Semantic Web Services: Approaches and Technologies

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- Semantic Web
- Web Services
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  - OWL-S
  - SAWSDL
- IRS-III

Motivation

The Internet has …

- 1/2 billion hosts (IP addresses)
- 1.17 billion users
- or 17.8% of the world's population

The Web has …

- 109 million distinct web sites
- 29.7 billion web pages
- ~5 pages for every man, woman, and child on the planet

7.2 billion Web searches/month (3.9 billion by Google) far exceed the world population

161 exabytes (10^8 TB) of information was created or replicated worldwide in 2006.

That's more than in the previous 5,000 years.

IDC estimates
6X growth by 2010 to
988 exabytes (a zetabyte) / year

New technical information doubles every 2 years.

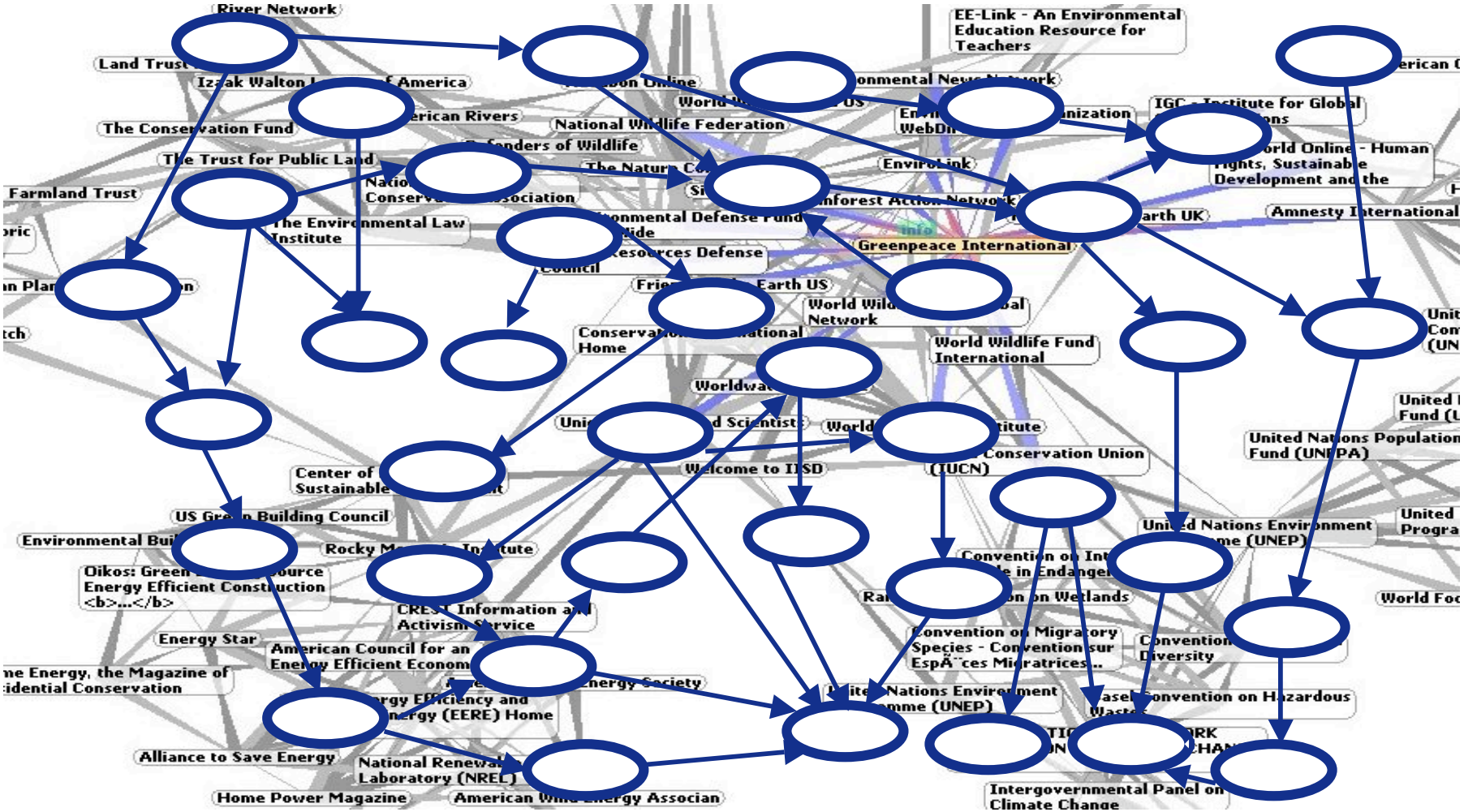
… every 72 hours
by 2010.

Achieving Web Scale

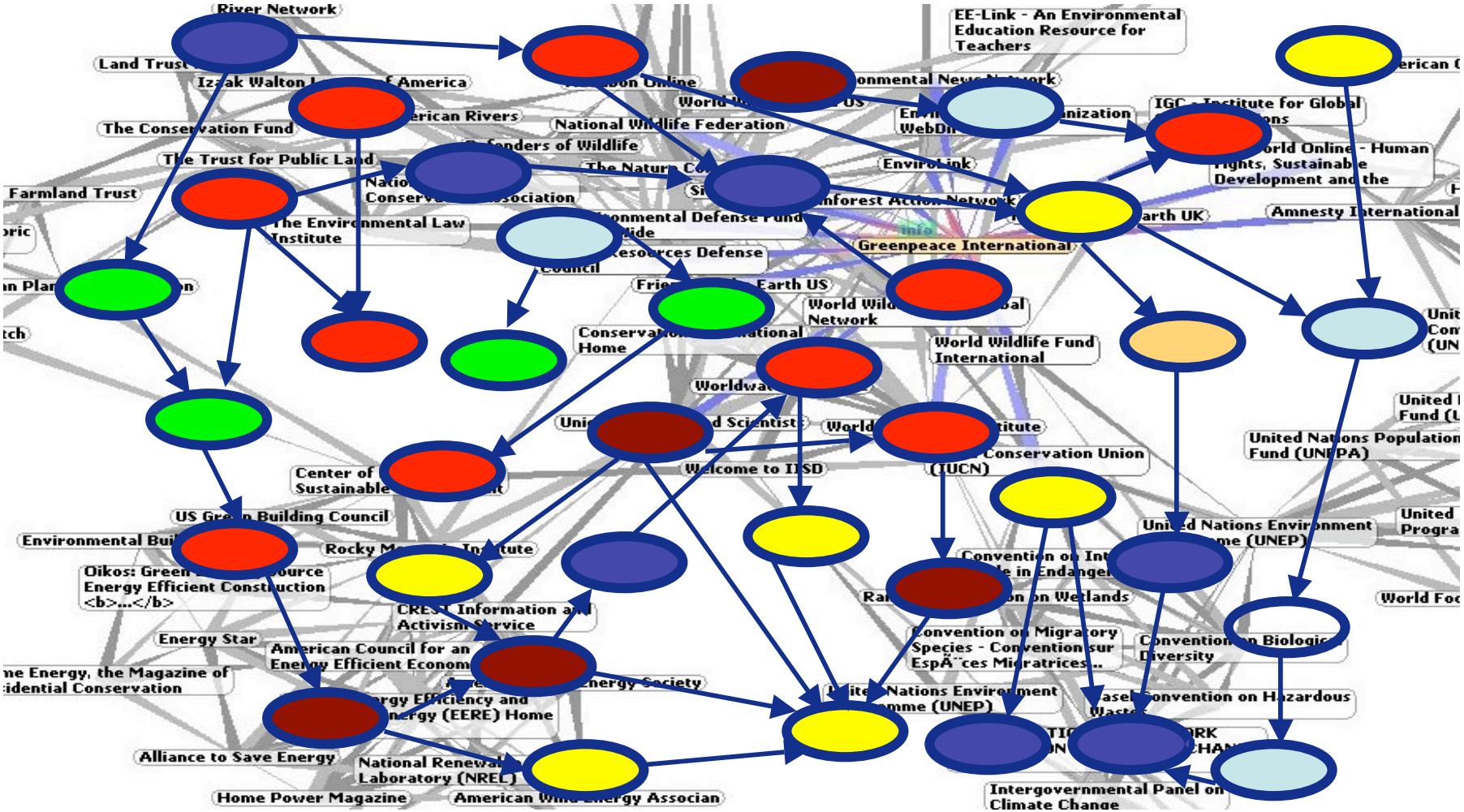
Semantic Web and Web Services

Semantic Web

SW = A Conceptual Layer over the web



SW is Heterogeneous!



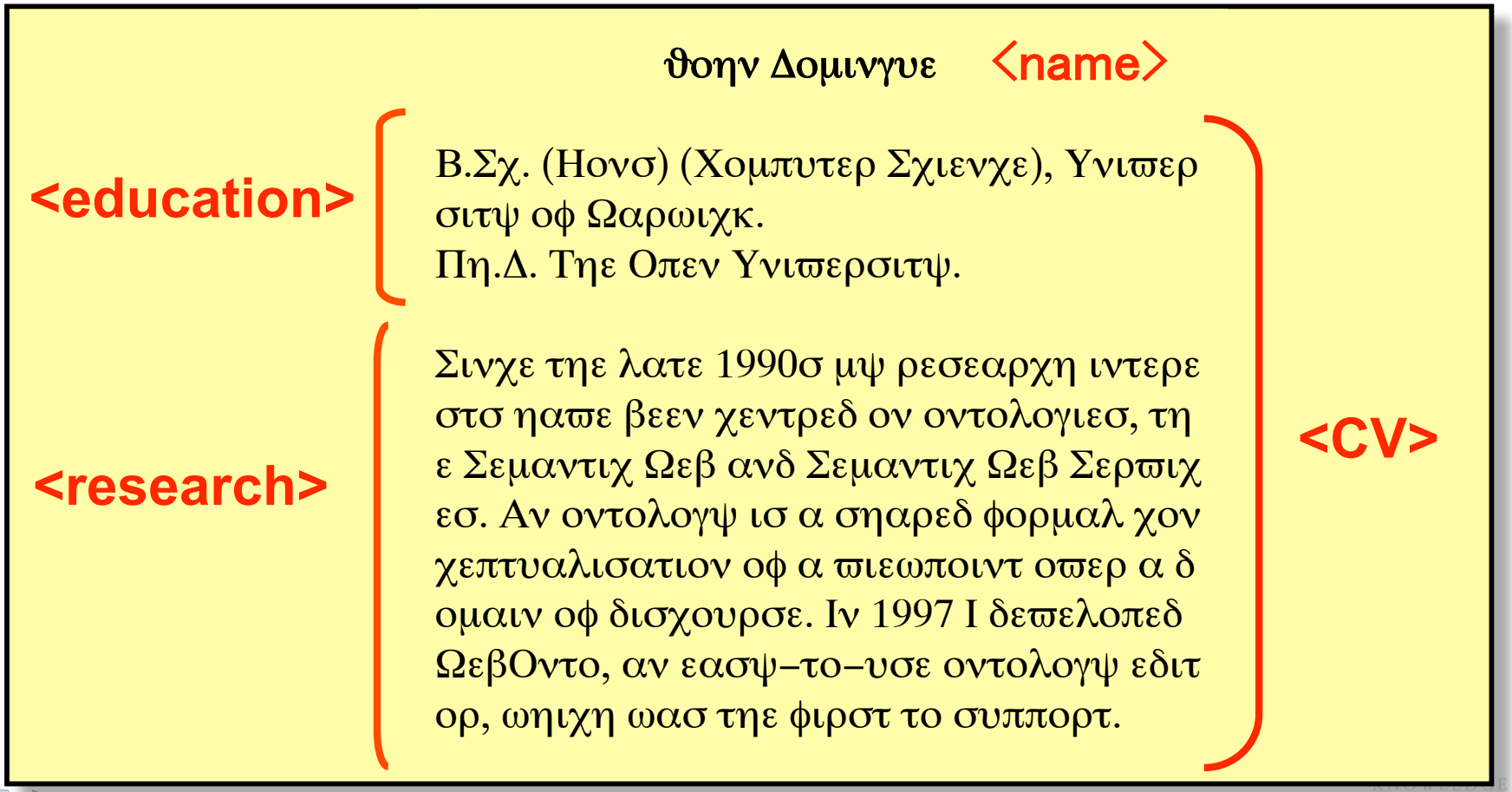
Machine Readable Web Pages

ϑοην Δομινγυε

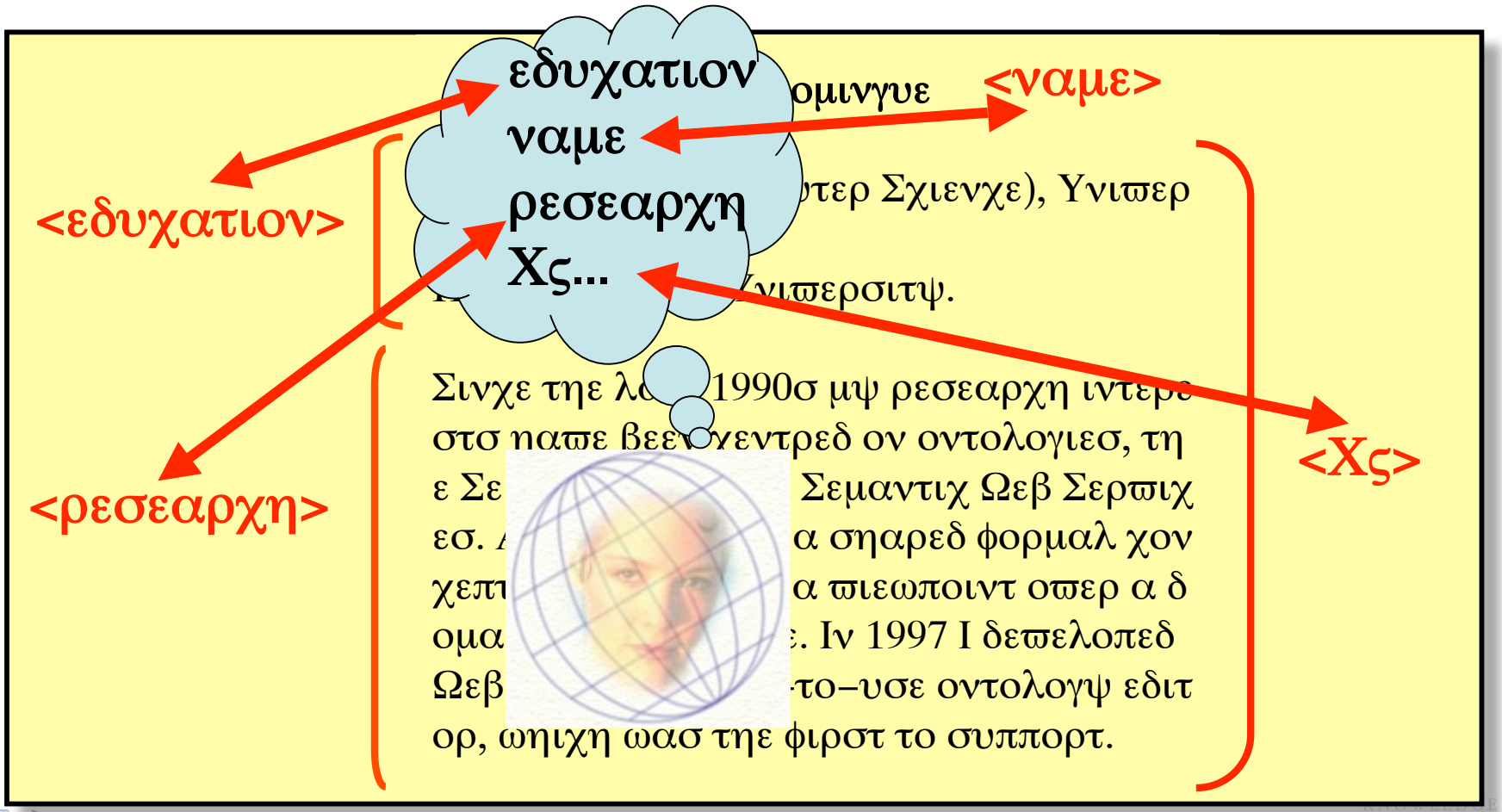
Β.Σχ. (Ηονσ) (Χομπυτερ Σχιενχε), Υνιωερ σιτψ οφ Ωαρωιχκ.
Πη.Δ. Τηε Οπεν Υνιωερσιτψ.

Σινχε τηε λατε 1990σ μψ ρεσεαρχη ιντερε στσ ηαωε βεεν χεντρεδ ον οντολογιεσ, τη ε Σεμαντιχ Ωεβ ανδ Σεμαντιχ Ωεβ Σερωιχ εσ. Αν οντολογψ ισ α σηαρεδ φορμαλ χον χεπτυαλισατιον οφ α ωιεωποιντ οωερ α δ ομαιν οφ δισχουρσε. Ιν 1997 Ι δεωελοπεδ ΩεβΟντο, αν εασψ–το–υσε οντολογψ εδιτ ορ, ωηιχη ωασ τηε φιρστ το συππορτ.

