Semantic Web, Linked Data, and Semantic 3D Media

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Significant buzz…

- There is quite a buzz around “Semantics”, “Semantic Technologies”, “Semantic Web”, “Web 3.0”, “Data Web”, etc, these days
- New applications, companies, tools, etc, come to the fore frequently

Significant buzz…

- It is, of course, not always clear what these terms all mean:
  - “Semantic Web” is a way to specify data and data relationships; it is also a collection of specific technologies (RDF, OWL, GRDDL, SPARQL, …)
  - “Semantic Technologies”, “Web 3.0” often mean more, including intelligent agents, usage of complex logical procedures, etc

Lots of Tools (*not* an exhaustive list!)

- Categories:
  - Triple Stores
  - Inference engines
  - Converters
  - Search engines
  - Middleware
  - CMS
  - Semantic Web browsers
  - Development environments
  - Semantic Wikis
  - …
- Some names:
  - Jena, AllegroGraph, Mulgara, Sesame, flickurl, …
  - TopBraid Suite, Virtuoso environment, Falcon, Drupal 7, Redland, Pellet, …
  - Disco, Oracle 11g, RacerPro, IODT, Ontobroker, OWLIM, Talis Platform, …
  - RDF Gateway, RDFLib, Open Anzo, DartGrid, Zitgist, Ontotext, Protégé, …
  - Thetus publisher, SemanticWorks, SWI-Prolog, RDFStore…
  - …

- The main lesson:
  - *Anybody can start developing Semantic Web applications*

There is a great community

- There are *lots* of tutorials, overviews, and books around
  - some of them good, some of them bad, just as with any other areas…
- Active developers' communities
  - blogs, IRC channels, mailing lists, various fora: more than what one person can oversee…
- Some measures claim that there are over 10^7 Semantic Web documents on the Web

Some deployment communities

- Major communities pick the technology up: digital libraries, defence, eGovernment, energy sector, financial services, health care, oil and gas industry, life sciences, social web applications …

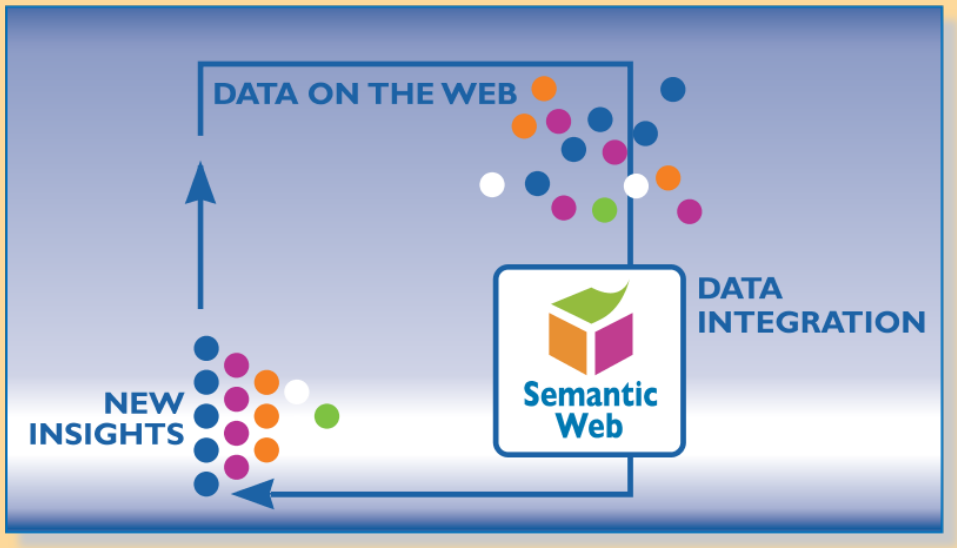
So what *is* the Semantic Web?

- There is a growing number of application patterns referring to the Semantic Web:
  - data integration using RDF, SKOS, OWL, …
  - knowledge engineering with complex ontologies
    - using, e.g., OWL and/or rule based reasoning
  - better data management, archiving, cataloguing, etc
    - e.g., digital library applications
  - managing, coordinating, combining Web services
  - intelligent software agents
  - improving search (usually using domain specific vocabularies…)
  - etc

Is this where we are?

- Maybe, but being an elephant is not necessary bad! ☺
  - it shows that the Semantic Web is a mature technology
  - that there is lots of interest, applications
  - various application areas pick what they need…
    - e.g., some need sophisticated knowledge management, so they go for complex ontology's…
    - some concentrate on semantically simpler vocabularies but large volume of data
  - …and that is fine, there is room for many!

- But it is good to (re-)emphasize some principles
- The Semantic Web:
  - *extends the principles of the Web from documents to data*; create a *Web of data*



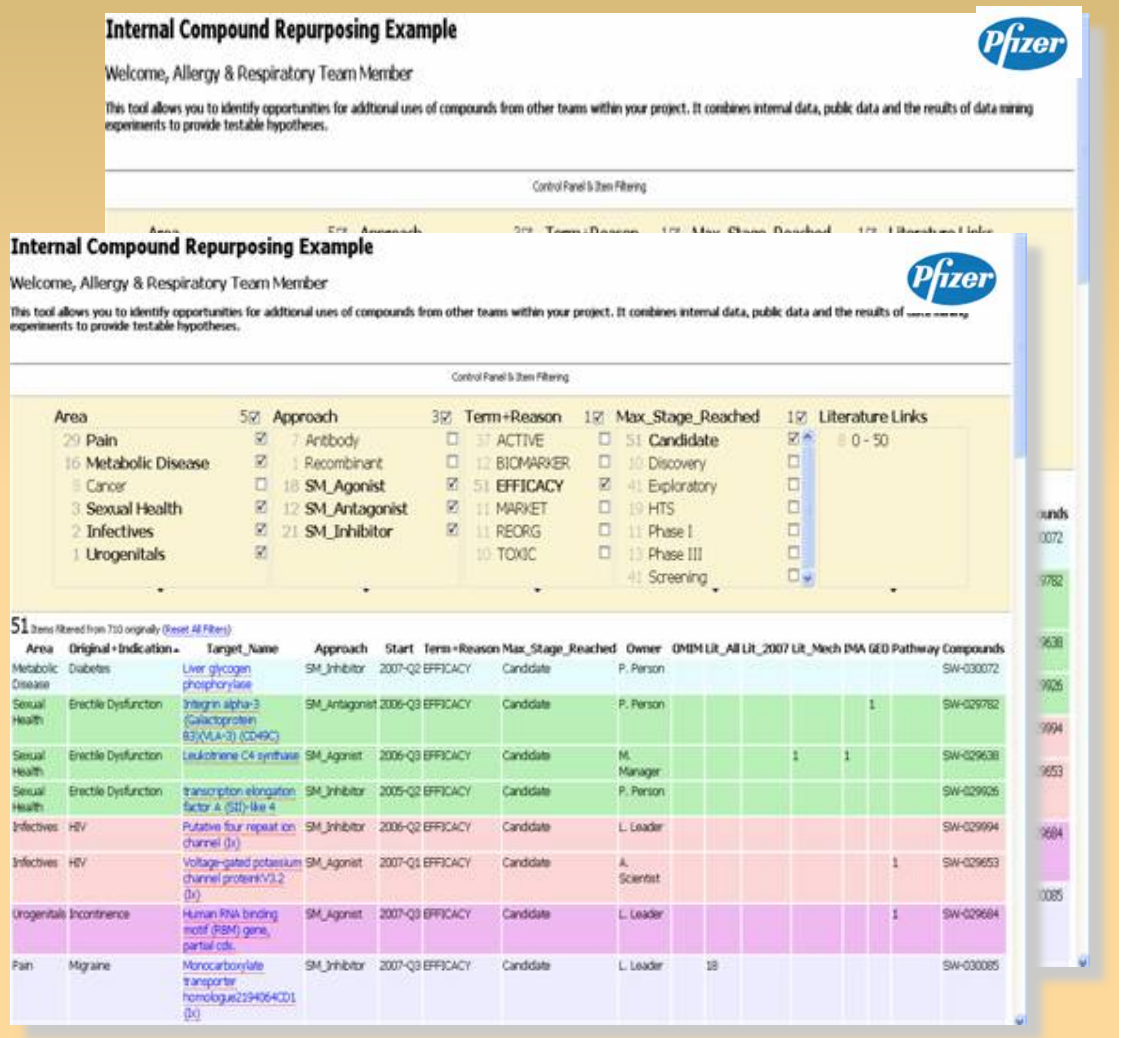
- It is the Semantic *Web*, and not only Semantics!
  - data, ontologies, vocabularies, etc, can (and should!) be shared, reused, potentially on Web scale
    - *the "network effect" on data*
- The major importance of RDF is that it provides an abstract integration layer for data on the Web

Applications are not always very complex…

- Eg: simple semantic annotations of data provides easy integration (eg, with MusicBrainz, Wikipedia, geographic data sets, etc)
- What is needed: some simple vocabularies, simple annotation
  - annotation an be generated by a server automatically, or
  - added by the user via some user interface
- This extra data can be in some microformats, in RDFa, …

A relatively simple application

- Goal: reuse of older experimental data
- Keep data in databases or XML, just export key “fact” as RDF
- Use a faceted browser to visualize and interact with the result

