



STI · INTERNATIONAL

Computer Science in the 21st Century

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SERVICE WARE

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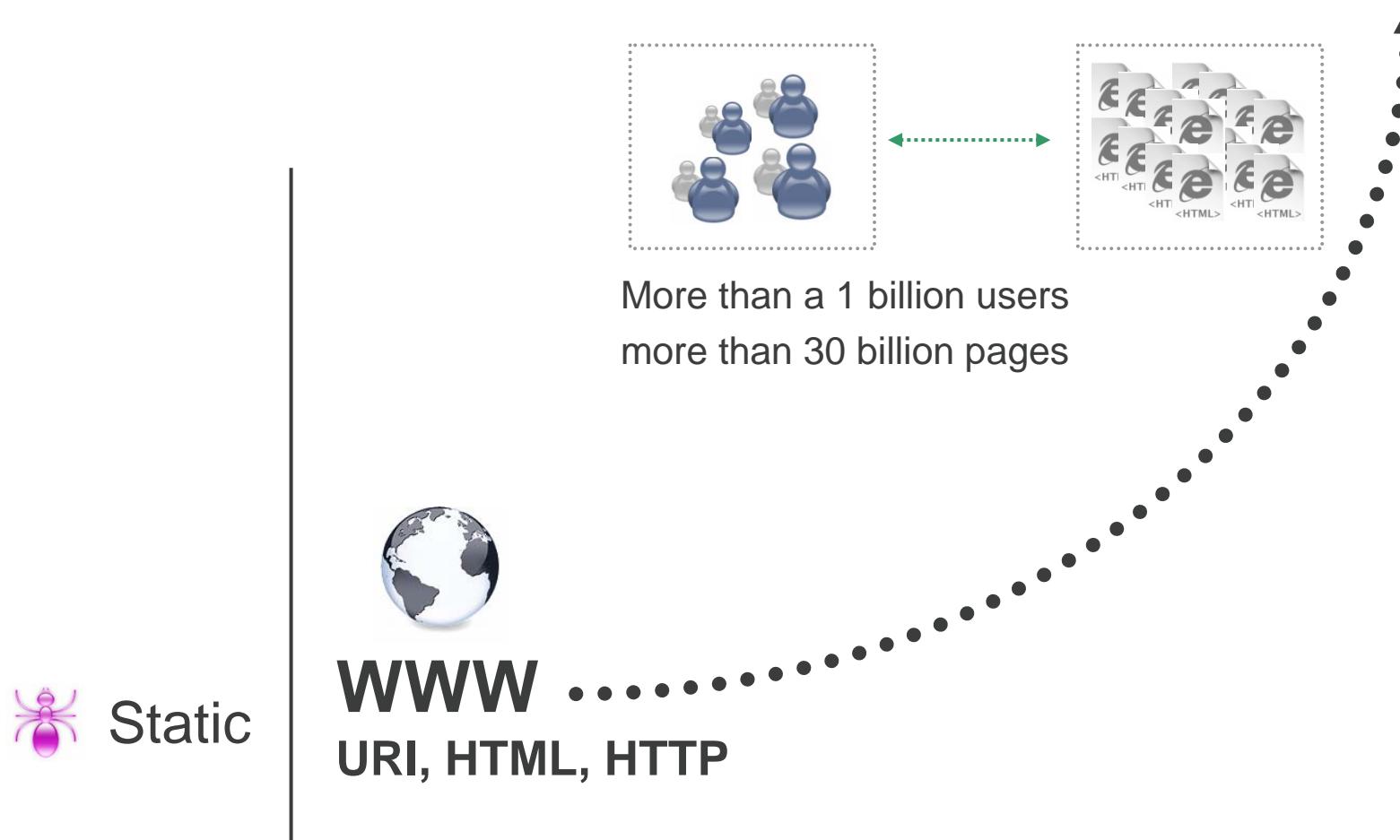
- Computer science is entering a new generation
 - The previous generation was based on abstracting from hardware.
 - The emerging generation comes from abstracting from software and sees all resources as services in a **service-oriented architecture (SOA)**.
- In a world of services, it is the service that counts for a customer and not the software or hardware components that implement the service.
- **Service-oriented architectures** are rapidly becoming the dominant computing paradigm.

- In a service-oriented world everything is a service
 - Programs are services.
 - Devices are services.
 - Different types of media (audio, video, text) are integrated.
 - Environments are dynamic and open.
 - Mobility; Ubiquity; RFID
- Service orientation needs to scale up to open and dynamic environments of ***billions*** of services.

- Current SOA solutions are however still restricted in their application context to companies intranets.
- A service web with billions of services depends on resolving fundamental challenges that SOA does not address currently
- Currently there exists only around 12000 Web services on the Web. See <http://www.seekda.com/>.



From Service Ware to Service Web



Requirements for Service Web



- A service Web with ***billions*** of services can be realized only if SOA can deal with
 - **Openness** – everybody can act as a provider or consumer of services.
 - **Heterogeneity** – services are created in isolation from one another thus interoperability is an issue.
 - **Distributedness** – there is no central control of services. Services can appear, change or disappear at any time in an uncontrolled fashion.
 - **Scalability** – with so many services available on the Service Web the Human may become the bottleneck.



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- Principle: everybody must contribute as a provider or consumer of services.
- Usage of this infrastructure as a service provider or consumer must be as simple, smooth, and unrestricted as possible.
- Openness is an essential necessity to ensure the success of an SOA platform.

- Principle: content can appear, change, or disappear in an uncontrolled fashion.
- That is, provisioning and modification of content must be under distributed control of the peers, rather than being controlled by a central authority.
- Central control would hamper access and therefore scalability, an element of chaos or “messiness” must be tolerated.

- **Scalability** can be ensured through **semantics**, that is through semantic descriptions of data and processes.
- Semantic technology enables a new generation of the Web, in which information has machine-processable and machine-understandable semantics.
- Allows machines to perform previously human-intensive tasks, quickly and efficiently at runtime

Tasks that need to be mechanized:

- **Publishing** create & publish Web service descriptions.
- **Discovery** determine usable services for a request.
- **Composition** combine services to achieve a goal.
- **Selection** choose the most appropriate service among the available ones.
- **Mediation** solve mismatches (data, protocol, process) that hamper interoperation.
- **Execution** invoke Web services following programmatic conventions.

Example: Web Service Discovery



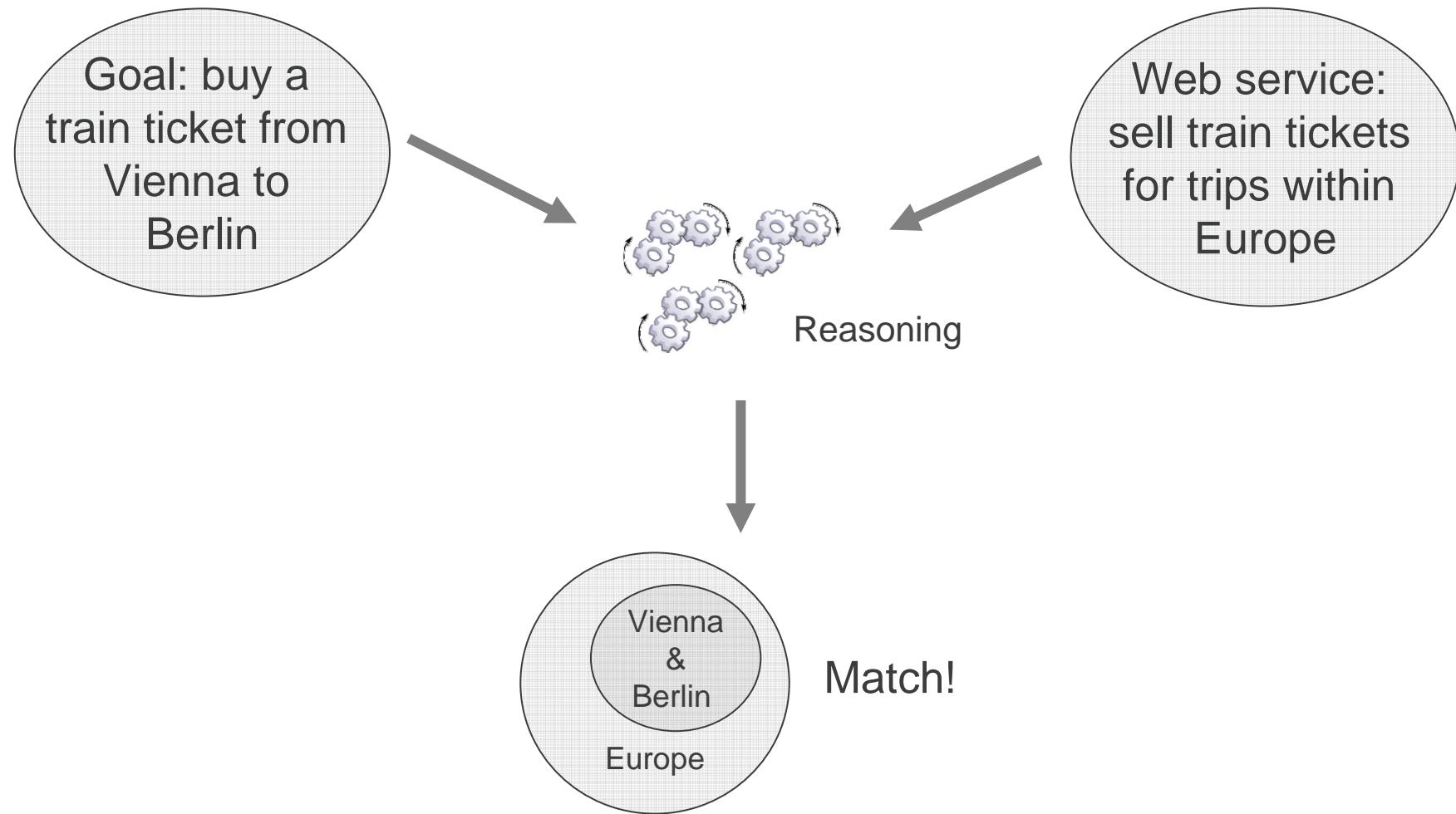
- Distinguish between “Web service” and “service”:
 - Web service: a computational entity able to provide many services
 - Service: a concrete invocation of a Web service
- What is a match?

Example: Web Service Discovery

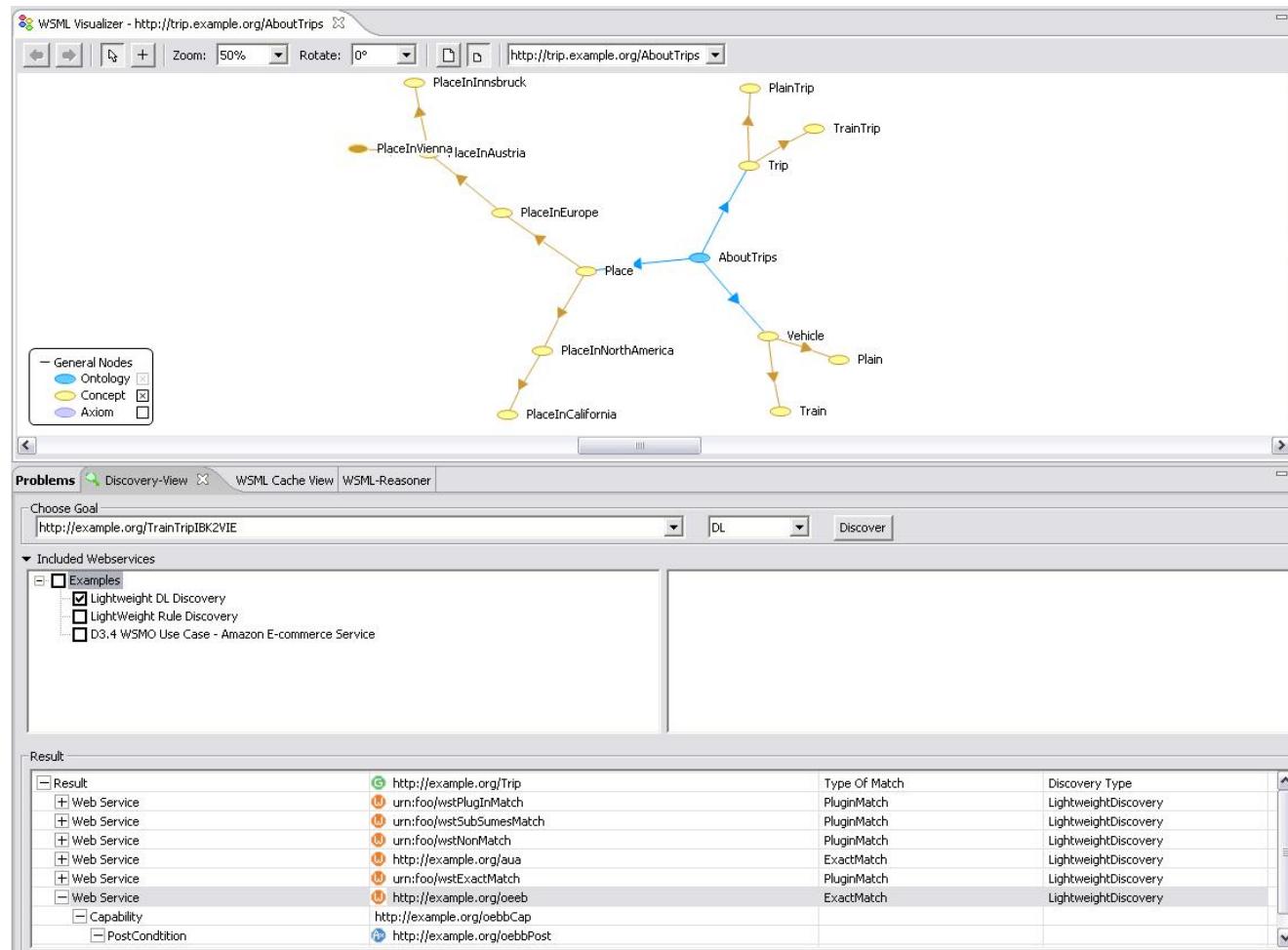


- The task
 - Client is interested in getting a specific service
 - Identify possible Web services, which are able to provide the requested service S for its clients
- Discovery
 - Given a goal and some Web Service repository determine the set of relevant services
 - Relevance or Matchmaking can be defined along multiple dimensions
 - *Capability (service semantics)*
 - *Non-functional properties (Quality of Service Parameters, Provider)*
 - *Choreography (how to interact with the web service)*

