Semantic Infrastructure and Platforms for Geospatial Services: A report from European Projects

4th International Workshop on Semantic and Conceptual Issues in GIS (SeCoGIS 2010)

Vancouver, Canada
November 1st, 2010

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Content

• ISO/TC211 19101, 19103, 19119 – OGC Ref.Architecture
• European projects (1): Orchestra, SANY
• Focus on Semantic technologies
• European projects (2): SWING, ENVISION
• European projects (3): Objective 6.4 projects
• ENVIP projects – objective 6 list
• TATOO, REMICS, …
• Future work – harmonisation/integration … standards?
Relevant European projects

- **Orchestra** - Open Architecture and Spatial Data
- **Sany** - Sensors Anywhere
- **SWING** - Semantic Web Services INteroperability in Geospatial decision making
- **ENVISION** - ENVIRONMENTal Services Infrastructure with Ontologies
- **NETMAR** - Open service network for marine environmental data
- **OEPI** - Exploring and Monitoring Any Organisation's Environmental Performance Indicators
- **PESCADO** - Personalized Environmental Service Configuration and Delivery Orchestration
- **SUDPLAN** - Sustainable Urban Development Planner for Climate Change Adaptation
- **TATOO** - Tagging Tool based on a Semantic Discovery Framework
- **UncertWeb** - The Uncertainty Enabled Model Web
- **UrbanFlood** - Building an Early Warning System Framework for European Cities
- **GENESIS** - GENerlic European Sustainable Information Space for environment
- **ICT-ENSURE** - ICT for Environmental Sustainability Research
- **GIGAS** - GEOSS INSPIRE and GMES an Action in Support
- **REMICS** - Migration to Cloud services – with Model Driven Service Interoperability
Web sites and Project references

- ISO/TC211: http://www.isotc211.org/
- OGC: http://www.opengeospatial.org/
- ORCHESTRA: http://www.eu-orchestra.org/
- SANY: http://www.sany-ip.eu/
- SERVUS (PhD- Usländer, 2010):
  - http://digbib.ubka.uni-karlsruhe.de/volltexte/1000016721
- SWING: http://138.232.65.156/swing
- ENVISION: http://www.envision-project.eu/
- ENVIP projects: http://ifgi.uni-muenster.de/~pajoma/persistent/ENVIP10/
The goal of ISO/TC 211...

... is to develop a family of international standards (using a conceptual modeling approach) that will

- support the understanding and usage of geographic information
- increase the availability, access, integration, and sharing of geographic information, enable inter-operability of geospatially enabled computer systems
- contribute to a unified approach to addressing global ecological and humanitarian problems
- ease the establishment of geospatial infrastructures on local, regional and global level
- contribute to sustainable development
ISO/TC 211 Publications (1)

- ISO 6709:2008 – Standard representation of geographic point location by coordinates
- ISO 19101:2002 – Reference model (under revision)
- ISO/TS 19103:2005 – Conceptual schema language (under revision)
- ISO 19105:2000 – Conformance and testing
- ISO 19106:2004 – Profiles
- ISO 19107:2003 – Spatial schema
- ISO 19108:2002 – Temporal schema
- ISO 19110:2005 – Feature cataloguing methodology
- ISO 19111:2007 – Spatial referencing by coordinates
- ISO 19112:2003 – Spatial referencing by geographic identifiers
- ISO 19113:2003 – Quality principles (under revision)
- ISO 19114:2003 – Quality evaluation procedures (under revision)
- ISO 19115:2003 – Metadata (under revision)
- ISO 19116:2004 – Positioning services
- ISO 19117:2005 – Portrayal (under revision)
ISO/TC 211 Publications (2)

