

Linked Data Principles and Examples



Victor de Boer
25-11-2014



Vague but exciting ...

Tim Berners-Lee, CERN/DD

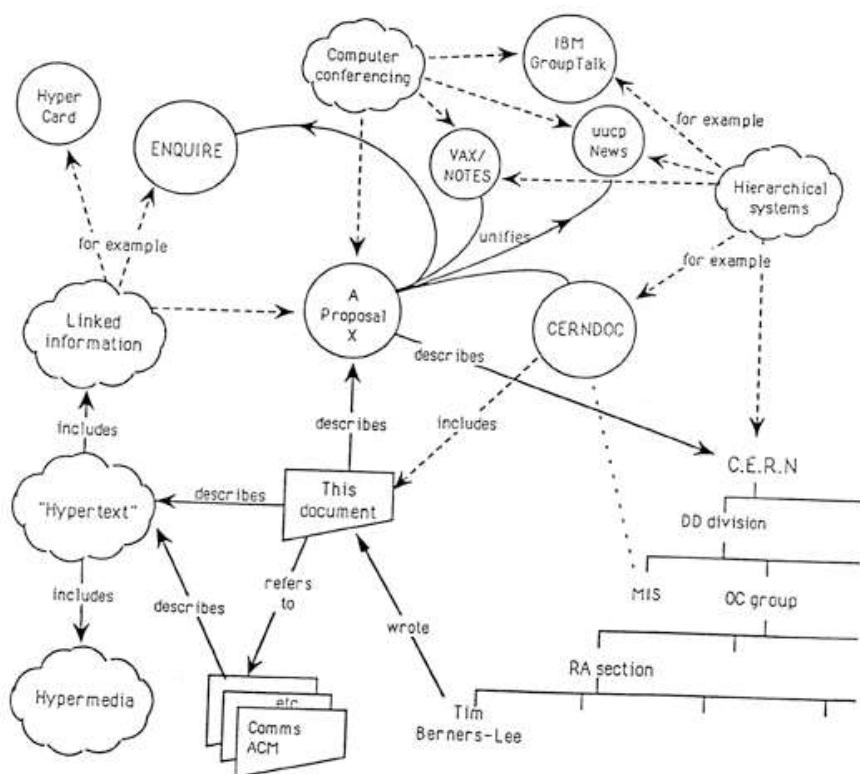
March 1989

Information Management: A Proposal

Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext system.

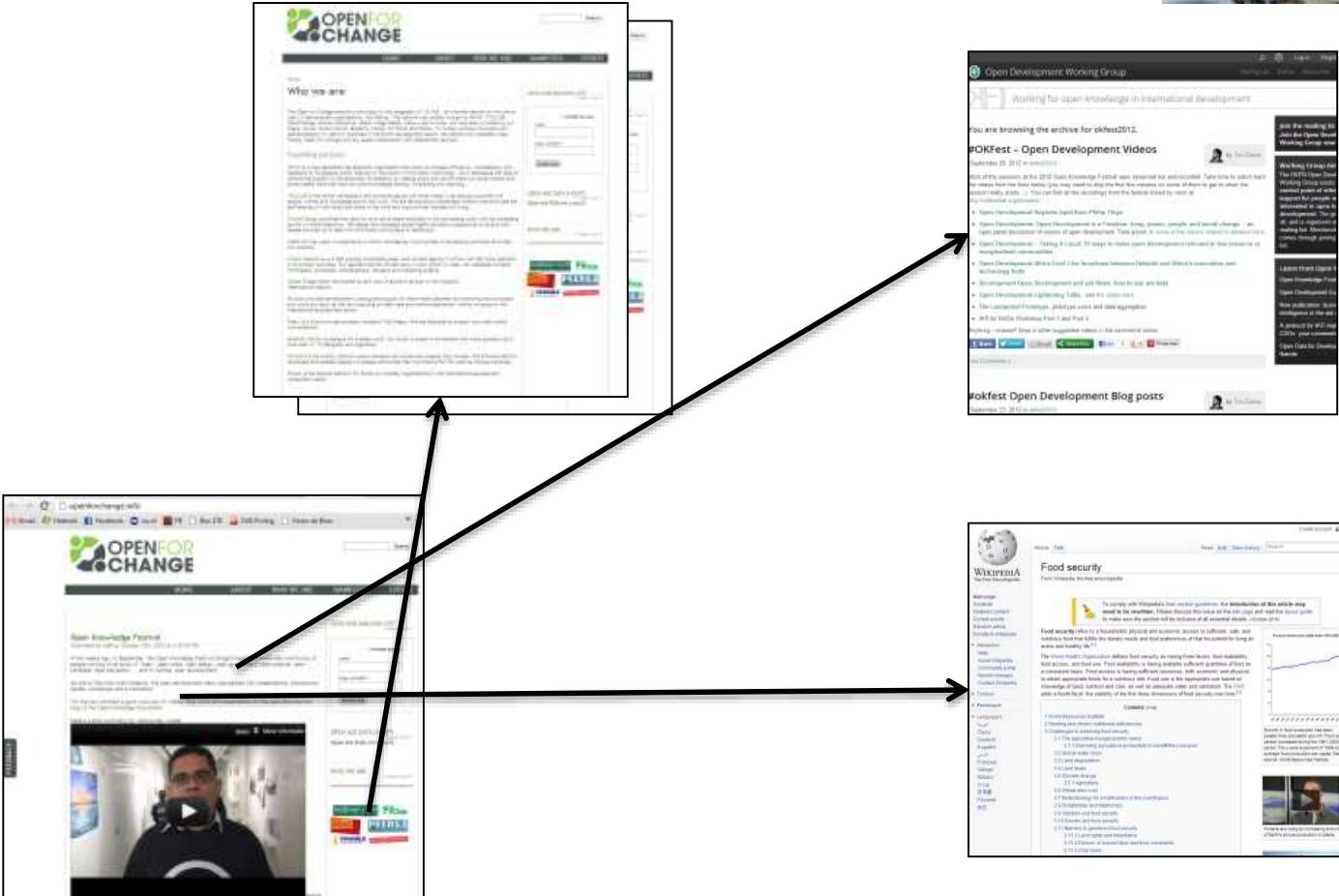
Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control



Tim Berners-Lee
(The inventor of the Web)

Web of Documents (WWW)

