The Web of Everything

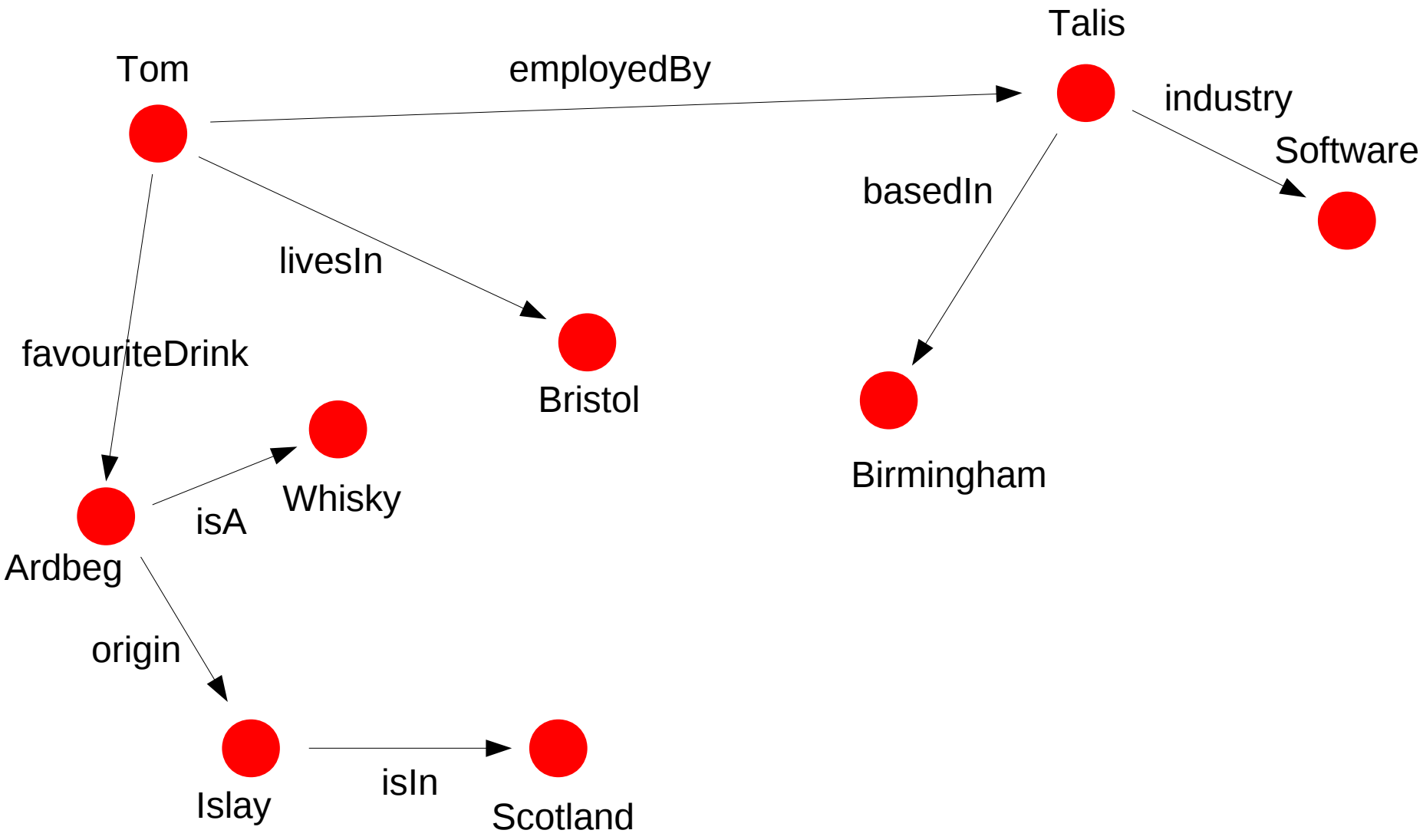
Dr. Tom Heath
Lead Researcher
Talis Systems Ltd

tom.heath@talis.com
http://tomheath.com/id/me

ISO15926 & Semantic Technology Conference, Sogndal, Norway

9 September 2011

About Me


Talis
Tom
employedBy
industry
Software
basedIn
livesIn
favouriteDrink
Bristol
Birmingham
Whisky
isA
Ardbeg
origin
Islay
isIn
Scotland

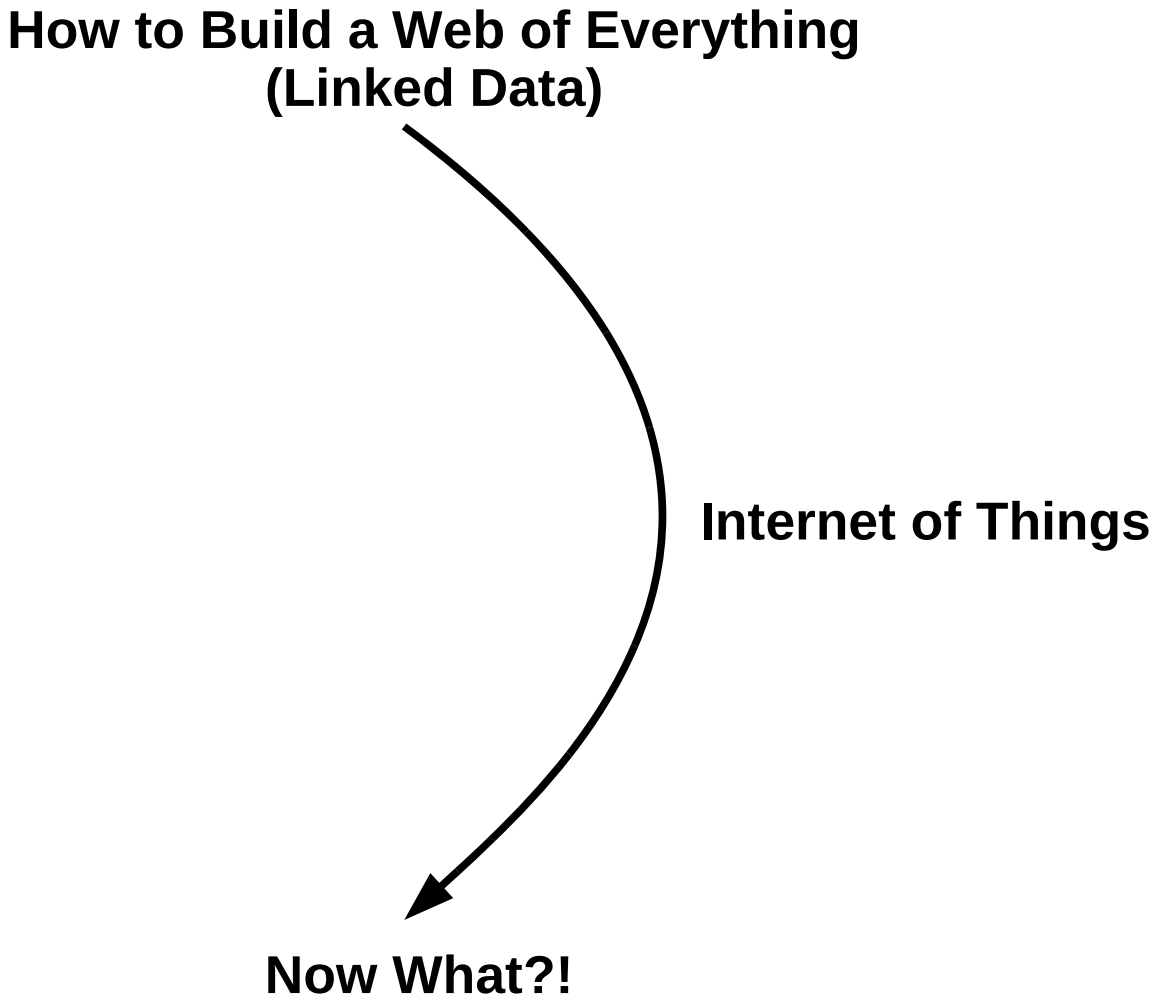
About Talis

- One of the oldest software companies in the UK (kind of)
- Sharing data since the very beginning
- Several distinct businesses in Talis Group
  - Talis Aspire (reading/resource list management for Unis)
  - Kasabi (data marketplace)
  - Talis Consulting
- All predicated on Linked Data / Semantic Web technologies
- All underpinned by a common technology platform

Overview

- How to Build a Web of Everything
  - The Linked Data Backstory
  - Principles, Progress and Publishing
- Linked Data and the Internet of Things
  - [Internet of Things Intro]
  - [Lodometer]
- Now What?
  - Application Architectures and Grand Challenges
  - Implications of Linked Data for Applications
  - The 'Killer App' Question

Overview

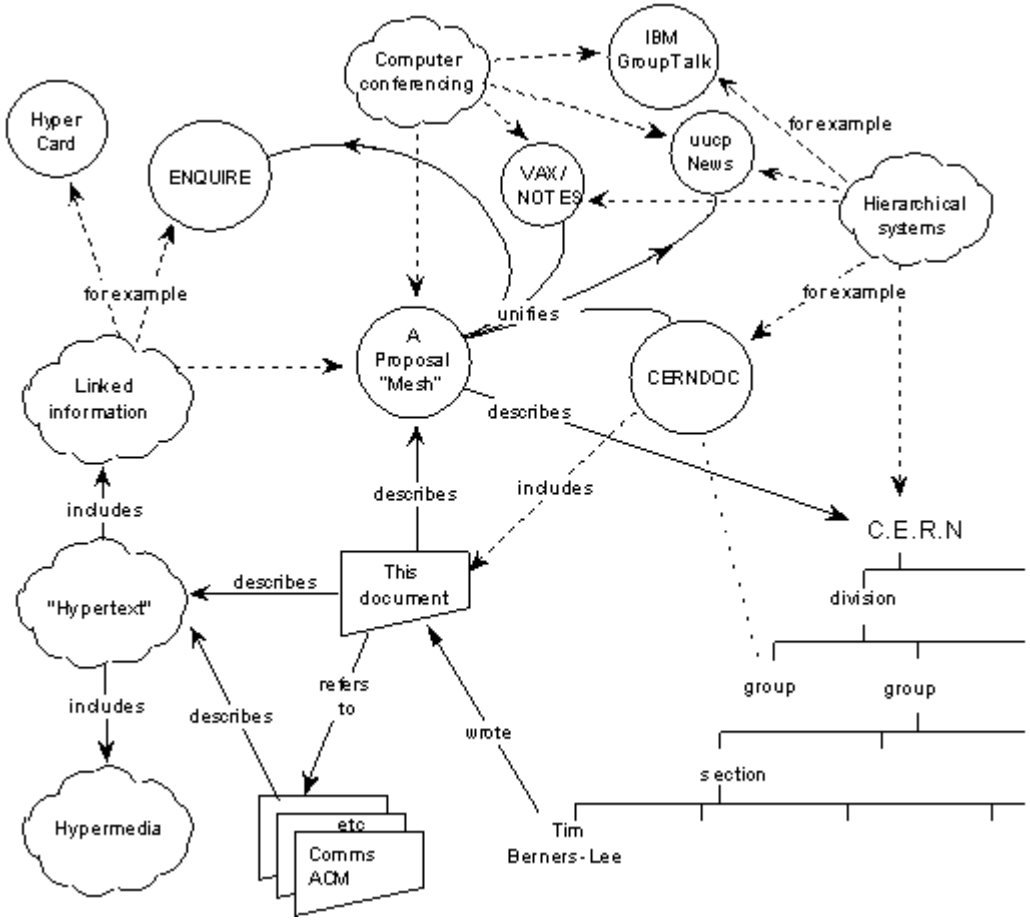

How to Build a Web of Everything
(Linked Data)
Internet of Things
Now What?!

Part 1:
How to Build a Web of Everything

A Web of Everything?

- Web of Documents
- Web of Services and Transactions
  - actually simply services delivered and transactions conducted over the Web
- Web of People
  - aka “Social Web”, actually simply “Networks of People interacting via the Web”
- Web of Data
  - actually a Web of Data about Things
- Web of Everything

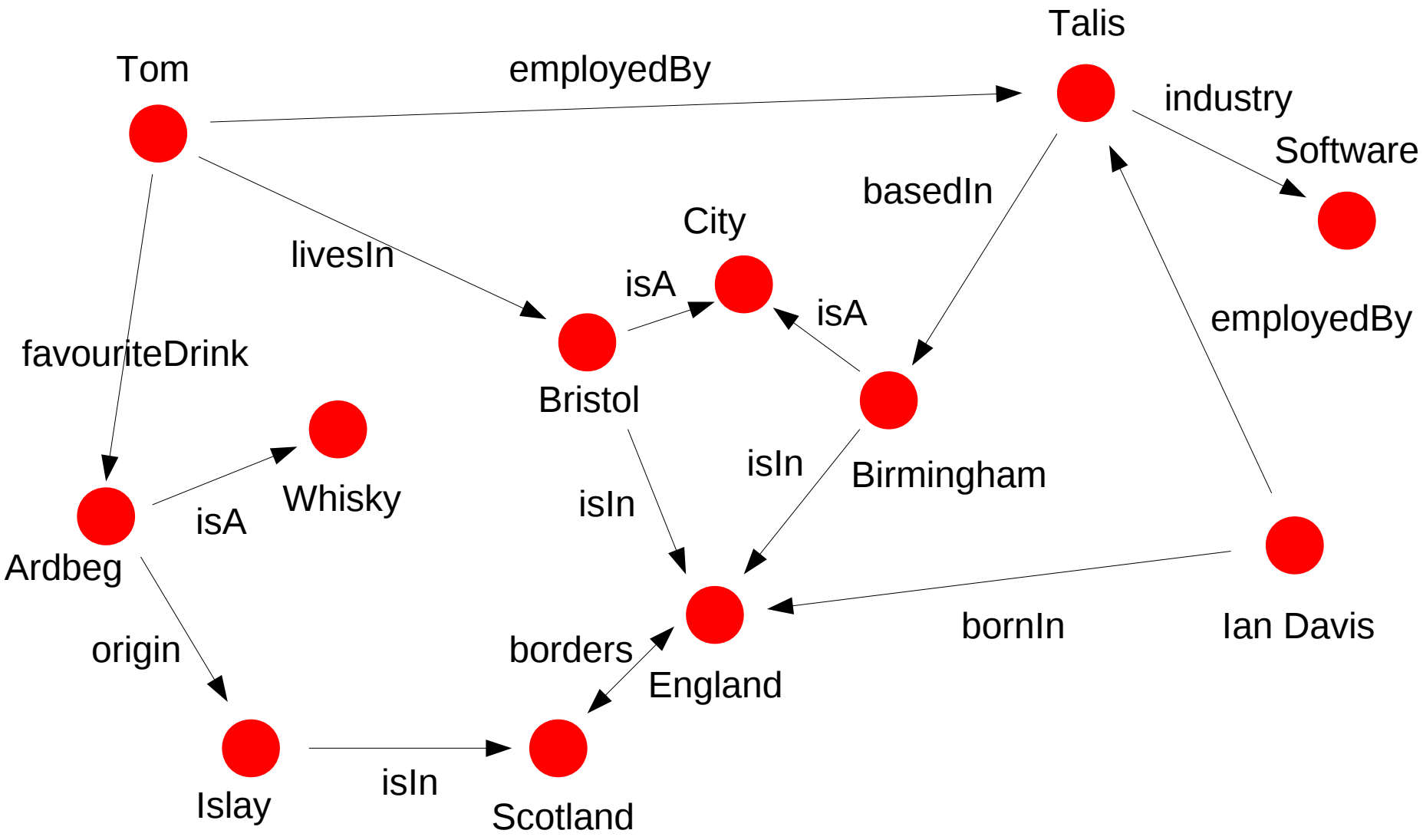
“Information Management: A Proposal”



http://www.w3.org/History/1989/proposal.html

© Tim Berners-Lee, 1989 onwards

Putting Graph Data into the Web



Linked Data Principles (TimBL, 2006)