Example: Web Service Discovery



Example: Web Service Discovery

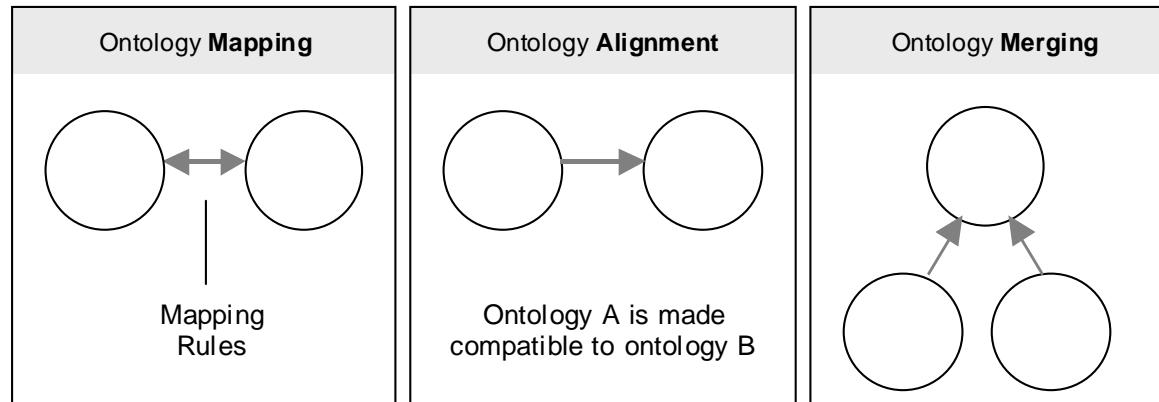


Example: Mediation

- Heterogeneity as inherent characteristic of Web:
 - heterogeneous terminology
 - heterogeneous languages / formalisms
 - heterogeneous functionalities
 - heterogeneous communication protocols and business processes
- Approach: declarative, generic mismatch resolution
 - classification of possible and resolvable mismatches
 - mediation definition language and mediation patterns
 - execution environment for mediation definitions

Example: Data Mediation

- Data Mediation is needed when two different groups have two ontologies representing the same domain
- Ontology Integration Techniques:

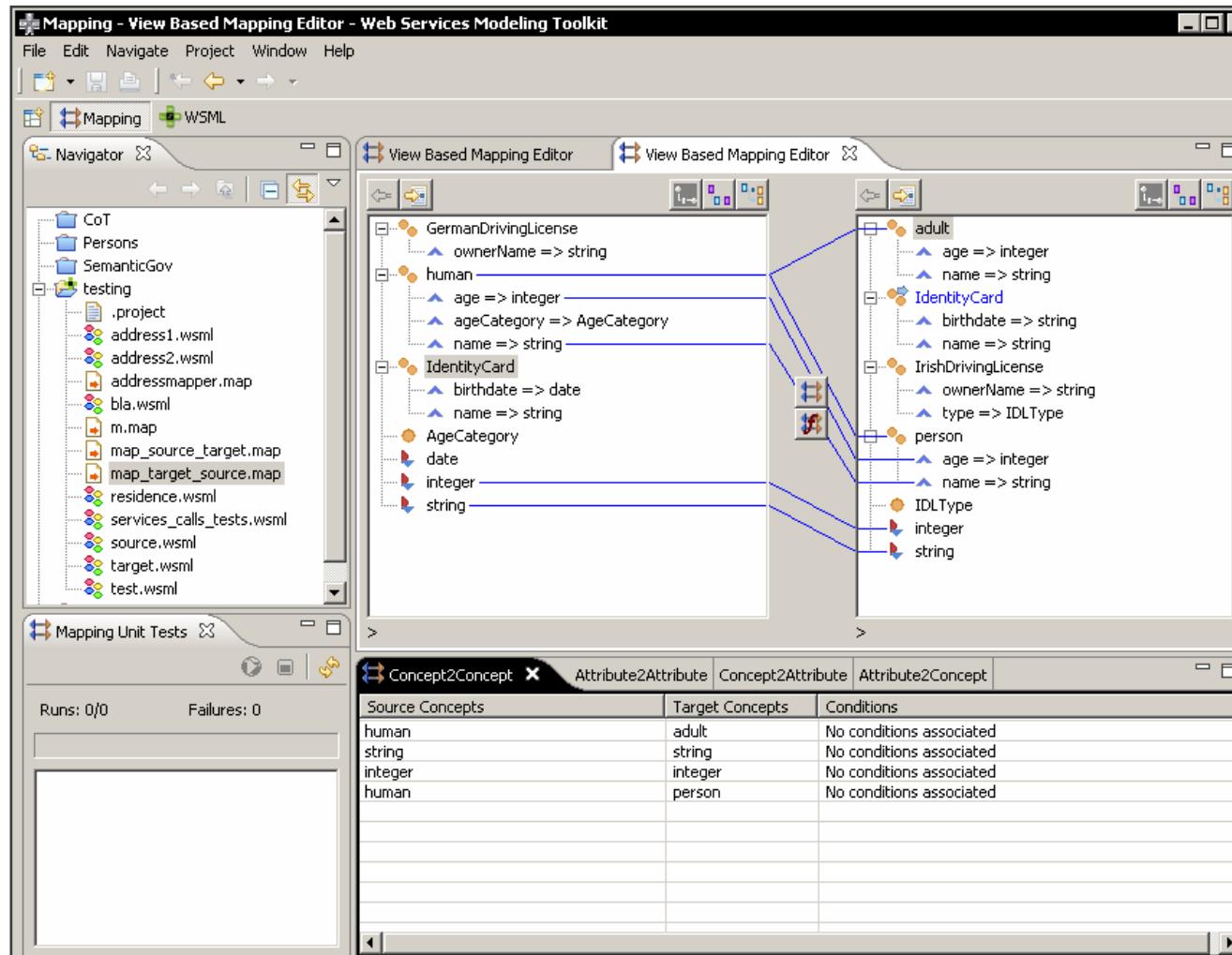


- Semi-automatic versus Automatic
 - human intervention needed for “integration decision”
 - graphical support for ontology mapping as central technique

Example: Data Mediation



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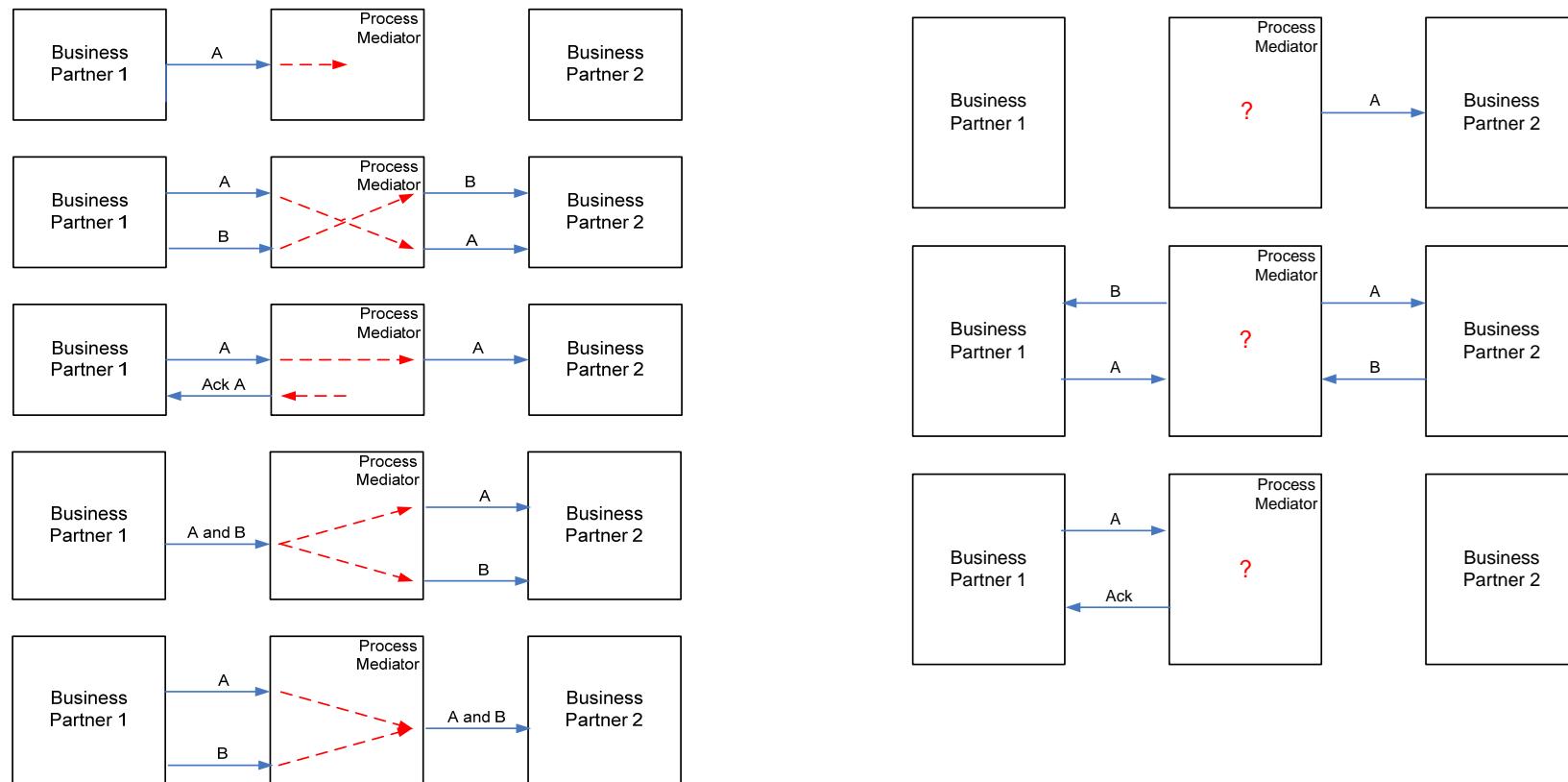
Example: Process Mediation



- Heterogeneity may exist between exposed communication interfaces of service providers and those expected by service requesters
 - Messages in the wrong order
 - Messages sent separately that are expected together
 - Messages sent together that are expected separately
 - Messages sent that are never expected
 - Messages expected but never sent
- Process Mediation required to addresses these heterogeneity issues and enable dynamic communication between requester and provider

Example: Process Mediation

Some Mismatches can be resolved..... Others cannot





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SEMANTIC WEB - Data

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- If the Web is about the global networking of data through URL, HTML, and HTTP...
- ... the **Semantic Web** is about the global networking of knowledge through URI, RDF, and SPARQL
- This knowledge can be annotating Web data (*this picture depicts Innsbruck*) or just for knowledge's sake (*Innsbruck is a city in Austria*)
- The aim is for machines to perform tasks on the Web automatically (*tell me about more about Innsbruck...*)



- URIs are used to identify **resources**, not necessarily anything that exists on the Web, e.g. *Sir Tim Berners-Lee, Dr Frankenstein, my black Mercedes*
- RDF is used to make statements about resources in the form of **triples**
<subject, property, object>
- Resources can belong to **classes** (*my Mercedes belongs to the class of cars*) and classes can be **subclasses** or **superclasses** of other classes
(*vehicles are a superclass of cars, cabriolets are a subclass of cars*)



Semantic Web - Data

A screenshot of Microsoft Internet Explorer displaying a news article from CNN.com. A sidebar titled 'KIM Plugin' is open, showing a tree view of ontological classes under 'Place'. The 'Country' class is selected, indicated by a checked checkbox. A red circle highlights the 'Annotate' button at the top left of the sidebar. Another red circle highlights the 'Country' checkbox in the tree view. A large red arrow points from the 'Annotate' button towards the annotated text in the main content area.

