Dataförädling med semantiska tekniker

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Contents

- Trends in information / data
  - Critical factors ... growing importance
- Needs
  - Highlighting areas of needs
- Technology
  - Enabling technology
- Applications
  - Examples

Contents:

Trends in information / data

Emerging needs

Technology

Applications

Trends – Information/Data Volumes

Growing volumes

- Price/performance
- Networking
- Devices
- Storage, etc

Structured vs unstructured data!

Challenge: capacity and capability to handle huge data volumes

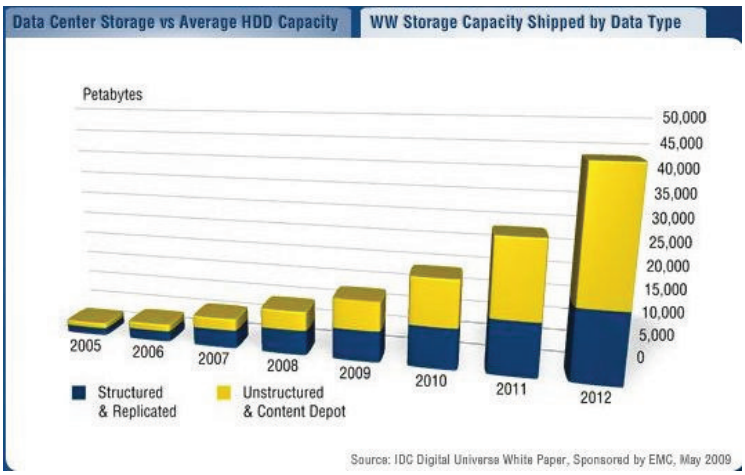


Illustration source: IDC/EMC "Digital Universe" (2009)

Trends – Information/Data Volumes

Total volume vs number of units

Increased number of small data chunks

Challenge: keeping track of many small-size data chunks

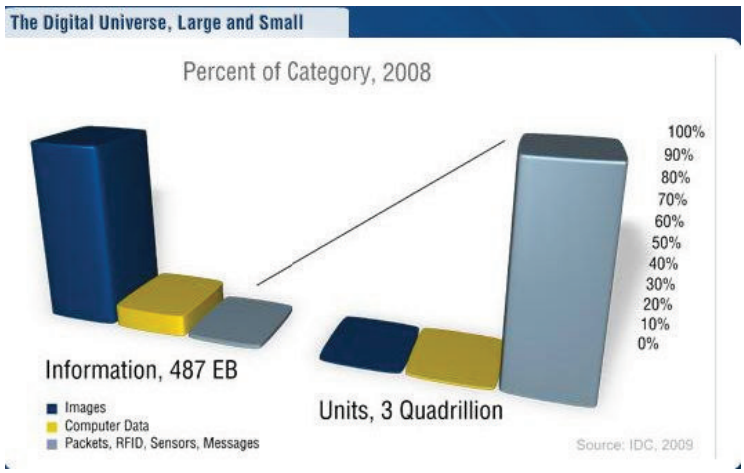


Illustration source: IDC/EMC "Digital Universe" (2009)

Trends – Information/Data Sources

New types of devices arriving in accelerated pace

Sources of information / data

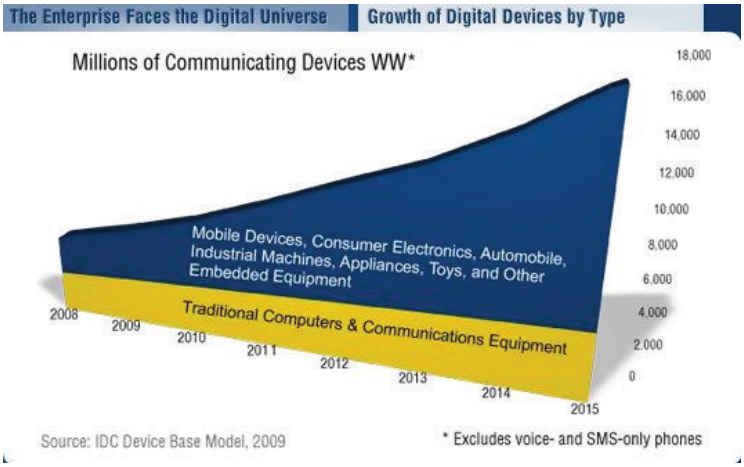


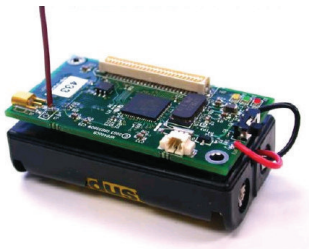
Illustration source: IDC/EMC "Digital Universe" (2009)

Challenge: Tracking data and dynamic sources

Trends – Information/Data Sources

Data generating device examples

- Wireless sensor networks: multipurpose ...
- Mobile phones: GPS, temperature, ...



