



K-Wf Grid



Knowledge-based Workflow System for Grid Applications

K-Wf Grid consortium,
Marian Babik
**Institute of Informatics, Slovak
Academy of Sciences**

Fraunhofer
Institut
Rechnerarchitektur
und Softwaretechnik



LogicDIS
GROUP

softeco SISMAT
information technology

- **K-Wf Grid objectives, requirements**
- **Workflows**
- **Knowledge**
 - Grid Organizational Memory
 - Knowledge Assimilation Agent
 - User Assistant Agent
- **Flood-forecasting application**

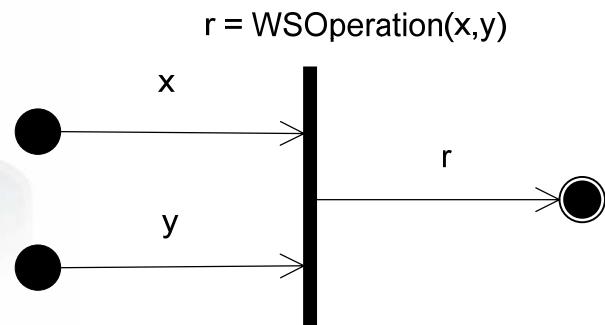
K-Wf Grid Objectives

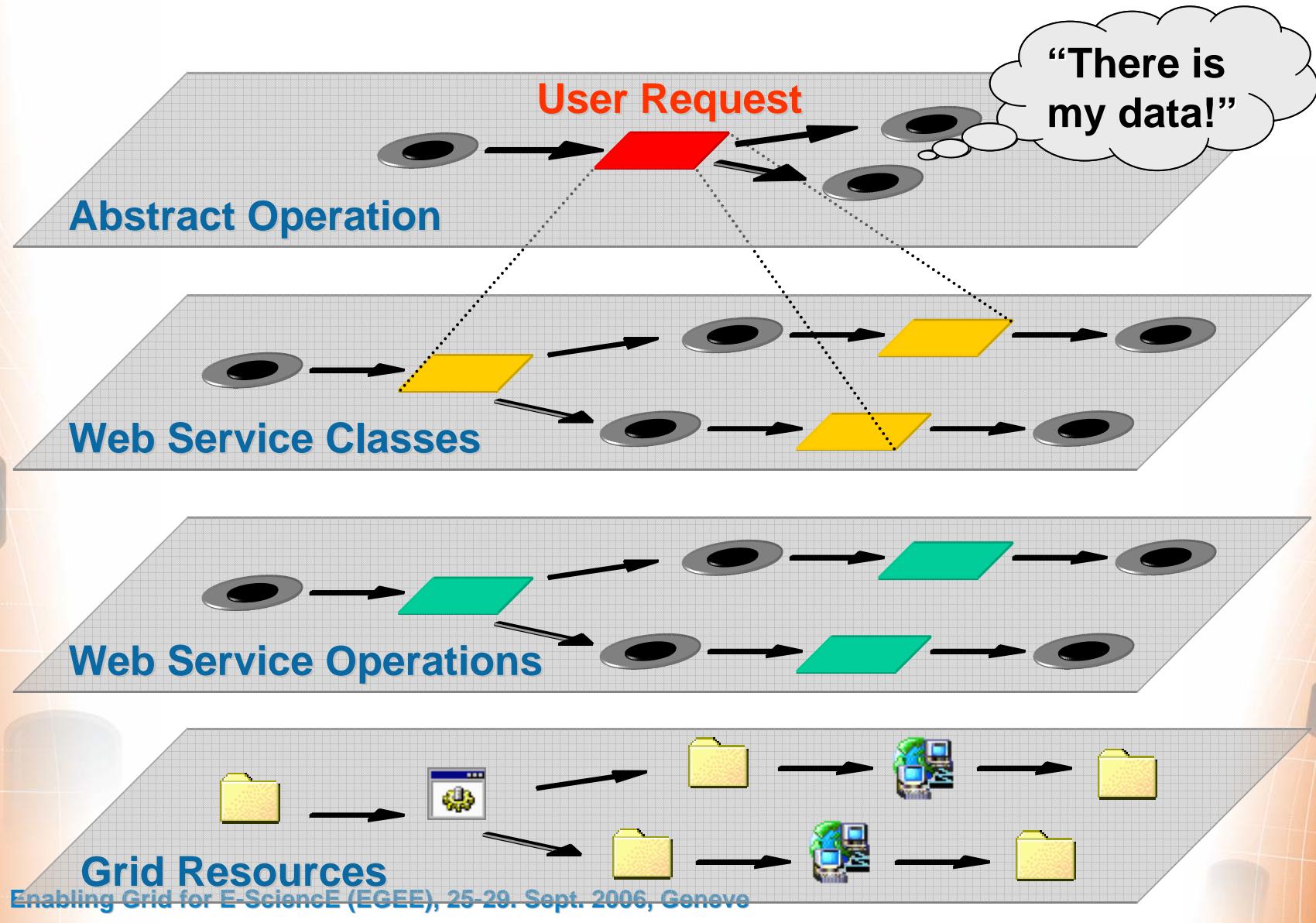
- ❑ **Integrating services into coherent application scenarios**
- ❑ **Enabling automatic construction and reuse of workflows with knowledge gathered during operation**
- ❑ **Involving monitoring and knowledge acquisition services in order to provide added value for end users**

□ Requirements:

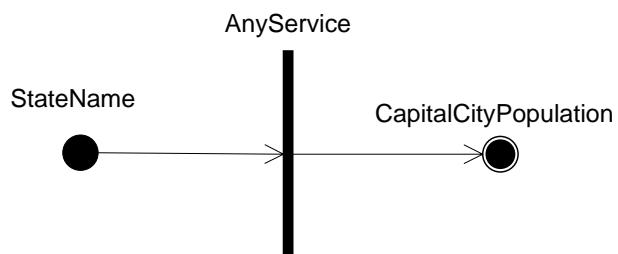
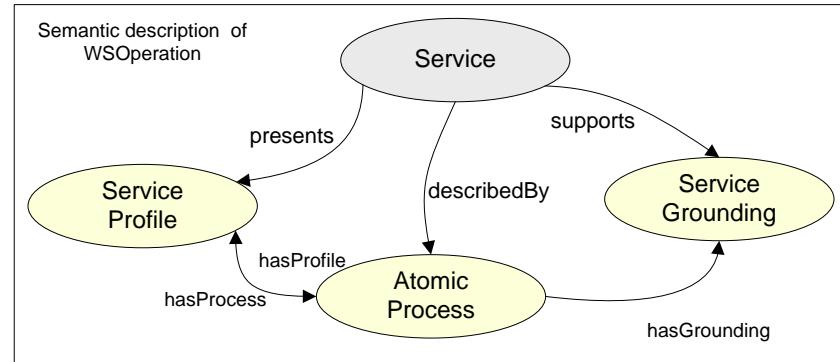
- Composition based on high-level objectives (e.g. flood forecasting for Bratislava tomorrow)
- Automated discovery, composition and invocation of heterogeneous services
 - Technology for merging heterogeneous meta-data about services is needed
 - Complex service descriptions
- Automated selection between different service providers of the same service
 - Quality of service and service provider meta-data
- Support for end-user interactions (manipulating workflows, end-user input, visualization)