- ISO 19119:2005 – Services
- ISO/TR 19121:2000 – Imagery and gridded data
- ISO/TR 19122:2004 – Qualification and certification of personnel
- ISO 19123:2005 – Schema for coverage geometry and functions
- ISO 19125-1:2004 – Simple feature access – Part 1: Common architecture (under revision)
- ISO/TS 19127:2005 – Geodetic codes and parameters
- ISO/TS 19129:2009 – Imagery, gridded and coverage data framework
- ISO 19131:2007 – Data product specification
- ISO 19132:2007 – Location-based services – Reference model
- ISO 19133:2005 – Location-based services – Tracking and navigation
- ISO 19134:2007 – Location-based services – Multimodal routing and navigation
- ISO 19135:2005 – Procedures for item registration
- ISO 19136:2007 – Geography Markup Language (GML)
- ISO 19137:2007 – Core profile of the spatial schema
- ISO/TS 19138:2006 – Data quality measures (under revision)
- ISO 19144-1:2009 – Classification systems – Part 1: Classification system structure
ISO 19101 (revised version, 2010)
19101 – Use of conceptual modeling
Reference model conceptual framework for the ISO geographic information standards

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<th>Processing and service foundation</th>
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Open Geospatial Consortium

- Consortium of 330+ companies, government agencies, and academic institutes
- Open Standards development by consensus process
- Interoperability Programs provide end-to-end implementation and testing before spec approval
- **Standard encodings**, e.g.
  - GeographyML, SensorML, Observations & Measurements, TransducerML, etc.
- Standard Web Service interfaces, e.g.
  - Web Map Service
  - Web Feature Service
  - Web Coverage Service
  - Catalog Service
  - **Sensor Web Enablement Services** (Sensor Observation Service, Sensor Alert Service, Sensor Process Service, etc.)

**OGC Mission**

*To lead in the development, promotion and harmonization of open spatial standards*
ORCHESTRA

Latest News. More dissemination activities...
» Catalogue and Ontology Access Service specifications updated in the Documents area NEW!
» ORCHESTRA - One of the European Union’s major research and innovation projects for risk management [Atos Origin Press Release]
» ORCHESTRA Pilot presentations available at the Links area
» ORCHESTRA Final Event took place at Atos Origin headquarters in Madrid on 27/02/2008
Open Geospatial Service Platform
RM-OA Design Process

Reference Model for the ORCHESTRA Architecture

• Basis: Reference Model for Open Distributed Computing (RM-ODP ISO/IEC 10746)
• Follows the structure of RM-ODP (viewpoints for different layers from enterprise to technology viewpoint)
• RM-ODP-viewpoints are mapped to ORCHESTRA viewpoints
• In addition: precise definition of relevant terms (ORCHESTRA service, OSN, meta information…)
• Definition of the high level requirements: what means open?, …
RM-OA Scope
RM-OA Design

Meta-information for "Discovery"

Service Capabilities

Catalogue

Integration Domain

Mediation and Processing Domain

User Domain

Source System Domain
Influence of standards on RM-OA
Evolution of Reference Models

- OGC RM
  - Geospatial Computing
  - Geospatial Services
- RM-OA
  - Environmental Risk Management
  - Geospatial SOA
- SensorSA
  - Environmental Monitoring
  - Sensor Web
- SERVUS Reference Model (section 5)

- Open Distributed Processing (ODP)
  - Object-oriented Middleware
  - ISO RM-ODP
- Service-Oriented Architecture (SOA)
  - Web Services
  - OASIS RM-SOA
- OASIS Reference Ontology
  - Semantic SOA
  - Semantics
  - SOA Ontology
  - The Open Group
  - SoaML
  - OMG

Timeline:
- 1998
- 2003
- 2006
- 2007
- 2008
- 2009
OA Infrastructure services

- Feature Access Service
- Map and Diagram Service
- Document Access Service
- Sensor Access Service

- User Management Service
- Authorisation Service
- Authentication Service

- Catalogue Service
- Service Monitoring Service
High level architecture

- Rigorous Use of Standards
- Loosely Coupled Components
- Technology Independence
- Evolutionary Development
- Component Independence
- Generic Infrastructure
- Self-describing Components
OA Support services