Linked Documents



From text to data > increased semantics

Information Connections ↑



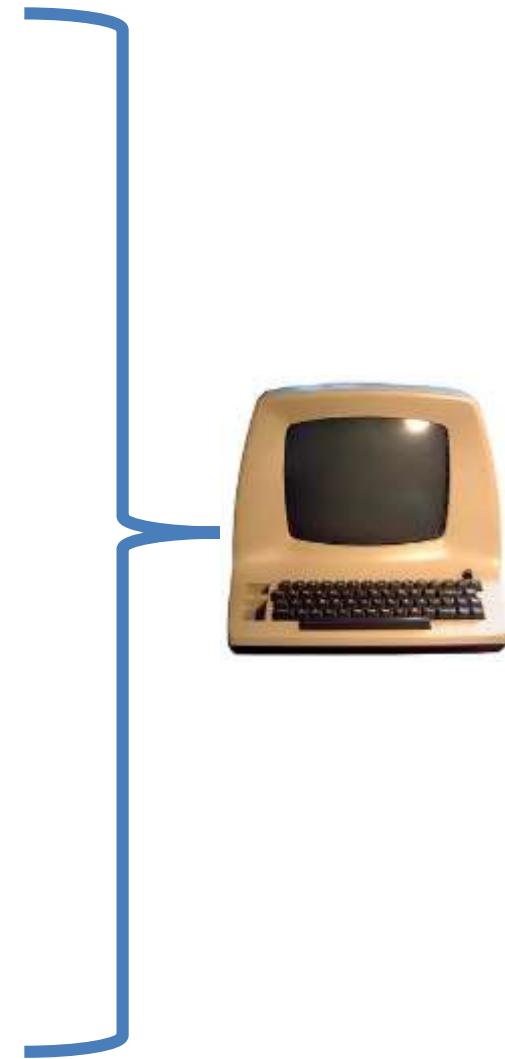
Semantics of Social Connections →



Source: Radar Networks & Nova Spivack, 2007 – www.radarnetworks.com

More and more structured data available online

- Governments
- Social web data
- Medical data
- Museums
- Research data



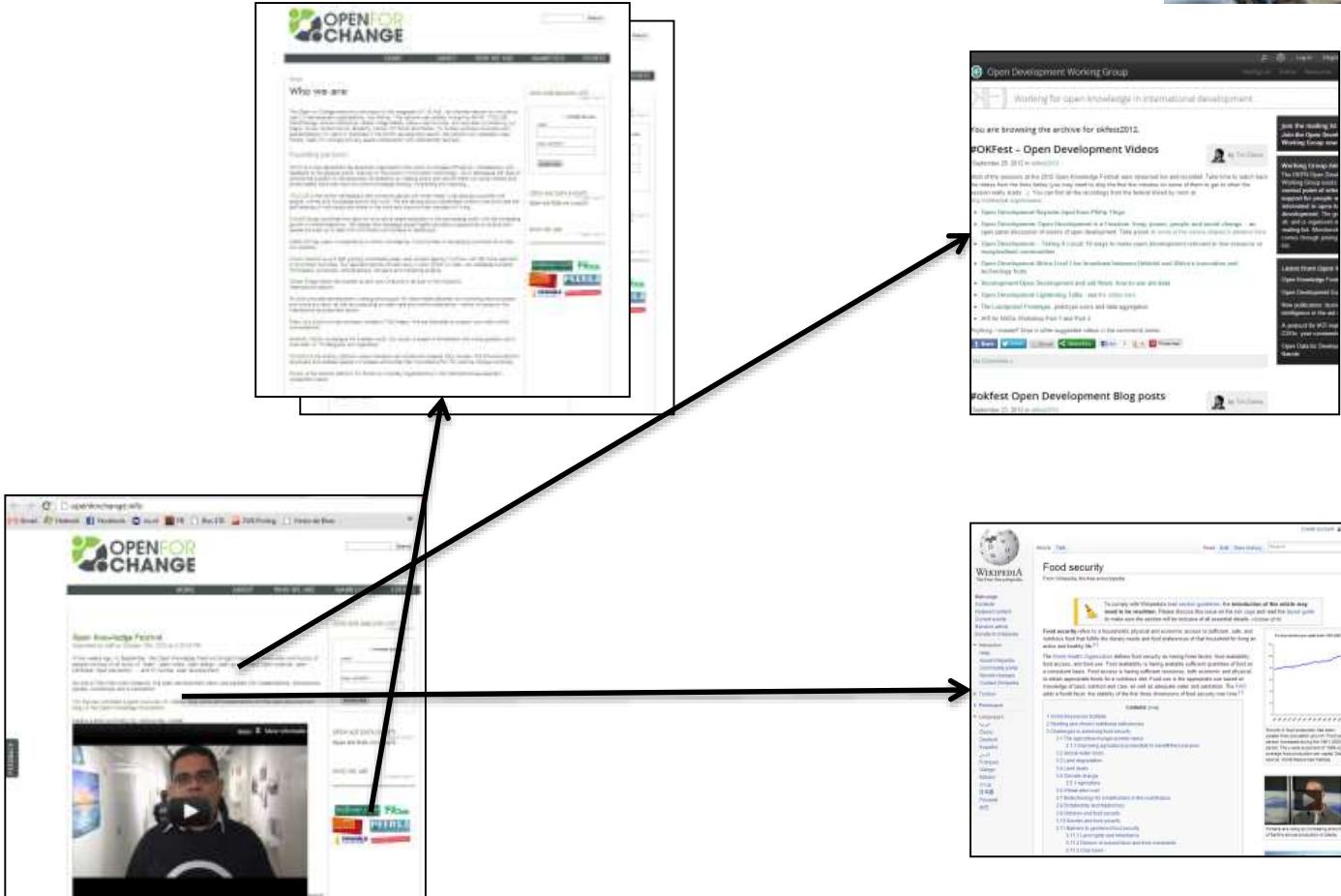
Web of Documents vs Web of Data

- People are often not interested in **documents**, they are interested in **things** (information)
 - Humans are very good at reading (web) documents and distilling information
- Computers are very good at **calculating, combining and filtering information**. But they are very bad at reading documents
 - We need to help machines understand web data
 - Write it down in a way that they can understand



