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UNIVERSITY OF
ECONOMICS
AND BUSINESS

„Weaving a Web of Actions“

Beschreibung und Ausführung datenorientierter Prozesse und Dienste im Web

Prof. Dr. Axel Polleres

web: http://polleres.net

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Outline

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- A short history of the Web and Linked Data...
- A short history of Web Services...
- A future vision of Services and processes on the Web

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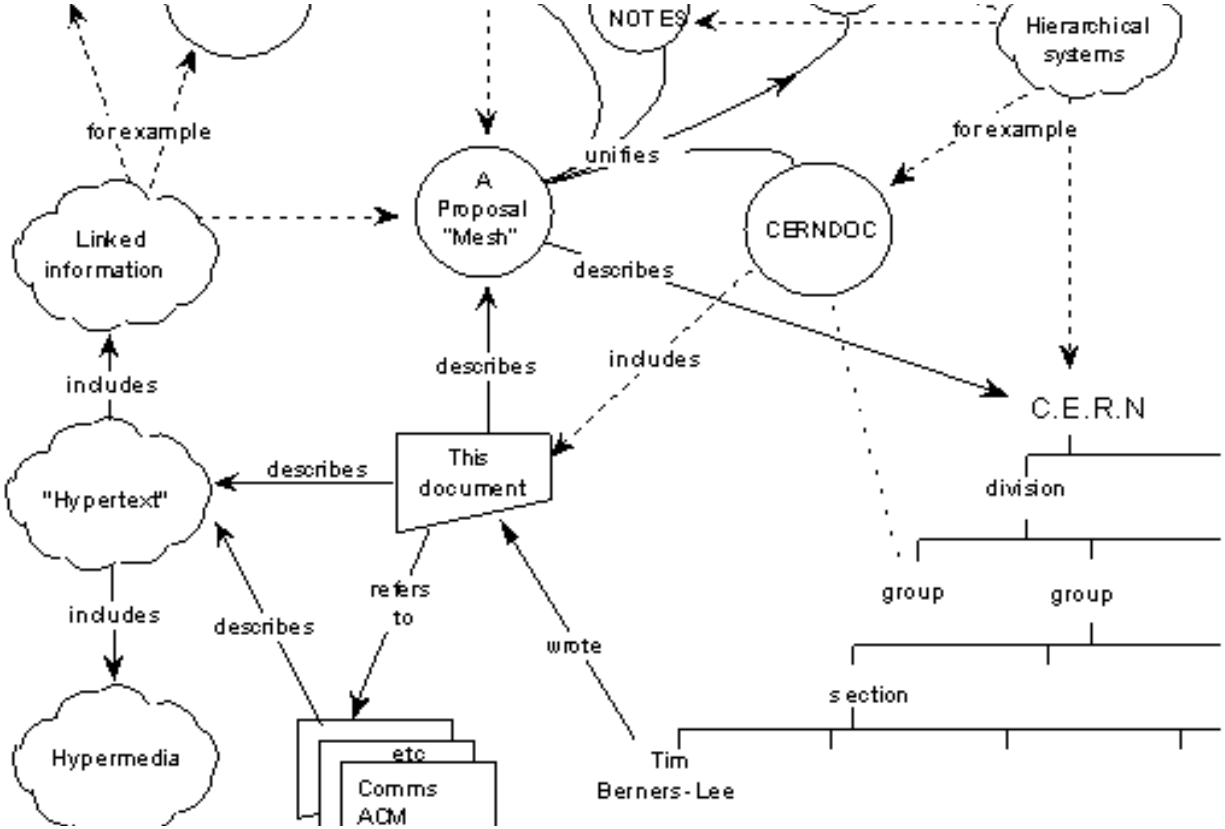
The Web 1989…

*"This proposal concerns the **management of general information** about accelerators and experiments at CERN […] based on a **distributed hypertext system**. "*



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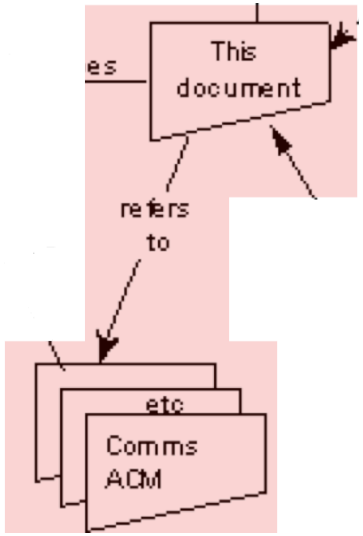
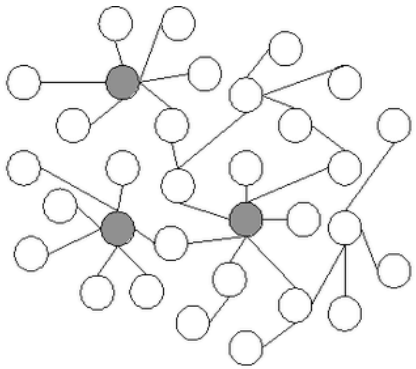


- Globally Unique identifiers **URIs**
- Links between Documents (href)
- A common protocol **HTTP**

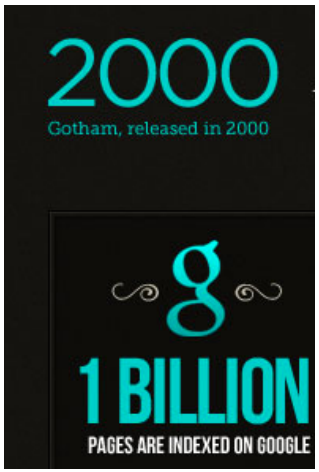
The Web

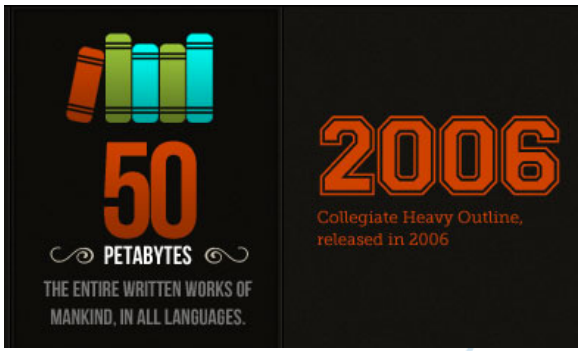
- A **downstripped** version of the original idea!
- Success factors:
  - **Decentralized**, global infrastructure
  - **Simple protocol**

→Allowed the development of a scale-free network...