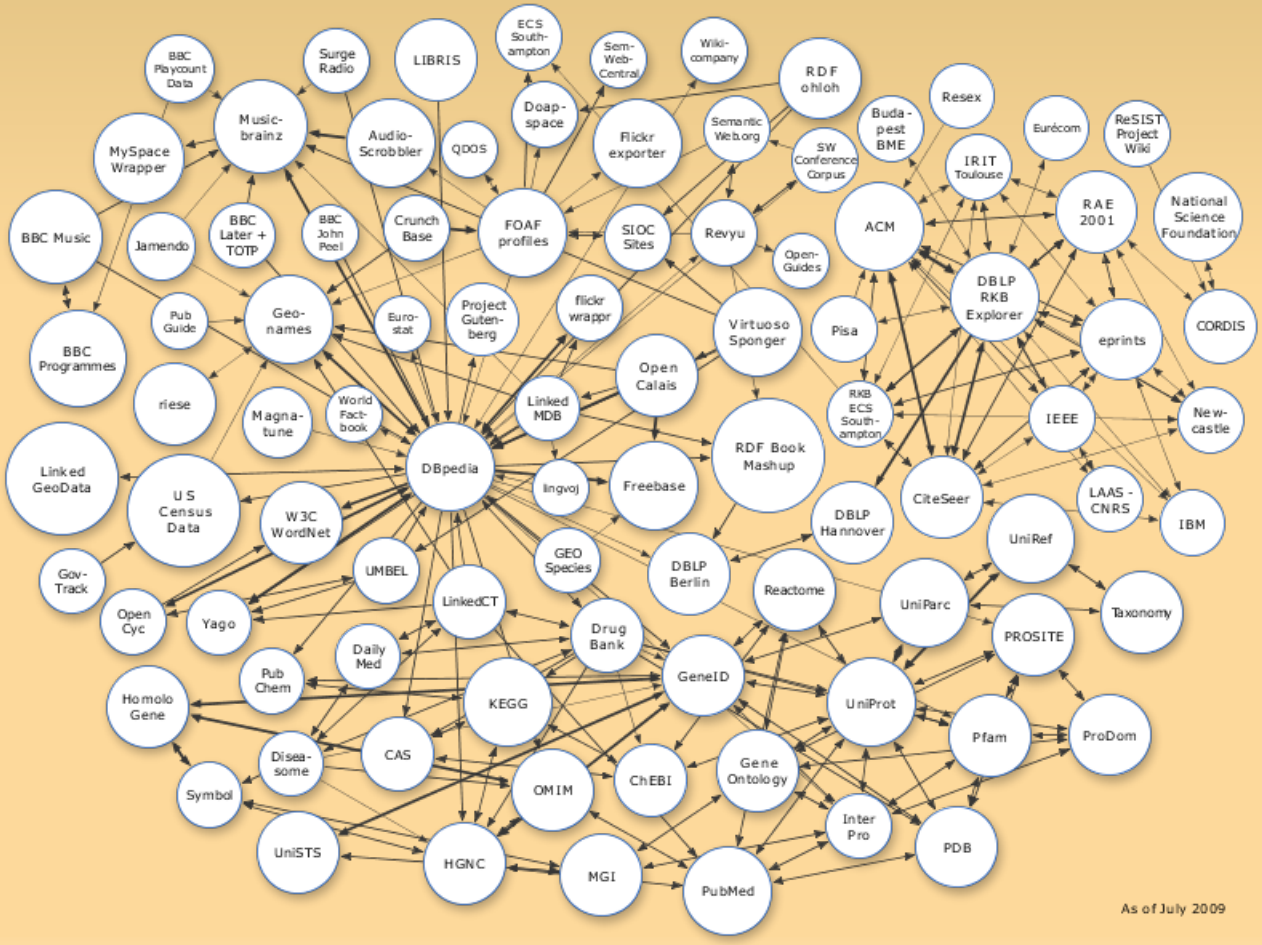


Courtesy of Nigel Wilkinson, Lee Harland, Pfizer Ltd, Melliyal Annamalai, Oracle [(SWEO Case Study)]

But is there already a Web of Data out there?

Linking Open Data Project

- Goal: “expose” open datasets in RDF
- *Set RDF links among the data items* from different datasets
- Set up query endpoints
- Billions triples, millions of “links”



Example data source: DBpedia

- DBpedia is a community effort to
  - extract structured (“infobox”) information from Wikipedia
  - provide a SPARQL endpoint to the dataset
  - interlink the DBpedia dataset with other datasets on the Web

Extracting structured data from Wikipedia

Amsterdam

The Keizersgracht at dusk

Location of Amsterdam

Coordinates: 52°22'23"N 4°53'32"E

Country	Netherlands
Province	North Holland
Government	
- Type	Municipality
- Mayor	Job Cohen[1] (PvdA)
- Aldermen	Lodewijk Asscher Carolien Gehrels Tjeerd Herrema Maarten van Poelgeest Marijke Vos
- Secretary	Erik Gerritsen
Area [2][3]	
- City	219 km² (84.6 sq mi)
- Land	166 km² (64.1 sq mi)
- Water	53 km² (20.5 sq mi)
- Urban	1,003 km² (387.3 sq mi)
- Metro	1,815 km² (700.8 sq mi)
Elevation [4]	2 m (7 ft)
Population (1 October 2008)[5][6]	
- City	755,269
- Density	4,459/km² (11,548.8/sq mi)
- Urban	1,364,422
- Metro	2,158,372
- Demonym	Amsterdammer
Time zone	CET (UTC+1)
- Summer (DST)	CEST (UTC+2)
Postcodes	1011 – 1109
Area code(s)	020

Website: www.amsterdam.nl

```
@prefix dbpedia <http://dbpedia.org/resource/>.
@prefix dbterm  <http://dbpedia.org/property/>.

dbpedia:Amsterdam
   dbterm:officialName "Amsterdam" ;
   dbterm:longd "4" ;
   dbterm:longm "53" ;
   dbterm:longs "32" ;
   ...
   dbterm:leaderName dbpedia:Job_Cohen ;
   ...
   dbterm:areaTotalKm "219" ;
   ...
dbpedia:ABN_AMRO
   dbterm:location dbpedia:Amsterdam ;
   ...
```

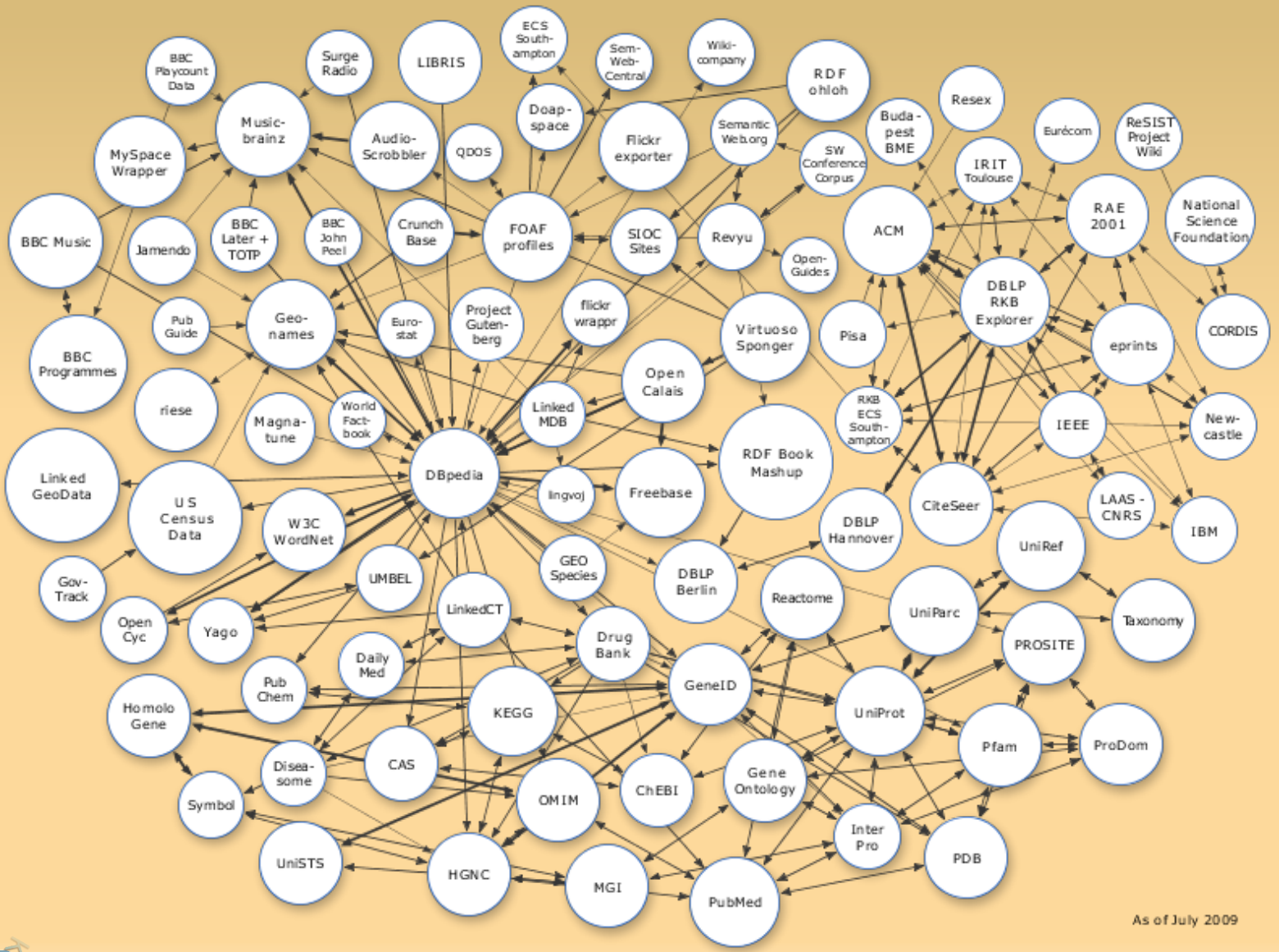
Automatic links among open datasets

```
<http://dbpedia.org/resource/Amsterdam>
  owl:sameAs <http://rdf.freebase.com/ns/...> ;
  owl:sameAs <http://sws.geonames.org/2759793> ;
  ...
```

```
<http://sws.geonames.org/2759793>
  owl:sameAs <http://dbpedia.org/resource/Amsterdam>
  wgs84_pos:lat "52.3666667" ;
  wgs84_pos:long "4.8833333" ;
  geo:inCountry <http://www.geonames.org/countries/#NL> ;
  ...
```

Processors can switch automatically from one to the other…

The real value is in the links!