Machine Readable Web Pages



Machine Readable Web Pages

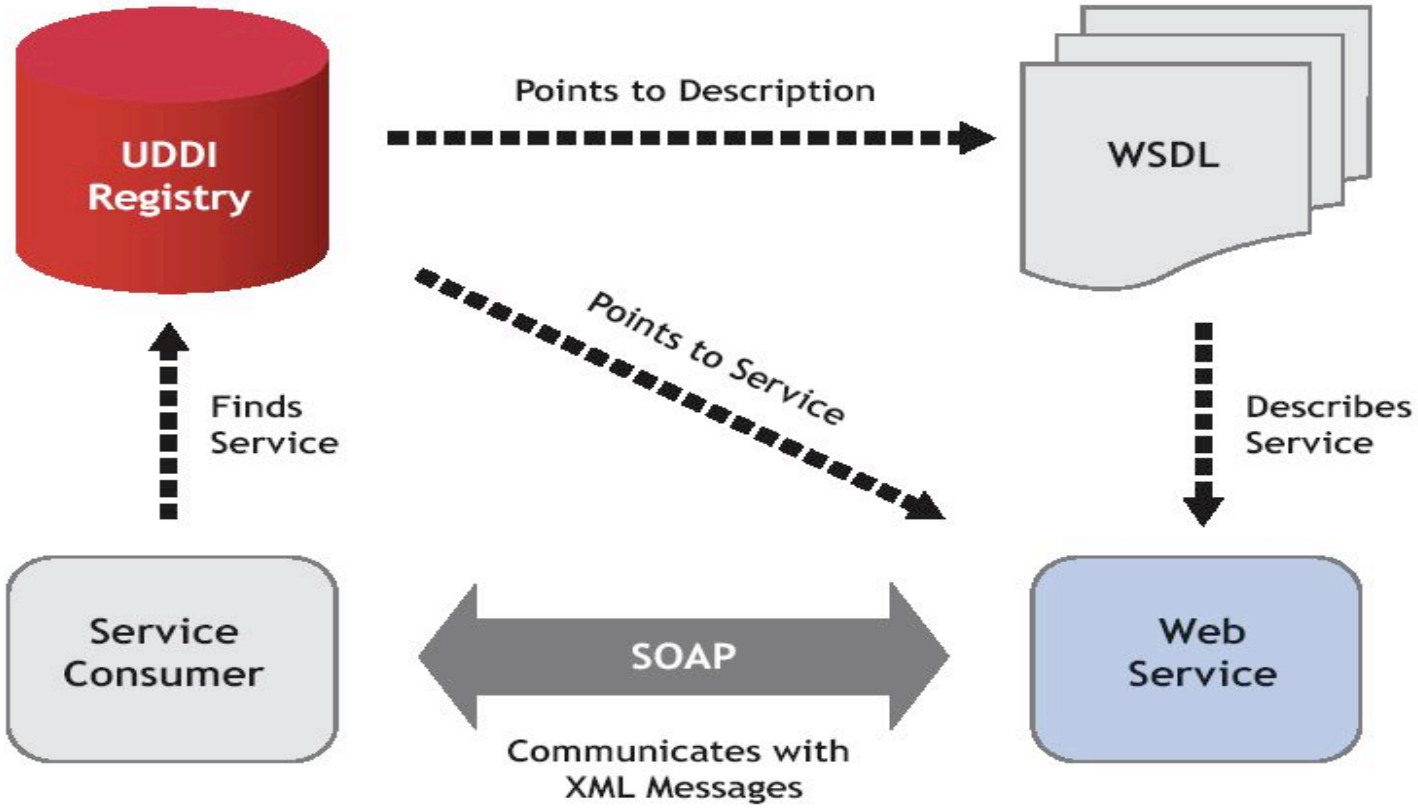


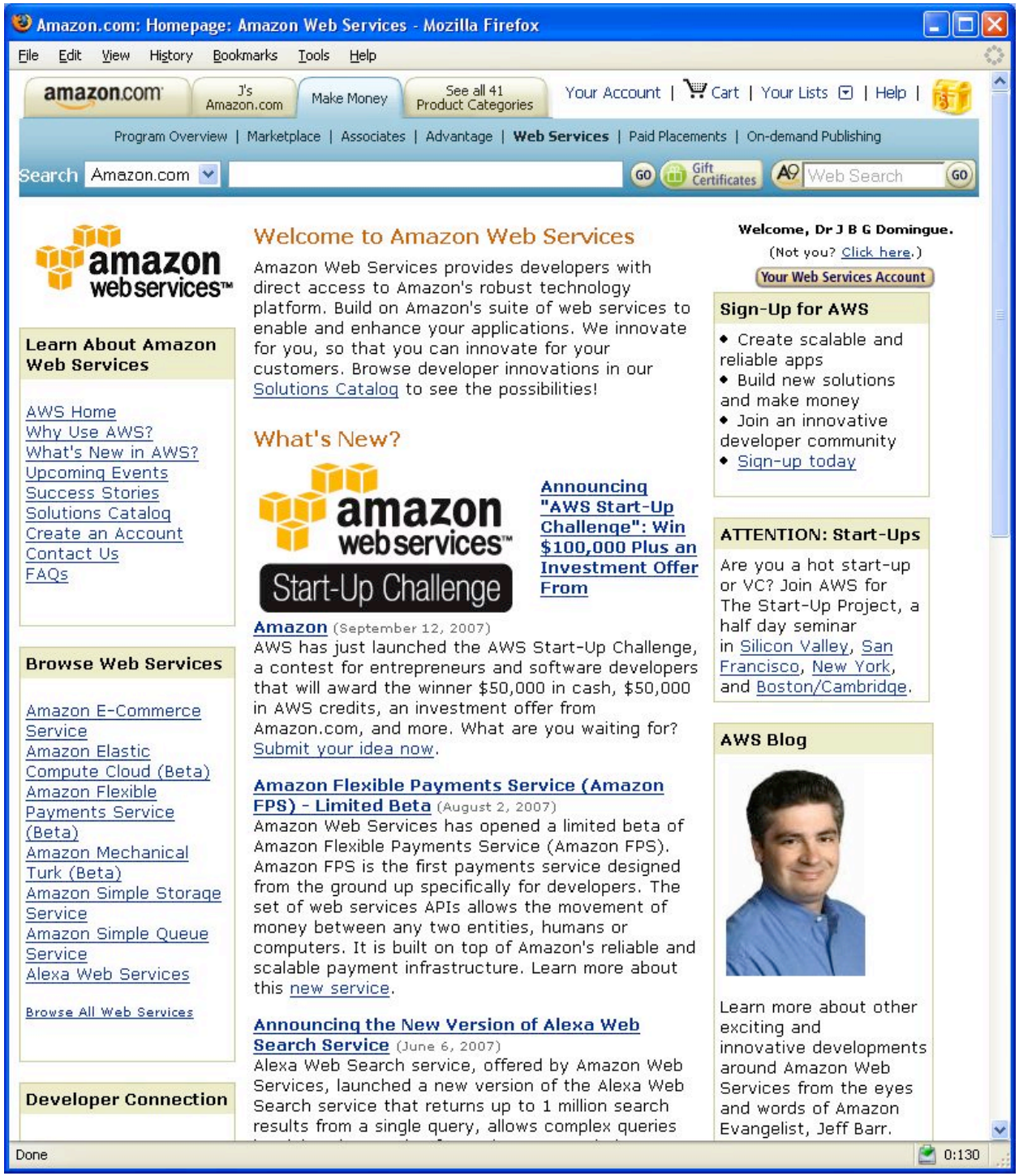
Web Services

What's a Web Service?

- A program programmatically accessible over standard internet protocols
- Loosely coupled, reusable components
- Encapsulate discrete functionality
- Distributed
- Add new level of functionality on top of the current web

