



1. Introduction

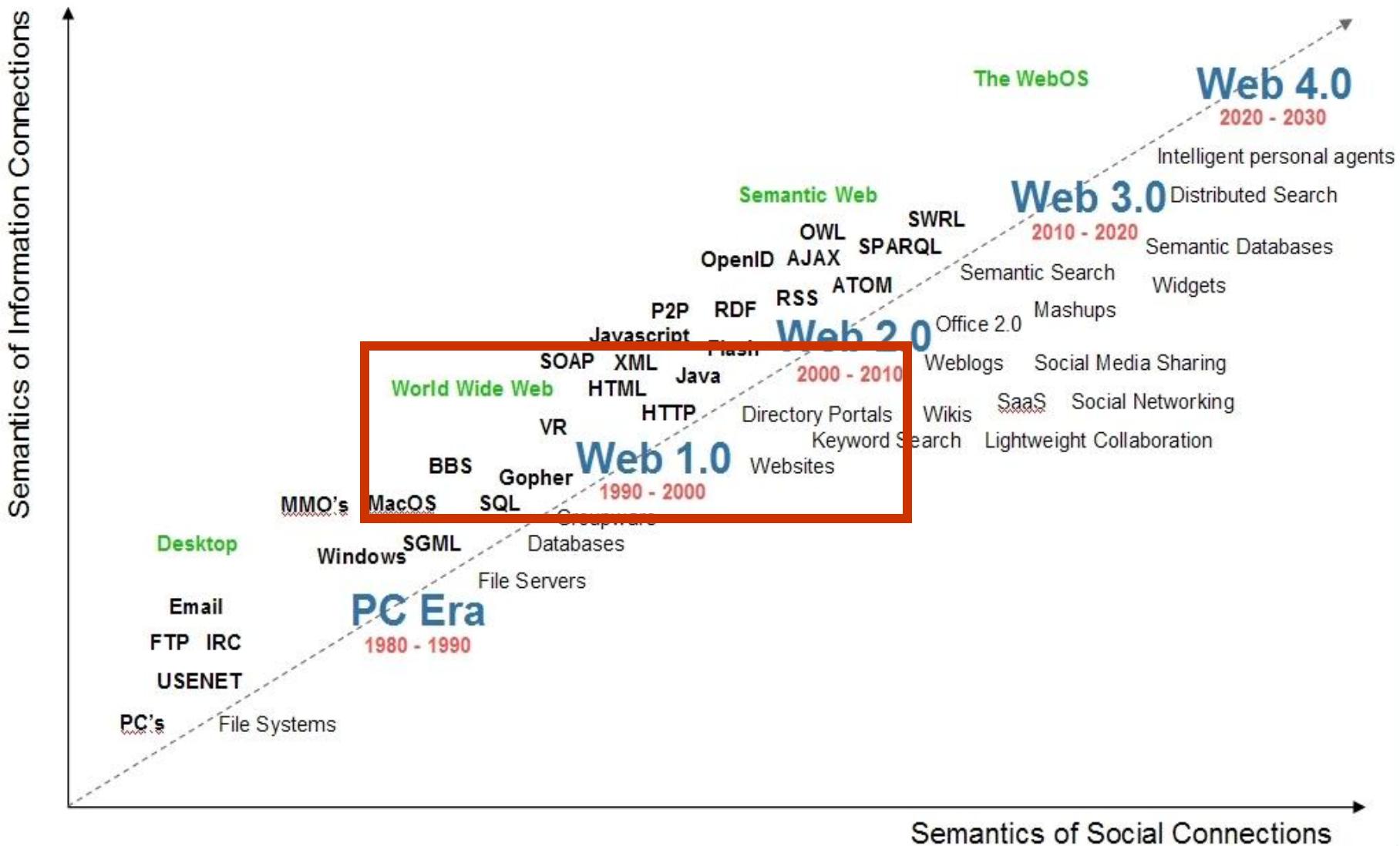
Asunción Gómez-Pérez
`{asun}@fi.upm.es`
<http://www.oeg-upm.net>

Omtological Engineering Group
Laboratorio de Inteligencia Artificial
Facultad de Informática
Universidad Politécnica de Madrid
Campus de Montegancedo sn,
28660 Boadilla del Monte, Madrid, Spain

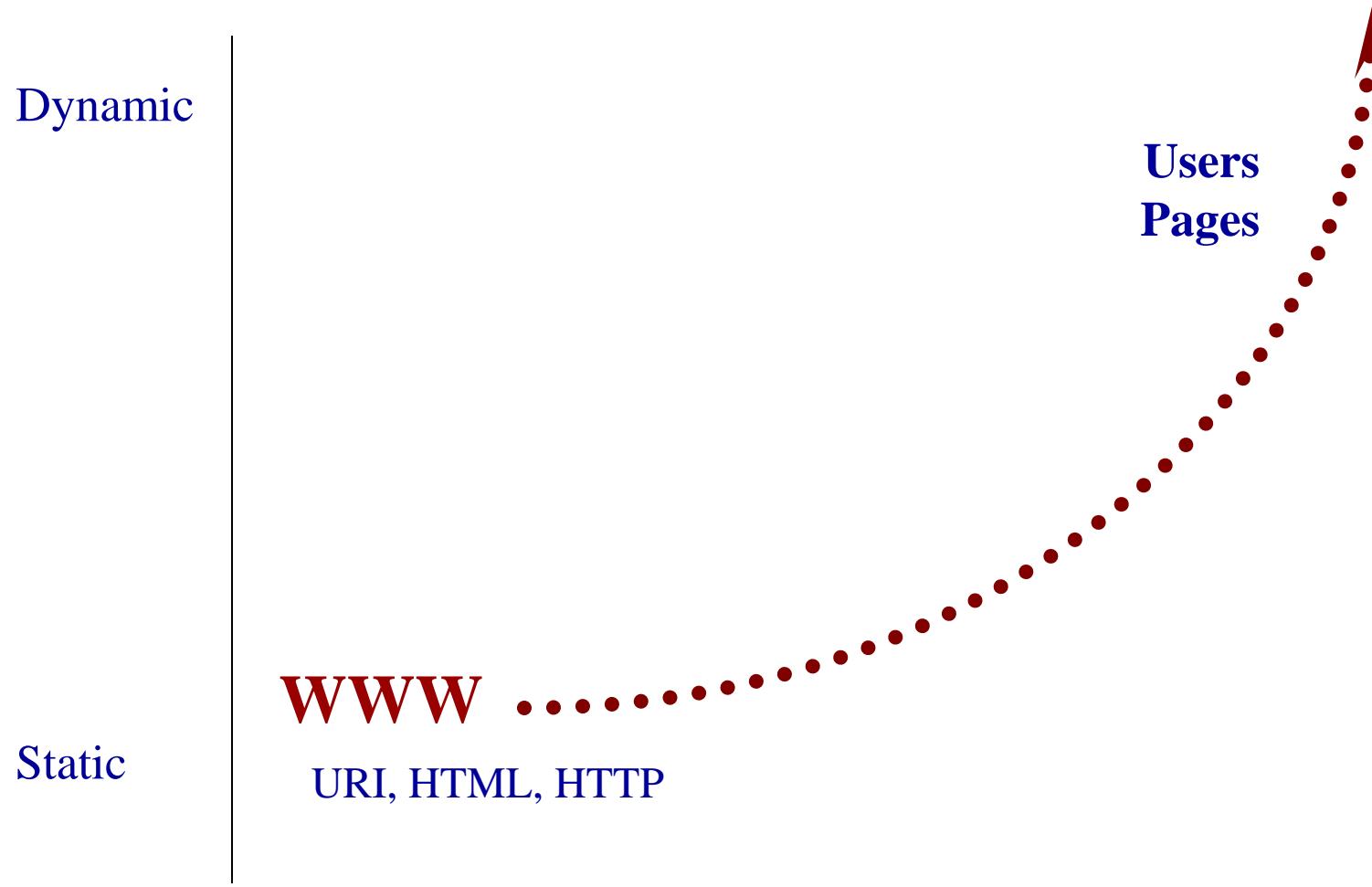
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- Web
- Web 2.0
- Web 3.0 and the Semantic Web
- Linked data
- Examples of semantic applications
 - Semantic Webs
 - Corporative Semantics
 - Annotation at large scale
 - Semantic portals
 - Semantic Web Services

Web n+1: Roadmap

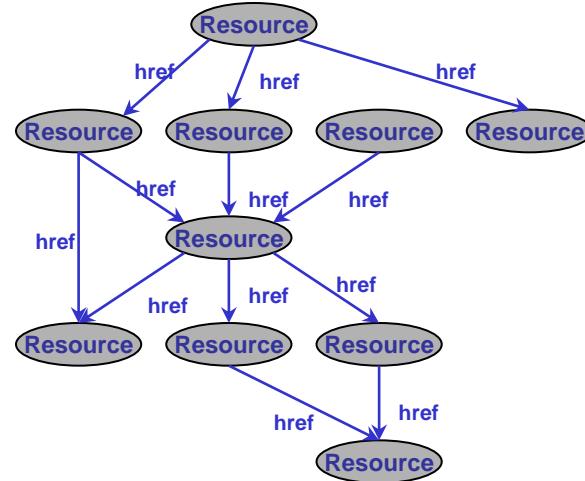


The problem: Information overload on the Web



Where we are Today: the *Syntactic* Web

The screenshot shows the homepage of the International Summer School on Grid Computing 2006. At the top, there's a banner with the school's name and logo. Below it, a navigation bar with links like 'MAIN', 'REGISTRATION', 'CURRICULUM', 'PRACTICAL INFORMATION', 'CONTACT', and 'LOGISTICS'. The main content area is titled 'Curriculum' and lists the schedule for the first and second weeks. It includes details for each day, such as dates, times, sessions, and speakers. For example, on Sunday, July 9, 2006, sessions include 'Welcome', 'Registration', 'Basic Java, UML & XML Materials', and 'Introduction to Grid Computing'.

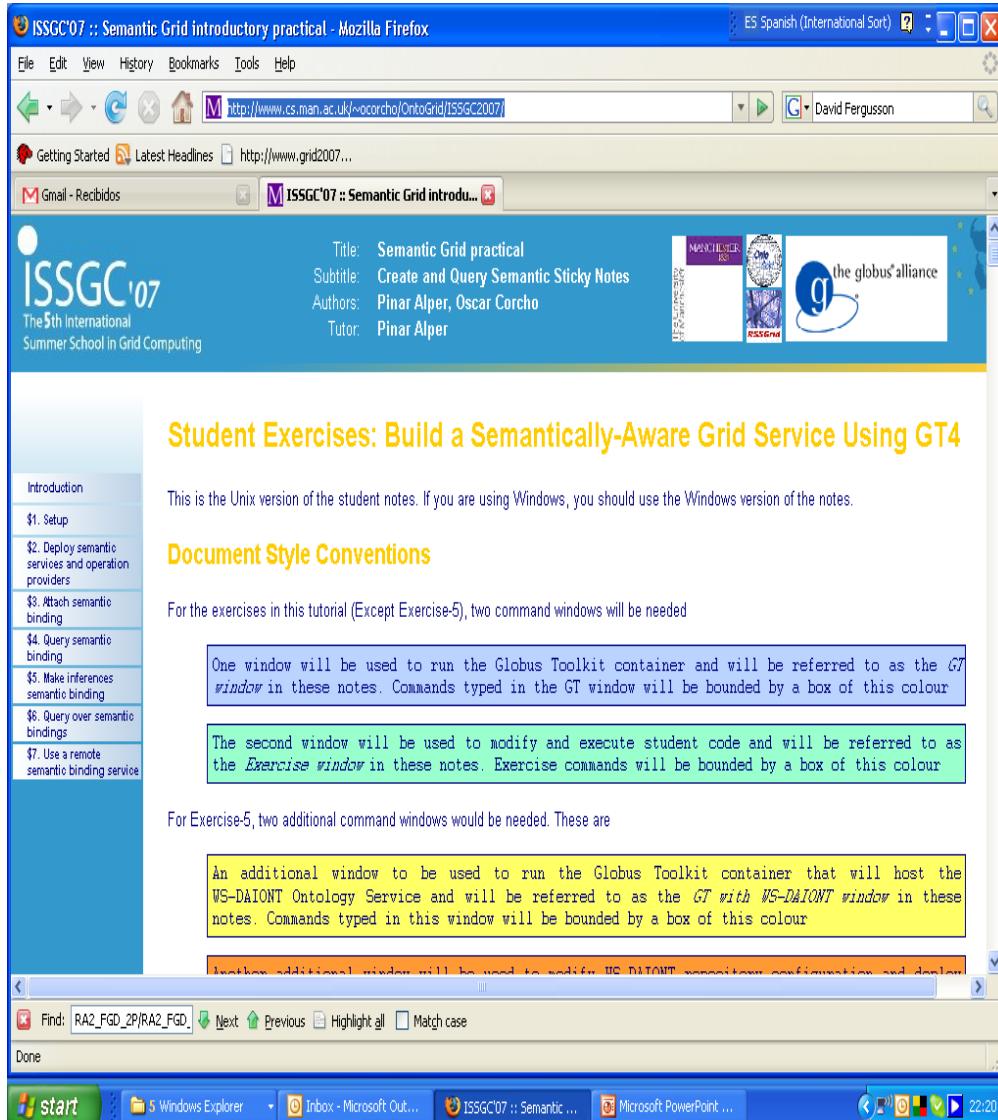


The screenshot shows a specific session page from the website. The title is 'Session 2: Day 2: Time 11:00 to 12:30 Principles of Distributed and Grid Systems'. Below the title, it says 'Professor Malcolm Atkinson (Programme Chair)'. The page contains two main sections: 'Content' and 'The Service Registry design pattern'. The 'Content' section lists topics like 'Introduction to distributed systems architecture & principles', 'Principles through a sequence of composable system design patterns', 'Client server model - their variations - examples', 'Centralized vs distributed', and 'Central-server example - examples'. The 'Service Registry design pattern' section provides a detailed description of the pattern, its purpose, and examples.