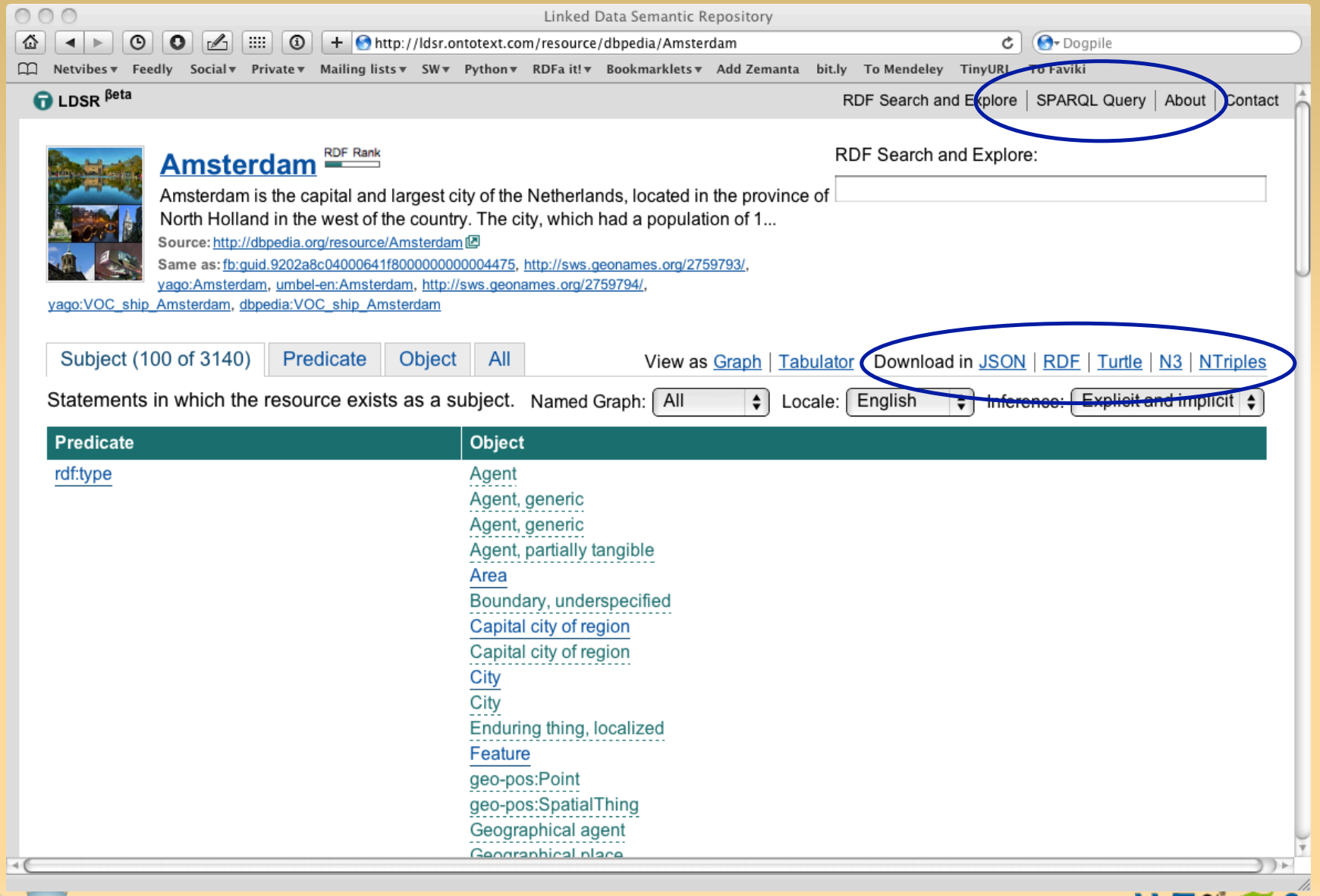


As of July 2009

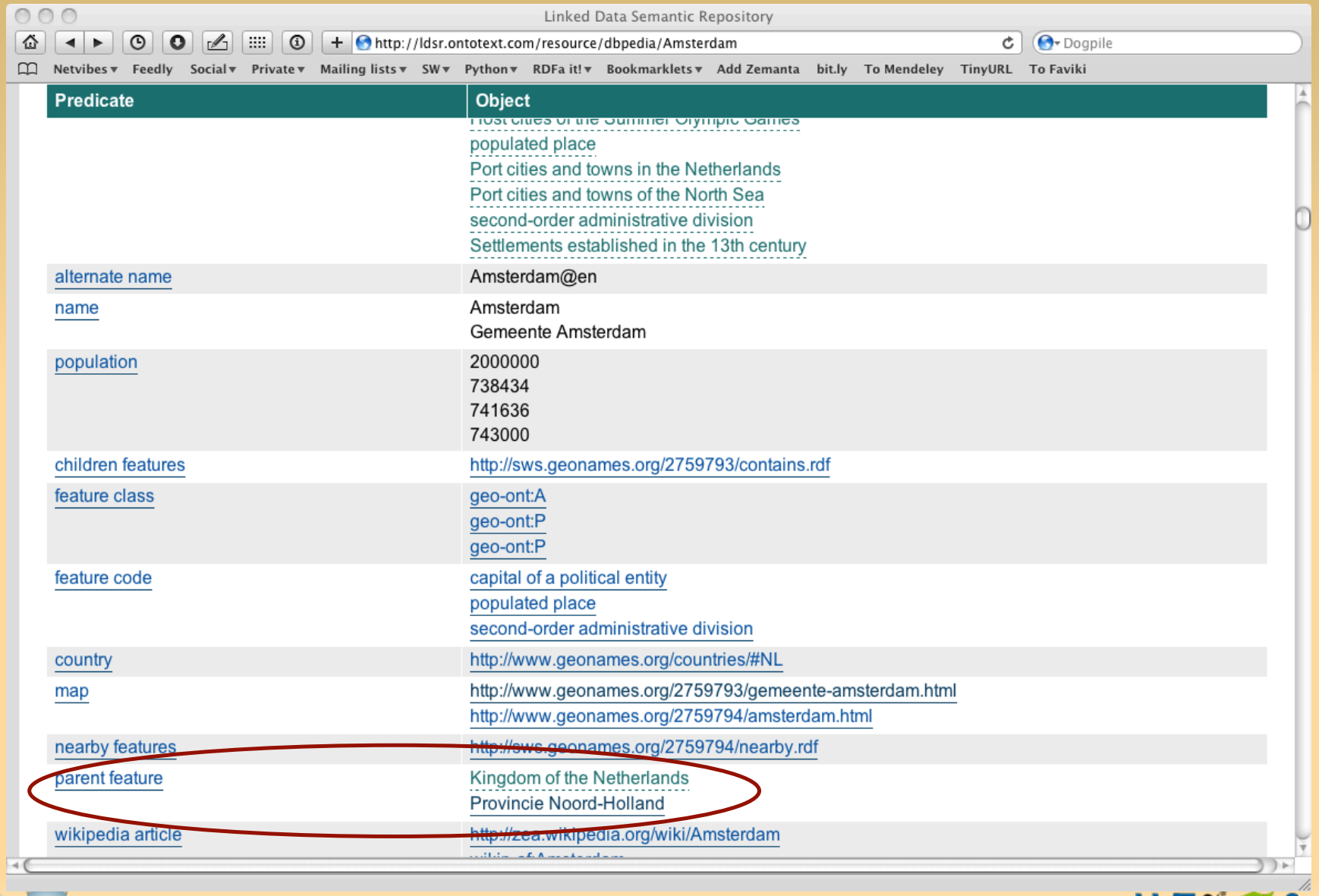
Accessing the cloud

- Applications can access the data directly (via the URI-s)
- There are several “instantiations” of part of the cloud that user can access
  - these store copies of several “blobs”
    - possibly with some inferred triples based on, eg, OWL
  - often offering a SPARQL endpoint to query to cloud