- **Workflow – data and control flow**
- **Representation:**
 - Script-based workflows (GridAnt, BPEL4WS, etc.)
 - Graph-based (Symphony, DAGman, etc.)
 - Easier, more intuitive
 - Limited expressiveness
- **High-Level Petri Nets – GWorkflowDL**
 - Implicit parallelism, possibility to analyze workflows
- **Abstract/Concrete Workflow**
- **Composition done by backward-chaining WS operations**



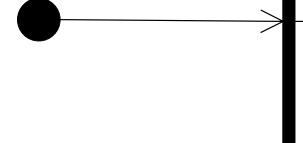


- Semantic Web technology
- Ontologies (OWL)
 - Grid Resources (CIM)
 - Data
 - Applications
 - Coordinated Traffic Management
 - Flood-forecasting
 - Enterprise Resource Modeling
 - Services (OWL-S)
 - Semantic Web/Grid Service descriptions (OWL-S)



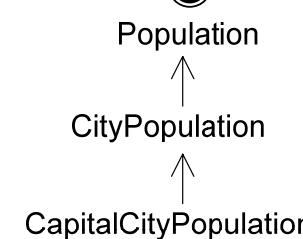
CapitalName StateCapitalService(StateName)

StateName



CityName CityPopulService(Population)

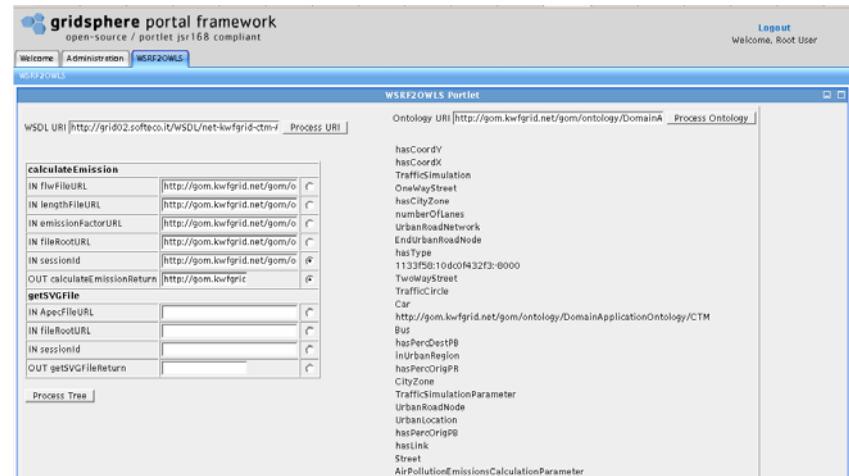
Capital Name
↑
CityName



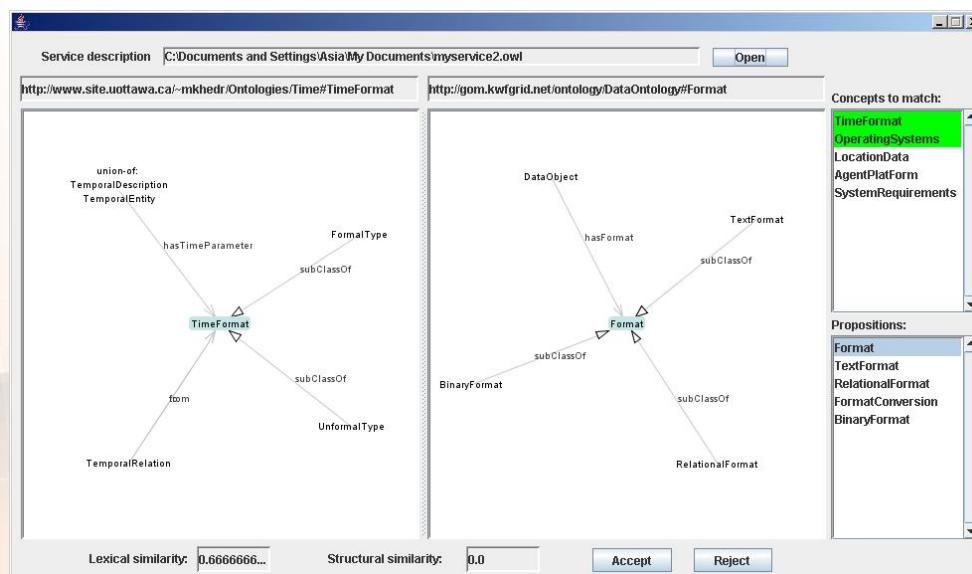
Knowledge Repository (Grid Organizational Memory)

- Distributed knowledge repository
 - Service index
 - RDQL, SPARQL
 - User Interface through Protégé