Web Services Framework

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Program Overview | Marketplace | Associates | Advantage | Web Services | Paid Placements | On-demand Publishing
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Welcome to Amazon Web Services
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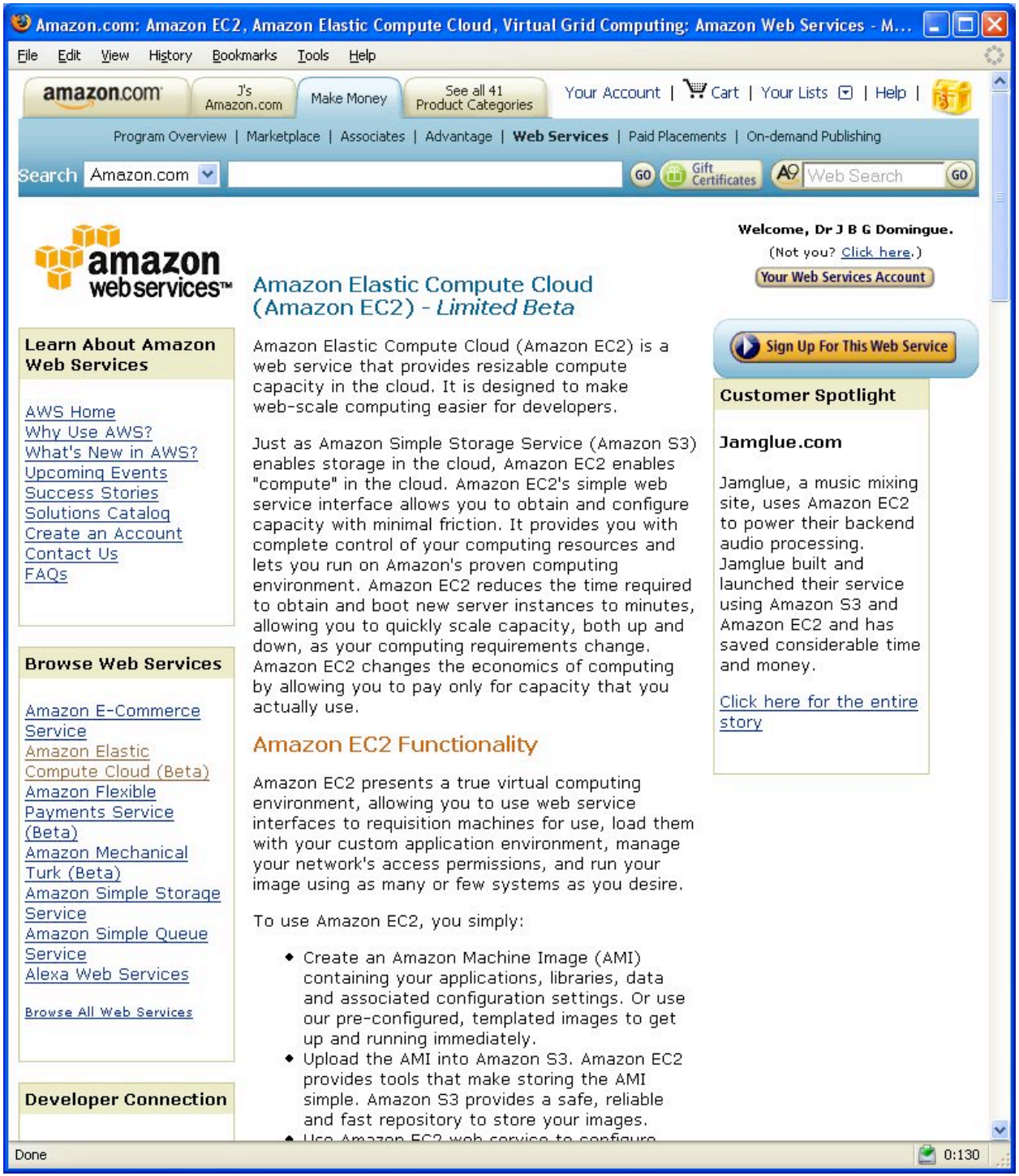
Start-Up Challenge
Announcing "AWS Start-Up Challenge": Win $100,000 Plus an Investment Offer From Amazon (September 12, 2007)
AWS has just launched the AWS Start-Up Challenge, a contest for entrepreneurs and software developers that will award the winner $50,000 in cash, $50,000 in AWS credits, an investment offer from Amazon.com, and more. What are you waiting for? Submit your idea now.
ATTENTION: Start-Ups
Are you a hot start-up or VC? Join AWS for The Start-Up Project, a half day seminar in Silicon Valley, San Francisco, New York, and Boston/Cambridge.
Browse Web Services
Amazon E-Commerce Service
Amazon Elastic Compute Cloud (Beta)
Amazon Flexible Payments Service (Beta)
Amazon Mechanical Turk (Beta)
Amazon Simple Storage Service
Amazon Simple Queue Service
Alexa Web Services
Browse All Web Services
Amazon Flexible Payments Service (Amazon FPS) - Limited Beta (August 2, 2007)
Amazon Web Services has opened a limited beta of Amazon Flexible Payments Service (Amazon FPS). Amazon FPS is the first payments service designed from the ground up specifically for developers. The set of web services APIs allows the movement of money between any two entities, humans or computers. It is built on top of Amazon's reliable and scalable payment infrastructure. Learn more about this new service.
AWS Blog
Learn more about other exciting and innovative developments around Amazon Web Services from the eyes and words of Amazon Evangelist, Jeff Barr.
Developer Connection
Announcing the New Version of Alexa Web Search Service (June 6, 2007)
Alexa Web Search service, offered by Amazon Web Services, launched a new version of the Alexa Web Search service that returns up to 1 million search results from a single query, allows complex queries
Done
0:130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amazon web services™
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Sign Up For This Web Service
Learn About Amazon Web Services
AWS Home
Why Use AWS?
What's New in AWS?
Upcoming Events
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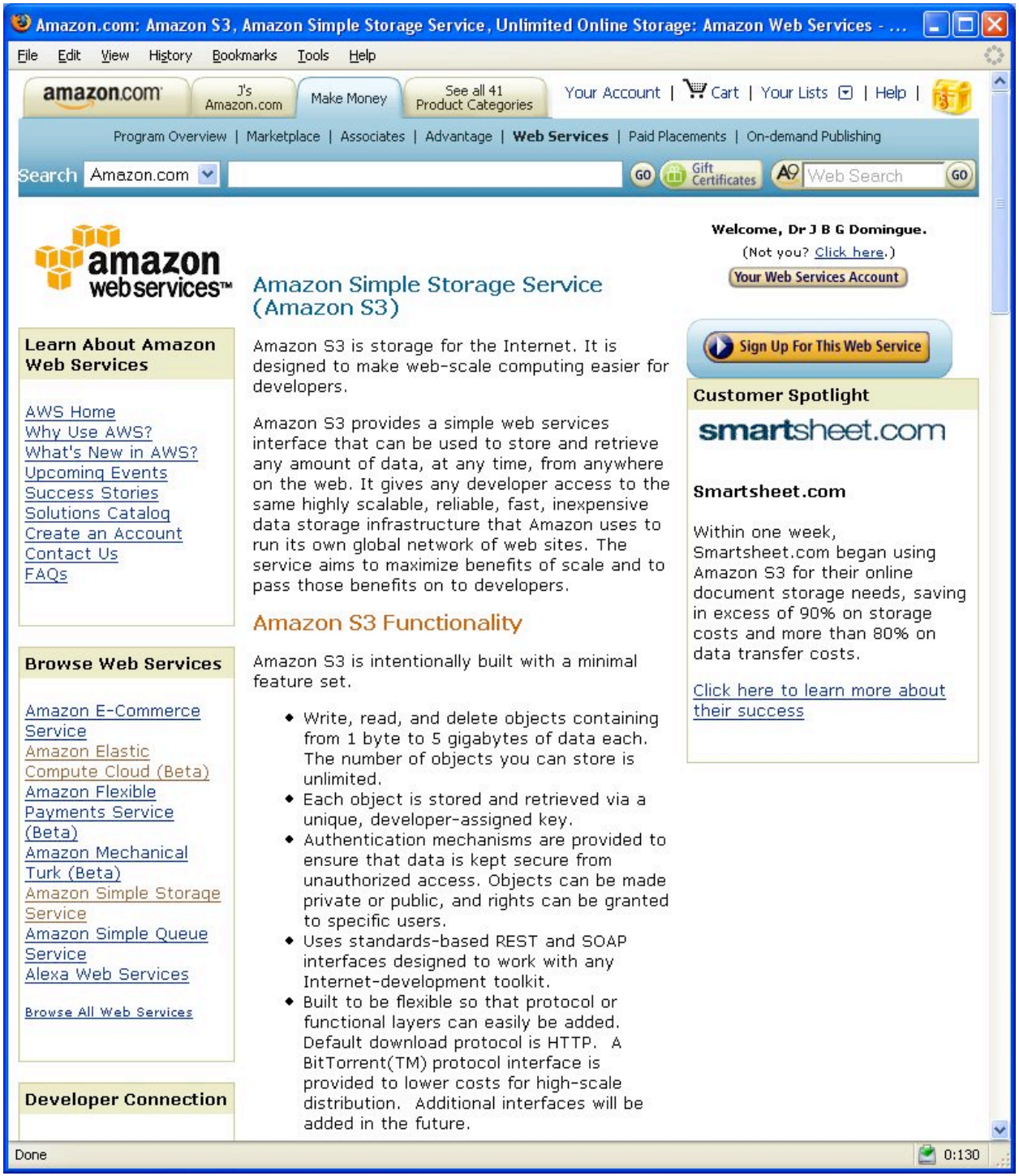
FAQs
Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier for developers.
Just as Amazon Simple Storage Service (Amazon S3) enables storage in the cloud, Amazon EC2 enables "compute" in the cloud. Amazon EC2's simple web service interface allows you to obtain and configure capacity with minimal friction. It provides you with complete control of your computing resources and lets you run on Amazon's proven computing environment. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing you to quickly scale capacity, both up and down, as your computing requirements change. Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use.
Customer Spotlight
Jamglue.com
Jamglue, a music mixing site, uses Amazon EC2 to power their backend audio processing. Jamglue built and launched their service using Amazon S3 and Amazon EC2 and has saved considerable time and money.
Click here for the entire story
Browse Web Services
Amazon E-Commerce Service
Amazon Elastic Compute Cloud (Beta)
Amazon Flexible Payments Service (Beta)
Amazon Mechanical Turk (Beta)
Amazon Simple Storage Service
Amazon Simple Queue Service
Alexa Web Services
Browse All Web Services
Amazon EC2 Functionality
Amazon EC2 presents a true virtual computing environment, allowing you to use web service interfaces to requisition machines for use, load them with your custom application environment, manage your network's access permissions, and run your image using as many or few systems as you desire.
To use Amazon EC2, you simply:
Create an Amazon Machine Image (AMI) containing your applications, libraries, data and associated configuration settings. Or use our pre-configured, templated images to get up and running immediately.
Upload the AMI into Amazon S3. Amazon EC2 provides tools that make storing the AMI simple. Amazon S3 provides a safe, reliable and fast repository to store your images.
Developer Connection
Done
0:130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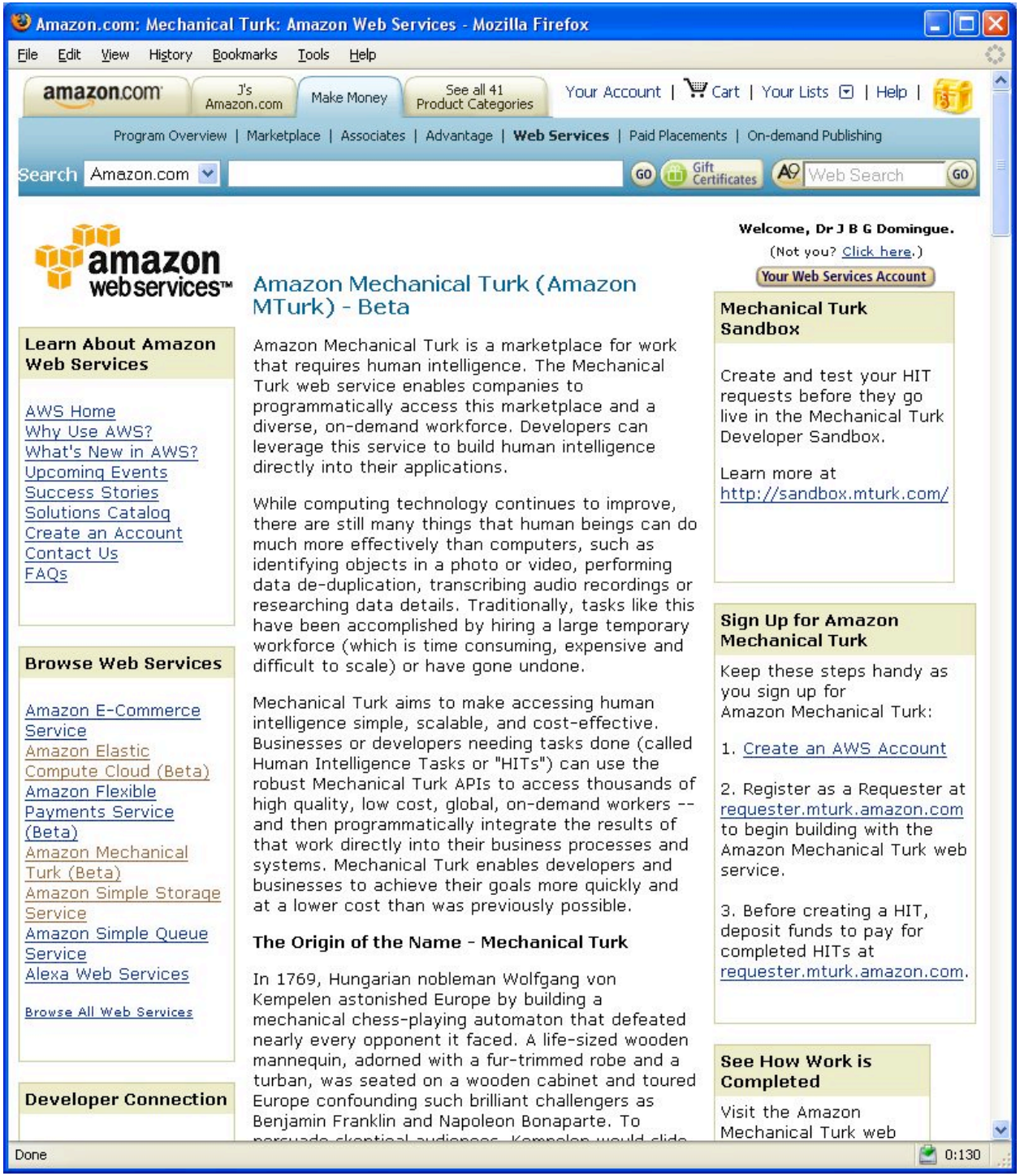
FAQs
Amazon S3 is storage for the Internet. It is designed to make web-scale computing easier for developers.
Amazon S3 provides a simple web services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web. It gives any developer access to the same highly scalable, reliable, fast, inexpensive data storage infrastructure that Amazon uses to run its own global network of web sites. The service aims to maximize benefits of scale and to pass those benefits on to developers.
Amazon S3 Functionality
Amazon S3 is intentionally built with a minimal feature set.
Write, read, and delete objects containing from 1 byte to 5 gigabytes of data each. The number of objects you can store is unlimited.
Each object is stored and retrieved via a unique, developer-assigned key.
Authentication mechanisms are provided to ensure that data is kept secure from unauthorized access. Objects can be made private or public, and rights can be granted to specific users.
Uses standards-based REST and SOAP interfaces designed to work with any Internet-development toolkit.
Built to be flexible so that protocol or functional layers can easily be added. Default download protocol is HTTP. A BitTorrent(TM) protocol interface is provided to lower costs for high-scale distribution. Additional interfaces will be added in the future.
Customer Spotlight
smartsheet.com
Smartsheet.com
Within one week, Smartsheet.com began using Amazon S3 for their online document storage needs, saving in excess of 90% on storage costs and more than 80% on data transfer costs.
Click here to learn more about their success
Browse Web Services
Amazon E-Commerce Service
Amazon Elastic Compute Cloud (Beta)
Amazon Flexible Payments Service (Beta)
Amazon Mechanical Turk (Beta)
Amazon Simple Storage Service
Amazon Simple Queue Service
Alexa Web Services
Browse All Web Services
Developer Connection
Done
0:130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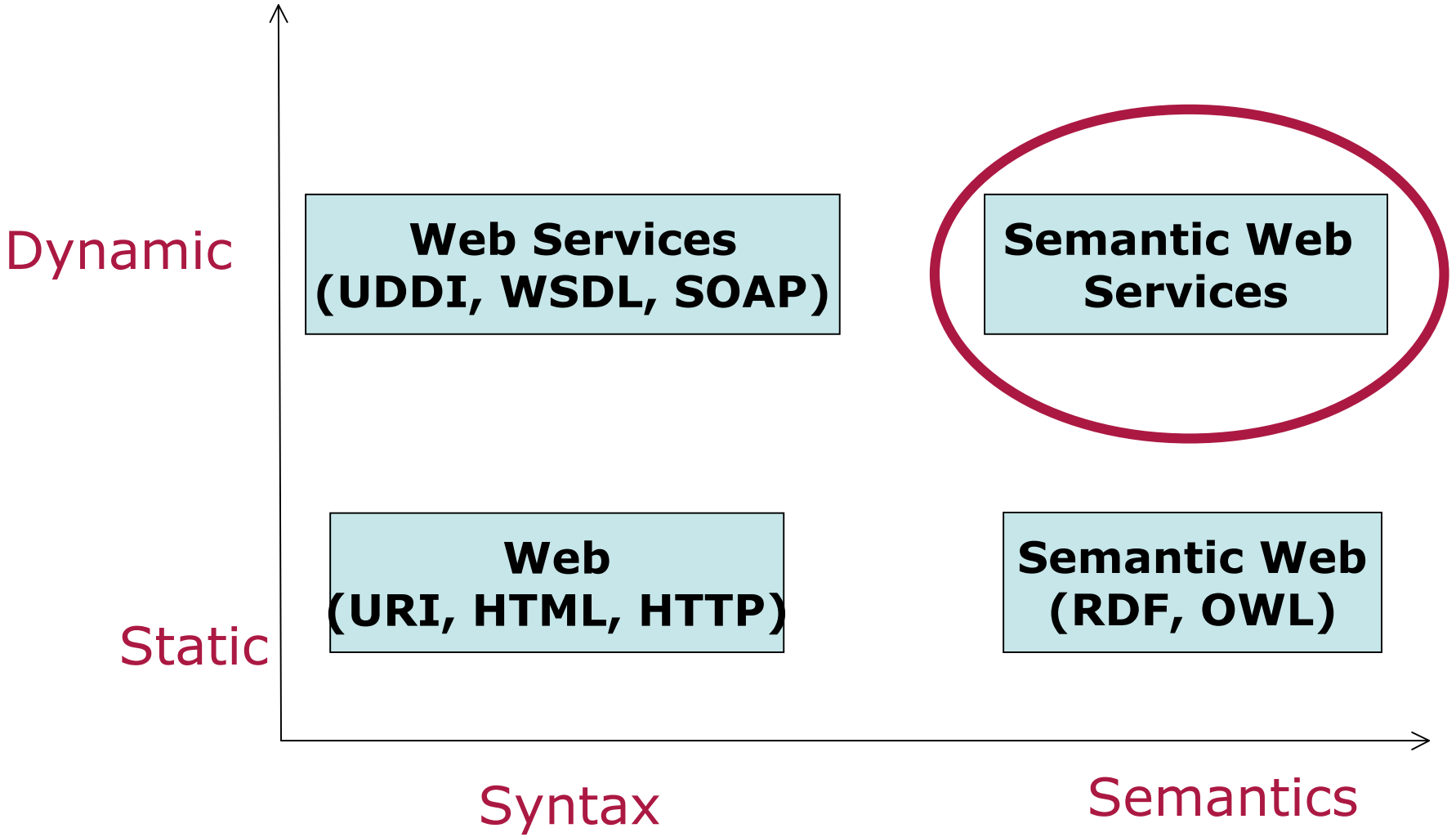
Amazon Flexible Payments Service (Beta)
Amazon Mechanical Turk (Beta)
Amazon Simple Storage Service
Amazon Simple Queue Service
Alexa Web Services
Browse All Web Services
Developer Connection
Amazon Mechanical Turk is a marketplace for work that requires human intelligence. The Mechanical Turk web service enables companies to programmatically access this marketplace and a diverse, on-demand workforce. Developers can leverage this service to build human intelligence directly into their applications.
While computing technology continues to improve, there are still many things that human beings can do much more effectively than computers, such as identifying objects in a photo or video, performing data de-duplication, transcribing audio recordings or researching data details. Traditionally, tasks like this have been accomplished by hiring a large temporary workforce (which is time consuming, expensive and difficult to scale) or have gone undone.
Mechanical Turk aims to make accessing human intelligence simple, scalable, and cost-effective. Businesses or developers needing tasks done (called Human Intelligence Tasks or "HITs") can use the robust Mechanical Turk APIs to access thousands of high quality, low cost, global, on-demand workers -- and then programmatically integrate the results of that work directly into their business processes and systems. Mechanical Turk enables developers and businesses to achieve their goals more quickly and at a lower cost than was previously possible.
The Origin of the Name - Mechanical Turk
In 1769, Hungarian nobleman Wolfgang von Kempelen astonished Europe by building a mechanical chess-playing automaton that defeated nearly every opponent it faced. A life-sized wooden mannequin, adorned with a fur-trimmed robe and a turban, was seated on a wooden cabinet and toured Europe confounding such brilliant challengers as Benjamin Franklin and Napoleon Bonaparte. To
Mechanical Turk Sandbox
Create and test your HIT requests before they go live in the Mechanical Turk Developer Sandbox.
Learn more at http://sandbox.mturk.com/
Sign Up for Amazon Mechanical Turk
Keep these steps handy as you sign up for Amazon Mechanical Turk:
1. Create an AWS Account
2. Register as a Requester at requester.mturk.amazon.com to begin building with the Amazon Mechanical Turk web service.
3. Before creating a HIT, deposit funds to pay for completed HITs at requester.mturk.amazon.com.
See How Work is Completed
Visit the Amazon Mechanical Turk web
Done
0:130

Problems with Web Services Today

- Descriptions are syntactic
- All tasks associated with web services application development have to be carried out by humans:
  - discovery, composition and invocation
- Problems of scalability

SWS Vision


Dynamic
Static
Web Services (UDDI, WSDL, SOAP)
Semantic Web Services
Web (URI, HTML, HTTP)
Semantic Web (RDF, OWL)
Syntax
Semantics

Semantic Web Services (is)

- Semantic Web Technology
  - Machine readable data
  - Ontological basis

Applied to

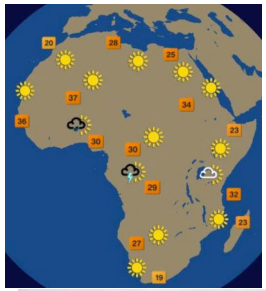
- Web Services Technology
  - Reusable computational resources

To automate all aspects of application development through reuse

Semantic Web Service Broker

Client

Semantic Execution Environment



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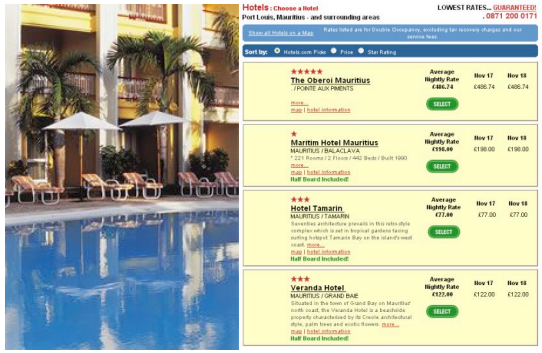
British Airways Flight 123	3:45pm London, Great Britain (LHR)	7:25am - Thu, Dec 1 Next day arrival Mauritius, Mauritius (MRU)	11hrs 40min - Nonstop	$1,236 per person Select
Air France Flight 1371 / 868	11:15am London, Great Britain (LHR)	5:55am - Thu, Dec 1 Next day arrival Mauritius, Mauritius (MRU)	14hrs 40min - 1 Stop Change planes in Charles de Gaulle, France (CDG)	$1,297 per person Select
Air France Flight 1371 Air Mauritius Flight 51 operated by AIR FRANCE	11:15am London, Great Britain (LHR)	5:55am - Thu, Dec 1 Next day arrival Mauritius, Mauritius (MRU)	14hrs 40min - 1 Stop Change planes in Charles de Gaulle, France (CDG)	$1,369 per person Select
Air France Flight 5021 operated by CITY JET Air Mauritius Flight 51 operated by AIR FRANCE	9:05am London, Great Britain (LCY)	5:55am - Thu, Dec 1 Next day arrival Mauritius, Mauritius (MRU)	16hrs 50min - 1 Stop Change planes in Charles de Gaulle, France (CDG)	$1,380 per person Select



Services

Web Service Modelling Ontology (WSMO)

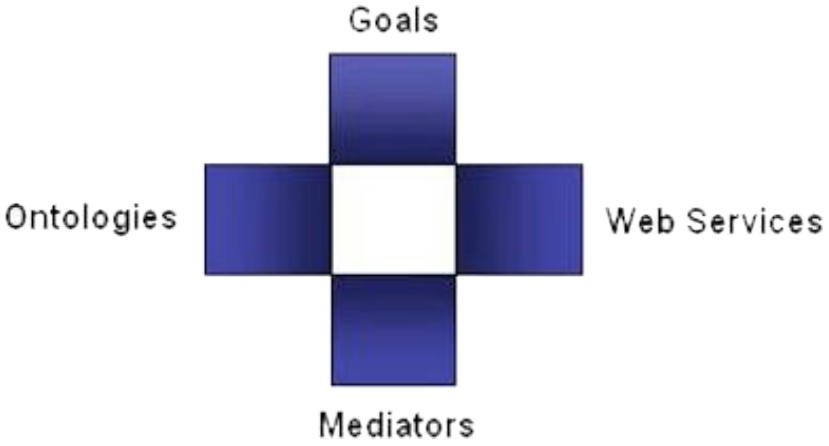
WSMO Design Principles

- Web Compliance
- Ontology-Based
- Strict Decoupling
- Centrality of Mediation
- Ontological Role Separation
- Description versus Implementation Execution Semantics
- Service versus Web service

WSMO Top Level Notions

Objectives that a client wants to achieve by using Web Services

Provide the formally specified terminology of the information used by all other components



Semantic description of Web Services:
- **Capability** *(functional)*
- **Interfaces** *(usage)*

Connectors between components with mediation facilities for handling heterogeneities

Non-Functional Properties

- Every WSMO element can be described by properties that contain relevant, non-functional aspects.