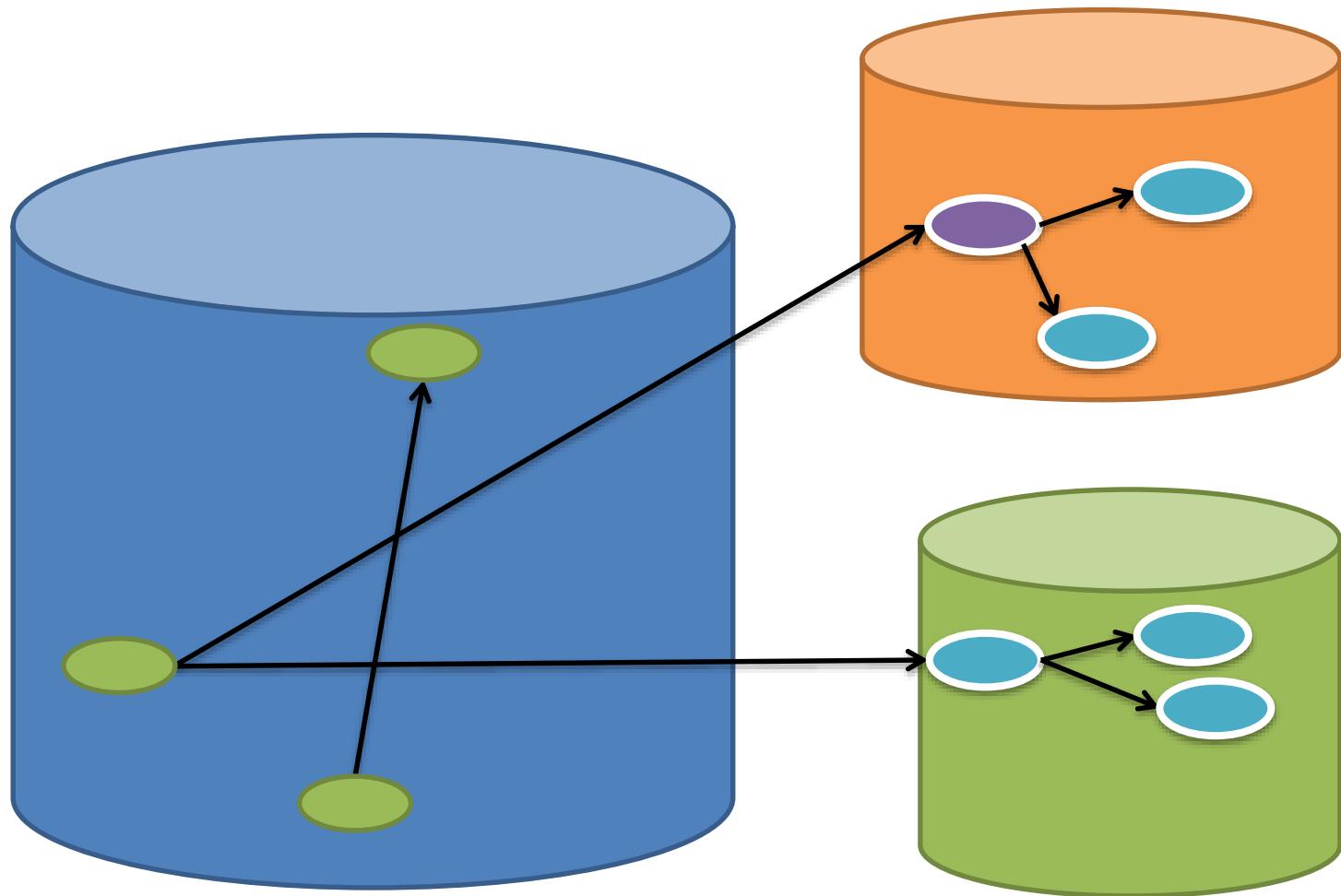
Web of Documents (WWW)

