

Semantic Grid Infrastructure for Applications in Biomedicine

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Outline

- Semantic Grid
 - Grid, Grid Services, OGSA
 - Semantics, Ontologies
 - Semantic Web Services
- SEAGRIN – Semantic Grid Infrastructure
 - Biomedical grid
 - “Overlay grid”

Grids

- **Computational grids** for sharing high-end resources (supercomputers)
- sharing across organization boundaries more important than computations
- **Collaborative grids** for videoconferencing and remote control of instruments
- **Information grids** for sharing data and knowledge



Grid services

- 1st generation grids (SETI@home) made ad hoc
- 2nd generation (Globus2) used many specialized protocols (GRAM, GASS, LDAP, GridFTP, ...)
- 3rd generation based on Web Services - SOAP/ XML messaging and open standards

OGSA

- Open Grid Services Architecture defined by Global Grid Forum
- WS-Resources for lifecycle and state
- security using PKI, X509 and proxy certificates
- described on syntactic level only (WSDL)
- must know exact names of services, operations, data types

Semantic web and ontologies

- semantics (meaning) defined by ontologies
- ontology captures knowledge about some domain, using a taxonomy and inference rules (next slide)
- standard OWL – Web Ontology Language defined by W3C, based on XML, 3 versions - Light, DL, Full
- classes, properties, individuals referenced by URIs
- OWL ontologies can be composed from smaller parts
- OWL DL allows automated reasoning (RACER)

Ontology example

The screenshot shows an ontology editor interface with the following components:

- Top Bar:** Includes tabs for OWLClasses, Properties, Forms, Individuals, Metadata, and OWLViz.
- Subclass Relationship Panel:** Displays an asserted hierarchy for the project 'pizza'. The hierarchy is:
 - owl:Thing
 - Pizza
 - CheesyPizza
 - NamedPizza
 - AmericanaHotPizza
 - AmericanaPizza
 - MargheritaPizza (selected)
 - SohoPizza
 - VegetarianPizza
 - PizzaBase
 - DeepPanBase
 - ThinAndCrispyBase
 - PizzaTopping
 - CheeseTopping
 - MozzarellaTopping
 - ParmezanTopping
 - MeatTopping
 - HamTopping
 - PepperoniTopping
 - SalamiTopping
 - SpicyBeefTopping
 - SeaFoodTopping

- Class Editor Panel:** Shows details for the class 'MargheritaPizza' (instance of owl:Class).
- Name:** MargheritaPizza
- SameAs:** (empty)
- DifferentFrom:** (empty)
- Annotations:** A table with columns Property, Value, and Lang. It contains one entry: Property: rdfs:comment, Value: pizza that has only tomato ar..., Lang: (empty).
- Asserted Conditions:** A list of conditions for the class:
 - NamedPizza (NECESSARY & SUFFICIENT)
 - \forall hasTopping (MozzarellaTopping \sqcup TomatoTopping) (NECESSARY)
 - \exists hasTopping TomatoTopping (NECESSARY)
 - \exists hasTopping MozzarellaTopping (NECESSARY)
 - \exists hasBase PizzaBase (INHERITED [from Pizza])
- Properties Panel:** Shows properties for the class:
- hasBase (single PizzaBase) with a restriction to PizzaBase [from Pizza]
- hasTopping (multiple PizzaTopping) with a restriction to MozzarellaTopping \sqcup TomatoTopping
- Disjoints Panel:** Lists disjunct classes: SohoPizza, AmericanaHotPizza, and AmericanaPizza.

Semantic web services

- each grid service is a web service
- semantic web techniques can be applied
- semantic web services described by
 - Data semantics (I/O data)
 - Functional semantics (operations)
 - QoS semantics (price, availability, ...)
 - Execution semantics (preconditions, ...)
- not yet standardized, OWL-S vs. WSDL-S

Semantic Web

- “extension of the current Web in which information is given a well-defined meaning”

Semantic Grid

- “extension of the current Grid in which information and services are given a well-defined meaning”

Biomedical grid

- project MediGrid (CESNET, Faculty Hospital Motol, Masaryk Hospital in Ústí nad Labem)
- the goal is biomedical grid for collaboration of specialists from various areas
- grid deals with heterogeneity, security
- semantics used for modularity and services composition