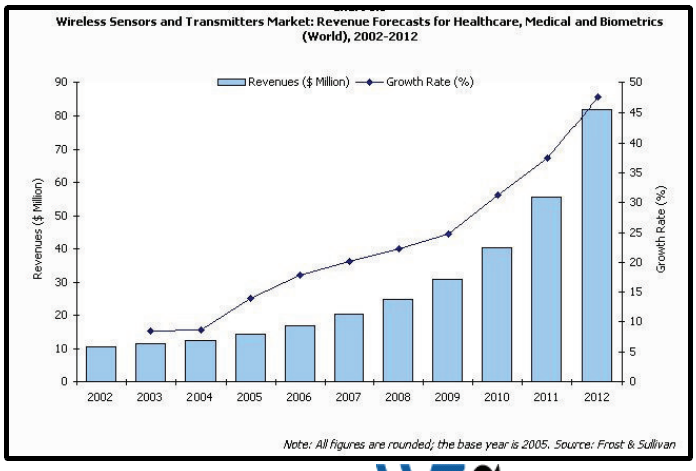


Illustration source: Frost&Sullivan (2009)

Trends– Information/Data Communication

Internet paradigm evolving

- From *transmission centric*
- To *content centric*

Focus on data

- Content distribution
- (cf. the web!)

<u>Challenge</u>: how to package and describe data to profit from envisioned Internet functionality

Illustration source: UC San Diego (2009)

Contents

Trends in information / data

Emerging needs

Technology

Applications

Emerging needs – stream processing

Processing data on-the-fly

- Data/information generated continuously
- Streams of data
- Data stream processing

Drivers, examples:

- Sensor networks – Internet-of-Things
- Messaging, blogging, micro-blogging

Challenge: how to process data efficiently/effectively

Emerging needs – the web data space

Web context as picture of business context

- Interconnected sources of data
- Business interdependencies
  - "Data I need" vs. "Data I have & data you have"

Drivers:

- growing volumes of available data
  - cf. "public sector information"
- data evolution
- Cost-efficiency!

Challenge: how to increase automation, data interoperability, adaptive processing

Contents

Technology – Semantic Web

Web technology

- Formats (XML, WS-*, MathML, RDF, SVG, ...)
- Protocols (HTTP, SOAP, ...)
- Processing (XForms, DOM, Powder, Pipeline, ...)

Semantic Web Technologies

- Rich representation:
  - RDF, RDFS, OWL, SKOS, ...
- Processing support:
  - OWL, RIF, SPARQL, ...

The "semantics" in the Semantic Web

Semantic web is about what?

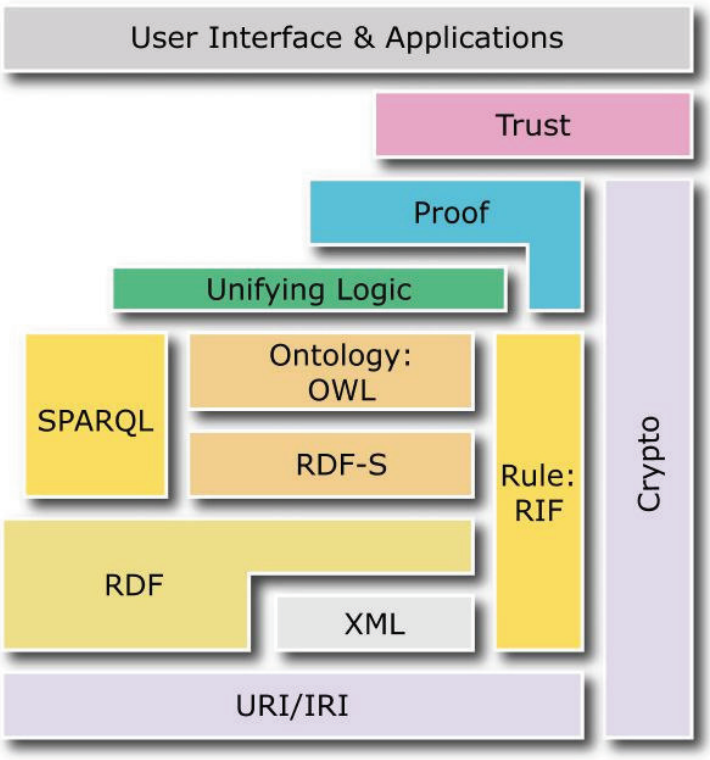
- about "meaning" and automation
  - "Meaning-based" automation

"Meaning" -- pragmatic approach in Semantic Web:

- a program "knows" what it *can* do with data
- self-describing data

No magic ... instead well-founded engineering

Semantic web building blocks



RDF – Resource Description Framework

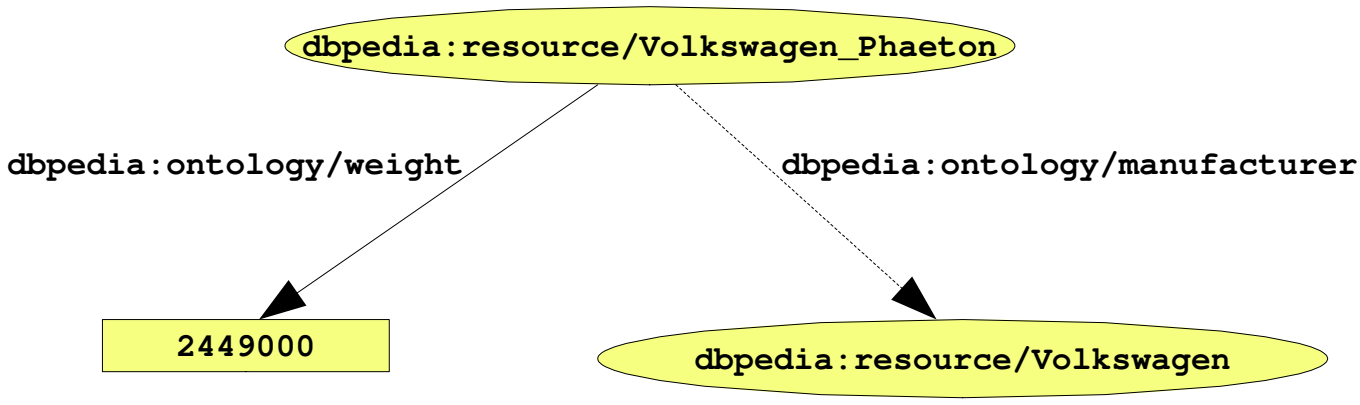
Basic data model – a “triple”

- triple `(s,p,o)` :
  - “`s`” -- subject
  - “`p`” -- predicate
  - “`o`” -- object
- Conceptually: “`s`” is related by “`p`” to “`o`”

RDF is a general model for such triples

- machine readable formats like RDF/XML, Turtle, n3, RXR

RDF Example




```
dbpedia:resource/Volkswagen_Phaeton
dbpedia:ontology/weight
2449000

dbpedia:resource/Volkswagen_Phaeton
dbpedia:ontology/manufacturer
dbpedia:resource/Volkswagen
```

OWL – Web Ontology Language

Define ontologies (conceptual model, ...) for data

Built on top of RDF

Basic components:

- *instance* – entity
- *class* – type
- *property* – relationship

Ontology enables:

- Checking consistency of instance graph
- Inferring implicit statements about instance graph

SKOS – Simple Knowledge Organisation System

Define simple ontologies (conceptual model, ...)

Targeting traditional modelling approaches

- Taxonomies, classification schemes, thesauri, ...

Built on top of RDF

Compatible with modelling standards:

- NISO Z39.19 - 2005; ISO 5964:1985

SPARQL – RDF Query Language

Retrieve RDF data from RDF data graphs

- RDF graph as answer to query

Syntax inspired by SQL

Example:

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX dbo: <http://dbpedia.org/ontology/>
SELECT ?manufacturer ?name ?car
WHERE {
    ?car skos:subject <http://dbpedia.org/resource/Category:Luxury_vehicles> .
    ?car foaf:name ?name .
    ?car dbo:manufacturer ?man .
    ?man foaf:name ?manufacturer
}
ORDER by ?manufacturer ?name
```

In progress, functionality for:

- update; subqueries; negation; etc

Triple store

Database system for triples (RDF graphs)

- store, manage, query

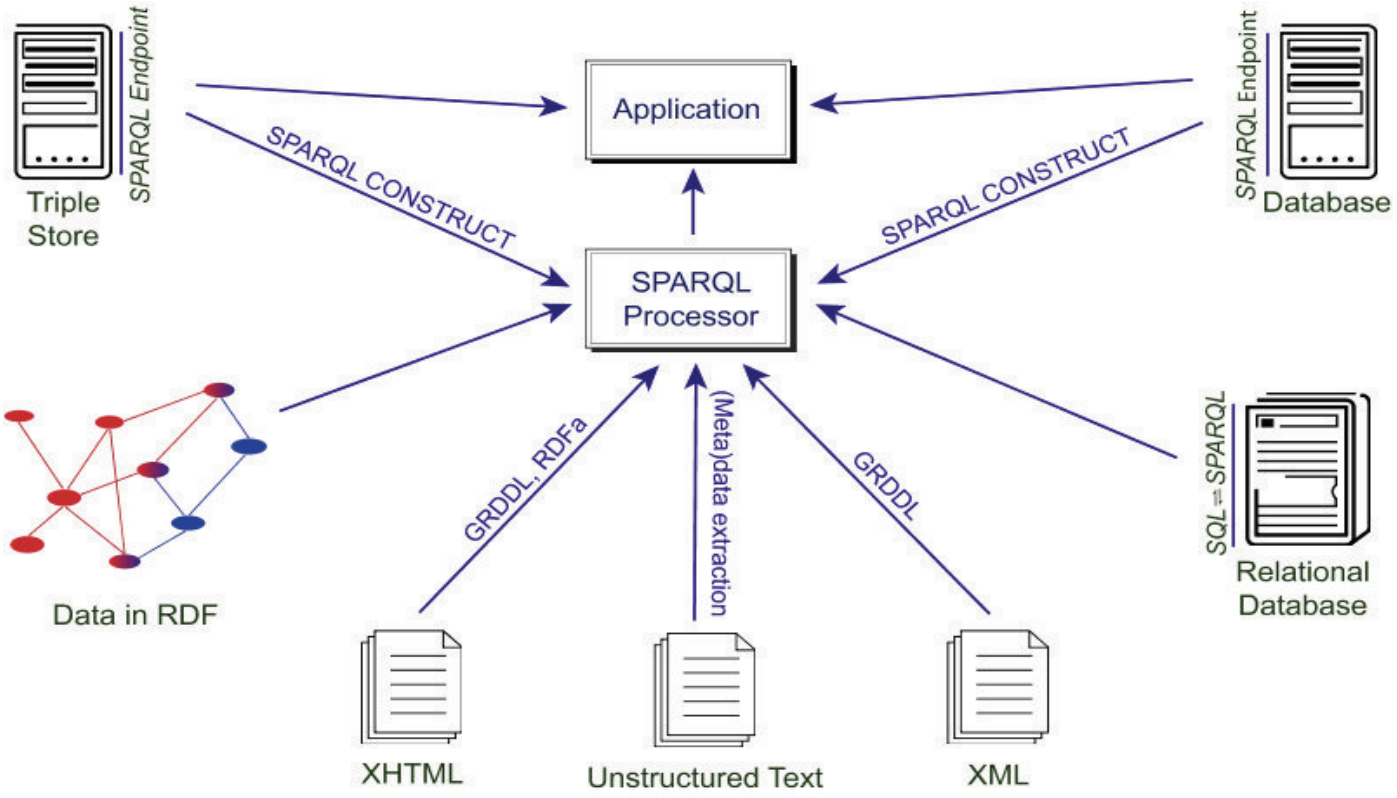
Implementation approaches

- Native triple store – RDF from ground up
- “triplified” RDB – basic storage in relational form

Interface:

- SPARQL

Integration via SPARQL



SemWeb technology implementations

Free / open source:

- Franz, Google, HP, Mozilla, ...

Commercial:

- IBM, Ontoprise, OpenLink, Oracle, Talis, ...

Still somewhat fragmented supplier space.

- “And the winner will be ...?”

But core standards are established!

Contents

Applications of SemWeb

Aspects:

- Technology: availability; quality; cost; ...
- Methodology: scope; depth; ...
- Application areas: selection; scope; ...
- Technological environment: interoperability; ...
- Needs evolution: stable, isolated; dynamic, open; ...

Ambition:

- Small, component-oriented, add-on, ...
- Large, all-embracing; ...