Example for cloud exploration

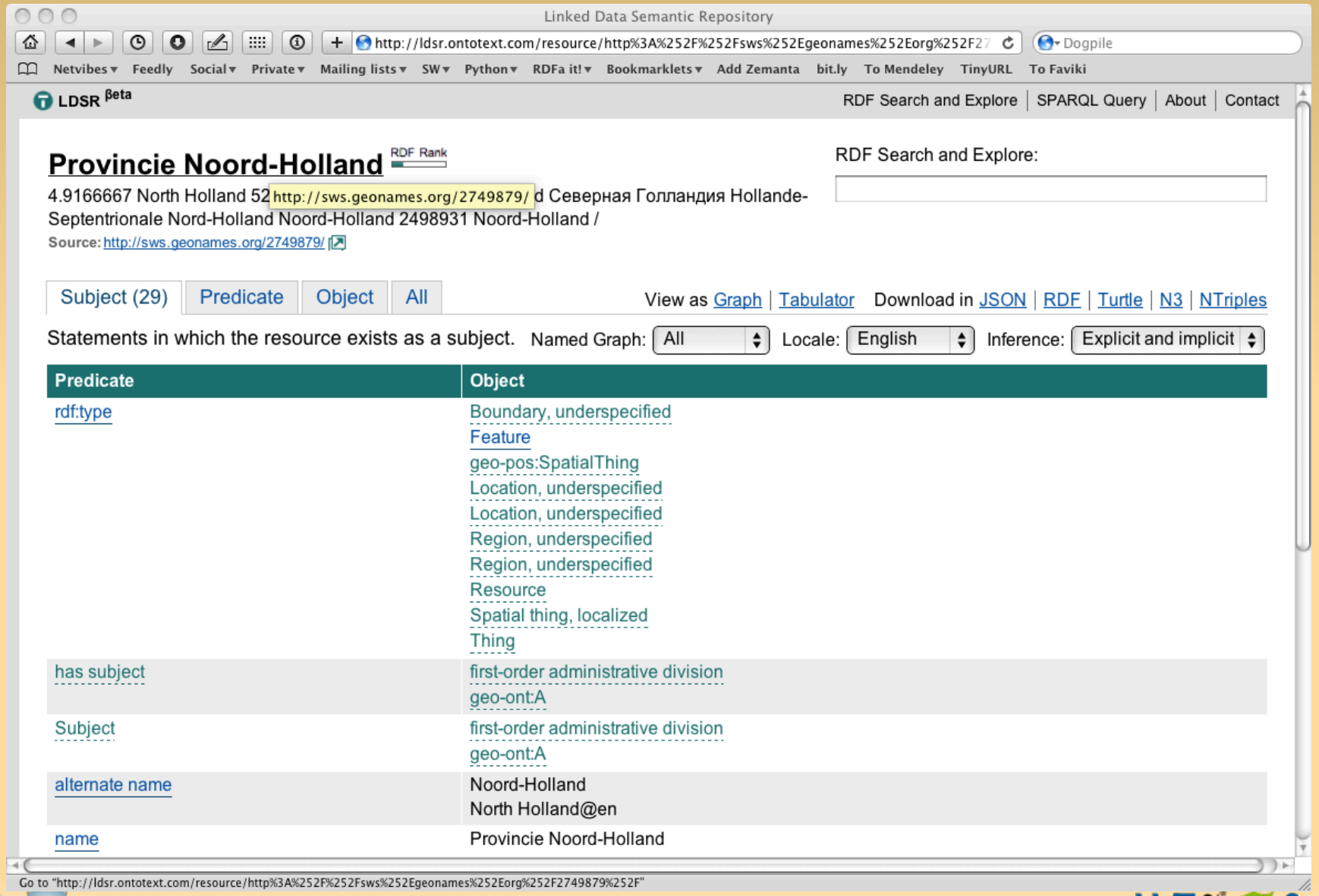


Example for cloud exploration

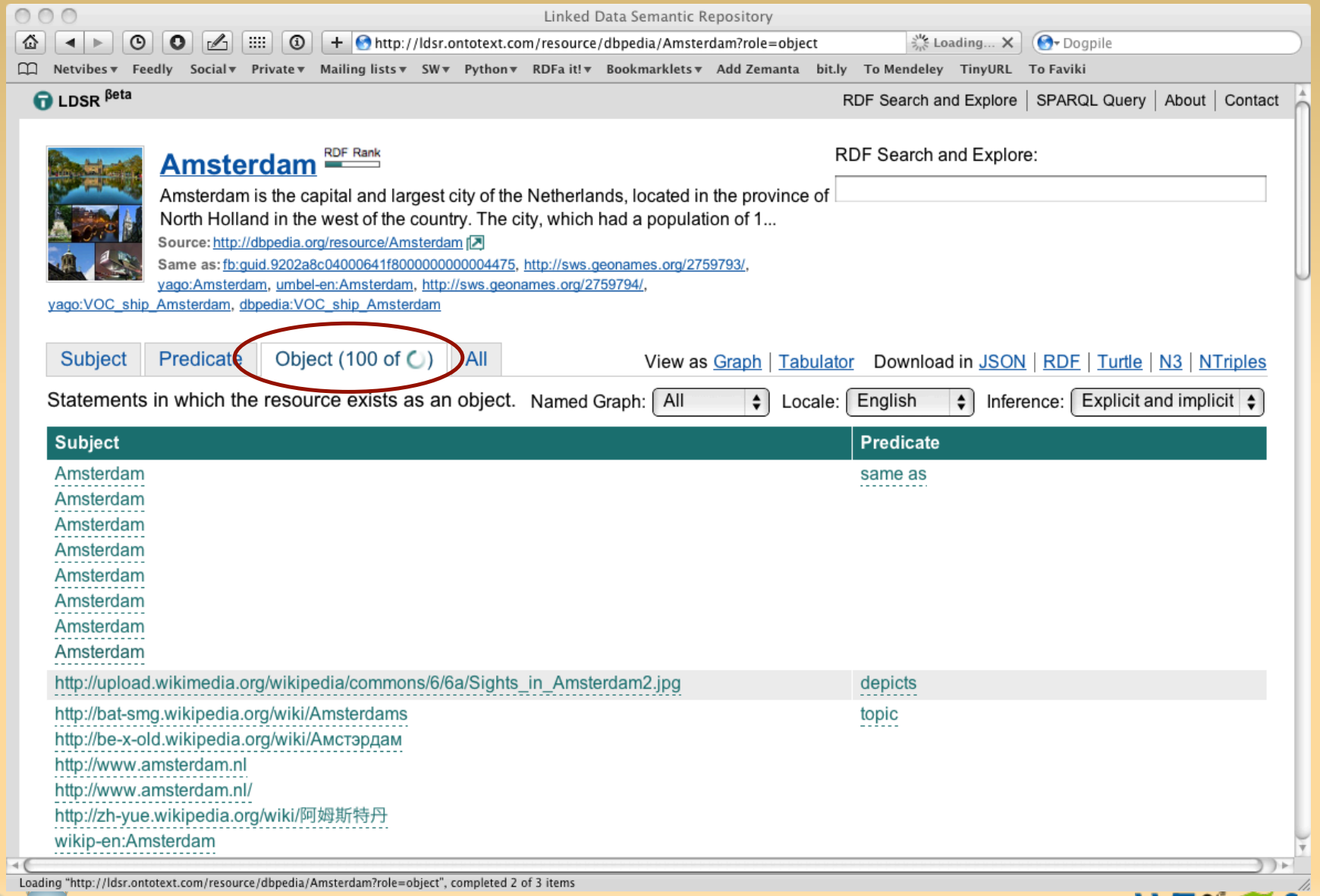


Predicate	Object
	populated place Port cities and towns in the Netherlands Port cities and towns of the North Sea second-order administrative division Settlements established in the 13th century
alternate name	Amsterdam@en
name	Amsterdam Gemeente Amsterdam
population	2000000 738434 741636 743000
children features	http://sws.geonames.org/2759793/contains.rdf
feature class	geo-ont:A geo-ont:P geo-ont:P
feature code	capital of a political entity populated place second-order administrative division
country	http://www.geonames.org/countries/#NL
map	http://www.geonames.org/2759793/gemeente-amsterdam.html http://www.geonames.org/2759794/amsterdam.html
nearby features	http://sws.geonames.org/2759794/nearby.rdf
parent feature	Kingdom of the Netherlands Provincie Noord-Holland
wikipedia article	http://zea.wikipedia.org/wiki/Amsterdam

Example for cloud exploration



Example for cloud exploration



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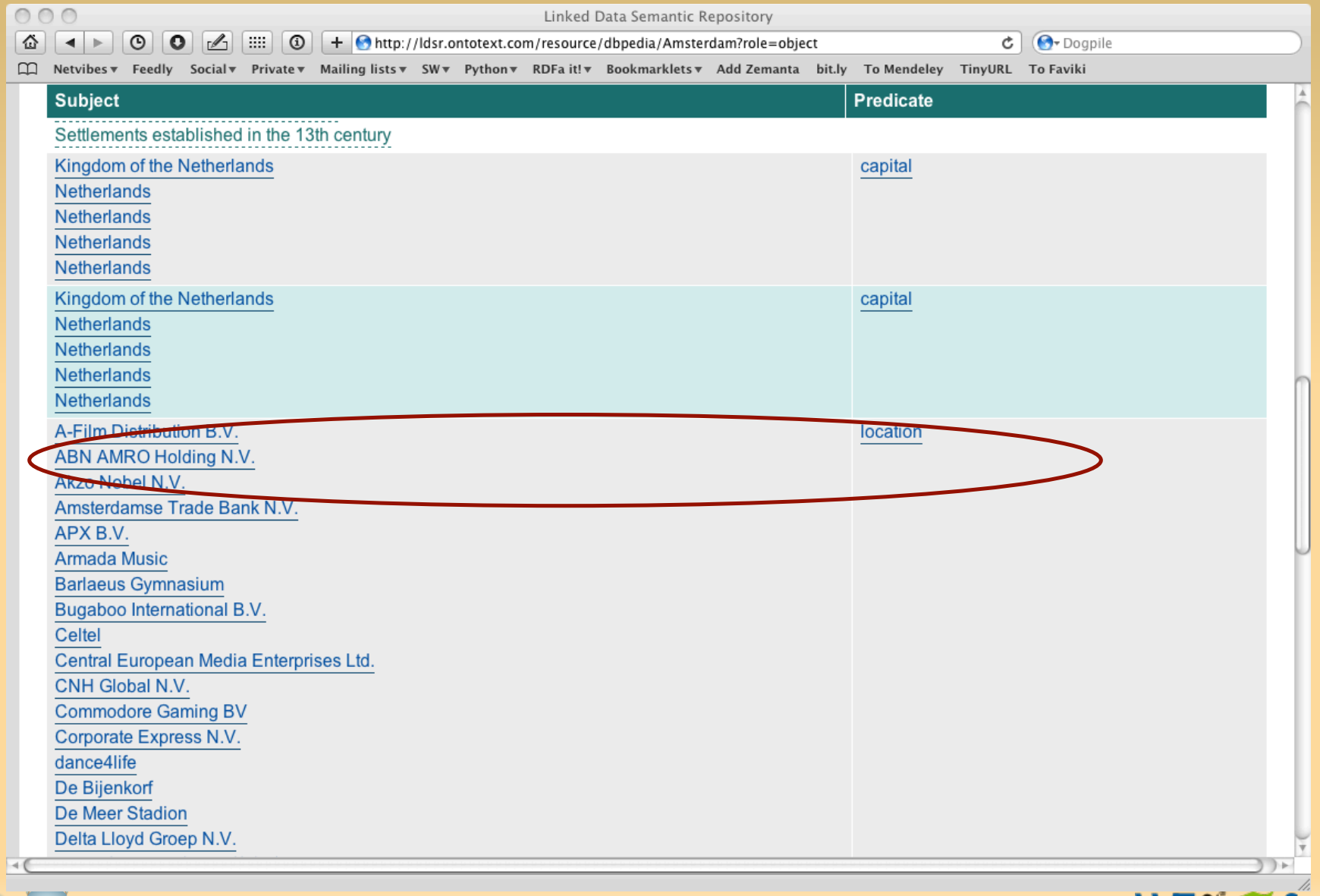
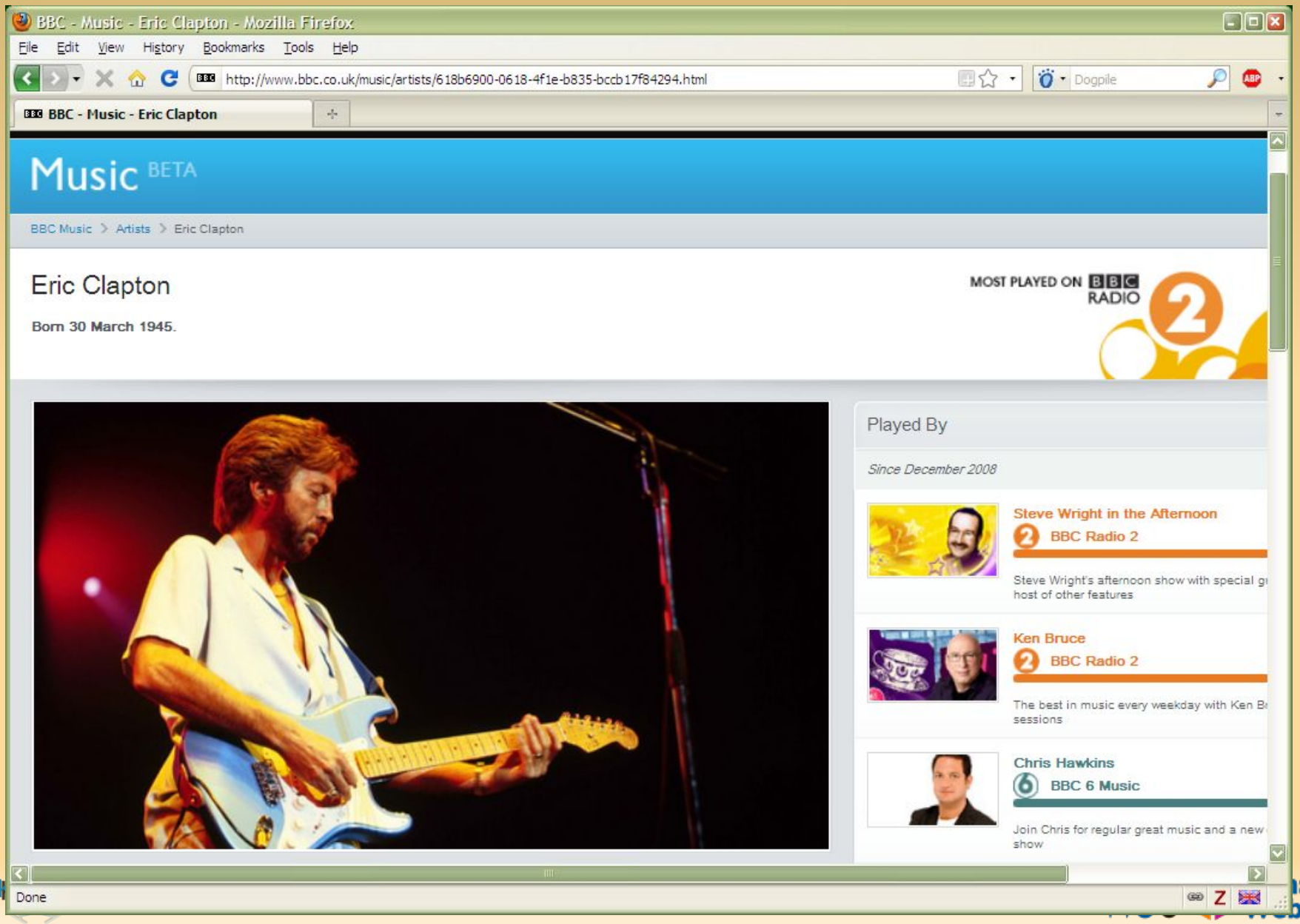


Linking Open Data Project (cont)

- This is a *major* community project
  - anybody can participate; to subscribe to the list:
    - http://lists.w3.org/Archives/public/public-lod/
  - or look at the project site:
    - http://esw.w3.org/topic/SweoIG/TaskForces/CommunityProjects/LinkingOpenData
  - if you know of open data sets: contact the project to incorporate it with the rest!

