Adaptable Environmental Service Chains: The Challenges of Distributed Execution and Information Collection

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Envision Project Details

• Environmental Services Infrastructure with Ontologies (Envision)

• Consortium
  – SINTEF ICT {Coordinator, Workflow Editing Component}
  – SINTEF MET {Oil Spill Scenario Provider}
  – BRGM {Landslide Scenario Provider, Portal Components}
  – University of Muenster {Technical Coordinator, Ontologies}
  – Institut Jozef Stefan {Annotation, Stream Mining}
  – National and Kapodistrian University of Athens {Execution Infrastructure}
  – University of Innsbruck {Discovery, Semantics}
  – Norwegian Mapping Agency {Standardization, Scenario Providers}
Outline

• Introduction
• Goal of the Paper
• Data-Driven Process Adaptation
• Proposed Approach
  – Architecture
  – Semantic Context Space Engine
  – Service Orchestration Engine
• Conclusions
Introduction: Trends

- Environmental Information Systems (EIS) are shifting towards the Service Oriented Computing (SOC) paradigm
  - Several initiatives and directives are spurring this transformation, e.g. INSPIRE, GMES or SEIS

- Service Process Adaptation is being pursued since the onset of SOC
Challenges

• EIS are inherently associated to:
  – The use of information elements provided by numerous information sources available in the web or privately managed networks
  – Tasks that necessitate either the use of
    • large volumes of computational resources or
    • the manipulation and exchange of large sets of information elements
Goal of this Paper

• To outline an approach supporting the
  – Adaptation of environmental service chains, leveraged by the
  – Collection of information from several sources, and the
  – Distributed execution of service chains
Data-Driven Adaptation

• Enables a service process to utilize the information available within its environment and adapt its execution accordingly

• Process state depends
  – on the values of its internal parameters,
  – on the outcomes from the invocation of constituent services and/or on its internal operations, and
  – on information pertaining to the process environment
High Level Architecture
Semantic Context Space Engine

- Provides an open space where one may place relevant information. The SCS Engine leverages one to:
  - *Write and Retrieve* information within the process’s environment and
  - *Logically Group* information of interest to a specific domain and
    *Specify associations* among logical information groups

- Technically it:
  - Provides an implementation of the Tuplespace paradigm
  - Incorporates appropriate extensions to support semantic as well as
    spatiotemporal annotations
Service Orchestration Engine

• Provides a BPEL-based engine that facilitates
  – The distributed execution of heterogeneous service processes (e.g. Web & OGC service processes)
  – The monitoring and reconfiguration of process execution according to preconfigured adaptation steps specified by the Process Optimizer

• Technically it (is):
  – Based on an existing BPEL engine, i.e. Apache ODE engine
  – Incorporates a P2P overlay to support the distribution of a service process
Service Orchestration Engine (cont)

Graphical representation showing interactions between different data sources and processes:
- Weather and Sea Observations
- Bathymetry
- Coastline
- Location, Date, Discharge, OilType
- OilSpillModel
- ODE Runtime

Processes:
- S: Sequence
- A1: Assign
- I1: Invoke PredictOilDrift
- I2: Invoke PredictCodEffects
- R1: Receive
- R2: Reply

Data nodes:
- OilDriftPrediction
- CodPopulationData

Other nodes:
- RH: Resource Handler
- Peer Node
- Advertisement
Conclusions

- The presented approach:
  - Accommodates the provision of data-driven adaptable heterogeneous service processes
  - Can support the requirements imposed by EIS, e.g. exchanged of large volumes of information, etc.
  - Promotes the decoupling among collaborating parties
Environmental Services Infrastructure with Ontologies (Envision)

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