... with various side-effects:



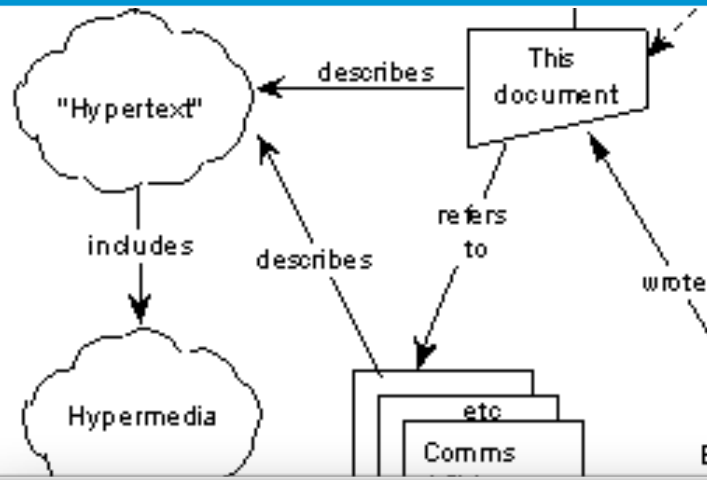


http://maxcdn.webappers.com/img/2011/10/web-standards.jpg

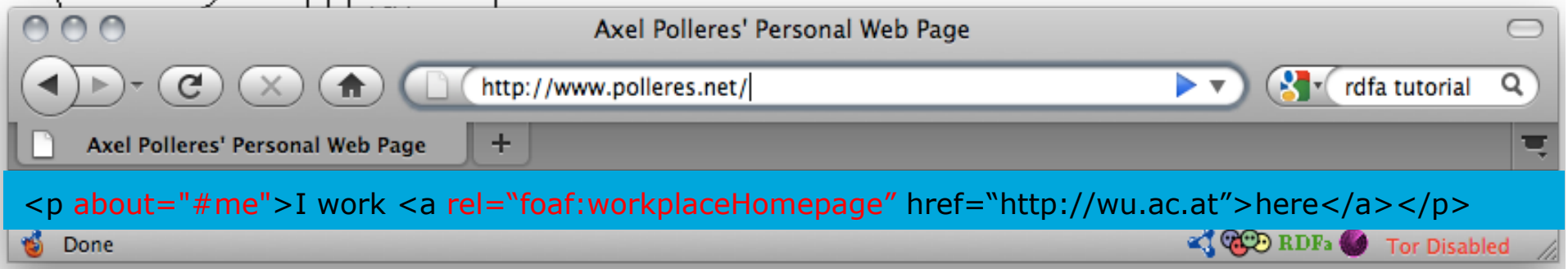
The Web of data ~1999…

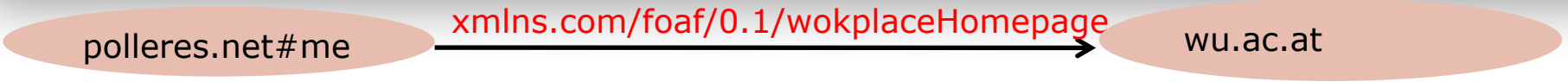
*"If **HTML** and the Web made all the online documents look like one huge **book**, **RDF**, **schema** and **inference** languages will make all the data in the world look like one huge **database**"* *Tim Berners-Lee, Weaving the Web, 1999*

The Web **of Data** ~1999…



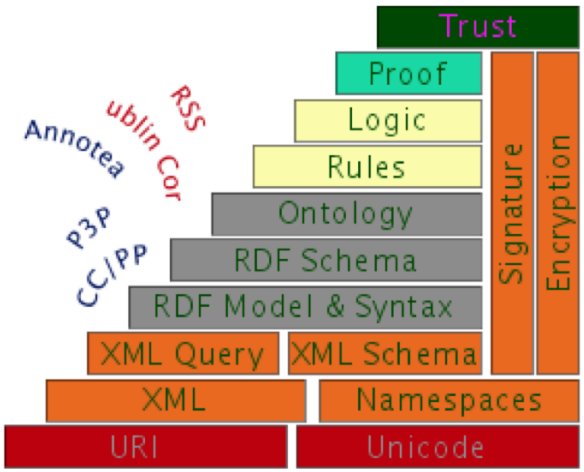
- Globally Unique identifiers — URIs
- **Typed** Links between **Entities** — RDF
- A common protocol — HTTP



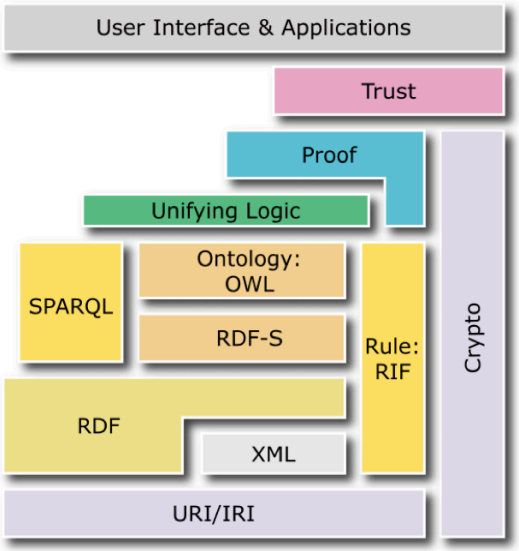


Person — Document

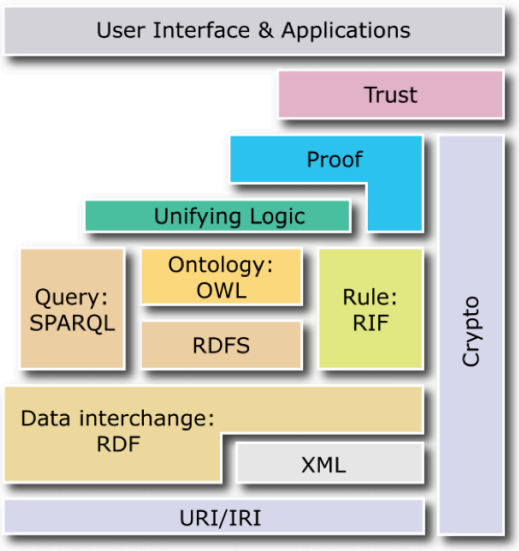
Semantic Web architecturre:



2004[a]



2007[b]