Linked Documents

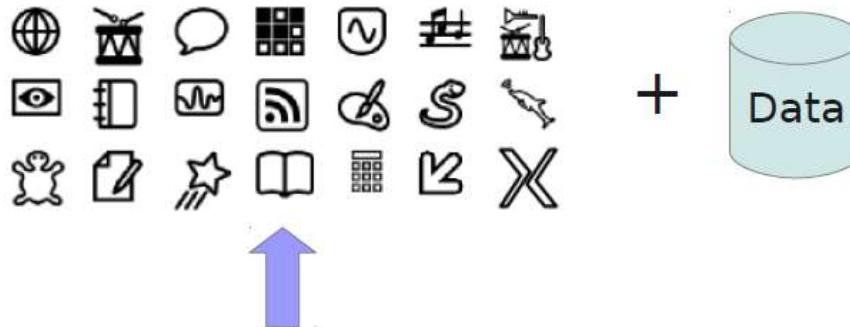


Web of Data

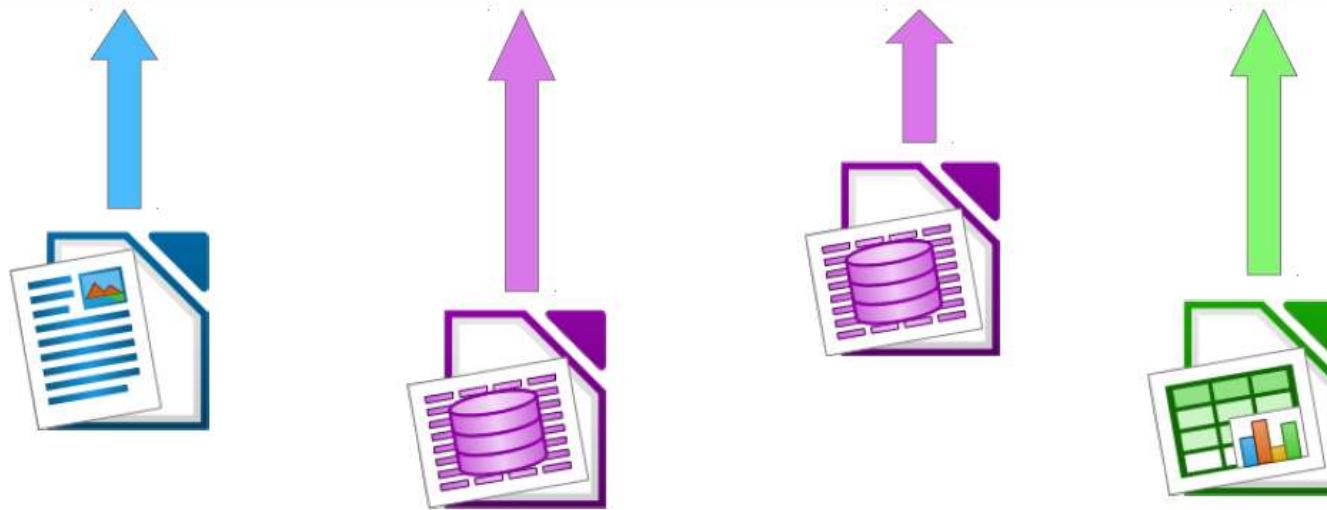
Linked Data



without

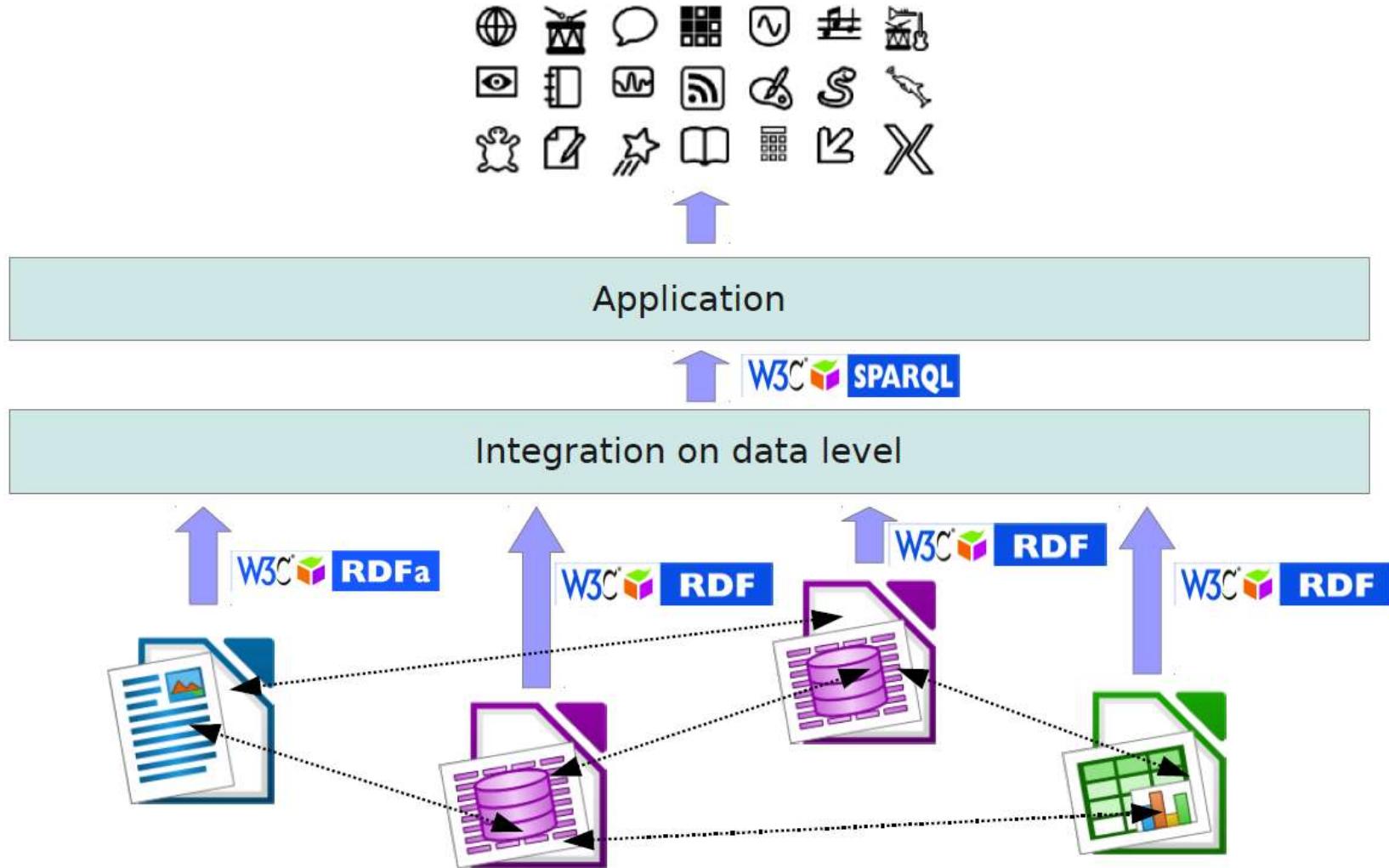


Data integration realised at application level



Inspired from <http://www.slideshare.net/ABLVienna>, Icons by <http://yumakino.deviantart.com/>

with Linked Data



Inspired from <http://www.slideshare.net/ABLVienna>, Icons by <http://yumakino.deviantart.com/>

Intermezzo

What is **Linked Open Data?**

Intermezzo

Intermezzo

Linked Data

is about *technology* for interoperability

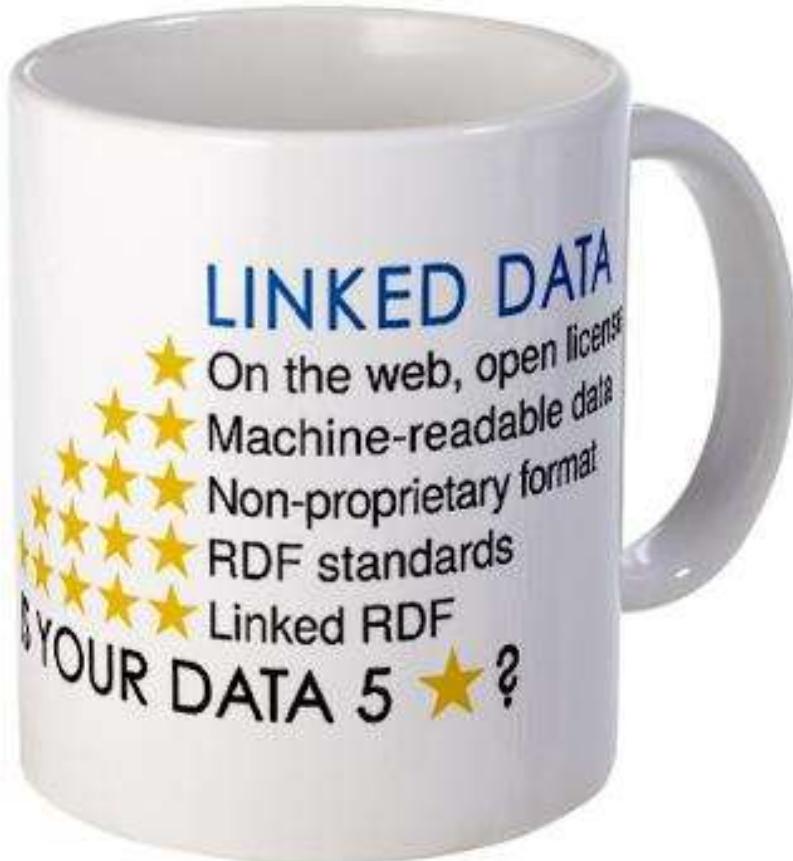
Open Data

is about *licenses* to allow reuse

Intermezzo

Intermezzo

Linked Data five star system (TBL)



★	Available on the web (whatever format), but with an open license
★★	Available as machine-readable structured data (e.g. excel instead of image scan of a table)
★★★	as (2) plus non-proprietary format (e.g. CSV instead of excel)
★★★★	All the above plus, Use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff
★★★★★	All the above, plus: Link your data to other people's data to provide context

Intermezzo

www.w3.org/designissues/linkeddata.html

Examples of Linked Data

- Academia, Research
- Community
- Libraries, Museums, Cultural Heritage
- Government and public institutions
(Open Data)
- Media
- Business

Queens of the Stone Age

Formed 1996.