- Sample information sets are:
  - Dublin Core Metadata Set:
    - For resource management
  - Versioning Information
    - For evolution support
  - Quality of Service Information
    - For availability, stability
  - Other

Non-Functional Properties List

Dublin Core Metadata

- Contributor
- Coverage
- Creator
- Description
- Format
- Identifier
- Language
- Publisher
- Relation
- Rights
- Source
- Subject
- Title
- Type

Quality of Service

- Accuracy
- NetworkRelatedQoS
- Performance
- Reliability
- Robustness
- Scalability
- Security
- Transactional
- Trust

WSMO Top Level Notions

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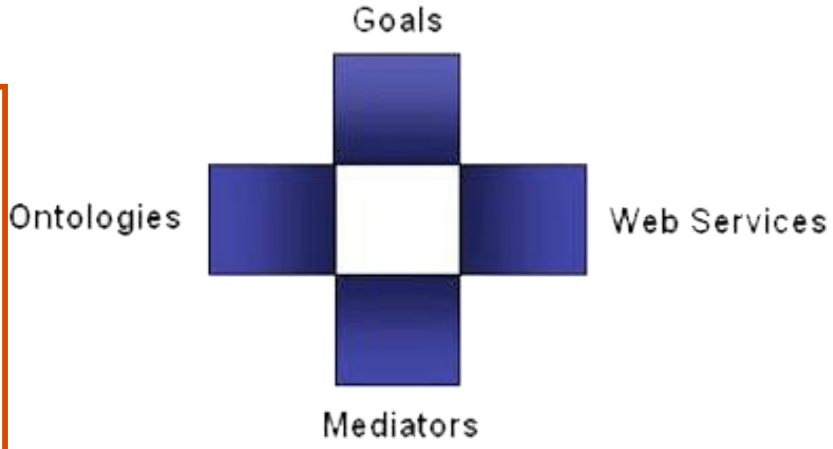
Provide the formally specified terminology of the information used by all other components



Semantic description of Web Services:
- **Capability** *(functional)*
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Ontology Description and Usage

- Ontologies are used as the 'data model' throughout WSMO
  - WSMO is defined in terms of itself
  - All data-types used in Web Service interfaces are ontology concepts
  - Discovery, mediation and composition are based on ontology reasoning
- WSMO Ontology Language WSML
  - Conceptual syntax for describing WSMO elements
  - Logical language for axiomatic expressions (WSML Layering)

WSMO Ontology Design

- Modularization
  - import / re-using ontologies
- De-Coupling
  - heterogeneity handled by OO Mediators

Ontology Specification

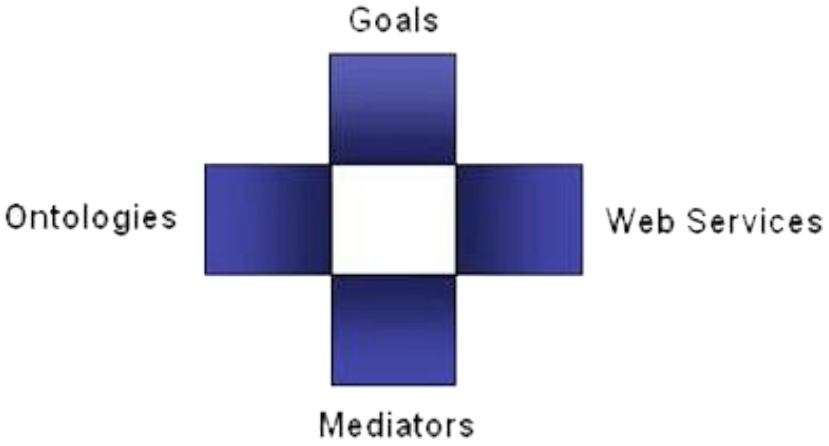
- **Non functional properties** (see before)
- **Imported Ontologies**
  - importing existing ontologies where no heterogeneities arise
- **Used mediators**
  - OO Mediators (ontology import with terminology mismatch handling)
- **Ontology Elements:**

Concepts	set of concepts that belong to the ontology, incl.
Attributes	set of attributes that belong to a concept
Relations	define interrelations between several concepts
Functions	special type of relation (unary range = return value)
Instances	set of instances that belong to the represented ontology
Axioms	axiomatic expressions in ontology (logical statement)

WSMO Top Level Notions

Objectives that a client wants to achieve by using Web Services

Provide the formally specified terminology of the information used by all other components



Semantic description of Web Services:
- **Capability** *(functional)*
- **Interfaces** *(usage)*

Connectors between components with mediation facilities for handling heterogeneities

Goals

- Ontological De-coupling of Requester and Provider
- Derived from task / problem solving methods/domain model
- Structure and reuse of requests
  - Search
  - Diagnose
  - Classify
  - Personalise
  - Book a holiday
- Requests may in principle not be satisfiable
- Ontological relationships & mediators used to link goals to Web services

Goal Specification (1/2)

- **Non functional properties**
- **Imported Ontologies**
- **Used mediators**
  - *OO Mediators:* importing ontologies with heterogeneity resolution
  - *GG Mediator:*
    - Goal definition by reusing an already existing goal
    - allows definition of **Goal Ontologies**

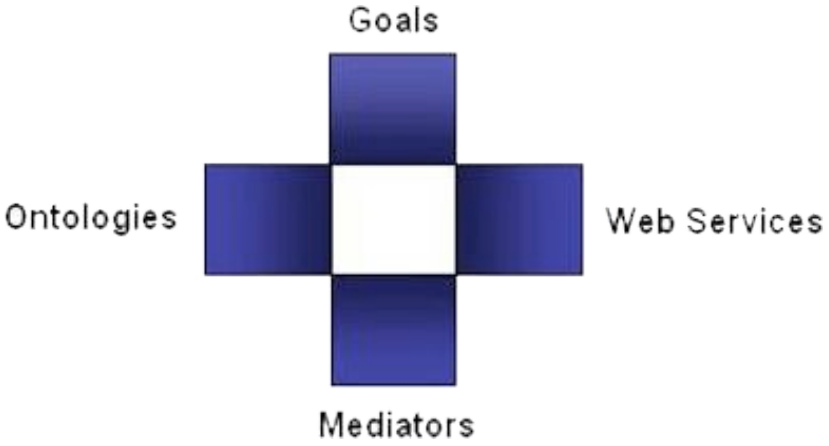
Goal Specification (2/2)

- **Requested Capability**
  - describes service functionality expected to resolve the objective
  - defined as capability description from the requester perspective
- **Requested Interface**
  - describes communication behaviour supported by the requester for consuming a Web Service (Choreography)
  - Restrictions / preferences on orchestrations of acceptable Web Services

WSMO Top Level Notions

Objectives that a client wants to achieve by using Web Services

Provide the formally specified terminology of the information used by all other components



Semantic description of Web Services:
- **Capability** *(functional)*
- **Interfaces** *(usage)*

Connectors between components with mediation facilities for handling heterogeneities

WSMO Web Service Description

- complete item description
- quality aspects
- Web Service Management

Non-functional Properties

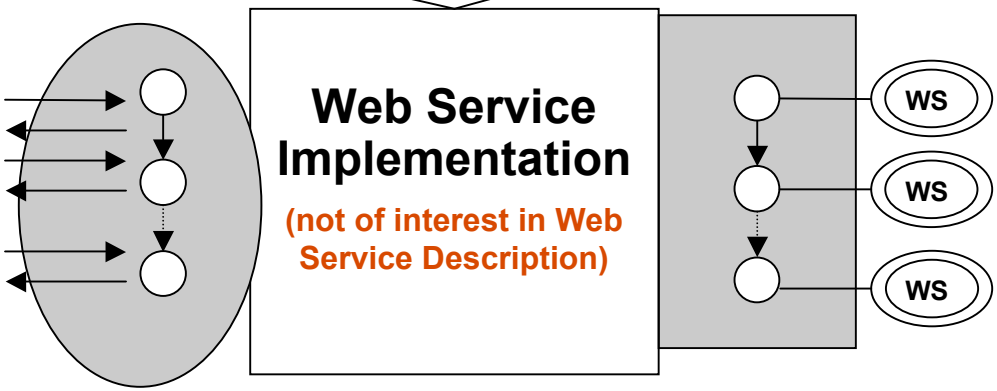
DC + QoS + Version + financial

- Advertising of Web Service
- Support for WS Discovery

Capability

functional description

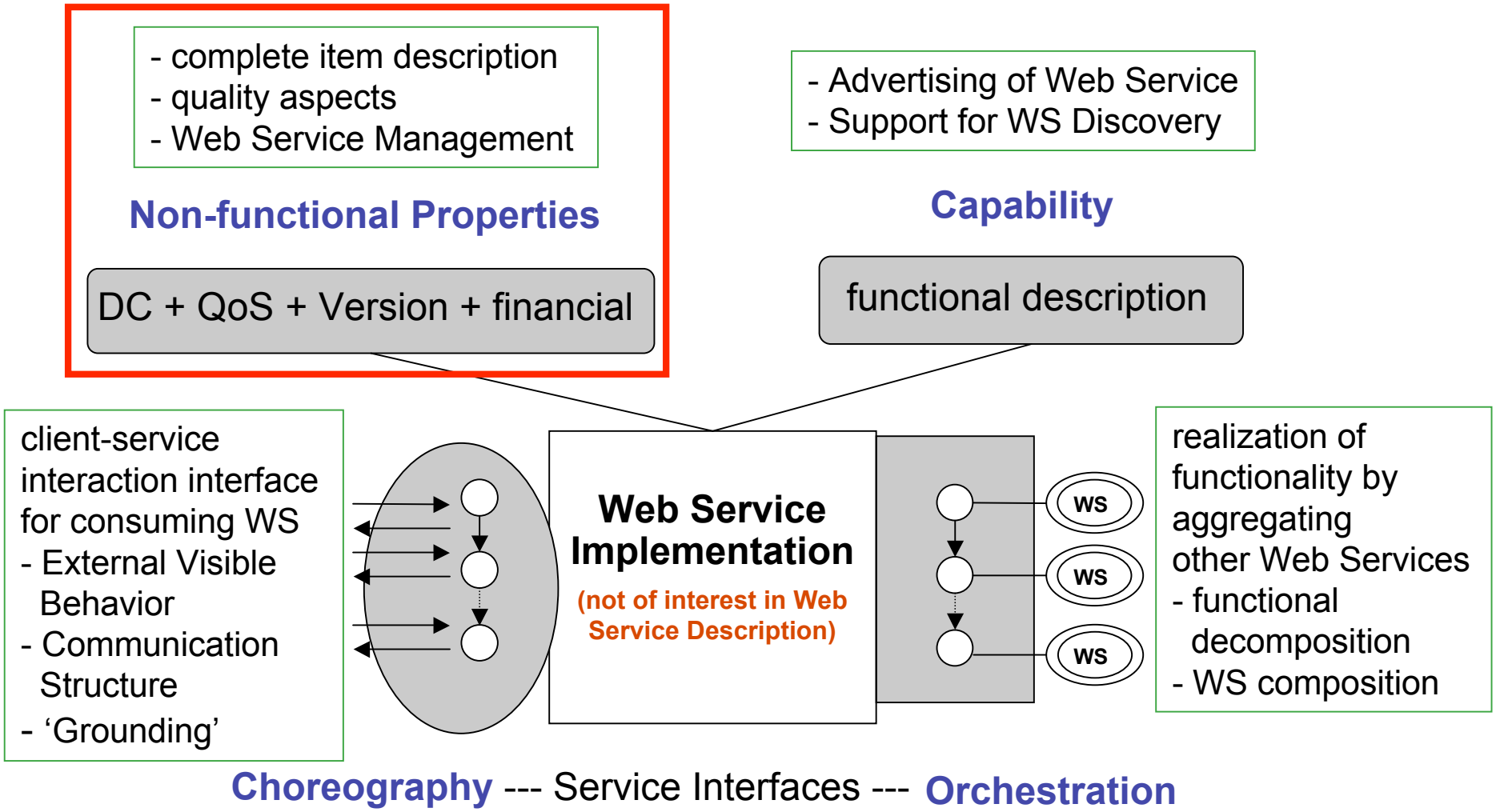
client-service interaction interface for consuming WS
- External Visible Behavior
- Communication Structure
- 'Grounding'



realization of functionality by aggregating other Web Services
- functional decomposition
- WS composition

Choreography --- Service Interfaces --- **Orchestration**

WSMO Web Service Description



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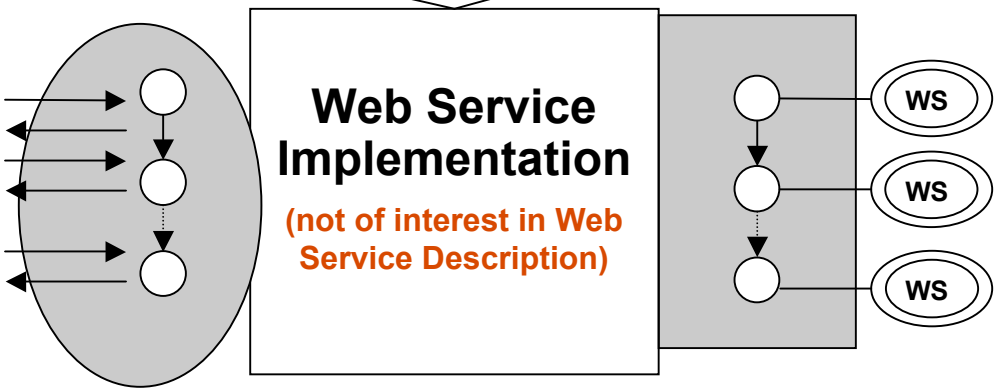


realization of functionality by aggregating other Web Services
- functional decomposition
- WS composition

Choreography --- Service Interfaces --- **Orchestration**

Capability Specification (1/2)

- **Non functional properties**
- **Imported Ontologies**
- **Used mediators**
  - OO Mediator: importing ontologies with mismatch resolution
  - WG Mediator: link to a Goal wherefore service is not usable a priori

Capability Specification (2/2)

- **Pre-conditions**
  - What a web service expects in order to be able to provide its service
  - Define conditions over the input.
- **Assumptions**
  - Conditions on the state of the world that has to hold before the Web service can be executed
- **Post-conditions**
  - Describes the result of the WS in relation to the input, and conditions on it
- **Effects**
  - Conditions on the state of the world that hold after execution of the Web service (i.e. changes in the state of the world)

WSMO Web Service Description

- complete item description
- quality aspects
- Web Service Management

Non-functional Properties

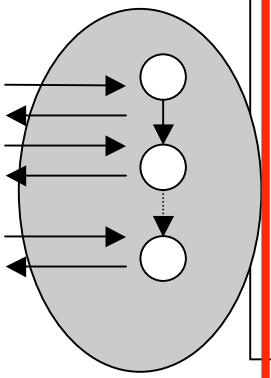
DC + QoS + Version + financial

- Advertising of Web Service
- Support for WS Discovery

Capability

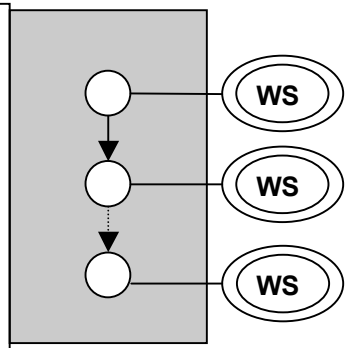
functional description

client-service interaction interface for consuming WS
- External Visible Behavior
- Communication Structure
- 'Grounding'