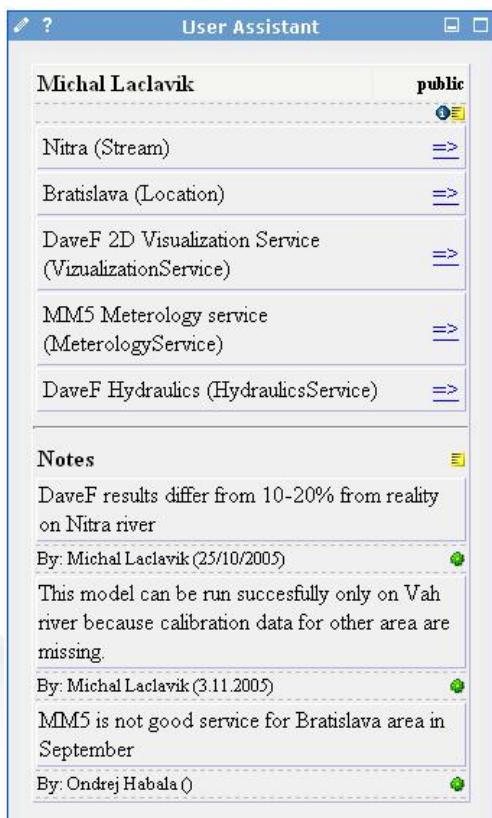
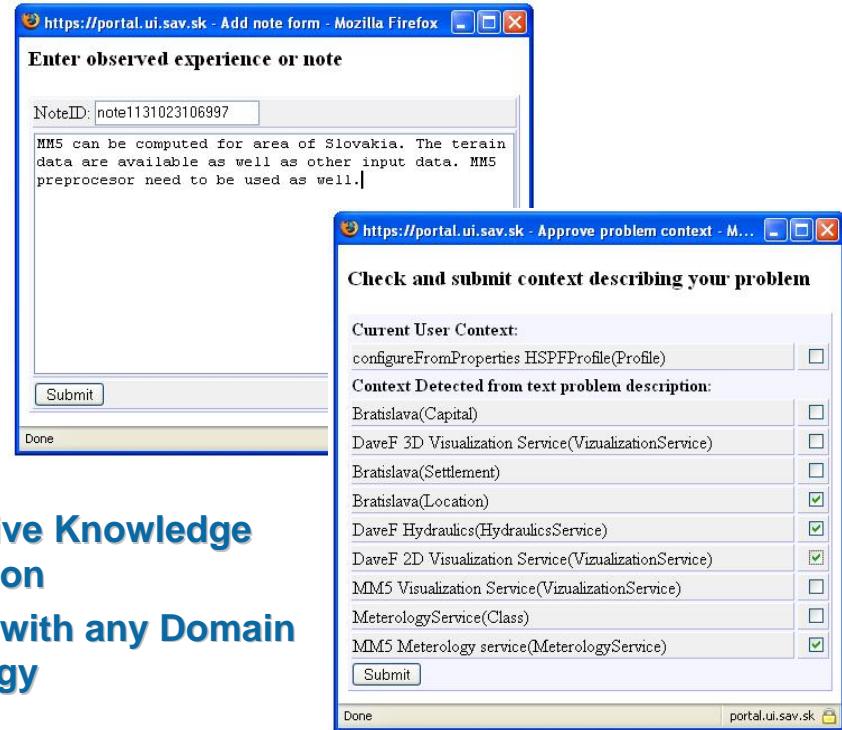
- **Workflow Analysis and Recommendation**
 - Workflow history
 - Matching workflows for a given problem
 - Workflow recommendation
- **Translation of WSDL to OWL-S (wsrf2owl-s tool)**
- **Ontology alignment (OnTal)**



The screenshot shows the wsrf2owl-s tool interface. It displays a table of WSDL URIs and their corresponding OWL-S components. The columns include calculateEmission, getSVGFile, and getSVGFileReturn. The rows show various parameters and their URLs, such as IN fluFileURL, OUT calculateEmissionReturn, IN ApedfileURL, OUT getSVGFileReturn, etc. On the right side, there is a list of ontology terms including hasCoordV, hasCoordX, TrafficSimulation, OneWayStreet, hasCityZone, numberOfLanes, UrbanRoadNetwork, EndUrbanRoadNode, hasType, 11319B11D0C4F32F3-8000, TwoWayStreet, TrafficCircle, Car, Bus, hasPerceDestPB, InUrbanRegion, hasPerceOrgPR, CityZone, TrafficSimulationParameter, UrbanRoadNode, UrbanLocation, hasPerceOrgPB, hasLink, Street, and AirPollutionEmissionsCalculationParameter.



- **Collaboration among Users**
- **Knowledge Sharing and Recommendation**
- **User Problem Specification**
- **Representation of Experience or Knowledge**
 - **Text Notes**

The image contains two side-by-side browser windows.

Left Window: A form titled "Enter observed experience or note". It has a "NoteID" input field containing "note1131023106997" and a text area with the following text:
 MM5 can be computed for area of Slovakia. The terrain data are available as well as other input data. MM5 preprocessor need to be used as well.

Right Window: A form titled "Check and submit context describing your problem". It has a "Current User Context" section with "configureFromProperties HSPFProfile(Profile)" and a "Context Detected from text problem description" section with several items checked:

- Bratislava(Capital)
- DaveF 3D Visualization Service(VizualizationService)
- Bratislava(Settlement)
- Bratislava(Location)
- DaveF Hydraulics(HydraulicsService)
- DaveF 2D Visualization Service(VizualizationService)
- MM5 Visualization Service(VizualizationService)
- MeterologyService(Class)
- MM5 Meterology service(MeterologyService)

 There is a "Submit" button at the bottom.

- **Proactive Knowledge Provision**
- **Works with any Domain Ontology**

Current work:

- **Experience (Knowledge) Management**
- **Knowledge, Semantic, Ontologies**
- **Text Processing & Semantic Annotation**
- **User Interaction**
- **Knowledge Relevance, Problem Detection**

Monitoring and Analysis: Performance Analysis and Visualization

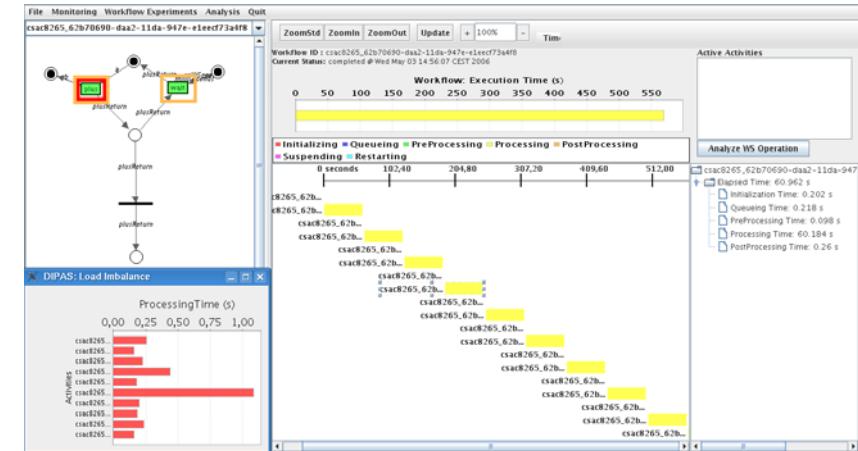
- Basic dependability analysis
- New performance visualization of workflows