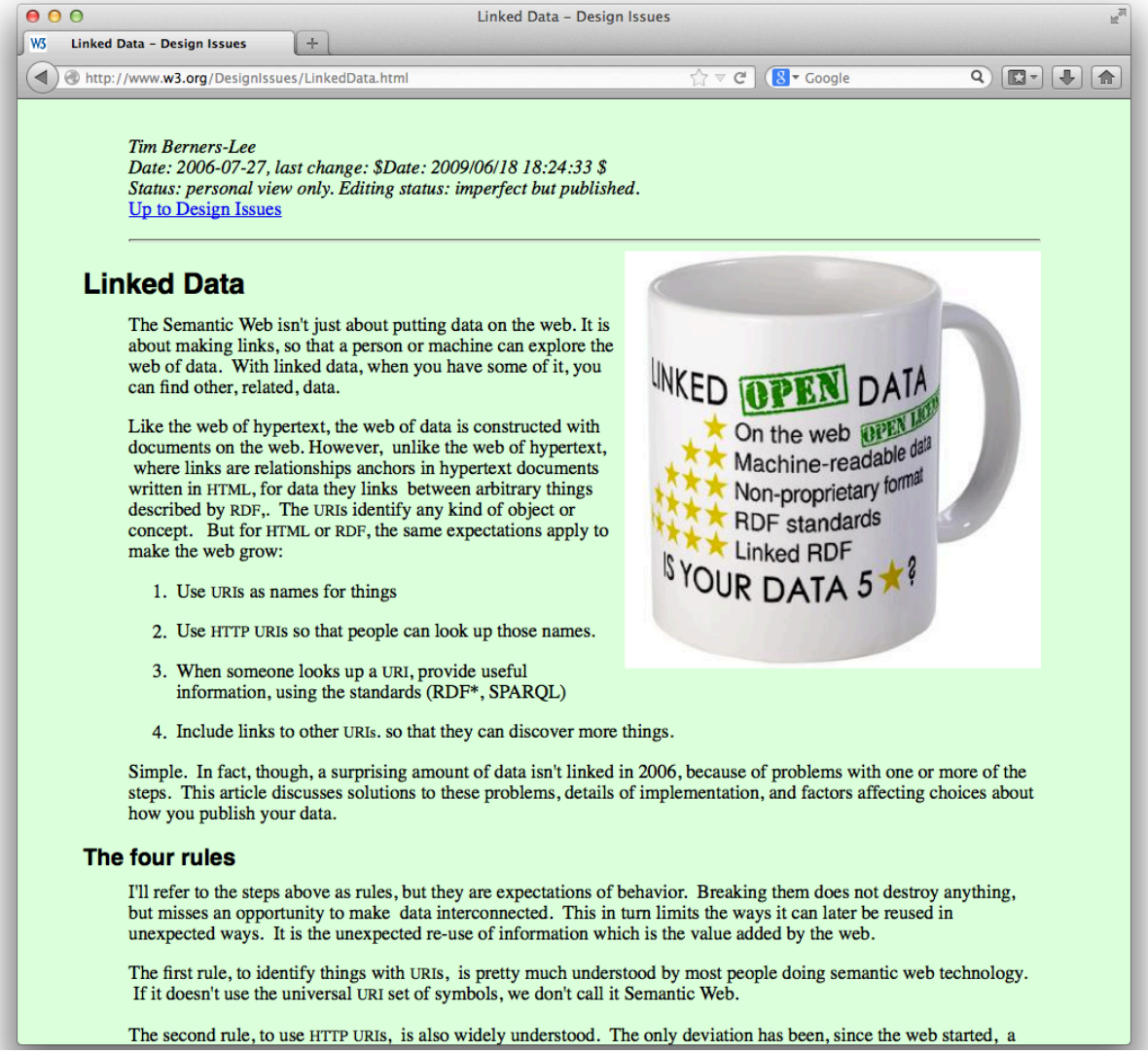
2009[c]

[a] http://www.w3.org/2004/Talks/0319- RDF- WGs/sw_stack.png

[b] http://www.w3.org/2007/Talks/0130- sb- W3CTechSemWeb/layerCake- 4.png

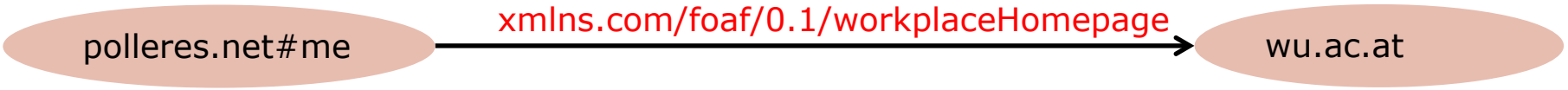
[c] http://www.w3c.it/talks/2009/athena/images/layerCake.png

... but again needed downstripping to succeed ~2009



Linked Data Principles

1. Everything gets a URI (papers, people, talks, organizations, topics…)
2. These URIs are linked via RDF describing relations
3. Relations are URIs again (e.g. :name)
4. When I dereference the URIs, I should find more information about them, defining them.



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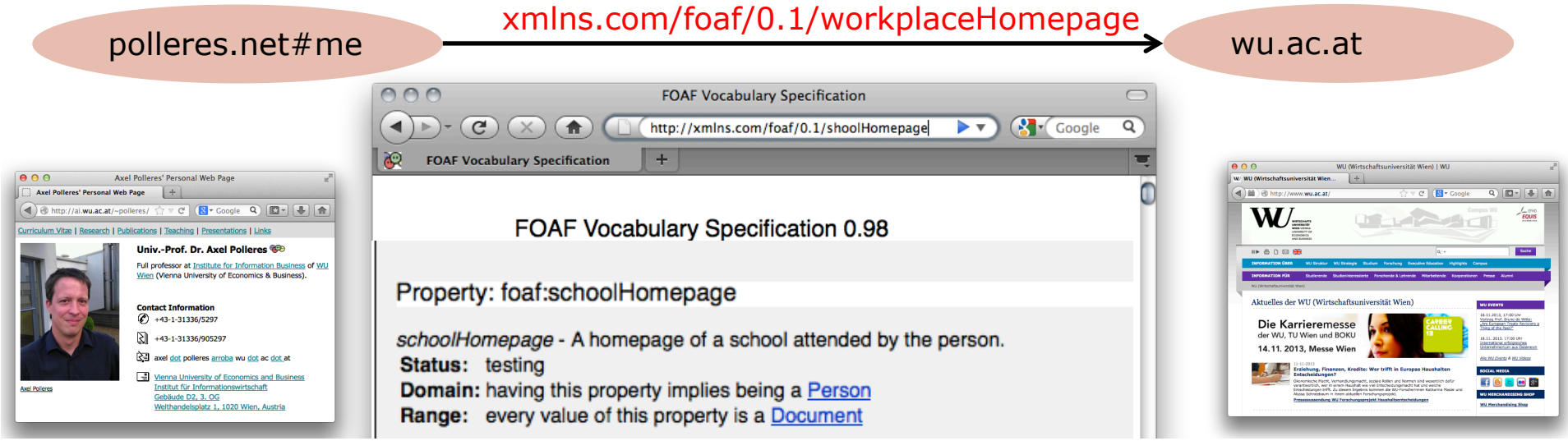