PLAYED MOST ON BBC RADIO



MARY ANNE HOBBS | BBC RADIO 6 MUSIC

Joshua Homme: Key Of Life Interview With Mary Anne Hobbs (Extended Cut)

Hear candid words of wisdom from the Queens of the Stone Age front man

QUEENS OF THE STONE AGE 1:4 OF 6

Featured on BBC MUSIC SHOWCASE



JO SHUA HOMME: KEY OF LIFE...

JO SH HOMME CATCHES UP WITH ZANE AT...

QUEEN S OF THE STONE AGE - IND ONE...

QUEEN S OF THE STONE AGE LIVE AT...

Biography

Queens of the Stone Age is an American rock band from Palm Desert, California, United States, formed in 1996. The band's line-up includes founder Josh Homme (lead vocals, guitar, piano), alongside longtime members Troy Van Leeuwen (guitar, lap steel, keyboard, percussion, backing vocals), Michael Shuman (bass guitar, keyboard, backing vocals), Dean Fertita (keyboards, guitar, percussion, backing vocals), and recent addition Jon Theodore (drums, percussion).

Formed after the dissolution of Homme's previous band, Kyuss, Queens of the Stone Age developed a style of riff-oriented, heavy rock music. Their sound has since evolved to incorporate a variety of different styles and influences, including working with ZZ Top member Billy Gibbons and steady contributor Mark Lanegan.

[Read more at Wikipedia...](#)

WIKIPEDIA This entry is from Wikipedia, the user-contributed encyclopedia. It may not have been reviewed by professional editors and is licensed under the [GNU Free Documentation License](#). If you find the biography content factually incorrect, defamatory or highly offensive you can edit this article at [Wikipedia](#). [Find out more about our use of this data.](#)

Links & Information

LINKS

Official homepage at qotsa.com

Fanpage at qotsa.mysiteonline.com

Youtube at youtube.com/user/QueensStoneAgeVEVO

MySpace at myspace.com/queensofthestoneage

Wikipedia article on Queens of the Stone Age

IMDb at imdb.com/name/nm1892949

Last.fm page on Queens of the Stone Age

Discogs at discogs.com/artist/Queens+Of+The+Stone+Age

Share This Page 122 so far

[Share](#) [Facebook](#) [Twitter](#)

More BBC Music Highlights



Latest Tracks Played On The BBC

I Sat By The Ocean

BBC RADIO 6 MUSIC | RADCLIFFE AND MACONIE WILL GREGORY OF GOLDFRAPP



My God Is The Sun

BBC RADIO 1 | ROCK SHOW WITH DANIEL P CARTER ENTER SHIKARI SIT IN FOR DAN



In My Head

BBC RADIO 6 MUSIC | MARY ANNE HOBBS SONIC SUNDAY AND THE BBC PROMS



The Lost Art Of Keeping A Secret

BBC RADIO 6 MUSIC | RADCLIFFE AND MACONIE 26/07/2013



Smooth Sailing

BBC RADIO 6 MUSIC | SHAUN KEAVNEY MARY ANNE HOBBS SITS IN



Played By

Since December 2008



Zane Lowe

BBC Radio 1



Shaun Keaveny

BBC Radio 6 Music



Lauren Laverne

BBC Radio 6 Music



Chris Hawkins

BBC Radio 6 Music



Steve Lamacq

BBC Radio 6 Music



6 Music's Jukebox

BBC Radio 6 Music

http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
PREFIX rdf: <<http://www.w3.org/1999/02/22-rdf-syntax-ns#>> .
PREFIX rdfs: <<http://www.w3.org/2000/01/rdf-schema#>> .
PREFIX owl: <<http://www.w3.org/2002/07/owl#>> .
PREFIX foaf: <<http://xmlns.com/foaf/0.1/>> .
PREFIX dc: <<http://purl.org/dc/terms/>> .
PREFIX dcterms: <<http://purl.org/dc/terms/>> .
PREFIX skos: <<http://www.w3.org/2004/02/skos/core#>> .
PREFIX xsd: <<http://www.w3.org/2001/XMLSchema#>> .
PREFIX po: <<http://purl.org/ontology/po/>> .
PREFIX wo: <<http://purl.org/ontology/wo/>> .

[Mallards](#) are the archetypal and most recognisable ducks. They are found wherever there is water, from rivers and lakes to remote ponds and coastal marshes. It is their adaptability to all kinds of environment that has brought mallards to towns and parks. The males have a glossy green head and white neck ring, whilst the females lack in colour they make a noise. The familiar 'quack' is the call of a female when summoning her ducklings. Mallards are the ancestors of many breeds of domestic duck and will readily interbreed with them.

[via platiynchos](#)

Mallard duck

MALLARD

BBC

Local authority
Bill Oddie Goes Wild
Duck ponds provide a useful resource for wild birds.

Bill Oddie -
Unhatched domestic ducks are a novelty but still behave like wild ducks.

A female...
plays a risky game to...
keep a mink away from...
her hidden chicks.

ducklings...
make a...
long leap for freedom

Top 10...
for a...
long leap for freedom

Distribution

Found in the following regions: United Kingdom, Africa

Habitats

Find out what these habitats are like and which other plants and animals live in them.



Classification

Animals
Vertebrates
Birds
Anseriformes
- Ducks, geese and swans
- Anser
Mallard

Find wildlife

Search for your favourite wildlife

Featured in...

Archived

Archived

Show all downloads...

Google knowledge graph

Google search results for "frank lloyd wright". A red circle highlights the Knowledge Graph panel on the right.

Search Results for **frank lloyd wright** (About 18,131,000 results (0.61 seconds))

Everything Showing results for **frank lloyd wright**
Search instead for **frank lloyd wright**

Frank Lloyd Wright Foundation
www.franklloydwright.org
The foundation established by **Wright** himself at Taliesin West in Arizona aims to advance the principles of organic architecture and preserve **Wright's** archive.

