ARTICLE REVIEW
On the Standardization of a Testing Framework for Application Deployment on Grid and Cloud Infrastructures

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AGENDA

- Definitions
- Introduction
- Testing Framework
- Interoperability Event
- Summary
- Bibliography
DEFINITIONS

- **Cloud Computing**
  - “...refers to the provision of computational resources on demand via a computer network.”
  - Infrastructure as a Service (IaaS): Hardware & Operating Software

- **Grid Computing**
  - “…referring to the combination of computer resources from multiple administrative domains to reach a common goal. …grids tend to be more loosely coupled, heterogeneous, and geographically dispersed.”
  - Computation Intensive Applications

- **Interoperability**
  - Agreed Specifications
  - Defined Architectures, Interfaces, and Protocols
  - Independent from Implementation

- **Testing Framework**
  - Defines a Structured Approach to Test Specifications
  - Within a Given Domain

- **Grid Component Model**
  - “component architecture and framework for the portability, and reusability of Grid applications, the integration with SOA infrastructures, and providing interoperability of GRID systems”
**WHY: FLEXIBILITY, INNOVATION, MARKETS**

- Business Units want more Choices due to Cost Pressures
- Multi-Vendor Integrations are Key to Product Success
- Conformance & Interoperability Testing Importance is Increasing
- Knowledge of Testing Frameworks and their Use will Increase your Success
PURPOSE OF THIS ARTICLE

- Customer: European Telecommunications Standards Institute
- Standardization of Cloud & Grid Software
- Presentation of a Testing Framework
- Assessment of Interoperability of Clouds & Grids
- Proof of Success at an Interoperability Event
Conformance vs Interoperability Testing

Conformance Testing
- Check an Implementation
- Follows the Requirements
- Functional Black-Box Testing
- Sophisticated Testing Tools

Interoperability Testing
- Demonstrates End to End Functionality
- Operates as Described or Implied by a Specification

ETSI Approach
- Hybrid
- Feedback on Standardization
- Economic Alternative to Full Conformance Testing
**Testing Framework: Grid Component Model**

- XML Resource Information
- CGM AD: Application Descriptors
- CGM DD: Deployment Descriptors
- CGM Differentiates between Infrastructures with Direct Access vs Indirect Access

![Diagram of GCM Architecture](image)

*Figure 2. GCM Architecture*
TEST ARCHITECTURE

- Isolation of Standards Interfaces
- Point of Control & Observation (PCO)

Figure 3. A test architecture for GCM-based deployment
TEST CONFIGURATION

- Refinement of Test Architecture
- Structural in Nature
- Define Equipment Participants
- Test Purpose Specification

Figure 5. Two infrastructures and bridges

<table>
<thead>
<tr>
<th>TP ID:</th>
<th>TP_GCM_DD_DA_PA_001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause Ref:</td>
<td>ETSI TS 102 827 V1.1.1 clause 7.1</td>
</tr>
<tr>
<td>Configuration</td>
<td>Single infrastructure or single infrastructure with a bridge</td>
</tr>
<tr>
<td>Summary:</td>
<td>Ensure that an infrastructure with direct resource access provides a single processor as specified in the GCM DD</td>
</tr>
</tbody>
</table>

Figure 6. Test purpose “Single processor with direct resource access”
SPECIFICATION OF INTEROPERABILITY
TEST DESCRIPTIONS

Test Selection & Execution

- Implementation Conformance Statement (ICS)
  - Supported Features Defined
  - All Pre-Conditions Ensured

- Protocol Implementation Extra Information for Testing (PIXIT)
  - Infra Specific Aspects

- Each Vendor Assessed Under Same Conditions
Figure 8. Test configuration “Two infrastructures and bridges” exemplified by Globus Toolkit and Amazon *Elastic Compute Cloud* (EC2)
INTEROPERABILITY EVENT: DEPLOYMENT DESCRIPTORS

Listing 1. GCM DD for Globus Toolkit

```xml
<?xml version="1.0" encoding="UTF-8"?>
<GCMDeployment xmlns="urn:gc:deployment:1.0"
xsi:xslns="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:gc:deployment:1.0
  http://etsi.org/schemas/GCMDScemmas/extensionSchemas.xsd">
  <environment>
    <javaPropertyVariable name="user.home"/>
  </environment>
  <resources>
    <bridge refid="globusGateway"/>
    <group refid="globusGrid"/>
    <host refid="ComputeNodeUnix"/>
  </resources>
  <infrastructure>
    <hosts>
      <host id="ComputeNodeUnix" os="unix" hostCapacity="4">
        <homeDirectory base="root" relpath="${user.home}"/>
      </host>
    </hosts>
    <groups>
      <globusGroup id="globusGrid"
        hostname="globus.grid.local"
        bookedNodesAccess="ssh"
        queue="free">
        <maxTime>5</maxTime>
        <stdout>/output</stdout>
        <stderr>/error</stderr>
      </globusGroup>
      <groups>
        <bridges>
          <sshBridge id="globusGateway"
            hostname="grid.informatik.uni-goettingen.de"
            username="globususer"/>
        </bridges>
      </infrastructure>
    </groups>
  </infrastructure>
</GCMDeployment>
```

Listing 2. GCM DD for Amazon EC2

```xml
<GCMDeployment>
  <environment>
    <javaPropertyVariable name="user.home"/>
  </environment>
  <resources>
    <bridge refid="amazonCloudGateway"/>
    <group refid="amazonCloud"/>
    <host refid="ComputeNodeWindows"/>
  </resources>
  <infrastructure>
    <hosts>
      <host id="ComputeNodeWindows"
        os="Windows" hostCapacity="1">
        <homeDirectory base="administrator" relpath="${user.home}"/>
      </host>
    </hosts>
    <groups>
      <amazonCloudGroup id="amazonCloud"
        hostList="node-[01-10]">
      </amazonCloudGroup>
      <groups>
        <bridges>
          <sshBridge id="amazonGateway"
            hostname="aws.amazon.com"
            username="amazonuser"/>
        </bridges>
      </groups>
  </infrastructure>
</GCMDeployment>
```
INTEROPERABILITY EVENT

- Multiple Actors was Key
- Demonstrated Resource Reservation & Application Deployment
- Questionnaire
- Use Cases

Observations
- Non-Compliant Default Configuration
- Cloud Standards Slowly Evolving
- Allow Too Many Options
- Requirement for Fixed Location of Resources
- Desire for Standard API for Virtual Machines and Resource Management
SUMMARY

- Presented Background on Cloud and Grid
- Identified How to Build a Framework Architecture
- Showed How to Implement a Generic Interface
- Described a Test Description Specification
- Real World Example
- Provided Additional Material for Reading
BIBLIOGRAPHY & ADDITIONAL REFERENCES
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5. [http://cloud-standards.org](http://cloud-standards.org)
6. [http://www.dmtf.org/standards/cloud](http://www.dmtf.org/standards/cloud)