Rule-based performance analysis

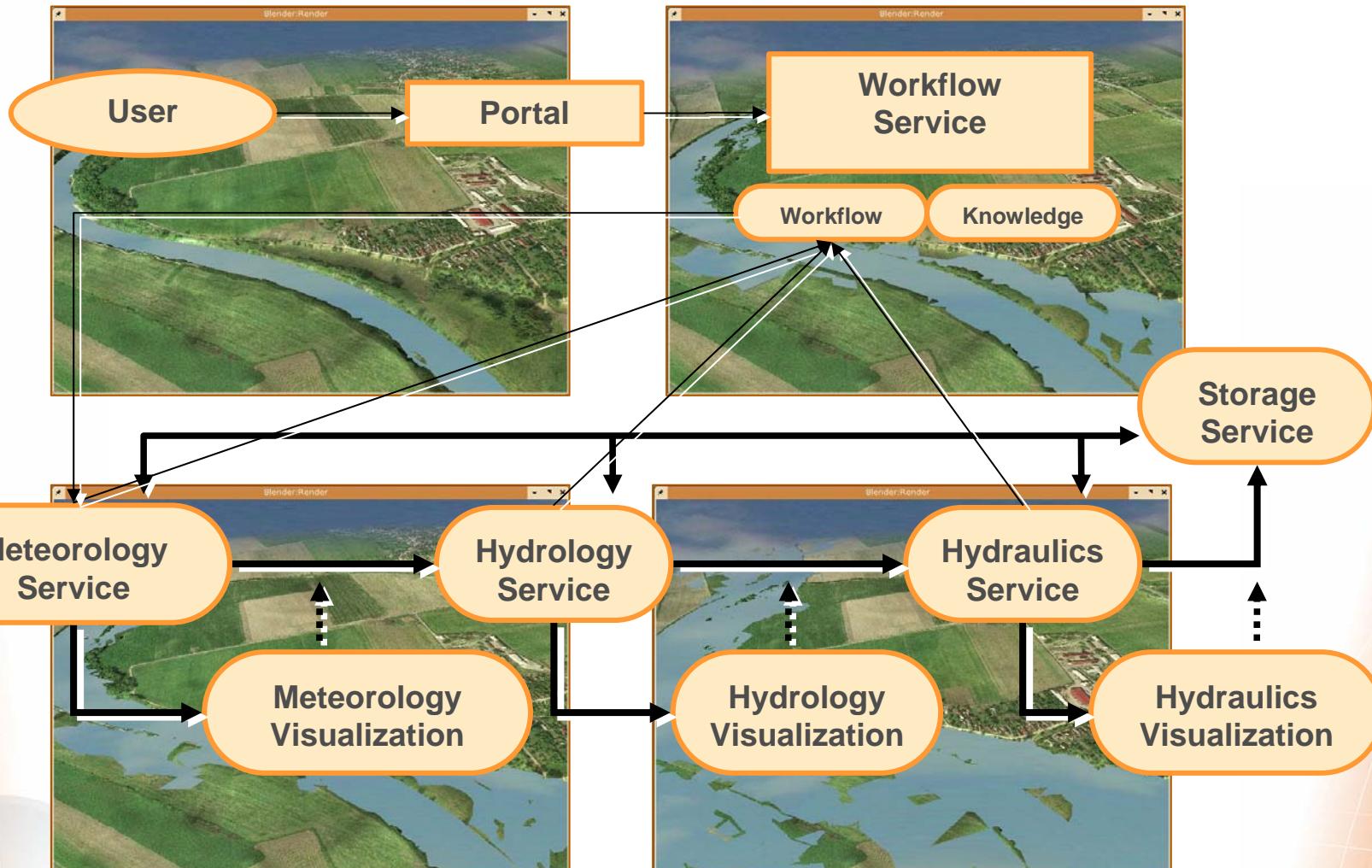
- Overhead classification
- Specification of performance problems
- Determining the severity of performance metrics for workflow activities during runtime
- Applying rules to raise an alarm when condition performance problem conditions are encountered.

Publications:

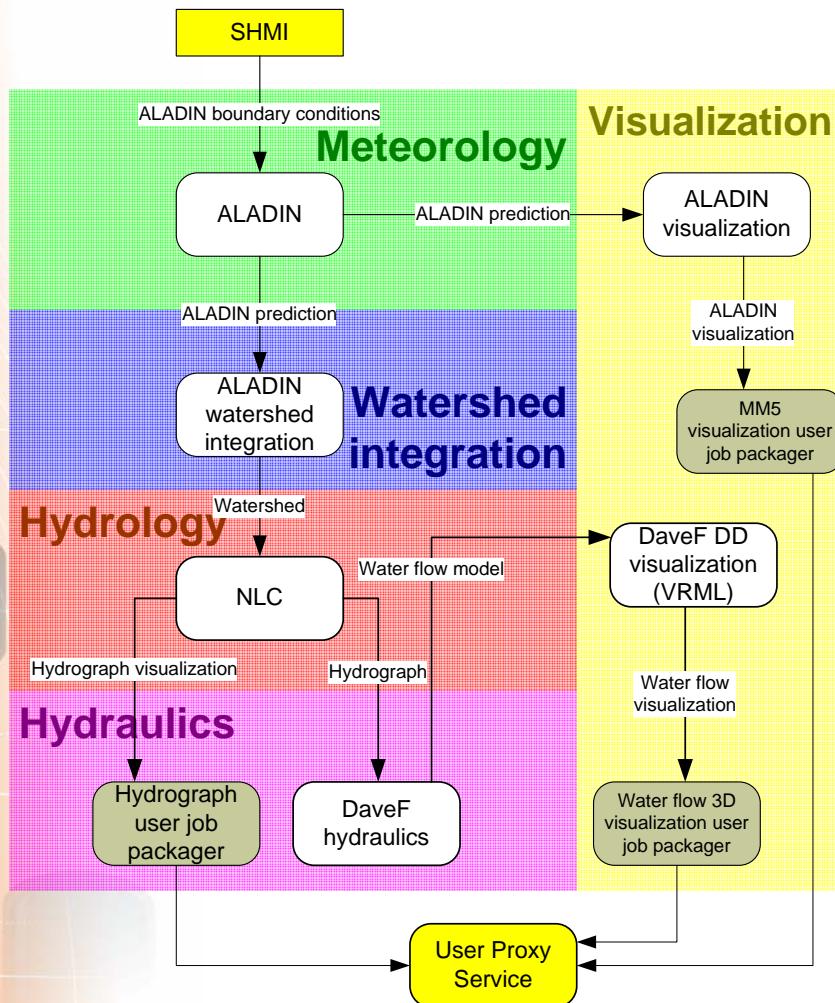
- Peter Brunner, Hong-Linh Truong, **Performance Monitoring and Visualization of Scientific Grid Workflows in ASKALON**, April 2006. Submitted.
- Francesco Nerieri, Radu Prodan, Thomas Fahringer: **Kalipy: a tool for online analysis of Grid workflows through Event Correlation**, May 2006. Submitted.
- Francesco Nerieri, Radu Prodan, Hong-Linh Truong: **Performance Analysis of Grid Workflow Applications**, May 2006. Submitted.