- A place where computers do the presentation (easy) and people do the linking and interpreting (hard).
- Why not get computers to do more of the hard work?

What's the Problem?

- Typical web page markup consists of:
 - Rendering information (e.g., font size and colour)
 - Hyper-links to related content
- Semantic content is accessible to humans but not (easily) to computers...



The current Web is multilingual

Árabe



الاسم: الهندسة فعلم النطرو
المؤلفون: آسنييون غومزبرز
السعر: \$74.95
المنتج: الكتاب

الاسم: الهندسة فعلم النطرو
المؤلفون: آسنييون غومزبرز
السعر: \$74.95
المنتج: المنتج

Noruego



Skjøte: Ontological Ingeniørarbeid
Forfatter: Overtakelse Gómez-Pérez...
Pris: 74.95€
Produkt: Bok

Skjøte: Ontological Ingeniørarbeid
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- .- HTML is useful for browsing the information
- .- Content is language-dependent
- .- High cost for keeping the information up-to-date



タイトル: 存在論工学
著者: アスンスイオン ゴメスペレス
価格: \$74.95
产品: 本

タイトル: 存在論工学
著者: アスンスイオン ゴメスペレス...
価格: \$74.95
产品: 本

Japonés



Title: Ontological Engineering
Authors: Asunción Gómez-Pérez...
Price: \$74.95
Product: Book

Title: Ontological Engineering
Authors: Asunción Gómez-Pérez...
Price: \$74.95
Product: Book

Ingles

Information a machine can see...

XML allows the creation of metadata with “meaning”



Árabe



الاسم: الهندسة فعلم التطوير
المؤلفون: آسنيسيون غوميز بيرز
السعر: \$74.95
المنتج: الكتاب

<الاسم/><الهندسة فعلم التطوير ><الاسم>
<المؤلفون/><آسنيسيون غوميز بيرز ><المؤلفون>
<السعر/><\$ 74.95><السعر>
<الكتاب/><المنتج ><الكتاب>

Inglés



Title: Ontological Engineering
Authors: Asunción Gómez-Pérez...
Price: \$74.95
Product: Book

<Title>Ontological Engineering</Title>
<Author>Asunción Gómez-Pérez...</Author>
<Price>\$74.95</Price>
<Product>Book</Product>

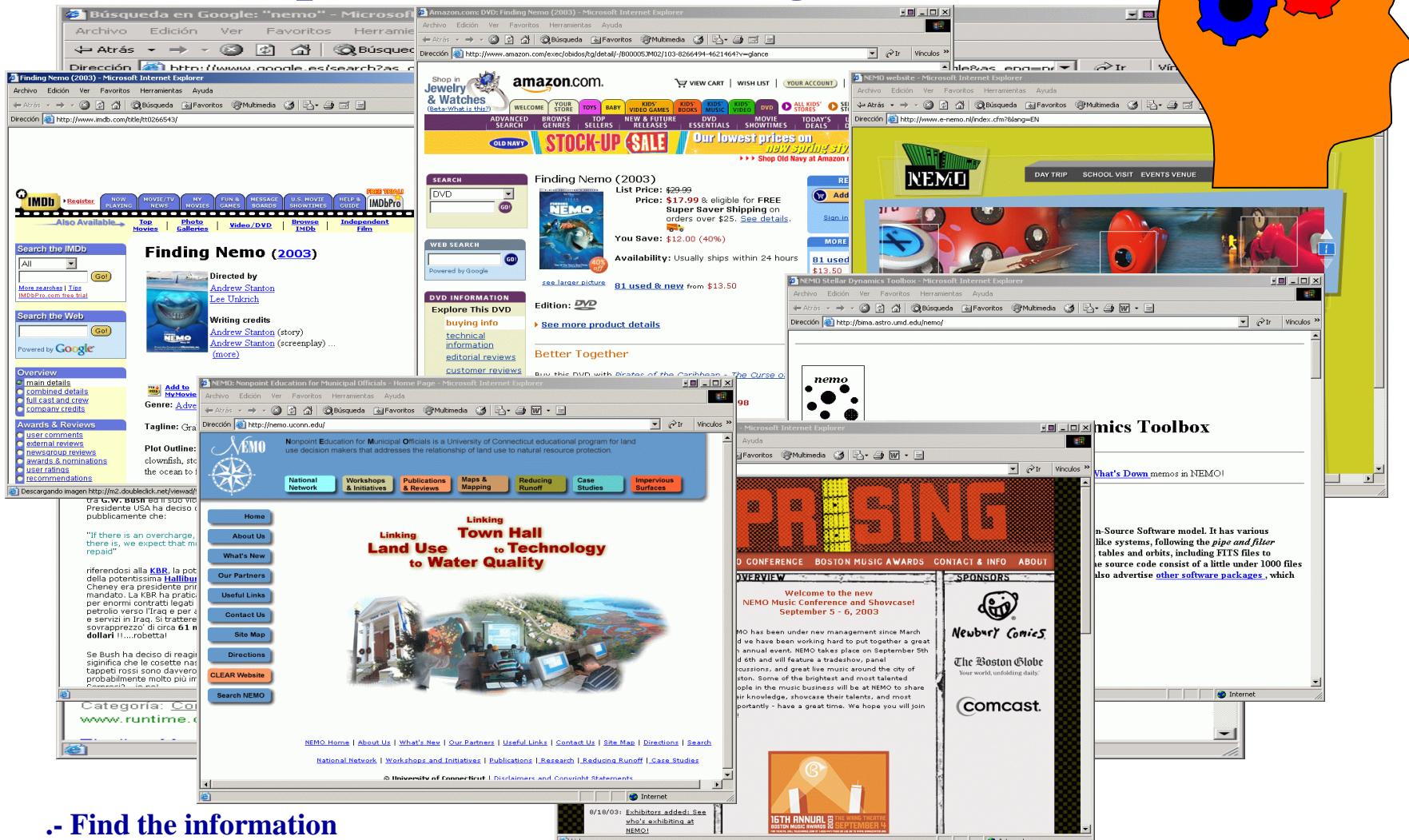
¿What do the tags mean for the machine?



Solution: XML markup with “meaningful” tags?

But What About...?

The problem of choosing information



- .- Find the information
- .- Extract relevant information
- .- Interpretation by human users
- .- Synthesis



The problem of content aggregation: From Madrid to Tokyo

VIAJES IBERIA - Microsoft Internet Explorer

Personalizada para el origen MADRID

Vuelos: Madrid, España - Frankfurt, Alemania

Sábado, 17 de Enero 2004

Vuelos desde Barajas (MAD), Madrid, España a Frankfurt Int'l (FRA), Frankfurt, Alemania

Reservado Turista

LEYENDA: OP=Vuelo operado por otra compañía, R=Solicitud en curso E=Candidato para billete electrónico

Seleccionar	Vuelo	Salida	Destino	Escala	Duración	Clase
<input checked="" type="checkbox"/>	Lufthansa LH 4412 E	Barajas (MAD), Madrid, España	06:20 Frankfurt Int'l (FRA) Frankfurt, Alemania	09:05 Sin escalas 320	2h45min	Turista
<input type="checkbox"/>	Spanair JK 8863 OP	Barajas (MAD), Madrid, España	06:20 Frankfurt Int'l (FRA) Frankfurt, Alemania	09:05 Sin escalas 320	2h45min	Turista
<input type="checkbox"/>	Iberia IB 3500 E	Barajas (MAD), Madrid, España	09:00 Frankfurt Int'l (FRA) Frankfurt, Alemania	11:40 Sin escalas 320	2h40min	Turista
<input type="checkbox"/>	Spanair JK 1285	Barajas (MAD), Madrid, España	09:45 Frankfurt Int'l (FRA) Frankfurt, Alemania	12:35 Sin escalas 320	2h45min	Turista
<input type="checkbox"/>	Lufthansa LH 2581 OP	Barajas (MAD), Madrid, España	09:45 Frankfurt Int'l (FRA) Frankfurt, Alemania	12:35 Sin escalas 320	2h45min	Turista
<input type="checkbox"/>	Iberia IB 3514 E	Barajas (MAD), Madrid, España	11:30 Frankfurt Int'l (FRA) Frankfurt, Alemania	14:15 Sin escalas 320	2h45min	Turista
<input type="checkbox"/>	Lufthansa LH 2592 OP	Barajas (MAD), Madrid, España	12:40 Frankfurt Int'l (FRA) Frankfurt, Alemania	15:20 Sin escalas 320	2h45min	Turista

東京全日空ホテル - Microsoft Internet Explorer

Atención al cliente: 902 116 225 (Quieres?)

Fair & Event - フェア・エベント

Stay Plan - ステイプラン

News & To Information SIMPLE PLAN

QUICK RESERVATIONS Arrival Date: WED 14 JANUARY 04

Ortzeit: 14:38 pm

Press Release Recruit

INTERCONTINENTAL FRANKFURT

INTERCONTINENTAL FRANKFURT

Reservierungen News & Angebote Lage Zimmerinformationen Essen & Unterhaltung Konditionen & Calendrier

New year's Eve Information: InterContinental Frankfurt ist direkt am Mainufer gelegen, nur Minuten vom Theater- und Börsenviertel sowie von den Strassen entfernt. 770 elegante eingerichtete Zimmer, darunter 100 Suiten und 100 Apartments. Ein Restaurant, das Zentrum und Säulen der Club InterContinental bringen Ihnen insbesondere Glühen einen besonderen Kontakt. 16 Konferenz- und Banketträume im Hauptgebäude bieten Platz für Tagungen bis zu 1.000 Personen.

Hauptgebäude Das über Frankfurt erhält man von der 21. Etage ein 360°-Panorama und das Tagungsraum

Interkontinental Frankfurt Signature mit euro-asischer Küche wird ergänzt durch das Restaurant "LEON'S". Die "D'AXX Manhattan's Bar" bietet Cocktails, kleine Gerichte und Livemusik.

TV TOKYO CINEMA STREET - Microsoft Internet Explorer

CINEMA STREET

NEW NATIONAL THEATRE, TOKYO

2004-01-13 新国立劇場舞台美術センター美利坚

2003-12-22 新国立劇場 第二期の公演が開幕いたしました。

2003-12-19 新国立劇場 第二期の公演が開幕いたしました。

2003-12-16 新国立劇場 第二期の公演「三毛鼠」

2003-12-15 ワルツリックを出走する愛馬の名前を

2003-12-15 2004-02-03 シーズン

2003-12-11 新国立劇場研修事業

2003-12-11 新国立劇場の公演

2003-12-11 本日の公演はございません

2月

日	月	火	水	木	金	土
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FRANKFURT FLUGHAFEN

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Buchen	Gruppe und Medalle	Mehrmalig	Wochenende
ECOM - ECONOMY 3 TURBO N.H.P. 115PS/106 1.1 oder ähnliche	244,90 €	244,90 €	244,90 €
CCMR - KOMPAKT 3 TURBO CITROËN XSARA 1.4 oder ähnliche	314,97 €	314,97 €	314,97 €
IDMR - MITTELKLASSE MANUE-OPEL VECTRA	384,97 €	384,97 €	384,97 €

トヨタレースカーデザイン!!

トヨタの新しいクルマ「ジエンタ」に24時間無料で乗れるチャンス!!