Web Service Implementation

(not of interest in Web Service Description)

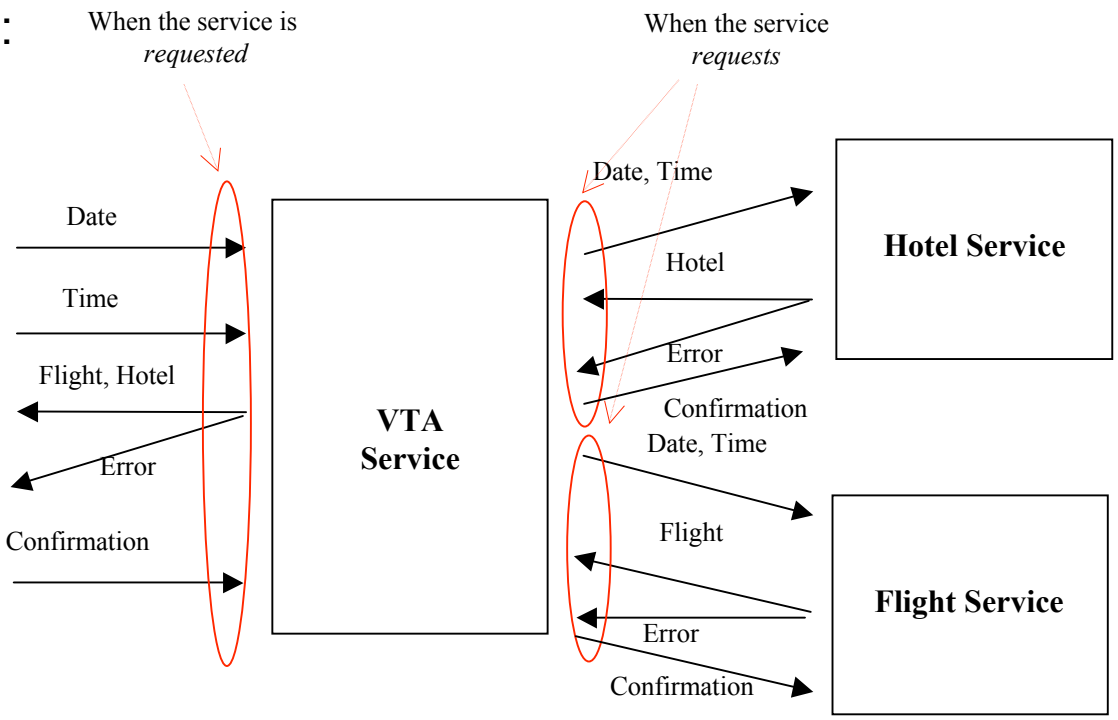


realization of functionality by aggregating other Web Services
- functional decomposition
- WS composition

Choreography --- Service Interfaces --- **Orchestration**

Choreography & Orchestration

VTA example:



Choreography Aspects (1/2)

- *Interface for consuming Web Service*
  - External Visible Behavior
    - those aspects of the workflow of a Web Service where Interaction is required
    - described by workflow constructs: sequence, split, loop, parallel
  - Communication Structure
    - messages sent and received
    - their order (communicative behavior for service consumption)
    - choreography related errors (e.g. input wrong, message timeout, etc.)

Choreography Aspects (2/2)

- *Interface for consuming Web Service*
  - Grounding
    - concrete communication technology for interaction
  - Formal Model
    - reasoning on Web Service interfaces (service interoperability)
    - allow mediation support on Web Service interfaces

WSMO Web Service Description

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- quality aspects
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Non-functional Properties

DC + QoS + Version + financial

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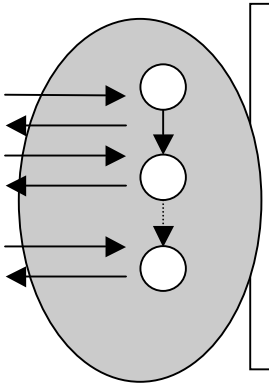
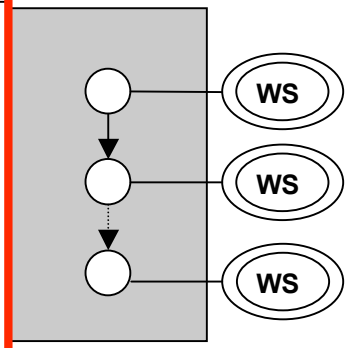


Web Service Implementation

(not of interest in Web Service Description)

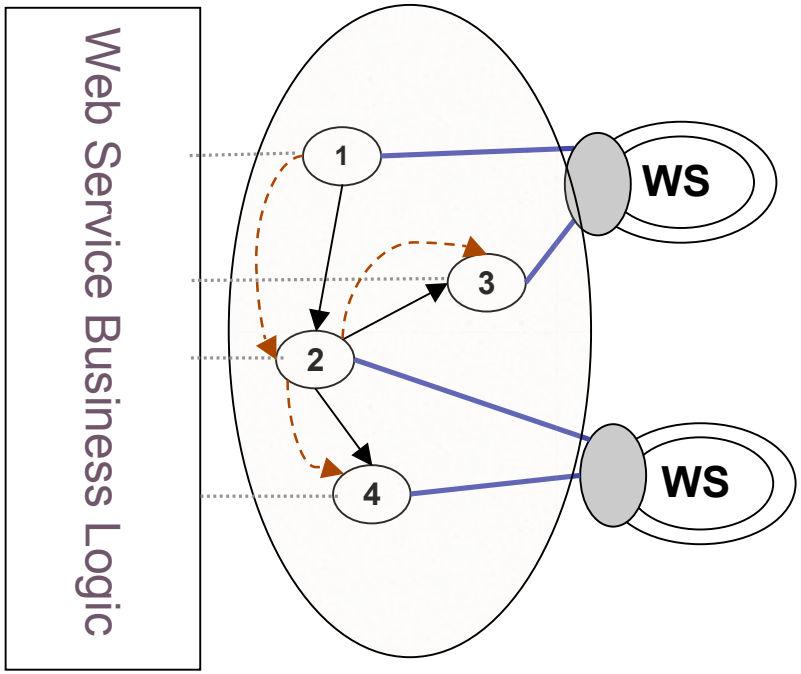


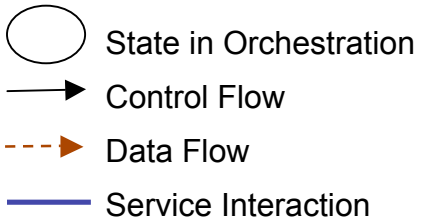
realization of functionality by aggregating other Web Services
- functional decomposition
- WS composition

Choreography --- Service Interfaces --- **Orchestration**

Orchestration Aspects

Control Structure for aggregation of other Web Services





- decomposition of service functionality
- all service interaction via choreographies

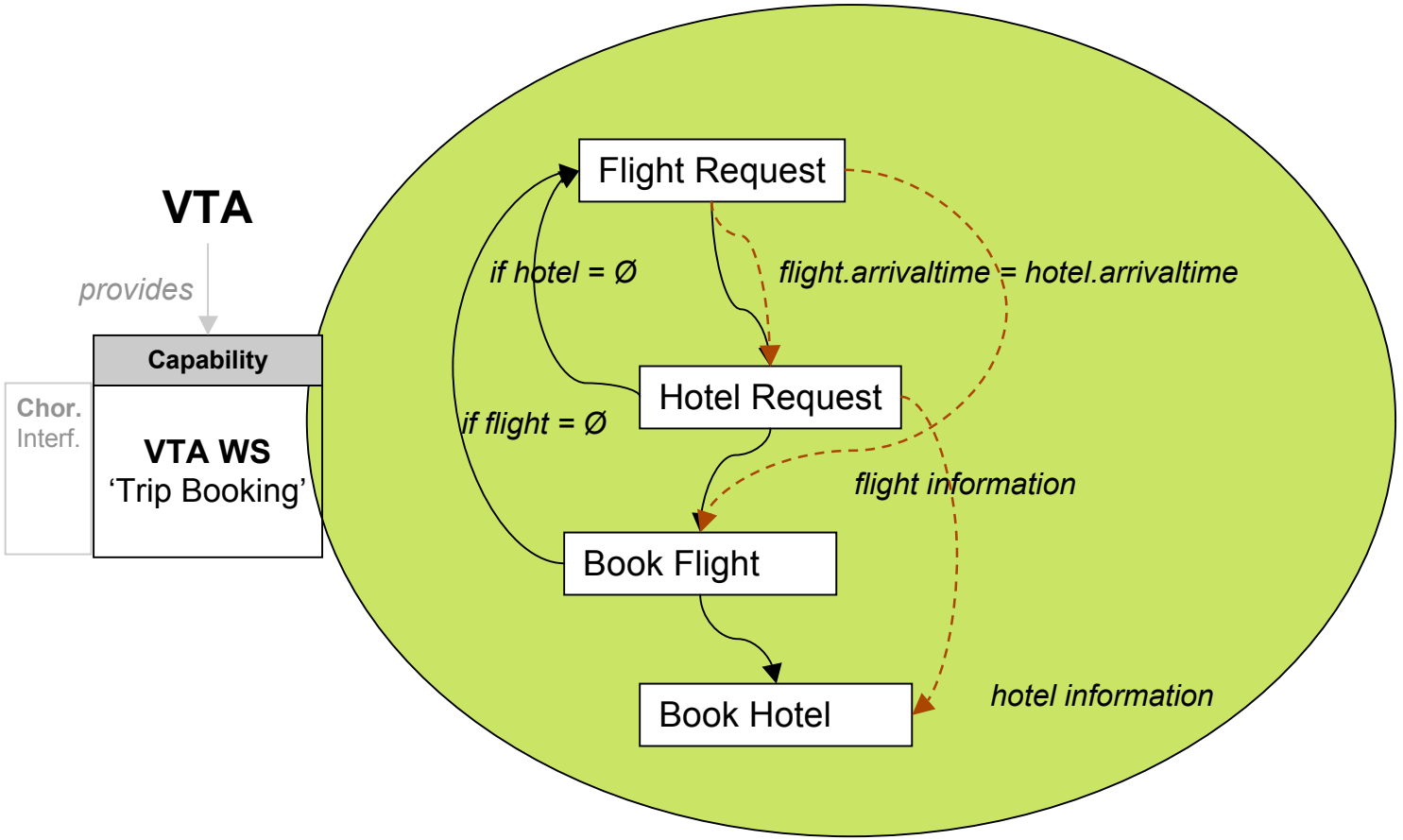
Orchestration Aspects

- Service interfaces are concerned with service consumption and interaction
- Choreography and Orchestration as sub-concepts of Service Interface

Common requirements for service interface description

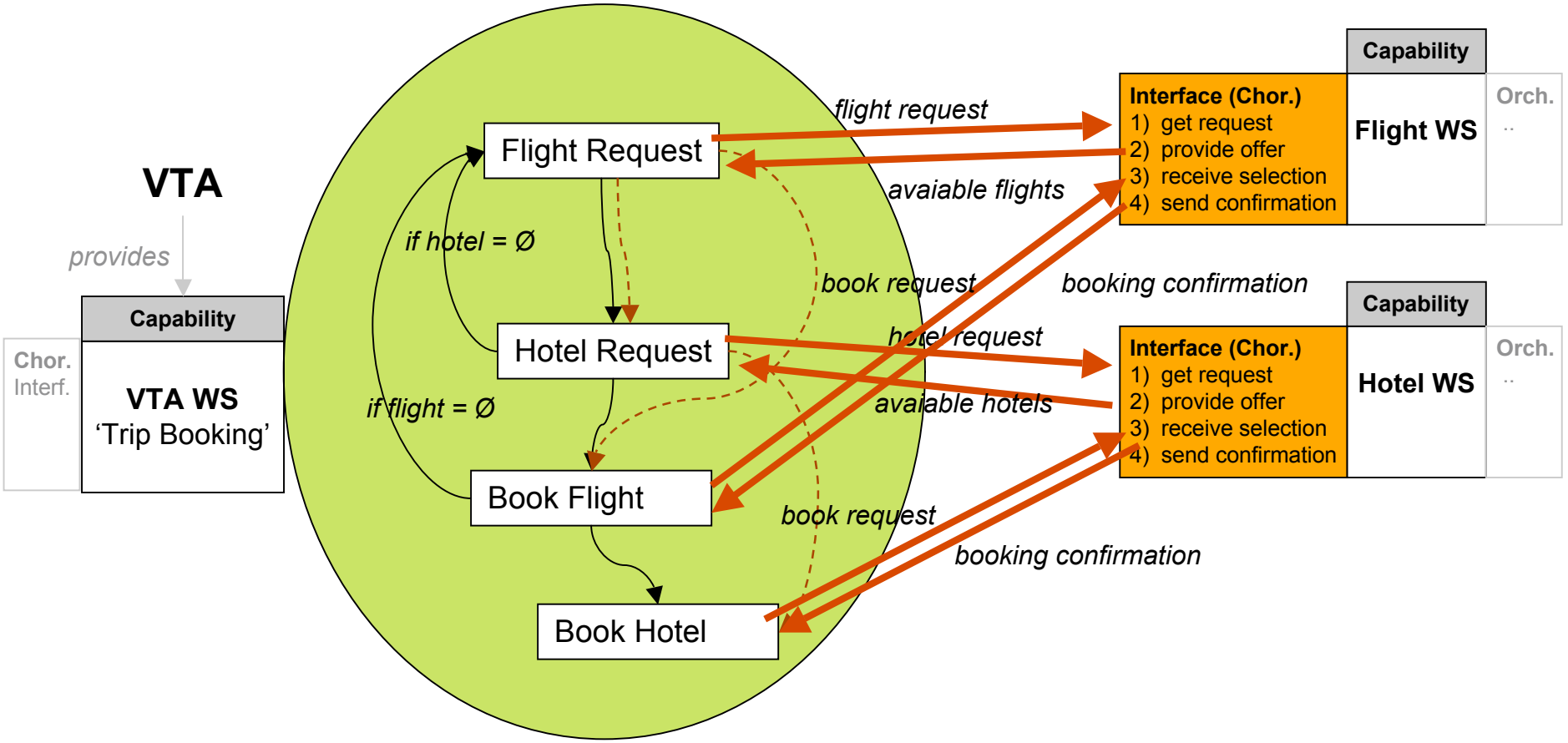
- Represent the dynamics of information interchange during service consumption and interaction
- Support ontologies as the underlying data model
- Appropriate communication technology for information interchange
- Sound formal model / semantics of service interface specifications in order to allow operations on them.