Linked Data on the Web: Adoption

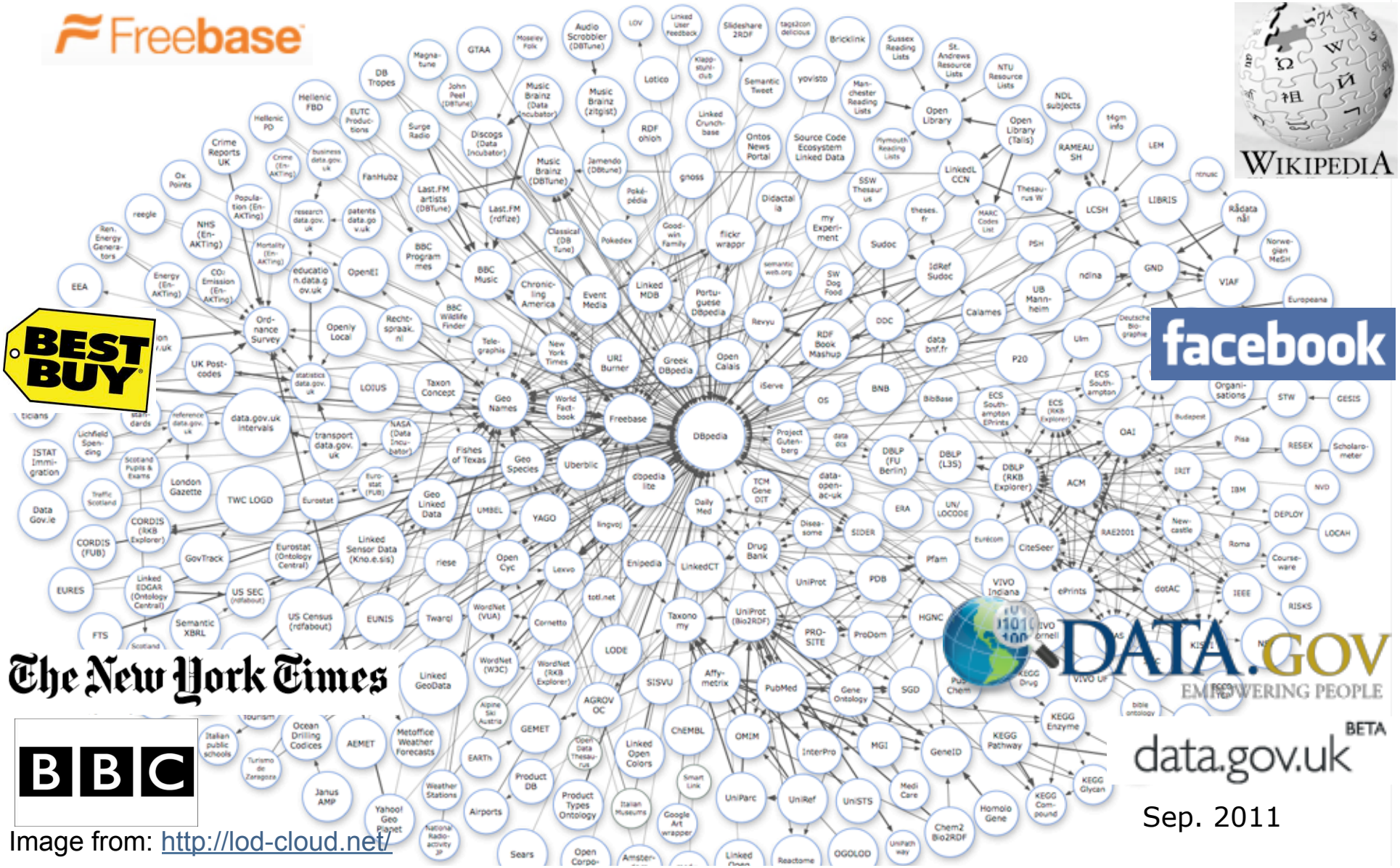

Image from: http://lod-cloud.net/

Sep. 2011

Linked Data Ontologies = **RDF Vocabularies (OWL, RDF Schema)**

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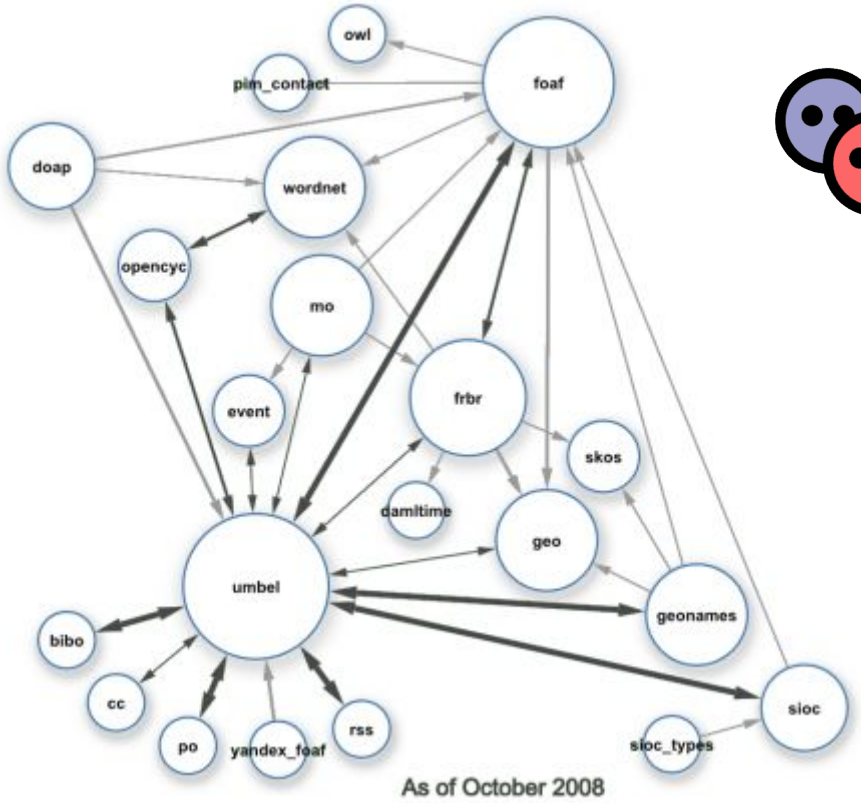
SIOC

GeoNames

DOAP



FOAF

DublinCore

DBpedia

GoodRelations
The Web Ontology for E-Commerce

music ontology

SKOS

umbel

...