SemWeb technologies vs the Web

Semantic web technologies :

- Support critical web requirements

Not necessarily used on the web

- Internal encapsulated component in some application

Web requirements positive effects on

- Interoperability; maintainability; evolution; ...

SemWeb acceptance analogous to XML, e.g.:

- Used in all contexts
- Standardised
- Uniform tool support
- Enables interoperability

Limited-scope application

Adobe XMP

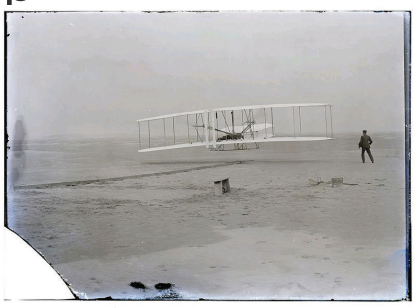
- Extensible Metadata Platform
- `Copyright, Creator, Date, Location, ...`

Aim:

- share metadata across applications, file formats, and devices

Metadata added by tools, e.g. Photoshop

- Formatted as RDF/XML



Advantage:

- Supports vendor-independent management of metadata

Limited-scope application

Dublin Core (DC)

- Document metadata (initial target: library metadata)
- “Dublin Core Metadata Element Set”
- `Title, Creator, Date, Publisher, Language, ...`

Aim:

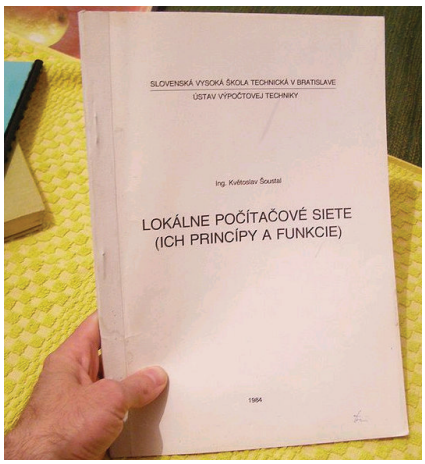
- Make existing DC metadata accessible as RDF

Simple change of format (syntax)

- Semantics unchanged

Advantage:

- Using standard technologies
- Simplifies data integration



Limited-scope application

Microsoft Interactive Media Manager (IMM)

- Extension to Sharepoint for media sector
- Metadata framework using RDF and OWL