Flood-forecasting Application



Flood-forecasting Application



□ Meteorology

- MM5Preprocessor, MM5 (simple, nested), Aladin

□ Watershed integration

- MM5Integration, 81-way MM5, MM52NAM, MM52DSS

□ Hydrology

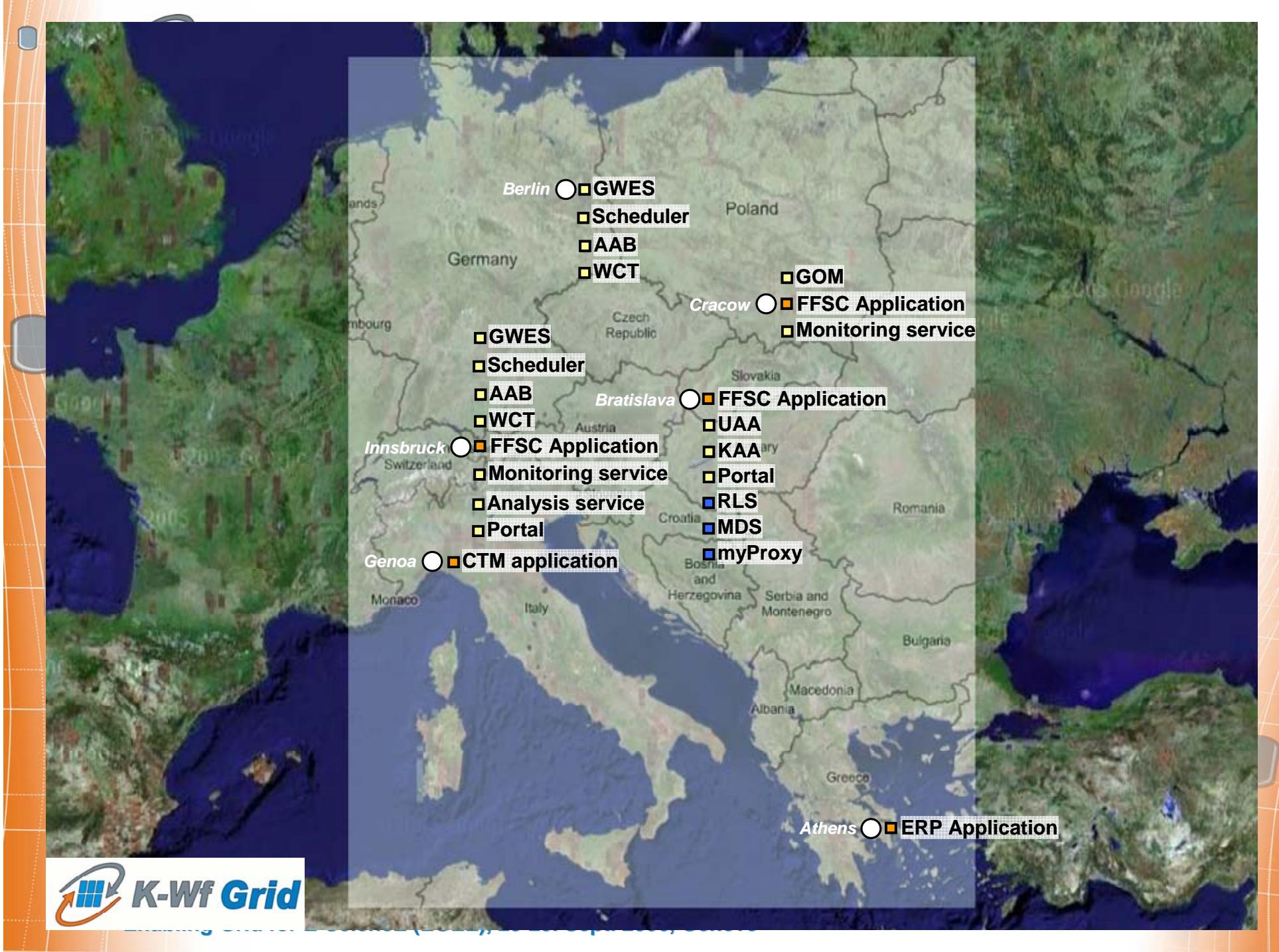
- HSPF, HSPF-Complex, NLC, NAM-MIKE, HEC-HMS

□ Hydraulics

- DaveF, MIKE 11 HD, MIKE 11 Flood, HEC-RAS

□ Visualization

- MM5, DaveF 2D, DaveF 3D, Aladin, HEC-GeoHMS, HEC-GeoRAS



Adresse <https://portal.ui.sav.sk/kwfportal/gridsphere?cid=kwf-ua&JavaScript=enabled> Wechseln zu

K-Wf Grid

Welcome Grid Kwf-Grid Collaboration Monitoring and Analysis

Logout
Welcome, Andreas Hoheisel

Log Viewer Workflows Knowledge Data KAA Service

Workflow Applet

https://portal.ui.sav.sk - Add problem form - Microsoft Internet Explorer

Enter text description of your current problem

ProblemID: problem1131492071868

flood forecasting Bratislava

Submit

Workflow has been initiated.

User Assistant

Andreas Hoheisel public

DaveF Hydraulics (HydraulicsService) =>

DaveF 3D Visualization Service (VizualizationService) =>

DaveF 2D Visualization Service (VizualizationService) =>

Notes

This model can be run successfully only on Vah river because calibration data for other area are missing.