Orchestration Definition



process (control + data flow) of goals

Runtime Orchestration

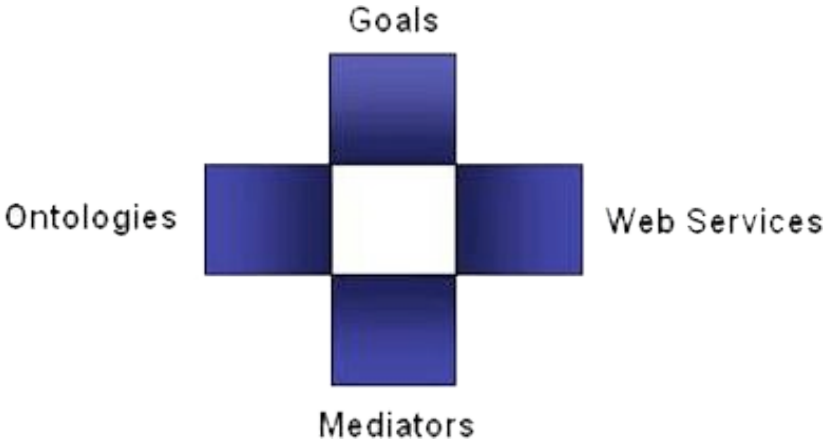


process (control + data flow) between "states"
+ communication behavior of orchestrating Web Service

WSMO Top Level Notions

Objectives that a client wants to achieve by using Web Services

Provide the formally specified terminology of the information used by all other components



Semantic description of Web Services:
- **Capability** *(functional)*
- **Interfaces** *(usage)*

Connectors between components with mediation facilities for handling heterogeneities

Mediation (Wiederhold, 94)

- Mediators as components that resolve mismatches
- Declarative Approach
- Semantic description of resources
- ‘Intelligent’ mechanisms that resolve mismatches independent of content
- Mediation cannot be fully automated (integration decision)

Mediation

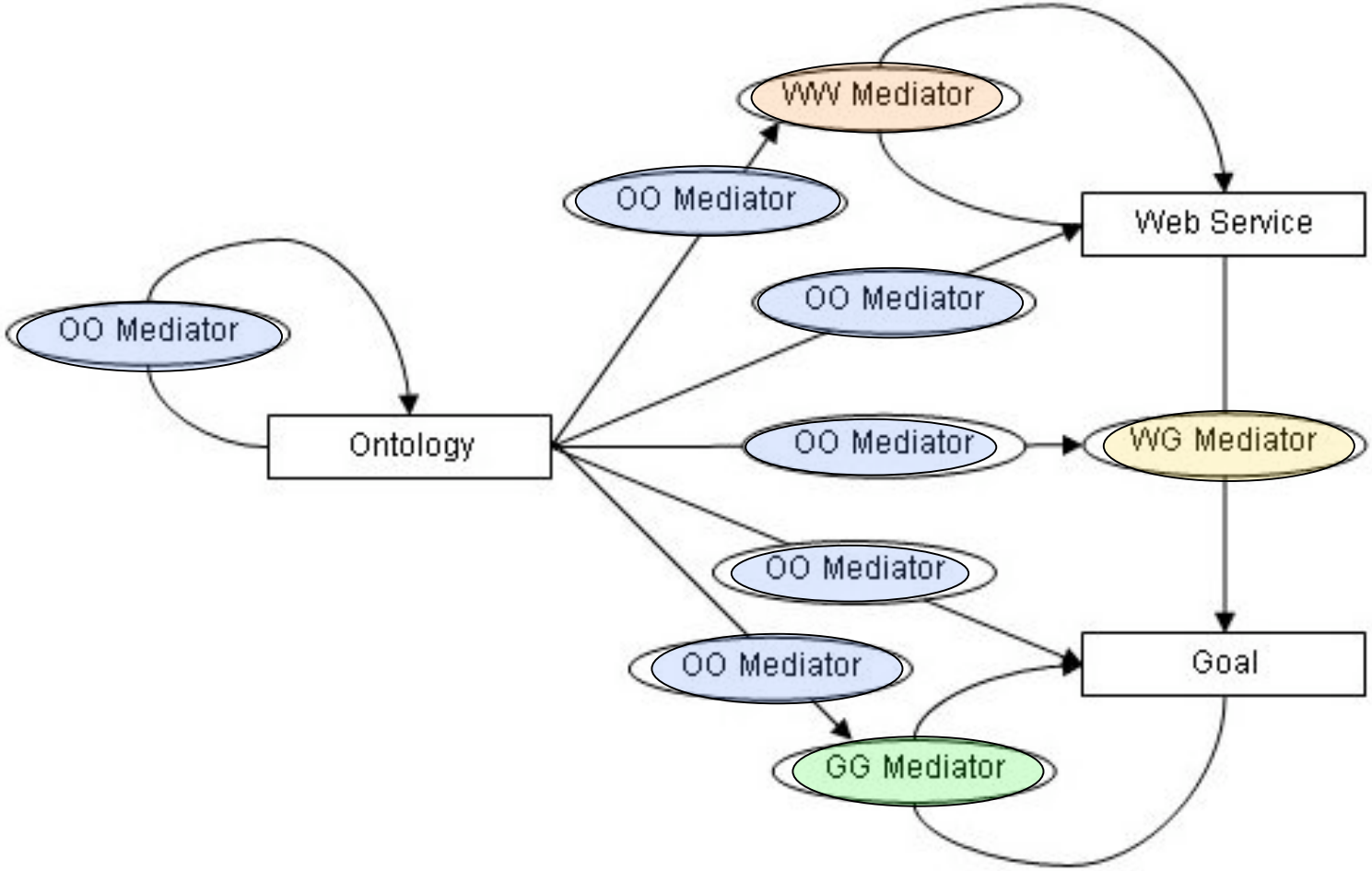
- For 1$ on programming, $5 - $9 on integration
- Mismatches on structural / semantic / conceptual / level
- Assume (nearly) always necessary
- Description of role

Levels of Mediation within Semantic Web Services

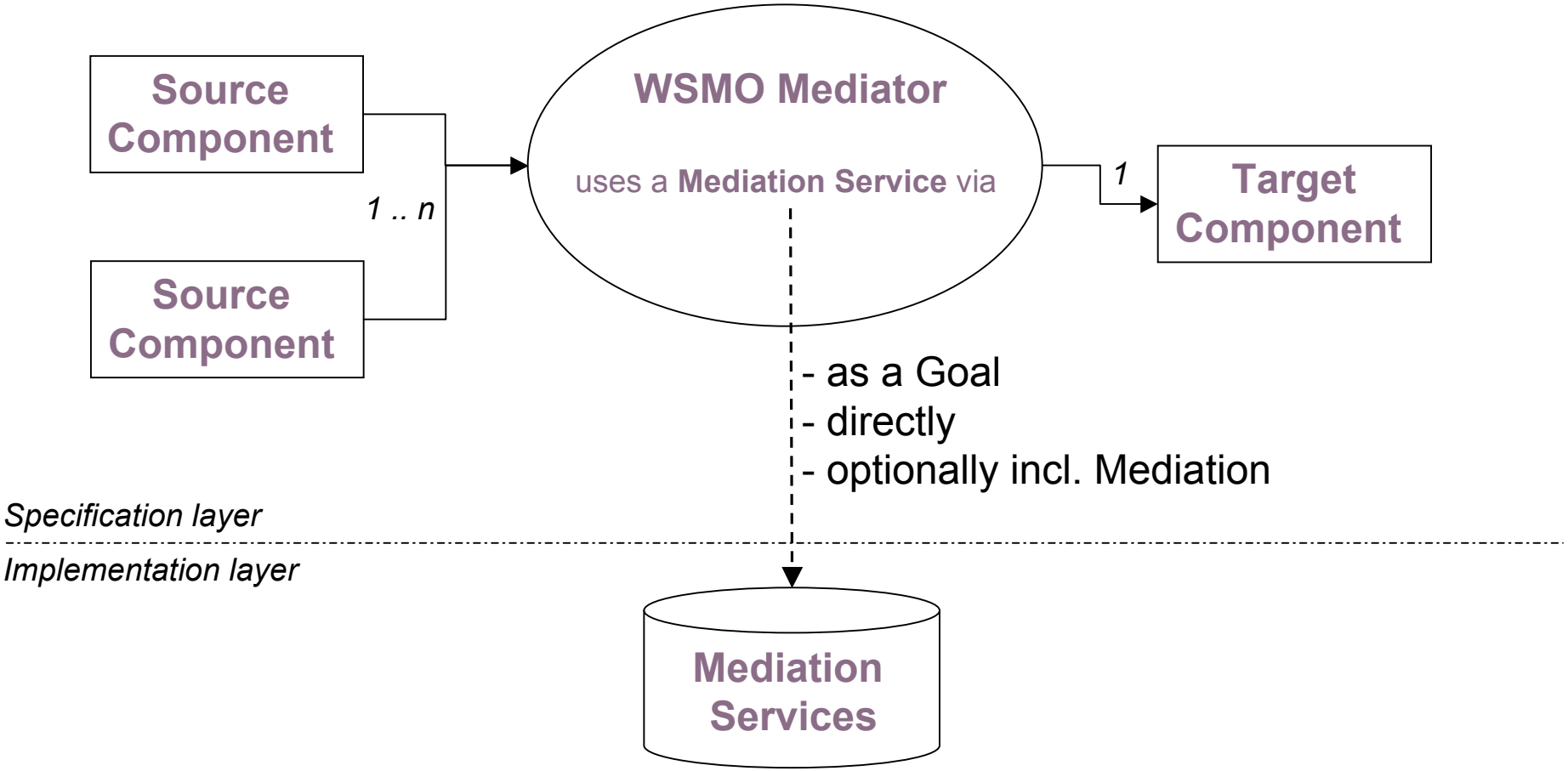
- **Data Level**
  - mediate heterogeneous Data Sources
- **Functional Level**
  - mediate mismatches between Web Service/Goal and Web Service/Goals functionalities
- **Process/Protocol Level**
  - mediate heterogeneous Business Processes/Communication Patterns

- **Layers of Mediators**
  - **Specification Layer** – WSMO Mediators
  - **Implementation Layer** – Levels of Mediation

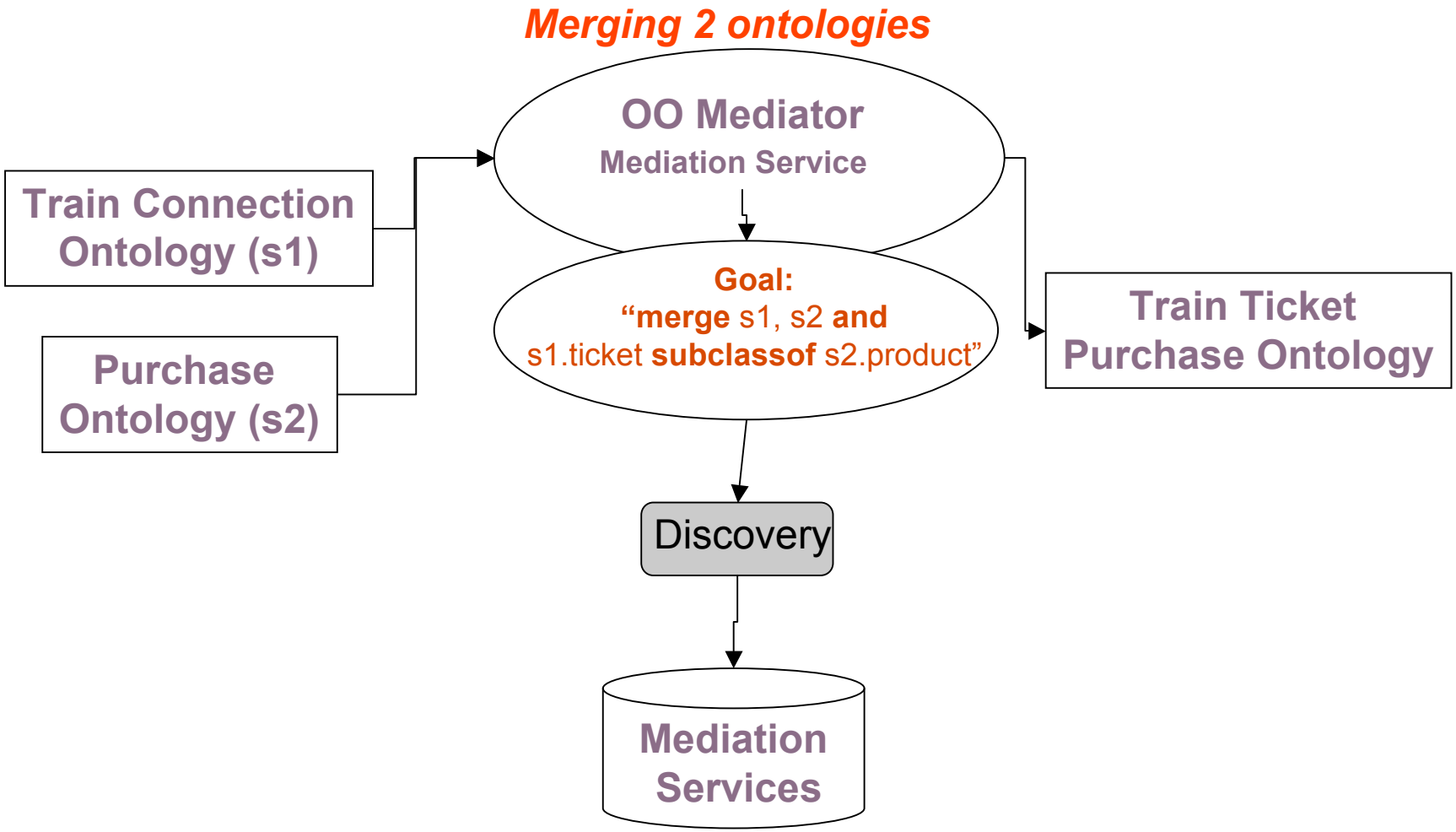
WSMO Mediators Overview



Mediator Structure



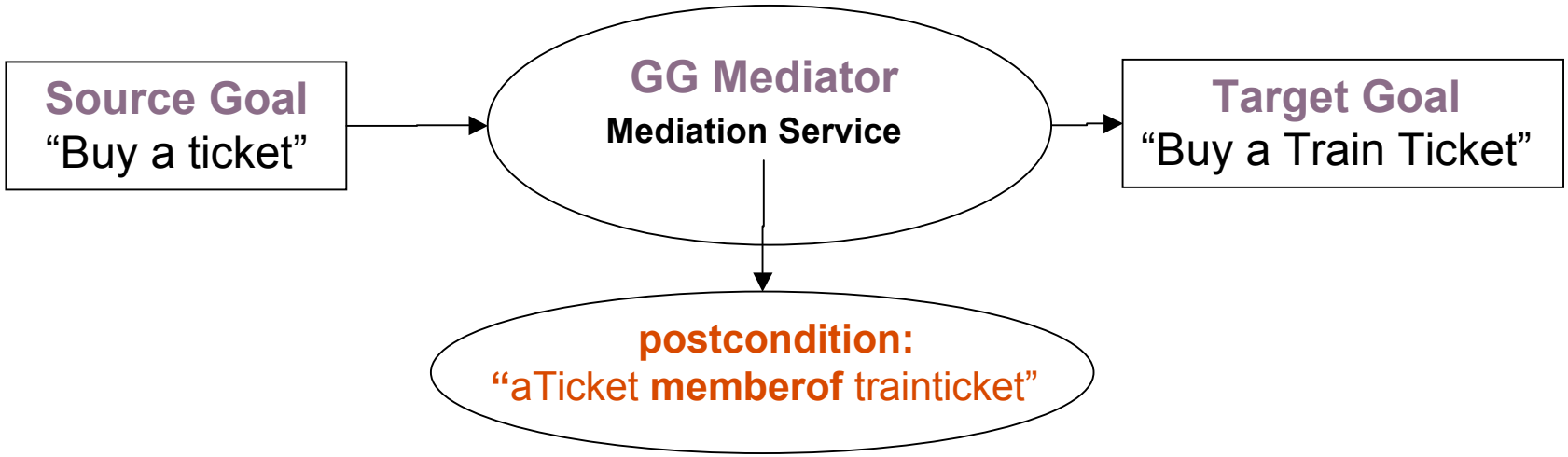
OO Mediator - Example



GG Mediators

- Support specification of Goals by re-using existing Goals
- Allow definition of **Goal Ontologies** (collection of pre-defined Goals)
- Terminology mismatches handled by OO Mediators

GG Mediator Example



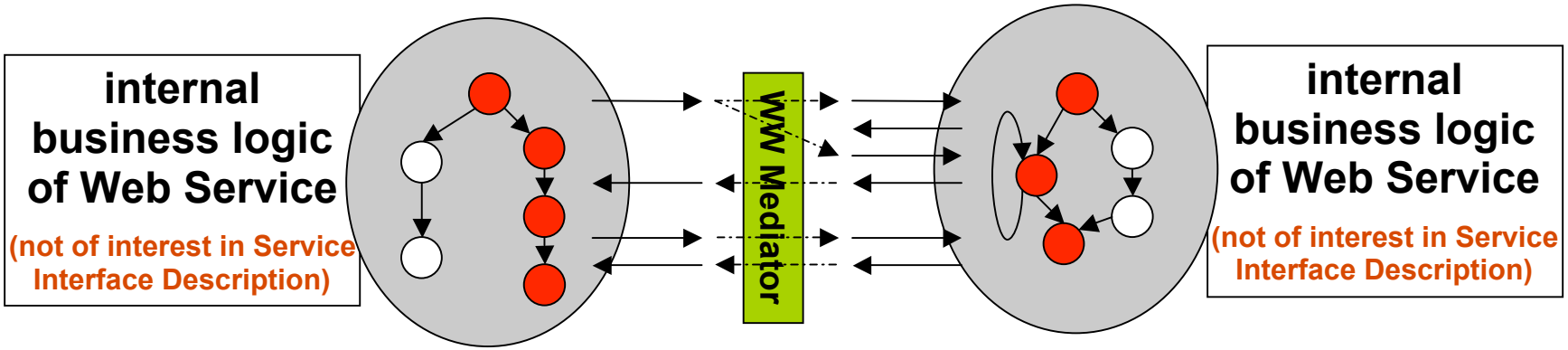
WG Mediators

- Link a Web Service to a Goal and resolve occurring mismatches
- Match Web Service and Goals that do not match a priori
- Handle terminology mismatches between Web Services and Goals
  - broader range of Goals solvable by a Web Service

WW Mediators

- Enable interoperability of heterogeneous Web Services
  - support automated collaboration between Web Services
- **OO Mediators** for terminology import with data level mediation
- Protocol Mediation for establishing valid multi-party collaborations
- Process Mediation for making Business Processes interoperable

WW Mediator Example



Data Level Mediation (1/2)

- Scope
  - Solving terminological mismatches
- Related Aspects / Techniques:
  - Ontology Integration (Mapping, Merging, Alignment)
  - Data Lifting & Lowering
  - Transformation between Languages / Formalisms

