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The OASIS Applications Semantic (Inter-) Connection Framework

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INFORMATICS & TELEMATICS INSTITUTE

Contents of this presentation

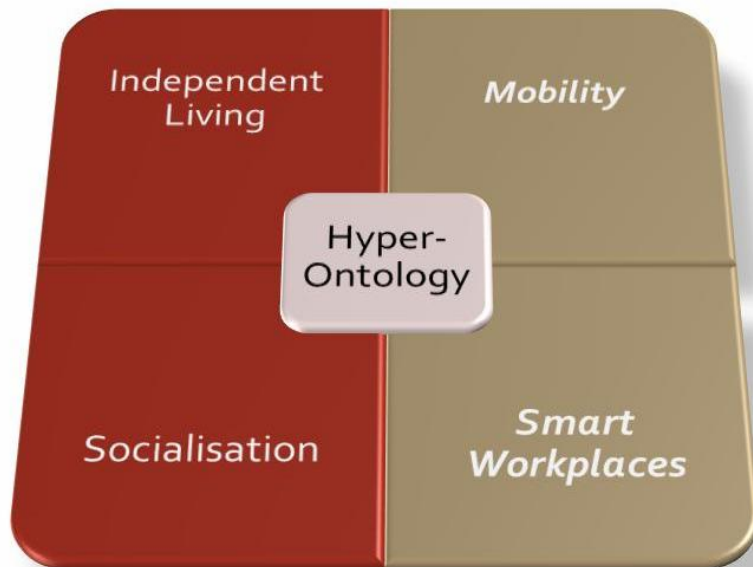
- Interoperability problems in OASIS
- The OASIS application integration paradigm
- The *Content Anchoring and Alignment Tool*
- OASIS ontologies



OASIS Interoperability problems



Inter-domain group of services

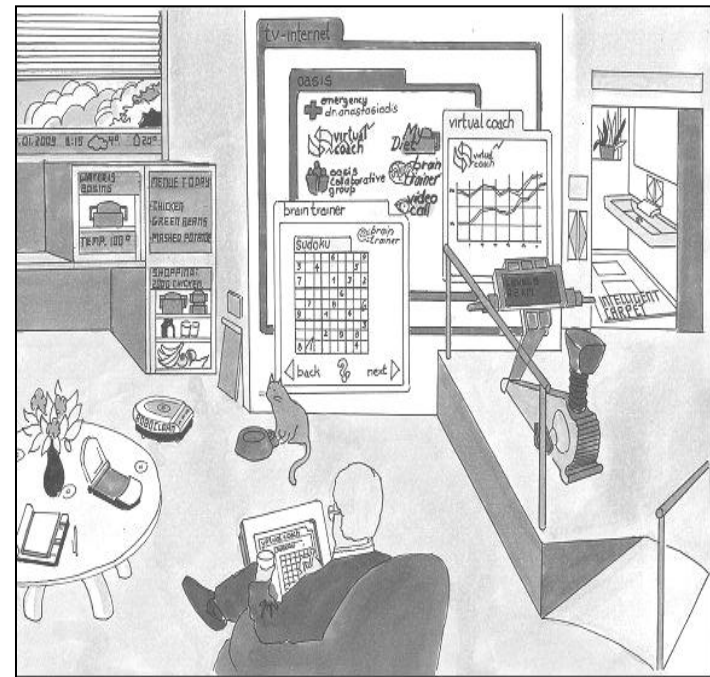


- **INDEPENDENT LIVING**
- **SOCIALISATION**
- **AUTONOMOUS MOBILITY**
- **SMART WORKPLACES**



OASIS Independent Living Applications

- Nutritional Advisor
- Activity coach
- Brain and skills trainer
- Social communities platform
- Health monitoring
- Environmental Control



Motivation for Interoperability

- A wide range of target services and applications are available in different flavours
 - One or more target Web services or family of WS may be provided by different service providers
 - Many web applications exist by different vendors that provide the desired functionality
 - Hardware devices
- How can we exploit all the available possibilities in the same development and integration framework?



The OASIS application integration paradigm



The OASIS approach

- Goal:
 - To create a framework that allows each interested party (service provider-application developer, hardware supplier) to register their assets in a common fashion.
 - Use service of different conceptual domains, e.g. an application can use and combine services of different providers transparently
- Approach
 - “Functionality” of each asset to be exported in the form of (SOAP) web services
 - All assets are described by **ontologies** provided in an open way
 - Tools to allow **seamless integration** of services and devices
 - Each provider should adhere to the OASIS business model in order to be an OASIS-compliant provider