- Gazetteer Service
- Thesaurus Access Service
- Schema Mapping Service
- Format Conversion Service
- Coordinate Operation Service
- Ontology Access Service
- Service Chain Access Service

- Query Mediation Service
- Inferencing Service
- Annotation Service
- Document Indexing Service
Orchestra Application Architecture
Thematic services

- Processing Service for
  - (geo) statistical calculation
  - aggregation
  - normalisation
  - image processing
- Simulation Management Services

- Project Management Support Service
- Communication Service
- Calendar Service
- Reporting Service
OMM Information and Service Meta model

ORCHESTRA Meta-Model
---
**rules**

OMM Information Meta-Model
---
UML <<MetaClass>>

OMM Service Meta-Model
---
UML <<Feature>>
UML <<Type>>
UML <<Interface>>

ORCHESTRA Application Schemas
---

ORCHESTRA Service/Interface Types
RM-OA Information viewpoint

Rules for the design of information models in UML according to ISO/OGC standards (e.g. General Feature Model) with ORCHESTRA Extensions

Definition of basic elements (e.g. basic data types)
Orchestra Information Meta Model

**Meta-model Level**
- **GFM** (General Feature Model)
  - is an evolution of
- **OMM** (ORCHESTRA Meta-Model)
  - rules defined by
- **OAS** (ORCHESTRA Application Schema)
  - structure defined by

**Schema Level**
- **OMM** (ORCHESTRA Meta-Model)
  - Meta-model for the specification of ORCHESTRA Application Schemas
- **OAS** (ORCHESTRA Application Schema)
  - application schema that has been compiled according to the rules of the OMM

**Feature Level**
- **OFS** (ORCHESTRA Feature Set)
  - set of ORCHESTRA feature instances (persistent or transient) that is structured according to an OAS and is accessed through ORCHESTRA Services.
RM-OA Service viewpoint

Viewpoints:
- Enterprise
- Information
- Service
- Technology
- Engineering

ORCHESTRA Service Meta-Model

Rules for the design of ORCHESTRA Services
Definition of generic re-usable interface types and service types
Service and Interface type examples

Generic, abstract, re-usable specification units
RM-OA Meta-information approach
Meta-information purposes

- The RM-OA defines a set of rules for building meta-information models OAS-MIs for “well-known” purposes like:
  - discovery (including search and navigation)
  - access, storage and service invocation
  - integration (collaboration)
  - interpretation
  - user profiling
  - quality control/management
  - transactions, synchronisation and locking
  - OSN configuration and management
SANY Sensor Anywhere - IST FP6 Integrated Project

The SANY integrated project focused on interoperability of in-situ sensors and sensor networks, and assuring the sensor data can be easily processed and used as a basis for decision making. SANY Sensor Service Architecture (SensorSA) therefore provides a quick and cost-efficient way to reuse of data and services from legacy sensor- and data-sources. This site presents the project itself, its achievements, related publications as well as the public deliverables and software developed in SANY.
SANY and SensorSA
SensorSA – Sensor Service Architecture

Distinct part of the functionality that is provided by an entity through interfaces (ISO 19119)

Set of rules to define the structure of a system and the interrelationships between its parts (ISO/IEC 10746-2)

Sensor Service Architecture (SensorSA)

- Devices
- Humans
- Models
SensorSA and RM-ODP

- SensorSA structured according to the ISO Reference Model for Open Distributed Processing (RM-ODP)
  - compliant to the OGC design process
  - interpreted for a service-oriented architecture (SOA)

Enterprise: What is required?
Information: What to deal with?
Service: Which functions?
Engineering: How to build?
Technology: What to use?
Service domains in SensorSA
RM-OA Sensor extensions