Image from http://blog.dbtune.org/public/.081005_lod_constellation_m.jpg

The Semantic Web

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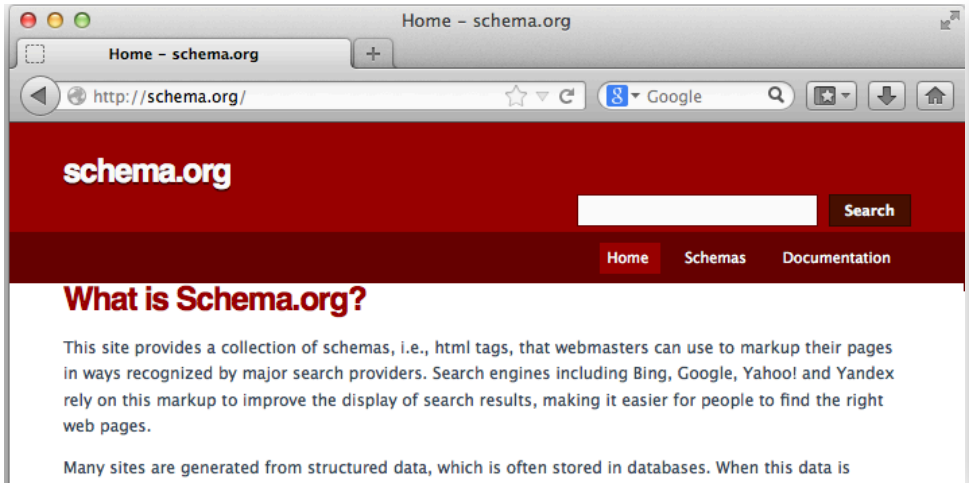
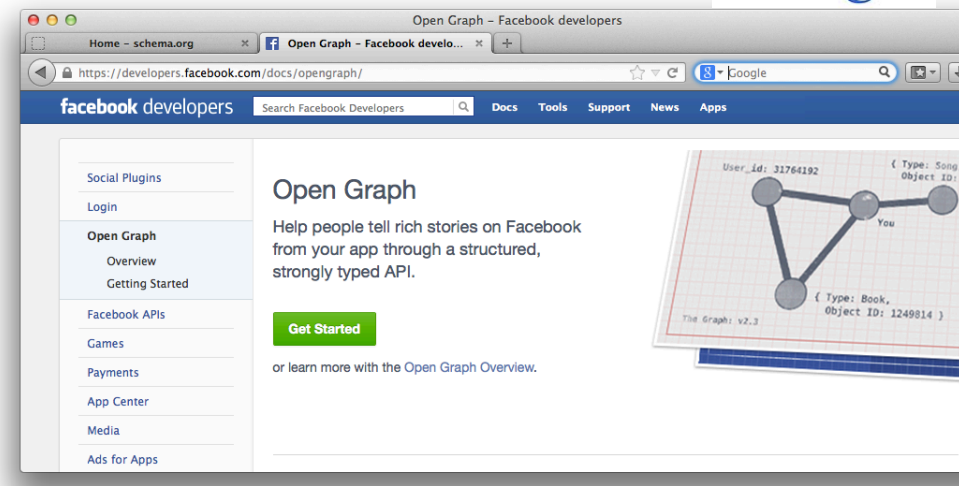
- Again: **downstripped** version of the original idea!
- Success factors:
  - Decentralized, global infrastructure
  - Simple protocol
  - Universal, **schemaless** data format

→ Now accelerated adoption even by big players:





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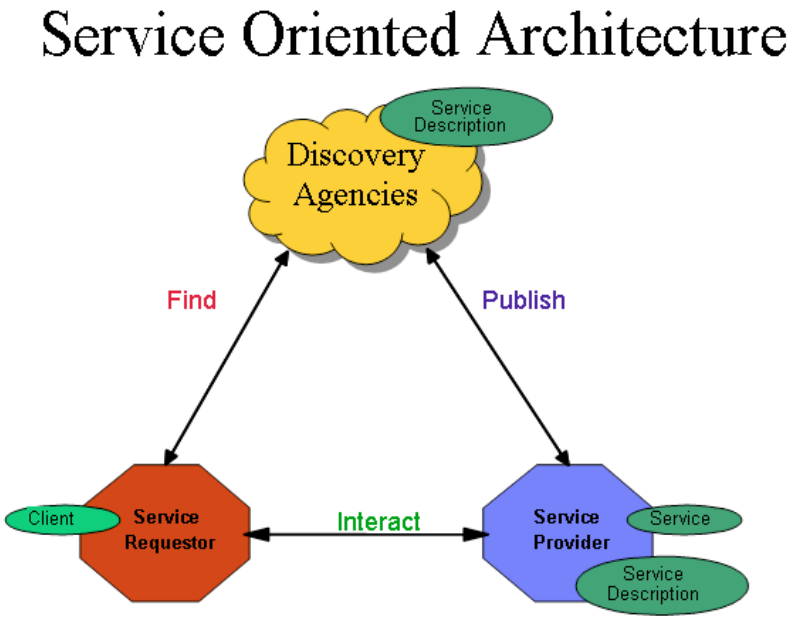
Web Services ~2000

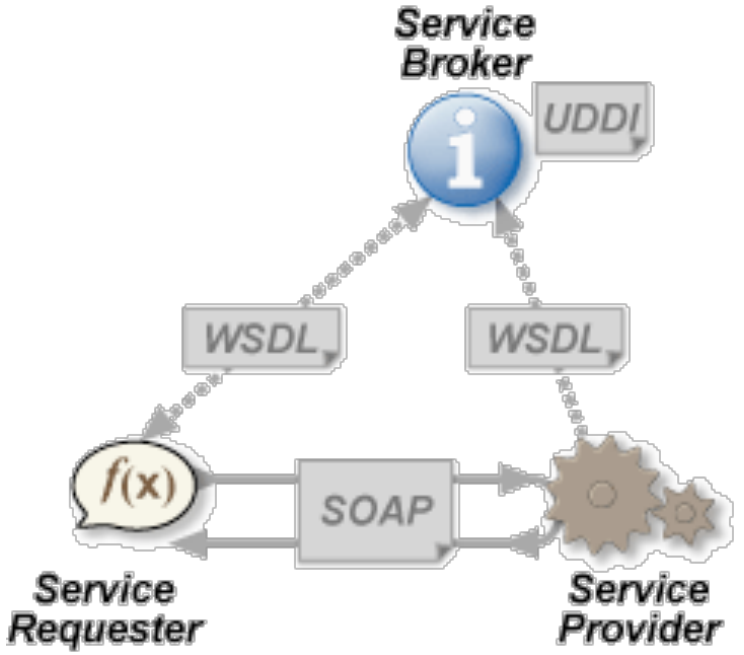
- Why only data?
- The Web is all about services!
  - E.g.,Travel booking, B2C eCommerce