- Use URIs as names for things
  - for anything, not just for documents
    - e.g. http://dbpedia.org/resource/Talis_Group
  - you are not your homepage
    - c.f. http://tomheath.com/id/me

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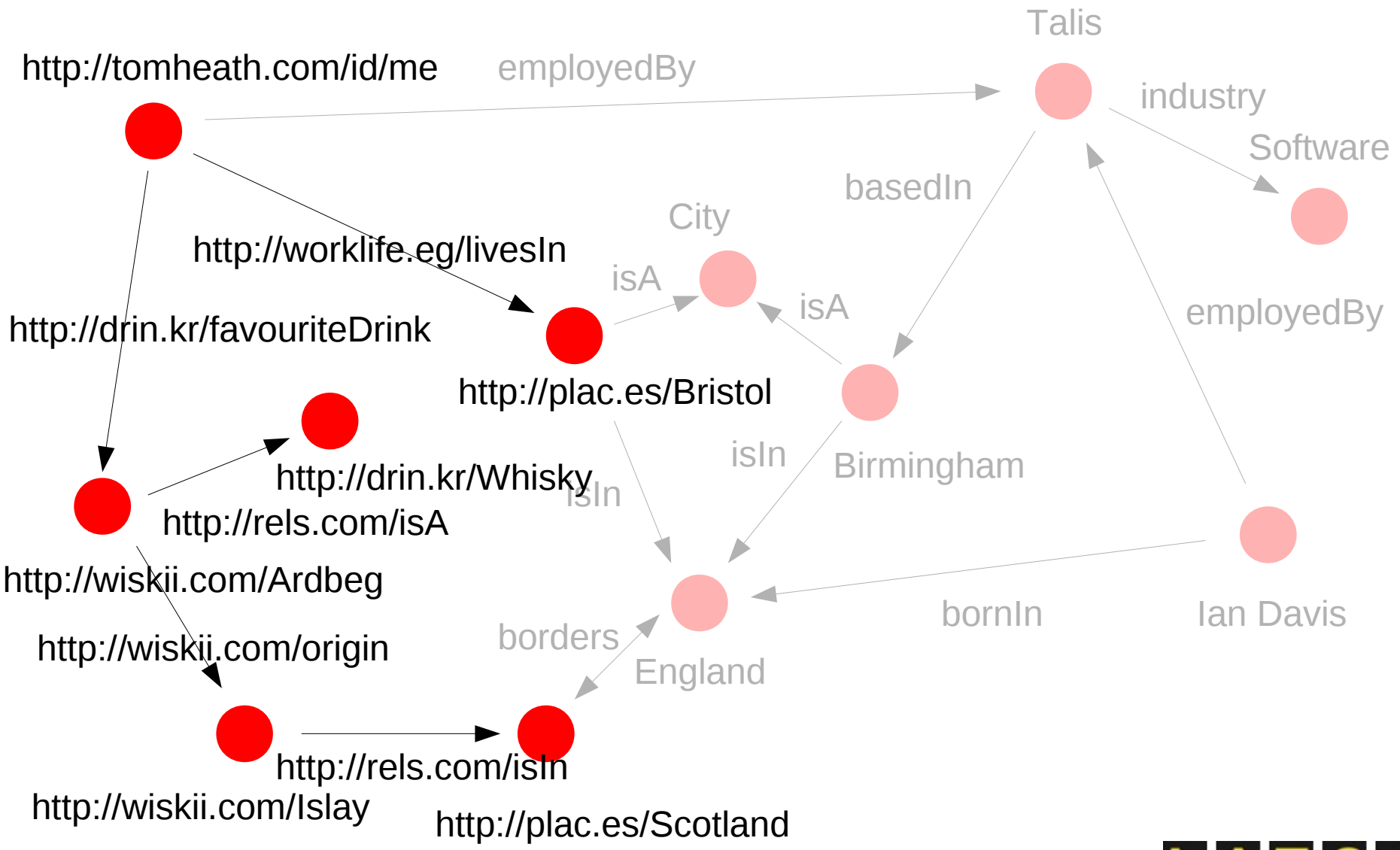
- Use HTTP URIs
  - globally unique names, distributed ownership
  - allows people to look up those names

URIs for All Things (Not Just for Documents)



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- Provide useful information in RDF
  - when someone looks up a URI

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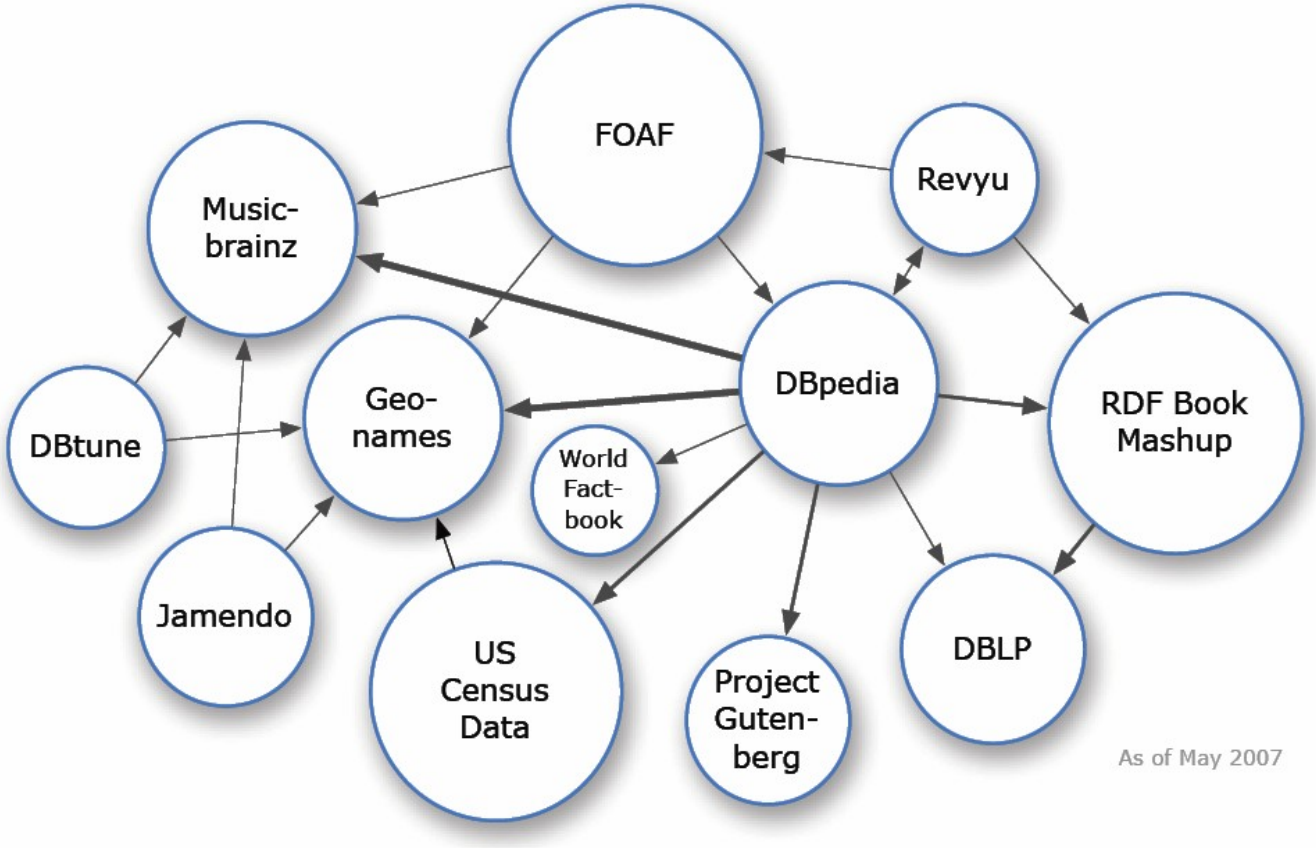
- Provide useful information in RDF
  - when someone looks up a URI
- Include RDF links to other URIs
  - to enable discovery of related information

Linked Data...

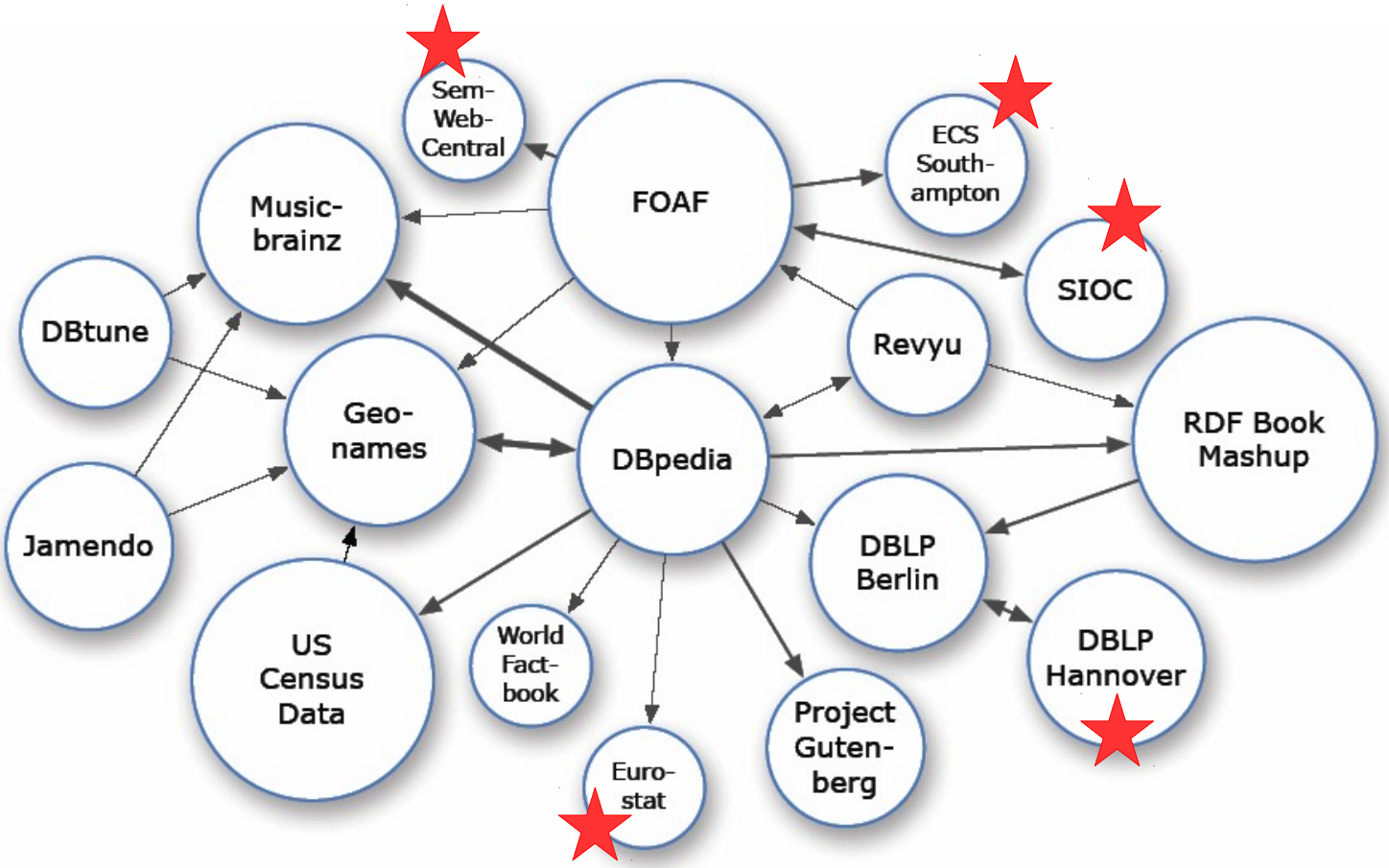
- ...is not just structured data published on the Web
  - not equivalent to CSV files, (plain) XML, database dumps
- ...is a way of putting data *into* the Web
- ...is based on well-established Web standards
- ...can add value
  - less redundancy, greater discoverability, network effects
  - value *does* depend on the use case
- ...is experiencing rapid adoption