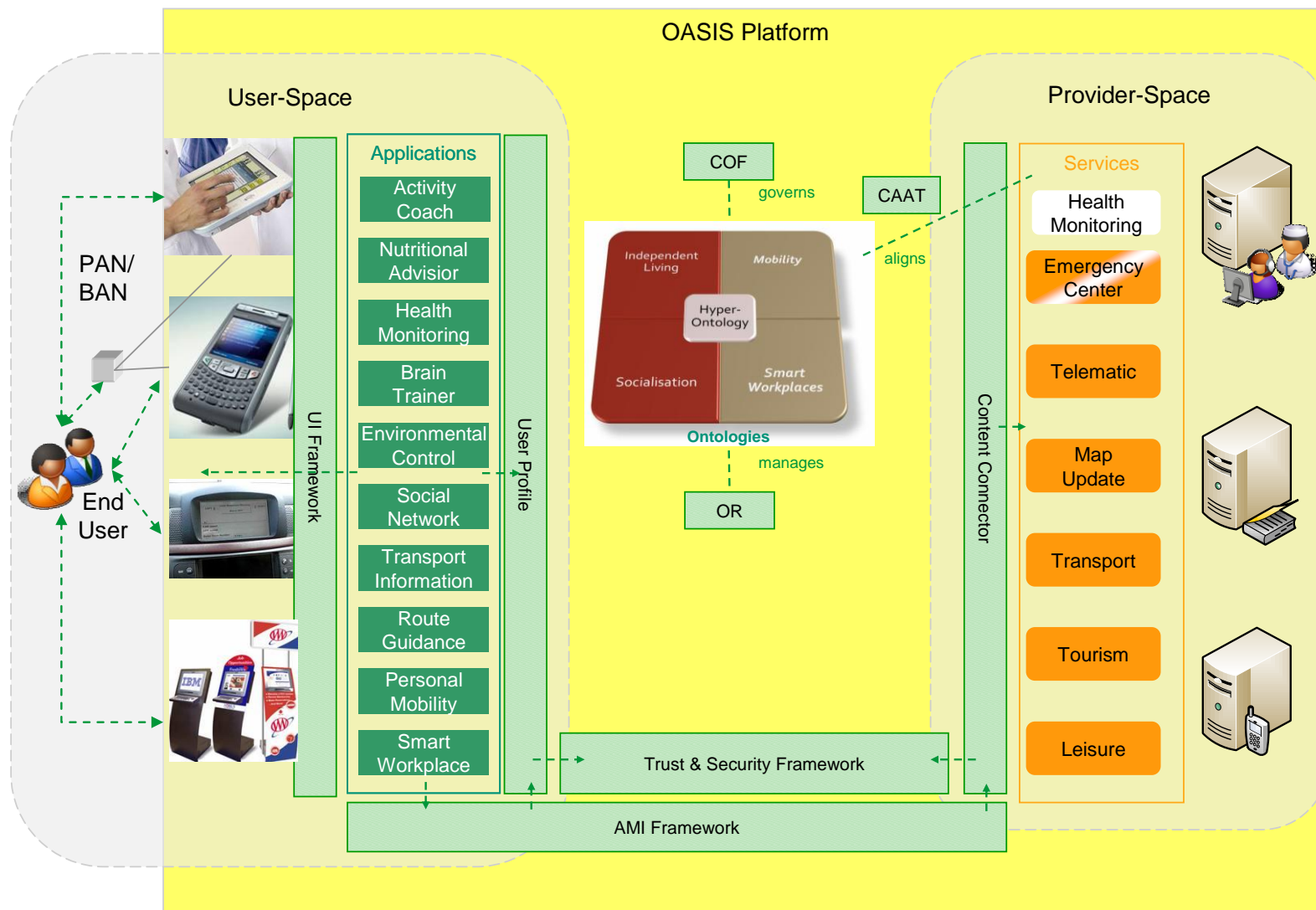


Why Web services?

- Language agnostic
- Can be called from any platform or client type
- Can be called remotely via HTTP requests
- Run on the web
- Easy to expose web methods to interested callers
- Designed to be consumed by machines



OASIS Conceptual Architecture



The *Concept Anchoring and Alignment Tool*



CAAT Purpose

- The purpose of Concept Anchoring and Alignment Tool (CAAT) is to
 - align the functionality of the provided services and /or devices with the ontologies stored in the ontology repository (ORATE).
- What do we mean by “align” services?
 - A service is “aligned” when it (and its structural components) are (semantically) matched with specific entities and components from the ontology.
- Why “align” services?
 - Once a service and its components are aligned, they are visible in the OASIS architecture. They can be invoked transparently through appropriate API and participate in complex workflows.