ガーリース

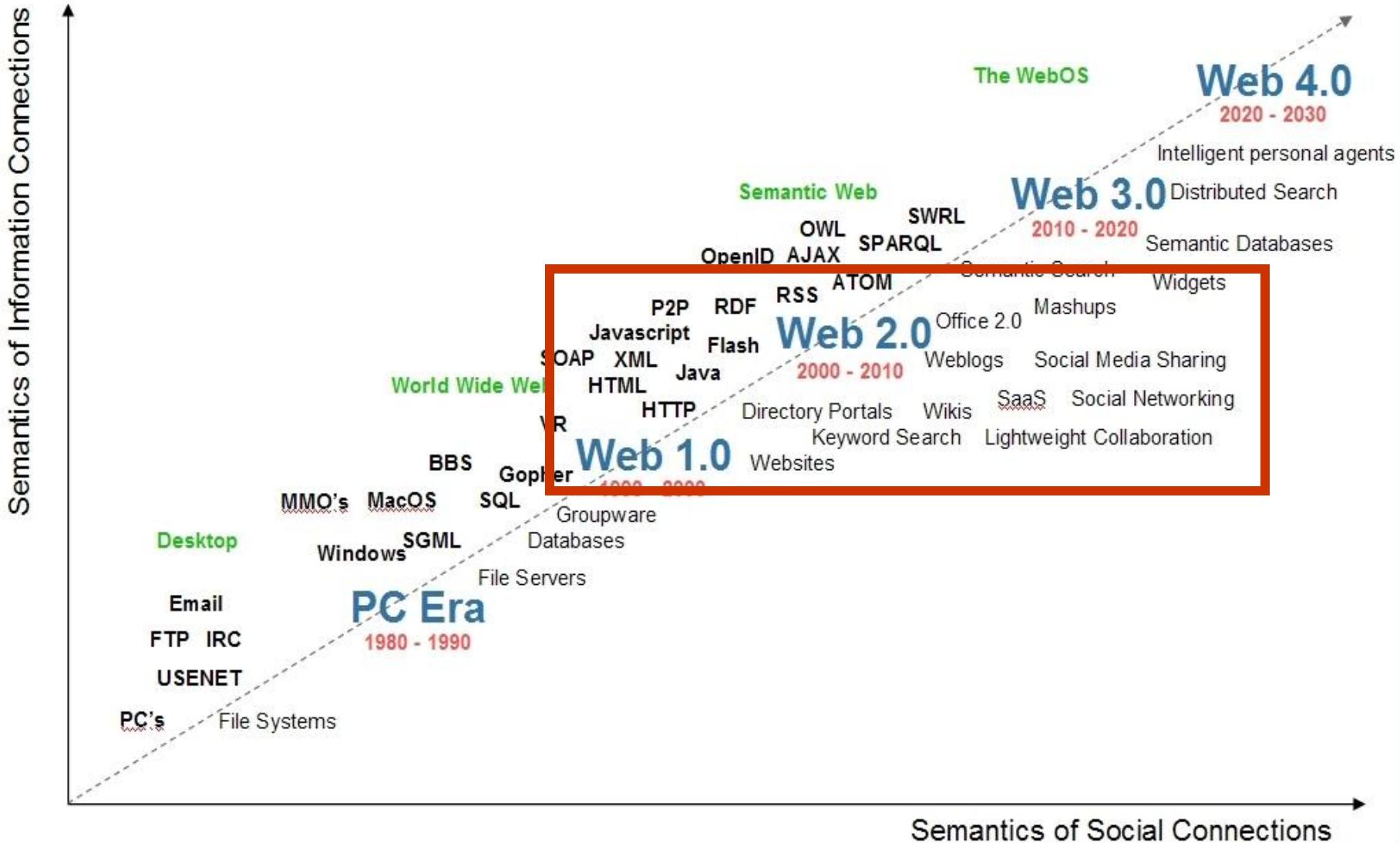
What was the Web intended to be?



“... a goal of the Web was that, if the interaction between person and hypertext could be so intuitive that the machine-readable information space gave an accurate representation of the state of people's thoughts, interactions, and work patterns, then machine analysis could become a very powerful management tool, seeing patterns in our work and facilitating our working together through the typical problems which beset the management of large organizations.”

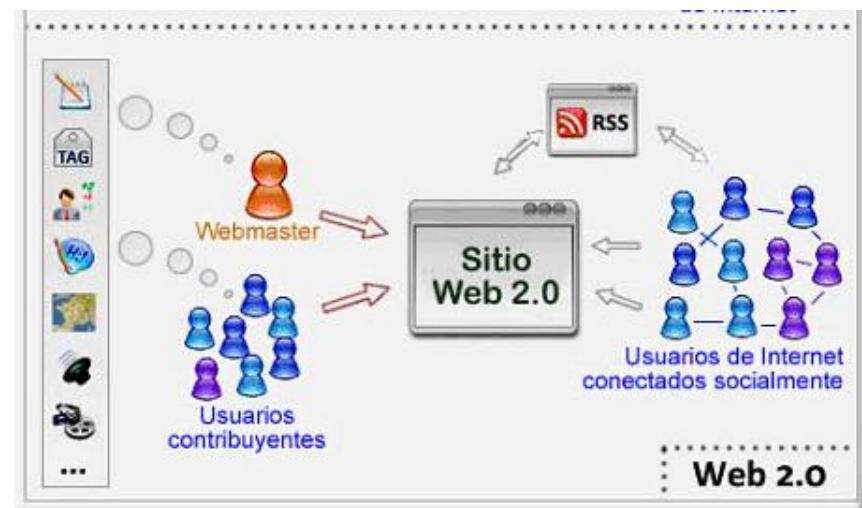
[Berners-Lee 1996]

Web n+1: Roadmap



Web 2.0

- **Users are both readers and writers**
 - Generate content
 - Control content
- **Ever-increasing amounts of content**
 - Dynamic content
- **Users participate**
 - Communication
 - Collaboration
- **Users add value to applications as they use it**
 - Collective intelligence by way of user participation
- **Rich user experience**
 - User-friendly interface
 - Personalized content
- **The Web as a programming platform**
 - Run applications entirely through a browser
 - Portability: software above the level of a single device
 - Openness



del.icio.us - Mozilla Firefox

Archivo Editar Ver Higtonal Marcadores Herramientas Ayuda

Personalizar vínculos http://pobladores.lyc... http://pobladores.lyc... Iberia.com

Google delicious web Buscar M Marcadores Corrector ortográfico Traductor Enviar a delicious Configuración

del.icio.us
social bookmarking

» all your bookmarks in one place
» bookmark things for yourself and friends
» check out what other people are bookmarking

learn more... **get started**

hotlist what's hot right now on del.icio.us

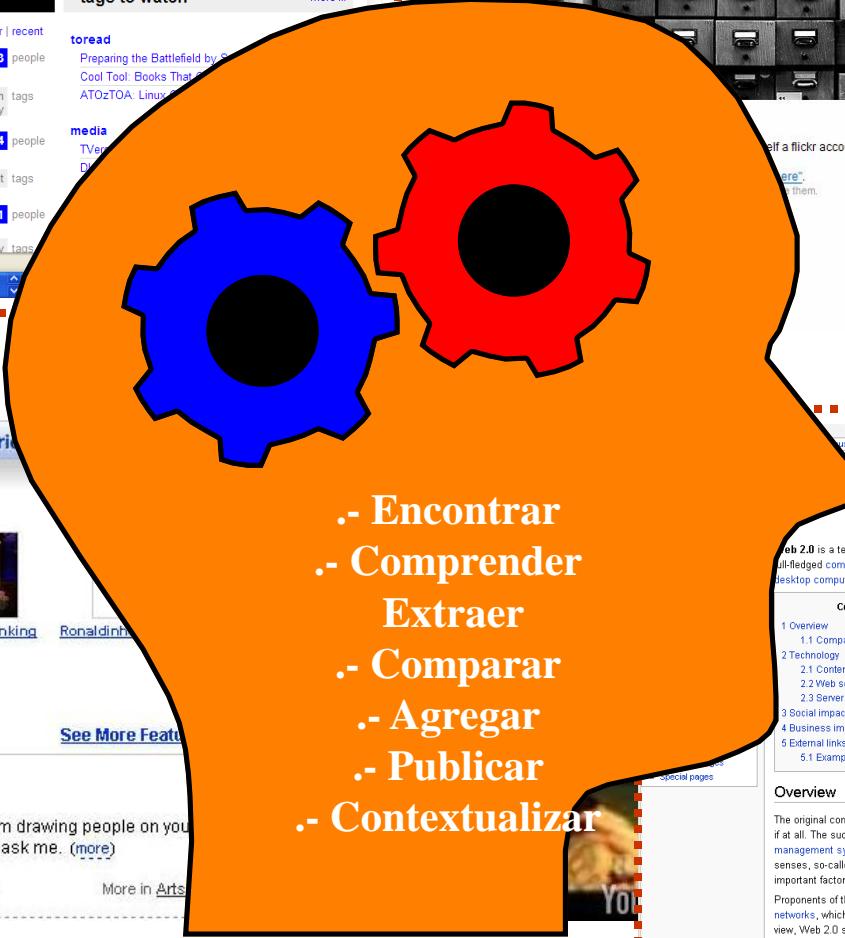
HOT NOW

- Gumption: Do You Just Get Me? Do I Even Get Myself? 103 people
- Ask The Readers: What Books Have Changed Your Life? 104 people
- 9 Steps to Achieving Flow (and Happiness) in Your Work | Zen Habits 121 people

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drawing youtube 02:04
This is a short version of the videos i did. I'm drawing people on you... you want me to draw a picture of you? Just ask me. (more)

From: [marcosejii](#) Views: 6,080 ★★★★☆ More in Arts

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Search everyone's photos Search

cardboxes

Upload on September 2, 2006 by **Nils K. Windisch (netomer)**

Nils K. Windisch (netomer)'s photostream

1,218 photos View as slideshow

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- 50mm
- 50mm f/1.8 AF
- D70
- Nikon
- black and white
- August
- 2006
- 0.4s
- f/8
- landscape format
- ISO200
- Göttingen
- Germany
- Europe
- Library
- State and University Library Göttingen
- on tour with Ralf Stockmann
- indoor
- historical Building
- geo:lat=51.534003
- geo:lon=9.932199

The neutrality of this article is disputed.
Please see the relevant discussion on the talk page.

Web 2.0 is a term often applied to a perceived ongoing transition of the **World Wide Web** from a collection of **websites** to a full-fledged computing platform serving **web applications** to **end users**. Ultimately **Web 2.0** services are expected to replace desktop computing applications for many purposes.

Contents [help]

- 1 Overview
- 1.1 Comparison with Semantic Web
- 2 Technology
 - 2.1 Content syndication
 - 2.2 Web services
 - 2.3 Server software
- 3 Social Impact
- 4 Business Impact
- 5 External links
- 5.1 Examples

Overview

The original conception of the web (in this context, labeled **Web 1.0**) comprised static **HTML** pages that were updated rarely, if at all. The success of the **dot-com** era depended on a more dynamic web (sometimes labeled **Web 1.5**) where **content management systems** served dynamic **HTML** web pages created on the fly from an ever-changing **content database**. In both senses, so-called **eyeballing** was considered intrinsic to the web experience, thus making **page hits** and visual aesthetics important factors.

Proponents of the **Web 2.0** approach believe that web usage is increasingly oriented toward interaction and rudimentary **social networks**, which can serve content that exploits **network effects** with or without creating a visual, interactive **web page**. In one view, **Web 2.0** sites act more as **points of presence**, or user-dependent **web portals**, than as traditional **websites**.

Comparison with Semantic Web

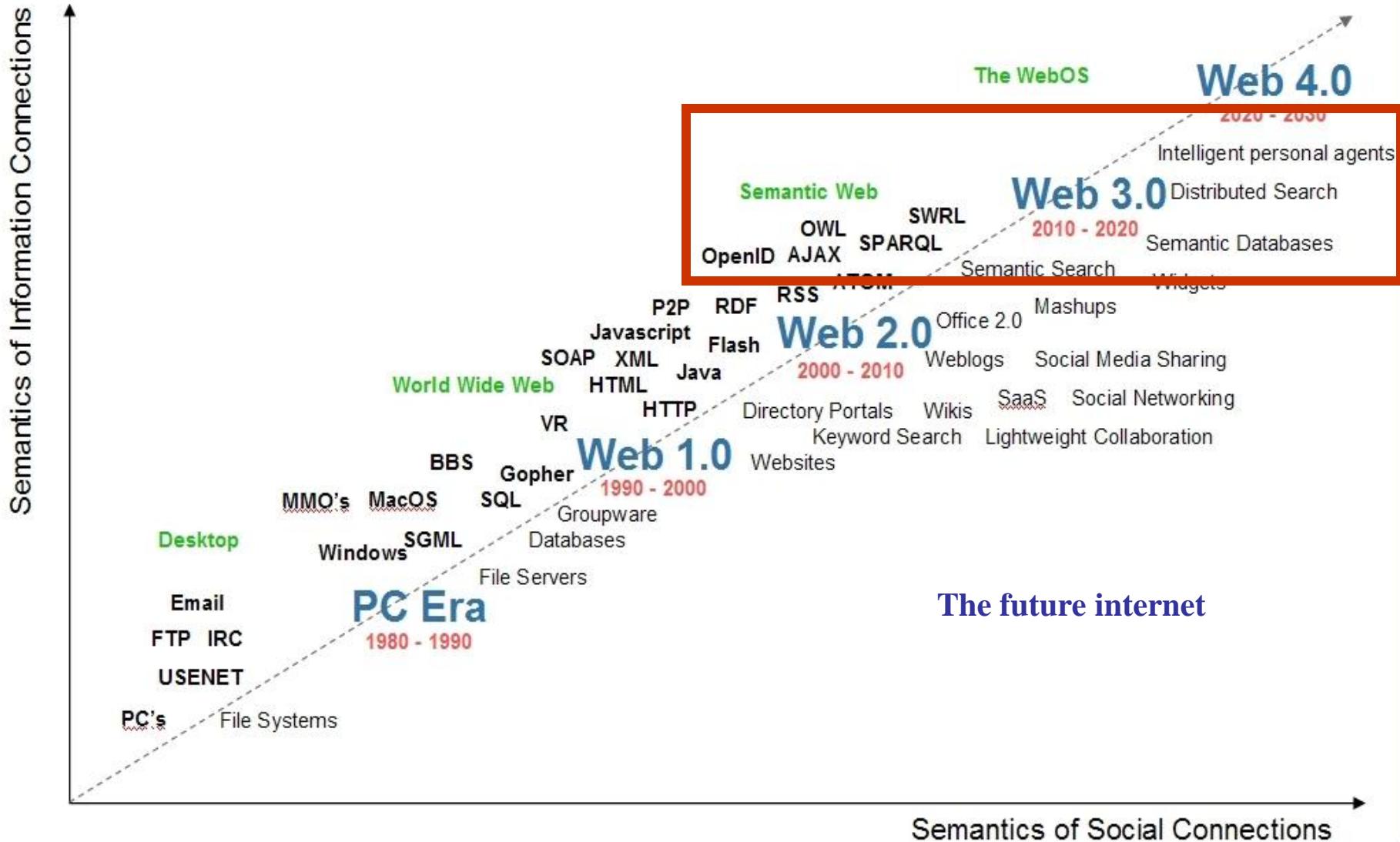
Ontology Engineering Group

and Tim Berneres-Lee [1996] sentence
is still valid for the Web 2.0



“... the machine-readable information space ...
... machine analysis could become a very
powerful management tool, ...
... facilitating our working together”