CNN.com - WORLD/Europe - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Mail

Address http://edition.cnn.com/WORLD/europe/archive/

KIM Plugin

Annotate Clear About

UK Prime Minister Tony Blair has led tributes to veteran broadcaster Alistair Cooke who has died aged 95, less than a month after recording his last "Letter from America."

[FULL STORY](#)

Explosives find in UK terror raid

British anti-terror police say they have seized a large amount of explosive materials and arrested eight men in a series of raids.

[FULL STORY](#)

Dutch farewell Queen Juliana

A somber nation bade farewell to Queen Juliana, a mother figure who reigned in the Netherlands during the post-war years of recovery and change.

[FULL STORY](#)

Internet

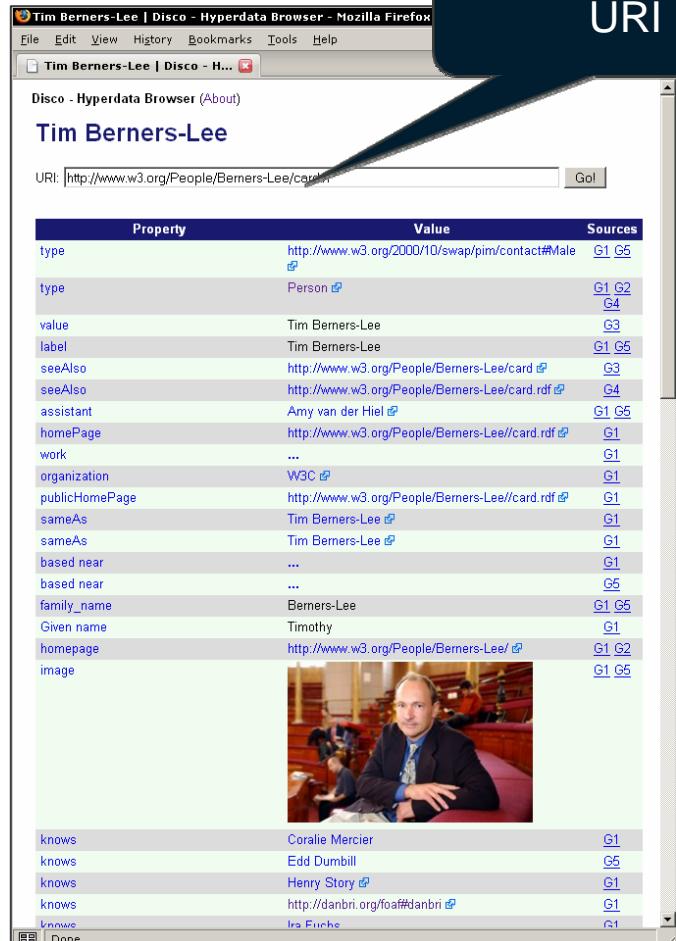
- **KIM Browser Plugin**

Web content is annotated using ontologies
Content can be searched and browsed intelligently

Annotated Content

Semantic Web - Data

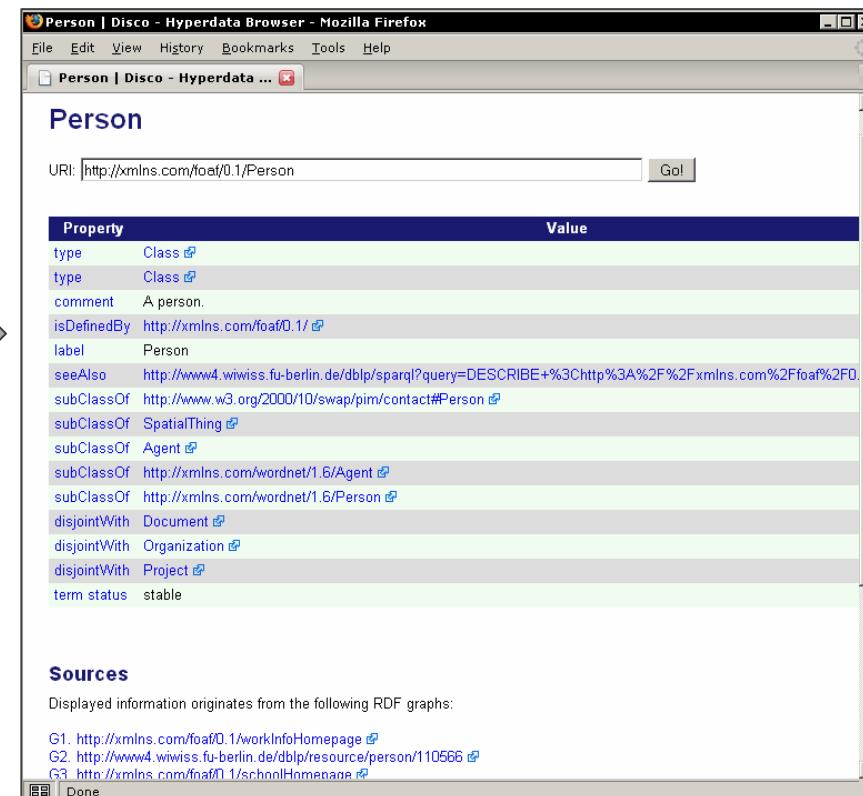
Dereferenceable
URI



The screenshot shows a Mozilla Firefox window titled "Tim Berners-Lee | Disco - Hyperdata Browser". The URL in the address bar is "http://www.w3.org/People/Berners-Lee/card". The main content area displays a table of properties for Tim Berners-Lee. The table has columns for "Property", "Value", and "Sources". Sources are indicated by small blue numbers (G1, G2, G3, G4, G5) next to the values. A large blue arrow points from this browser window to the right-hand side panel.

Property	Value	Sources
type	http://www.w3.org/2000/10/swap/pim/contact#Male	G1 G5
type	Person	G1 G2 G4
value	Tim Berners-Lee	G3
label	Tim Berners-Lee	G1 G5
seeAlso	http://www.w3.org/People/Berners-Lee/card	G3
seeAlso	http://www.w3.org/People/Berners-Lee/card.rdf	G4
assistant	Amy van der Hiel	G1 G5
homePage	http://www.w3.org/People/Berners-Lee/card.rdf	G1
work	...	G1
organization	W3C	G1
publicHomePage	http://www.w3.org/People/Berners-Lee/card.rdf	G1
sameAs	Tim Berners-Lee	G1
sameAs	Tim Berners-Lee	G1
based near	...	G1
based near	...	G5
family_name	Berners-Lee	G1 G5
Given name	Timothy	G1
homepage	http://www.w3.org/People/Berners-Lee/	G1 G2
image		G1 G5
knows	Coralie Mercier	G1
knows	Edd Dumbill	G5
knows	Henry Story	G1
knows	http://danbri.org/foaf#danbri	G1
knows	Ira Fuchs	G1

Disco Hyperdata Browser
navigating the Semantic Web as an
unbound set of data sources



The screenshot shows a Mozilla Firefox window titled "Person | Disco - Hyperdata Browser". The URL in the address bar is "http://xmlns.com/foaf/0.1/Person". The main content area displays a table of properties for a Person. The table has columns for "Property" and "Value". Sources are indicated by small blue numbers (G1, G2, G3, G4, G5) next to the values. A large blue arrow points from the left-hand side panel to this browser window.

Property	Value
type	Class
type	Class
comment	A person.
isDefinedBy	http://xmlns.com/foaf/0.1/
label	Person
seeAlso	http://www4.wiwiiss.fu-berlin.de/dblp/sparql?query=DESCRIBE+%3Chttp%3A%2F%2Fxmlns.com%2Ffoaf%2FO.
subClassOf	http://www.w3.org/2000/10/swap/pim/contact#Person
subClassOf	SpatialThing
subClassOf	Agent
subClassOf	http://xmlns.com/wordnet/1.6/Agent
subClassOf	http://xmlns.com/wordnet/1.6/Person
disjointWith	Document
disjointWith	Organization
disjointWith	Project
term status	stable

Sources
Displayed information originates from the following RDF graphs:
G1. http://xmlns.com/foaf/0.1/workInfoHomepage
G2. http://www4.wiwiiss.fu-berlin.de/dblp/resource/person/110566
G3. http://xmlns.com/foaf/0.1/schnellHomenage

Semantic Web - Data



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Search results for "Dieter Fensel" - FacetedDBLP - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Search results for "Dieter F..."

Searching the Digital Bibliography & Library Project

FACETED DBLP

Search for: Dieter Fensel in: All metadata Submit Query

Disable automatic phrases? Syntactic query expansion: Whole phrase

Searching for phrase **Dieter Fensel** (changed automatically) (no additional terms from query)

all metadata.

Publication years (Num. hits)

- 1991-1996 (17) 1997-1998 (18)
- 1999-2000 (18) 2001-2002 (28)
- 2003-2004 (19) 2005 (16)
- 2006-2007 (13)

Publication types (Num. hits)

- article(35) book(1)
- incollection(1) inproceedings(84)
- proceedings(8)

Venues (Conferences, Journals, ...)

- EKAW(8) Data Knowl. Eng.(5)
- IEEE Intelligent Systems(5)
- Int. J. Hum.-Comput. Stud.(5) KI(5)
- Spinning the Semantic Web(4)
- ECAI(3) ESWC(3)
- FLAIRS Conference(3)
- IEEE Trans. Knowl. Data Eng.(3)
- International Semantic Web Conf...(3)
- AICT/ICIW(2) ASWC(2)
- ECOWS(2) ICWS(2)
- Int. J. Cooperative Inf. Syst.(2)
- More (+10 of total 82)

Authors

Done

www.sti2.org

Faceted DBLP

uses the keywords provided in metadata annotations to automatically create light-weight topic categorization

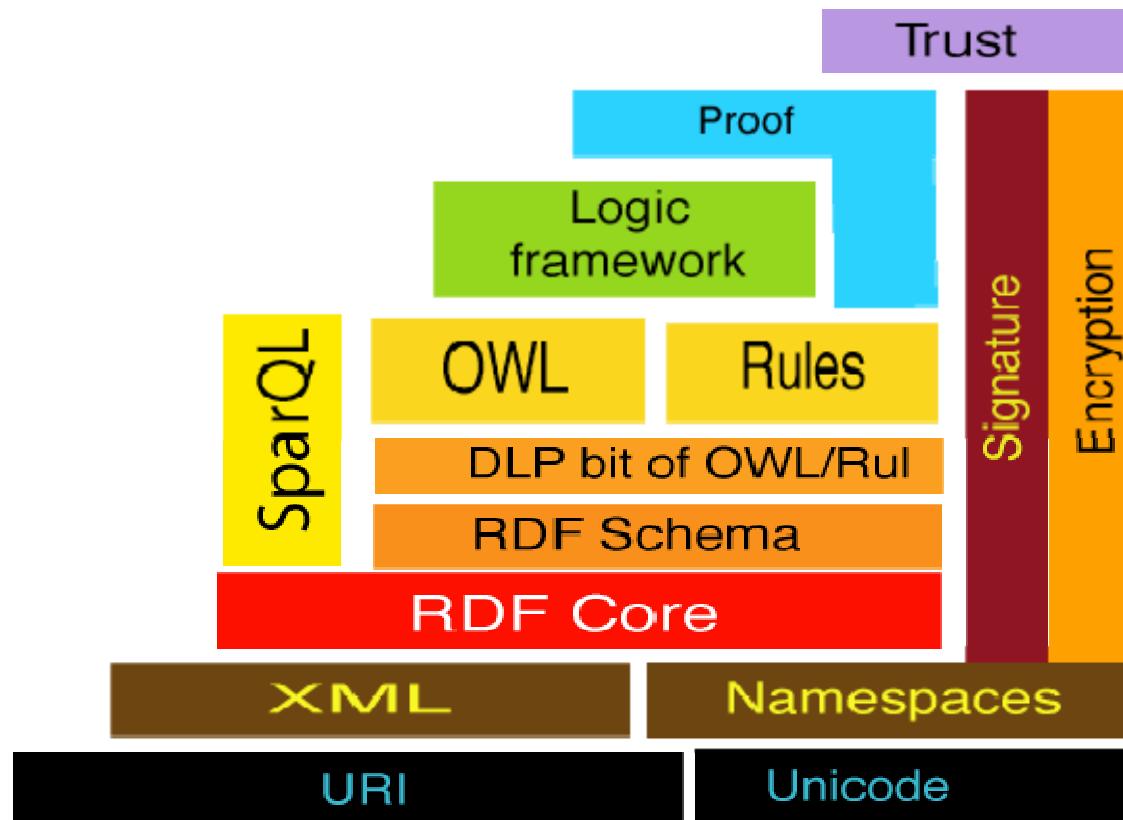
The Web Service Modeling Toolkit - An Integrated Development Environment for Semantic Web Services. | D2R Server publishing th...