Using the LOD to build Web site: BBC



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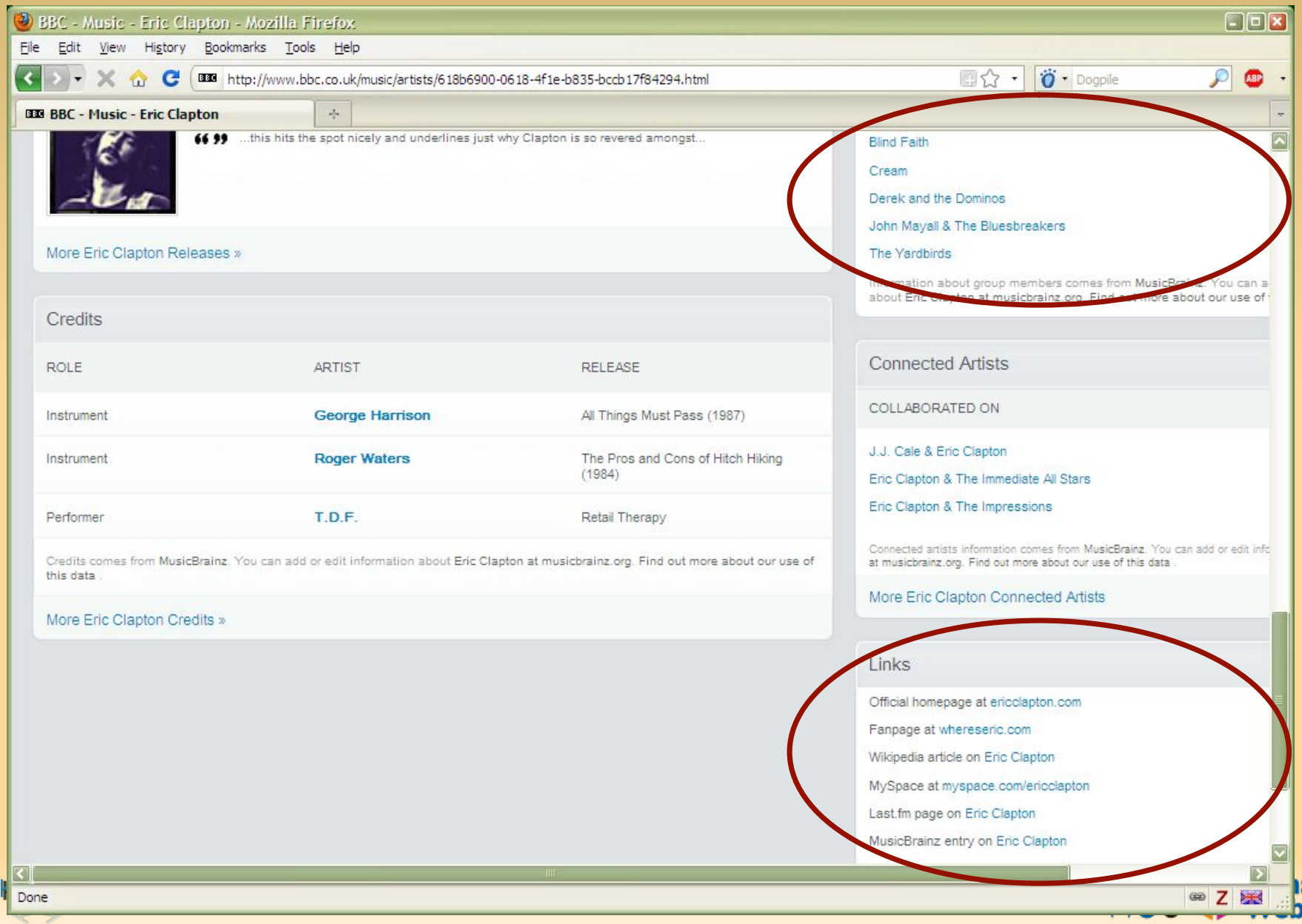

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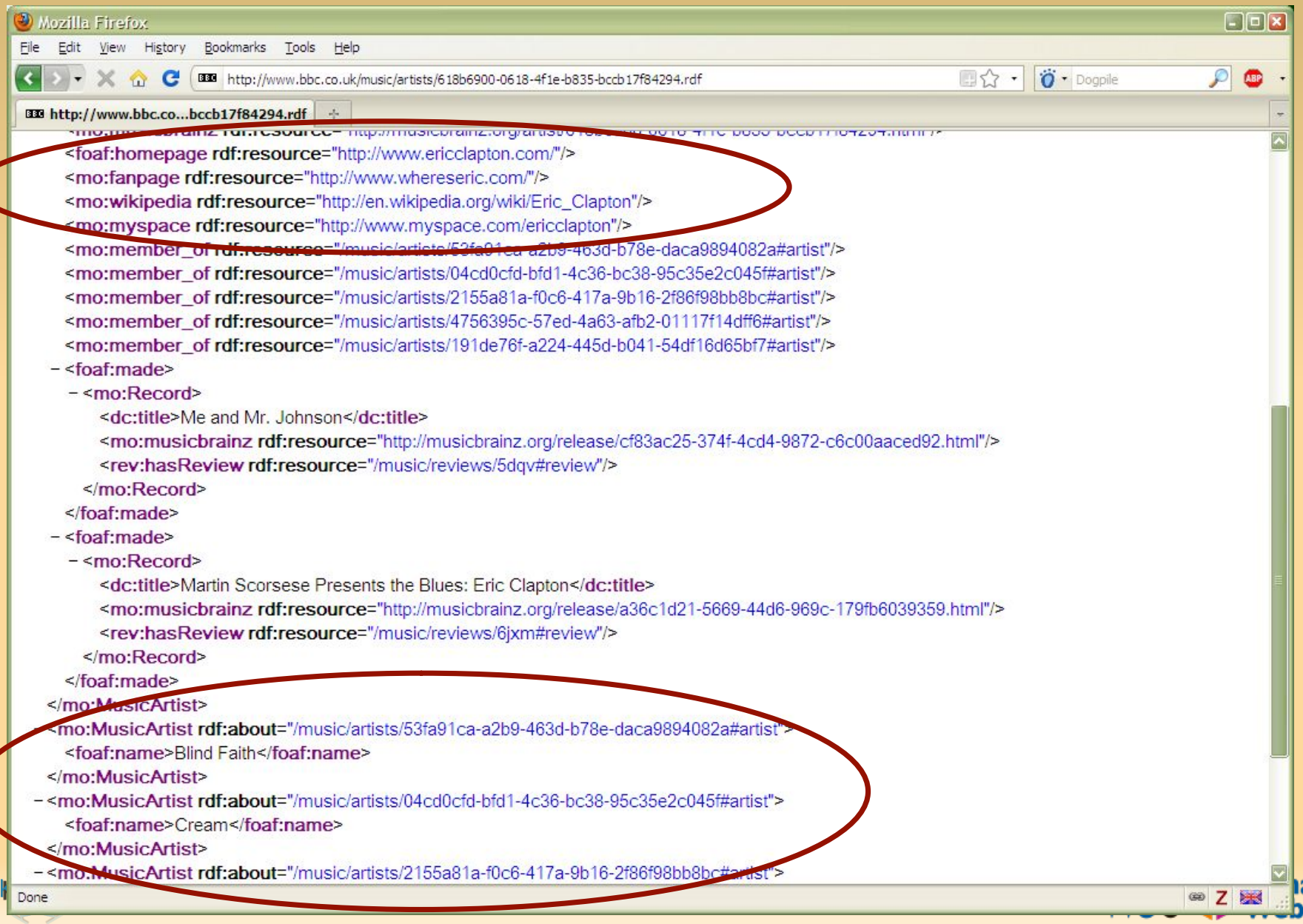