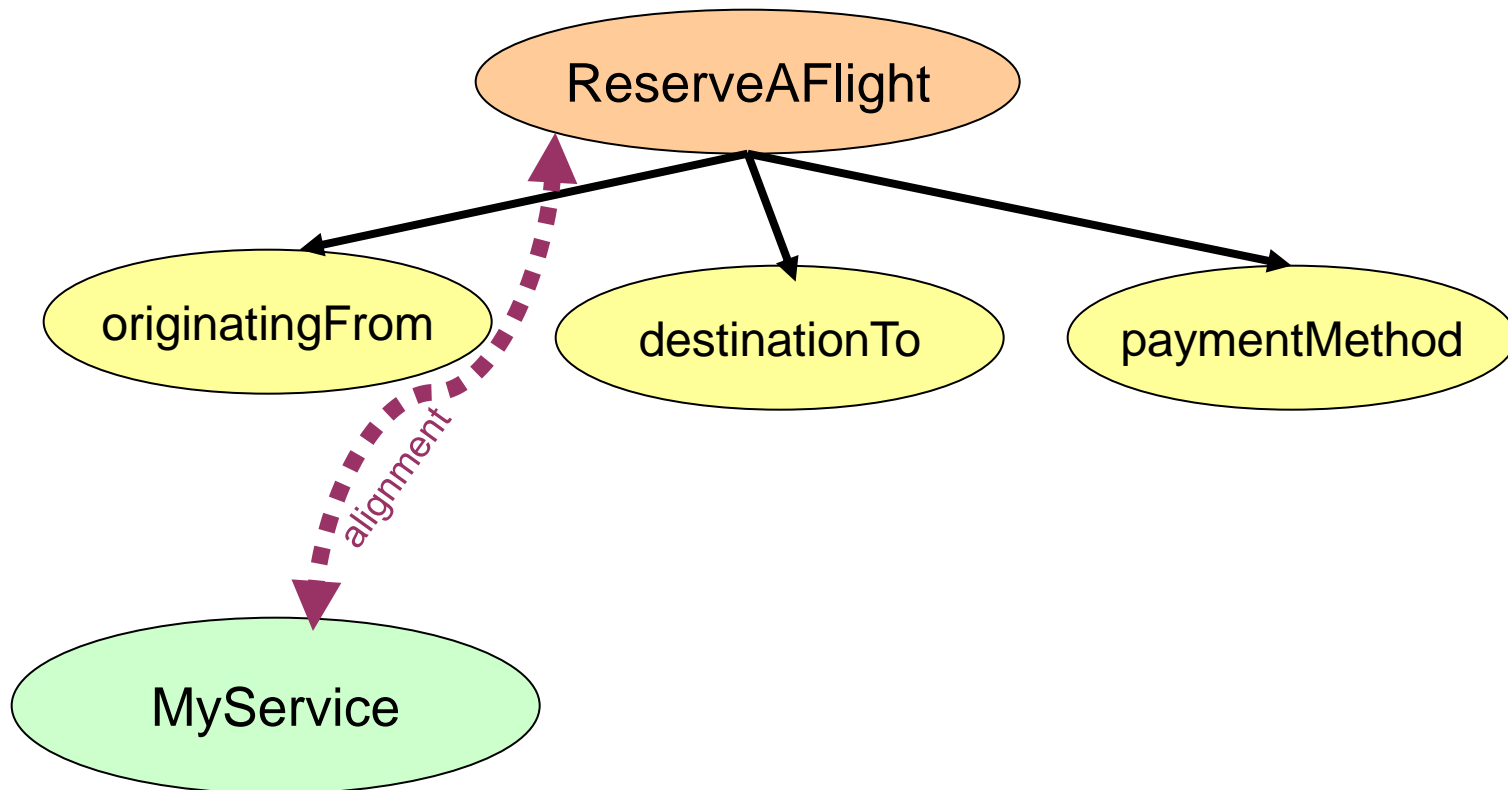


Research challenge

- How to automatically recognise WS semantics by WS structure and elements (data types, parameter names, etc.)
 - Semantic categorisation of a WS into application domains
 - Semantic categorisation of WS operations into “ideal” operations defined in terms of an ontology
 - Semantic categorisation of the WS operation i/o parameters into ontology concepts
- Web service categorisation is important for semantic annotation of services.
- This helps the dynamic creation of service catalogues and facilitates **service search and discovery**.

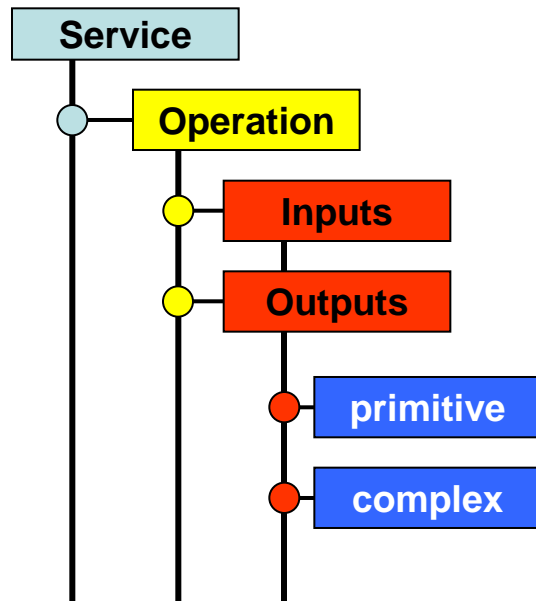


Services Alignment with Ontologies



Inside a WSDL file

Web service hierarchical structure



```

- <message name="GetForecastByZipSoapIn">
  <part name="parameters" element="s0:GetForecastByZip"/>
</message>
- <message name="GetForecastByZipSoapOut">
  <part name="parameters" element="s0:GetForecastByZipResponse"/>
</message>
- <message name="GetForecastByZipHttpGetIn">
  <part name="ZipCode" type="s:string"/>
</message>
- <message name="GetForecastByZipHttpGetOut">
  <part name="Body" element="s0:ArrayOfString"/>
</message>
- <message name="GetForecastByZipHttpPostIn">
  <part name="ZipCode" type="s:string"/>
</message>
+ <message name="GetForecastByZipHttpPostOut"></message>
- <portType name="ForecastByZipSoap">
  - <operation name="GetForecastByZip">
    <input message="s0:GetForecastByZipSoapIn"/>
    <output message="s0:GetForecastByZipSoapOut"/>
  </operation>
</portType>
- <portType name="ForecastByZipHttpGet">
  - <operation name="GetForecastByZip">
    <input message="s0:GetForecastByZipHttpGetIn"/>
    <output message="s0:GetForecastByZipHttpGetOut"/>
  </operation>
</portType>