- Idea of Web services:
  - Make services **machine-processable** on the Web...
  - ... just as we made data machine-readable on the Web
  - ... plus enable B2B service provision over the Web

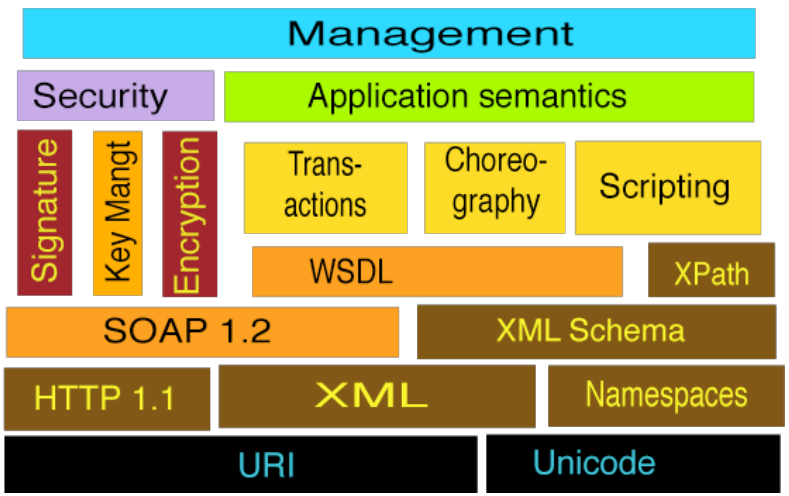
... On the **Web**, it failed... Why?

Web Service architecture:

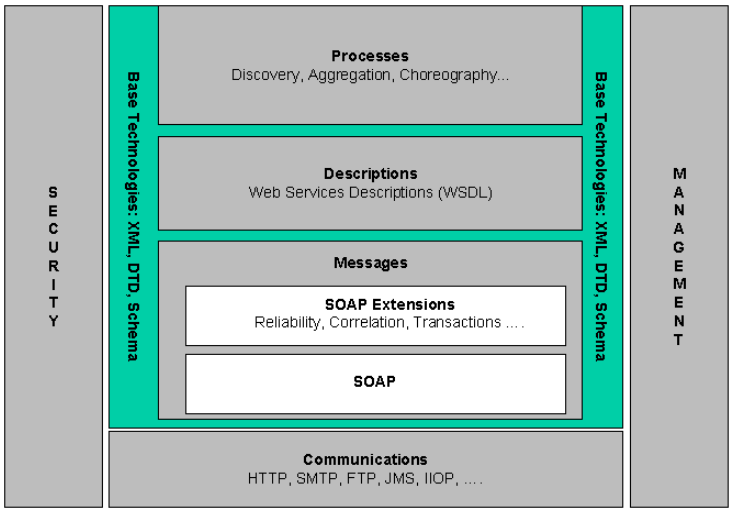




Web Service architecture:



[a] 2002



[b] 2004

...

[a] http://www.w3.org/DesignIssues/WebServices.html
[b] http://www.w3.org/TR/ws-arch/

Web Services?

- **Downstripped** version? Still to be determined:
  - Decentralized, global infrastructure?
    - Partially, but **not** at the level of ***processes***
  - Simple protocol?
    - Is SOAP needed?
    - Most services on the Web currently just work over *plain HTTP*
    - WSDL/UDDI implementations did not take off on the Web
  - Universal, schemaless data format
    - WSDL based on XML

    → attempt to fix ~2003: *Semantic* Web Services

Semantic Web Services 2004

W3C Member Submission

OWL-S: Semantic Markup for Web Services

W3C Member Submission 22 November 2004

This version:
http://www.w3.org/Submission/2004/SUBM-OWL-S-20041122/
Latest version:
http://www.w3.org/Submission/OWL-S
Authors:
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Terry Payne, University of Southampton
Evren Sirin, The MIND Laboratory of the University of Maryland at College Park
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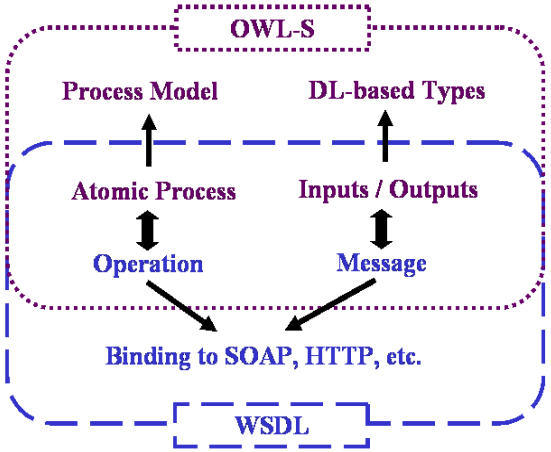
Katia Sycara, Carnegie Mellon University



- *Essentially:*
  - *An OWL ontology on top of WSDL*
  - *Allowed to model processes of executable on top of a **single** service*

Semantic Web Services 2005

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W3C Member Submission

Web Service Modeling Ontology (WSMO)

W3C Member Submission 3 June 2005

This version:
http://www.w3.org/Submission/2005/SUBM-WSMO-20050603/
Latest version:
http://www.w3.org/Submission/WSMO/
Editors:
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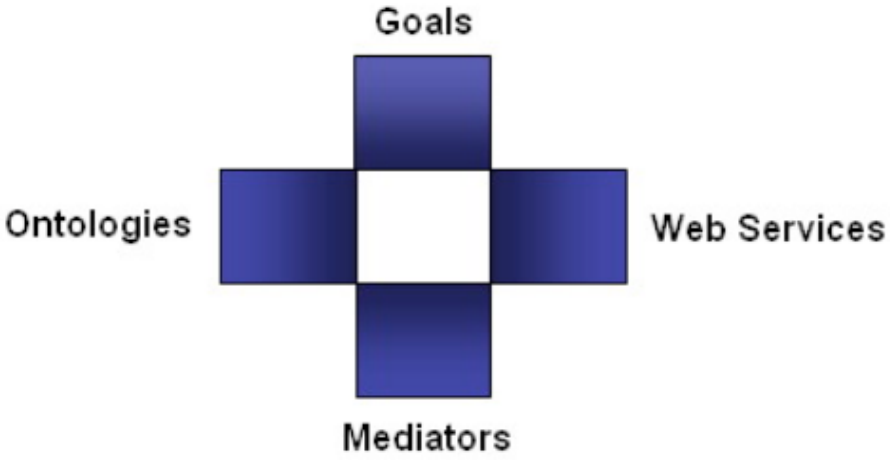