Resource URI: http://dblp.i3s.de/d2r/resource/publications/conf/esws/KerriganMTF07

Home | Example Publications

Property	Value
dcterms:bibliographicCitation	<http://dblp.uni-trier.de/rec/bibtex/conf/esws/KerriganMTF07>
dc:creator	<http://dblp.i3s.de/d2r/resource/authors/Adrian_Mocan>
dc:creator	<http://dblp.i3s.de/d2r/resource/authors/Dieter_Fensel>
dc:creator	<http://dblp.i3s.de/d2r/resource/authors/Martin_Tanler>
dc:creator	<http://dblp.i3s.de/d2r/resource/authors/Mick_Kerrigan>
foaf:homepage	<http://dx.doi.org/10.1007/978-3-540-72667-8_57>
dc:identifier	DBLP conf/esws/KerriganMTF07 (xsd:string)
dc:identifier	DOI 10.1007/978-3-540-72667-8_57 (xsd:string)
dcterms:issued	2007 (xsd:Year)
rdfs:label	The Web Service Modeling Toolkit - An Integrated Development Environment for Semantic Web Services. (xsd:string)
swrc:pages	789-798 (xsd:string)
dcterms:partOf	<http://dblp.i3s.de/d2r/resource/publications/conf/esws/2007>
owl:sameAs	<http://bibsonomy.org/uri/bibtexkey/conf/esws/KerriganMTF07/dblp>
rdfs:seeAlso	<http://dblp.uni-trier.de/db/conf/esws/eswc2007.html#KerriganMTF07>
rdfs:seeAlso	<http://dx.doi.org/10.1007/978-3-540-72667-8_57>
swrc:series	<http://dblp.i3s.de/d2r/resource/conferences/esws>
dc:title	The Web Service Modeling Toolkit - An Integrated Development Environment for Semantic Web Services. (xsd:string)
rdf:type	foaf:Document

Semantic Web - Data





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SEMANTIC WEB - Processes

Service Ware

Service Web

Semantic Web

Boundaries of semantics

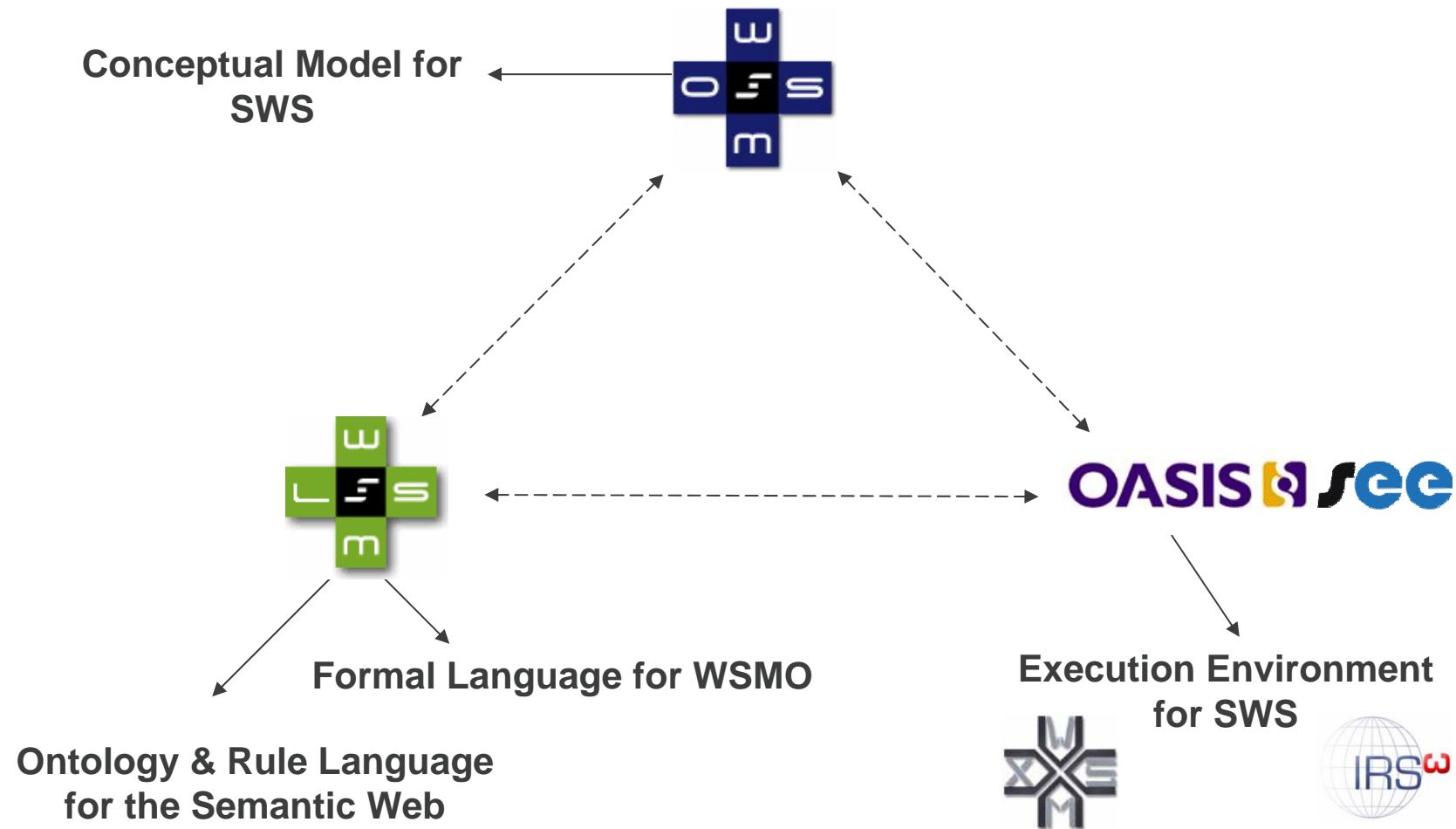
Computer science in the 21st century

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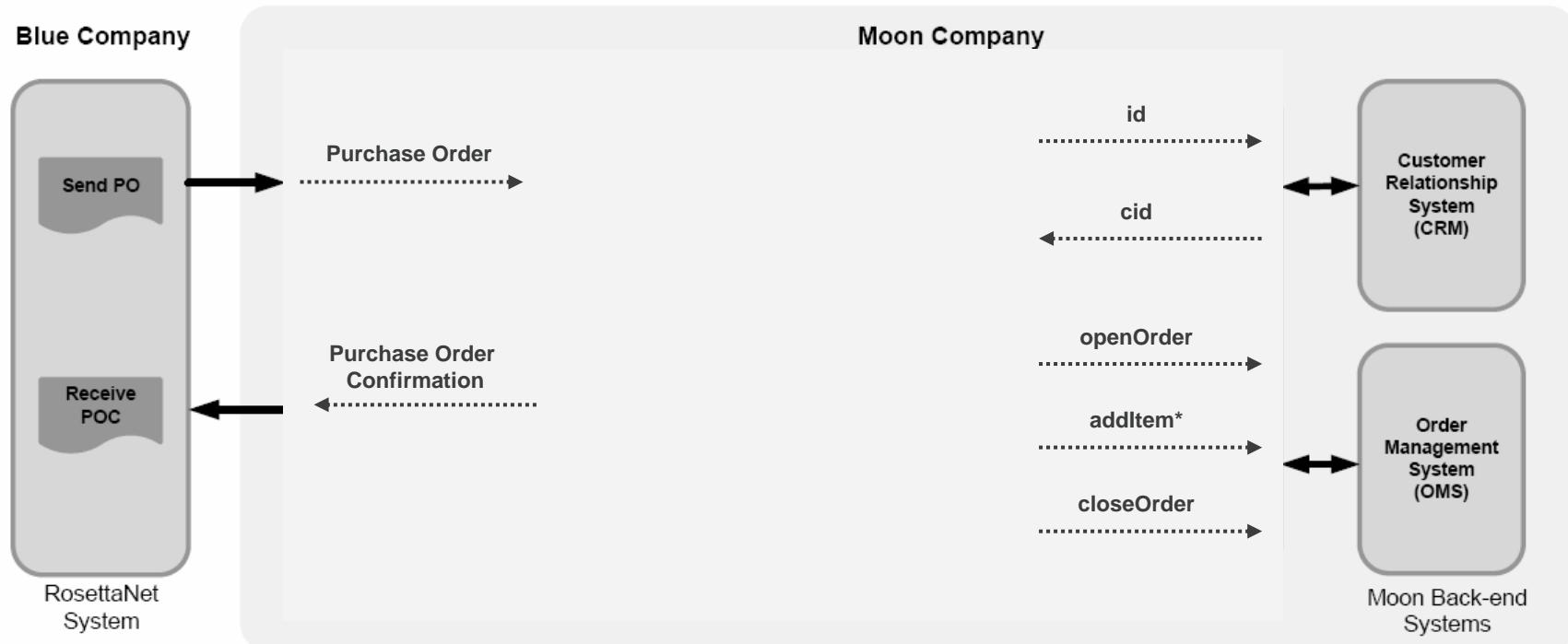
- Building Web 2.0, B2B or EAI applications involves huge amounts of human effort
 - Construction of services
 - Generating new information from existing data sources
 - Integrating data and processes between applications within or between enterprises
- Web services and Service Oriented Architectures provide a means to decouple requester and provider. But huge amounts of human effort is required in making these services collaborate and enabling interoperability between them

- The addition of semantics to form Semantic Web Services and Semantically Enabled Service-oriented Architectures can enable the automation of many of these currently human intensive tasks
 - Service Discovery, Adaptation, Ranking, Mediation, Invocation
- Frameworks:
 - **SAWSDL (WSDL-S)**: Semantic annotation of WSDL descriptions
 - **WSMO**: Ontologies, Goals, Web Services, Mediators
 - **OWL-S**: WS Description Ontology (Profile, Service Model, Grounding)
 - **SWSF**: Process-based Description Model & Language for WS

Semantic Web - Processes

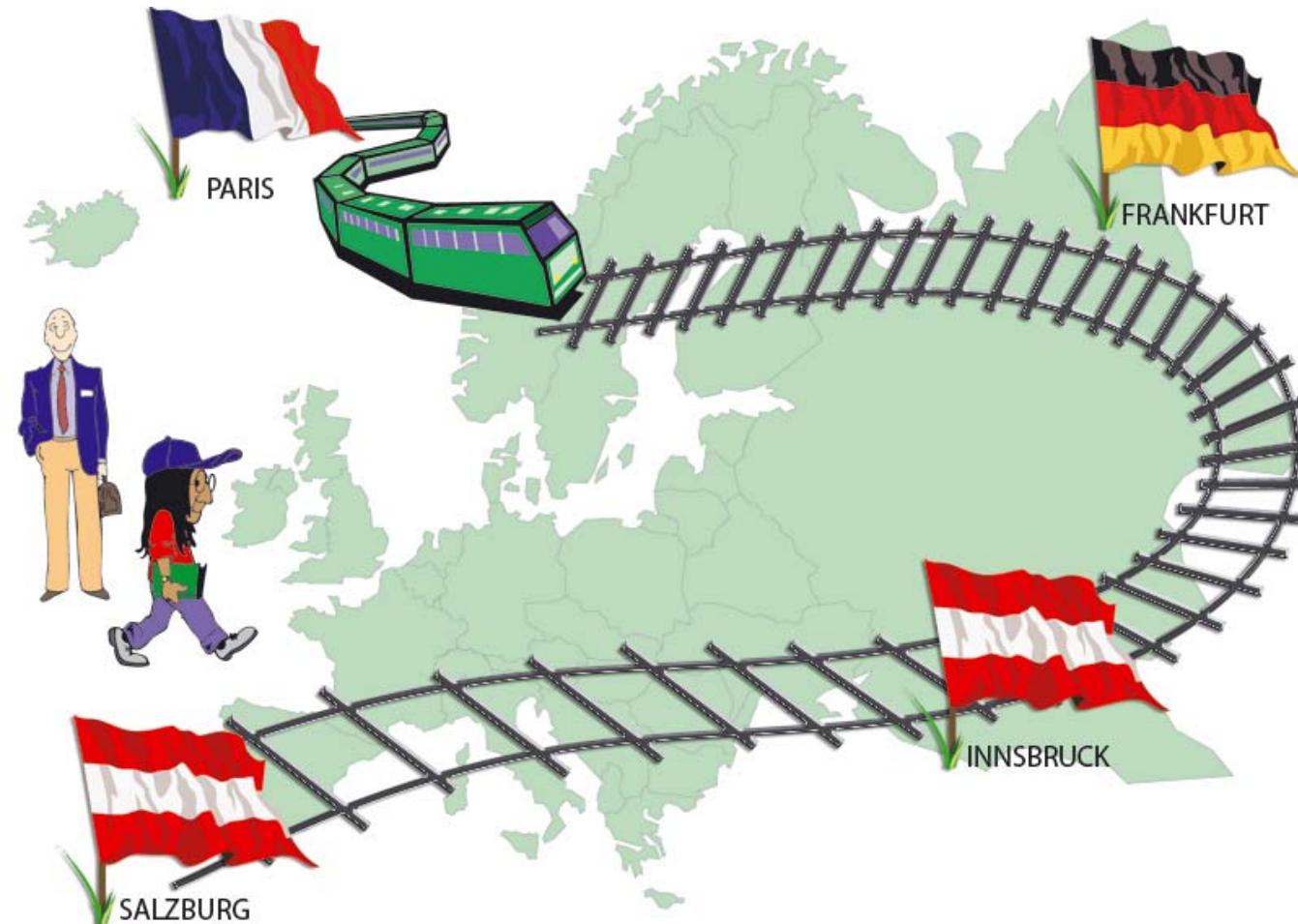


Semantic Web - Processes



- Blue company has discovered Moon company on the Web
- Blue company wishes to communicate with Moon company
- Broker required to resolve data and process interoperability issues