```

Input

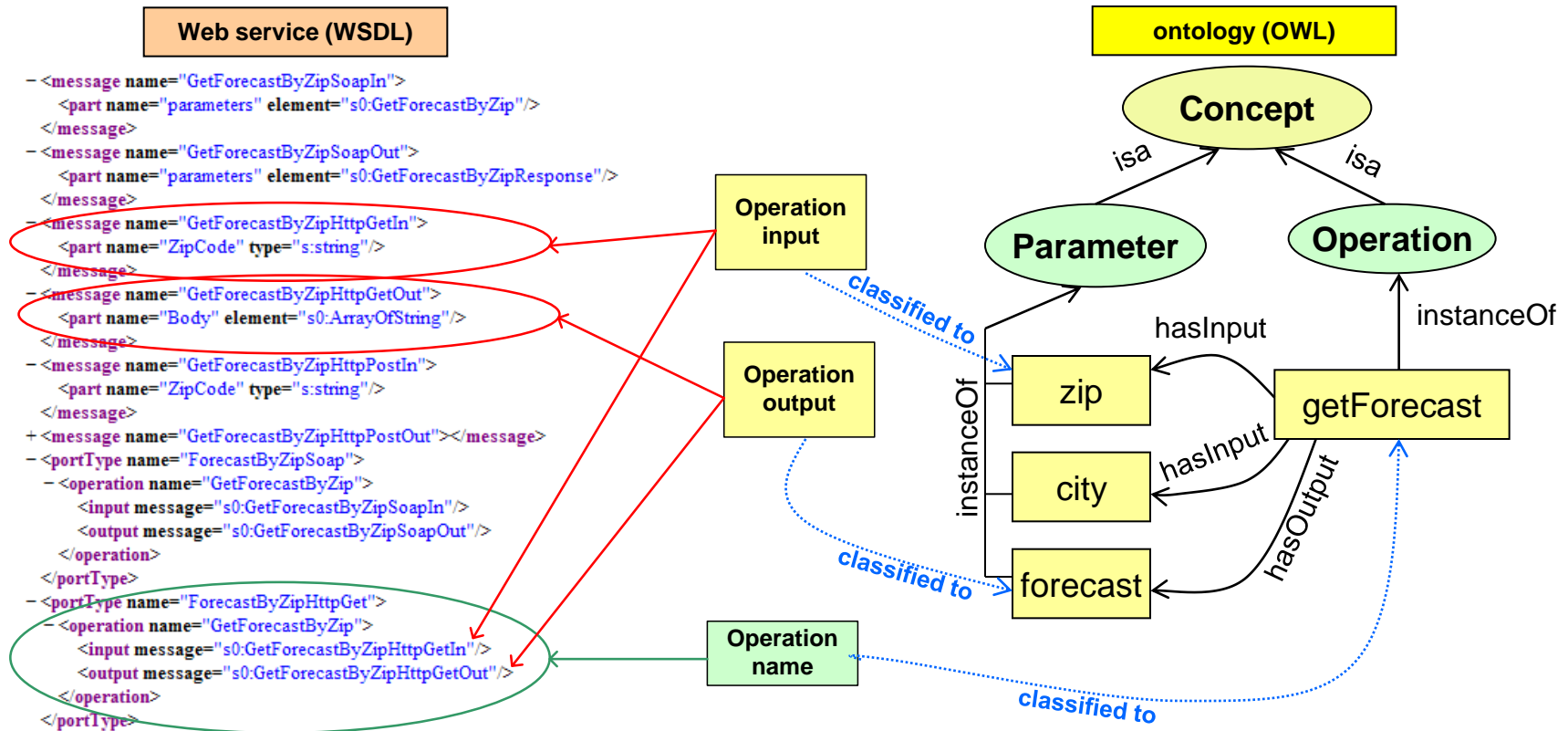
Output

Operation name

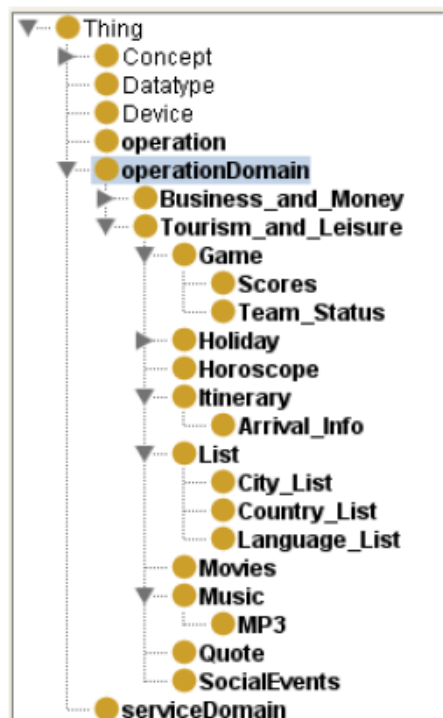


Web service categorisation

In the 2nd and 3rd layers our goal is to classify WS operations and their i/o parameters with respect to the ontologically defined counterparts



Service Ontology




- ObjectProperty: **hasInput**
 Domain: **Operation**
 Range: **Concept** ← Associates an operation to its input parameter
- ObjectProperty: **hasOutput**
 Domain: **Operation**
 Range: **Concept** ← Associates an operation to its output parameter
- ObjectProperty:
hasServiceDomain
 Domain: **Operation**
 Range: **Concept** ← Associates an operation to an application domain
- ObjectProperty: **hasType**
 Domain: **Concept**
 Range: **Concept or**
Data Type ← Associates an i/o parameter to a data type
- ObjectProperty:
belongsToPrototype
 Domain: **operation**
 Range: **operation** ← Defines if an operation is ideal or real



Open Ontology Repository

<http://orate.iti.gr/>


Logged In As normann
[My Account](#) [Log Out](#)

Building construction
Domotic Ontology

Welcome to ORATE

Use ORATE (Ontology Repository for Assistive Technologies) to access and share ontologies that are actively used in OASIS project. You can search for terms in ontologies (try typing "Device" or "Sensor" in the "Search all ontologies" box in the left column), browse a list of ontologies in ORATE (type "Building" in the "Find an ontology" box in the middle column). You can [link your own project that uses ontologies to the description of those ontologies](#), [find and create relations between terms in different ontologies](#), review and comment on ontologies and their components as you [browse](#) them. [Sign in to ORATE](#) to submit a new ontology or ontology-based project, provide comments on ontologies or add ontology mappings.