- *Essentially:*
  - *Similar in spirit to OWL-S*
  - *Focus on advertising service capabilities, requester goals and enabling formal matching between*

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Semantic Web Services

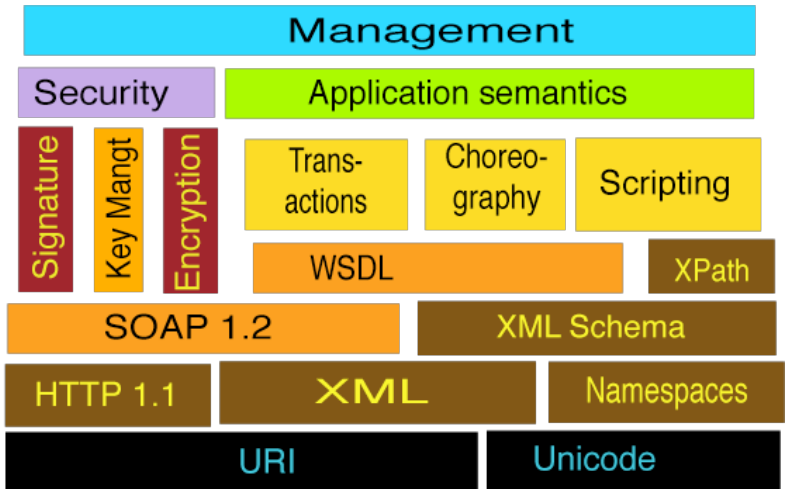
- Reasons for failure:
  - non of the two proposals (WSMO/OWL-S) were built upon the basic Web architecture (but rather on top of WSDL)… making things even more complex
  - complex service descriptions turned out to be too high an entry barrier

Plus:

later attempts to create downstripped versions (WSDL-S, WSMO-Lite) did not address these two basic mistaktes

What's the problem with Web Services?

- Too complex for the Web?
- SOAP: Why invent another protocol on top of HTTP?
- WSDL: Why start with thinking about how to describe processes without thinking about how to execute them in a *decentralized* manner?
- Similarly, efforts outside the W3C (BPEL, BPMN) not targeted for *decentralized* execution



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An alternative starting point for executing actions/services on the Web:

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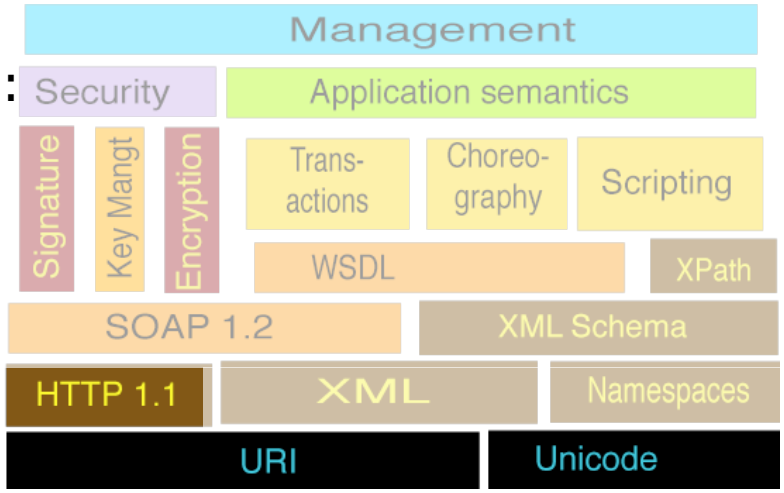
- A first step towards a „Web of Actions“:
  - Enable **processes** directly on top of HTTP:
    - „*HTTP+*“: Enable redirections of HTTP results to other HTTP services...
      ... including simple processes



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Typical execution of plain HTTP services:

- E.g.
- search for Flight from *Service 1* in a certain date range
- look for a rental car within the dates *Service 2*

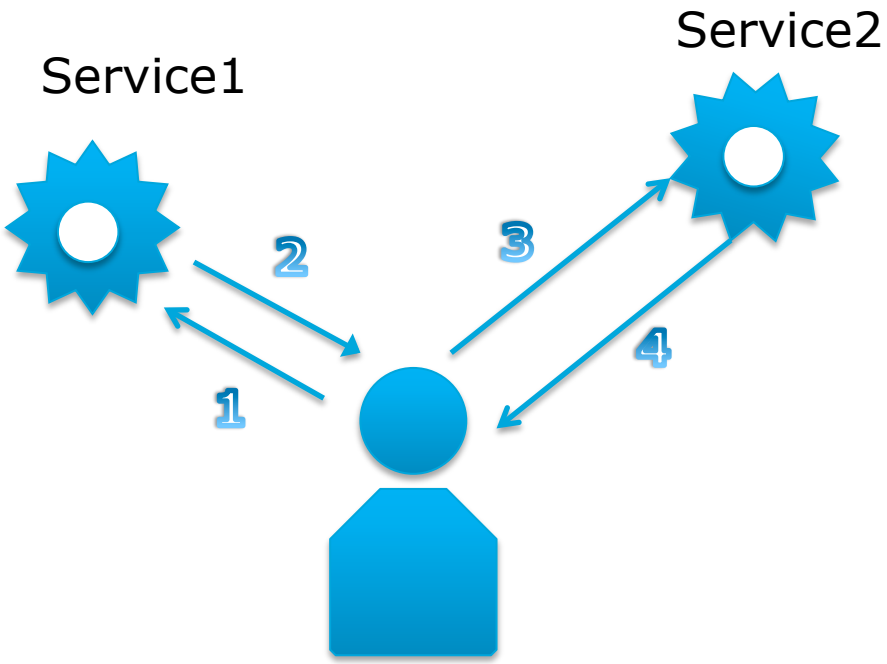
1 POST /book/flights HTTP/1.1
Host: service1.com
origin=MUC&**dest=VIE**&dateout=2013-11-25&datein=2013-11-26

2 HTTP/1.1 200 OK
Date: …
Server: …
price=300&currency=EUR&departureout=25-11-2013T06:00&**arrivalout=25-11T06:00&departurein=26-11-2013T19:00**&arrivalin=26-11T20:00