- Service Capabilities I/F
- Feature Access Service
- Map and Diagram Service
- Schema Mapping Interface
- Coordinate Operation Service
- Service Chain Access Service
- Processing Service
- Ontology Access Interface
- Inferencing Interface
- Annotation Service
- Catalogue Service
- Sensor Access Service

OGC Sensor Web Enablement:
- Sensor Observation Service
- Sensor Alert Service
- Sensor Planning Service
- Web Notification Service
RM-OA and SensorSA – as a platform
Future directions

- Sensor network and sensor service network to be added to “Sensor Model”
- Enhanced consideration of alternate architectural styles
  - event-driven interactions from sensor to application
  - collaboration with RESTful Web services
Decision Support Infrastructure – using the ESA SSE (Service Support Environment) Platform
Service-Oriented Design of Environmental Information Systems

Thomas Usländer

Karlsruher Schriften zur Anthropomatik
Band 5
SERVUS Model hierarchy

- EIS Business Environment
- Use Cases
  - requirements
- EIS Application
  - capability use
- Geospatial Service Network

SERVUS

- Domain Model
- Use Case/Process Model
- Design Model
- Reference Model

Bieberstein et al. (2006)
Semantic annotation of OGC Web Services
Principle of Rephrasing, Resource Discovery and Matching
Information, Resources and Service model

OGC General Feature Model (GFM) as part of OGC Reference Model (Percivall (ed.), 2003)

- Information Model
  - Service Model
  - Resource Model

Reference Model for the ORCHESTRA Architecture (RM-OA) (Usländer (ed.), 2007)
Integration of resource-oriented architecture concepts into the OGC Reference Model (Usländer, 2008b)
SERVUS Implementation architecture
Architecture of Semantic catalogue
Use os Semantic technologies (SWING, ENVISION, REMICS projects)

- Semantic publishing
- Semantic Annotation
- Semantic Discovery and matchmaking
- Semantic Interoperability and Mediation
- Semantic Composition
SWING

Semantic Web services interoperability for Geospatial decision making

ENVISION project

The follow-up of SWING project is the ENVISION project. Visit the ENVISION website.

Objectives

Today, a number of non-semantic web services are available within the geospatial domain. The scarcity of semantic annotation and the lack of a supportive environment for discovery and retrieval make it difficult to employ such services to solve a specific task in geospatial decision making.

SWING aims at deploying Semantic Web Service (SWS) technology in the geospatial domain. In particular, we address two major obstacles that must be overcome for SWS technology to be generally adopted, i.e. to reduce the complexity of creating semantic descriptions and to increase the number of semantically described services. Today, a comprehensive knowledge of logics, ontologies, metadata and various specification languages is required to describe a service semantically. We will develop methods and tools that can hide the complexity – and automate the creation – of the necessary semantic descriptions. The objective of SWING is to provide an open, easy-to-use SWS framework of suitable ontologies and inference tools for annotation, discovery, composition, and invocation of geospatial web services.
• **Semantic Web Services INteroperability in Geospatial decision making**
• A framework for **semantic discovery and composition** of geospatial services
• Prototyped in the area of Mineral Resources Management
Semantic Web and Web Services - SWS

Dynamic

Web Services
UDDI, WSDL, SOAP

Semantic Web Services

WWW
URI, HTML, HTTP

Static

Semantic Web
RDF, RDF(S), OWL, etc.
SWS – Tasks to be Automated

- **Service Description**: Describe the service explicitly, in a formal way.
- **Service Publishing**: Make available the description of the service.
- **Service Mediation**: Locate different services suitable for a given goal.
- **Service Composition**: Combine services to achieve a goal.
- **Service Discovery**: Choose the most appropriate services among the available ones.
- **Service Negotiation & Contracting**: Choose the most appropriate services among the available ones.
- **Invoke & Monitor**: Services following programmatic conventions.
- **Enactment & Monitoring**: Make available the description of the service.
- **Service Description**: Choose the most appropriate services among the available ones.