By: Michal Laclavik (3.11.2005)

Fertig Internet

Start GridSphere Por... Java Console http://grid02.s... https://porta... Camtasia Studi... DE 97% 00:20

Enabling Grid for E-SciencE (EGEE), 25-29. Sept. 2006, Geneve

Adresse <https://portal.ui.sav.sk/kwfportal/gridsphere?cid=kwf-ua&JavaScript=enabled> Wechseln zu

K-Wf Grid

Welcome Grid Kwf-Grid Collaboration Monitoring and Analysis

Logout
Welcome, Andreas Hoheisel

Log Viewer Workflows Knowledge Data KAA Service

Workflow Applet

Check and submit context describing your problem

Current User Context:

- DaveF Hydraulics(HydraulicsService)
- DaveF 3D Visualization Service(VizualizationService)
- DaveF 2D Visualization Service(VizualizationService)

Context Detected from text problem description:

- Location(Class)
- Bratislava(Location)
- DaveF 3D Visualization Service(VizualizationService)
- Bratislava(Capital)
- DaveF 2D Visualization Service(VizualizationService)
- DaveF Hydraulics(HydraulicsService)
- Bratislava(Settlement)

Submit

Fertig Internet

Workflow has been initiated.

User Assistant

Andreas Hoheisel public

- DaveF Hydraulics (HydraulicsService) =>
- DaveF 3D Visualization Service (VizualizationService) =>
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K-Wf Grid

Welcome Grid Kwf-Grid Collaboration Monitoring and Analysis

Logout
Welcome, Andreas Hoheisel

Log Viewer Workflows Knowledge Data KAA Service

Workflow Applet

Workflow has been initiated.

Workflow Applet

?

Workflow diagram:

```
graph TD; Start(( )) --> Task1[ ]; Task1 --> Task2{ ? };
```

User Assistant

Andreas Hoheisel public

- DaveF Hydraulics (HydraulicsService) =>
- DaveF 3D Visualization Service (VizualizationService) =>
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Notes

This model can be run successfully only on Vah river because calibration data for other area are missing.

By: Michal Laclavik (3.11.2005)

November 8, 2005

Enabling Grid for E-SciencE (EGEE), 25-29. Sept. 2006, Geneve



K-Wf Grid



Portal

K-Wf Grid

Welcome Grid Kwf-Grid Collaboration DG-AP Monitoring and Analysis

Logout
Welcome, Ondrej Habala

Log Viewer Workflows Knowledge Data Problem specification KAA WS Ontal Tool Workflow History Scheduler status Workflow list

Workflow Applet

User Assistant

User: Ondrej Habala

User Context Define Problem

User Help (Resource)

Info & Knowledge Add Knowledge

By clicking on Define Problem you can specify your problem using plain text which will be translated to formalized elements of application description
By: System (2006-08-10) 0.0

By clicking on Add Knowledge you can type new knowledge gathered which can be useful for you or other users in a future. You will be prompted with application specific formalized elements which can be assigned to knowledge as a context in which knowledge will be displayed in a future
By: System (2006-08-10) 0.0

Task List

Provide input data: MM5PreprocessorService: prop

Workflow Control

Workflow has been terminated.

August 23, 2006

Enabling Grid for E-SciencE (EGEE), 25-29. Sept. 2006, Geneve

- **K-Wf Grid, live demo at Cracow Grid Workshop 2006 and IST 2006**
 - <http://www.kwfgrid.eu>
- **Grid workflows**
 - GWorkflowDL, GWES
 - <http://www.gridworkflow.org>
 - Andreas Hoheisel, et.al.: A Grid Workflow Language Using High-Level Petri Nets,
- **Workflow composition (WCT)**
 - Tomasz Gubala, et.al. Semantic-based Grid Workflow Composition, In: Proc. of 6-th Intl. Conf. on Parallel Processing and Applied Mathematics PPAM'2005
- **Grid Organizational Memory (GOM)**
 - Bartosz Kryza, Kryza, B., Pieczykolan, J., Majewska, M., Slota, R., Babik, M., Toth, A., Kitowski, J., Hluchy, L.: Grid Organizational Memory - Semantic Framework for Metadata Management in the Grid, CGW 2006
- **Monitoring and Analysis**
 - Peter Brunner, Hong-Linh Truong, Performance Monitoring and Visualization of Scientific Grid Workflows in ASKALON, April 2006
- **WSRF2OWL-S Implementation**
 - Marian Babik, <http://www.tuke.sk/felcit/babik/wsrf2owl>
- **Knowledge Assimilation Agent (KAA)**
 - Zoltan.Balogh@savba.sk
- **UAA, Experience management**
 - Laclavik M., et.al. : Ontology based Text Annotation OnTeA. In: Proc. of 16-th European-Japanese Conf. on Information Modelling and Knowledge Bases, EJC'2006
 - <http://www.ikt.ui.sav.sk>

- **Meteorology**
 - MM5Preprocessor, MM5 (simple, nested), Aladin
- **Watershed integration**
 - MM5Integration, 81-way MM5, MM52NAM, MM52DSS
- **Hydrology**
 - HSPF, HSPF-Complex, NLC, NAM-MIKE, HEC-HMS
- **Hydraulics**
 - DaveF, MIKE 11 HD, MIKE 11 Flood, HEC-RAS
- **Visualization**
 - MM5, DaveF 2D, DaveF 3D, Aladin, HEC-GeoHMS, HEC-GeoRAS

