Reliable Web Service Execution and Deployment in Dynamic Environments*

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* This research is done in cooperation with the Advanced Infrastructure Program (AIP) group of SAP.

Outline

- Architecture of ServiceGlobe
- Dynamic Service Selection
- Load Balancing and Service Replication
- Current Utilization of the TechniquesConclusion

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Architecture of ServiceGlobe

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The ServiceGlobe System

- ServiceGlobe is an open, distributed, and extensible service platform developed for research purposes
- Fully implemented in Java 2
- Based on standards like XML, SOAP, UDDI, WSDL,...
- Offers standard functionality of a service platform
 - secure communication
 - □ transaction system
 - security system
- Supports mobile code, i.e., services can be distributed and instantiated during runtime on demand
 - > needed for automatic service replication

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Motivation Dynamic Service Selection



ServiceGlobe - Reliable Web Service Execution and Deployment in Dynamic Environments

Dynamic Service Selection

- DSS uses UDDI:
 - UDDI assigns Web services to tModels
 - tModel: semantic classification of functionality and formal description of interface
- DSS is 'Calling a tModel' instead of the traditional 'Calling a Web service'
- Web services are selected at runtime not at development time.
- Constraints can be used to influence Web service selection and invocation
- → Dynamic fusion of Web services
- → Reliable Web service execution

Survey of Dynamic Service Selection



Classification of Constraints



Constraints

Types of constraints:

- Metadata Constraints
- Location Constraints
- Mode Constraints
- Reply Constraints
- Result Constraints
- Constraints are either Preferences or Conditions
- Constraints can be combined using logical operators

Metadata Constraints

- XPath queries applied to service metadata
- Metadata: UDDI + additional metadata
- Examples: <metadataPreference> /businessEntity/name= "Company" </metadataPreference> <metadataCondition> /ServiceMetadata/CostsPerCall="0"
 - </metadataCondition>

Location Constraints

- Selection based on the location of services (stored in UDDI)
- Example: <locationCondition addressType="Geographical" serviceType="All"> <center>DE-BY-PAS</center> <maxDistance>50km</maxDistance> </locationCondition>

Mode Constraints

- Specify the number of Web services to invoke
- Modes: One, Some, All
- Example:

<modeCondition modeType="Some" number="5%"/>

Reply Constraints

- Property Constraints:
 - Query properties of replies (signature, age of data, encryption,...)
 - Insertion of properties by Web services, service platforms
- Selection Constraints: XPath queries applied to SOAP response
- Example:

<propertyCondition> <maxAgeOfData unit="hours">2</maxAgeOfData> </propertyCondition>

Result Constraints

- Timeout Constraints
- First-N Constraints
- Examples:

<timeoutCondition value="100"</pre>

valueUnit="Seconds"/>

```
<firstNCondition number="10"
    numberType="Percentage"/>
```

Combination of Constraints

- Operators: AND, OR
- Example:

```
<andGroup>
  <metadataCondition>
    /businessEntity/name="Company"
  </metadataCondition>
    <timeoutCondition
      value="100"
      valueUnit="Seconds" />
  </andGroup>
```

Evaluation of Constraints

- Combine all constraints for a single tModel call conjunctively
- Transformation into DNF
- Resolve conflicts based on priorities
- Parallel evaluation of disjunctively combined AND terms



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Motivation

- A single service host is often not sufficient to provide low response times.
- Downtime can be costly.
- Integration of load balancing into services is error-prone and expensive.
- →Modular dispatcher service

Advantages of a Modular Dispatcher Service

- Can act as proxy for arbitrary services
- Software-based layer-7 switch realized as a regular service
 - seamlessly integrated into the platform
- It is possible to enhance many existing services or develop new services with load balancing and high availability features
 - as long as Concurrency control mechanisms are used (e.g., DBMS as back end)
- Additional feature: automatic service replication
 Reliable Web service deployment

Architecture of the Dispatcher





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Survey of the Load Balancing System



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Automatic Service Replication in Complex Environments



Availability using a Dispatcher

 $\alpha = \alpha_{ServiceHost} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$

$$\alpha_{pool} = \sum_{i=1}^{N} \alpha^{i} (1-\alpha)^{(N-i)} = 1 - (1-\alpha)^{N}$$

Example: MTBF = 48h, MTTR = 12h, 8 hosts
 1.5 minutes unavailable a year

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Current Utilization of the Techniques

- The presented technologies are currently integrated into SAP NetWeaver platform to supplement its service virtualization capabilities.
- A demonstration was shown at the SAPphire 2003, SAP's user conference.

SAP NetWeaver



ServiceGlobe - Reliable Web Service Execution and Deployment in Dynamic Environments

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- Single Point of Control
- Server Landscape and Application Service Management
- Dynamic Demand driven Resource
 Assignment
 - Change Management

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Conclusion

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We presented techniques for reliable Web service execution and deployment
 Dynamic Service Selection/Fusion and
 Load Balancing and Service Replication
 in the Context of ServiceGlobe

Thank You for Your Attention!



... any questions???