**ENVISION**
Objectives that a client may have when consulting a Web Service

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

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

- **Web Services**
  - Connectors between components with mediation facilities for handling heterogeneities

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**The WSMO Approach to SWS**
Wide Variety of Languages for Specifying Ontologies

- **Graphical**: Semantic Networks, Topic Maps, UML, RDF

  ![Graphical Examples]

- **Logical**: Description Logics, First Order Logic, Rules, Conceptual Graphs

  **Description Logics**
  - $C_1 \cap \ldots \cap C_n$
  - $C_1 \cup \ldots \cup C_n$
  - $\exists x \in \{x_1, \ldots, x_n\}$
  - $\forall P C$
  - $\exists P C$
  - $\leq n P$
  - $\geq n P$

  **Example**
  - Human $\cap$ Male
  - Doctor $\cup$ Lawyer $\neg$ Male
  - $\exists C_1, \ldots, C_n$
  - $\forall P C$
  - $\exists P C$
  - $\leq n P$
  - $\geq n P$

  **Logical Expressions**
  - $\forall x, y \text{ Brother}(x, y) \Rightarrow \text{Sibling}(x, y)$
  - “Sibling” is symmetric
  - $\forall x, y \text{ Sibling}(x, y) \Leftrightarrow \text{Sibling}(y, x)$
  - One’s mother is one’s female parent
  - $\forall x, y \text{ Mother}(x, y) \Leftrightarrow (\text{Female}(x) \land \text{Parent}(x, y))$
  - A first cousin is a child of a parent’s sibling
  - $\forall x, y \text{ FirstCousin}(x, y) \Leftrightarrow \exists p, ps \text{ Parent}(p, x) \land \text{Sibling}(ps, p) \land \text{Parent}(ps, y)$

  **Rules**
  - $\text{sibling}(X, Y) \leftarrow \text{parent}(X, Z), \text{parent}(X, Y)$
  - $\text{parent}(X, Y) \leftarrow \text{father}(X, Z), \text{parent}(X, Y)$
  - $\text{mother}(X, Y) \leftarrow \text{mother}(X, Y), \text{parent}(X, Y)$
  - $\text{father}(X, Y) \leftarrow \text{father}(X, Y), \text{parent}(X, Y)$
  - $\text{mother}(X, Y) \leftarrow \text{mother}(X, Y), \text{parent}(X, Y)$
  - $\text{father}(X, Y) \leftarrow \text{father}(X, Y), \text{parent}(X, Y)$
  - $\text{firstCousin}(X, Y) \leftarrow \exists p, ps \text{ Parent}(p, X) \land \text{Sibling}(ps, p) \land \text{Parent}(ps, Y)$

  **Conceptual Graphs**

  ![Conceptual Graphs]

  **Propositions**
  - Proposition: $\text{Parent}(X, Y)$
  - $\text{Age}(X)$
  - $\text{Married}(X, Y)$
  - $\text{Work}(X)$
  - $\text{Age}(X)$
  - $\text{Married}(X, Y)$
  - $\text{Work}(X)$

  **Situation**
  - $T$
A Conceptual Model for Web Services

- complete item description
- quality aspects
- Web Service Management

Non-functional Properties
DC + QoS + Version + financial

Capability
functional description

- Advertising of Web Service
- Support for WS Discovery

Interface

Web Service Implementation
(not of interest in Web Service Description)

Orchestration

realization of functionality by aggregation
- functional decomposition
- WS composition

client-service interaction interface for consuming WS
- external visible behavior
- communication structure
- ‘grounding’
SWING – High-level Architecture

See demo at http://www.swing-project.org/showcase.html
SWING components and tools