LINKINGOPENDATA
W3C SWEO Community Project

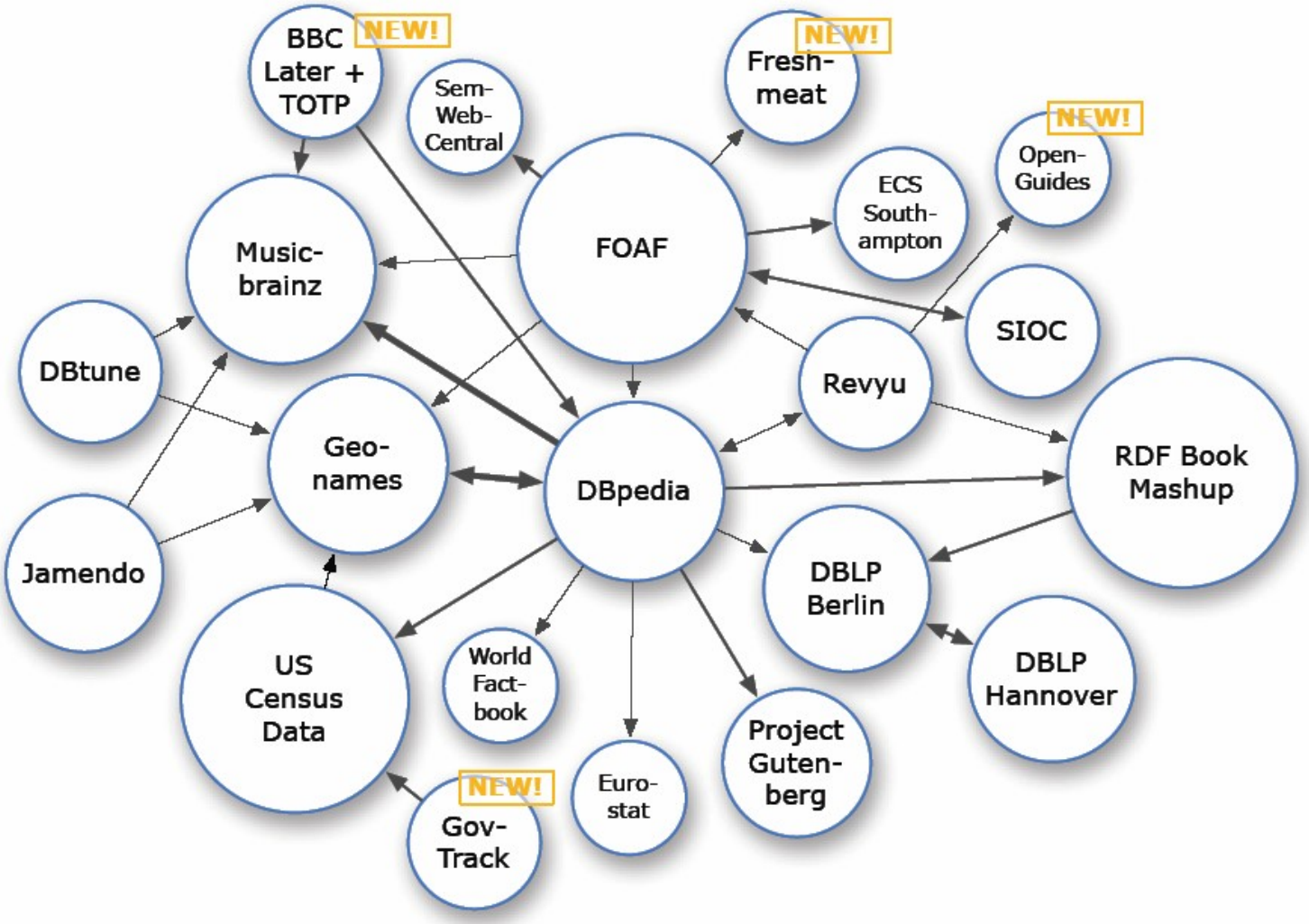
The LOD "Cloud" - May 2007



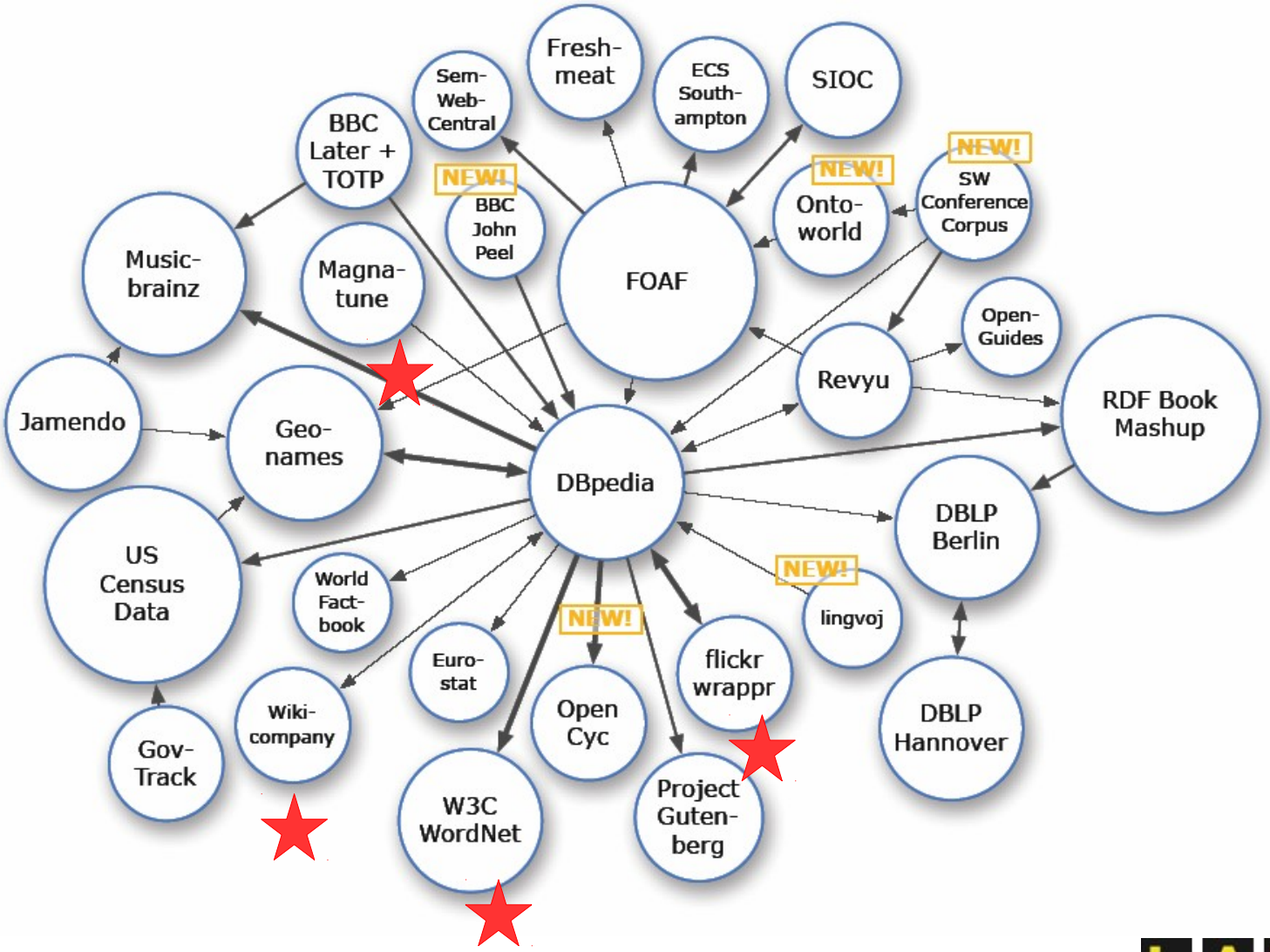
The LOD "Cloud" - July 2007



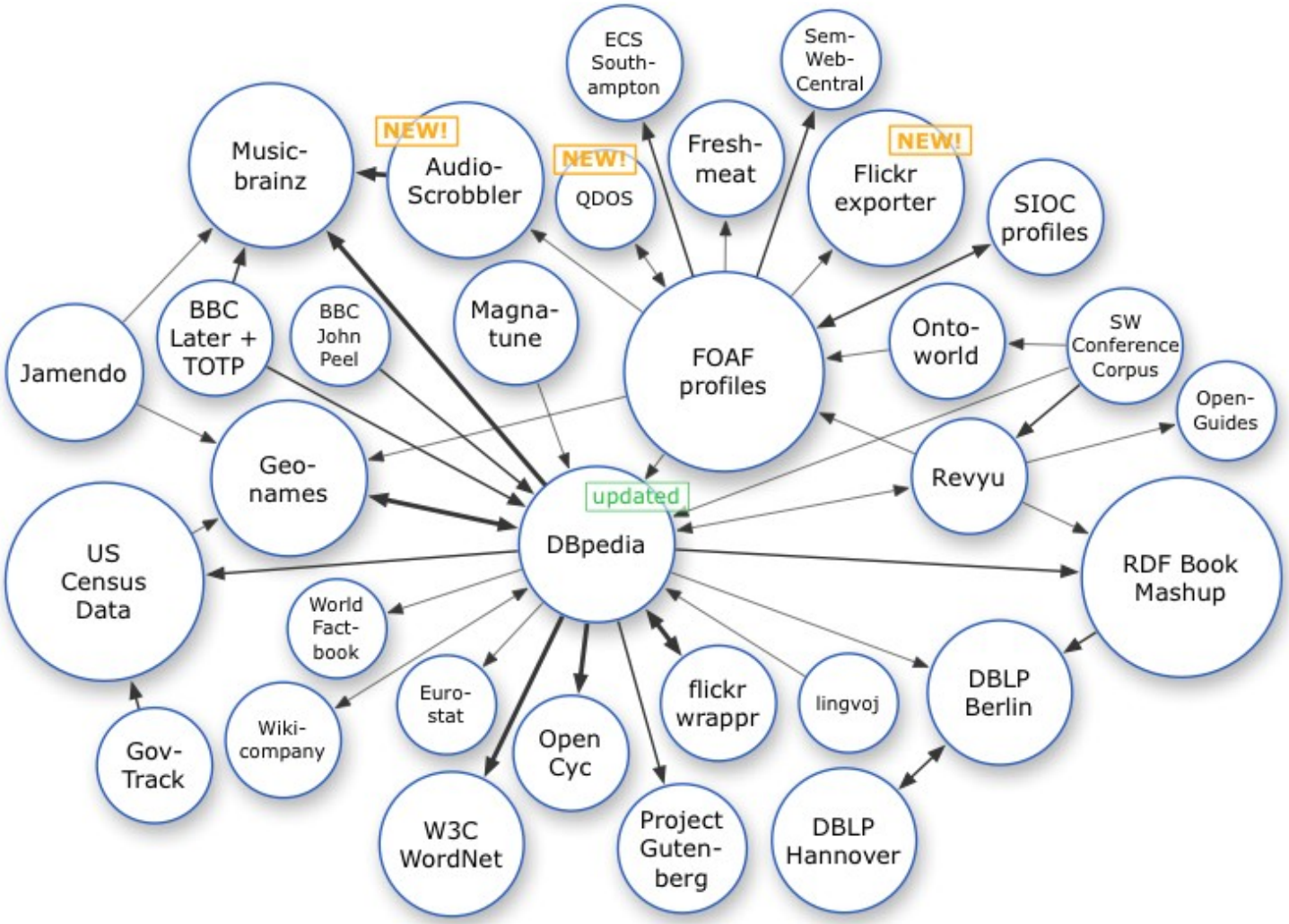
The LOD "Cloud" - August 2007



The LOD "Cloud" - November 2007



The LOD "Cloud" – Feb 2008



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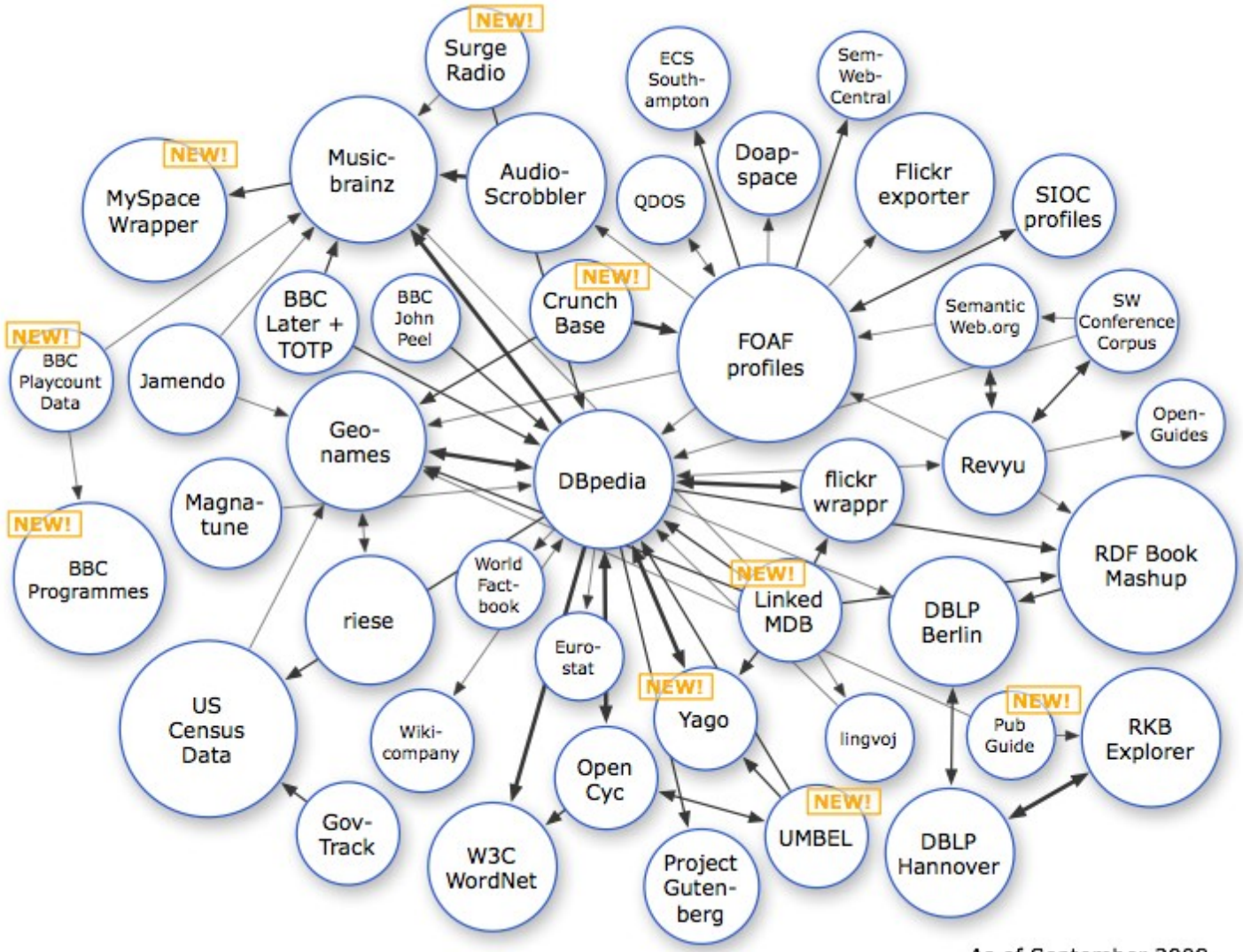
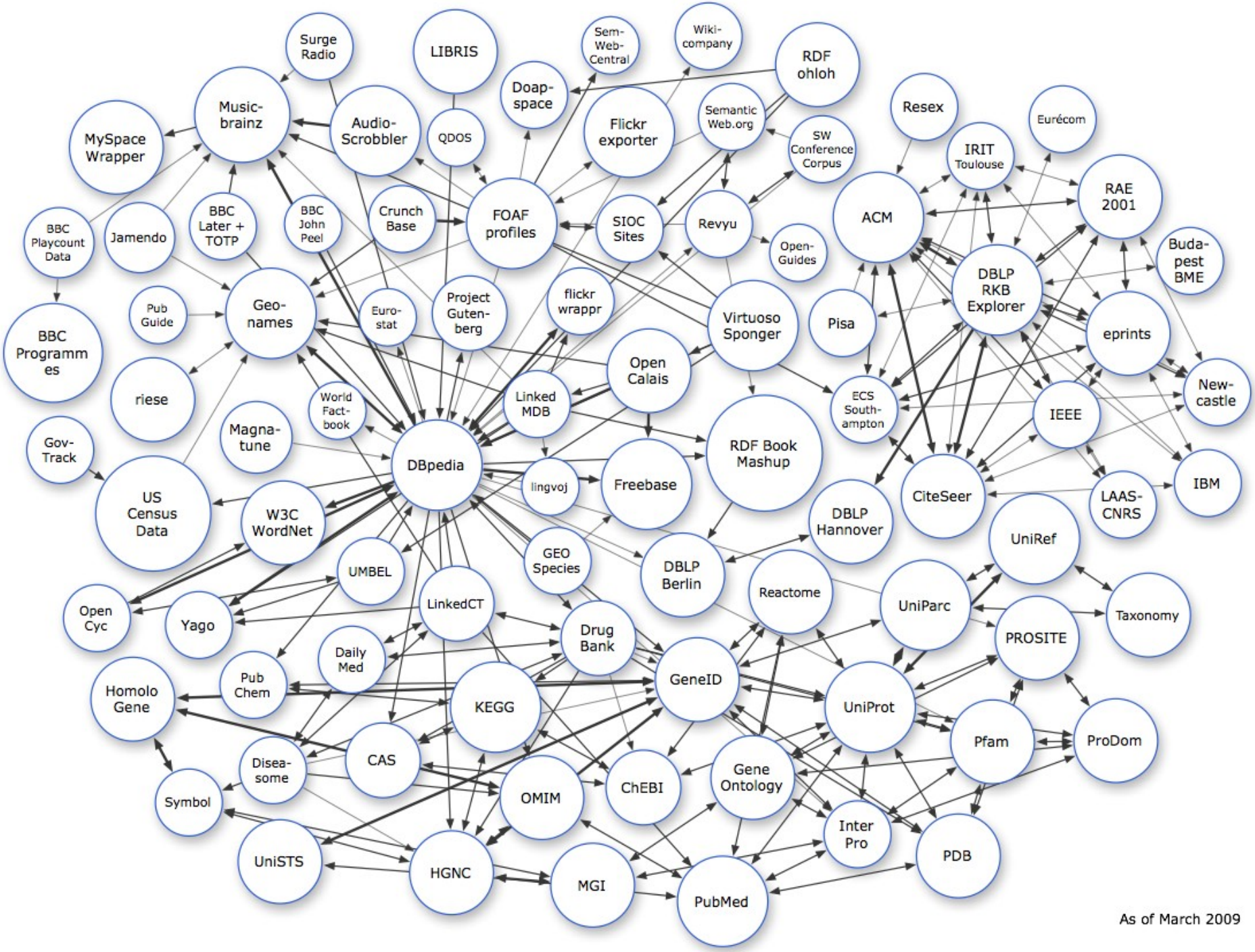
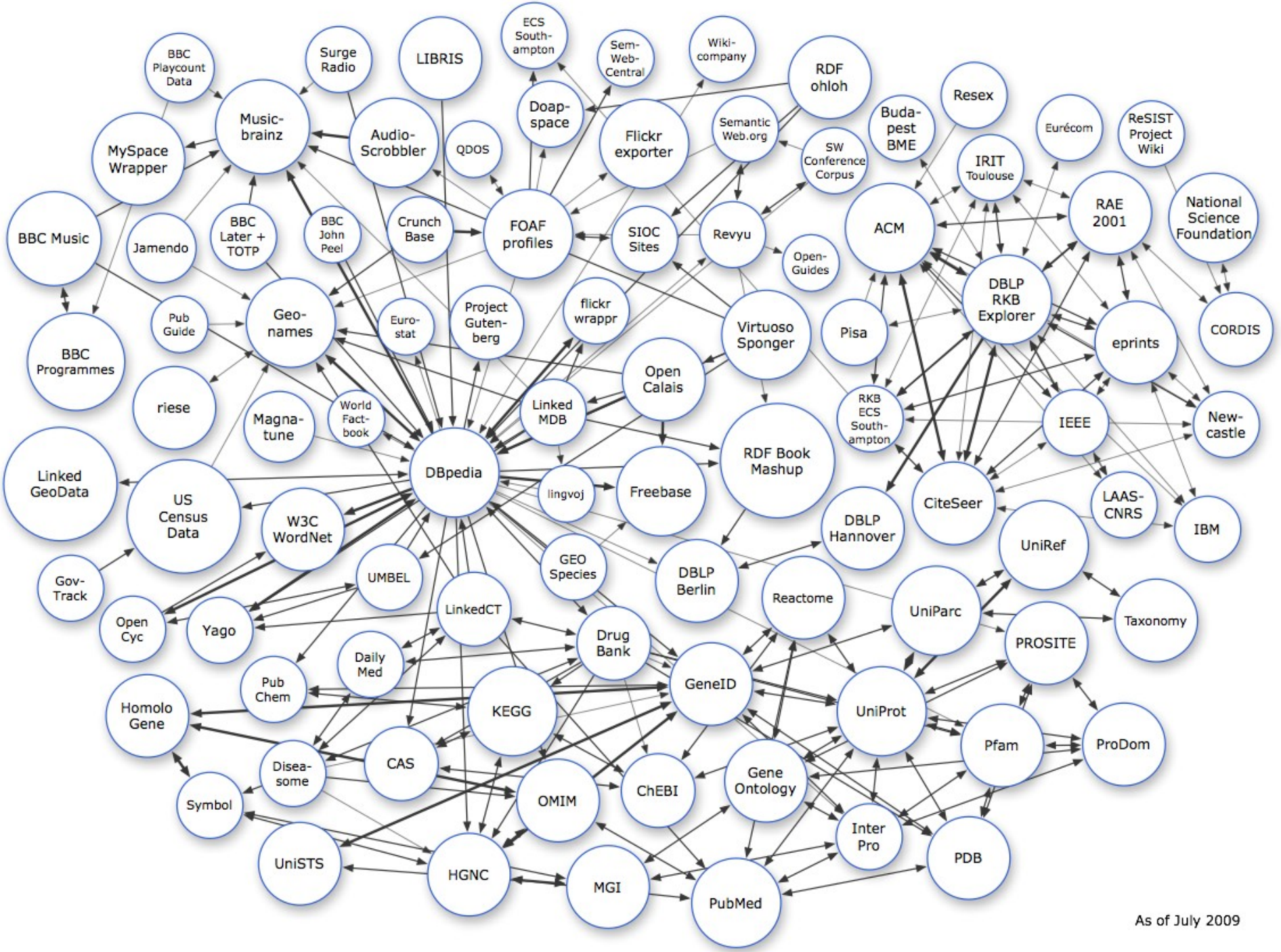
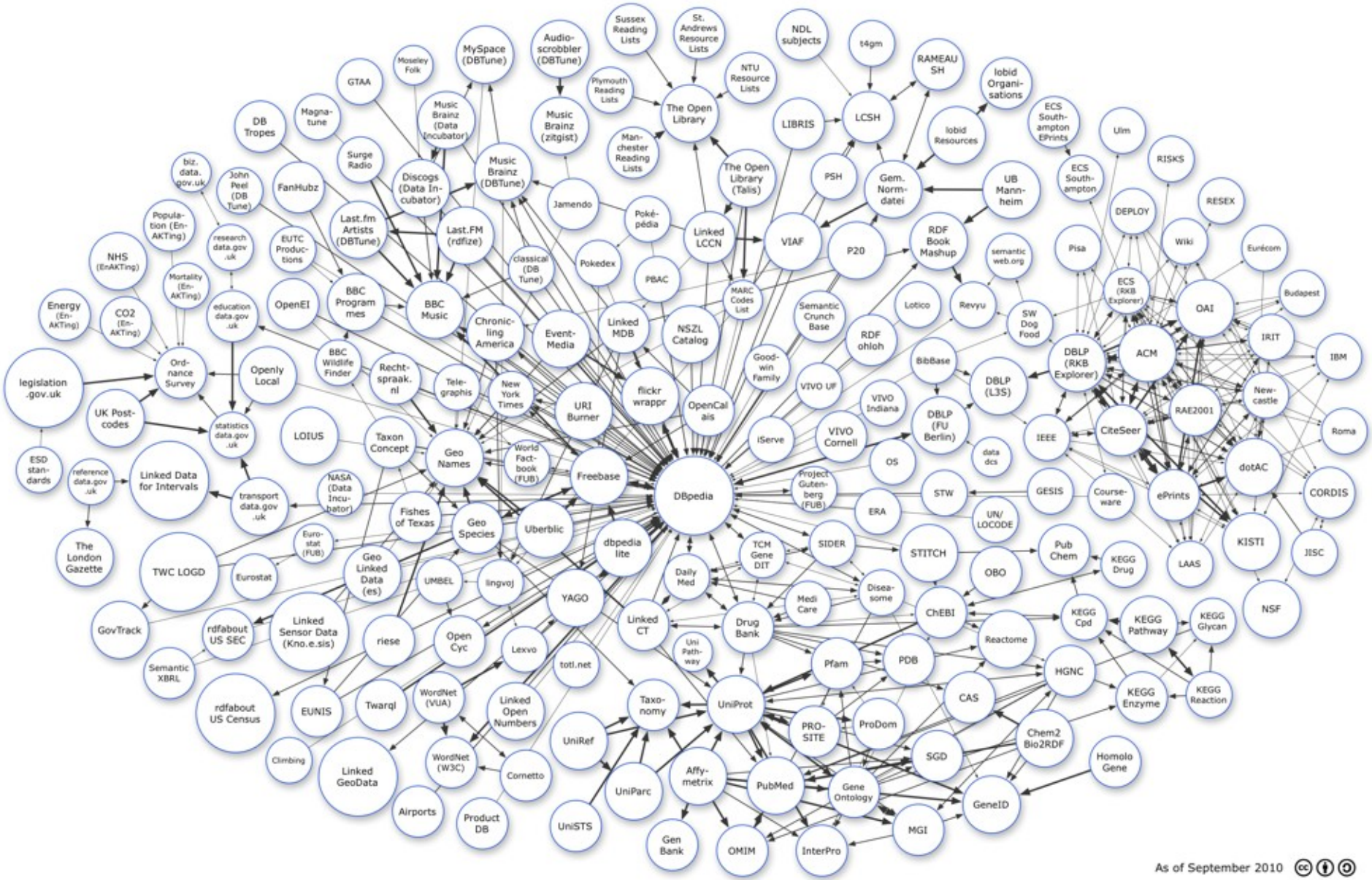



Surge Radio
LIBRIS
Sem-Web-Central
Wiki-company
RDF ohloh
Doap-space
Music-brainz
Audio-Scrobbler
QDOS
Flickr exporter
Semantic Web.org
SW Conference Corpus
Resex
Eurécom
IRIT Toulouse
MySpace Wrapper
BBC Playcount Data
Jamendo
BBC Later + TOTP
BBC John Peel
Crunch Base
FOAF profiles
SIOC Sites
Revyu
Open-Guides
ACM
RAE 2001
Buda-pest BME
BBC Programm es
Pub Guide
Geo-names
Euro-stat
Project Guten-berg
flickr wrappr
Virtuoso Sponger
Pisa
DBLP RKB Explorer
eprints
riese
World Fact-book
Linked MDB
Open Calais
ECS South-ampton
IEEE
New-castle
Gov-Track
Magna-tune
DBpedia
RDF Book Mashup
US Census Data
W3C WordNet
lingvoj
Freebase
CiteSeer
LAAS-CNRS
IBM
DBLP Hannover
UniRef
UMBEL
GEO Species
DBLP Berlin
Reactome
UniParc
Taxonomy
Open Cyc
Yago
LinkedCT
Drug Bank
PROSITE
Daily Med
Pub Chem
GeneID
Homolo Gene
KEGG
UniProt
Pfam
ProDom
Disea-some
CAS
Gene Ontology
Symbol
OMIM
ChEBI
Inter Pro
UniSTS
HGNC
MGI
PubMed
PDB
As of March 2009


BBC Playcount Data
Surge Radio
LIBRIS
ECS South-ampton
Sem-Web-Central
Wiki-company
RDF ohloh
Resex
Buda-pest BME
Eurécom
ReSIST Project Wiki
Music-brainz
Audio-Scrobbler
QDOS
Doap-space
Flickr exporter
Semantic Web.org
SW Conference Corpus
IRIT Toulouse
MySpace Wrapper
BBC Music
Jamendo
BBC Later + TOTP
BBC John Peel
Crunch Base
FOAF profiles
SIOC Sites
Revyu
Open-Guides
ACM
RAE 2001
National Science Foundation
Pub Guide
Geo-names
Euro-stat
Project Guten-berg
flickr wrappr
Virtuoso Sponger
Pisa
DBLP RKB Explorer
eprints
CORDIS
BBC Programmes
riese
Magna-tune
World Fact-book
Linked MDB
Open Calais
RKB ECS South-ampton
IEEE
New-castle
Linked GeoData
US Census Data
DBpedia
lingvoj
Freebase
RDF Book Mashup
CiteSeer
LAAS-CNRS
IBM
Gov-Track
W3C WordNet
UMBEL
GEO Species
DBLP Berlin
DBLP Hannover
UniRef
Reactome
UniParc
Taxonomy
Open Cyc
Yago
LinkedCT
Drug Bank
PROSITE
Daily Med
GeneID
Pub Chem
KEGG
UniProt
Homolo Gene
Pfam
ProDom
Disea-some
CAS
Gene Ontology
Symbol
OMIM
ChEBI
Inter Pro
UniSTS
HGNC
MGI
PubMed
PDB
As of July 2009


Sussex Reading Lists
St. Andrews Resource Lists
NDL subjects
t4gm
RAMEAU SH
lobid Organi-sations
MySpace (DBTune)
Audio-scrobbler (DBTune)
Moseley Folk
GTAA
Plymouth Reading Lists
NTU Resource Lists
The Open Library
LIBRIS
LCSH
ECS South-ampton EPrints
Ulm
Magna-tune
DB Tropes
Music Brainz (Data Incubator)
Music Brainz (zitgist)
Man-chester Reading Lists
lobid Resources
RISKS
Surge Radio
Discogs (Data In-cubator)
Music Brainz (DBTune)
The Open Library (Talis)
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ECS South-ampton
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FanHubz
Jamendo
Poké-pédia
DEPLOY
RESEX
Popula-tion (En-AKTing)