Aim:

- Support workflow for media assets

Advantage:

- Metadata sharing between systems
- Simplifies data integration

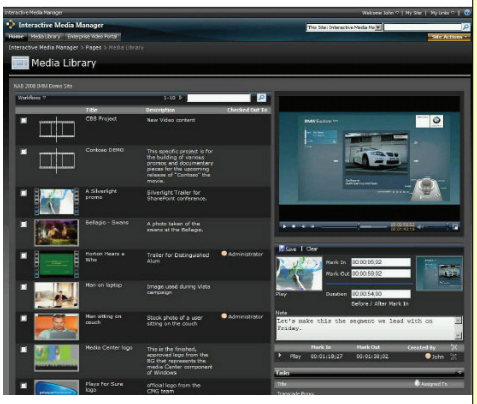


Illustration source: Microsoft

Larger application

Renault Automotive Repair

- Generate context-sensitive diagnosis/repair information
- Fetch general information from several sources

Aim:

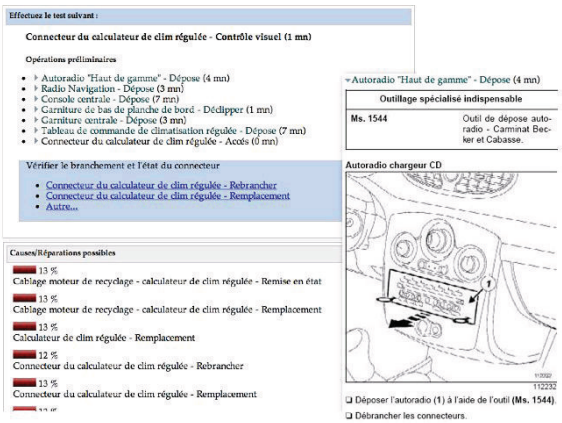
- Provide user with relevant information

Source information

- Metamodel in OWL

Advantage

- Sharable modeling.
- Unified view over distributed data.



Larger application

NASA Expertise Finder - “POPS”

- Find expertise for task at hand
- 70,000 experts in organisation and contractor workforce

Aim:

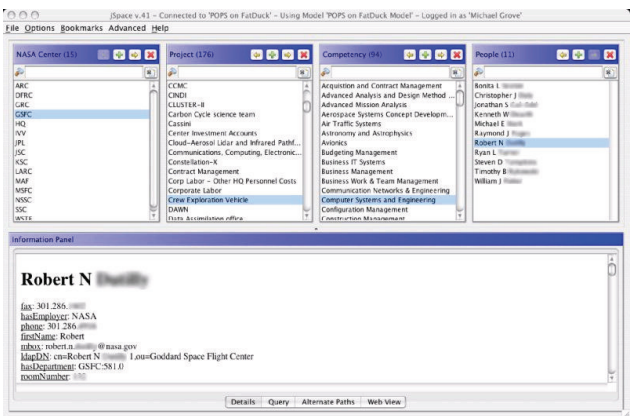
- Search tool against several databases

Solution

- RDF-based integrating framework

Advantage

- Consistent data model
- Loosely coupled infrastructure
- Share and reuse information



Larger application

BBC Music

- Provide rich information about broadcast music
- Not only broadcast data

Aim:

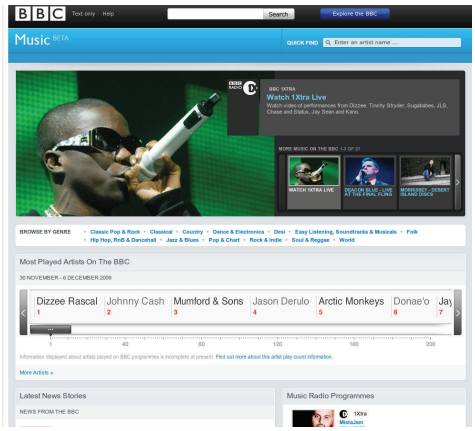
- Offer users fresh data, enable navigation to non-BBC sites

Solution

- RDF-based; uses other RDF sources

Advantage

- Minimizes own data management
- New sources appear: easy to extend



Linked Open Data Initiative

Web of data:

- Many open datasets on the web
- Interoperable when accessible as RDF

Examples:

- Wikipedia (“text”) ==> dbpedia (RDF);
- Scientific data sets (experimental data)
- Public sector information (geodata, census data, statistics, ...)

Different aims and coverage

- But semantically interrelated
- Increasingly so over time!

Linked Open Data Initiative

Experimental initiative

- Explore opportunities
- Identify technology strength/weakness
- Synthesize best-practice guidance

Stakeholders

- Data owners
- Data re-users

Specific case, profit from experience

- Open public data
- PSI directive
- How to make data more easy to reuse?

Linked Open Data Initiative

Linked Open Data (LOD) objective:

"expose" open datasets via RDF

set RDF links among the data items from different datasets

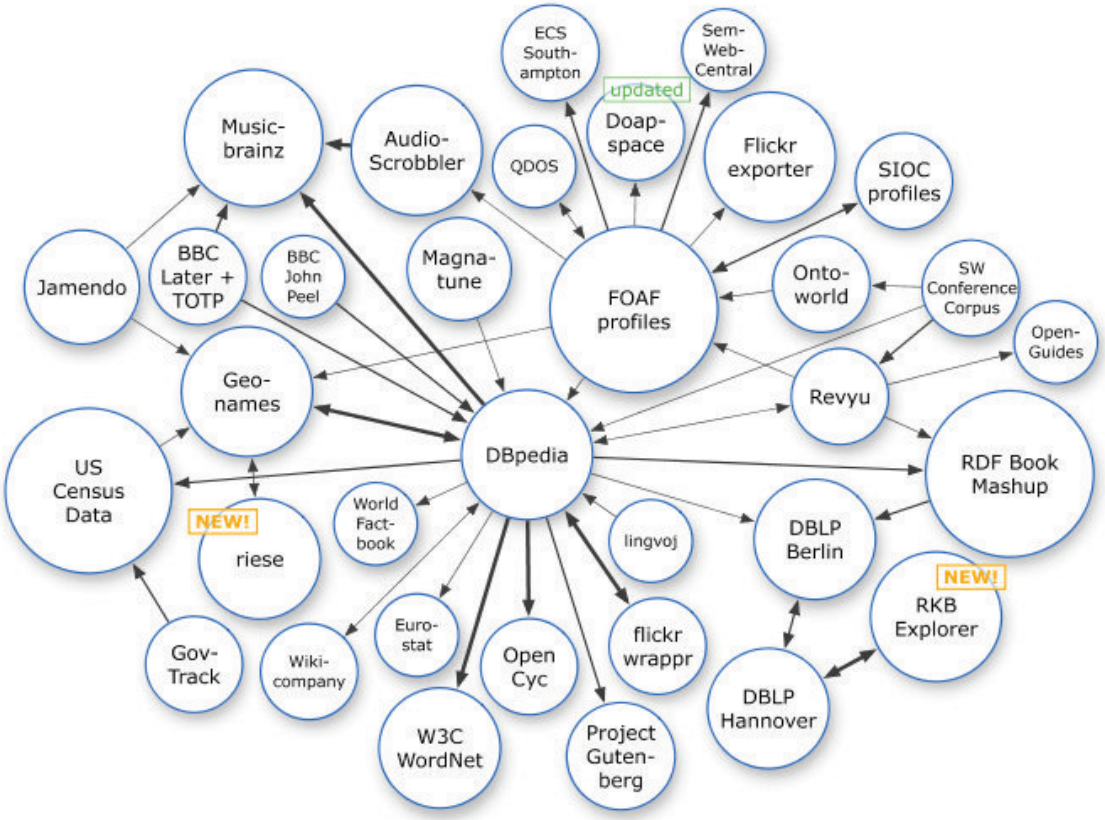
a typical example is to set an owl:sameAs between two items in different datasets that refer to the same "thing"

set up query endpoints (usually SPARQL)

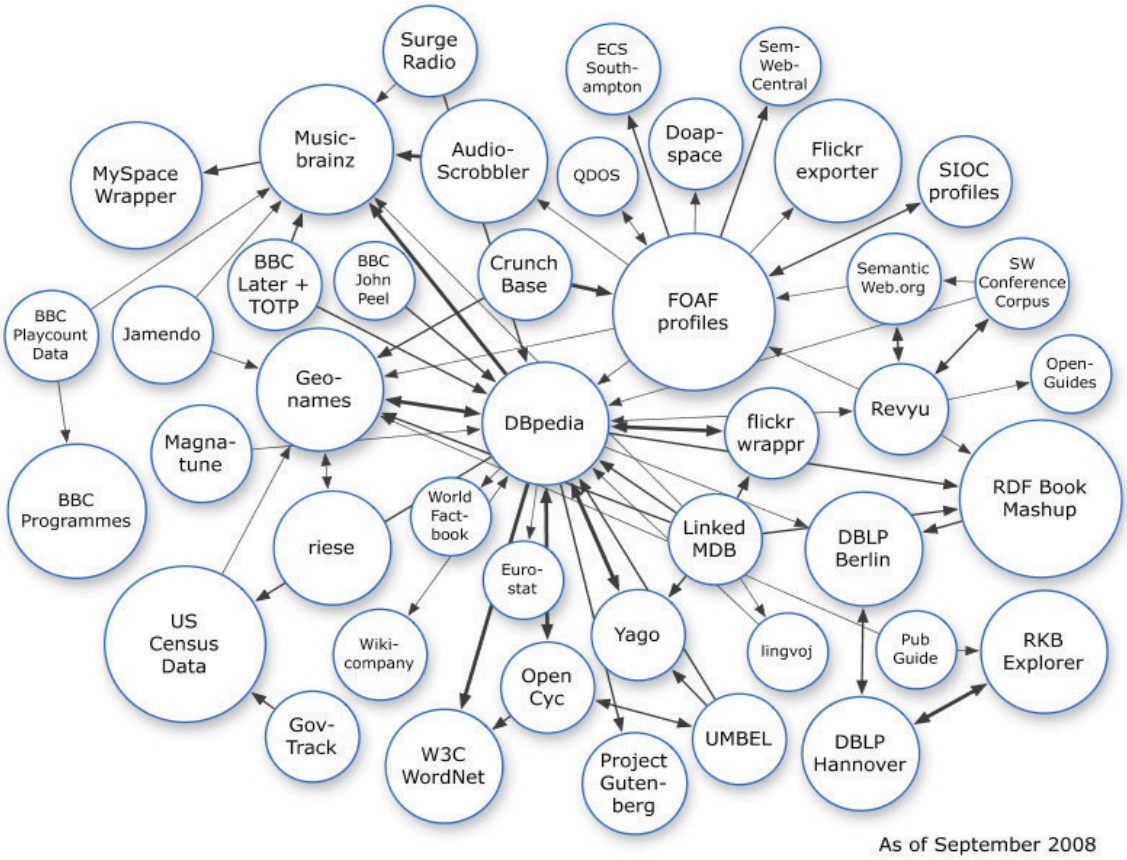
Altogether billions of triples, millions of links…

The "seed" for a general Web of Data

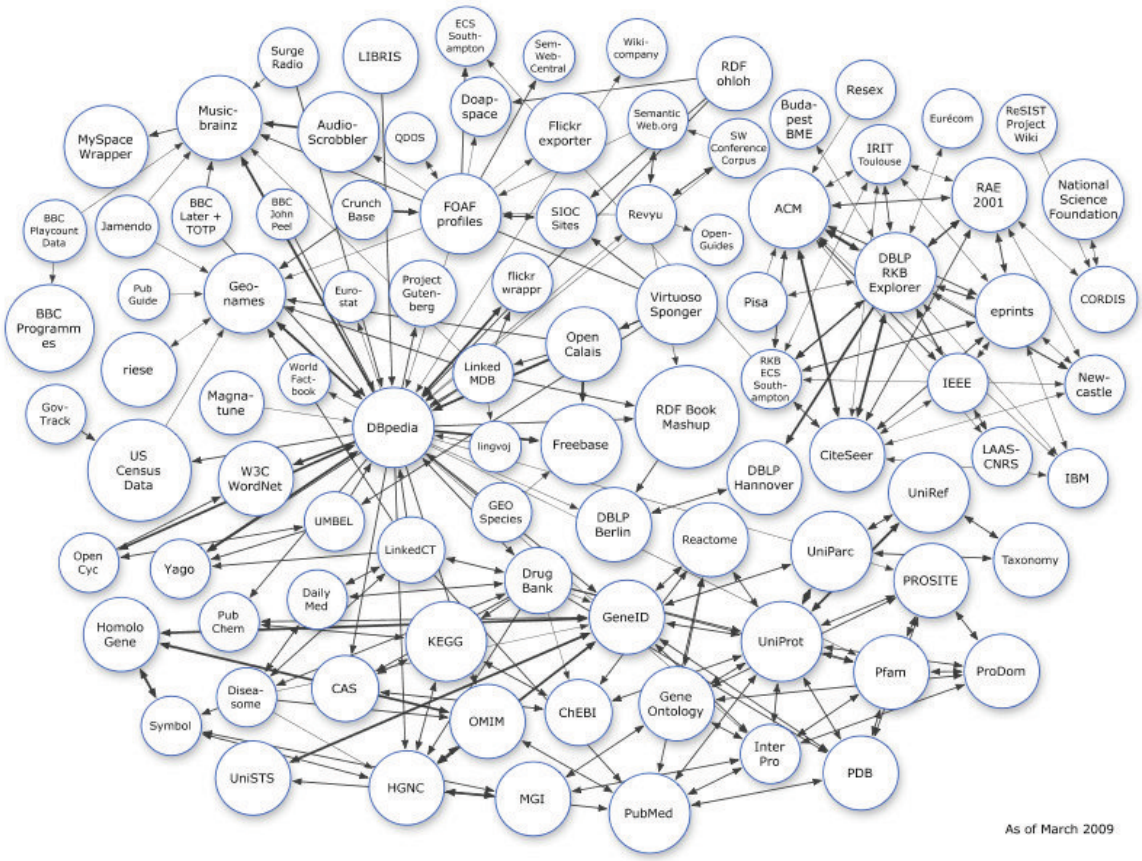
The LOD "cloud", March 2008



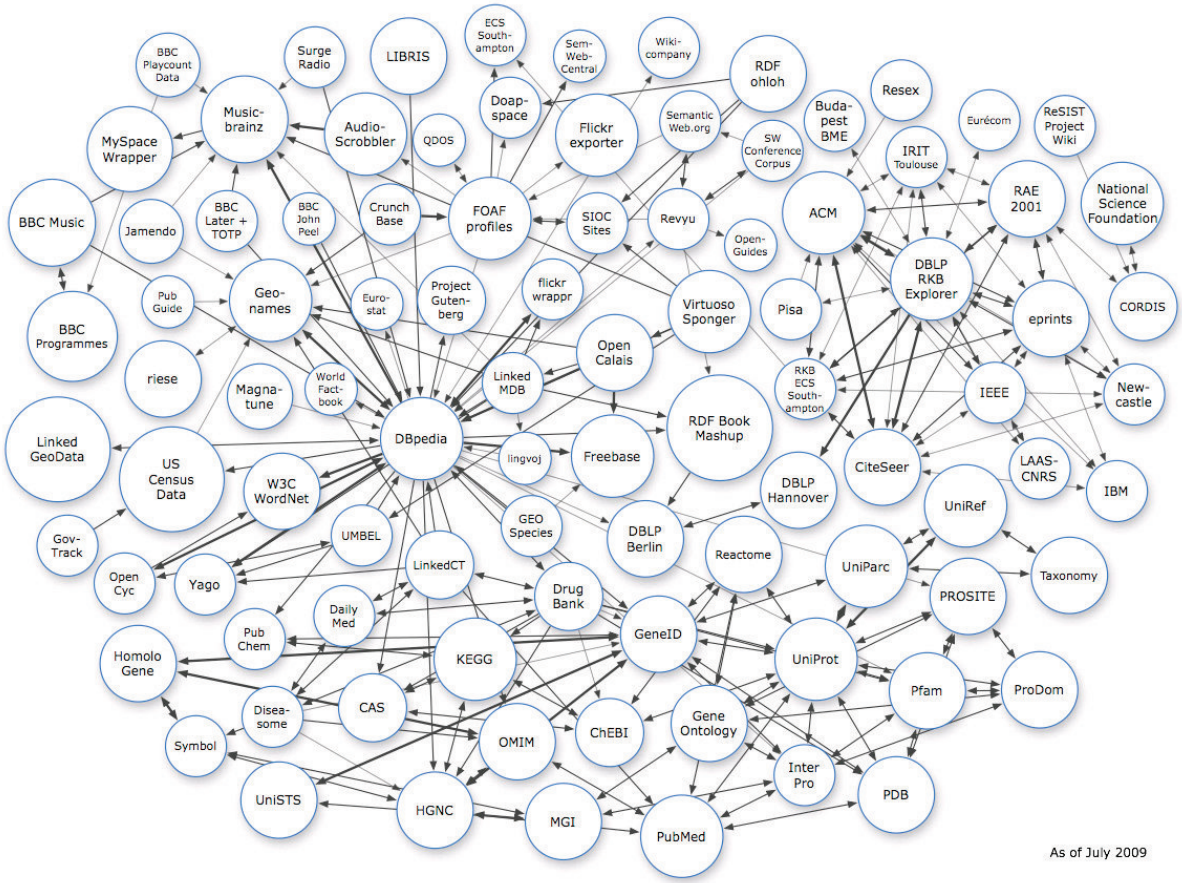
The LOD "cloud", September 2008



The LOD "cloud", March 2009



The LOD "cloud", July 2009