- **MiMS**: Environment for domain expert
  - Convenient semantic annotation & discovery; use composed services
- **WSMX**: Semantic web services platform
  - Geospatial semantic discovery; execution of composed services
- **Concept Repository**: Ontologies for semantic annotation
  - Used throughout components
- **Visual OntoBridge**: Annotation tool
  - Semi-automatic annotation of services and queries
- **Catalogue**: OGC Catalogue
  - Semantic discovery in interaction with WSMX
- **Composition Studio**: Environment for IT expert
  - Convenient semantic annotation & discovery; graphically compose services
The ENVISION project provides an ENVIronmental Services Infrastructure with ONtologies that aims to support non ICT-skilled users in the process of semantic discovery and adaptive chaining and composition of environmental services. Innovations in ENVISION are: on-the-Web enabling and packaging of technologies for their use by non ICT-skilled users, support for migrating environmental models to be provided as models as a service (Maas), and the use of data streaming information for harvesting information for dynamic building of ontologies and adapting service execution.

The ENVISION Environmental Decision Portal supports the creation of web-based applications enabled for dynamic discovery and visual service chaining. The ENVISION Ontology Infrastructure provides support for visual semantic annotation tools and multilingual ontology management. The ENVISION Execution infrastructure comprises a semantic discovery catalogue and a semantic service mediator based on a generic semantic framework and adaptive service chaining with data-driven adaptability.
ENVISION – An Infrastructure for MaaS

- ENVIronmental Services Infrastructure with ONtologies
- Portal with a pluggable decision support framework
  - Visual service chaining
  - Migration of existing models to MaaS
- Semantic annotation infrastructure
  - Visual semantic annotation mechanism
  - Multilanguage ontology management
- Execution space
  - Semantic discovery catalogue
  - Semantic service mediator
  - Adaptive service chaining execution
ENVISION Architecture

Design Environment

- ENVISION Design Components
  - Annotation Client
  - Environmental Decision Support Portal
  - Ontology Client
  - MaSS Composition Portal
- ENVISION Semantic Annotation
  - Visual Semantic Annotation and Tools
  - Multi-Language Annotation Management
  - Ontology Repository
  - Metadata Repository

Runtime Environment

- ENVISION Scenarios and Pilots
  - Landslide Decision Support
  - Oil Spill Decision Support
- ENVISION Runtime Components
  - Visualisation Client
- ENVISION Execution Space
  - Adaptive Execution Infrastructure
    - Semantic Mediation Mechanisms
    - Adaptation Mechanisms
  - Processing Service (WPS)
  - Distributed Data Space
  - Model Service (MaSS)
  - Data Service (WPS)
  - Sensor Service (SOSS)
A General Scenario for MaaS – User Operations

Design time
(provide on-the-shelf modeling solutions)

- Discover existing resources
- Build the modeling workflow
- Register/Annotate the new Service

Set-up time
(connect the appropriate sources of information to feed the modeling service)

- Discover existing Modeling Services
- Select a region of interest
- Discover existing data sources
- Select the data sources
- Set the parameters
- Play the scenario

Execution time
(interact with the information provided by the models and monitor the system)

- Discover existing Modeling Services
- Select a region of interest
- Discover existing data sources
- Select the appropriate sensors data streams
- Select functional parameters for the alerting system

Semantic Annotations are a key enabler for discovery of services!
MaaS Scenario – Landslide Hazard Risk Assessment

How to set up Web services that can be manipulated by non-technical operators and can simulate damage under different climatic and/or another potential trigger (e.g. earthquake) for landslides scenarios?
MaaS Scenario – Oil Spill Risk Analysis

How to set up Web services that can be manipulated by non-technical operators and can enable a quick and adequate response in order to minimize biological consequences of oil spills at sea?
Environmental Information Systems and Services
Infrastructures and Platforms

Workshop Description:

The Shared Environmental Information System (SEIS) is one of three major initiatives along with the INSPIRE Directive and the Global Monitoring for Environment and Security (GMES) undertaken by Europe to collect and share environmental information for the benefit of the global society.