Search all ontologies

[Advanced Search](#)

Find an ontology

Most Active Ontologies

Ontology	Version	Notes	Mappings
Trip	0.1	0	7
OS-Buildings-and-Places	1.1	0	6
Transportation	1.0	0	6
Building architecture	0.1	1	2
General Purpose Ontology	1.0	0	3

Latest Notes

[levels of buildings](#)
[OASISEnvironment_v1:Level \(Building architecture\)](#) 11/04/09 normann
second floor of an office building

Latest Mappings

[gist:Building \(GIST\) => Building \(OS-Buildings-and-Places\)](#)
12/22/09 bateman

[Building \(OS-Buildings-and-Places\) => gist:Building \(GIST\)](#)
12/22/09 bateman

[gist:Building \(GIST\) => BuildingArchitecture:Building \(Building architecture\)](#)
12/22/09 bateman

[BuildingArchitecture:Building \(Building architecture\) => gist:Building \(GIST\)](#)
12/22/09 bateman

[gist:Building \(GIST\) => BuildingArchitecture:Building \(Building architecture\)](#)
12/22/09 bateman

Statistics

Ontologies	48
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feedback



Basic CAAT Functionalities



CAAT features

- Downloadable standalone Java application with auto update
- Semi-automatic web service semantic categorisation in domain/operation/parameter
- Creation of new service ontologies
- Business-rules editor for specifying business policies
- Business process editor for web service composition
- Invocation of services and business processes



Supported Functionalities



1. integrate services into the platform,
2. manually invoke one registered service,
3. edit information (meta data) about the aligned WSs,
4. edit already aligned services,
5. change personal information,
6. link “ideal” operations (i.e. operations defined in the ontology),
7. create new business processes,
8. download the latest ontology,
9. log out.



Adding a new service

Please type in the url location of the WSDL that describes your Web service or choose a file

Current Classification Model: optimal

Available Classification Models:

optimal	<input type="button" value="Delete"/>
---------	---------------------------------------

Details

```
Data Preparation Parameters
Word Parsing Parameters
WordStemming:true
Singularize:true
FeatureOccurrence:Frequency
NegativeDictionary:true
WordMinimumLength:2
```

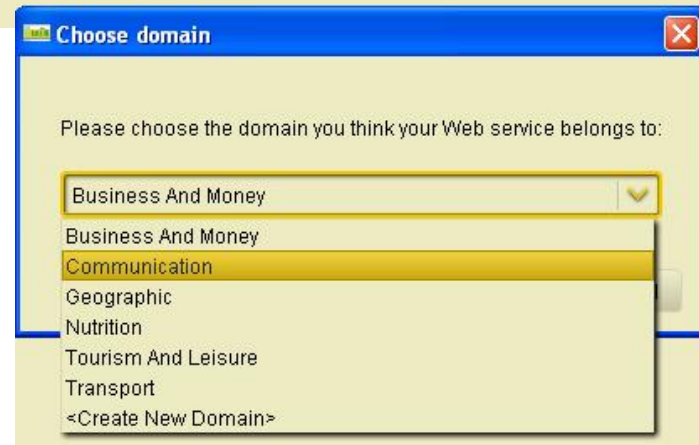


New service domain classification



The screenshot shows the 'Concept Anchoring and Alignment Tool' interface. On the left is the OASIS NTOLOGIE logo. The main title is 'Concept Anchoring and Alignment Tool' with the subtitle 'DOMAIN CLASSIFICATION'. Below the title are 'Previous' and 'Next' buttons. A message states: 'Your Web service was classified to domain **Tourism And Leisure**'. To the right of this message is a 'Change domain' button.

manually change the domain



The 'Choose domain' dialog box is open, showing a list of domain options. The current selection is 'Business And Money'. The list includes: 'Business And Money', 'Business And Money', 'Communication', 'Geographic', 'Nutrition', 'Tourism And Leisure', 'Transport', and '<Create New Domain>'. The 'Communication' option is highlighted.



Alignment of operations

- The user has three methods to choose from

Select Classification Method:

- Data Mining and Classification (2nd Level)
- Data Mining, Classification and Lexicographic (2nd Level)
- Data Mining, Classification and Lexicographic (2nd & 3rd Level)

Current model: optimal(geographic)

Available models

optimal(geographic)

Delete

Create New Classification Model

Details

Data Preparation Parameters
Word Parsing Parameters
WordStemming:true
NegativeDictionary:true
WordMinimumLength:2



Alignment of operations and i/o parameters

Concept Anchoring and Alignment Tool

INPUT - OUTPUT ALIGNMENT

Operation Classification Score: 0.184

Ideal operations in 'social_platform' domain: addEventIdeal

WSDL Operation

AddEvent

- Inputs
 - Email {string}
 - Password {string}
 - EventTypeID {int}**
 - EventName {string}
 - BeginDate {dateTime}
 - EndDate {dateTime}
 - Location {string}
 - InformationURL {string}
 - Description {string}
- Outputs
 - AddEventResult {int}

INPUT

WSDL Concept Name	Ontology Concept Name	Matching Score
Description	description	1.000
Email	contact	0.708
EndDate	end_date	0.850
InformationURL	end_time	0.414
EventTypeID		
Password		
Location		
BeginDate		
EventName		

OUTPUT

WSDL Concept Name	Ontology Concept Name	Matching Score
AddEventResult	status	0.323

addEventIdeal

- Inputs
 - auth_token
 - token [string]
 - event
 - description [string]
 - contact [string]
 - end_date [string]
 - end_time [string]
 - event_tags [string]**
 - fees [string]
 - id [string]
 - long_description [string]
 - organiser [string]
 - start_date [string]
 - start_time [string]
 - title [string]
 - venue [string]
- Outputs
 - return
 - status [string]

Confirm Alignment

Align 'EventTypeID' to 'event_tags' ?