Web n+1: Roadmap



SOME RIGHTS RESERVED

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

Web 3.0

- **Web Inteligente**

- Semantic Web technologies
- The Data Web – a global database
- Intelligent applications (NLP, machine learning, machine reasoning, autonomous agents)

- **Conexión Ubicua**

- Broadband adoption
- Mobile Internet access
- Mobile devices

- **Computación en red**

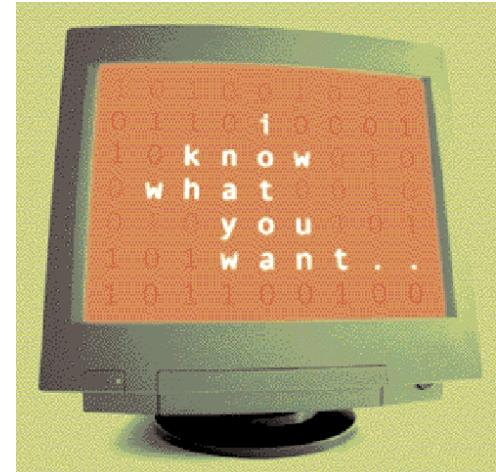
- Software-as-a-service business models
- Web services interoperability
- Distributed computing (P2P, grid computing, hosted "cloud computing" server farms)

- **Tecnologías abiertas**

- Open APIs and protocols
- Open data formats
- Open-source software platforms
- Open data (Creative Commons, Open Data License, etc.)

- **Open Identity**

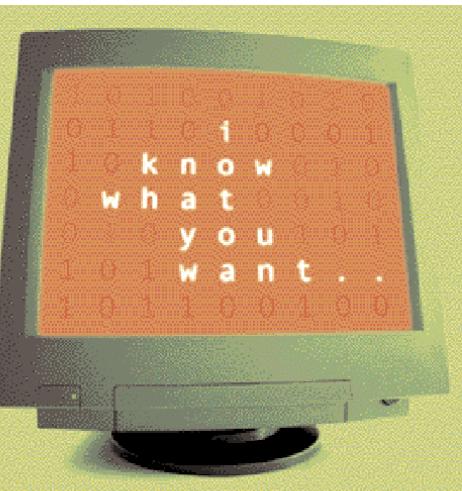
- Open identity (OpenID)
- Open reputation
- Portable identity and personal data



<http://lifeboat.com/ex/web.3.0>

What is the Semantic Web?

“The Semantic Web is an **extension** of the current Web in which information is given **well-defined meaning**, better enabling computers and people to work in **cooperation**. It is based on the idea of having data on the Web **defined and linked such that it can be used for more effective discovery, automation, integration, and reuse across various applications.**”



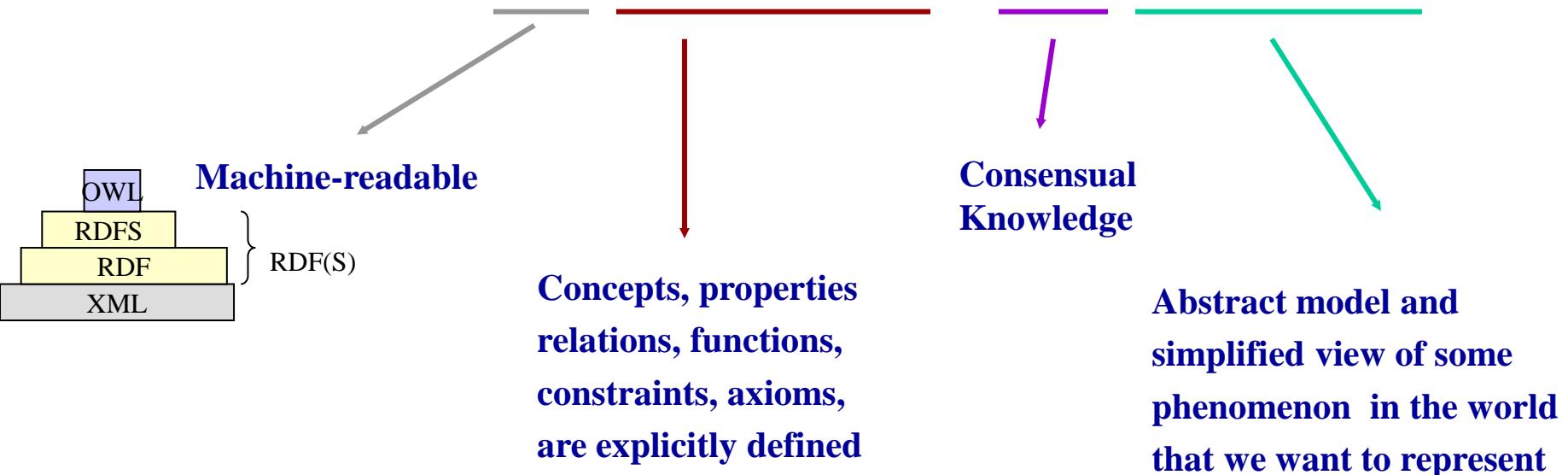
Ontologies

Anotation

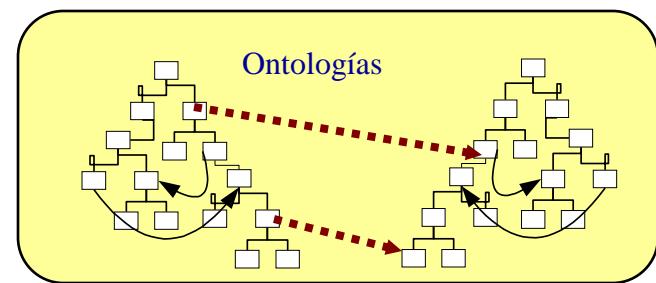
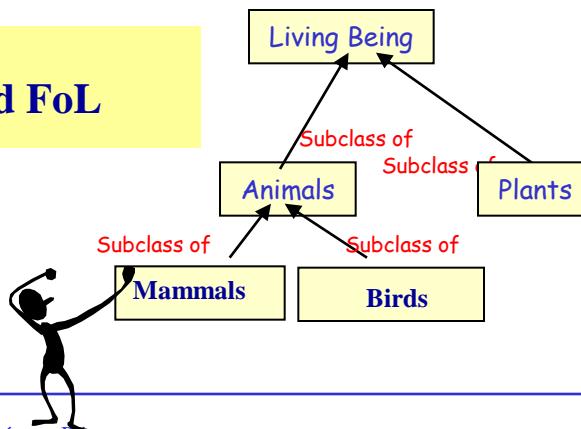
Hendler, J., Berners-Lee, T., and Miller, E.
Integrating Applications on the Semantic Web, 2002,
<http://www.w3.org/2002/07/swint.html>

Definition of Ontology

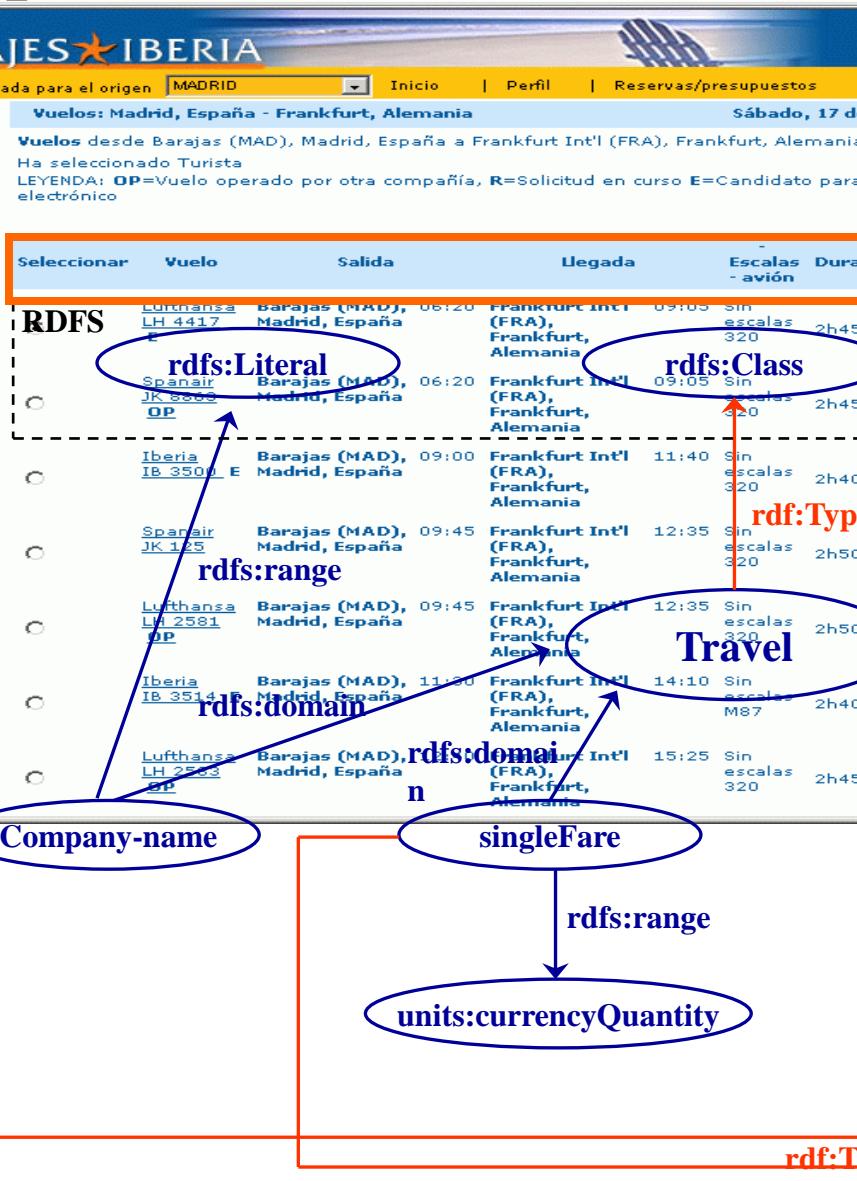
“An ontology is a formal, explicit specification of a **shared conceptualization**”



Frames and FoL



Ontology



```

<rdfs:Class rdf:ID="Travel">
<rdfs:comment>A journey from place to place</rdfs:comment>
</rdfs:Class>

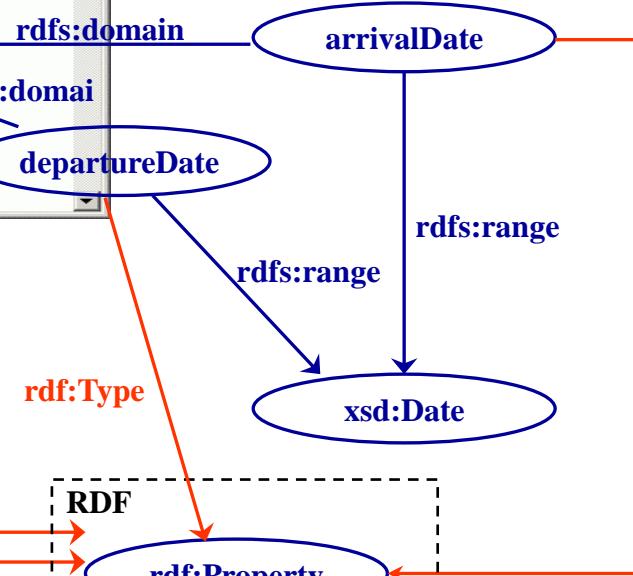
```

```

<rdf:Property rdf:ID="arrivalDate">
<rdfs:domain rdf:resource="#Travel"/>
<rdfs:range rdf:resource="&xsd;date"/>
</rdf:Property>

<rdf:Property rdf:ID="departureDate">
<rdfs:domain rdf:resource="#Travel"/>
<rdfs:range rdf:resource="&xsd;date"/>
</rdf:Property>