Using the LOD cloud on an iPhone

Courtesy of Chris Bizer and Christian Becker, Freie Universität, Berlin

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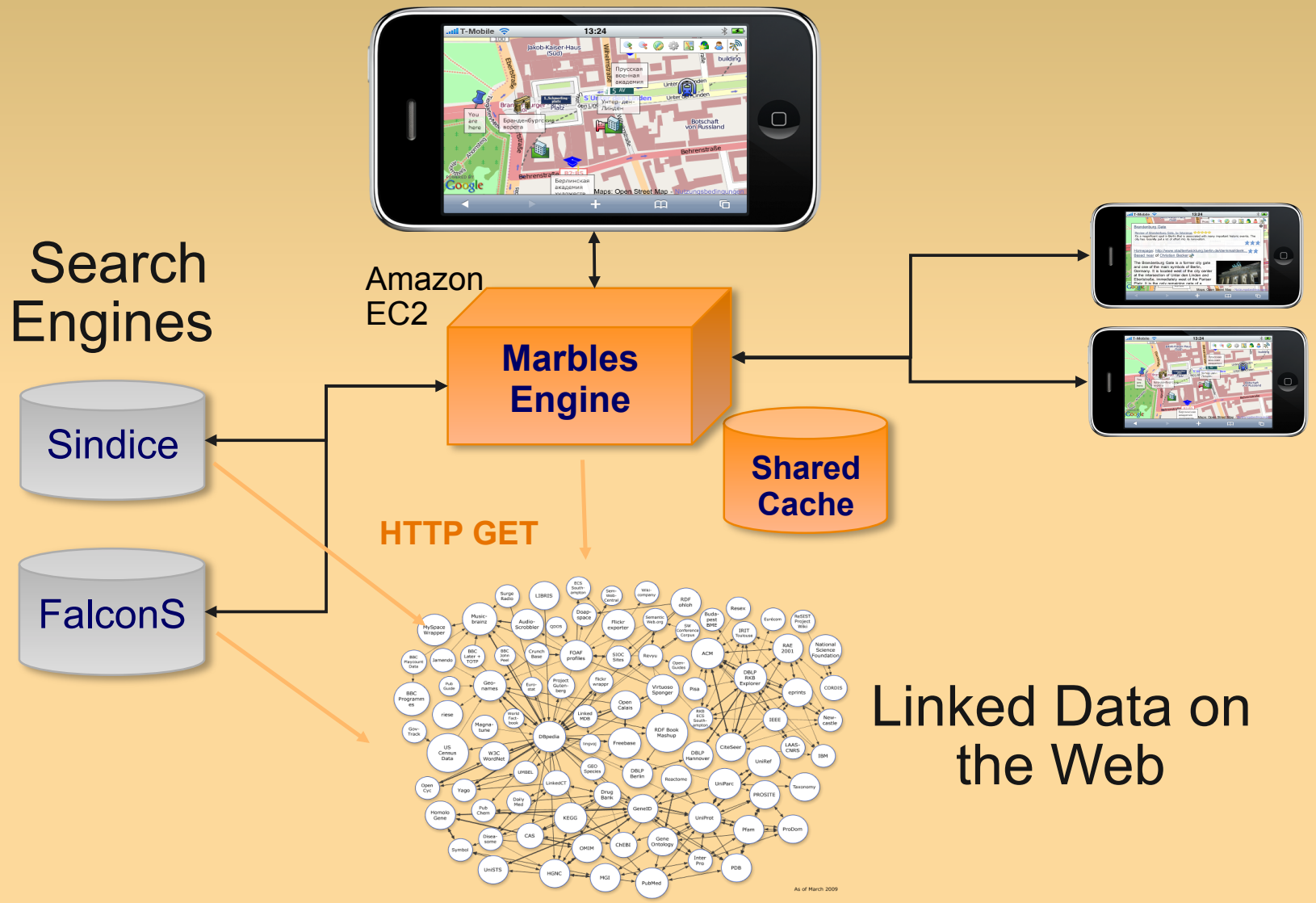
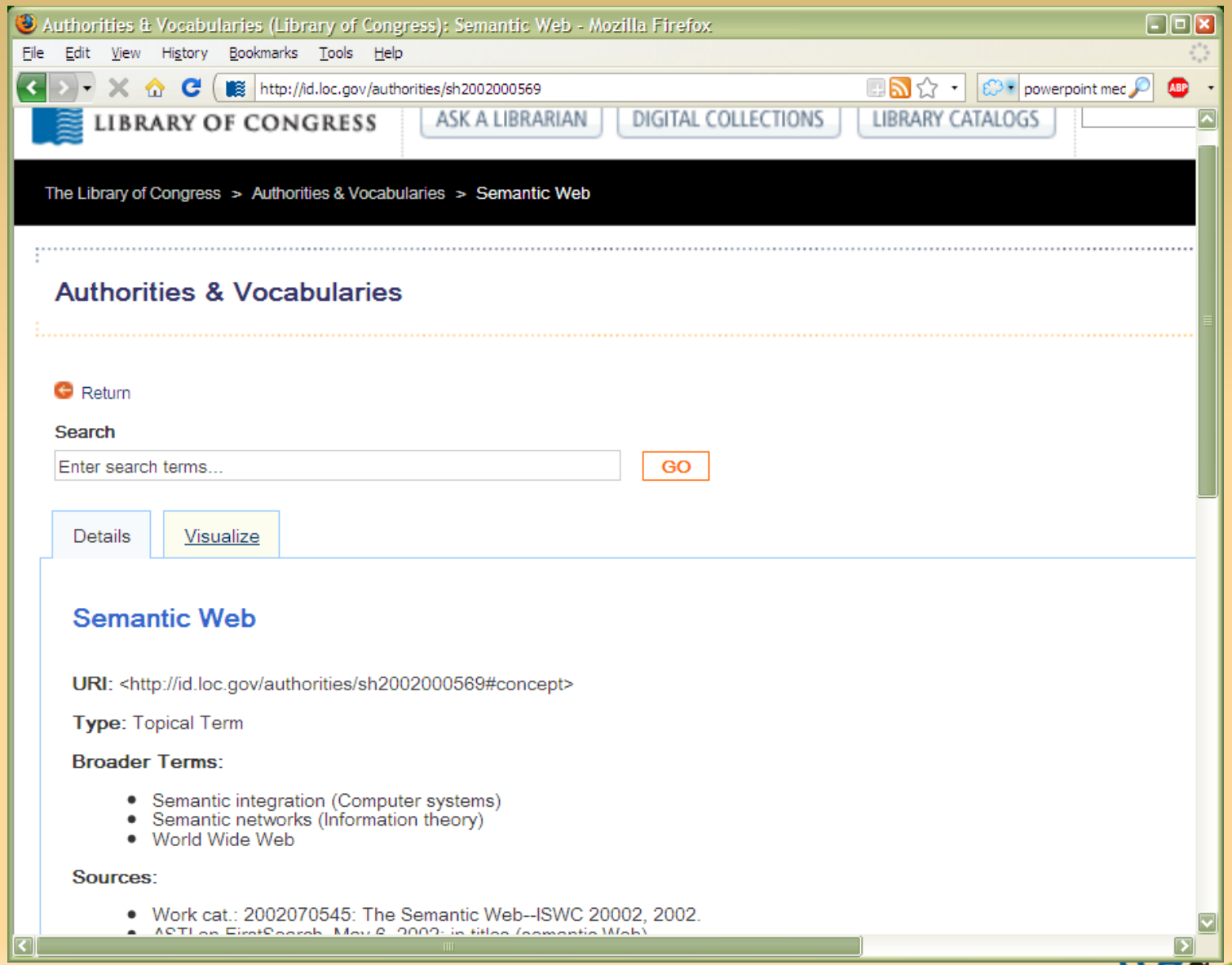


Courtesy of Chris Bizer and Christian Becker, Freie Universität, Berlin

Publication of data: Library of Congress Subject Headings



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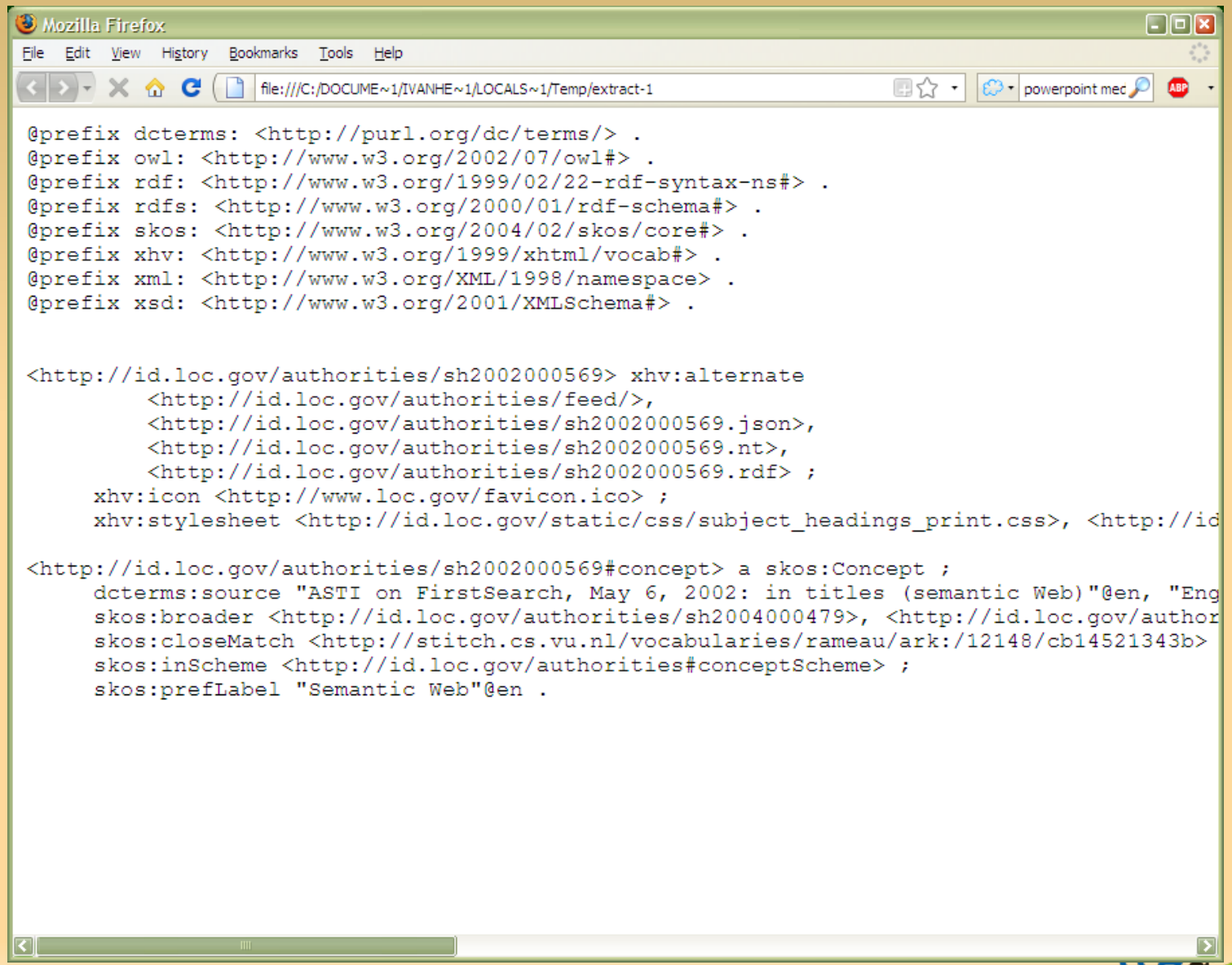



```
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix xhv: <http://www.w3.org/1999/xhtml/vocab#> .
@prefix xml: <http://www.w3.org/XML/1998/namespace> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .


<http://id.loc.gov/authorities/sh2002000569> xhv:alternate
         <http://id.loc.gov/authorities/feed/>,
         <http://id.loc.gov/authorities/sh2002000569.json>,
         <http://id.loc.gov/authorities/sh2002000569.nt>,
         <http://id.loc.gov/authorities/sh2002000569.rdf> ;
     xhv:icon <http://www.loc.gov/favicon.ico> ;
     xhv:stylesheet <http://id.loc.gov/static/css/subject_headings_print.css>, <http://id

<http://id.loc.gov/authorities/sh2002000569#concept> a skos:Concept ;
     dcterms:source "ASTI on FirstSearch, May 6, 2002: in titles (semantic Web)"@en, "Eng
     skos:broader <http://id.loc.gov/authorities/sh2004000479>, <http://id.loc.gov/author
     skos:closeMatch <http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb14521343b>
     skos:inScheme <http://id.loc.gov/authorities#conceptScheme> ;
     skos:prefLabel "Semantic Web"@en .
```

And what about ontologies?

- I.e.: where does, e.g., OWL comes into the LOD picture?
- Ontologies are necessary to properly integrate data
  - “term used in this dataset relates to the term used there this and this way…”
  - OWL, Rules, RDF vocabularies are vital

And what about ontologies?

- But…
  - Ontologies/vocabularies can be very simple (few terms)
  - Expressivity vs. complexity of management and usage has always be balanced
- *You are perfectly decent Semantic Web citizen even if you do not use complex OWL (or not use OWL at all…)*

How does this apply to Semantic 3D?

Caveat: I am an outsider, sorry if I bang on open doors…

Think of the data out there from the start!

- Modeling 3D objects with Semantic technologies (OWL, SKOS, etc) is important
  - (and looks fairly complex from where I stand…)
- But… think of the data out there!
  - applications may use this in many different ways…
- Also: contribute if you can, make your data widely available!

An artificial example

- There is, of course, the 3D modeling aspect
- But there may be, also, additional data on the artifact
- This can be connected to the outside world

An artificial example

An artificial example

About: http://dbpedia.org/resource/Ramesses_I

http://dbpedia.org/page/Ramesses_I

About: http://dbpedia.org/resource/Ramesses_I

An Entity in Data Space: dbpedia.org

Menpehtyre Ramesses I was the founding Pharaoh of Ancient Egypt's 19th dynasty. The dates for his short reign are not completely known but the time-line of late 1292-1290 BC is frequently cited as well as 1295-1294 BC.