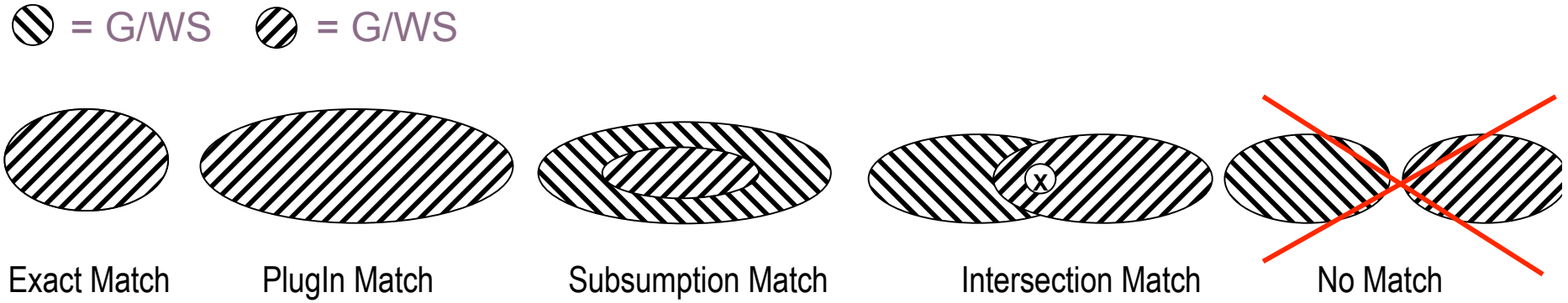
Data Level Mediation (2/2)

- Terminology Mismatches Classification
  - Conceptualization Mismatches
    - same domain concepts, but different conceptualization
    - different levels of abstraction
    - different ontological structure
    - => resolution only includes human intervention
  - Explication Mismatches
    - mismatches between:
      - T (Term used), D (definition of concepts), C (real world concept)
    - => automated resolution partially possible

Functional Level Mediation (1/2)

- Scope
  - Solving functional mismatches between goals and/or ws
- Related Aspects/Techniques
  - Discovery
  - Semantic Matchmaking
- Matchmaking Mismatches

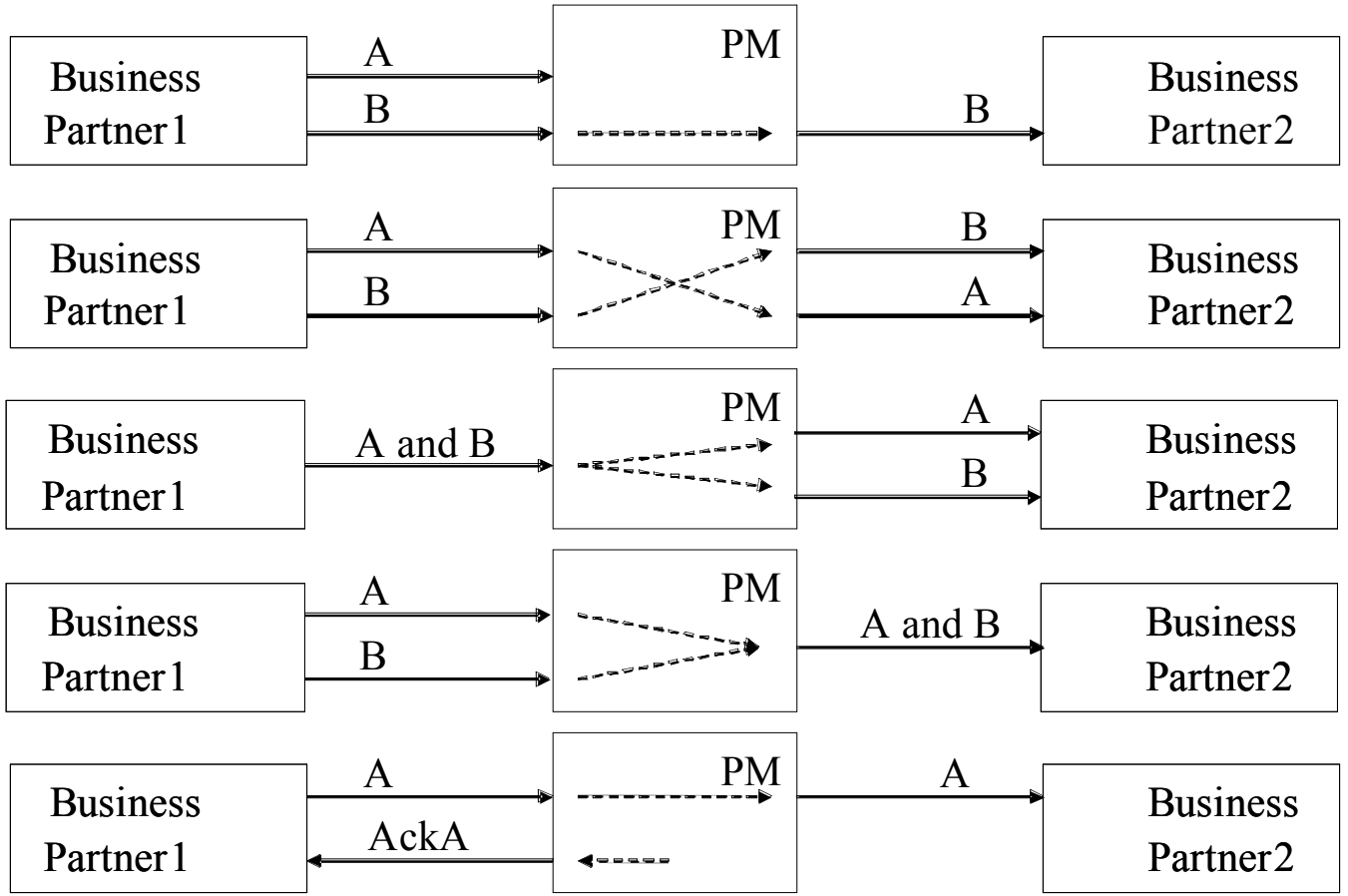
Functional Level Mediation (2/2)



Process Level Mediation (1/2)

- Scope
  - Resolves communication mismatches and establish behavior compatibility
- Related Aspects/Techniques
  - Data and control flow composition
- Process Mismatches
  - Signature terminology mismatches (need for data level mediation)
  - Communication/behavior mismatches

Process Level Mediation (2/2)



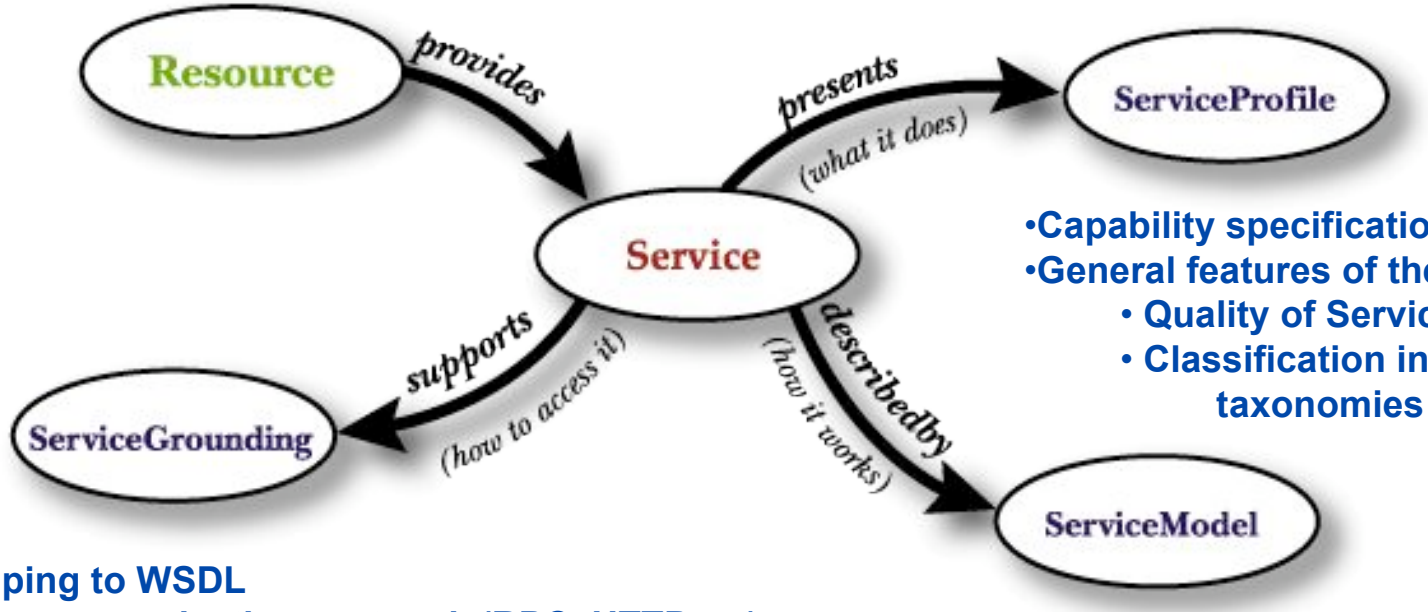
Other Semantic Web Service Initiatives

OWL-S

OWL-S Ontology

- OWL-S is an OWL ontology to describe Web services
- OWL-S leverages on OWL to
  - Support capability based discovery of Web services
  - Support automatic composition of Web Services
  - Support automatic invocation of Web services
  - OWL-S provides a semantic layer over Web services standards
    - OWL-S relies on WSDL for Web service invocation
    - OWL-s Expands UDDI for Web service discovery

OWL-S Upper Ontology



- Capability specification
- General features of the Service
  - Quality of Service
  - Classification in Service taxonomies

- Mapping to WSDL
  - communication protocol (RPC, HTTP, …)
  - marshalling/serialization
  - transformation to and from XSD to OWL

- Control flow of the service
  - Black/Grey/Glass Box view
- Protocol Specification
- Abstract Messages

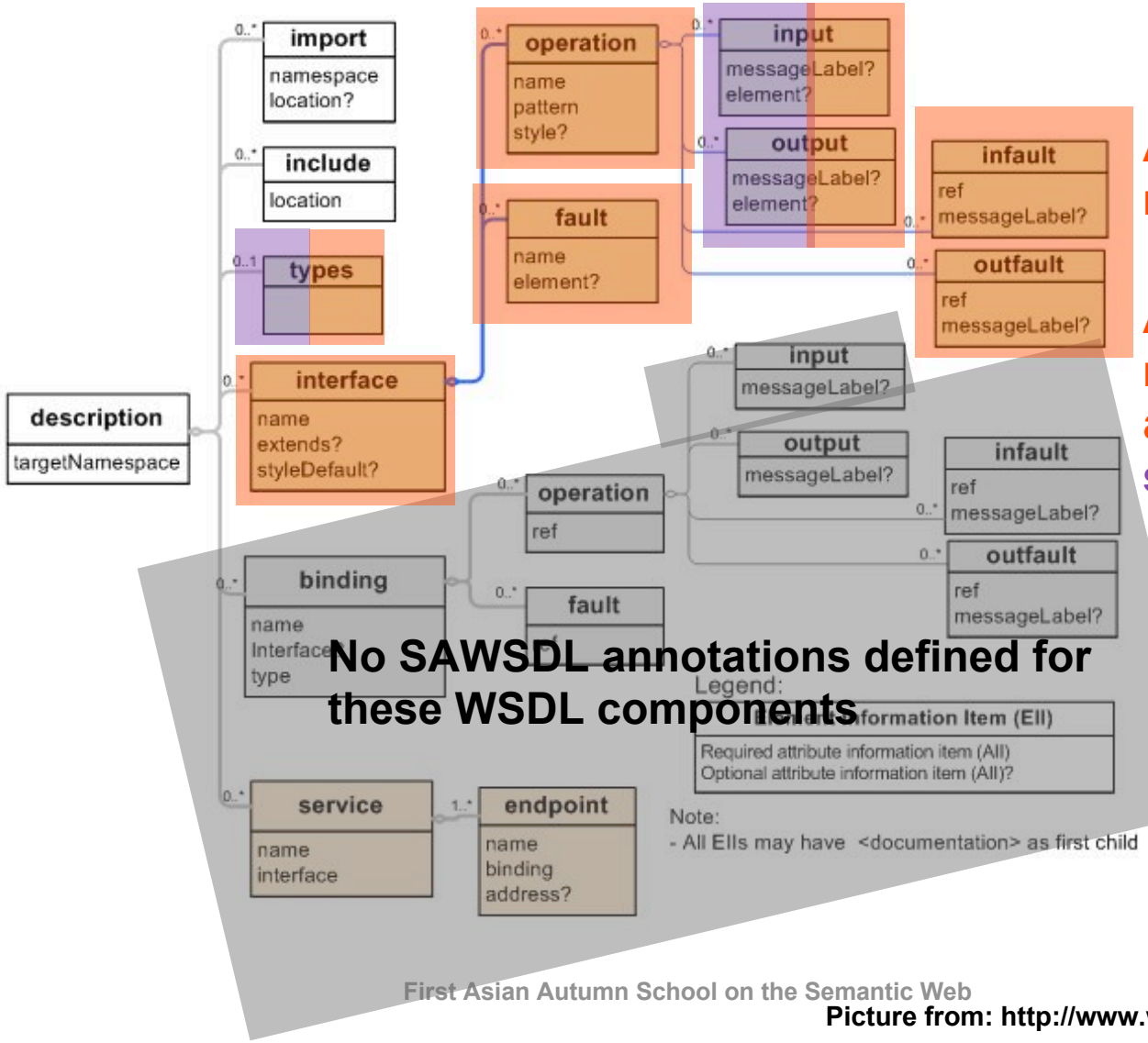
WSMO OWL-S Comparison

- Historical
  - OWL-S planning (agents)
  - WSMO knowledge modelling and B2B integration
- Representation
  - OWL-S based on OWL
  - WSMO on WSML family
- WSMO explicit conceptualisation of user context
- WSMO explicit conceptualisation of mediation
- WSMO Interfaces ≈ process model
  - WSMO provides choreography + orchestration while OWL-S provides only orchestration
  - WSMO service interface description model with ASM-based formal semantics
  - OWL-S formal semantics has been developed in very different frameworks such as Situation Calculus, Petri Nets, Pi-calculus
  - OWL-S Process Model is extended by SWRL / FLOWS
- OWL-S Grounding ≈ current WSMO Grounding

Semantic Annotations for WSDL (SAWSDL)

W3C Candidate Recommendation

SAWSDL Scope

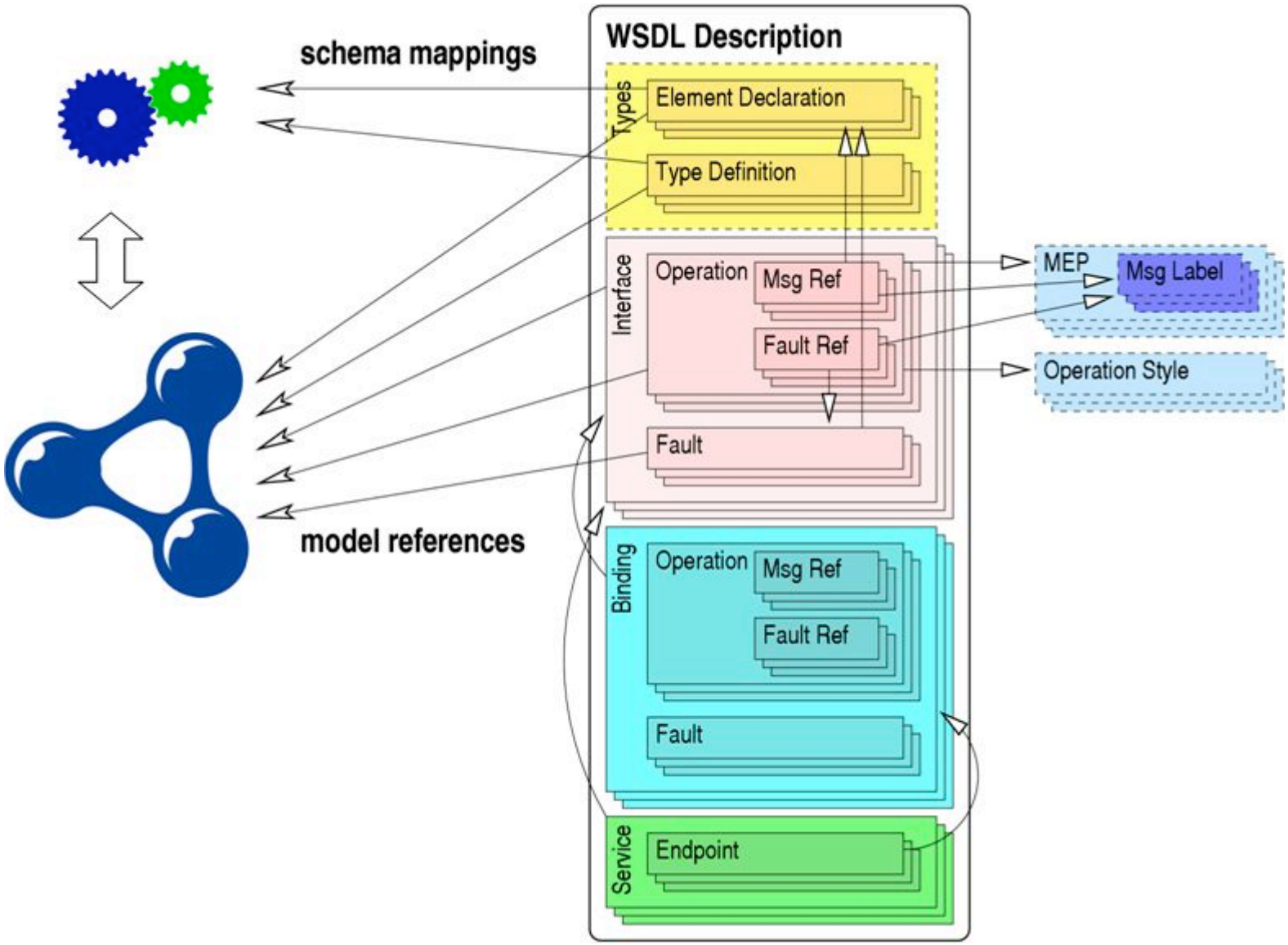


Annotated using modelReference

Annotated using modelReference and schemaMapping

No SAWSDL annotations defined for these WSDL components

Picture from: http://www.w3.org/TR/wsdl20-primer/


schema mappings
model references
WSDL Description
Types
Element Declaration
Type Definition
Interface
Operation
Msg Ref
Fault Ref
Fault
MEP
Msg Label
Operation Style
Binding
Operation
Msg Ref
Fault Ref
Fault
Service
Endpoint