Last.fm Artists (DBTune)
Last.FM (rdfize)
Linked LCCN
VIAF
P20
RDF Book Mashup
Wiki
Pisa
Eurécom
NHS (EnAKTing)
research data.gov .uk
EUTC Produc-tions
classical (DB Tune)
Pokedex
PBAC
semantic web.org
ECS (RKB Explorer)
Budapest
Energy (En-AKTing)
Mortality (En-AKTing)
BBC Programmes
BBC Music
MARC Codes List
Semantic Crunch Base
Lotico
Revyu
SW Dog Food
OAI
CO2 (En-AKTing)
education data.gov .uk
OpenEI
Chronic-ling America
Event-Media
Linked MDB
NSZL Catalog
RDF ohloh
BibBase
DBLP (RKB Explorer)
ACM
IRIT
IBM
legislation .gov.uk
Ord-nance Survey
Openly Local
BBC Wildlife Finder
Recht-spraak. nl
Tele-graphis
New York Times
URI Burner
flickr wrappr
OpenCal ais
Good-win Family
VIVO UF
VIVO Indiana
DBLP (L3S)
New-castle
UK Post-codes
statistics data.gov .uk
LOIUS
Taxon Concept
Geo Names
World Fact-book (FUB)
Freebase
DBpedia
iServe
VIVO Cornell
DBLP (FU Berlin)
IEEE
CiteSeer
RAE2001
Roma
ESD stan-dards
reference data.gov .uk
Linked Data for Intervals
transport data.gov .uk
NASA (Data Incu-bator)
Project Guten-berg (FUB)
OS
data dcs
dotAC
CORDIS
Fishes of Texas
Geo Species
Uberblic
dbpedia lite
STW
GESIS
Course-ware
ePrints
The London Gazette
Euro-stat (FUB)
ERA
UN/ LOCODE
KISTI
JISC
TWC LOGD
Eurostat
Geo Linked Data (es)
UMBEL
lingvoj
YAGO
Daily Med
TCM Gene DIT
SIDER
STITCH
OBO
Pub Chem
KEGG Drug
LAAS
GovTrack
Linked Sensor Data (Kno.e.sis)
Open Cyc
Linked CT
Drug Bank
Medi Care
Disea-some
ChEBI
KEGG Cpd
KEGG Pathway
KEGG Glycan
NSF
Semantic XBRL
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totl.net
Uni Path-way
Pfam
PDB
Reactome
HGNC
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WordNet (VUA)
Linked Open Numbers
Taxo-nomy
UniProt
CAS
Climbing
Linked GeoData
WordNet (W3C)
Cornetto
UniRef
PRO-SITE
ProDom
SGD
Chem2 Bio2RDF
Homolo Gene
Airports
Product DB
UniParc
Affy-metrix
PubMed
Gene Ontology
GeneID
UniSTS
Gen Bank
OMIM
InterPro
MGI
As of September 2010

The Sky at Night

Reporting on the latest cosmological events and the people who observe them

WEBSITE: **Go to the homepage for 'The Sky at Night'**
PREVIOUS PROGRAMMES: **by year** (78)

Coming up

Sorry, no programmes coming up.

More from BBC One

- Factual > Science & Nature

Last on

Star Birth
MORE: **programme information** | **related links**
Broadcast **Saturday, 14:10** on **BBC Two (except Northern Ireland (Analogue), Wales (Analogue))** but **no longer available** on BBC iPlayer.
A look at new images of star-forming areas of our galaxy from the Herschel telescope.

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WILDLIFE FINDER

WATCH THE MOST AMAZING ANIMALS IN THE WORLD

BBC Nature

LATEST WILDLIFE

3 programmes
they perch upright
16 June 2010

Gharial
1 sound 1 programme
Gharials are once again on the verge of extinction in the wild. After 30 years of conservation effort and restocking, there may still be fewer than 200 breeding adults left in the wild.
16 June 2010

Mute swan
Mute swans are a familiar
and other urban areas.

COLLECTIONS

Collections offer a new perspective on the vast catalogue of clips showcasing presenter favourites, aspects of wildlife film-making, and gathering content together in illuminating ways.