Semantic Web - Processes



Semantic Web - Processes

VTA - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Media Mail



Name: Dieter Fensel

Type: Business

Departure: Innsbruck

Arrival: London

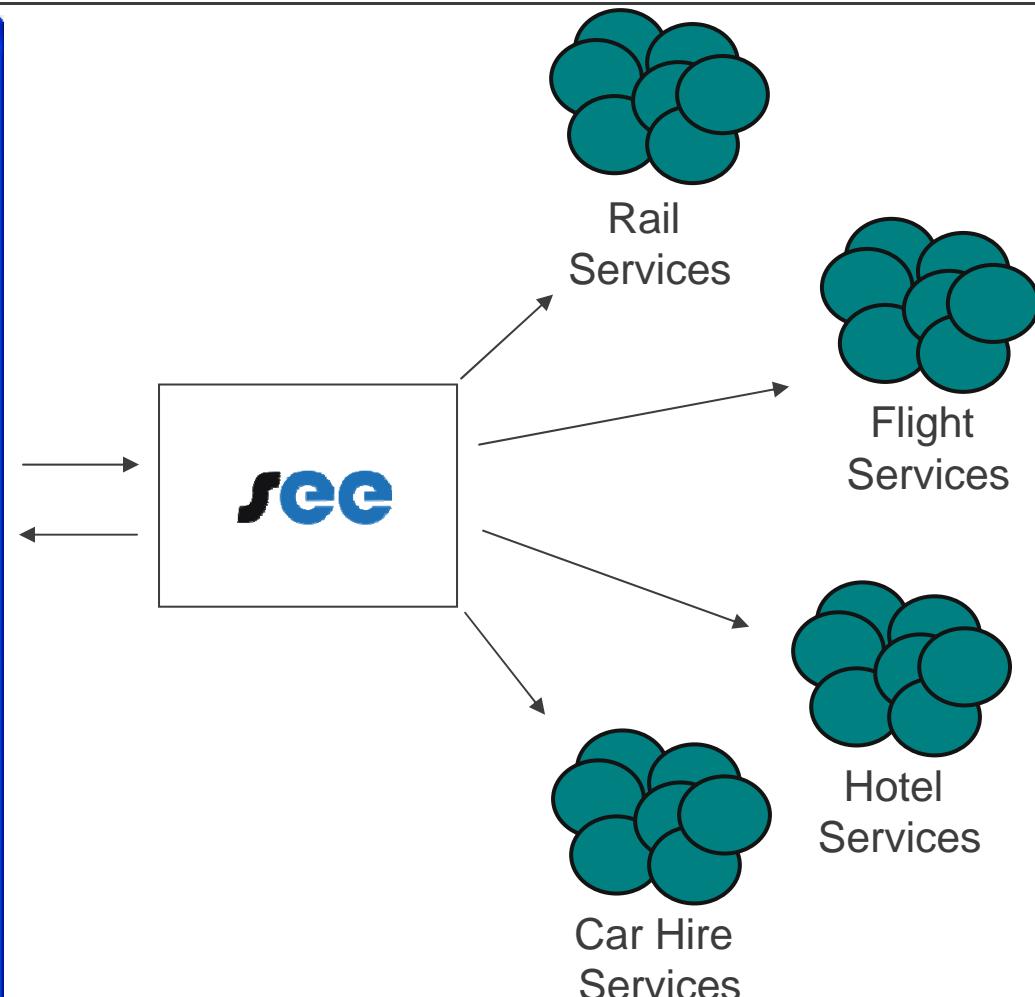
Start Date: 07 December 2007
19 00

End Date: 10 December 2007
9 00

Hotel Reservation:

Car Hire:

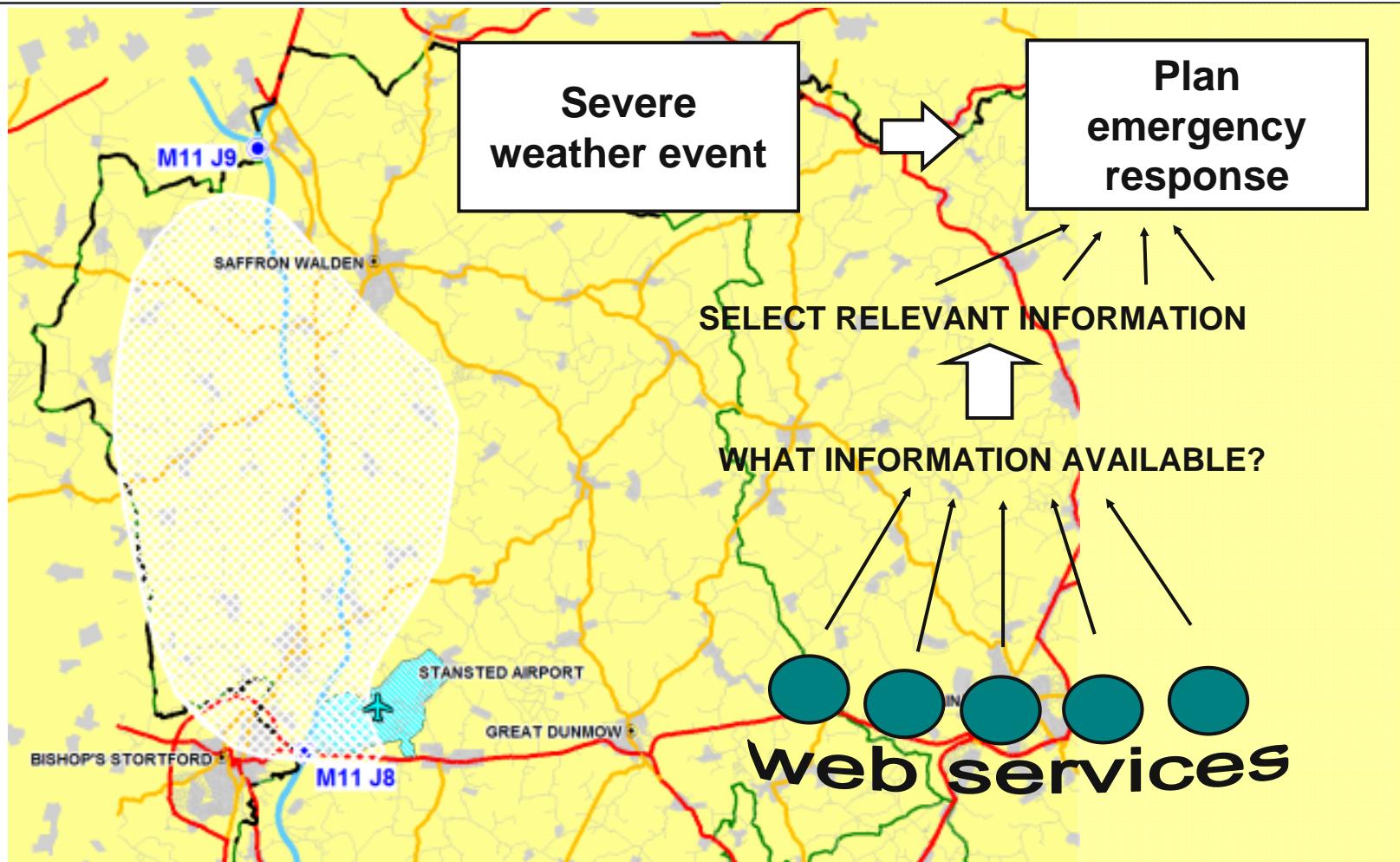
Done My Computer



MK3

From Dieter: slide 30-33 need a bit more explanations.
Mick Kerrigan, 2007-10-26

Semantic Web - Processes

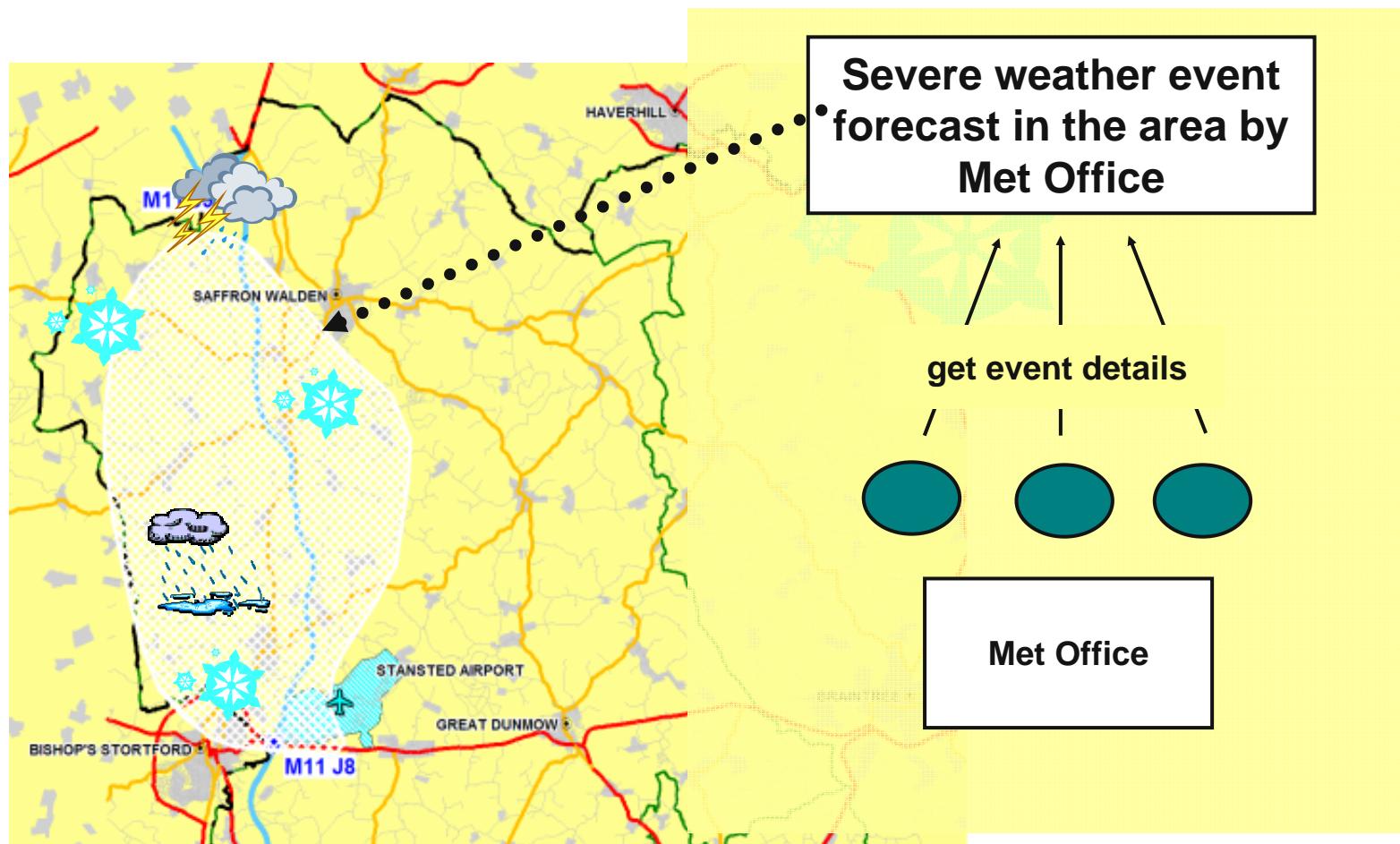


John Domingue: Semantic Web Services – Application Areas, Asian Autumn School on Semantic Web (AASSW07)