Property	Value
dbpedia-owl:thumbnail	http://upload.wikimedia.org/wikipedia/commons/thumb/1/16/StatueHeadC
dbpprop:abstract	Menpehtyre Ramesses I was the founding Pharaoh of Ancient Egypt's 19 was the founder of the 19th Dynasty, in reality his brief reign marked the bring Egypt up to new heights of imperial power.
dbpprop:burial	dbpedia:KV16
dbpprop:caption	Stone head carving of Paramessu (Ramesses I), originally part of a statu
dbpprop:children	dbpedia:Seti_I
dbpprop:died	1290 BC
dbpprop:dynasty	dbpedia:Nineteenth_Dynasty_of_Egypt
dbpprop:father	dbpedia:Seti_(commander)
dbpprop:hasPhotoCollection	http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/Ramesses_I

About: http://dbpedia.org/resource/Nineteenth_Dynasty_of_Egypt

http://dbpedia.org/page/Nineteenth_Dynasty_of_Eg

About: http://dbpedia.org/resource/Nineteenth_Dynasty_of_Egy

An Entity in Data Space: dbpedia.org

Property	Value
dbpprop:redirect	dbpedia:Nineteenth_dynasty_of_Egypt
is dbpprop:dynasty of	dbpedia:Amenmesse dbpedia:Merneptah dbpedia:Ramesses_I dbpedia:Ramesses_II dbpedia:Seti_I dbpedia:Siptah dbpedia:Seti_II dbpedia:Twosret

Browse using: OpenLink Data Explorer | Zitgist Data Viewer | Marbles | DISCO | Tabulator Raw Data in: N3/Turtle | JSON+RDF | RDF/XML About

POWERED BY VIRTUOSO LINKINGOPENDATA W3C SPARQL OPEN DATA

You can of course make it nicer…

Obviously, there are other datasets

- Use Geodata for precise information on Egypt
- Use the LOC data to give precise subject descriptions
- …

Make the data available!

- Make the data available to others!
- Wouldn't it be cool to see your data appear on an iPhone?

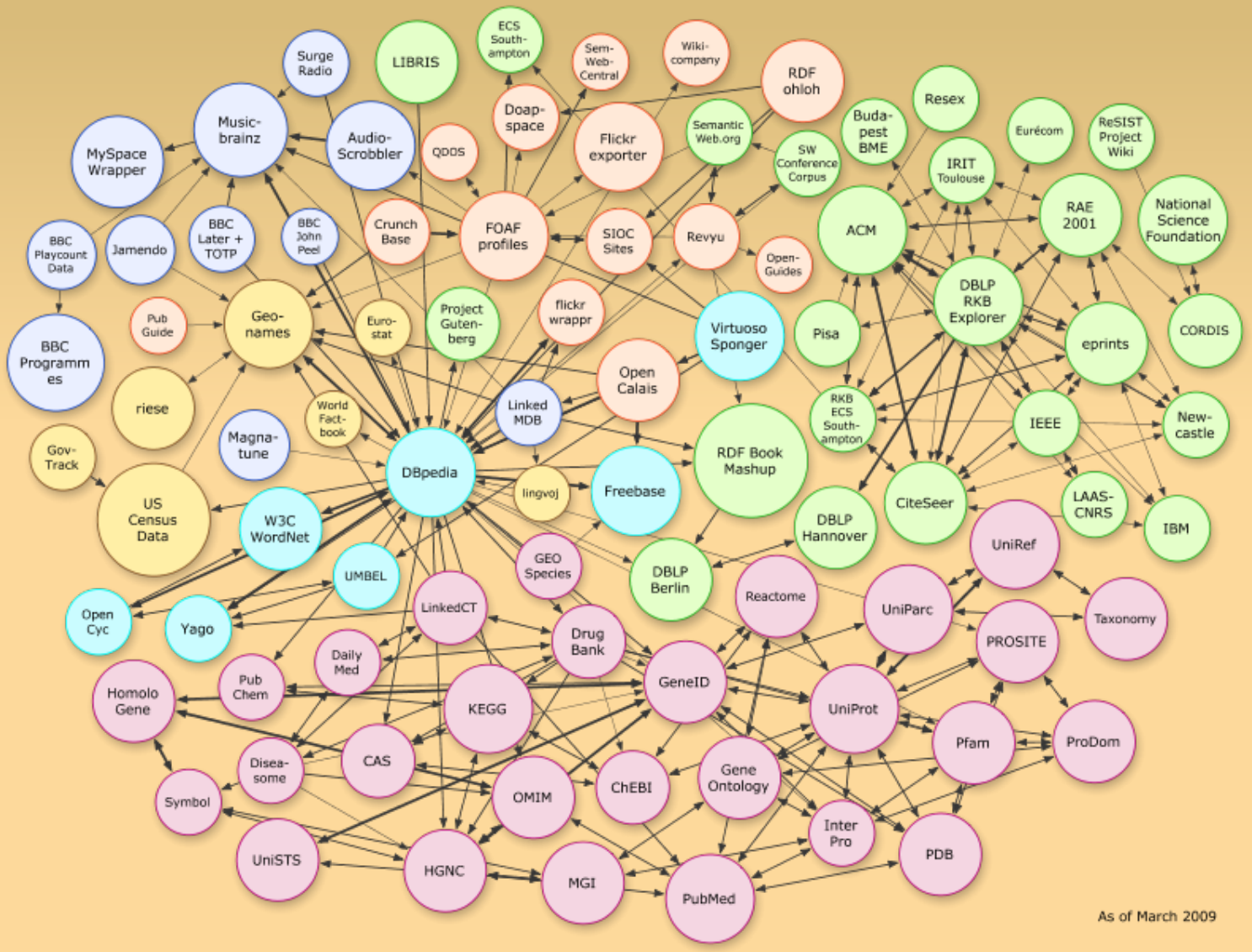
What does it mean in practice?

- Add (meta)data to your artifacts
  - use http URI-s
  - use public vocabularies if possible
- *Add links to other public datasets*
  - that is how others will find you!
- Make your data and vocabularies public
- If you can: set up a SPARQL endpoint

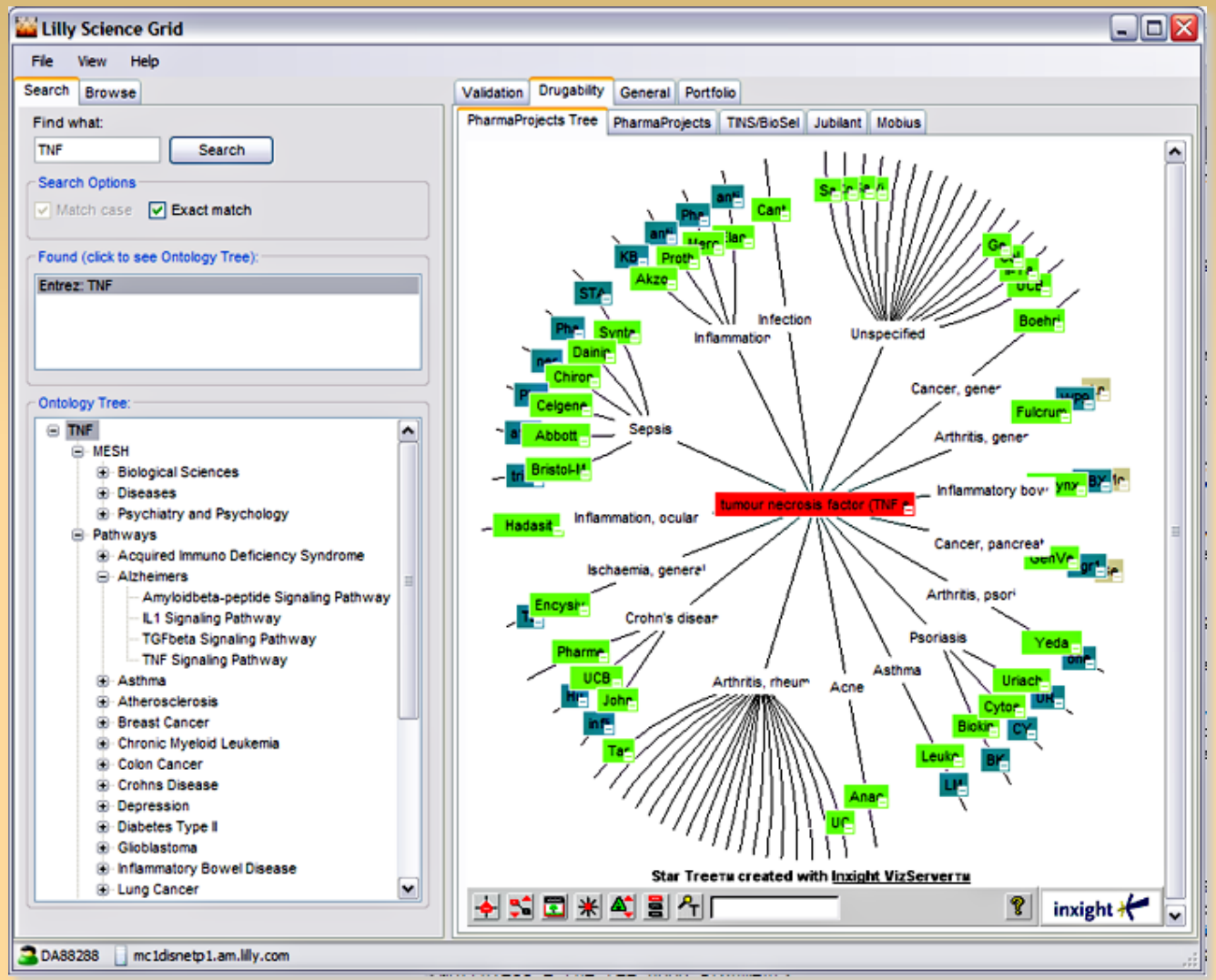
Practice in other areas

- I used a very “webby” example with Wikipedia
- Of course other areas have their own datasets that can be used