Brilliant bees
Bees are amazing - not only do they fulfil a vital role in our ecosystem, they are one of the most complex and sophisticated living things in the history of evolution.

Wildlife wind-ups

EDITOR'S CHOICE

Spotted any ravens lately? Or a black red fox? Take a look at who's featuring on Springwatch.

Raven 3 videos

Otter 11 videos

WELCOME TO WILDLIFE FINDER

Explore a wealth of video, sounds, stories and breaking news on your favourite animals, and find out more about how and where they live.

Wildlife Finder gives you access to an ever growing catalogue of BBC natural history programmes, with video clips from series such as: Planet Earth, Blue Planet, Life on Earth, Natural World, Life and many more.

WHAT'S NEW?

10 June 2010

DATA.GOV
EMPOWERING PEOPLE

Most Popular Datasets

1. US Topo 7.5-minute map for Imperial, TX
2. U.S. Overseas Loans and Grants (Greenbook)
3. Worldwide M1+ Earthquakes, Past 7 Days
4. Latest Volumes of Foreign Relations of the...
5. Import/Export Price Indexes

SEARCH OUR CATALOGS

Search our catalogs.. SEARCH

APPS

With so much government data to work with, developers are creating a wide variety of applications, mashups, and visualizations. From crime statistics by neighborhood to the best towns to find a job to seeing the environmental health of your community–these applications arm citizens with the information they need to

COMMUNITY

Data.gov is leading the way in democratizing public sector data and driving innovation. The data is being surfaced from many locations making the Government data stores available to researchers to perform their own analysis. Developers are finding good uses for the datasets, providing interesting and useful applications that allow for new views and public analysis. This is a work in progress, but this movement is spreading to cities, states, and other countries. After just one year a community is born around open government data.

Just look at the numbers:

6 Other nations establishing open data
8 States now offering data sites

SEMANTIC WEB

As the Web of linked documents evolves to include the Web of linked data, we're working to maximize the potential of Semantic Web technologies to realize the promise of Linked Open Government Data.

Thanks to our collaboration with the **Tetherless World Constellation** at the **Rensselaer Polytechnic Institute**, Data.gov is now hosting one of the largest open collections of RDF datasets in the world! Check out some of their

HM Government

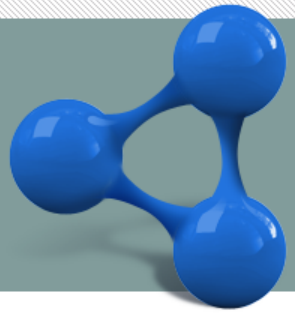
data.gov.uk

BETA

Home | Blog | Data | SPARQL | Apps | Ideas | Forum | Wiki | Resources | About

Unlocking innovation

Working with UK Public Sector information and data



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Local Data Panel

Latest datasets

14 June	More COINS public spending data: now covers 2005 to 2010
10 June	Lists of all Special Advisers and Cabinet Office staff
4 June	COINS database of Public Spending
2 June	NHS Weekly MRSA and C-Difficile dataset
1 June	Senior Civil Servants with salaries over £150,000

What we do

data.gov.uk is a key part of the Government's Transparency programme for the UK public sector as a whole. Working with Sir Tim Berners-Lee, Professor Nigel Shadbolt and Tom Steinberg and other members of the Cabinet Office Minister's new Public Sector Transparency Board this site seeks to give a way into the wealth of government data becoming available. It's under constant development and we want to work with you to make it better.

What is the Semantic Web?

Combining different data sources has never been easy but the Semantic Web will enable data to be joined easily across boundaries.

Read more

Digital Engagement Twitter stream

RT

LATC

Datasets: energy

Keyword search

Search within results

Search More options

Current search

[×] energy

Guided search

Click a term to refine your current search.

Nation
England (111)
Scotland (106)
Wales (105)
Northern Ireland (93)

Public body
Department of Energy and Climate Change (45)
Department for Business (13)
Innovation and Skills (13)
Scottish Government (9)
Northern Ireland Executive (5)
Department for Communities and Local Government (4)
Department for Environment (2)
Food and Rural Affairs (2)
Her Majesty's Revenue and Customs (2)
Home Office (2)
more...

Tags
business-and-energy (91)

Results 1 - 10 of 128

Energy Consumption in the UK

This publication brings together **energy** consumption data for previous year from a variety of different sources in order to give a comprehensive view of how **energy** has been used in the UK since the 1970s. The publication is divided ...

Tags: energy transport

UK Energy Sector Indicators: key and supporting indicators

... of the gas and electricity markets; the structure of the **energy** market; and fuel poverty. Supporting indicators, explain in more detail ... by the key indicators, as well as covering carbon and **energy** intensity; gas and electricity capacity; the diversity of fuels used in ...

Tags: electricity emissions energy fuel gas green greenhouse-gas housing

High Level Indicators of Energy Use at Regional and Local Authority Level

Indicators of regional **energy** use compared with a variety of socio-economic variables Source agency: **Energy** and Climate Change Designation: Official Statistics not designated ... Language: English Alternative title: Regional **energy** high level indicators Overview ...

Tags: business-and-energy business-and-industry energy energy-and-fuel energy-production-and-consumption indicator regional

Energy Trends

Provides statistics on **energy** in the United Kingdom which provides a

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Local Data Panel

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Read more

Digital Engagement Twitter stream

RT

@RosslynAnalytic We'll have #COINS ready in web analytics for everyone in hours. bit.ly/9Z5Etp <-and they did: well done

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Tell us your idea

Ordnance Survey Linked Data

A description of the resource identified by **http://data.ordnancesurvey.co.uk/**

Title	Ordnance Survey Linked Data
Description	Ordnance Survey is Great Britain's national mapping agency, providing the most accurate and up-to-date geographic data, relied on by government, business and individuals. OS OpenData is the opening up of Ordnance Survey data as part of the drive to increase innovation and support the "Making Public Data Public" initiative. As part of this initiative Ordnance Survey has published a number of its products as Linked Data. Linked Data is a growing part of the Web where data is published on the Web and then linked to other published data in much the same way that web pages are interlinked using hypertext. The term Linked Data is used to describe a method of exposing, sharing, and connecting data via URIs on the Web. To find more Linked Data published as part of this initiative please go to data.gov.uk . If you are not familiar with Linked Data, OS OpenData products are also available in alternative formats from the OS OpenData website. Ordnance Survey can provide support for the Ordnance Survey OpenData products, but cannot give advice or support on using RDF, SPARQL or SPARQL Endpoints. Ordnance Survey has published two separate linked data resources: the 1:50 000 Scale Gazetteer and the administrative gazetteer for Great Britain.
Creator	Ordnance Survey
Date issued	2010-04-01
Example resource	Southampton Portswood Southampton, Itchen The County of Hampshire The City of Southampton Southampton Common
SPARQL endpoint	Sparql
URI lookup point	Meta?about=
Vocabulary used	Spatial Relations Ontology Administrative Geography Ontology WGS84 Geo Positioning FOAF OWL Gazetteer Ontology
URI regex pattern	http://data.ordnancesurvey.co.uk/id/.+
See also	data.gov.uk

The Open Graph Protocol

Introduction

The Open Graph protocol enables any web page to become a rich object in a social graph. For instance, this is used on Facebook to enable any web page to have the same functionality as a Facebook Page.

While many different technologies and schemas exist and could be combined together, there isn't a single technology which provides enough information to richly represent any web page within the social graph. The Open Graph protocol builds on these existing technologies and gives developers one thing to implement. Developer simplicity is a key goal of the Open Graph protocol which has informed many of the technical design decisions.

Basic metadata

To turn your web pages into graph objects, you need to add basic metadata to your page. We've based the initial version of the protocol on RDFa which means that you'll place additional `<meta>` tags in the `<head>` of your web page. The four required properties for every page are:

- `og:title` - The title of your object as it should appear within the graph, e.g., "The Rock".
- `og:type` - The type of your object, e.g., "movie". Depending on the type you specify, other properties may also be required.
- `og:image` - An image URL which should represent your object within the graph.

schema.org

Search

Home Schemas Documentation

What is Schema.org?

This site provides a collection of schemas, i.e., html tags, that webmasters can use to markup their pages in ways recognized by major search providers. Search engines including Bing, Google and Yahoo! rely on this markup to improve the display of search results, making it easier for people to find the right web pages.

Many sites are generated from structured data, which is often stored in databases. When this data is formatted into HTML, it becomes very difficult to recover the original structured data. Many applications, especially search engines, can benefit greatly from direct access to this structured data. On-page markup enables search engines to understand the information on web pages and provide richer search results in order to make it easier for users to find relevant information on the web. Markup can also enable new tools and applications that make use of the structure.

A shared markup vocabulary makes easier for webmasters to decide on a markup schema and get the maximum benefit for their efforts. So, in the spirit of sitemaps.org, Bing, Google and Yahoo! have come together to provide a shared collection of schemas that webmasters can use.

We invite you to get started!

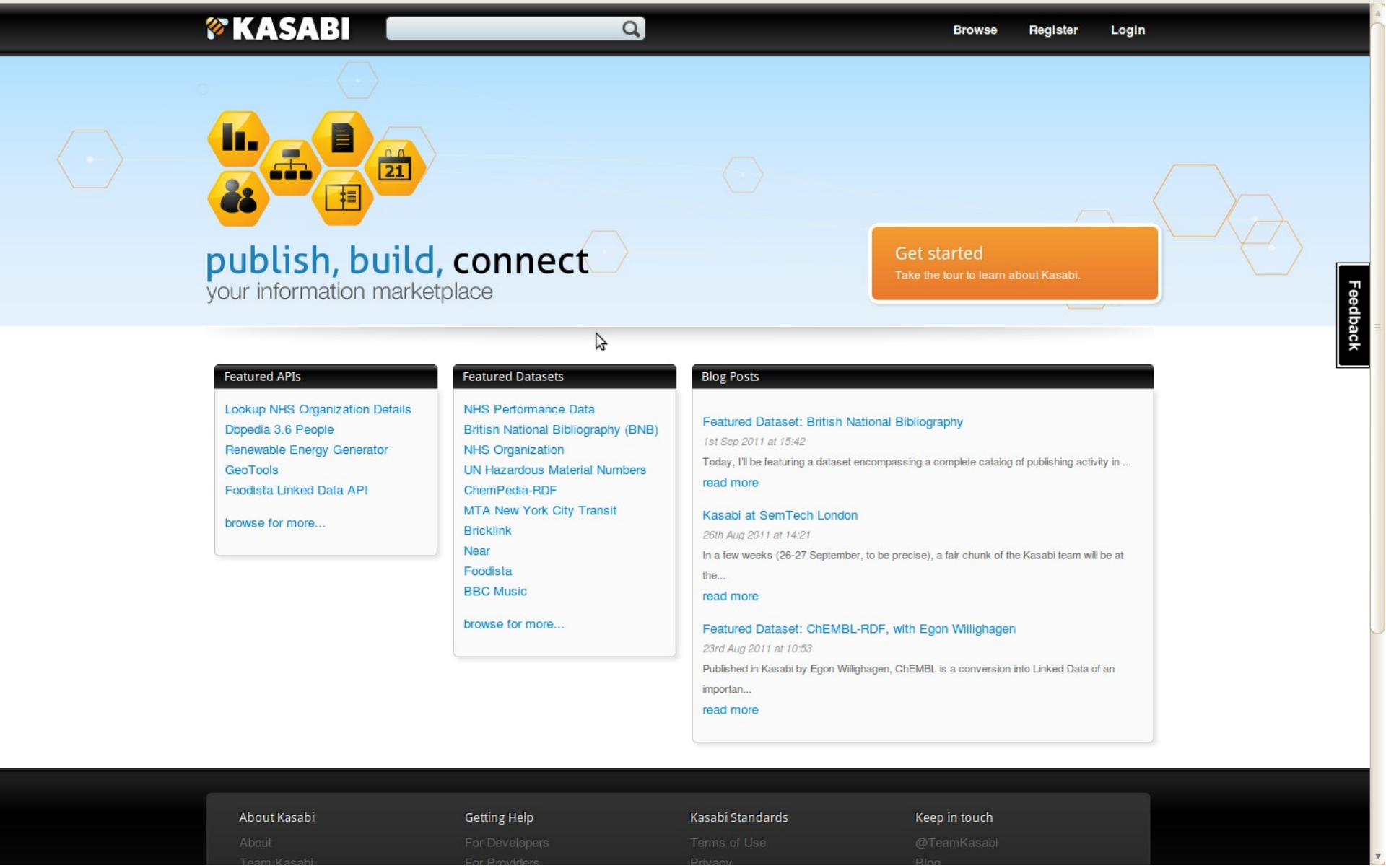
New! View our blog at blog.schema.org.

Last Updated: 21 Jul 2011

Terms and conditions

Google YAHOO! UK bing™

LATC



- http://kasabi.com/

Linked Data *cf.* Open Data *cf.* Linked Open Data

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http://www.opendefinition.org/

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    http://www.opendefinition.org/
- Openness is not on the critical path to Linked Data adoption

Linked Data Publishing Patterns

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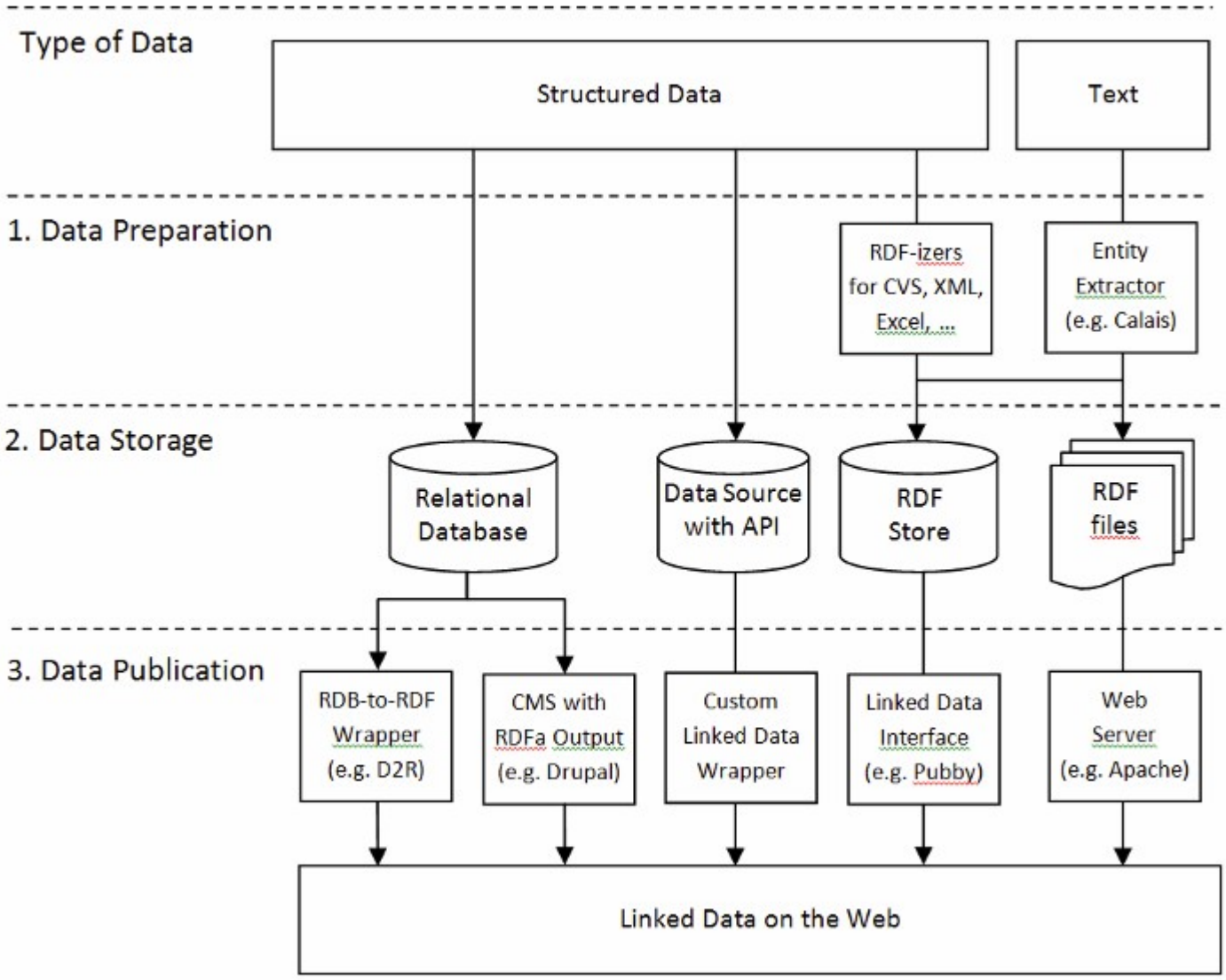