Frank Lloyd Wright - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Frank_Lloyd_Wright
Frank Lloyd Wright (born Frank Lincoln Wright, June 8, 1867 – April 9, 1959) was an American architect, interior designer, writer and educator, who designed more than 1,000 structures and completed 500 works.
» List of Frank Lloyd Wright works - Fallingwater - Taliesin - Mamah Borthwick

Frank Lloyd Wright architecture tours, Home and Studio - Oak Park, IL
www.gowright.org/
Architecture tours of the **Frank Lloyd Wright** Home and Studio, Robie House - a Prairie style masterpiece, and The Rookery Building in Chicago. Featuring Fallingwater, Taliesin, Taliesin West, Robie House, and Ennis House.

Frank Lloyd Wright biography
www.angusandeliza.com/louiswright.html
Frank Lloyd Wright, containing a biography about his life.

Frank Lloyd Wright
www.pbs.org/wgbh/
PBS **Frank Lloyd Wright** Web site, a companion to the Ken Burns/Lynn Novick film, contains biographical information, drawings and blueprints, analysis of ...

Images for frank lloyd wright - Report images


Welcome To Frank Lloyd Wright Foundation Store
www.franklloydwright.com/
The bookstore at Taliesin West offers a collection of gifts & decorative accessories representing the architectural & graphic designs of **Frank Lloyd Wright**.

Frank Lloyd Wright in Oak Park, Illinois (1889-1909)
www.apbt.com/few/
Illustrated guide to **Wright's** buildings in this Chicago suburb, indexed by street and by date. Includes news and events.
» Show map of 951 Chicago Avenue, Oak Park, IL 60302

Frank Lloyd Wright
Frank Lloyd Wright was an American architect, interior designer, writer and educator, who designed more than 1,000 structures and completed 500 works.
Born: June 8, 1867, Richland Center
Died: April 9, 1959, Phoenix, AZ
Education: University of Wisconsin-Madison
Spouse: Olgivanna Wright (m. 1928); Maude "Milan" Wright (m. 1923–1927); More
Children: John Lloyd Wright, Lloyd Wright

Structures


People also search for


How does all this work?

- Data, not documents
- Structured data
- Graph (networked) data!
- W3C Web standards stack
 - URIs, HTTP, RDF, RDFa, RDFS, OWL, SPARQL, etc.



Four rules of Linked Data

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**)
4. Include **links** to other URIs. so that they can discover more things.

Resource Description Framework (RDF)

Semantic Web standard for writing down data, information

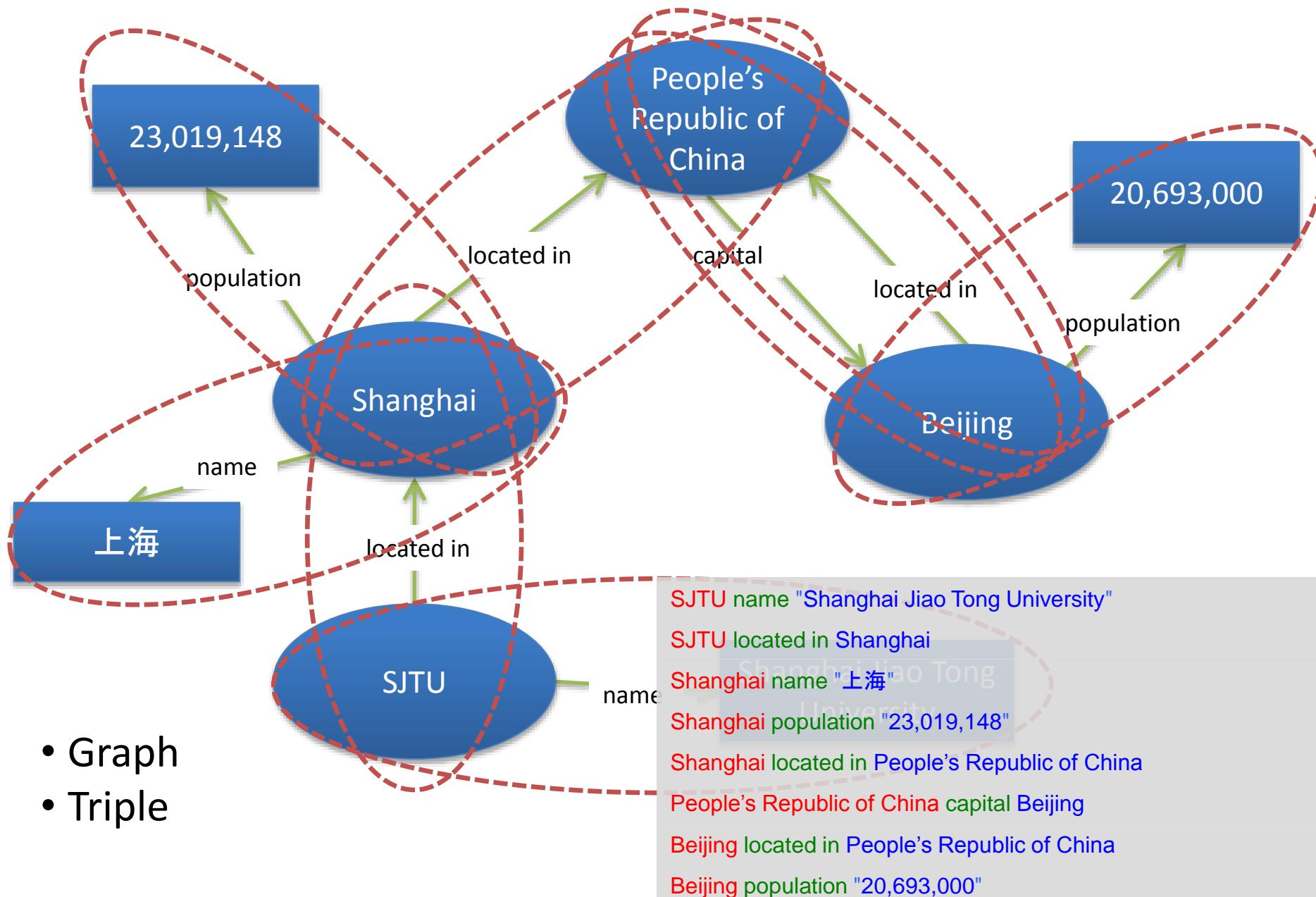
Triples!!