OK Cancel

Save Current Alignment Test Invocation Create New Ideal Operation Upload Ontology



Service Invocation

Concept Anchoring and Alignment Tool

INVOKE SERVICES FROM ONTOLOGY

Wsdsl operation

Ideal Operations **Aligned Operations**

Domains

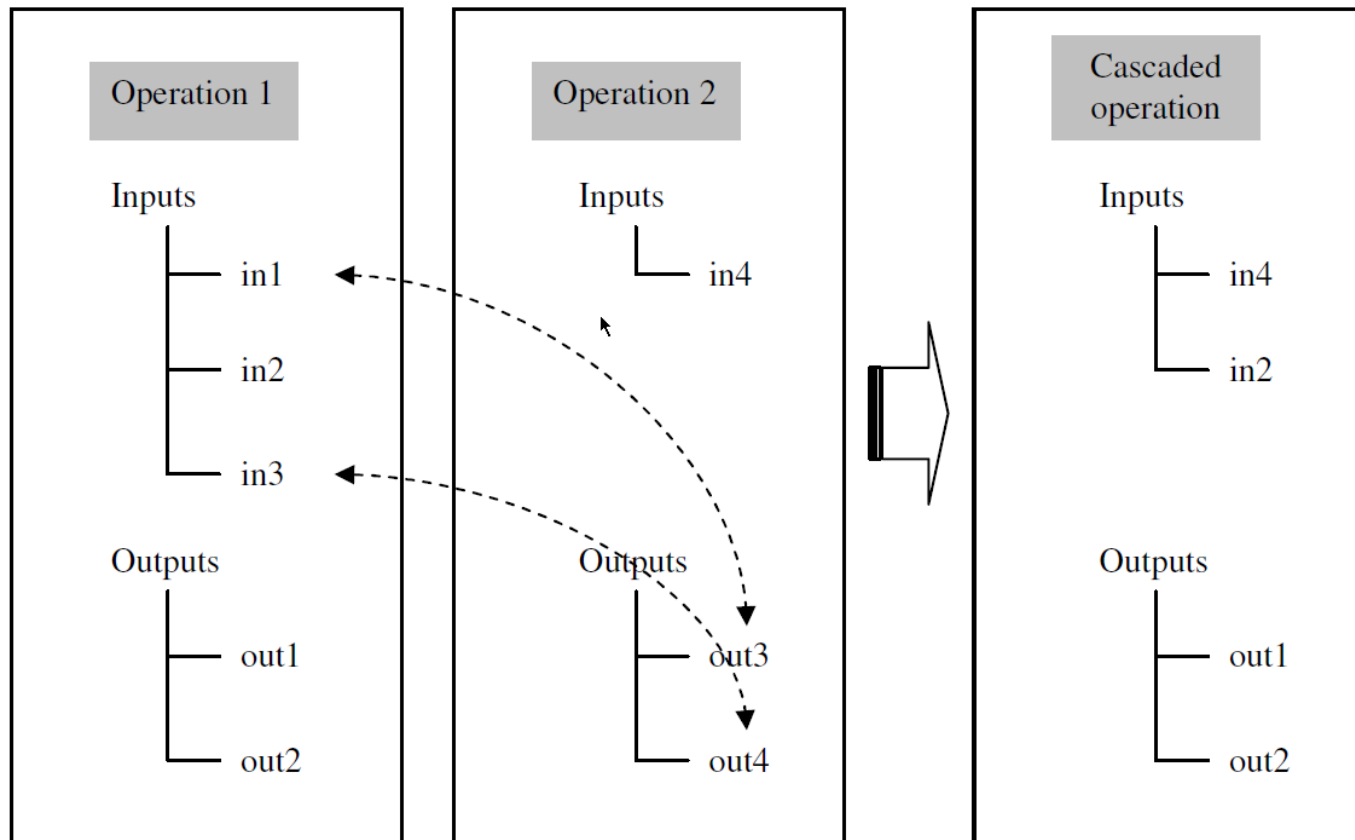
- business_and_money
- communication
- geographic
- nutrition
- tourism_and_leisure
 - getReservations (0)
 - getCategories (1)
 - getVenue (1)
 - loadTrips (1)
 - getVenues (1)
 - saveTrips (0)
 - deleteTrips (0)
 - createtinerary (0)
 - deletetinerary (0)
 - setRoomAvailability (0)
 - getSocialEventList (1)**
 - getPOIs (0)
 - getRoomAvailability (0)
 - loaditineraryLine (1)
 - planTrips (1)
 - loadBookingsFortinerary (0)
 - getHolidays (3)
 - resettineraryLine (2)
- transport

INPUTS	OUTPUTS
<p>GetTotalSocialEvents</p> <ul style="list-style-type: none"> Inputs <ul style="list-style-type: none"> eventDate (EventDate) <ul style="list-style-type: none"> month (positiveInteger) [1 2] year (int) [1980] day (int) [1 2] 	<p>GetTotalSocialEvents</p> <ul style="list-style-type: none"> Outputs <ul style="list-style-type: none"> GetTotalSocialEventsResult (int) [4]
<p>GetTotalSocialEventsResult</p> <p>Output value: 4</p>	
Request SOAP Message	Result SOAP Message
<?xml version='1.0' encoding='utf-8'?'><soapenv	<?xml version='1.0' encoding='utf-8'?'><soap:En