Source: Heath and Bizer (2011)

Six Steps to Publishing Linked Data

Six Steps to Publishing Linked Data

1. Understand the Principles
2. Model Your Data
3. Choose URIs for Things in your Data
4. Setup Your Infrastructure
5. Link to other Data Sets
6. Describe and Publicise your Data

1. Linked Data Principles: Redux

- Use URIs as names for things
- Use HTTP URIs
- Provide useful information in RDF
- Include RDF links to other URIs

2. Model Your Data

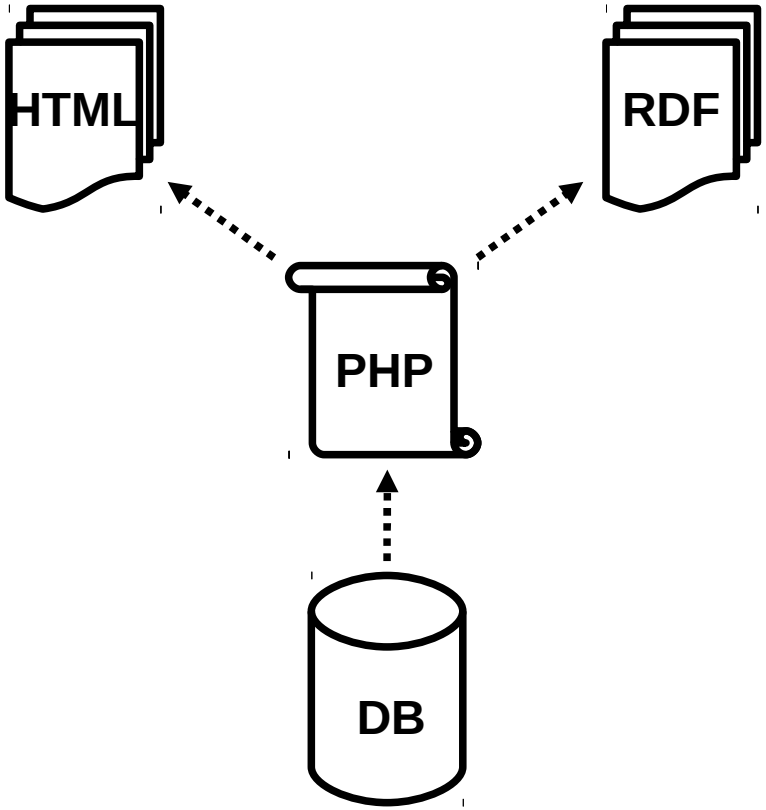
- What vocabularies can be used to describe your data?
  - Topical coverage
  - Breadth of adoption
  - Maintenance, documentation
  - How are you going to query it?
  - Reasoning implications
- Principles
  - Reuse wherever possible, don't reinvent
  - Mix liberally

3. Choosing URIs: Common Patterns

- http://dbpedia.org/resource/New_York_City ← Thing
- http://dbpedia.org/data/New_York_City ← RDF data
- http://dbpedia.org/page/New_York_City ← HTML page

- http://mydomain.com/thing ← Thing
- http://mydomain.com/thing.rdf ← RDF data
- http://mydomain.com/thing.html ← HTML page

4. Setup Your Infrastructure



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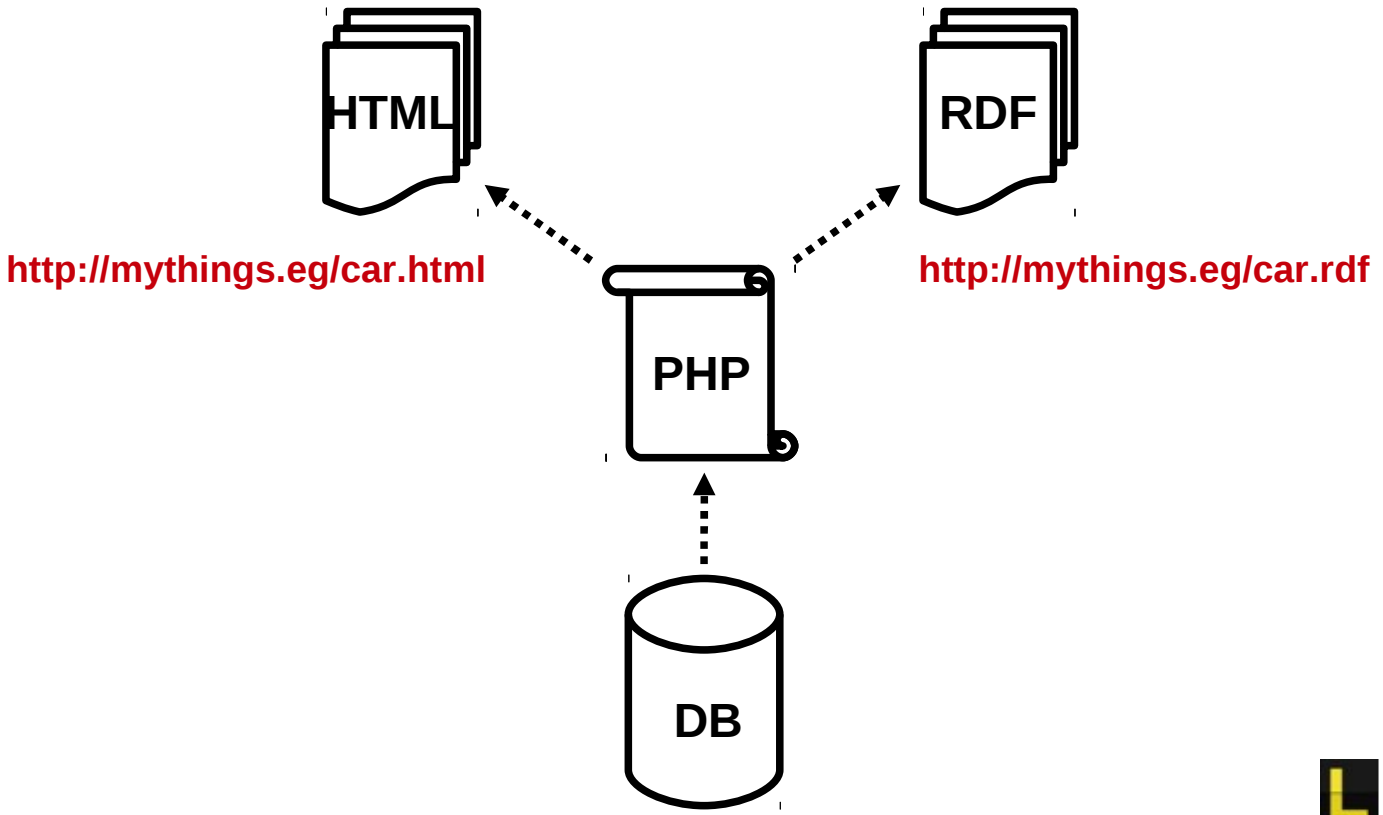

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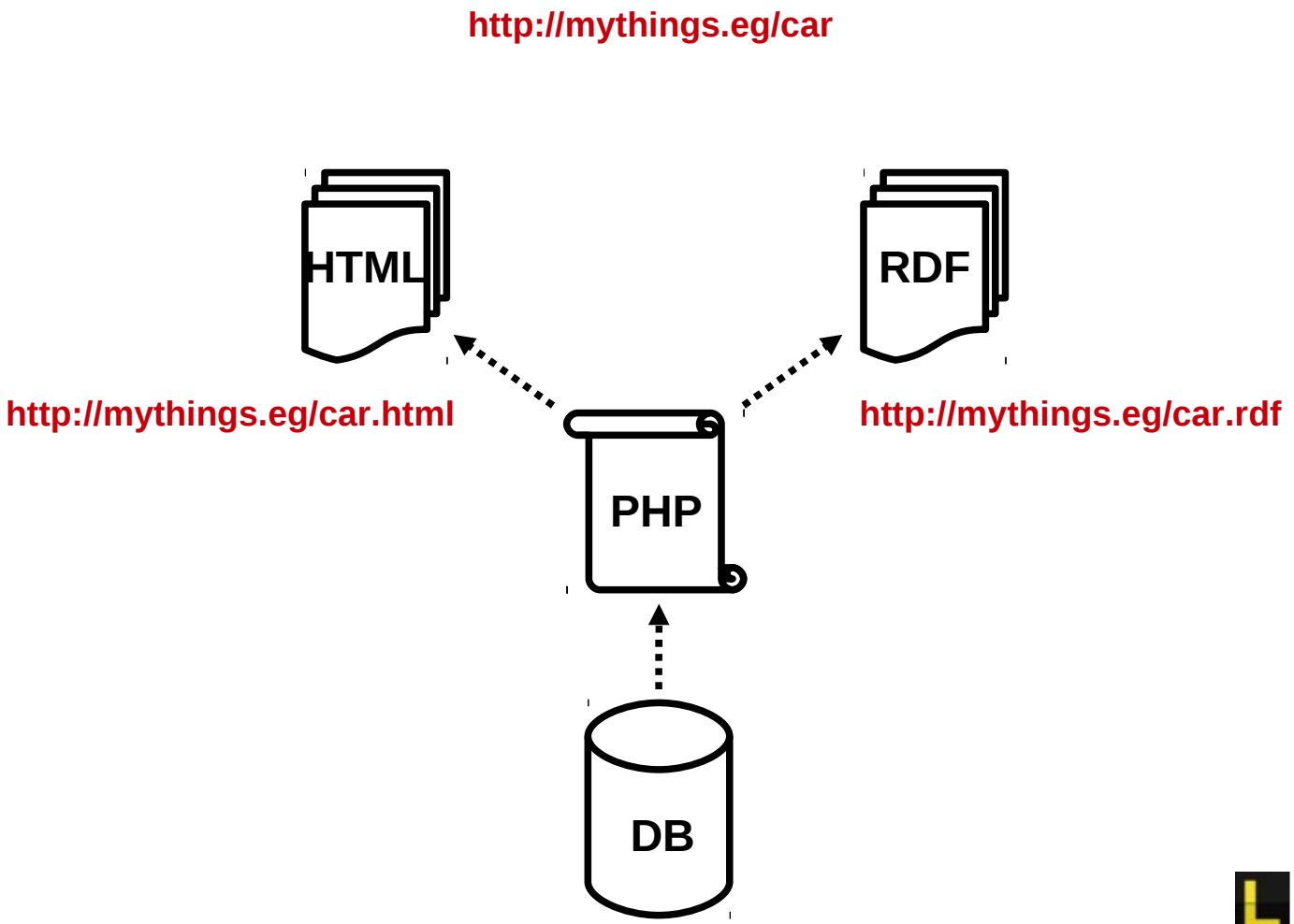

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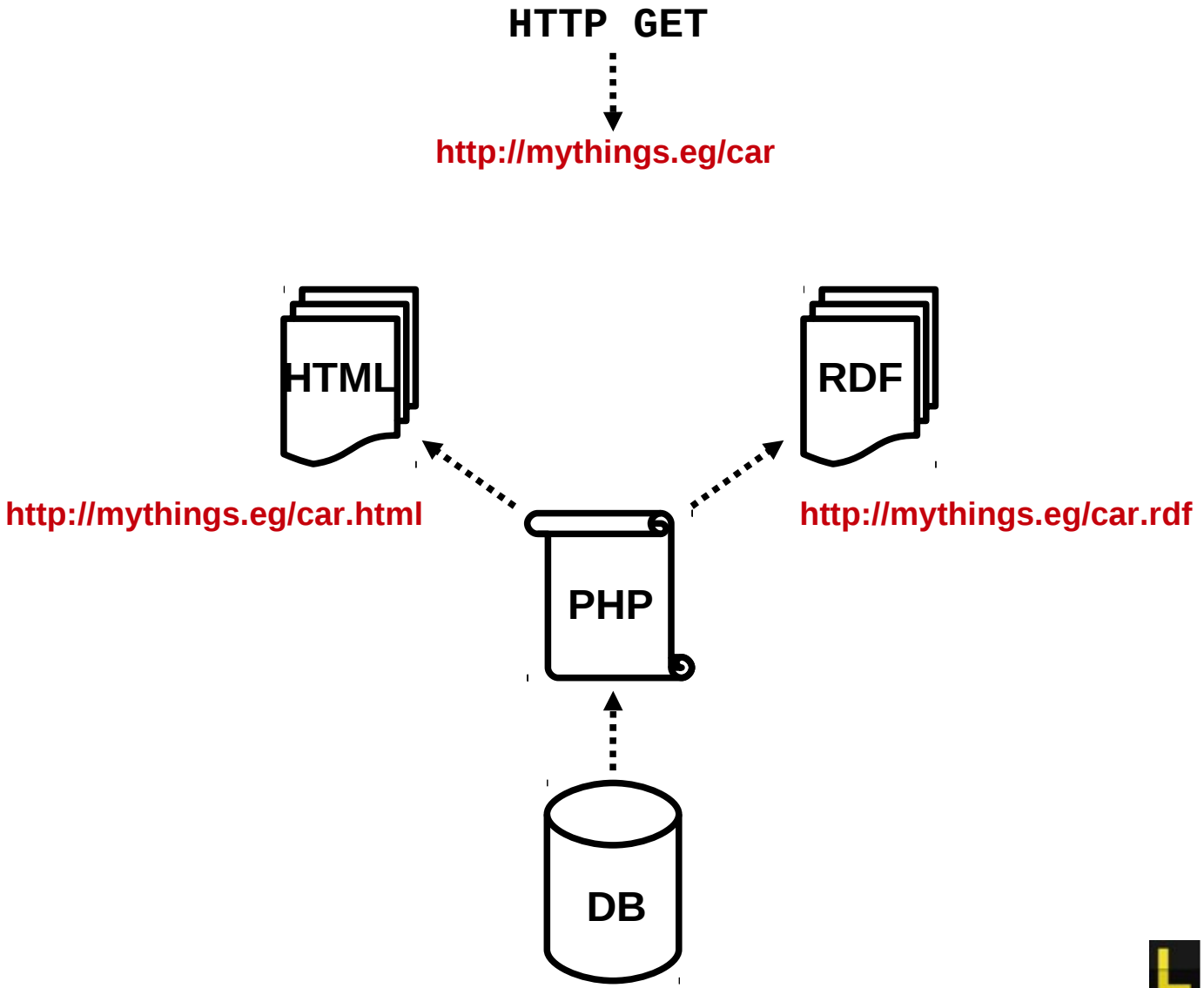