IRS-III

Design Principles

- *Ontology-Based*
- *Ontological Role Separation*
- Brokering role
- Capability Based Invocation
- Single representation language
- Ease of Use
- Seamless publishing of services
- Inspectable
- Interoperable with SWS Frameworks and Platforms
- Executable semantic descriptions

Features of IRS-III (1/3)

- Based on Soap messaging standard
- Provides Java API for client applications
- Provides built-in brokering and service discovery support
- Provides capability-centred service invocation

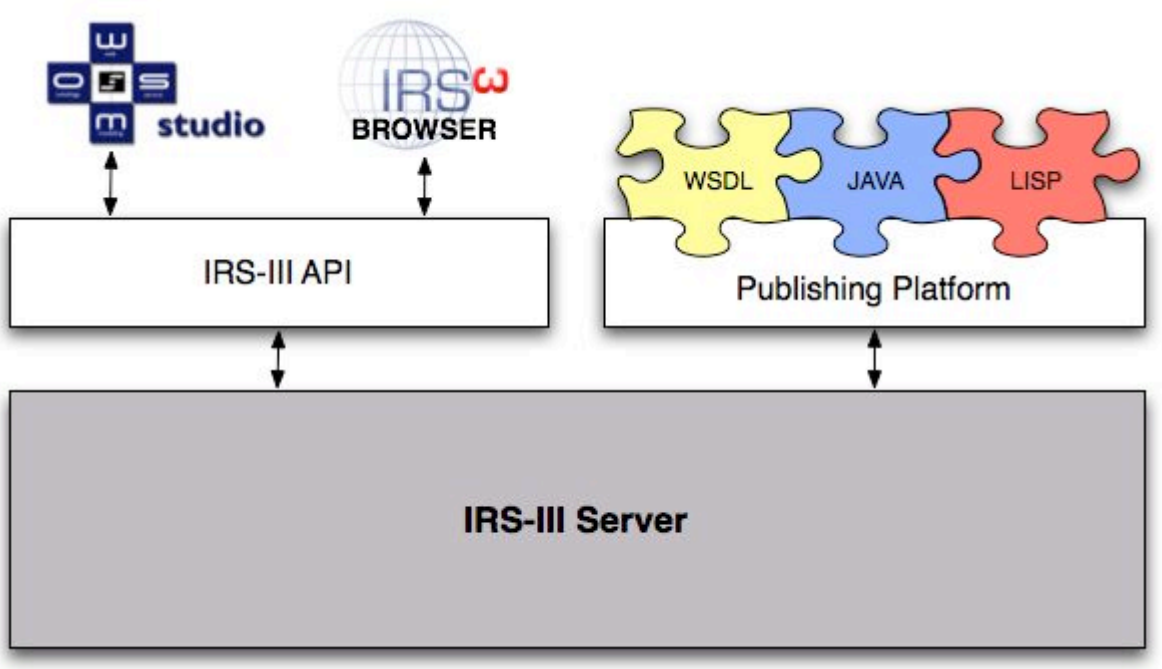
Features of IRS-III (2/3)

- Publishing support for variety of platforms
  - Java, Lisp, Web Applications, Java Web Services
- Enables publication of ‘standard code’
  - Provides clever wrappers
  - One-click publishing of web services

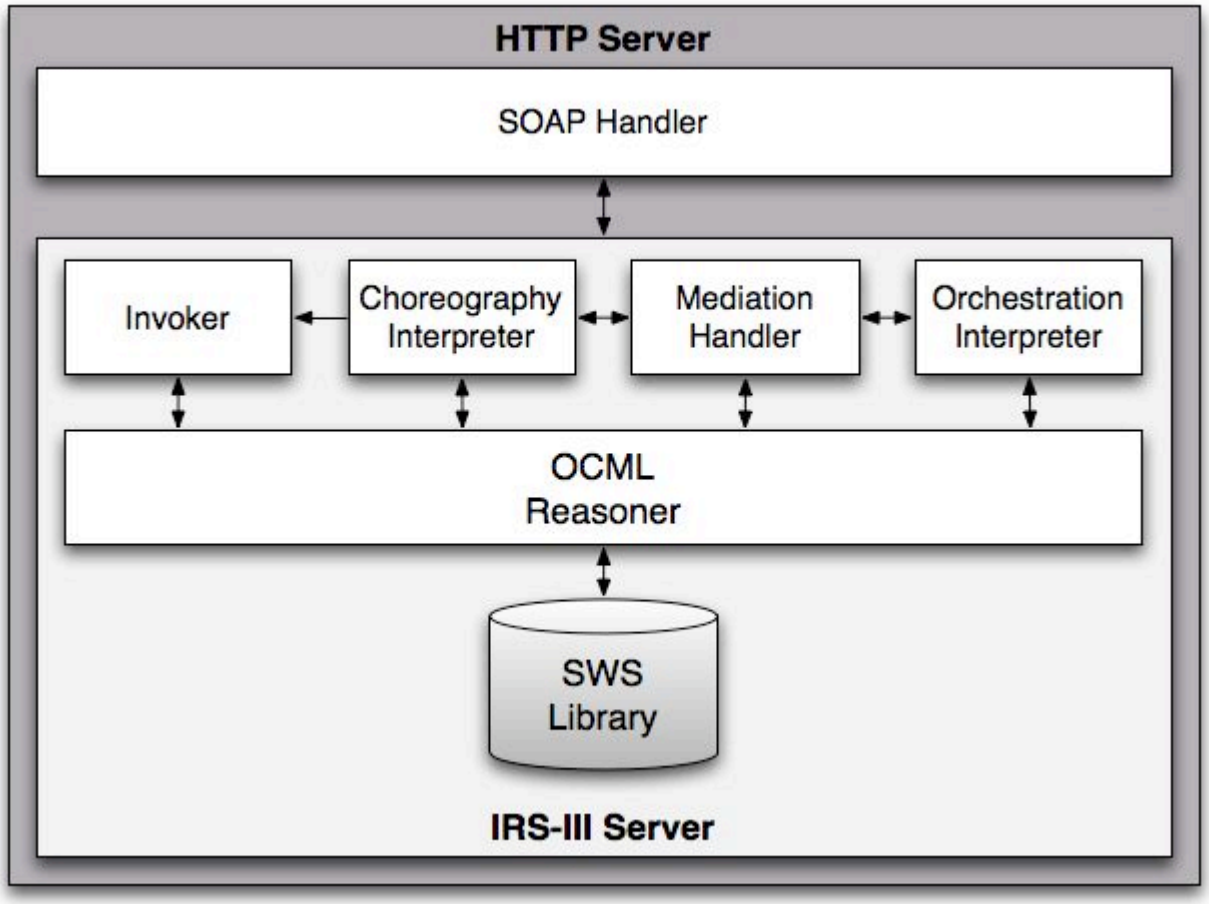
Features of IRS-III (3/3)

- Integrated with standard Web Services world
  - Semantic web service to IRS
  - ‘Ordinary’ web service

IRS-III Overall Architecture

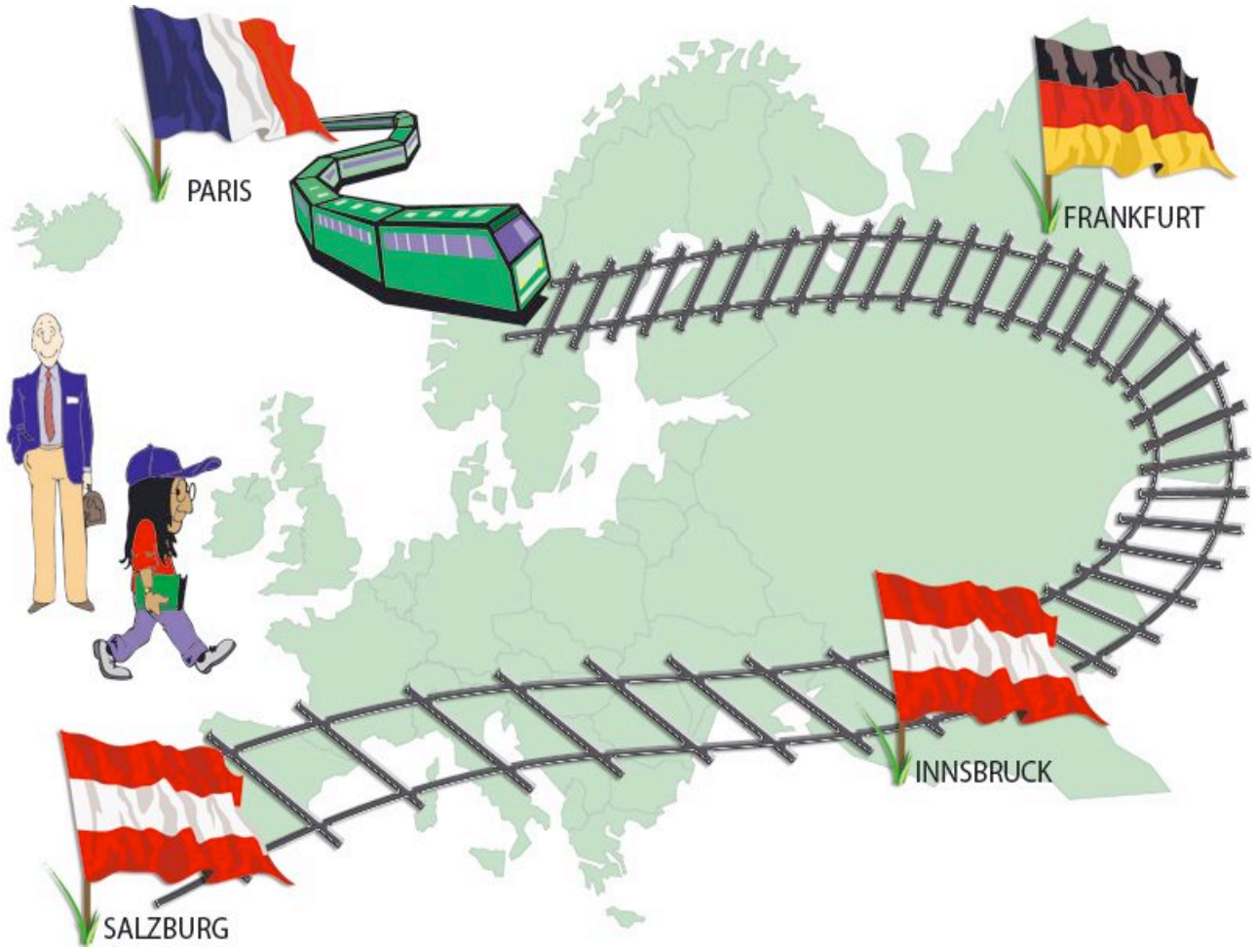


IRS-III Server

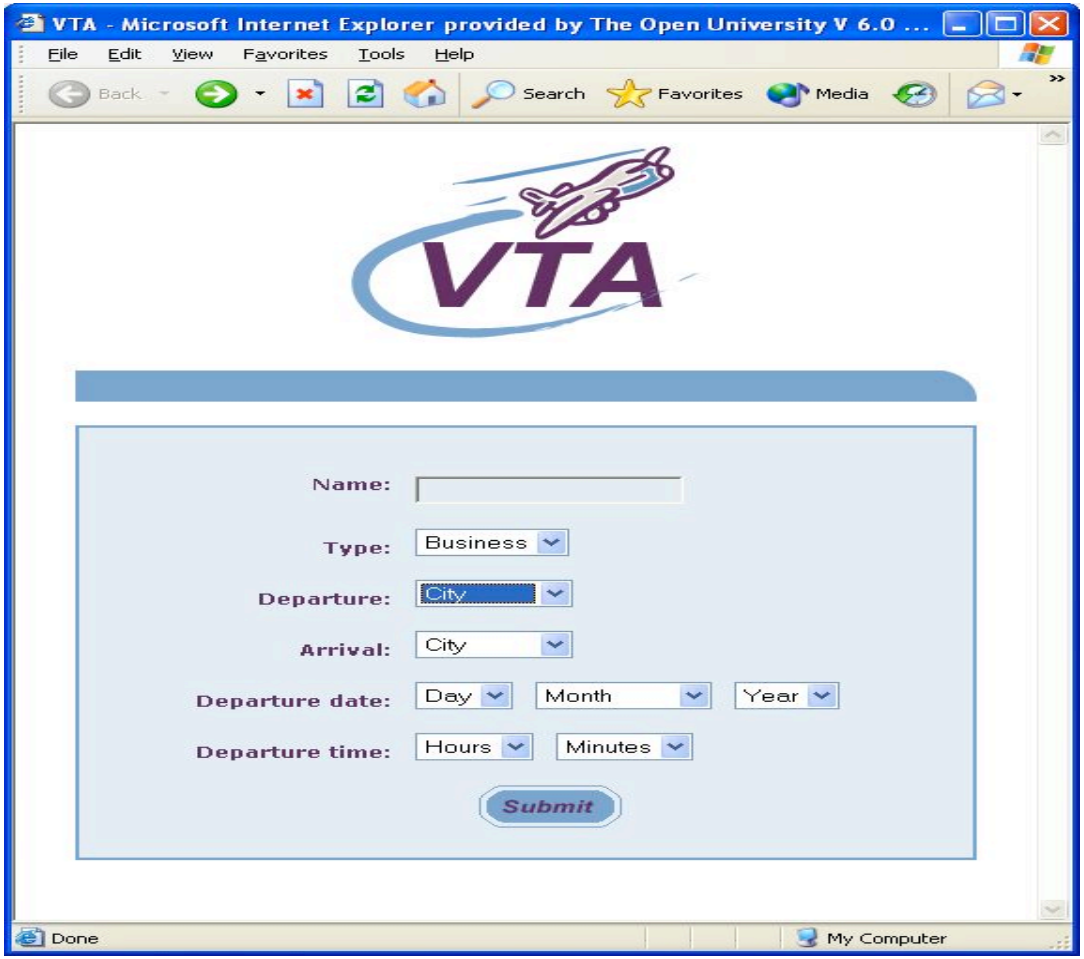


IRS-III Demo Context

European Travel Scenario



European Travel Demo



IRS-III Demo

Summary (1/2)

- Semantic Web Services
  - Potential to cope with Web scale
  - Applies SW to automate application development through reuse of Web services
- WSMO
  - Ontology describing Web services
  - Goals, Mediators, Web Services
  - Choreography and Orchestration

Summary (2/2)

- OWL-S
  - SWS initiative based on OWL
- SAWSDL
  - W3C recommendation
  - Embeds semantics into WSDL files
- IRS-III
  - SWS broker
  - WSMO compliant

Relevant URLs

- WSMO
  - http://www.wsmo.org/
- IRS-III
  - http://kmi.open.ac.uk/projects/irs/
- OWL-S
  - http://www.daml.org/services/owl-s/
- SAWSDL
  - http://www.w3.org/2002/ws/sawsdl/

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- Mike Brodie
- Michael Stollberg
- Enrico Motta
- Frank van Harmelen
- WSMO Working Group
- DIP project

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KMi

INSTITUTE