MK4

From Dieter: slide 30-33 need a bit more explanations.
Mick Kerrigan, 2007-10-26

Semantic Web - Processes

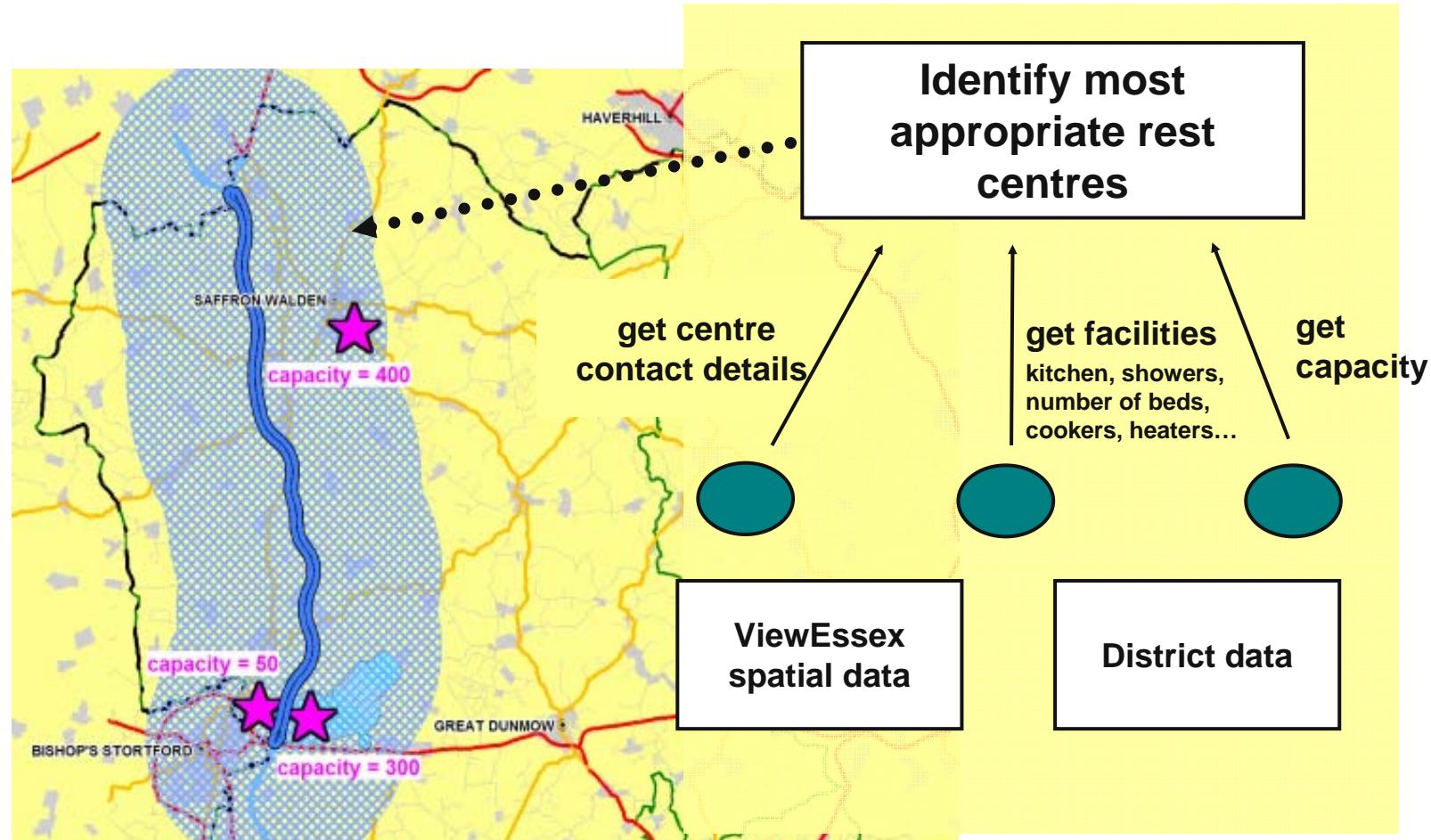


John Domingue: Semantic Web Services – Application Areas, Asian Autumn School on Semantic Web (AASSW07)

MK5

From Dieter: slide 30-33 need a bit more explanations.
Mick Kerrigan, 2007-10-26

Semantic Web - Processes

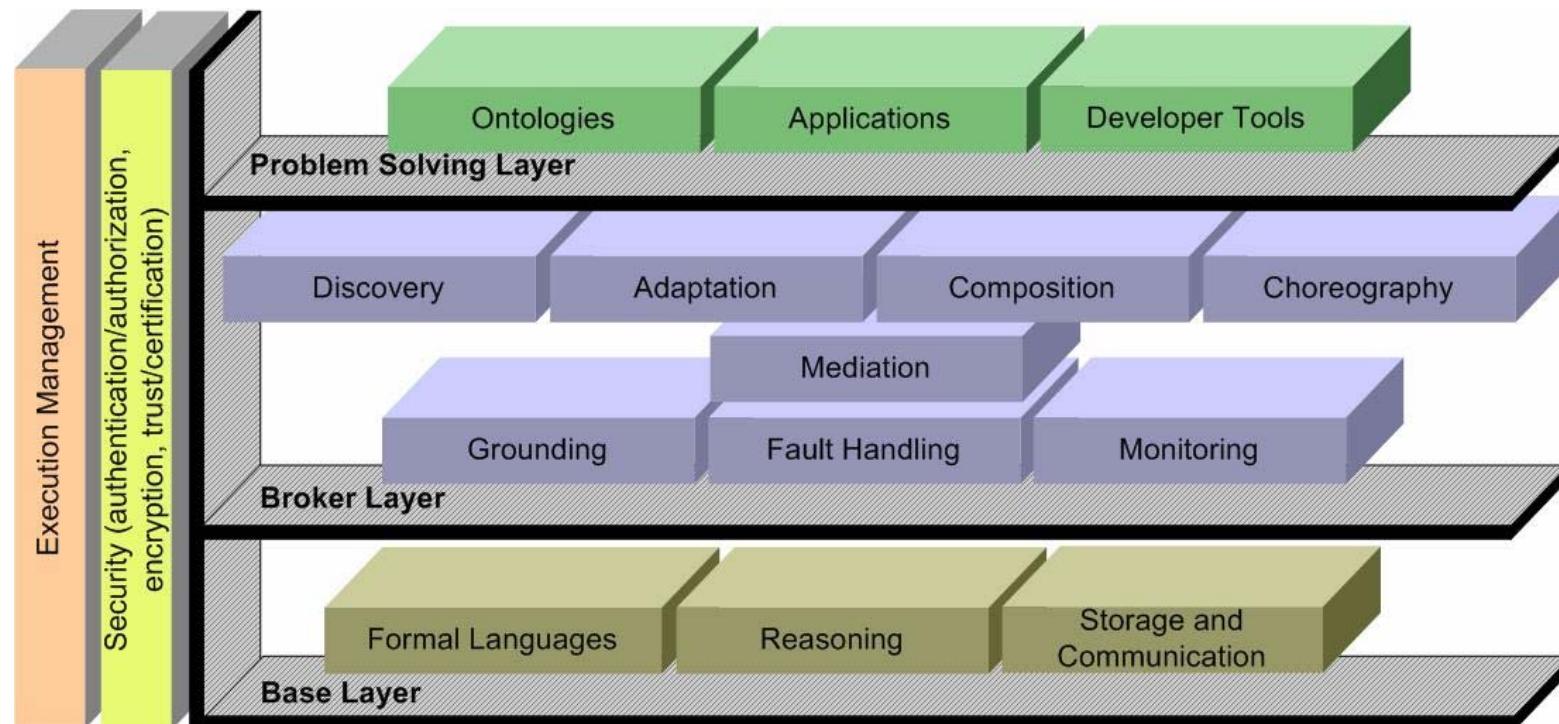


John Domingue: Semantic Web Services – Application Areas, Asian Autumn School on Semantic Web (AASSW07)

MK6

From Dieter: slide 30-33 need a bit more explanations.
Mick Kerrigan, 2007-10-26

Semantic Web - Processes





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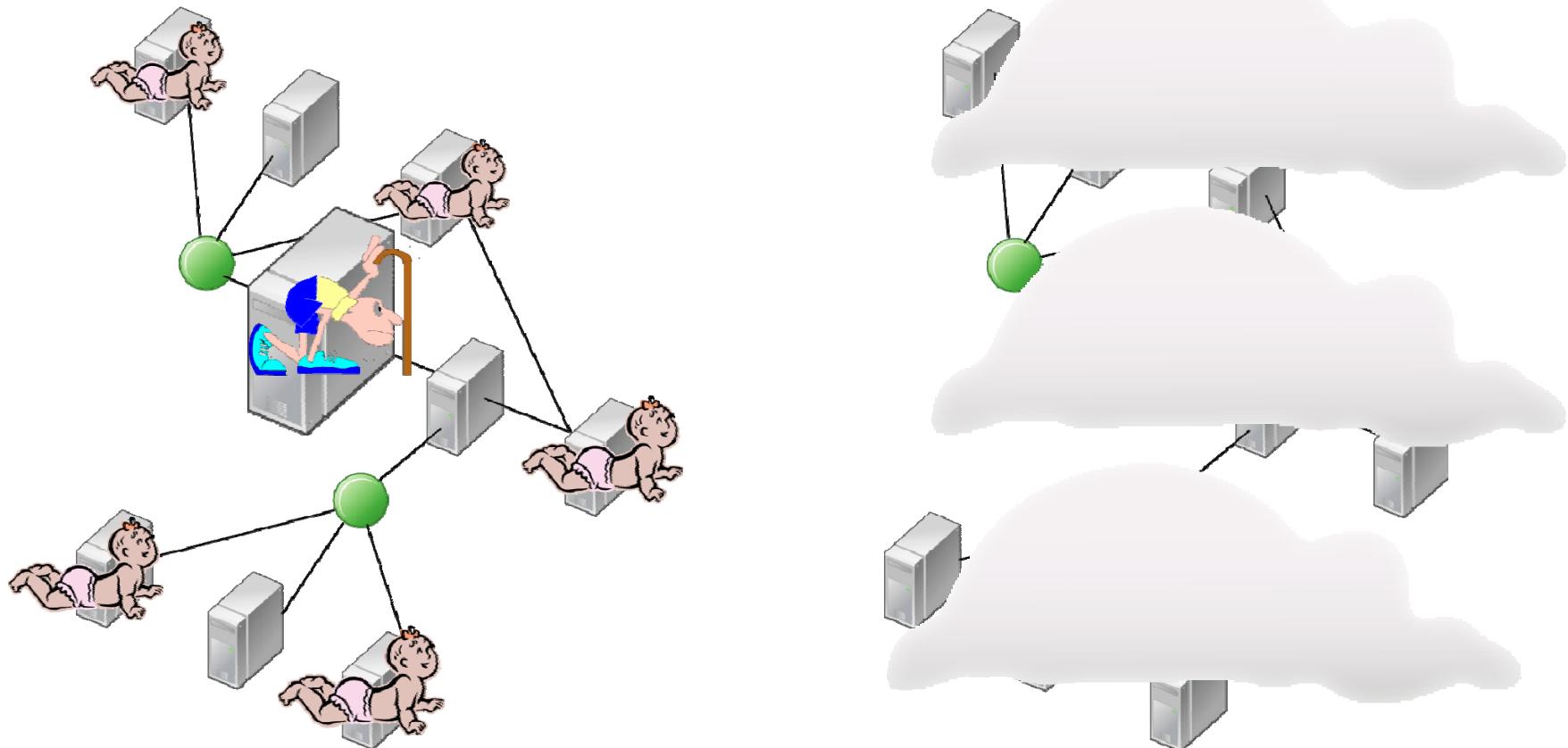
BOUNDARIES OF SEMANTICS