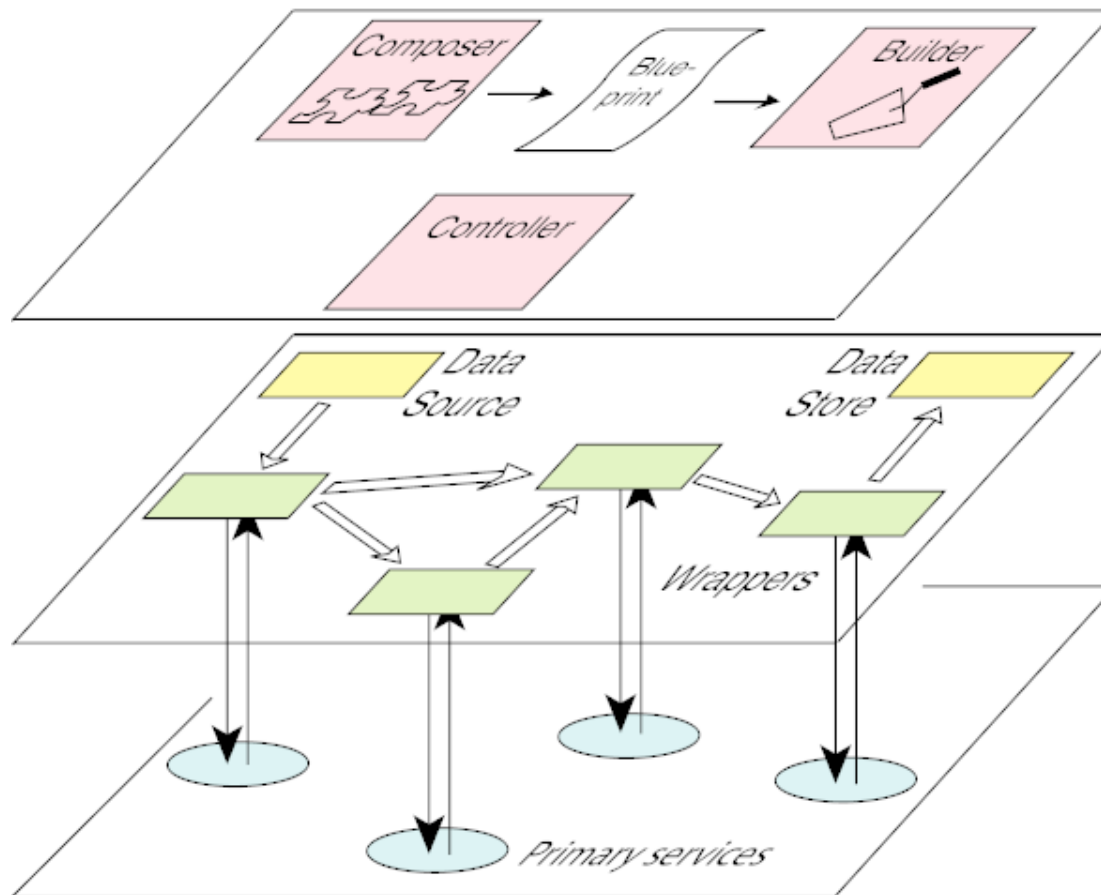
SEAGRIN

- **S**emantic **A**daptive **G**rid **I**nfrastructure
- Primary Services – semantic web services
- semantic descriptions of input and output data types used for composing workflows
- output of some services used as input of other services
- workflow is decentralized
- each primary service has a Wrapper Service – grid service

SEAGRIN (2)

- communication is among Wrappers
- Wrapper adapts data for its service
 - translation – syntactic transformation (tag names)
 - conversion – for example imperial/SI units
 - merging of multiple input data into one message
 - splitting of output data into multiple messages

Overlay grid



SEAGRIN (3)

- more Infrastructure Services
 - Composer – creates blueprints for workflows
 - Builder – instantiates workflows
 - Controller – runs workflows
 - Nest – creates Wrappers on demand
 - Data Source, Data Store

Conclusions

- Semantic grid is a grid with well-defined meaning of information in machine-understandable form
- utilizes advances in semantic web and semantic web services
- in biomedicine can help collaboration among specialists

Thank you

- Questions ?