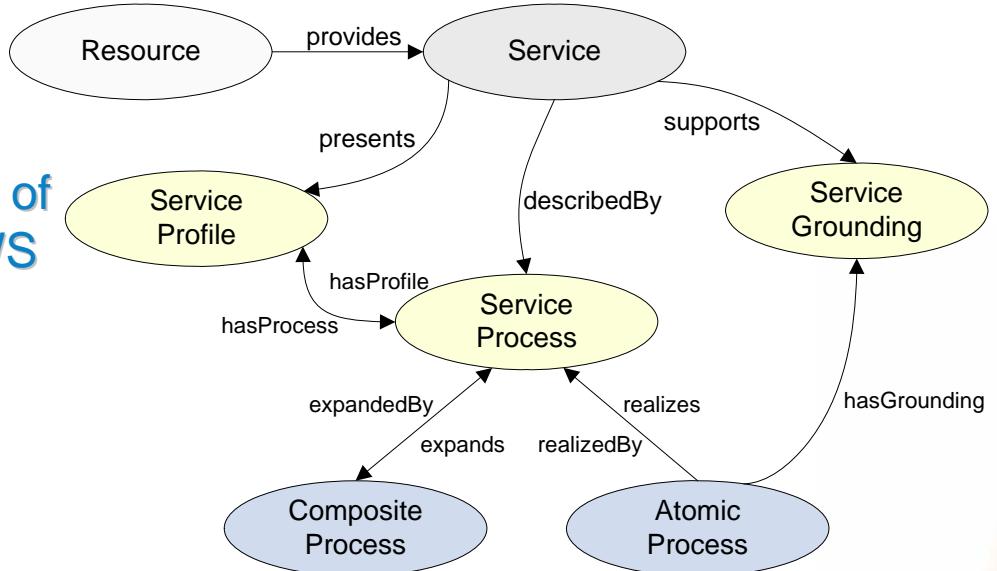
- **Workflows based on the Petri nets**
 - GWorkflowDL
- <http://www.gridworkflow.org>
 - Martin Alt, Sergei Gorlatch, Andreas Hoheisel and Hans-Werner Pohl. A Grid Workflow Language Using High-Level Petri Nets. In Second Grid Resource Management Workshop, Poznan, Poland, September 2005.
- **Workflow composition done by backward-chaining OWL-S IOPEs**
 - Tomasz Gubala, Marian Bubak, Maciej Malawski, Katarzyna Rycerz. Semantic-based Grid Workflow Composition, In: Proc. of 6-th Intl. Conf. on Parallel Processing and Applied Mathematics PPAM'2005
- **Annotation**
 - Laclavik M., et.al. : [Ontology based Text Annotation OnTeA](#). In: Proc. of 16-th European-Japanese Conf. on Information Modelling and Knowledge Bases, EJC'2006,

Semantic Web Services

- ❑ **Web Service Modeling Ontology (WSMO)**
- ❑ **WSML, WSMX**
- ❑ **Based on four concepts:**
 - Web services
 - Ontologies
 - Goals
 - Mediators
- ❑ **Internet Reasoning Service (IRS-III)**
- ❑ **Implementation of WSMO**
- ❑ **OWL-S (DAML-S)**
- ❑ **BBN, Carnegie-Mellon, Nokia, Stanford, SRI Int., Yale**
- ❑ **Upper ontology for semantic web services**
- ❑ **Benefits from developments in agent based and planning technologies**
- ❑ **WSDL-S**
- ❑ **Identifies four basic categories of semantics**
 - data semantics
 - functional semantics
 - execution semantics
 - quality-of-service semantics
- ❑ **WSDL-S, Enhanced UDDI**

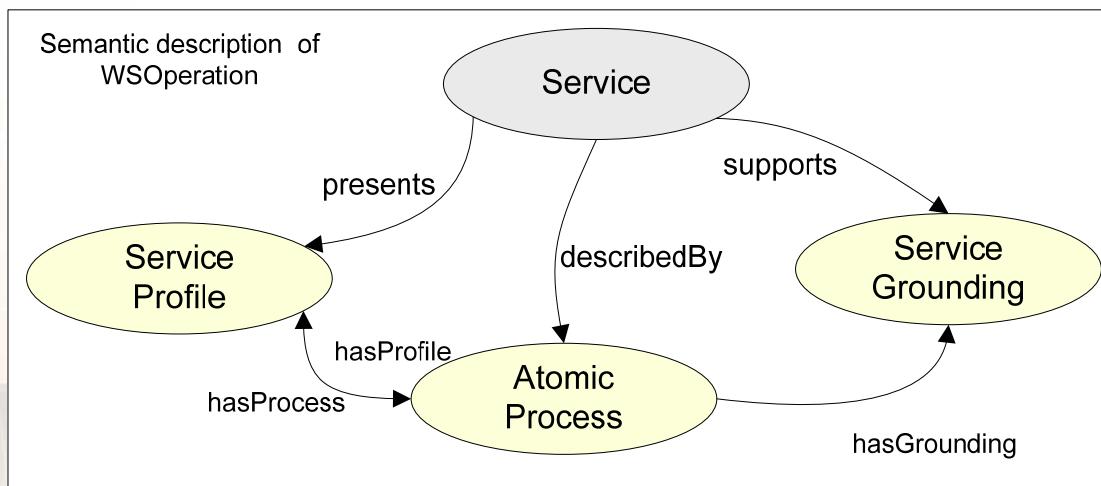
Semantic Web Services (OWL-S)

- **OWL-S Profile**
- **Functional properties**
 - describes transformation of data and states during WS execution (IOPEs)
 - Inputs
 - Outputs
 - Preconditions
 - Effects
- **Non-functional properties**
 - Semi-structured information intended for human users
 - ServiceName
 - ServiceDescription
 - ServiceParameter e.g. quality of service, security, geographical scope



- **OWL-S Grounding**
 - abstract concepts of OWL-S Profile to concrete WSDL messages

- **Create ontology with domain concepts (watershed, geographical location, etc.)**
- **Map these concepts to the inputs, outputs, precondition and effects of Service Profile**
- **During composition determine the “equivalence” of concepts**