Applications using the cloud emerge

Bookmarking systems, exploration of social graphs, financial reporting

LOD nodes (eg, DBPedia) provide a set of referenceable URI-s for many things

Worth looking at the proceedings of the latest workshop, for example

April 2009, at WWW2009

http://events.linkeddata.org/ldow2009

Semantic Sensor Web

Sensor networks deliver data

Semantic Sensor Web (OGC: Sensor Web Enablement)

- Deliver semantically represented data
- Control sensing & delivery via semantic specifications
- Discovery, access, tasking, alerts

Towards a semantic

Internet-of-Things

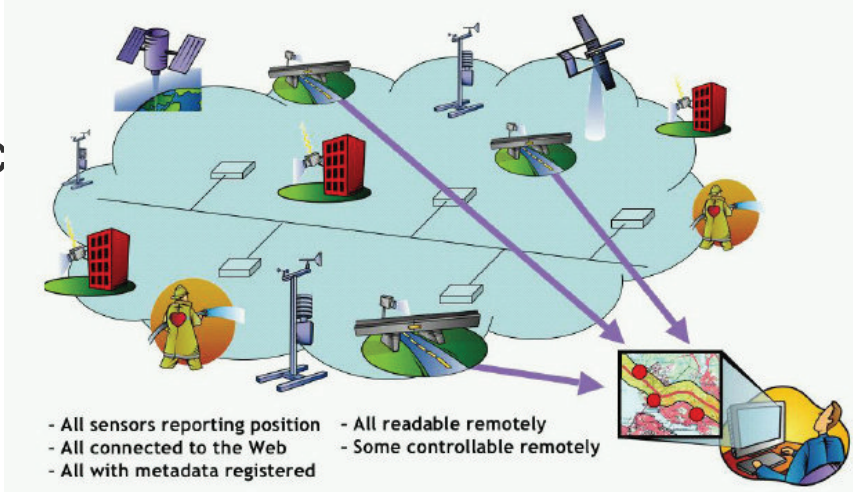


Illustration source: OGC (2007)

Reflections and Conclusions

Semantic techniques

Toolset

- Basic standardised technologies
- Proven through use
- Emerging extensions and additions (needs driven)

Applications

- Many products and applications in use

Competence

- Awareness and experience growing

Drivers

- More demanding business needs
- Public sector initiatives

Growth of data / information

Increased volumes

- Moore's law helps!

Increased diversity (more types of data)

- Semantic techniques definitely appropriate

Increased complexity (more interconnections)

- Semantic techniques are enabling

Increased rate of change

- (the tough challenge!)

Thank you for your attention