```



VIAJES IBERIA - Microsoft Internet Explorer

Archivo Edición Ver Favoritos Herramientas Ayuda

Atrás Búsqueda Favoritos Multimedia Ir

Dirección http://www.viajesiberia.com/ Atención al cliente 902 116 221 ¿Quieres re

VIAJES IBERIA

Personalizada para el origen MADRID Inicio Perfil Reservas/presupuestos

Vuelos: Madrid, España - Frankfurt, Alemania Sábado, 17 de Enero 2004

Vuelos desde Barajas (MAD), Madrid, España a Frankfurt Int'l (FRA), Frankfurt, Alemania

Ha seleccionado Turista

LEYENDA: OP=Vuelo operado por otra compañía, R=Solicitud en curso E=Candidato para billete electrónico

Seleccionar	Vuelo	Salida	Llegada	Escalas avión	Duración	Clase
<input checked="" type="radio"/>	Lufthansa LH 4417 E	Barajas (MAD), Madrid, España	06:20	Frankfurt Int'l (FRA), Frankfurt, Alemania	09:05 Sin escalas 320	2h45min Turista
<input type="radio"/>	Spanair JK 8863 OP	Barajas (MAD), Madrid, España	06:20	Frankfurt Int'l (FRA), Frankfurt, Alemania	09:06 Sin escalas 320	2h45min Turista
<input type="radio"/>	Iberia IB 3500 E	Barajas (MAD), Madrid, España	09:00	Frankfurt Int'l (FRA), Frankfurt, Alemania	11:40 Sin escalas 320	2h40min Turista
<input type="radio"/>	Spanair JK 1225	Barajas (MAD), Madrid, España	09:45	Frankfurt Int'l (FRA), Frankfurt, Alemania	12:35 Sin escalas 320	2h50min Turista
<input type="radio"/>	Lufthansa LH 2581 OP	Barajas (MAD), Madrid, España	09:45	Frankfurt Int'l (FRA), Frankfurt, Alemania	12:35 Sin escalas 320	2h50min Turista
<input type="radio"/>	Iberia IB 3514 E	Barajas (MAD), Madrid, España	11:30	Frankfurt Int'l (FRA), Frankfurt, Alemania	14:10 Sin escalas M87	2h40min Turista
<input type="radio"/>	Lufthansa LH 2583 OP	Barajas (MAD), Madrid, España	12:40	Frankfurt Int'l (FRA), Frankfurt, Alemania	15:25 Sin escalas 320	2h45min Turista

Metadata

Company-name

IB-4321

singleFare

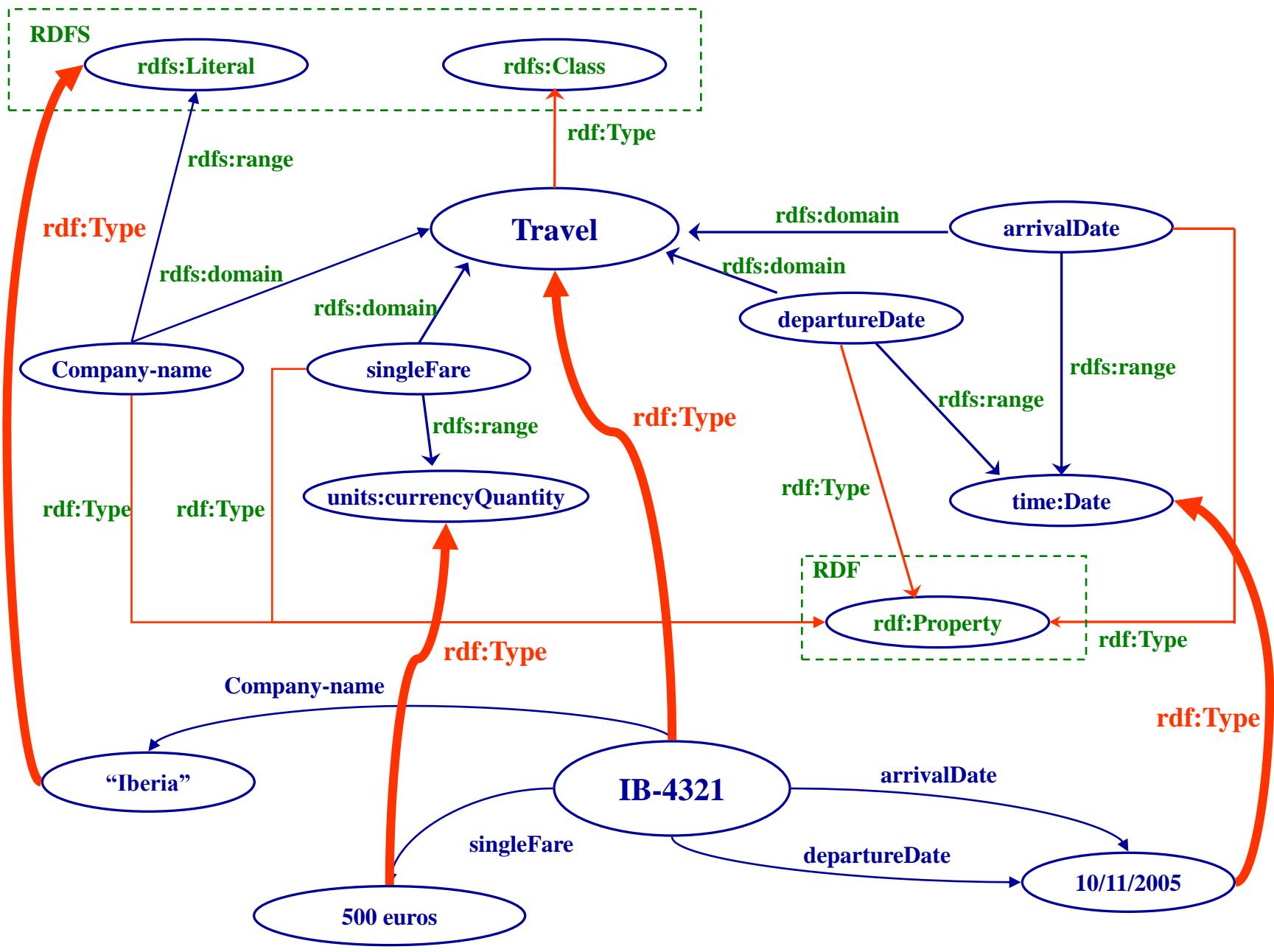
departureDate

arrivalDate

10/11/2005

```

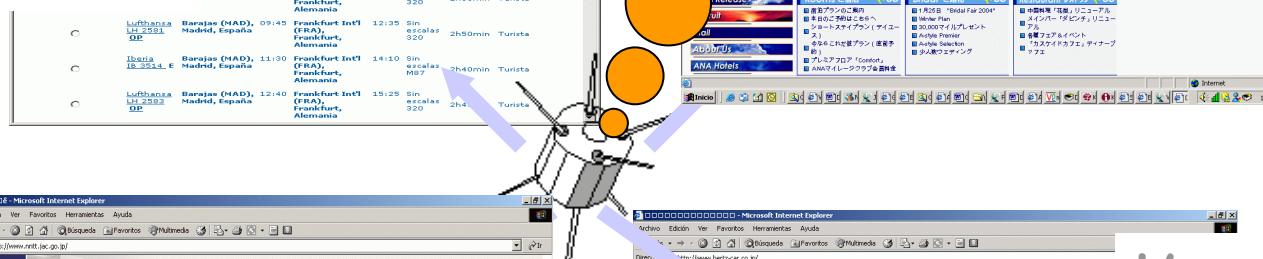
<Travel rdf:ID="IB-4321">
  <Company-name>Iberia</Company-name>
  <singleFare>500 Euros</singleFare>
  <departureDate rdf:datatype="&xsd;date">
    2005-11-10
  </departureDate>
  <arrivalDate rdf:datatype="&xsd;date">
    2005-11-10
  </arrivalDate>
  <arrivalPlace rdf:resource="#Paris"/>
</Travel>
```





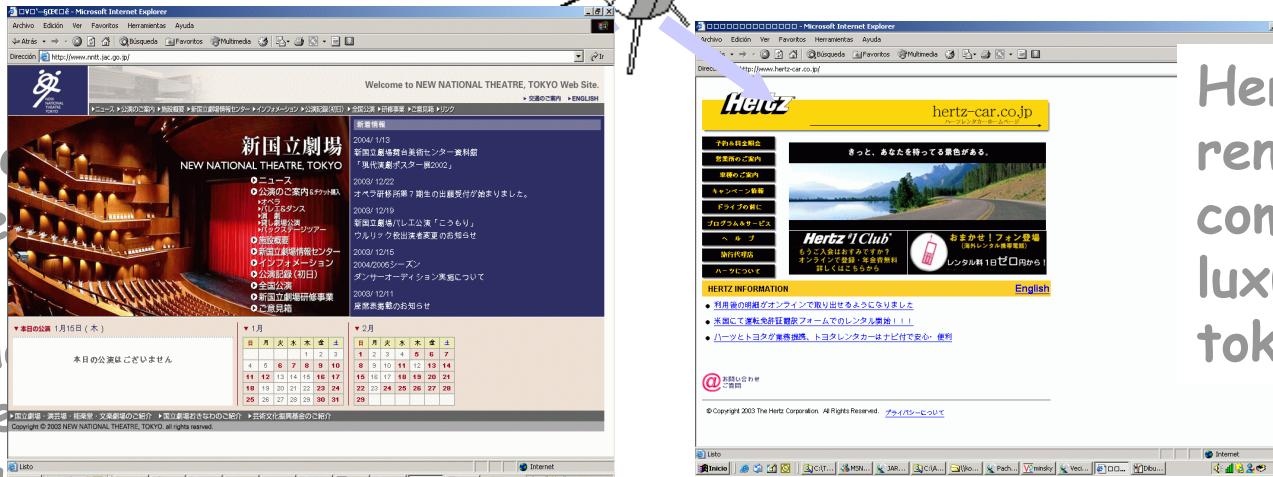
Why not make the computers do the work?

IBXX is a flight. Its departure place is Madrid and its arrival place is Tokyo.
Madrid is an european city. Tokyo is an asian city.



Xxx is a hotel placed in Tokyo

The new national theater is a theater located in Tokyo. It has performances every Saturday.



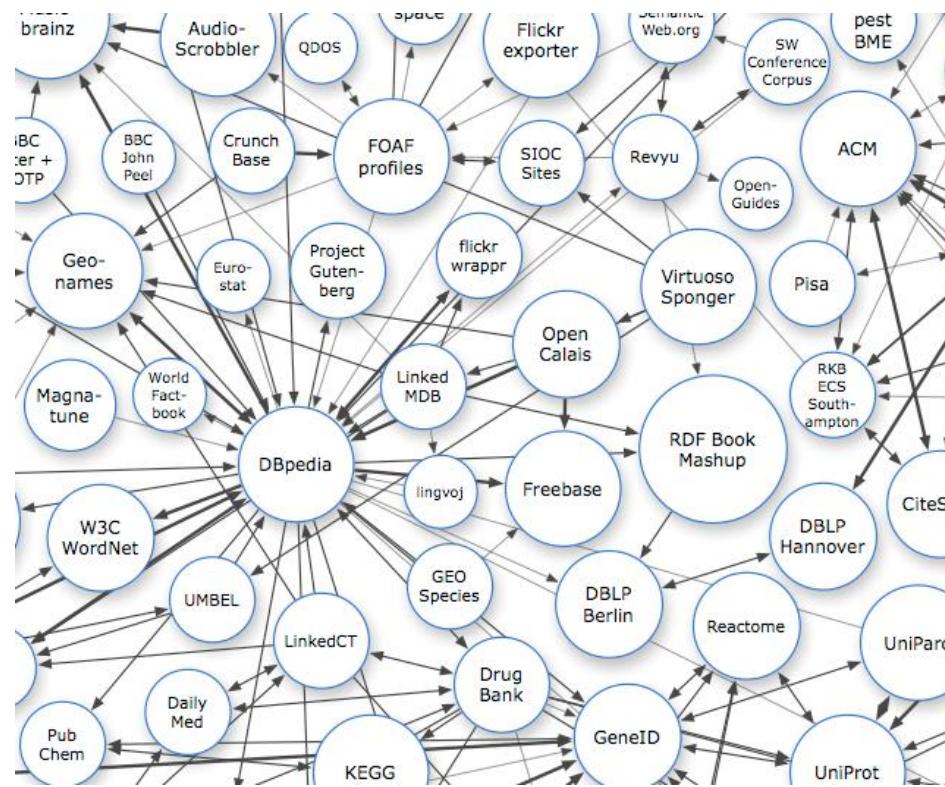
Herzt is a rental car company with luxury cars in tokyo.