3 POST /book/cars HTTP/1.1
Host: service2.com
city=VIE&arrival=25-11T06:00&departure=26-11-2013T19:00

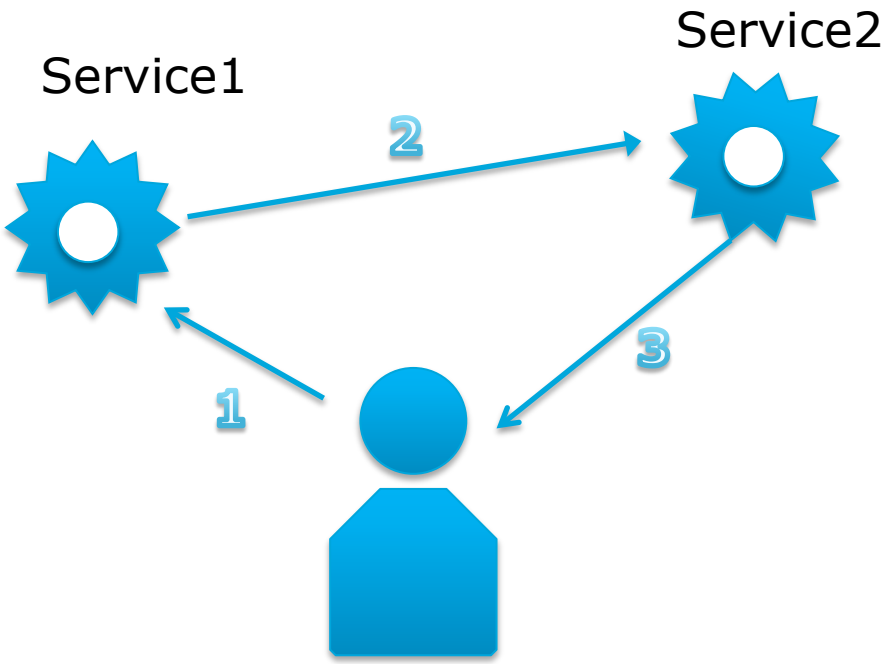
4 HTTP/1.1 200 OK
…

Typically: Centralized execution



- Note: Basic HTTP does not even allow for simple sequential processes

„HTTP+“: Decentralized execution



- **Processes** *within* HTTP could enable decentralized execution

Typical execution of plain HTTP services…

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3 POST /book/cars HTTP/1.1
Host: service2.com
city=VIE&arrival=25-11T06:00&departure=26-11-2013T19:00

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… in a combined „HTTP+“ call (mockup)

POST /book/flights HTTP/1.1
Host: service1.com
origin=MUC&**dest=VIE**&dateout=2013-11-25&datein=2013-11-26

1 ;

POST /book/cars HTTP/1.1
Host: service2.com
city=dest&arrival=arrivalout&departure=departurein

„HTTP+“ ingredients in a nutshell

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- At ist core, this needs a **functional programming language** on top of HTTP

- Could be based on a standard functional language such as **XQuery**

→ A powerful extension of HTTP, that would enable truely decentralized service execution.

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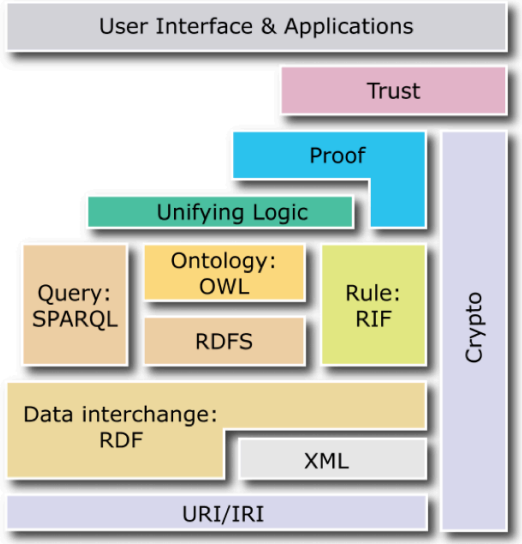
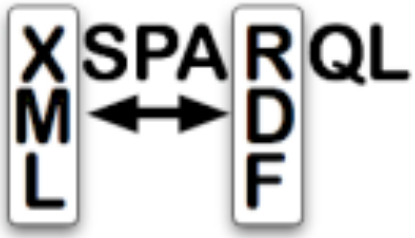
Future work:



How to bring Semantic Web back in?

- Describe input and output parameters in terms of RDF
- Use SPARQL to query/transform RDF

- Good news: a combination of SPARQL and XQuery already exists:



http://xsparql.deri.org/
http://polleres.net/presentations/20110608semtech2011.pptx

Take-home messages:

- The Web of Data is on the edge of repeating the success of the HTML Web
- Key success factors:
  - Global, unique identifiers (URIs)
  - A standard protocol (HTTP)
  - A universal data format (RDF)
  - Links
- The original idea of „Web Services" did not build up on these success factors
- A different breed of Web Services & Web executable processes would be possible

- *Time to think about Web services and Web Processes from a different angle!*

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- Thanks to:
  - Claudio Guttierrez
  - Armin Haller
  - Andreas Harth
  - Rene Schubotz
  - Thomas Steiner
  - Ruben Verborgh

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About the speaker: Axel Polleres

Research Topics:

Query languages
Reasoning about Ontologies,
Rules Languages
Logic programming
Semantic Data Management
Semantic Web Technologies
Web Services
Linked Open Data
Configuration Technologies
Data Analytics
Decision Support Systems

Prof. Dr. Axel Polleres (http://polleres.net/) joined the Institute of Information Business of Vienna University of Economics and Business (WU Wien) in Sept 2013 as a full professor in the area of "Data and Knowledge Engineering".

He obtained his doctorate and habilitation from Vienna University of Technology and worked at University of Innsbruck, Austria, Universidad Rey Juan Carlos, Madrid, Spain, the Digital Enterprise Research Institute (DERI) at the National University of Ireland, Galway, and for Siemens AG's Corporate Technology Research division before joining WU Wien. His research focuses on querying and reasoning about ontologies, rules languages, logic programming, Semantic Web technologies, Web services, knowledge management, Linked Open Data, configuration technologies and their applications. He has worked in several European and national research projects in these areas.

Dr. Polleres has published more than 100 articles in journals, books, and conference and workshop contributions and co-organised several international conferences and workshops in the areas of logic programming, Semantic Web, data management, Web services and related topics and acts as editorial board member for SWJ and IJSWIS. Moreover, he actively contributed to international standardisation efforts within the World Wide Web Consortium (W3C) where he co-chaired the W3C SPARQL working group.