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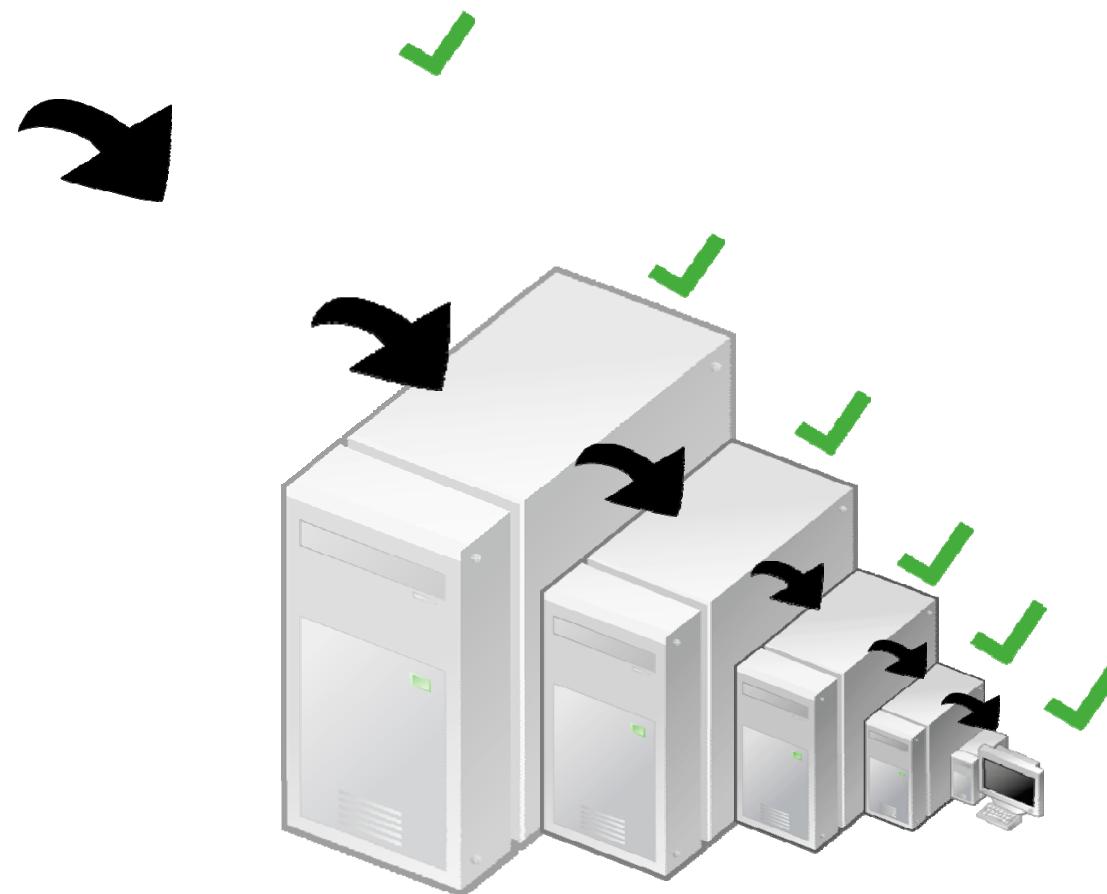
- The principal limits of describing large, heterogeneous, and distributed systems
 - The principal limits of self representation and self reflection
- > **Necessarily incompleteness and incorrectness of semantic descriptions.**

Boundaries of Semantics

The principal limits of describing large, heterogeneous, and distributed systems



The principal limits of self representation and self reflection



Boundaries of Semantics



The principal limits of self representation and self reflection



The mission of STI International establishes as a core modern engineer supposed leading think tank field.

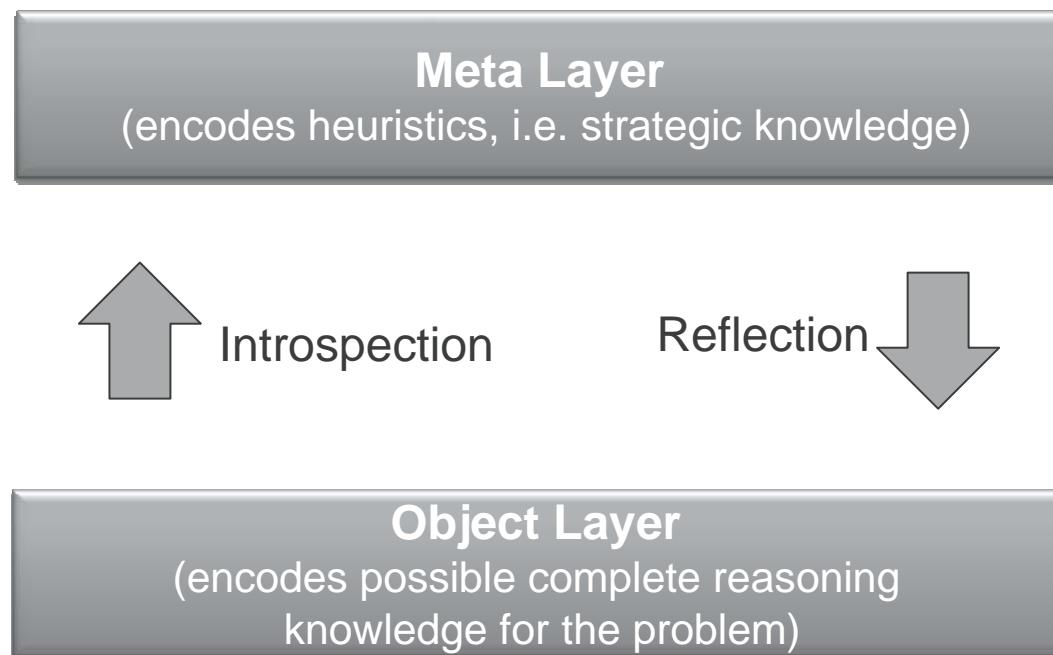
The mission of STI International establishes as a core modern engineer supposed leading

The mission of STI International establishes as a core modern engineer supposed leading

T h



The principal limits of self representation and self reflection



- The meta layer should apply ***heuristics*** that may help
 - Speed up the overall reasoning process.
 - Increase its flexibility.
- Therefore, it needs to be incomplete in various aspects and resemble important aspects of our consciousness.
 - Introspection
 - Reflection
- Unbounded rationality, constrained rationality, limited rationality.

- Description of data by metadata or programs by metaprograms
 - Always larger ...
 - ... or always an approximation
 - In order to thoroughly describe a computer we need an even larger computer
 - *This is then a recurrent problem*

Data look-up on the Web

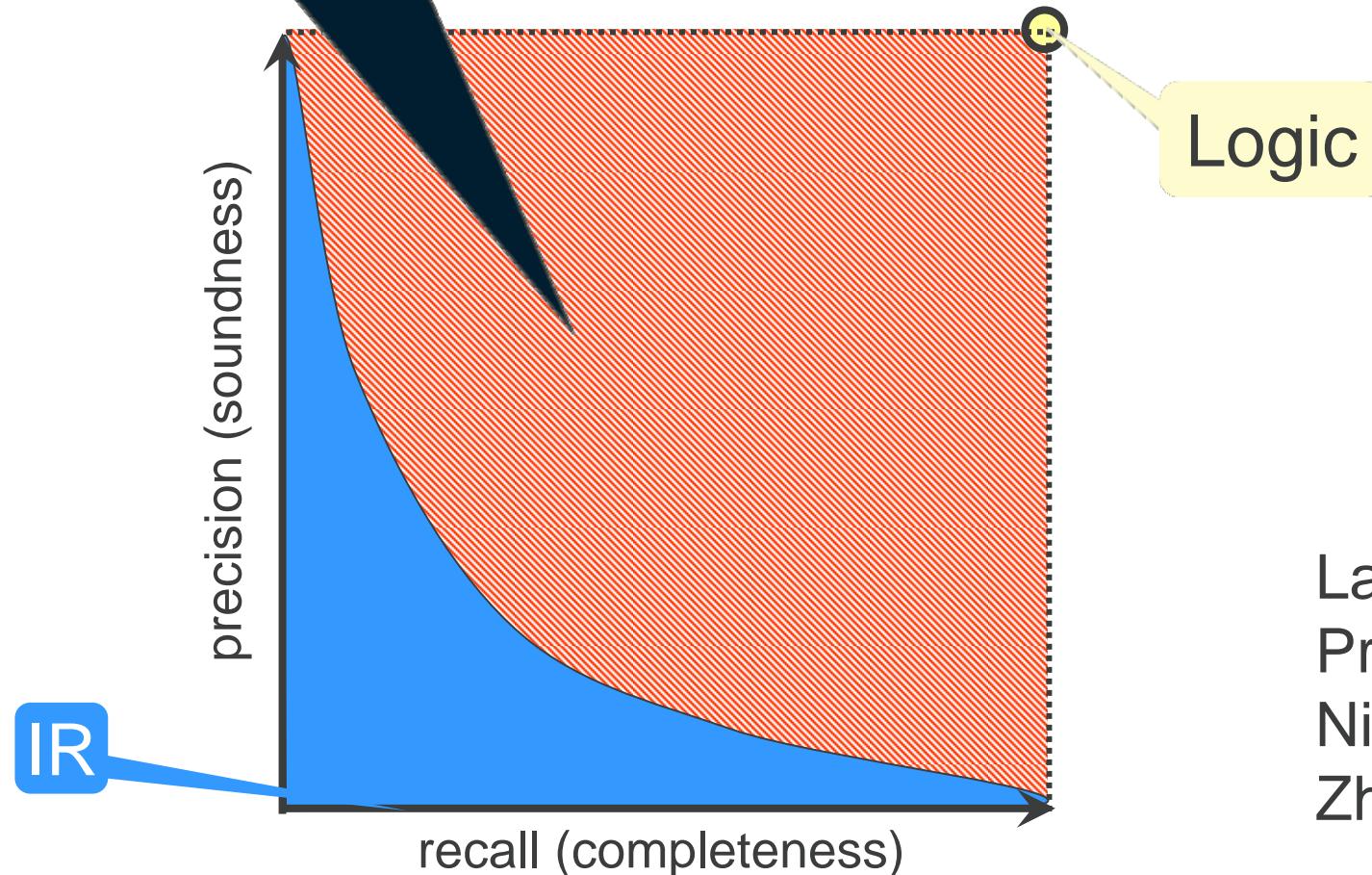


- In a large, distributed, and heterogeneous environment, classical ACID guarantees of the database world no longer scale in any sense.
- Even a simple **read** operation in an environment such as the Web, a peer-to-peer storage network, a set of distributed repositories, or a **space**, cannot guarantee **completeness** in the sense of assuming that if data was not returned, then it was not there.
- Similarly, a write can also not guarantee a **consistent** state that it is immediately replicated to all the storage facilities at once.

- Modern information retrieval applies the same principles
 - In information retrieval, the notion of completeness (recall) becomes more and more meaningless in the context of Web scale information infrastructures.
 - It is very unlikely a user requests all the information relevant to a certain topic and existing on a worldwide scale on a certain topic since this may easily go far beyond the amount of information processing he or she is investing in achieving a certain goal.
 - Therefore, instead of investigating the full space of precision and recall, information retrieval is starting to focus more around improving precision and proper ranking of results.

- What holds for simple data look-up holds in an even stronger sense for reasoning on Web scale.
- The notion of 100% completeness and correctness as usually assumed in logic-based reasoning does not even make sense anymore since the underlying fact base is changing faster than any reasoning process can process it.
- Therefore, we have to develop a notion of usability of inferred results and relate them with the resources that are requested for it.

Semantic Web



LarKc –
Prof.
Ning
Zhong

- In a world of billions of services it may significantly cost too much to find the “optimal” service in relation to the gain of having actually found the optimal solution.
- Pragmatic approaches in service discovery will focus on utility, i.e., stop the search process when a service is found that is “good” enough to fulfill a request.
- Also, it is unrealistic to assume that semantic descriptions of services are correct and complete, i.e., duplicate the functionality of a service at the description level.



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- With the Web we have an open, heterogeneous, distributed, and fast changing computing environment.
- Therefore we need computing understood as
 - A **goal driven approach** where the solution process is only partially determined and actually decided during runtime, based on available data and services.
 - A **heuristic approach** that gives up on absolute notion of completeness and correctness in order to gain scalability.
- The times of 100% complete and correct solutions are gone.