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What is the Web of Linked Data?

- An extension of the current Web...
 - ... where information is 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

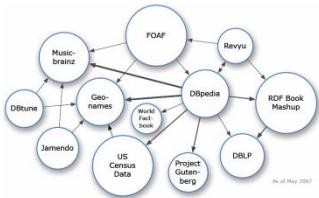


What is Linked Data?

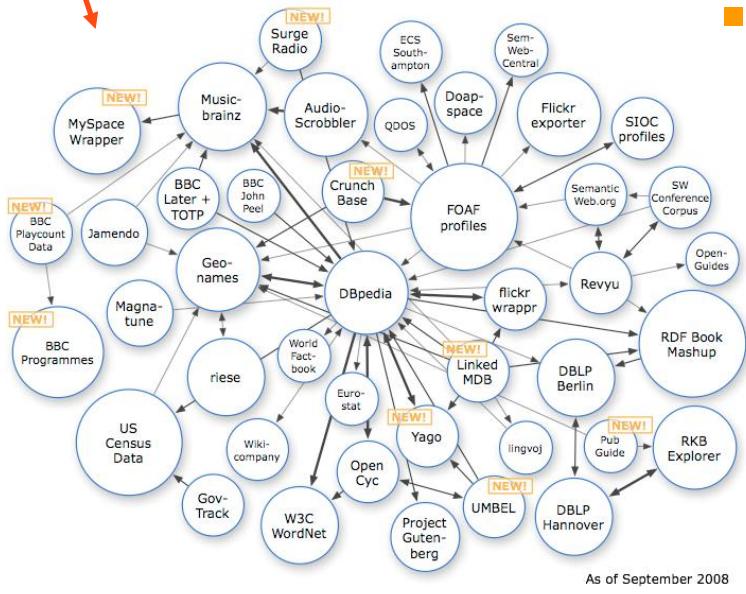
- Linked Data is a term used to describe a recommended **best practice** for exposing, sharing, and connecting pieces of data, information, and knowledge on the Semantic Web using URIs and RDF.
 - Part of the Semantic Web
 - Exposing, sharing and connecting data
 - Technologies: URIs and RDF (although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

Linked Open Data evolution

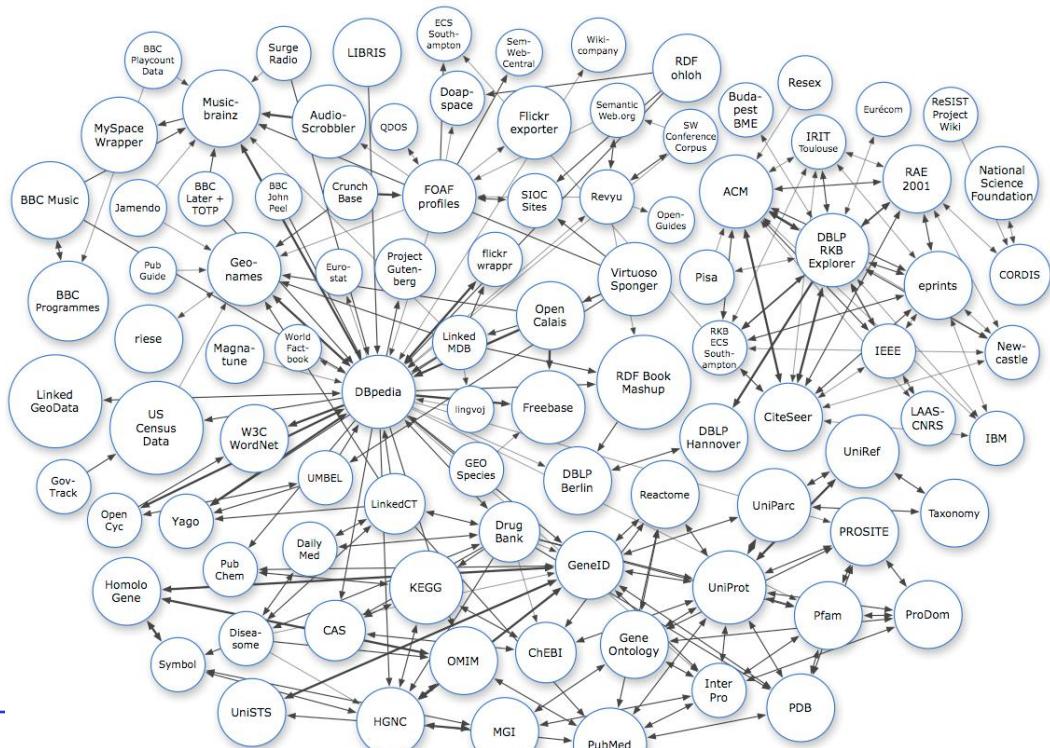
■ 2007



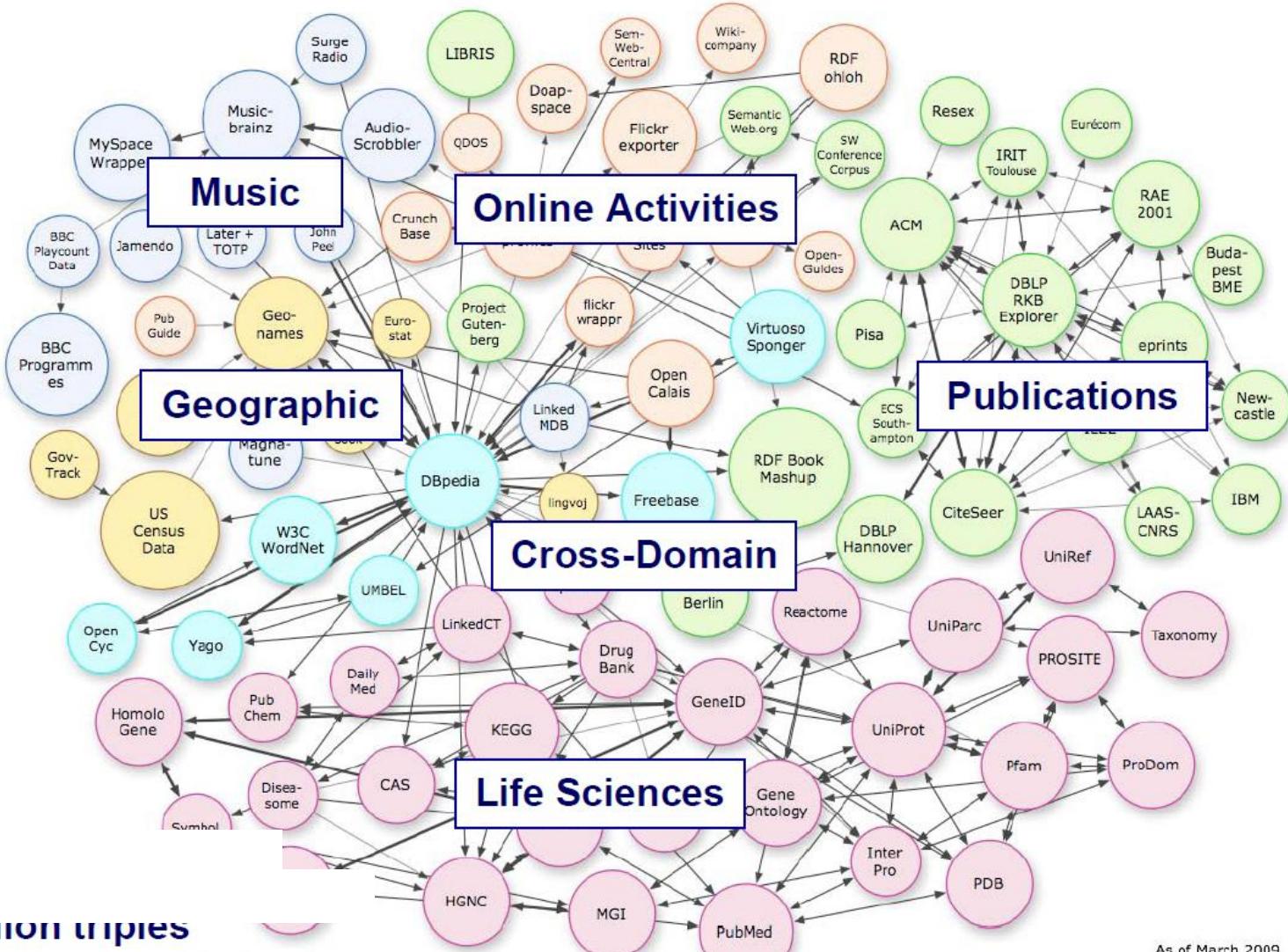
■ 2008



■ 2009



LOD clouds



4.5 billion triples

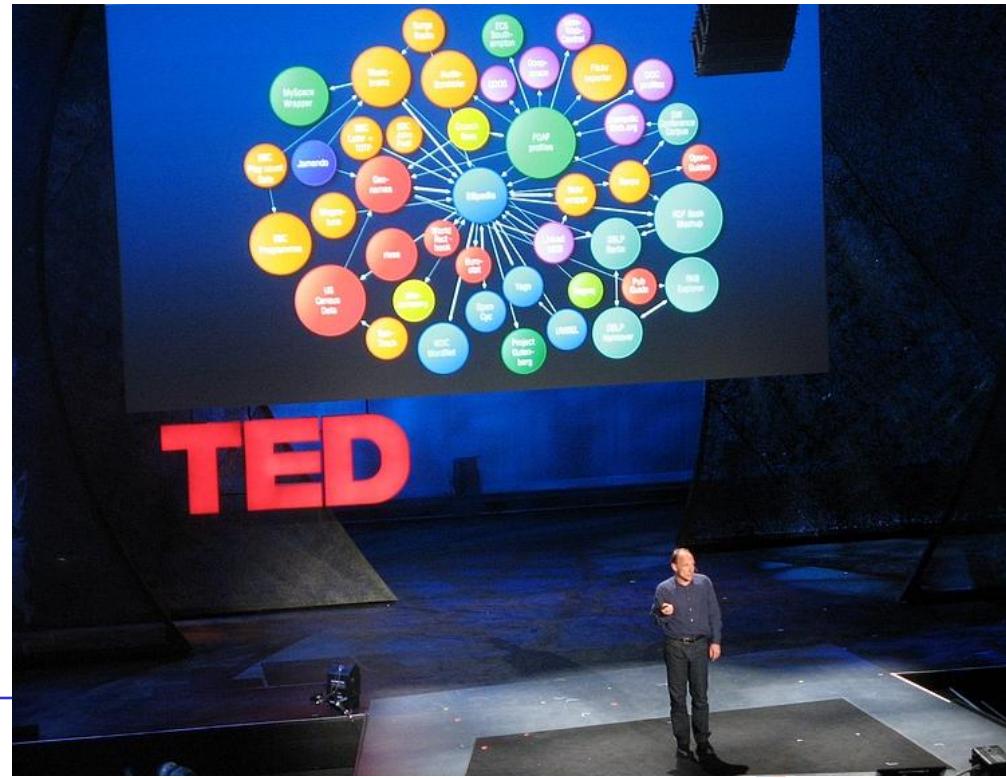
180 million data links

As of March 2009

The four principles (Tim Berners Lee, 2006)

http://www.ted.com/talks/tim_berners_lee_on_the_next_web.html

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>



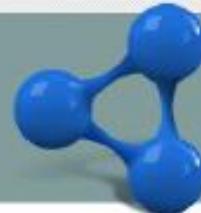
Open Government. USA and UK

HM Government

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Unlocking innovation

Working with UK Public Sector Information and data



Latest datasets

- 2 July Public servants earning over £150,000 now also covers NDPBs
- 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's Transparency programme for the UK public sector as a whole. Working with Sir Tim Berners-Lee, Professor Nigel Shadbolt and Tim Steinberg and other members of the Cabinet Office Minister's new Public Sector Transparency Board this site seeks to give a ready way for the wealth of government data becoming available. It's under constant development and we want to work with you to make it better.

Se

TOP-DOWN

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What is the Semantic Web?