(Subject, Relation, Object)

<Painting001, has_location, Amsterdam>



Graph Thinking



Use HTTP URIs for *Things*

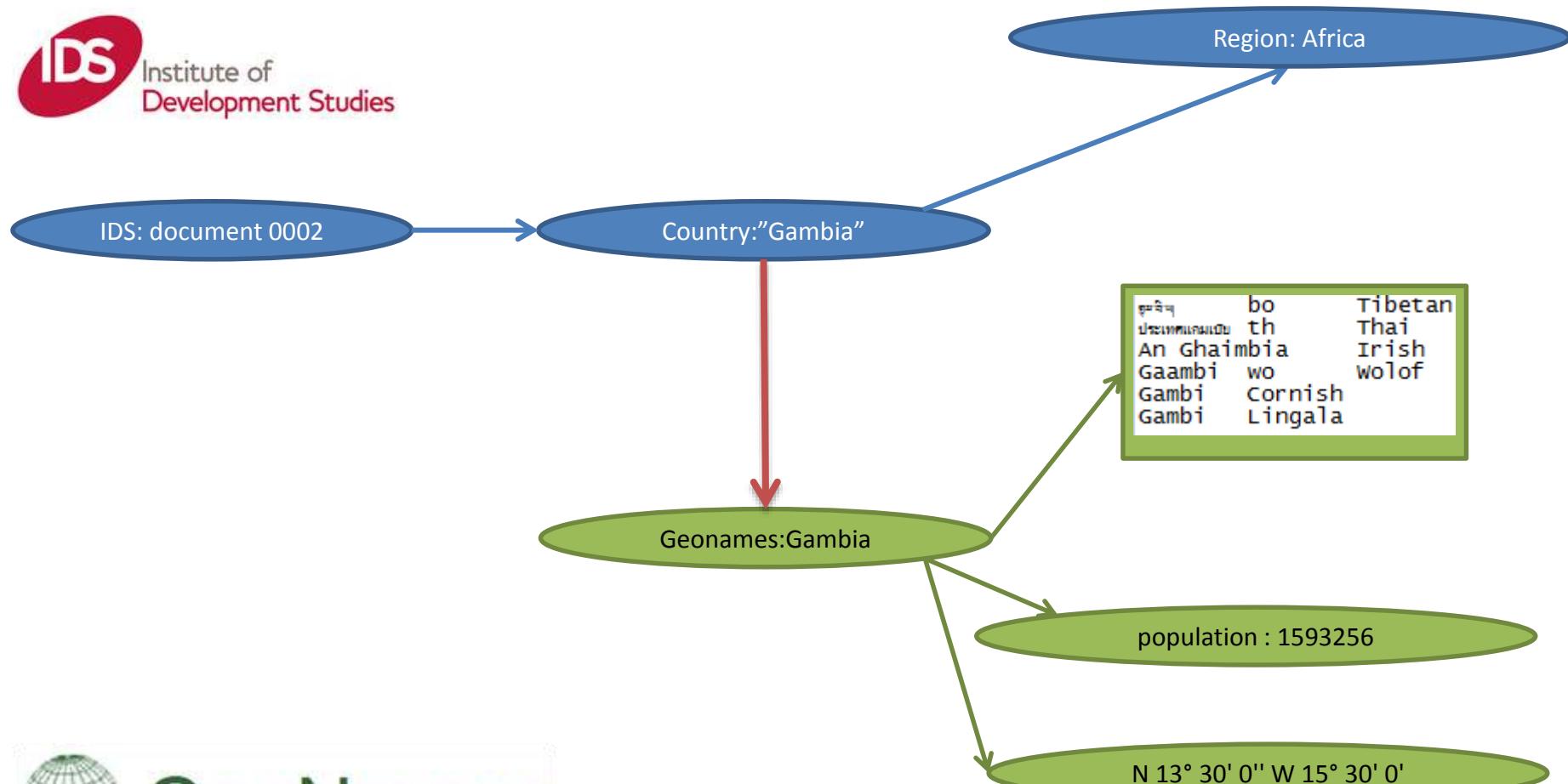
- Uniform Resource Identifier (URI) is a string of characters used to identify a name of a resource
- <http://rijksmuseum.nl/data/schilderij1>
 - I can go there (*dereference*) and then I get information about it
 - HTML page for humans
 - RDF data for machines

or (rijks:schilderij1)

Links

- Link your data to other data
 - By establishing RDF triples that point to other people's data
 - By reusing other people's URIs

Example: Link to Geonames



Reuse things: Vocabularies

- **FOAF** (Friend of a Friend): People, Organisations, Social Networks
- **Dublin Core** (Bibliographic): publications, authors, media, etc.
- **schema.org** (Google, Yahoo!, Bing, Yandex): cross-domain, what search engines are interested in (people, events, products, locations)
- **Good Relations**: business, products, etc.



Reuse things: Datasets

- **GeoNames:** Geographical data
- **DBpedia:** RDF version of Wikipedia (also in Dutch)
- **GTAA:** (Gemeenschappelijke Thesaurus Audiovisuele Archieven): Persons, topics, AV-terms
- **VIAF:** Persons