Different efforts are now emerging towards the creation of infrastructures and platforms for Environmental Information Systems and Services – including Infrastructures for flexible discovery and chaining of distributed environmental services.

Information and Communication Technologies (ICT) have an essential role to play in the context of Environmental systems as they provide the necessary support in terms of tools, systems and protocols to establish a dynamic environmental space of collaboration in a more and more sophisticated digital world. Core challenges are not only related to providing seamless environmental data access

Program

The keynotes for the ENVIP workshop will be shared with the ENVIROINFO conference. The program of the conference is here.

Thursday 09:00-10:30, KEYNOTE (EnviroInfo) and Coffee Break

Thursday 10:30-12:30, Session 1
Infrastructures with Semantic annotation and Uncertainty

Chairs: Arne J. Berre, SINTEF and Denis Havlík, Austrian Institute of Technology

- Closing the discovery gap in environmental information resources using semantic annotations: the TaToo Approach
  by Tomas Pariente Lobo, Mauricio Ciprian, Gerald Schimak, Giuseppe Avellino, and Sascha Schlobinski

- Validation Scenario for Anthropogenic Impact and Global Climate Change for Tatoo
  by Jiri Hrebicke, Ladislav Dusek, Miroslav Kubasek, Jiri Jarkovsky, Karel Brabec, Ivan Holoubek, Lukas Kohut, and Jaroslav Urbanek
## Current ENVIP project areas

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<th>Ontologies / domain models</th>
<th>(Service) discovery</th>
<th>(Service) Composition</th>
<th>Sensors access / streams</th>
<th>(Web) visualization</th>
<th>Multilingualism</th>
<th>Transformation / mapping</th>
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Service-based infrastructure

User Services
- User Profile Management Service
- User-Interaction Service
- Problem Descr. Service
- KB Access Service
- Decision Service
- Content Select. Service
- Info. Production Service

Answer Service

Node Search Service
- Data Node Retrieval Service

Service Node Services
- Service orchestr. Service
- Data Fusion Service
- Web Data Extraction Service
- Data Retrieval Service

Data Services

Knowledge-based Services
WSMO-Lite tools
(Demo: SOA4All Studio http://www.so4all.eu/)
Linked Open (Geospatial) Data

Linked Data - Connect Distributed Data across the Web

Linked Data

Linked Data is about using the Web to connect related data that was not previously linked, or using the Web to lower the barriers to linking data currently linked using other methods. More specifically, Wikipedia defines Linked Data as "a term used to describe a recommended best practice for exposing, sharing, and connecting pieces of data, information, and knowledge on the Semantic Web using URIs and RDF."

This site exists to provide a home for, or pointers to, resources from across the Linked Data community.
Linked Open Services

Linked Open Services (LOS) are an approach to exposing services, that is functionalities, on the Web using the same technologies that are associated with Linked Data, in particular HTTP, RDF and SPARQL [read more...]

This site is intended to serve as:

- An information point on the development of LOS - both services and principles - via the blog
- A collaborative basis for the definition and refinement of principles and best practices - via the wiki

All work on LOS! is made available under the CC Share Alike license. [license]

Initial work on the LOS! Initiative was funded by the EU FP7 Integrated Project SOA4All [logo]

See: http://www.linkedopenservices.org/
Linked Open Services

Concretely, like Linked Data, Linked Open Services come with a set of guiding principles:

1. Describe services as **LOD prosumers** with input and output descriptions as **SPARQL graph patterns**
2. Communicate RDF by RESTful content negotiation
3. Include the **implicit knowledge contribution** that results from interactions in service descriptions and communications

Associated with the last principle is an optional fourth:

1. *When wrapping non-LOS services*, extend the (lifted, if non-RDF) message to make explicit the implicit knowledge, and to use Linked Data vocabularies, using **SPARQL CONSTRUCT** queries

LOS are also intended to be composed - by processes, mash-ups and other means - according to a related set of principles:

1. Decide control flow conditions based on **SPARQL ASK** queries
2. Base iteration on **SPARQL SELECT** queries
3. Define dataflow/mediation based on **SPARQL CONSTRUCT** queries
REMICS

Reuse and Migration of legacy applications to Interoperable Cloud Services

Main Menu
- Home
- Work Packages
- Consortium
- Public Deliverables
- Publications
- Downloads
- Videos
- News

Remics at a Glance
Total budget: 4,5 M€
Total effort: 328 PMs
Duration: 09/2010 - 08/2013

Welcome to Remics

Cloud computing and SOA are recognized game-changing technologies\[1\] for a cost-efficient and reliable service delivery. Software as a Service paradigm becomes more and more popular enabling flexible license payment schemas and moving the infrastructure management costs from consumers to service providers. However, building a SaaS system from scratch may require a huge investment in time and efforts. Moreover, the organizations legacy systems are difficult to reuse due to platform, documentation and architecture obsolescence.

OMG MDA (Model Driven Architecture) and related efforts around domain-specific languages have gained much popularity. These technologies put the model in the centre of the software engineering process (MDE). The software products are built with subsequent model refinements and transformations from business models (process, rules, motivation), down to component architectures (e.g. SOA), detailed platform specific design and finally implementation. Similarly, OMG ADM (Architecture Driven

See: www.remics.eu
Model Driven Service Interoperability in the REMICS project

Source Architecture
- Knowledge REMICS KDM
- Business Process and Rules
- Components SoaML
- Implementation UML, U2TP

Recover
- Knowledge Discovery
- Reverse Engineering

Legacy Artifacts
- Source code
- Binaries
- Documentation
- Users
- Knowledge
- Configuration files
- Execution logs and traces

Migrate
- Model Driven Interoperability
- Service mediation for adaptation
- SOA and Cloud Computing Patterns applied
- Legacy Components Replacement and Wrapping
- Design by Service Composition

Target Architecture for Service Cloud platform
- SoaML with REMICS extensions for Service Clouds
- Links to Business Models

Forward MDA through PIM4Cloud
- Model Transformation Code Generation Traceability

Service Cloud Implementation
- RESERVOIR, Joyant, Amazon, Google, Microsoft

Validate, Control and Supervise
- Models @ Runtime for application management
- Model Checking
- Model-based Testing for validation

- Source code, binaries, documentation, users, knowledge, configuration files, execution logs and traces

- Reverse Engineering
Semantic Interoperability using Flora2 (SINTEF)
Open Issues: Standardization

• Model References already standard (W3C SAWSDL)

• Support in OGC/TC211 Standards required
  – Storing semantic annotation
  – Querying semantic annotations
  – End-user tools support

• ...
Open Issues: Processes

• Model References already standard (W3C SAWSDL)
• Extensions for model based annotations?
• Support in OGC/TC211 Standards possible?
  – Storing semantic annotation
  – Querying semantic annotations
  – End-user tools support
• How can we annotate Geoprocesses
  – Domain vocabulary of Geo-operations required? All?
  – Or just describing relation between input and output?
Conclusions and Outlook

• Infrastructures and platforms based on service oriented architectures are maturing – link to a Future Internet Core platform …

• Modeling approaches for different resources – data/information, services (SoaML – see tutorial on Tuesday), events, processes are maturing

• Semantic technology extensions are being experimented with – what are the experiences and best practices?

• Further work on harmonisation, integration and standardisation of approaches is a logical next step. ENVIP community, ISO/TC211, OGC etc.

• Further work is needed on semantic interoperability and composition.
SWING Showcase

See: Showcase video at:

http://138.232.65.156/swing
In case of semantical query, the Keywords are only used to precise this query...
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<thead>
<tr>
<th>Queries</th>
<th>Proposed Concepts</th>
<th>Proposed Triples</th>
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Experience from the use steps as in use case 2, testing further information concerning road on between quarry and service is implemented based on the map.