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- Latest Volumes of Foreign Relations of the...
- Local Area Unemployment Statistics
- Personnel Trends by Gender/Race

COMMUNITY

Data.gov is leading the way in democratising 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 innovative and

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



BOTTOM-UP

Linked Data Mashup (data.gov)

Clean Air Status and Trends (CASTNET)

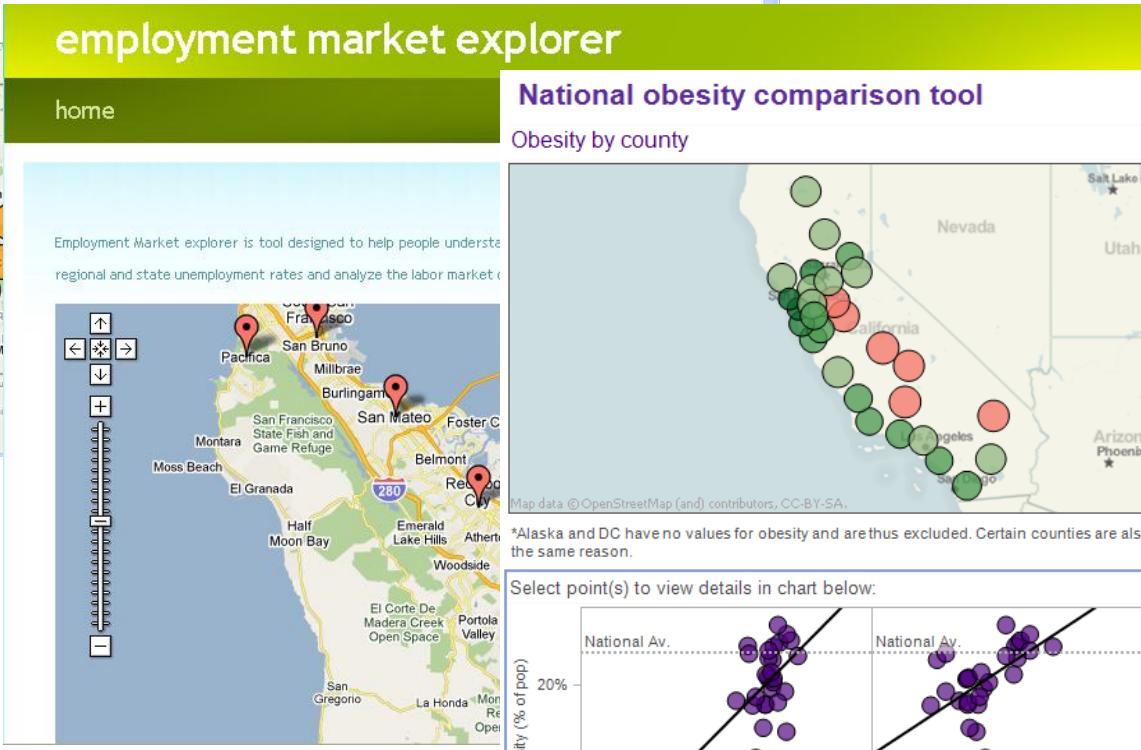
Clean Air Status and Trends Network (CASTNET)

Land Use
27 Agric
1 Coastal/Marsh
3 Desert
40 Forest

Terrain
37 Rolling
4 Mountaintop
1 Flat/Water
14 Flat

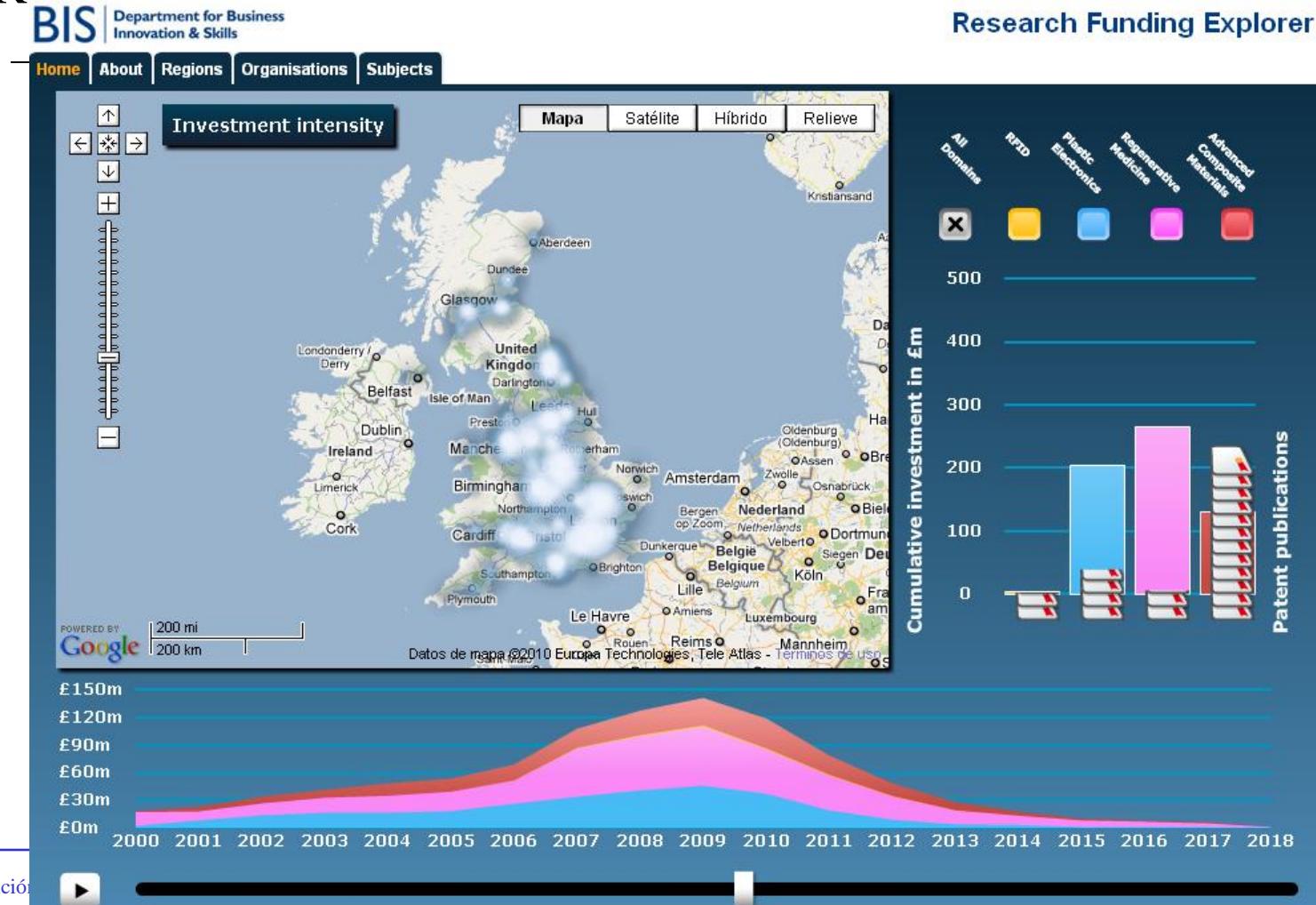
Agency
59 EPA
25 NPS

o-8-castnet.php



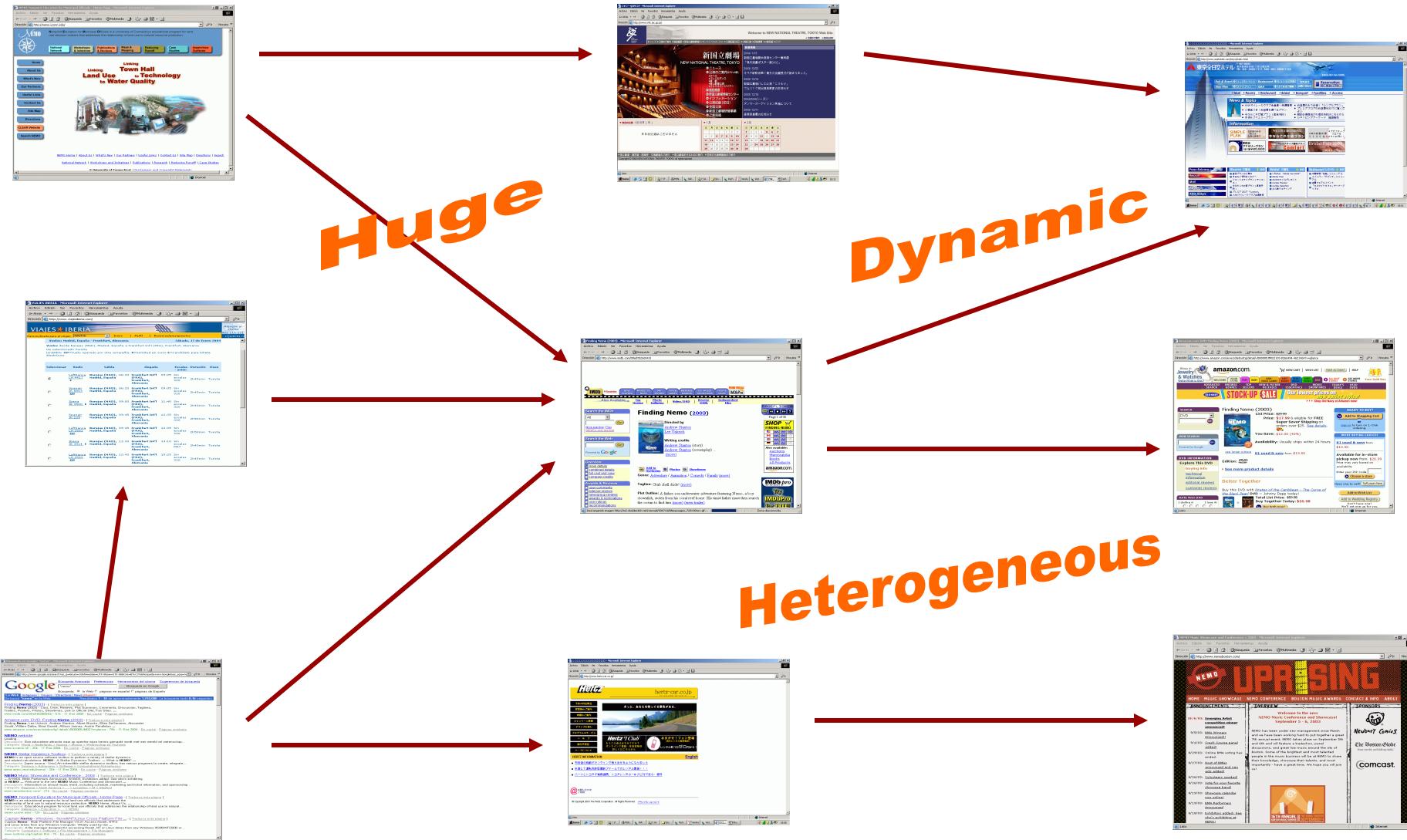
Linked Data Mashup (data.gov.uk)