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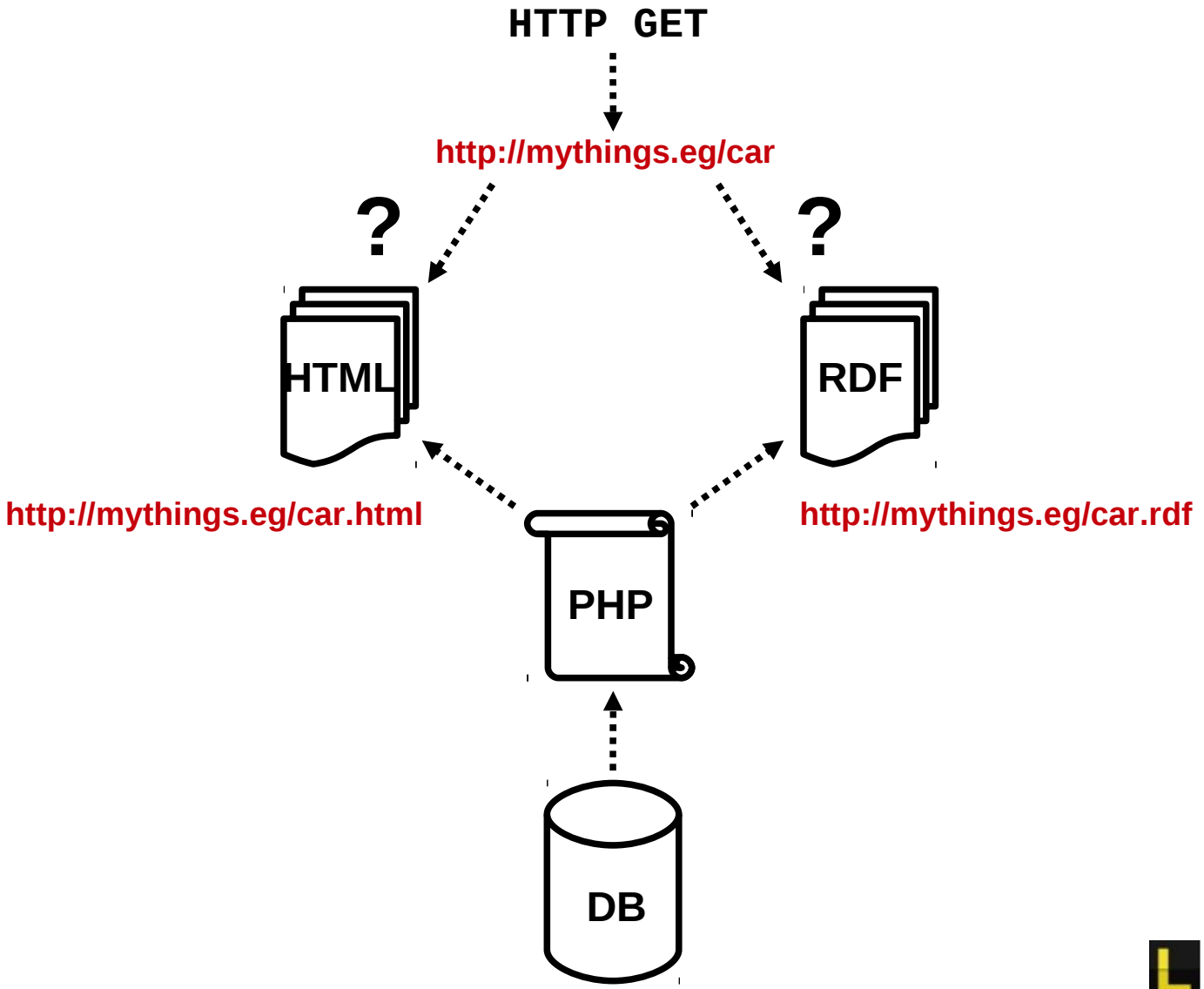
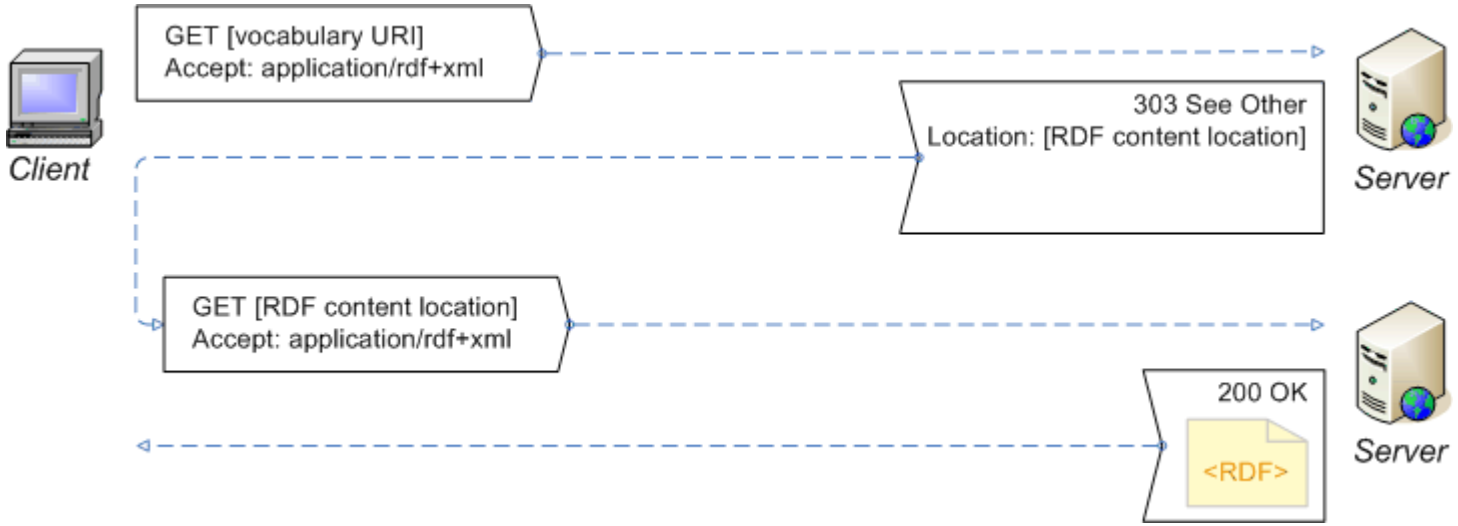


Content Negotiation and 303 Redirects



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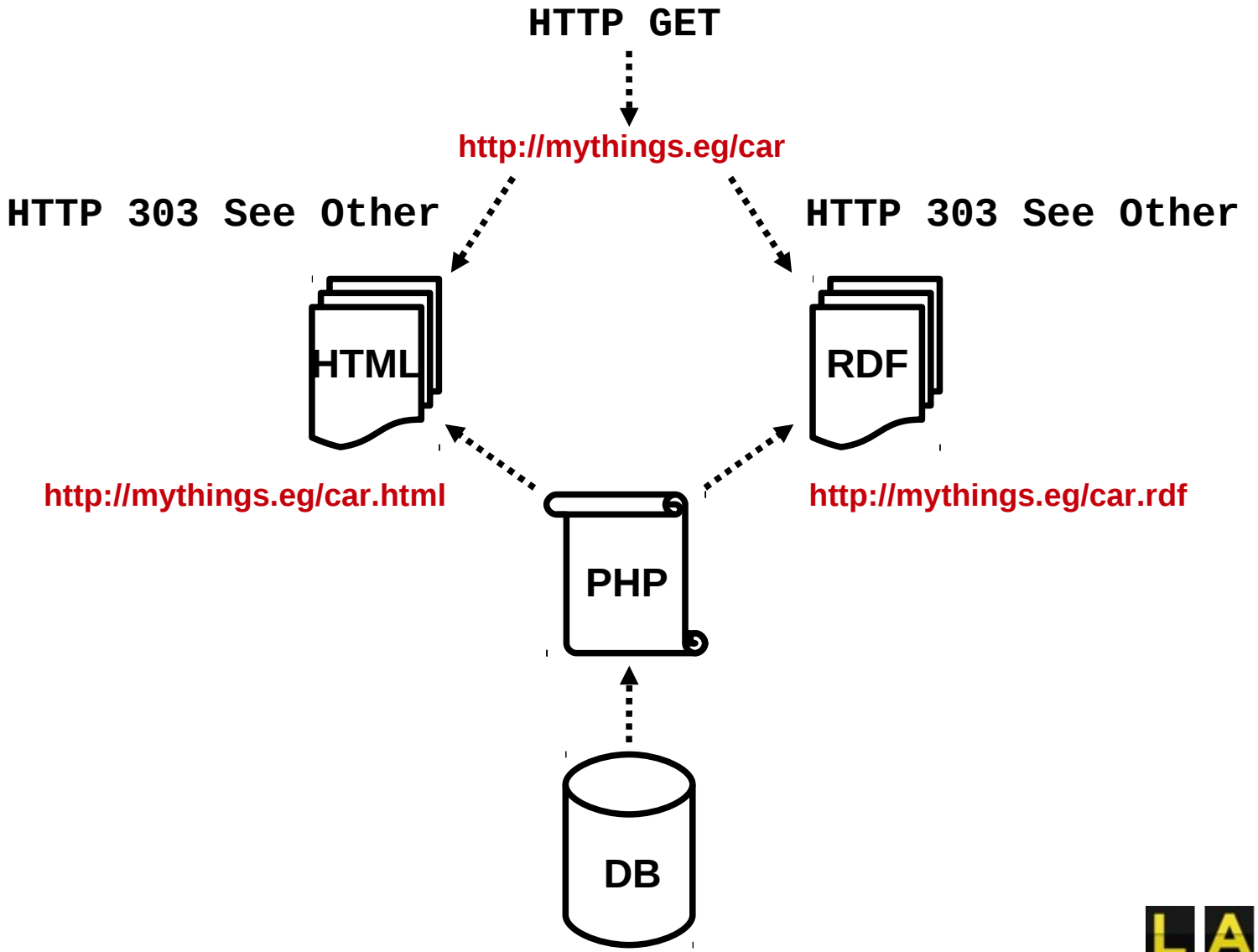


4. Setup Your Infrastructure

- Useful tools for debugging ConNeg and 303s
  - Firefox Extensions
    - Modify Headers
    - LiveHTTPHeaders
  - cURL
    - http://dowhatimean.net/2007/02/debugging-semantic-web-sites-with-curl
- You don't have to 'roll your own'
  - But it's really easy!

5. Link to other Data Sets

- 'Roll Your Own' Linking Approaches
  - String Matching
    - e.g. comparing labels using similarity metrics
  - Common Key Matching
    - e.g. ISBN, Musicbrainz IDs
  - Graph Matching
    - Do these two things have the same label, type and coordinates
- Linking Frameworks
  - See: http://linkeddatabook.com/editions/1.0/#htoc60
- Aim for reciprocal links

5. Link to other Data Sets (Popular Predicates)

- owl:sameAs (thing to thing) ← not the only show in town
- foaf:based_near / ov:near (thing to thing)

- foaf:homepage (thing to document)
- foaf:page (thing to document)
- foaf:made (thing to document)
- foaf:depiction (thing to document)

- foaf:primaryTopic (document to thing)
- foaf:topic (document to thing)
- foaf:maker (document to thing)

- rdfs:seeAlso (document to document)

6. Describe and Publicise your Data

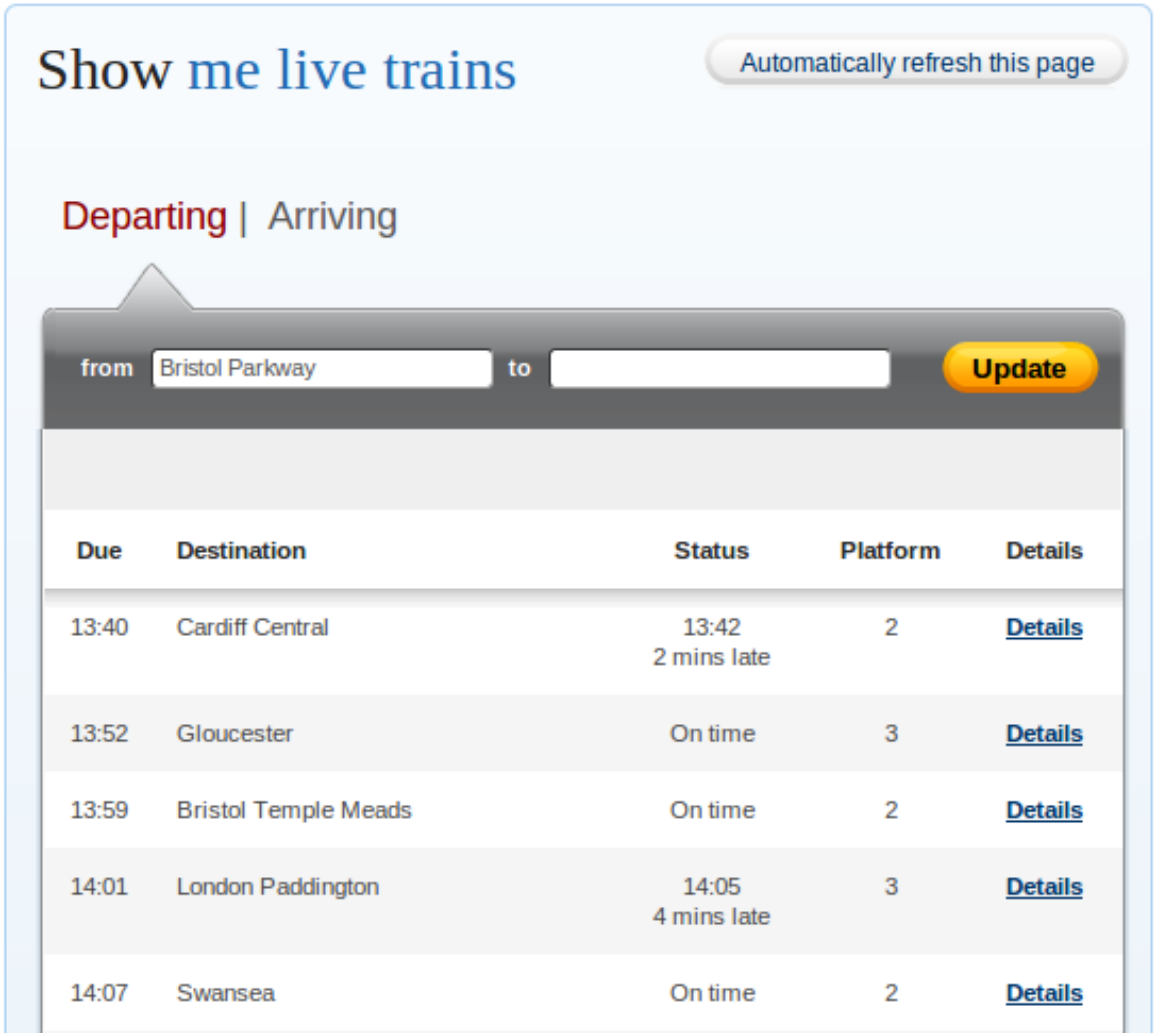
- Help others discover and index your data
  - Send pings to Sindice.com and pingthesemanticweb.com
  - Provide a Semantic Sitemap for your Data Set
  - Provide a voiD description of your Data Set
    - http://rdfs.org/ns/void-guide
- Apply a license or waiver to your data set
  - Protects consumers of your data => encourages reuse
  - Creative Commons is probably **not** applicable
  - Use the Open Database License (ODbL) or release into the public domain by applying PDDL or CC0 waivers
    - http://opendatacommons.org/

Additional Considerations

- How will you use the data?
  - Ease of publishing c.f. ease of querying
- Data volume and dynamism
  - Can you store / query all the data you produce?
  - Do you actually want / need to?
  - Which traditional solutions / architectures are applicable?