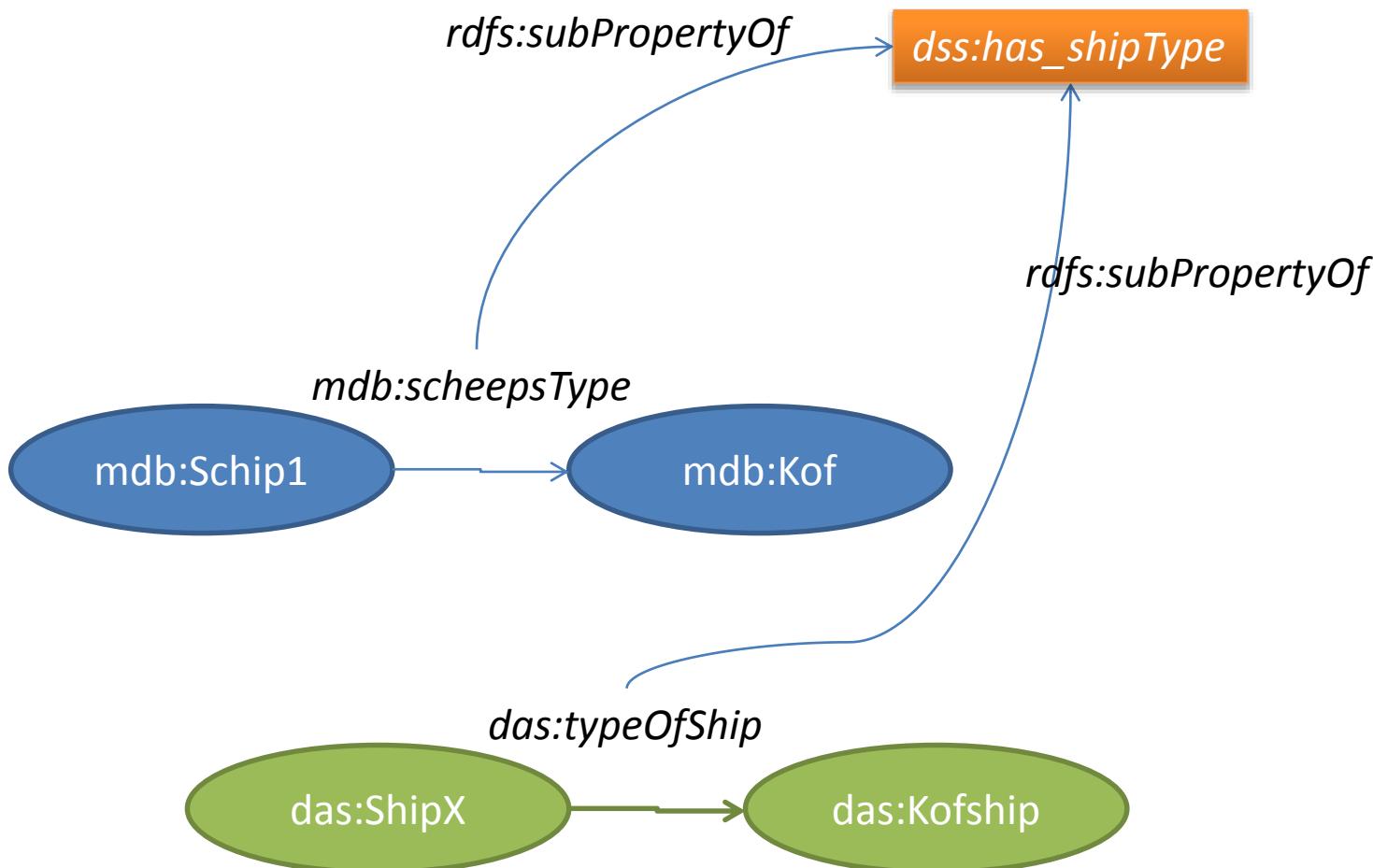
But why Linked Data

- Heterogeneous models, one dataformat
 - Link what can be linked
 - Keep specificity of original data
 - Allow integration at project level (and beyond)
- Links to other sources: re-use knowledge
- Extensible
- Allow multiple levels of semantic enrichment/
normalization
 - Provenance

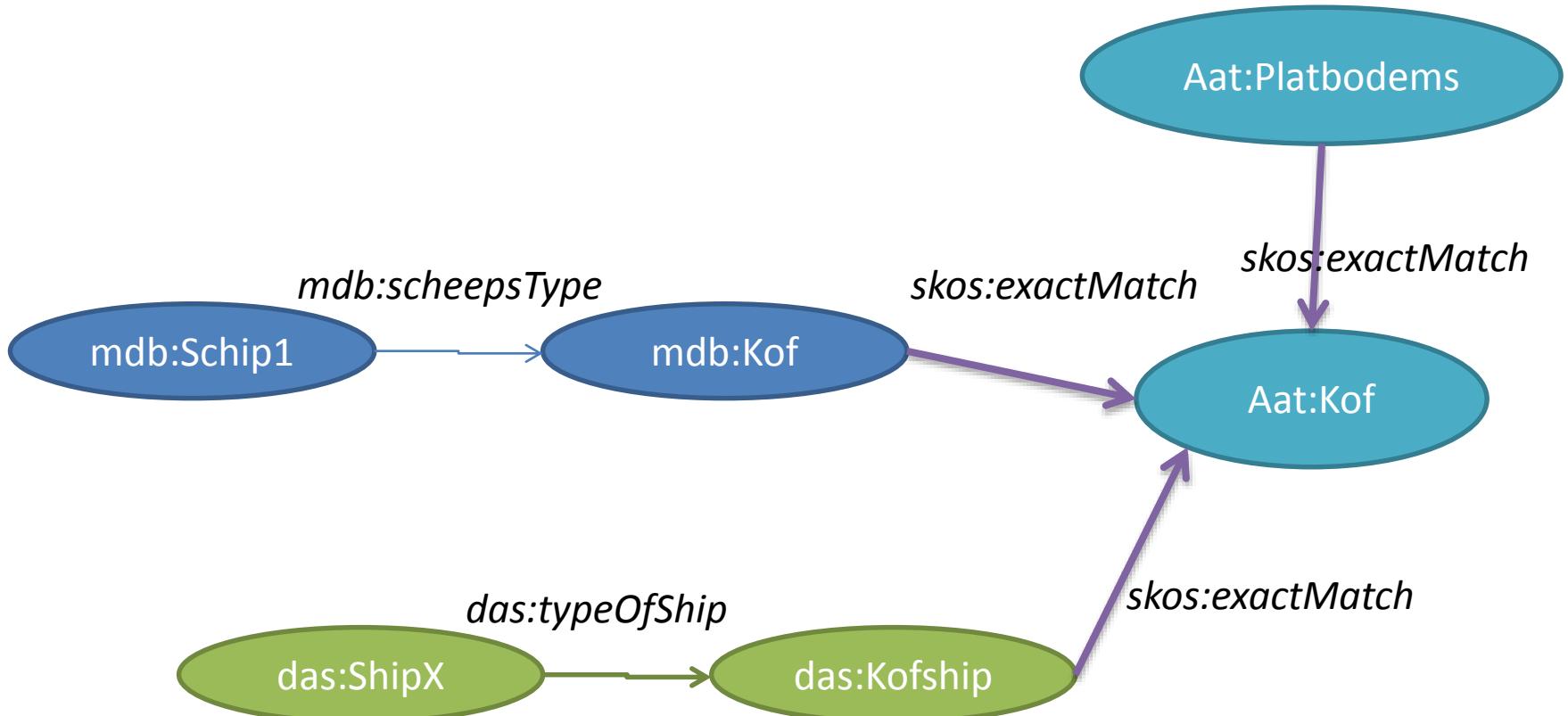
Modelling principles

- Model each dataset as directly as possible
 - Only “syntactical” transformation to RDF
 - No normalization
- Reusability
- Transparency, trust
- Normalize and link in second stage
 - store in separate RDF Named Graphs

Link properties and classes to interoperability layer



Vocabulary Links



Links to DBPedia (Ship types, places, ranks)

Links to Getty AAT (Ship types, ranks)

Links to GeoNames (Places)

Provenance

- Sets of triples have provenance information
 - Who made it (people/software?)
 - Based on what source
 - Content confidence
- Matches historical science requirements



Take Home

- Linked Data is a set of technologies and principles for formalizing data and information to make it usable for computers
 - Based on **triples** and **URIs**
 - Data takes the form of **graphs**
 - We can **link data from heterogeneous sources**
 - **Reuse**
- It mirrors the Web of Documents, Social Web
 - But behind the scenes
- **Networks** are very powerful and flexible for representing and sharing information