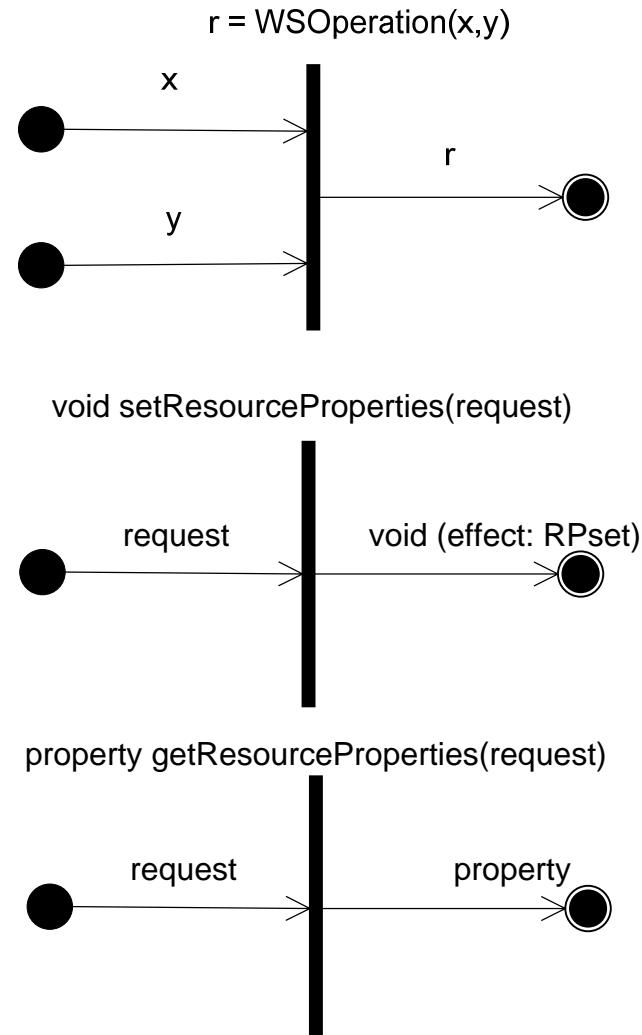


□ Web Services

- WS Operation
 - Inputs
 - Outputs

□ Grid Services

- WS Operation
 - Inputs
 - Outputs
 - Resource Properties



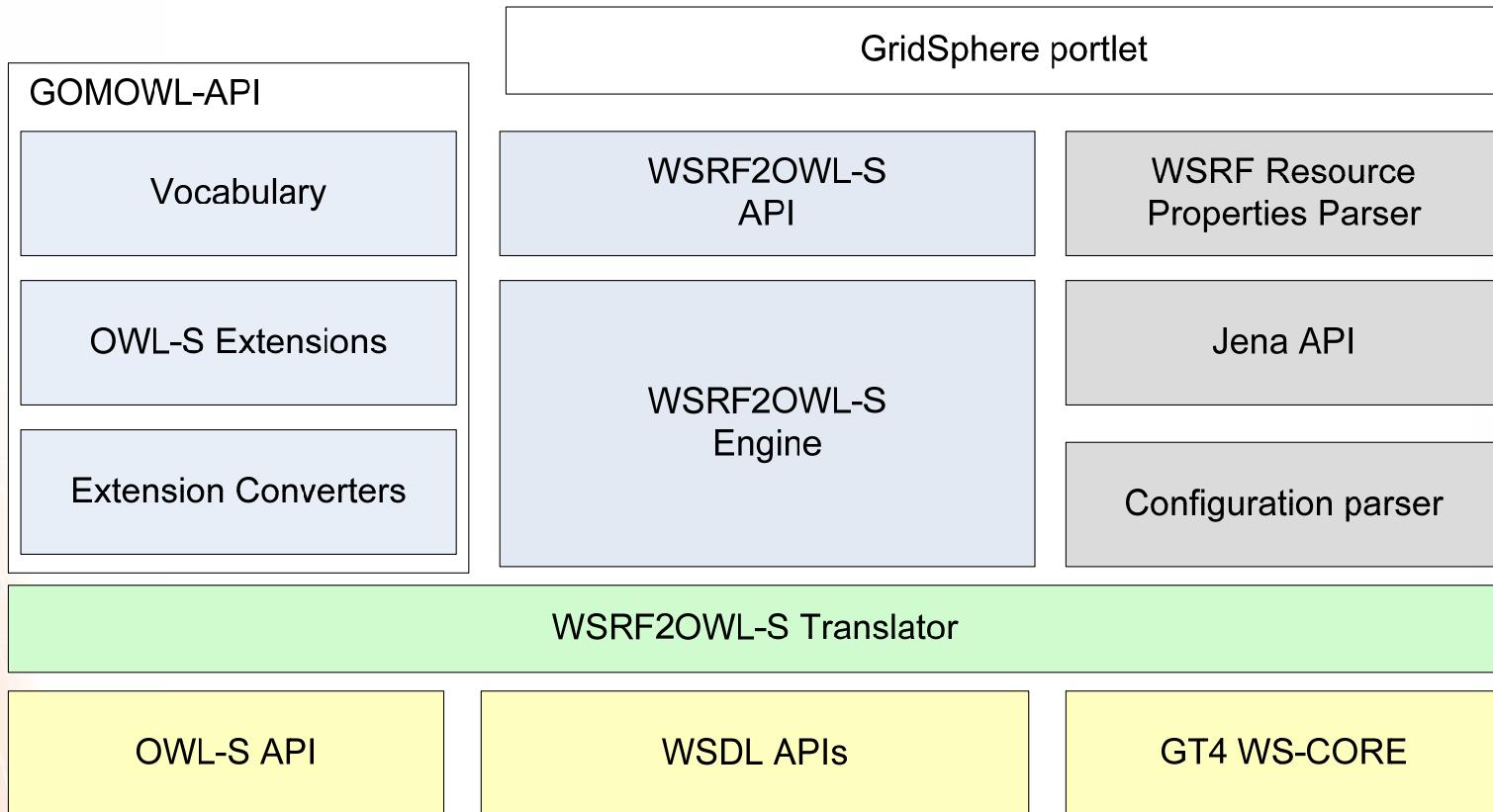
- **Service discovery issues:**
 - Resource properties can be dynamic
 - Resource properties inheritance
 - Explicit inputs/outputs hiding
- **Service invocation issues:**
 - EPR of the WS-Resource
 - Multiple providers
- **Service annotation**
 - based on extending WSDL (similar to WSDL-S)
 - Case-based reasoning (text notes)

□ **WSRF2OWL-S**

- OWL-S 1.1 support
- WSRF Services support (WSDL)
- Configuration supports inputs/outputs/precondition/effects
- Sample configuration and corresponding OWL-S descriptions for the Flood-Forecasting pilot application
- Automatic parsing of the WSDL and generation of the WSDL part of the configuration
- Generating configuration based on annotations (ongoing)
- graphic user interface via GridSphere portlet

□ **Other implementations**

- CMU's WSDL2OWL-s
- MINDSWAP's WSDL2OWL-S (part of OWL-S API)



□ **Grid Organizational Memory (GOM)**

- Distributed knowledge repository
- Service repository
- RDQL, SPARQL
- Integrated into Protégé

- Kryza, B., Pieczykolan, J., Majewska, M., Slota, R., Babik, M., Toth, A., Kitowski, J., Hluchy, L.: Grid Organizational Memory - Semantic Framework for Metadata Management in the Grid, to appear, In Proceedings of the Cracow Grid Workshop 2006, Academic Computer Centre CYFRONET AGH

- **SWS**
 - WSMO, OWL-S, WSDL-S
- **Semantic Grid**
 - S-OGSA, OntoGrid
 - IntelliGrid
 - China KnowledgeGrid
 - myGrid
 - NextGrid
 - Akogrimo
 - Grisino

- **Abstract/Concrete workflow**
 - Description of workflow on non-executable level
 - Binding to service providers
- **Basic element of workflow**
 - WS operation
- **Composition done by backward-chaining WS operations**