- Research Funding Explorer

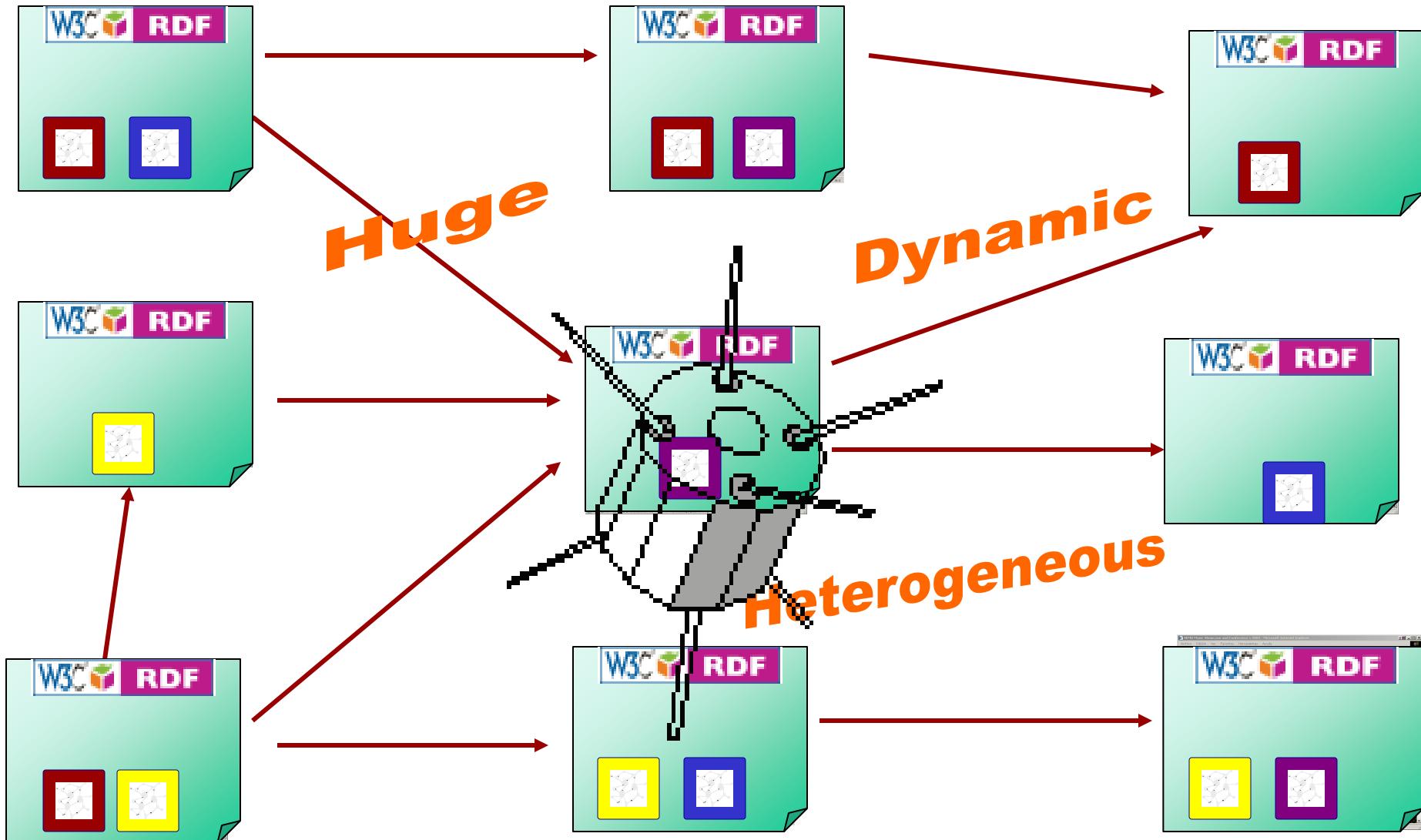


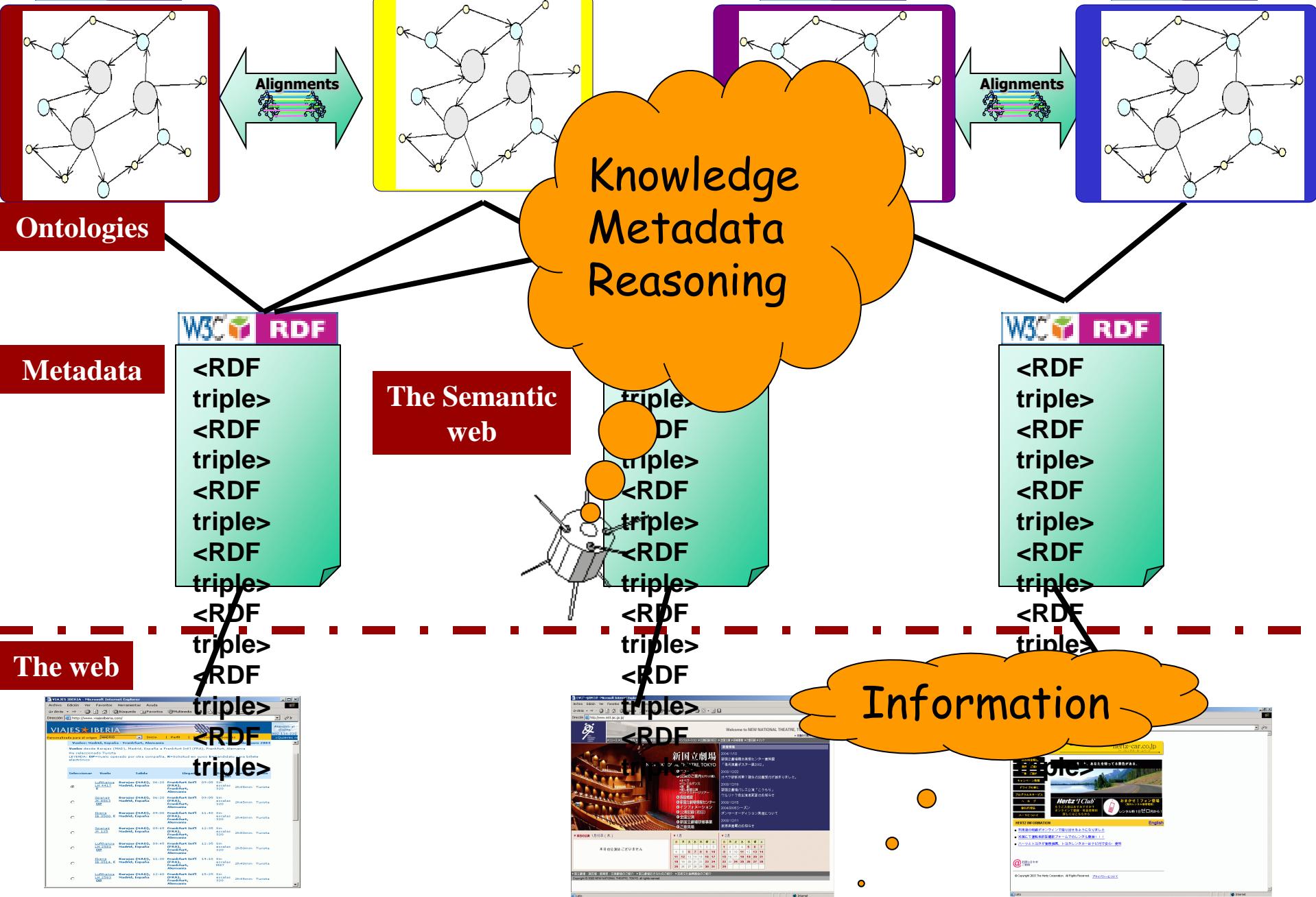
- Web
- Web 2.0
- Web 3.0 and the Semantic Web
- Examples of semantic applications
 - Semantic Webs
 - Corporative Semantics
 - Annotation at large scale
 - Semantic portals
 - Semantic Information exchange between heterogeneous data sources

The Web

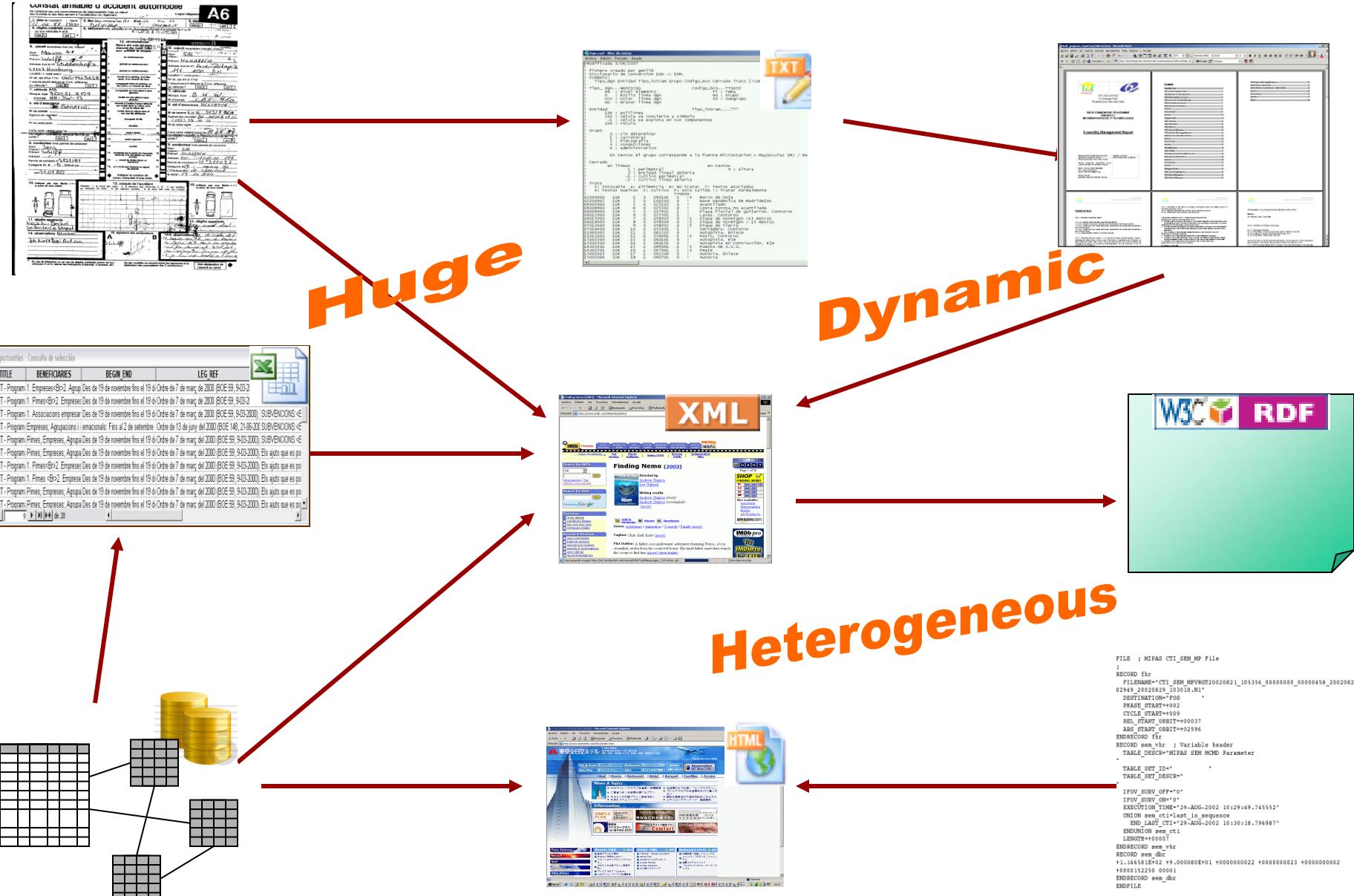


Semantic Webs

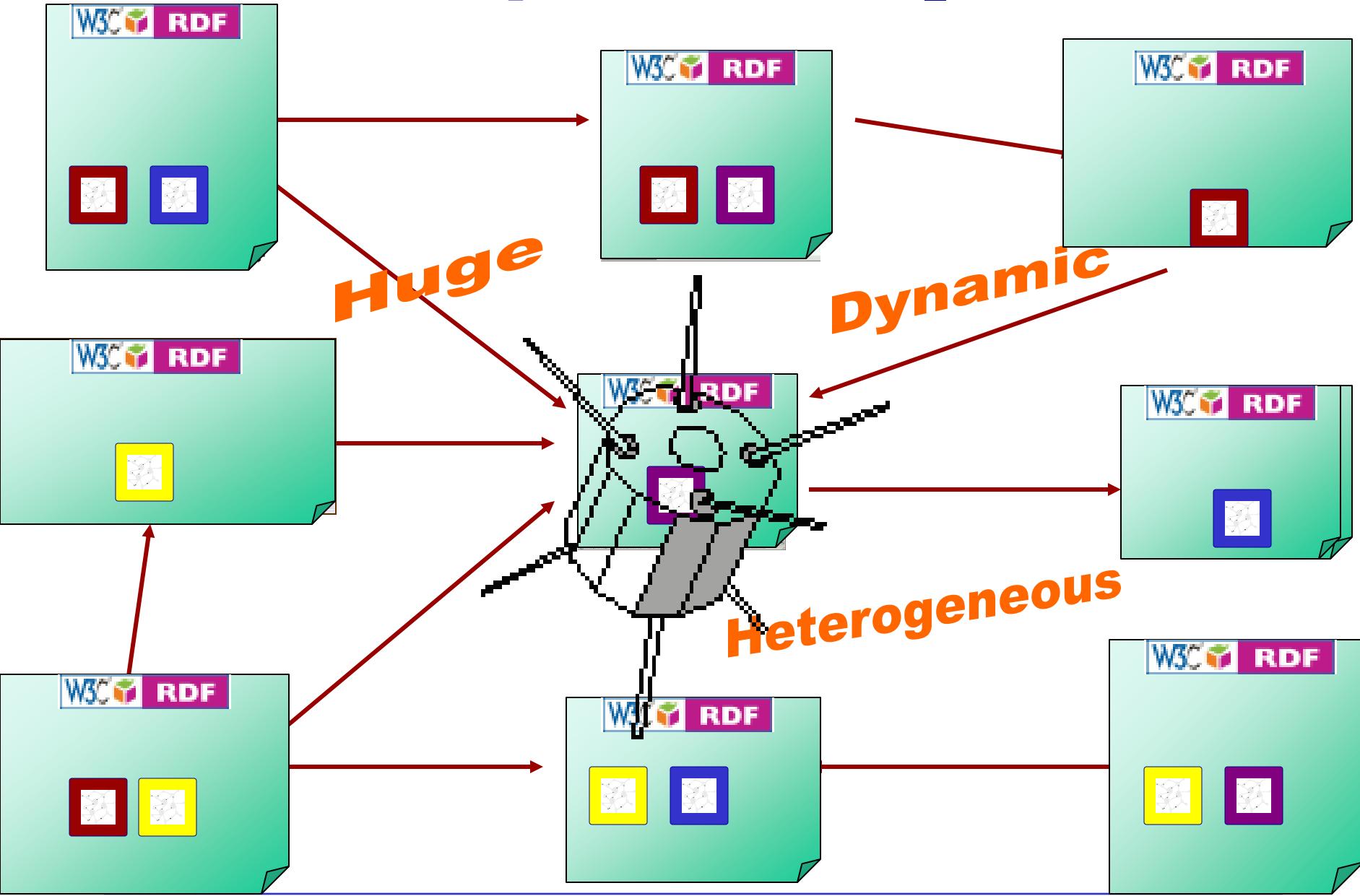




Corporative Semantics



Corporative Semantics



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)



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

Process for Publishing Linked Data on the Web

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