Part 2: Linked Data and the Internet of Things

Convergence of the Web and Physical Space



Internet of Things: Definitions

- "A global network infrastructure, linking physical and virtual objects through the exploitation of data capture and communication capabilities."
- "A world where physical objects are seamlessly integrated into the information network, and where the physical objects can become active participants in business processes."
- "The network formed by things/objects having identities, virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate with the users, social and environmental contexts."
- "Internet of Things (IoT) is an integrated part of Future Internet and could be defined as a dynamic global network infrastructure with self configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘things’ have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network."
- "The Internet of Things is not synonymous with ubiquitous / pervasive computing, the Internet Protocol (IP), communication technology, embedded devices, its applications, the Internet of People or the Intranet / Extranet of Things, yet it relies on all of these approaches"
- Source: http://en.wikipedia.org/wiki/Internet_of_Things

Internet of Things: “Orthodoxy” (1)

- Devices
  - RFID (tags and) tag readers
  - Fixed sensors
  - Motes: low-cost, portable, disposable
  - Handheld devices
  - Arduino
  - …

Internet of Things: “Orthodoxy” (2)

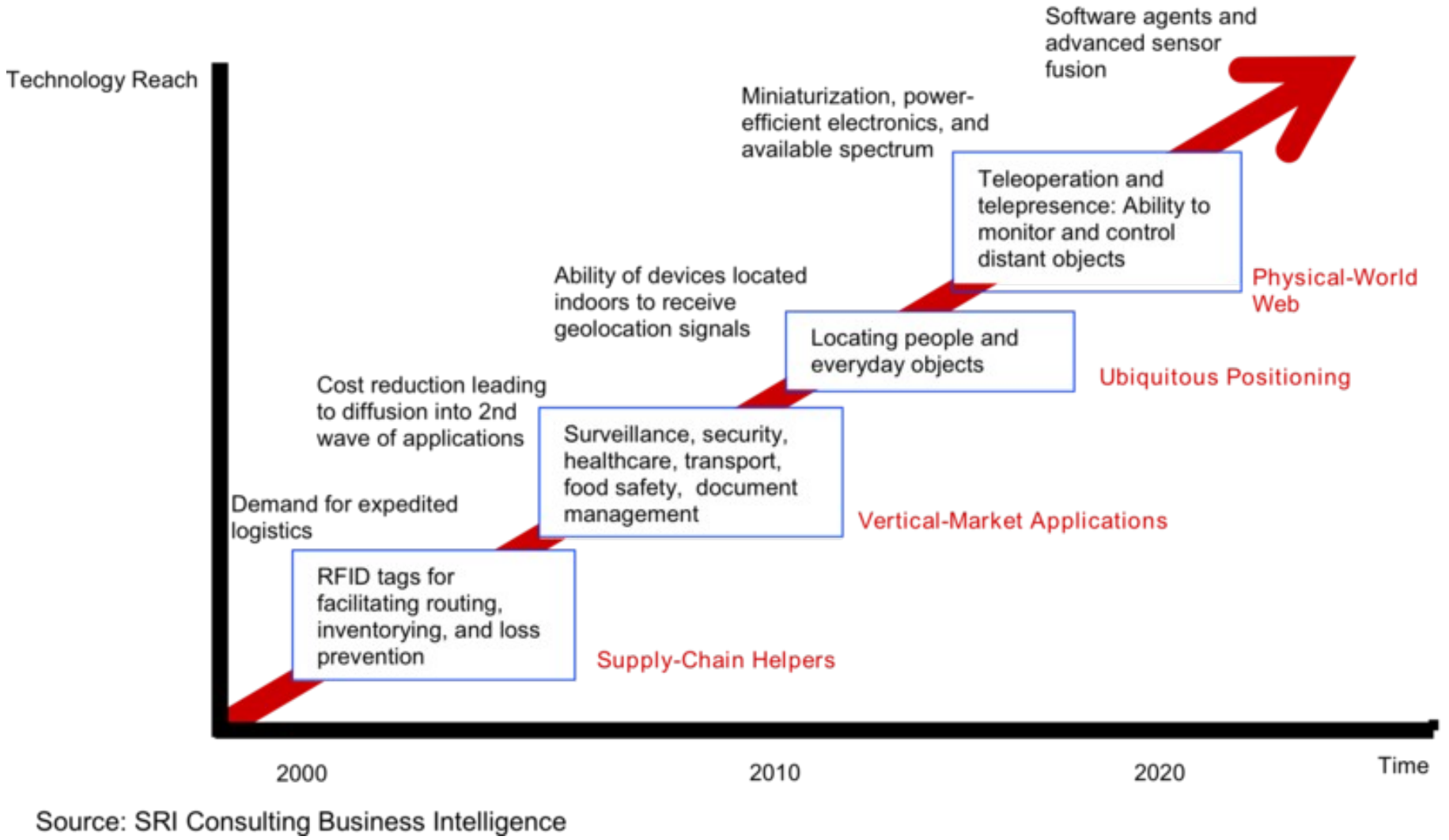
- Identification schemes
  - EPC
    - SGTIN, SSCC, SGLN, GRAI, GIAI, DOD, etc... !ISBN?
    - “The Electronic Product Code is a universal identifier for any physical object. It is used in information systems that need to track or otherwise refer to physical objects.”

      http://www.gs1.org/gsmp/kc/epcglobal/tds/tds_1_5-standard-20100818.pdf

    - urn:epc:id:giai:0614141.12345400
    - urn:epc:id:giai:CompanyPrefix.IndividulAssetReference
  - IP addresses

Internet of Things: “Orthodoxy” (3)

- Application areas:
  - supply chain/logistics
  - scientific research
  - safety and compliance
  - defense
  - domestic monitoring and automation
  - surveillance
  - facilities management
  - transport
  - ...



Source: SRI Consulting Business Intelligence

http://en.wikipedia.org/wiki/File:Internet_of_Things.png

Issues with the Orthodoxy (1)

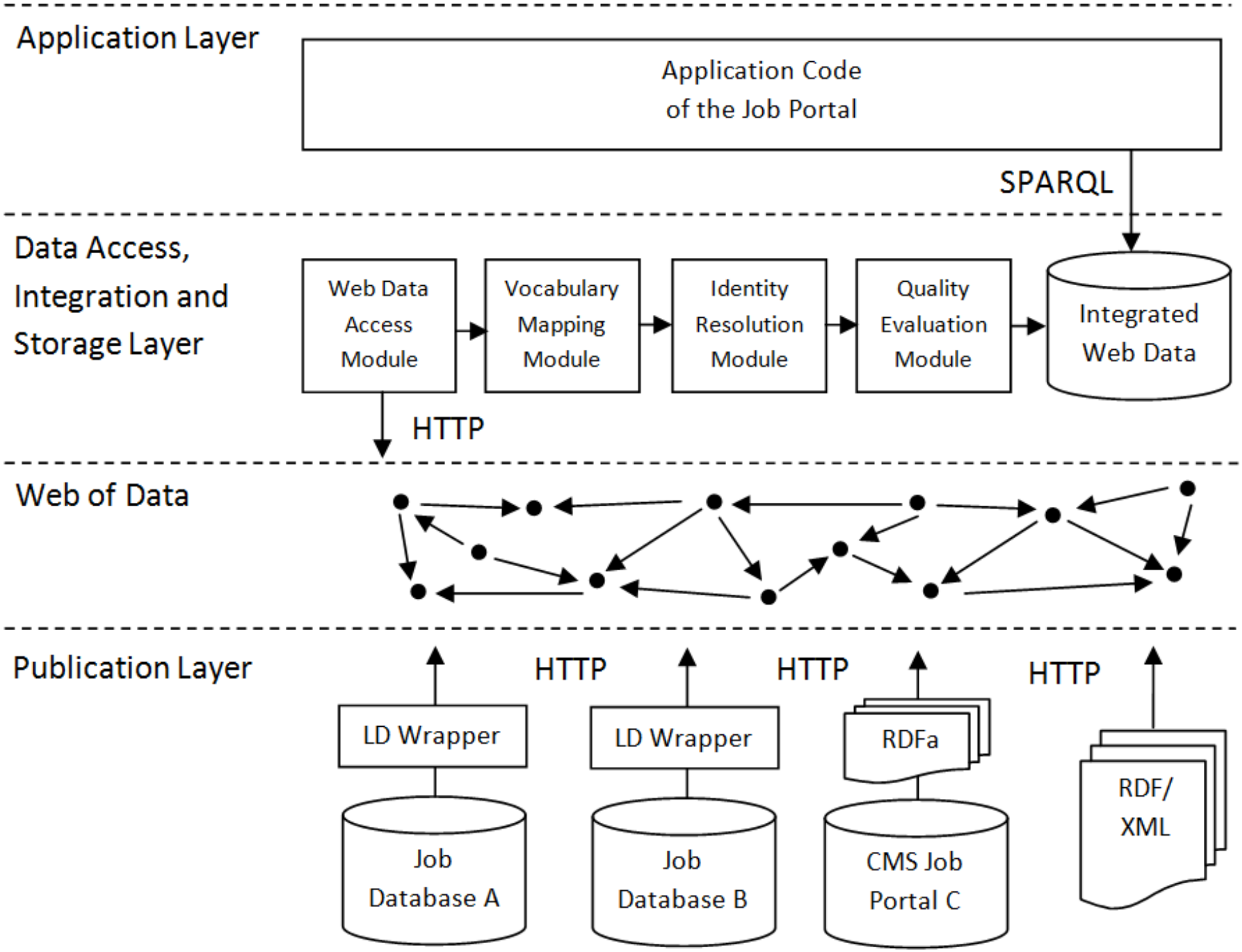
- Devices
  - Heterogeneous, often proprietary
  - Where is the generalised infrastructure?
  - Where are the generic, consumer-grade devices? (c.f. Android)
- Identifiers
  - Bottlenecks in assignment of identitiers?
    - urn:epc:id:giai:**CompanyPrefix**.IndividulAssetReference
    - Who assigns the company prefixes?
  - Lack of a universal lookup mechanism
    - Who controls the directory?

Issues with the Orthodoxy (2)

- Connectivity
  - Of devices
    - Is this really an Internet of Things, or simply “Things on the Internet?”
    - c.f. Data on the Web vs Web of Data.
    - Q: What differentiated the Internet (and Web) from what went before? A: A generalised, universal infrastructure.
  - Of data
    - Where are the links?

- Application Domains
  - Bit dull from a consumer perspective!
    - I already know how to find weather information!
    - Do I really need a networked wine rack, fridge, etc.?

Part 3: Now What?


Application Layer
Application Code of the Job Portal
SPARQL
Data Access, Integration and Storage Layer
Web Data Access Module
Vocabulary Mapping Module
Identity Resolution Module
Quality Evaluation Module
Integrated Web Data
HTTP
Web of Data
Publication Layer
HTTP
HTTP
HTTP
LD Wrapper
LD Wrapper
RDFa
RDF/ XML
Job Database A
Job Database B
CMS Job Portal C

Data Linking: Who Pays?

- Data Publishers
  - lowers the cost of consumption

http://tomheath.com/blog/2010/06/why-carry-the-cost-of-linked-data/

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Data Linking: Who Pays?

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  - lowers the cost of consumption
- Data Consumers
  - when the benefits outweigh the costs
- Third Parties
  - when there is a gap in the market

http://tomheath.com/blog/2010/06/why-carry-the-cost-of-linked-data/

Implications of Linked Data for the Applications we Build

CC BY

http://www.flickr.com/photos/khouri/

LATC

The Document Metaphor is Everywhere!

- "*I'd better clear all those messy **files** off my **desktop** before I connect to the projector*"
- "*Damn, I sent the **email** without attaching the **file***"
- "<sigh> *I really must update my home **page***"

Linked Data is not about...

- Searching for a specific document
- Visiting a particular Web site
- Browsing from one (RDF) document to the next

Linked Data is about Things

- Describe any aspect you like...
  ...of any *thing* you like!
- Give identifiers (URIs) to those things
- Interact with those things directly!

cc BY NC ND

http://www.flickr.com/photos/25831000@N08/

CC BY

http://www.flickr.com/photos/kathycsus/

Linked Document vs Linked Data Applications

- A document-centric perspective hides things inside documents, and constrains our imagination

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- A document-centric perspective hides things inside documents, and constrains our imagination
- If you don't feel constrained, then you're not thinking hard enough :)
- Linked Data promotes all things to first class Web citizens
- We need apps for direct actions on things, not just on documents about things

The 'Killer App' Question

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- No more obsessing or speculation allowed, principled analysis only!

Where do we Focus our Efforts?

- Sustaining innovation
- Disruptive innovation
  - Low-end disruption
  - New-market disruption

(Christensen and Raynor, *The Innovator's Solution*, 2003)

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- Risky business ideas?
  - A new search engine that exploits structured data
  - A reviewing and rating site that publishes data in RDF
  - A new CMS with Linked Data support

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  - **What can we do less well with Linked Data, but at significantly less cost than with existing approaches?**

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  - **What can we enable with Linked Data that a large number of people aren't doing right now because it's too hard, expensive or inconvenient?**

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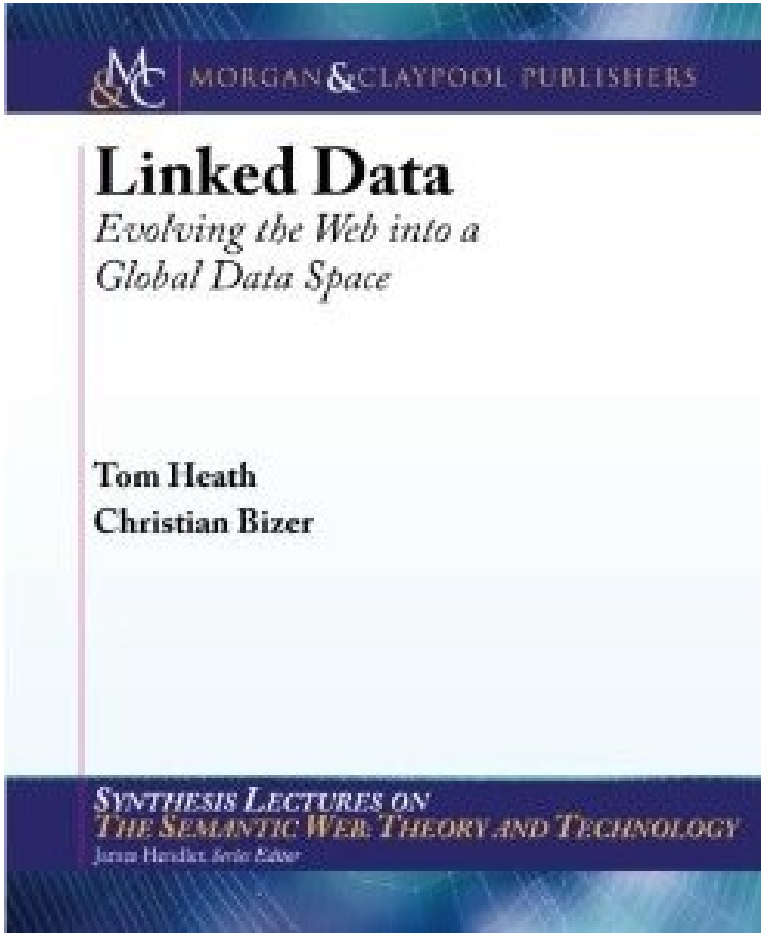
- The nature of applications consuming Linked Data needs discussion / research
- Principled analysis may reveal gaps for potential killer apps

Further Reading and Events

- http://linkeddatabook.com/#book



Questions?

- Contact Info
  - tom.heath@talis.com
  - http://tomheath.com/id/me
  - http://www.talis.com/
  - @tommyh (twitter)
- Slides
  - http://tomheath.com/slides/2011-09-.....

shared innovation