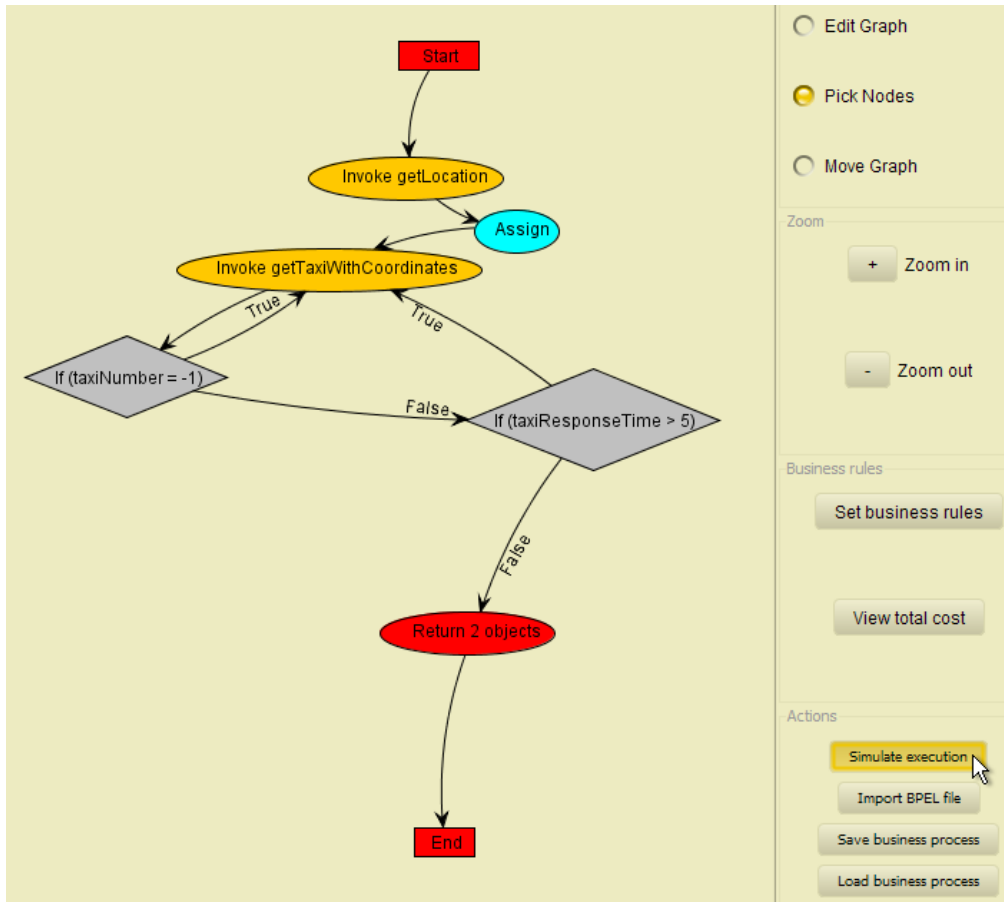
Operation Name	Score
GetTotalSocialEvents	0.106



Service composition



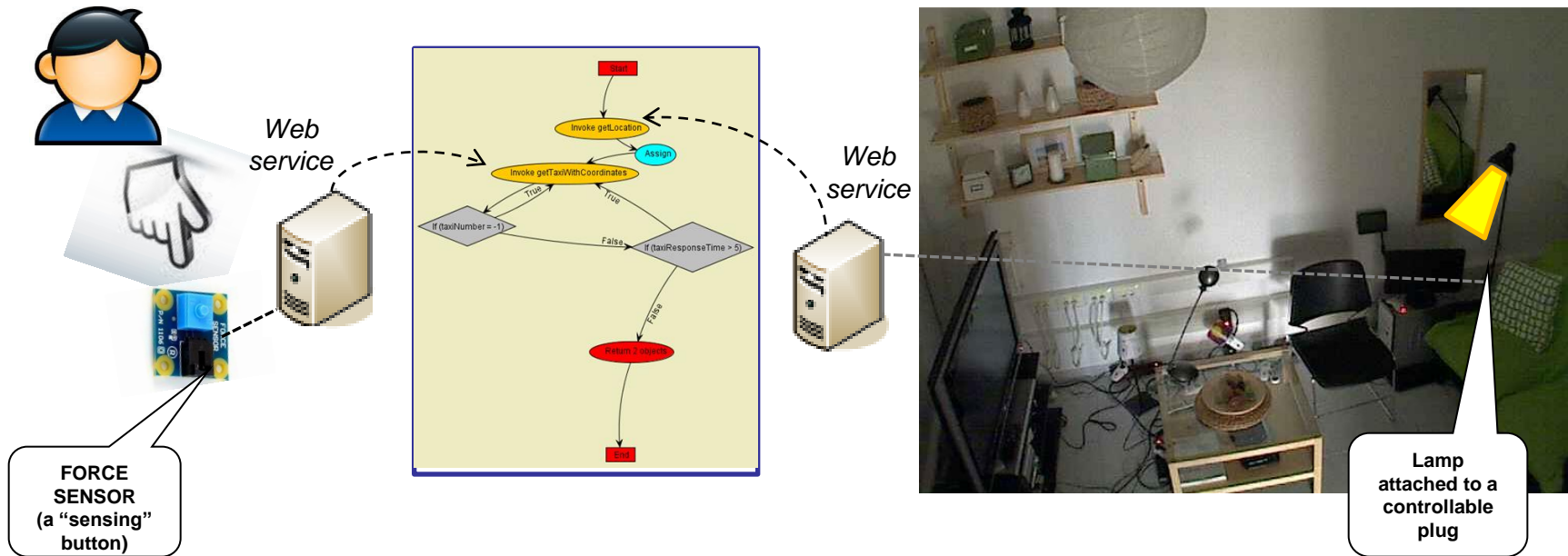
Service composition supported in CAAT



- A drawing canvas and a toolkit allows the graphical design of any business process
- Web services as well as devices can be connected within the same business process



