

Monitoring and Analysis of Dependability Metrics of Grid Services

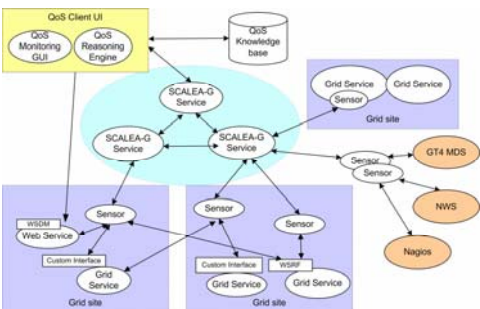
I. Abstract

Grid services, including machines, networks, middleware and applications, are diverse and their dependencies are complex. Thus, dependability metrics of these services will help to reason about problems and failures, and to select the best services suitable for specific purposes. This poster presents an architecture for measuring, analysis and reasoning about dependability metrics of Grid services and a prototype that visualizes and monitors Grid services and the dependencies between those services online.

II. Motivation

- There is a lack of dependability analysis tools for Grid that support the user and Grid middleware services to select the best fitting from many available, complement services distributed among many Grid sites.
- The complex dependencies among Grid services can vary greatly over time therefore they should be monitored and analyzed.

III. Architecture



- Distributed sensors** provide monitoring data for analyzing dependability metrics.
 - Performing the measurement directly.
 - Accessing data from existing monitoring data providers (Ganglia, Nagios, NWS, etc.).
 - Focusing on remote monitoring of services in a non-intrusive way, using publicly accessible interfaces.
- Monitoring middleware** collects monitoring data from sensors and delivers the data to clients.
 - Based on the SCALEA-G framework - a unified, P2P-WSRF-based performance monitoring and data integration for the Grid.

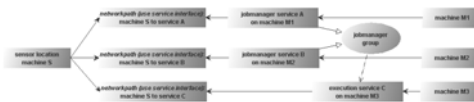
- QoS Client UI** supports graphically online monitoring, analysis, visualization of dependencies of services and dependability metrics

- Knowledge base** stores rules for reasoning and reacting to changes in monitored services.

IV. Modeling & Reasoning about Dependent Services

- The dependencies among Grid services are modeled as a graph.
 - Rectangle nodes** are monitored Grid services.
 - Ellipse nodes** are groups dependent on other Grid services.
 - Status** divides into **functional** and **operational**.
 - Edges** are dependency relationships, each can affect operational and functional properties.
 - Status propagation** depends on the type of relationship.

Example of Status Propagation



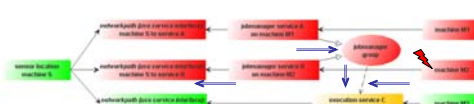
Initially, status of monitored services is unknown.



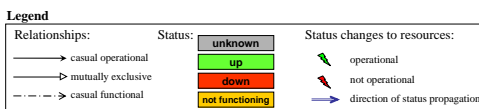
Status of monitored services changes based on online monitoring data. Status is propagated in the graph.



One job manager service is reported available. Status of the service group becomes operational.



Services A and B are down. Consequently, the job manager service group is down. Therefore service C cannot function properly, although it is available.



V. Dependability Analysis Approach

- Supporting dependability metrics, e.g., availability, reliability and manageability.
- Focusing on orthogonal, measurable metrics characterizing typical Grid services.
- Supporting different types of monitored resources including network path, machine, Grid middleware and application.
- Devising different techniques for obtaining relevant data from different types of resources.

Resource	Measurement Method	Dependability Metric
machine	ping	availability
network path	ping, TCP connection	availability
middleware	GRAM job run, GridFTP, logfile parsing	availability, accuracy, reliability
application	WS/WSRF/WSDM service calls, SOAP, instrumentation	availability, accuracy, reliability, manageability

VI. Experiment & Prototype

Experimental Monitoring Scenario

- Includes Grid services in the K-WfGrid test-bed.
- Contains many specific dependencies among monitored services.

QoS Client UI Prototype

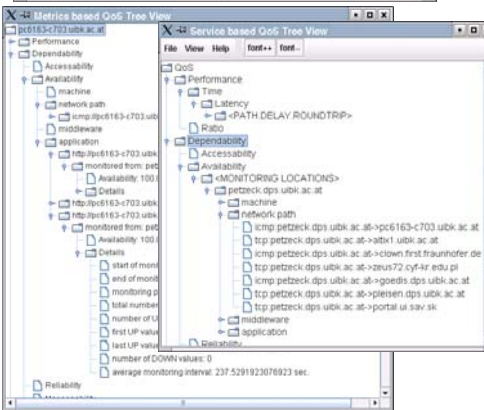
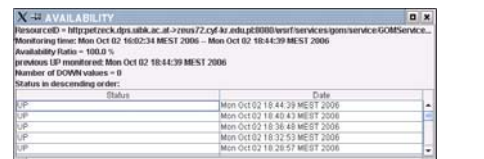
- The current status is being updated periodically based on online data.
- For each monitored service detailed information can be requested anytime.
- Different views for dependability metrics of services increase the readability.

Online Visualization of Monitoring Scenario



- Orange color of the node *Performance Experiment* indicates that the planned performance experiment cannot be conducted because of functional problems.
- Functional problems in available resources can be tracked back to the operationally failed component (colored red in the graph) following dependency relationships.

Observing Metrics in Detail



- QoS Tree Views:**
 - Easy to browse big amounts of data.
 - Data can be grouped based on metrics or service types.
 - In the service based view detailed metrics of services are retrieved on demand.

VII. Future Work

- Improve existing measurement methods.
- Provide more sensors for a broader range of Grid specific services.
- Extend the range of dependability metrics.
- Implement the knowledge base to support automated management of monitored resources.

VIII. References

- Hong-Linh Truong and Thomas Fahringer: Self-Managing Sensor-based Middleware for Performance Monitoring and Data Integration in Grids, In Proceedings of 19th IEEE International Parallel and Distributed Processing Symposium (IPDPS2005), Denver, Colorado, USA, April 4-8, 2005.
- Hong-Linh Truong, Robert Samborski, Thomas Fahringer: Towards a Framework for Monitoring and Analyzing QoS Metrics of Grid Services, 2nd IEEE International Conference on e-Science and Grid Computing, December 4-6 2006, Amsterdam, The Netherlands.
- A. Avizienis, J.-C. Laprie and B. Randell, Fundamental Concepts of Dependability, Research Report N01145, LAAS-CNRS, April 2001.
- http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsdm
- http://www.kwfgid.eu