Colored LOD cloud…

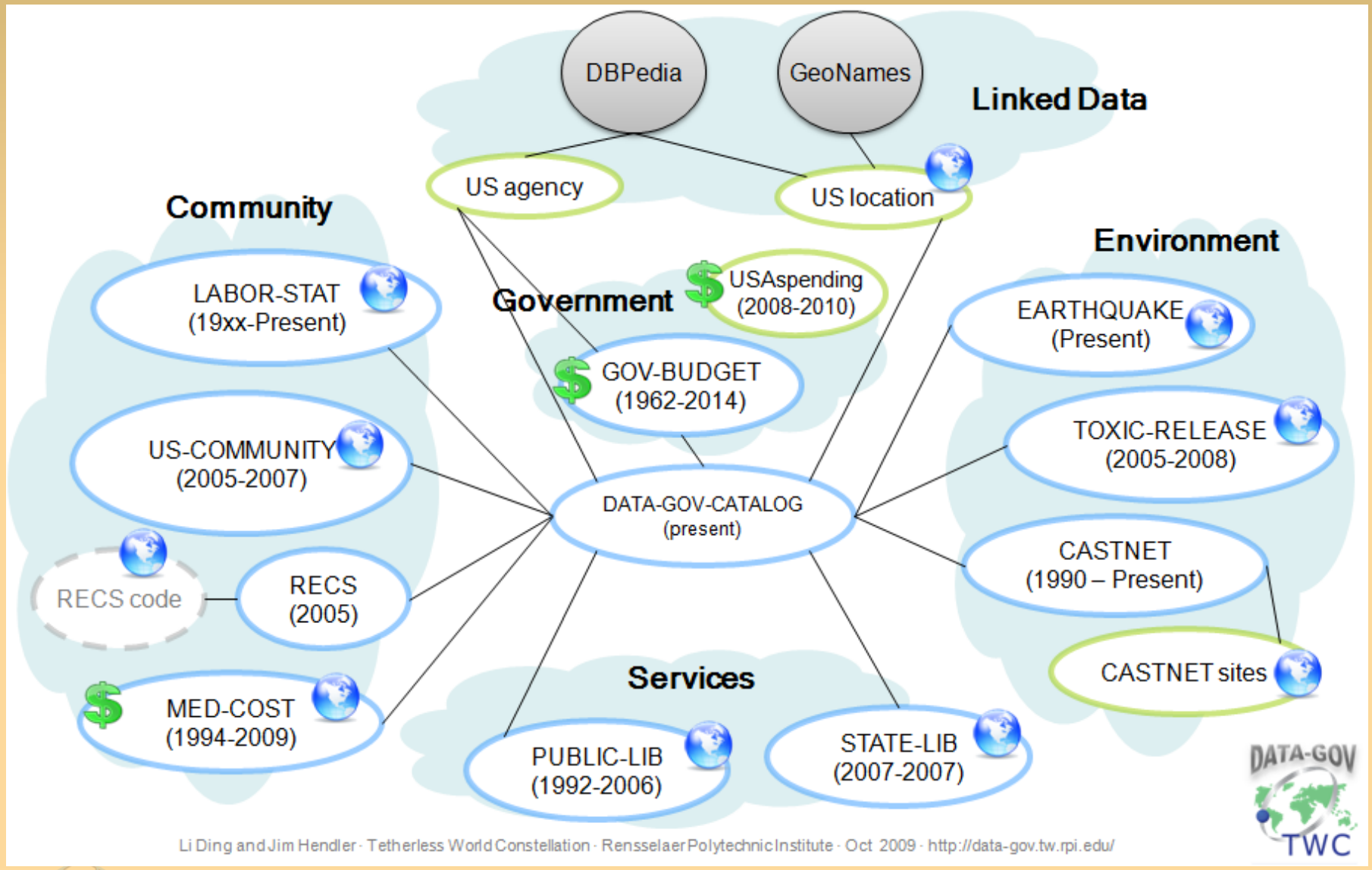


Eli Lilly's Target Assessment Tool

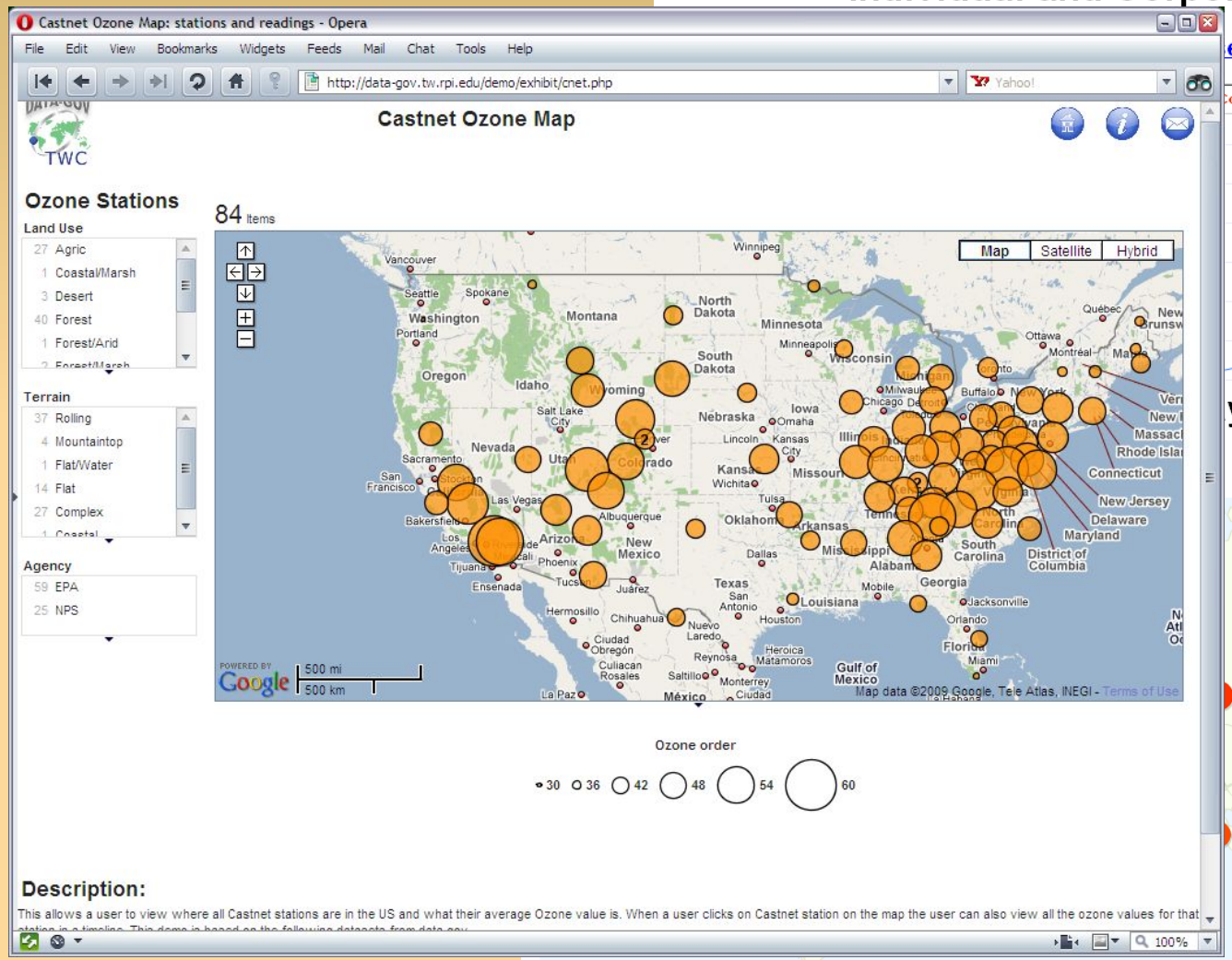


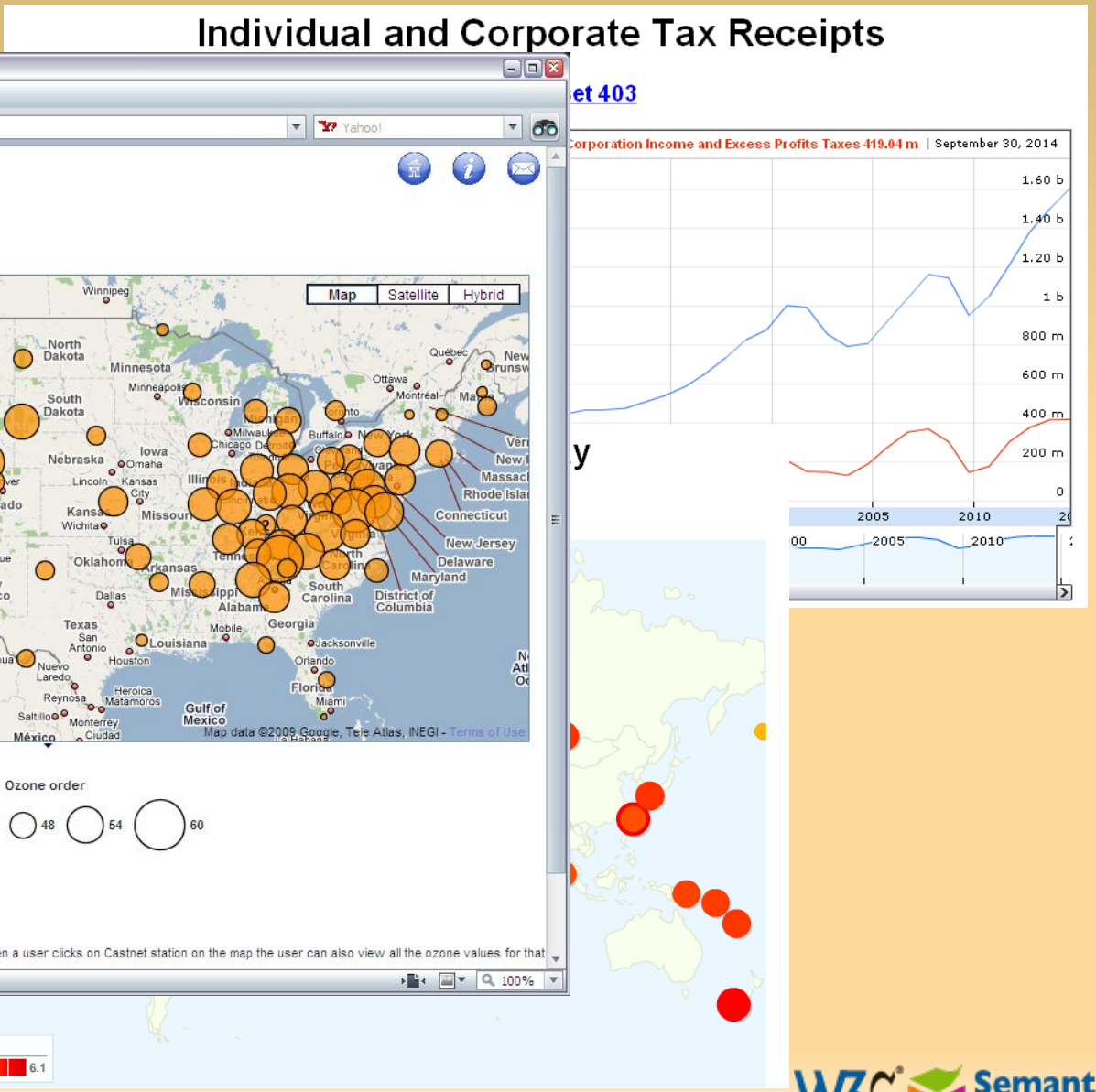
Courtesy of Susie Stephens, Eli Lilly [(SWEO Case Study)]

Linked Open eGov Data (US example)



You publish the raw data, others use it…





Examples from RPI's Data-gov Wiki, Jim Hendler & al.

An example with UK government data

Conclusions

- The Semantic Web is, primarily a *Web of Data*
- Think of the out there when looking at 3D Media
  - use data out there
  - link your data to the rest of the Web of Data
- Making these available opens up nice application facilities!

Thank you for your attention!

- These slides are publicly available on:

`http://www.w3.org/2010/Talks/0211-Sophia-IH/`