubby/>
- Installation
 - Use pubby-0.3.zip
 - Deploy the webapp folder (and rename) in Tomcat
 - Modify config.n3
 - Restart tomcat
 - Check: <http://localhost:8080/XXX/>

REST API

- For example, RDF2Go
 - Java abstraction over RDF repositories
 - <http://rdf2go.semweb4j.org/>



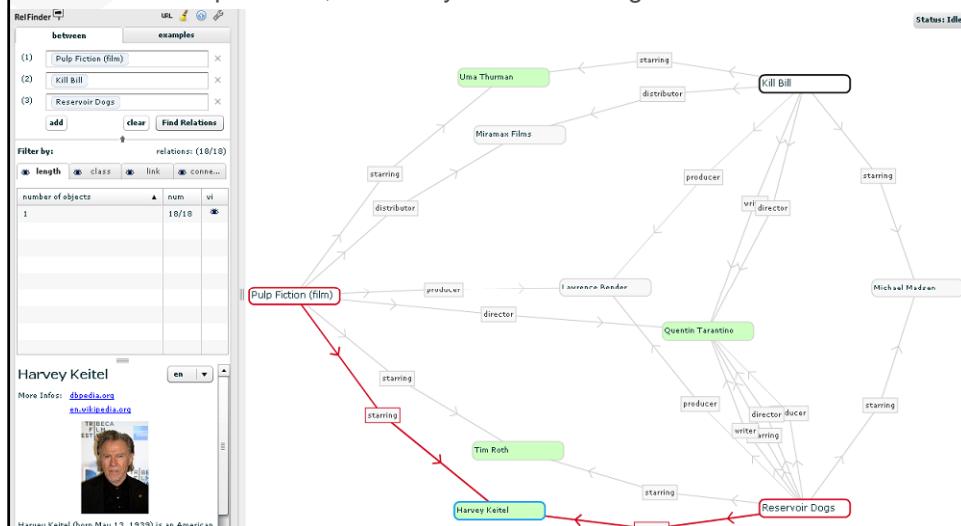
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RelFinder: finding relations in Linked Data

- E.g., relations between films
 - “Pulp Fiction”, “Kill Bill” y “Reservoir Dogs”



Exercise on data.gov.uk

- Public schools in London that contain the word "music"

Datasources:

Please select a datasource

Data format:

Please select a data format

Enter your SPARQL query:

```
prefix sch-ont: <http://education.data.gov.uk/def/school/>
SELECT ?name WHERE {
    ?school a sch-ont:School;
            sch-ont:establishmentName ?name;
            sch-ont:districtAdministrative
            <http://statistics.data.gov.uk/id/local-authority-district
            /00AA> .
    FILTER( regex(?name, "music", "i" ))
}
ORDER BY ?name
```

Exercise: find information in DBPedia



Image by <http://www.flickr.com/photos/bflv/>

http://dbpedia.org/resource/Darth_Vader

- Find fictitious serial killers in DBPedia

SPARQL results:

who
:Dalek
:Lord_Voldemort
:Darth_Vader
:His_Divine_Shadow
:Tommy_Vencetti
:Ganon
:Revan
:Darth_Malak
:Deathstroke
:Marisa_Coulter
:Aunt_Goldfinger
:Keyser_S%C3%BCze
:Francisco_Scararamaga
:Lord_Djibril
:Visser_Three
:Akhiro_Kurata
:Hate-Monger
:Baby_Donnie_Hood
:Darth_Krayt
:Delza
:Death_Guard
:Doctor_Nefarious
:Emperor_Malthazar
:Spike_(Buffy_the_Vampire_Slayer)
:Joker_(comics)
:Inn_Wannons
:Doctor_Light_(Arthur_Light)
:Emperor's_Children
:No_18
:Z%C3%A9a_Pequeno
:Shmueli_(TMNT)
(etc)

Designing URI sets for the Public Sector (UK)

- http://www.cabinetoffice.gov.uk/media/301253/public_sector_uri.pdf

URI Type	URI structure	Examples
Identifier	http://(domain)/id/(concept)/(reference) or http://(domain)/(concept)/(reference)#id	http://education.data.gov.uk/id/school/78 http://education.data.gov.uk/school/78#id http://transport.data.gov.uk/id/road/M5/junction/24
Document	http://(domain)/doc/(concept)/(reference)	http://education.data.gov.uk/doc/school/78
Representation	http://(domain)/doc/(concept)/(reference)/(doc.file-extension)	http://education.data.gov.uk/doc/school/78/doc.rdf
Definition of the scheme concept	http://(domain)/def/(concept)	http://education.data.gov.uk/def/school
List of scheme identifiers	http://(domain)/doc/(concept)}	http://education.data.gov.uk/doc/school
Set	http://(domain)/set/(concept)}	http://education.data.gov.uk/set/school

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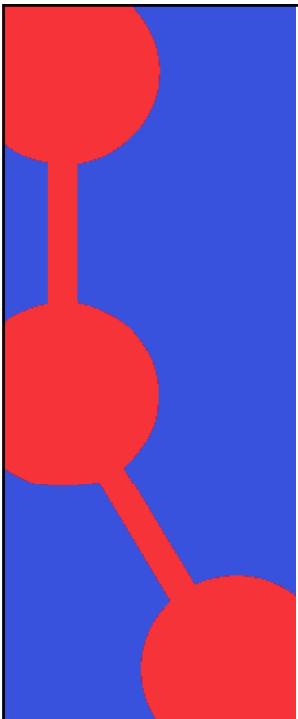
Asociación Española de Linked Data



www.aelid.es

- Fundada por miembros de iSOCO y UPM-OEG (Marzo, 2010)
- Objetivos:
 - Actuar como punto de encuentro de la comunidad española.
 - Organización y participación en eventos de diseminación, campañas de concienciación
 - Retos para estimular el desarrollo de la tecnología y aplicaciones Linked Data
 - Promoción de la investigación científica de alta calidad e innovación tecnológica, de acuerdo con los estándares de excelencia y mejores prácticas.
 - Establecimiento de relaciones con entidades públicas y privadas europeas.

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Linked Data Generation

Oscar Corcho, Asunción Gómez Pérez ({ocorcho, asun}@fi.upm.es)
Universidad Politécnica de Madrid

Credits: Raúl García Castro, Guillermo Alvaro, Oscar Muñoz, Jose Angel Ramos Gargantilla, María del Carmen Suárez de Figueroa, Boris Villazón, Alex de León, Víctor Saquicela, Luis Vilches, Miguel Angel García, Manuel Salvadores, Juan Sequeda, Carlos Ruiz Moreno and many others

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