The Need for Trade-offs:

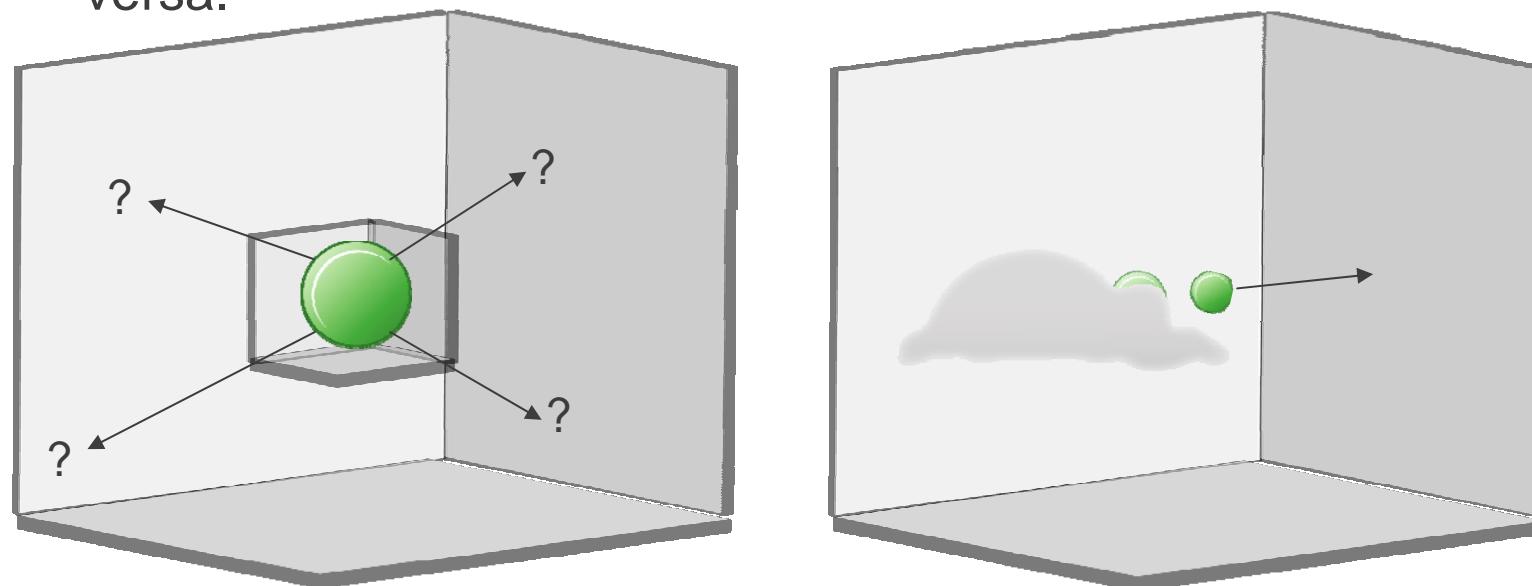
- In all areas one has to define the tradeoff between the guarantees one provides in terms of
 - service level agreements - completeness and correctness are just examples for some very strong guarantees - and
 - what this requires in terms of assumptions, and
 - computational complexity
- Different heuristic problem solving approaches are just different combinations of these three factors.

- Service level agreements (or goals) define what has to be provided as result of problem solving.
- Do we request an optimal solution, a semi-optimal solution, or just any solution?

- Assumptions describe the generality of the problem solving approach.
 - Assuming that there is only one solution allows stopping the search for an optimum immediately after a solution has been found.
 - Instead of a global optimization method, a much simpler heuristic search method can be used in this case, which would still deliver a global optimum.
- Computational complexity (scalability) or the resources that are required to fill the gap between the assumptions and the goals.

- Computer science in the 20th century was about **perfect** solutions in **closed** domains and applications.
- Computer science in the 21st century will be about **approximate** solutions and frameworks that capture the relationships of partial solutions and requirements in terms of computational costs, i.e., the proper balance of their ratio.

- This shift is comparable to the transition in physics, from classical physics to relativity theory and quantum mechanics,
- ...where the notion of absolute space and time is replaced by relativistic notions and the principle limits of precision.
- the more precise we know about the location of a particle in space, the less we know about its movement in time and vice versa.





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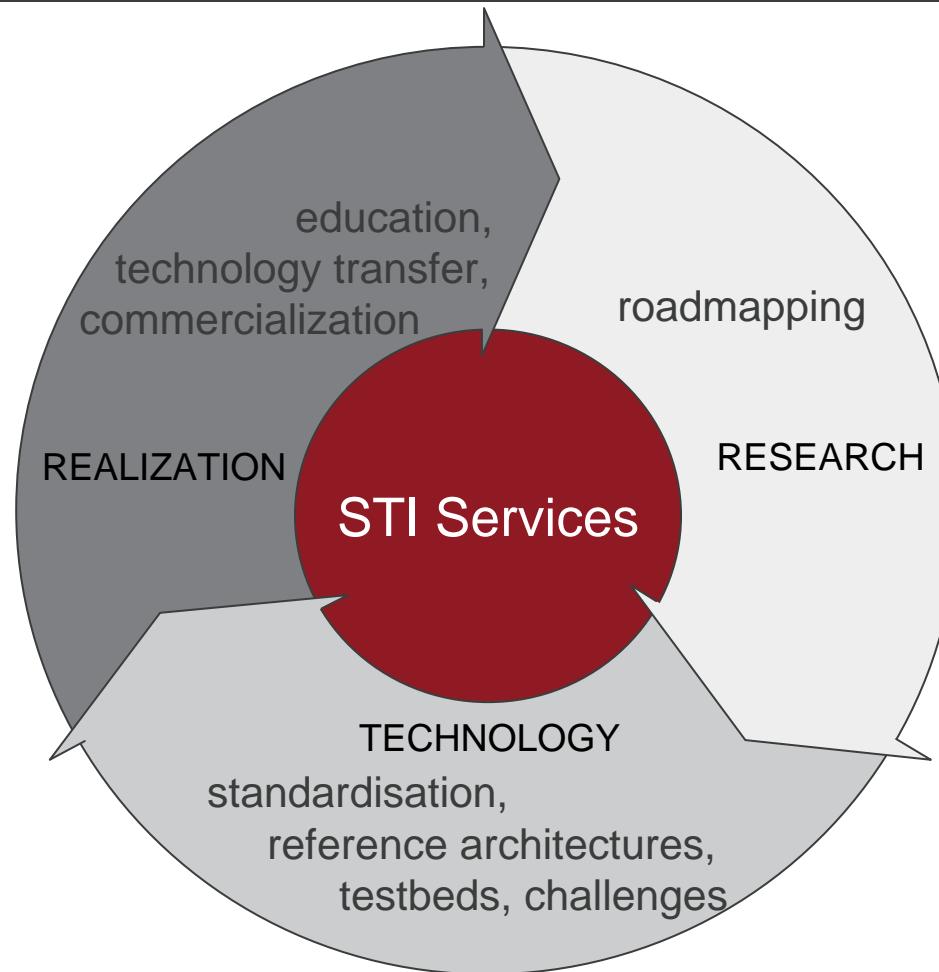
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Semantic Technology Institute
International

- The mission of Semantic Technology Institute International is to establish **semantics** as a core pillar of modern computer science.
- STI is organized as an **association** of jointly interested academic, industrial and governmental parties.
- It provides **services** to facilitate research, education, and commercialization activities around semantic technologies and the service web beyond the boundaries of individual projects or initiatives.

STI – The Services



STI · INTERNATIONAL



- STI International will create, maintain, and publish roadmaps as a means of planning and coordinating its activities towards the achievement of the mission.
- The service will focus on the five main areas of research in the field of semantic systems and services:
 - Ontologies and Ontology Engineering
 - Reasoning
 - Knowledge Acquisition and Sharing
 - Semantic Web Services
 - Social Networks.



Prof. Dr. Fabio Ciravegna
University of Sheffield, UK
Service Coordinator

STI Technology – Standardization and Reference Architectures



- STI International will provide services to academic and industrial communities interested in the Semantic Web focusing on standardization activities and the creation of reference architectures which could support the Semantic Web.
- We aim at
 - Establishing a communication channel with W3C, OASIS and OMG
 - Facilitating communication across the various projects and initiatives
 - Gaining leverage and impact by combining efforts
 - Providing relevant know-how.



Dr. John Domingue
The Open University, UK
Service Coordinator



Dr. Michal Zaremba
University of Innsbruck, AT
Service Coordinator

- STI International will facilitate the shared development of open, globally distributed testbeds for developing, deploying and testing Semantic Web technologies and Semantic Web Services at global scale.
- Challenge services will offer participants the chance to show the best of the Semantic Web and Semantic Web Services technologies in execution to identify promising approaches and to support relevant developments.



Dr. Emanuele Della Valle
CEFRIEL, Politecnico di Milano, I
Service Coordinator



Prof- Dr. Asunción Gómez-Pérez
Universidad Politécnica de Madrid, E
Service Coordinator

- STI International will facilitate the commercial exploitation of R&D results with the aim of increasing business opportunities.
- STI International performs, among others, the following activities for its members:
 - Knowledge Capitalization Structure
 - Market surveillance
 - Comprehensive offer building for proving the interest of SWS and Semantic Web in general
 - International position strategy
 - Diffusion by consolidation of dissemination plans and activities



Dr. Antonio Campos
CTIC Foundation, ES
Service Coordinator

- STI International will provide educational activities in the field of semantics and semantic technologies for academia and industry.
- The STI educational program includes:
 - Generation of high-quality training materials for specific target communities
 - Development and maintenance of training repositories and expert databases
 - Organization of different types of training and educational events
 - Provision of different types of training
 - Set-up of joint doctoral or exchange/internship programs between research institutions and between researchers and industry and operational support for their implementation.



Dr. Elena Simperl
University of Innsbruck, AT
Service Coordinator

STI – The Executive Board



Dr. Michael Brodie
Chair Advisory
Board



Dr. John Davies
Vice President
Realization



Univ.-Prof. Dr. Dieter Fensel
President



Prof. Dr. Fausto Giunchiglia
Vice President
Internationalization



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Technology



Prof. Dr. Rudi Studer
Vice President
Research



Alexander Wahler
CEO



Univ.-Prof. Hannes Werthner
Vice President
Members

STI – The Members



20 members
October 2007

More at www.sti2.org



DERI GALWAY



The
University
Of
Sheffield.

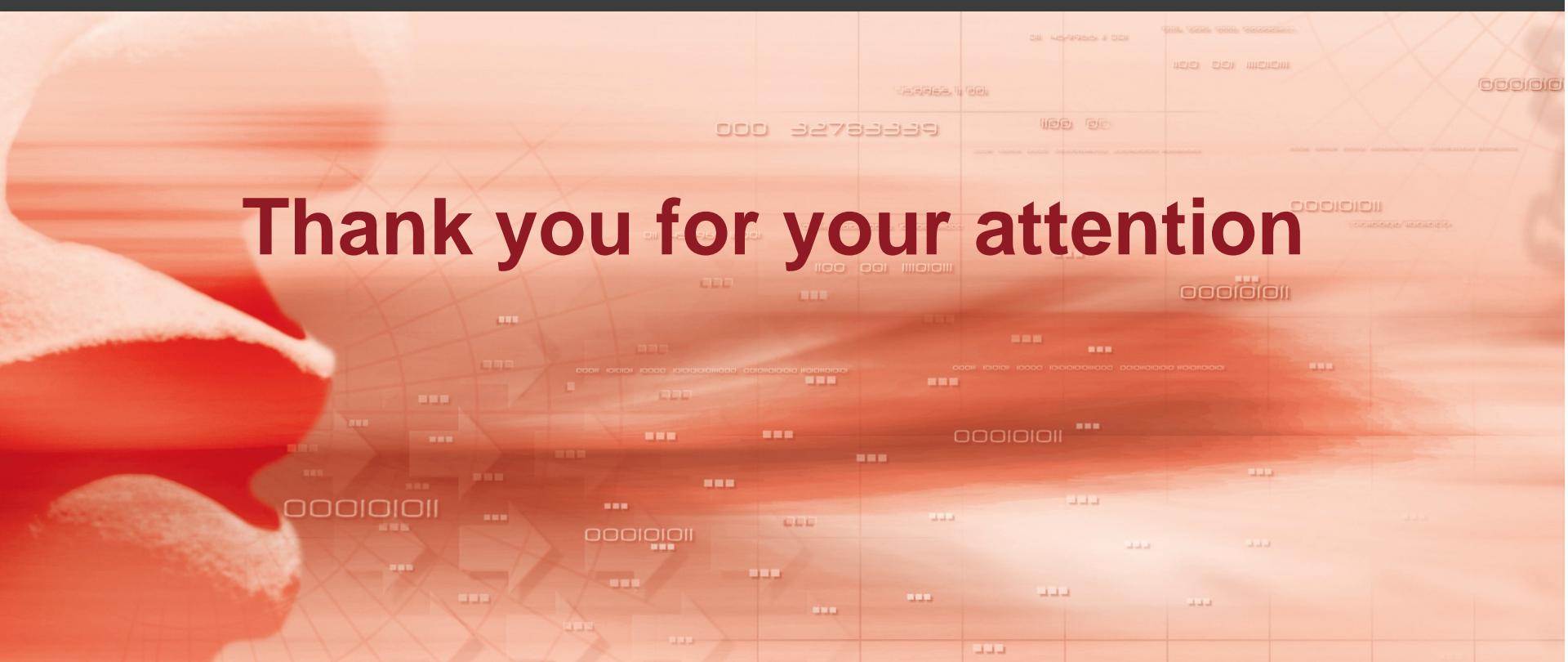


The Open University





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Thank you for your attention