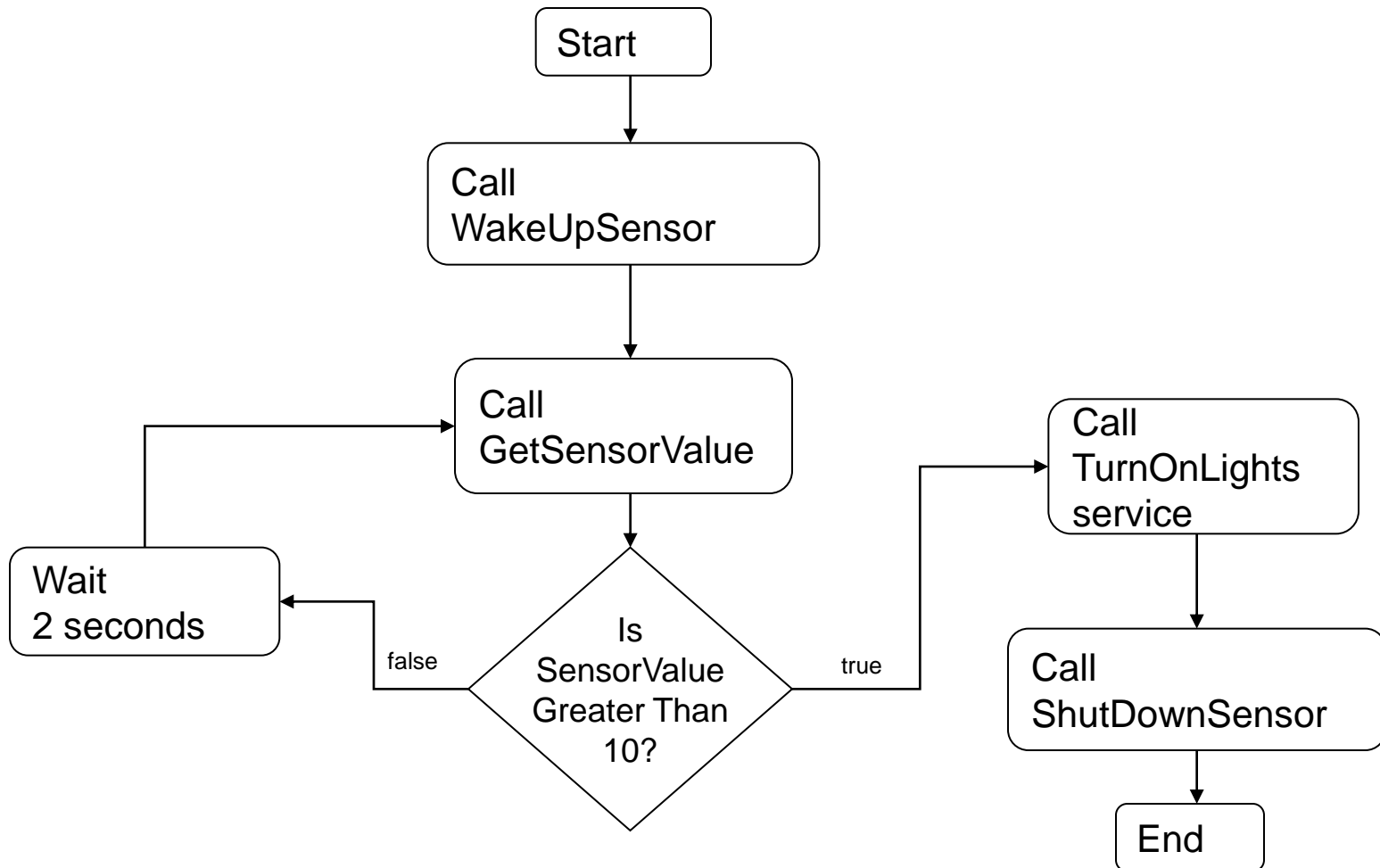
A working example



Use case: Integrate a force sensor along with other web services in order to control home lights (or any other appliance) from distance



Graphical Representation of the Business Process



*Live demonstration of CAAT during the
break...*



Outlook

- Increased classification accuracy
- Support more web service protocols (e.g. Restful)
- Automatic semantic web service composition



Relevant Publications

- Kehagias D., Giannoutakis K., Gravvanis G., Tzovaras D. Ontology-based Mechanism for Automatic Categorization of Web Services. *Concurrency and Computation: Practice and Experience*, DOI: 10.1002/cpe.1818 (accepted for publication), 2011
- Kehagias D., Kontotasiou D., Tzovaras D. Evaluation Framework for Ontology Development and Management Methodologies. *ESWC 2010 Workshop on Ontology Repositories and Editors for Semantic Web*, May 31st, 2010, Heraklion, Greece.
- Kehagias D., Tzovaras D., Mavridou E., Kalogirou K., Becker M. Implementing an open reference architecture based on web service mining for the integration of distributed applications and multi-agent systems. *2010 AAMAS Workshop on Agents and Data Mining Interaction*, May 11, 2010, Toronto, Canada.
- Kehagias D., Mavridou E., Giannoutakis K., Tzovaras D. A WSDL structure based approach for semantic categorization of web service elements. *6th Hellenic Conference on Artificial Intelligence, (SETN-10)* 4-7 May. 2010, Athens, Greece (*Lecture Notes in Artificial Intelligence*, vol. 6040) S. Konstantopoulos et al. (Eds.): pp. 333–338, 2010.
- Kehagias D., Ioannidis D., Tzovaras D. Towards seamless semantic integration of Web services: An ontology-based three-layer approach. *1st OASIS International Conference*, 4-5 Nov. 2009, Florence, Italy.
- Kehagias D. and Tzovaras D. A Semantic Web service-oriented application for mobility impaired users. *International Journal of Social and Humanistic Computing (Interscience)*, Vol. 1, No. 2, pp. 149-162, 2009
- Kehagias D., Garcia-Castro A., Giakoumis D., Tzovaras D. A Semantic Web Service Alignment Tool. *7th International Semantic Web Conference*, October 26-30, Karlsruhe, Germany 2008.
- Kehagias D., Giakoumis D., Tzovaras D. An ontology-based service-oriented application for mobility impaired users. *7th International Semantic Web Conference*, October 26-30, Karlsruhe, Germany, 2008
- Kehagias D. Giakoumis D. Tzovaras D. An Ontology-based Framework for Integrating Web Services for Mobility Impaired Users. *2nd ASK-IT International Conference*, June 2008.



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