Grid Management and Monitoring

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Czech Republic
Overview

Grid monitoring

- An information source for Grid management
- Resource-centric monitoring
  - State of the resources
  - State of the services
- Job-centric monitoring
  - Job flow through the Grid

Grid Management

- Steering of the infrastructure
Resource Centric Grid Monitoring

Grid Monitoring Architecture (GMA)

- GGF activity
- Basic components of GMA
  - Producers
  - Consumers
  - Directory service

Cracow, Poland 3 October 29th, 2003
GMA basic structure

- Consumer
- Producer
- Directory Service
- Events

Publication info:
GMA actual state

Focus on transfer of monitoring info

- Content independence
- Usually “push” model
- Security and persistence not primary focus (streaming data)
R-GMA

- Relational extensions of the GMA
  - Can support general SQL queries
- Developed within the DataGrid project
- Resilience through specific producers
- Java plus Tomcat/Apache based
  - C version under development
- Just basic security support
GridLab monitoring system

- Developed in SZTAKI (Hungary)
- All infrastructure components
- Focus on efficiency and scalability
- Secure transport layer
Grid Testbed Operation Center (GTOC): Masaryk University Brno

- Testbed status monitoring
- Bug tracking (Bugzilla server)
- Problem escalation (only manually)

Portal

- User and administrative portals unified

Information services

- Each site runs its own GIS (MDS-2) with default schema
- Local GISes register to GIIS in Brno (mds.gridlab.org)—master server
GridLab status testing

- Test availability of defined “services”
  - Components of GT2 (currently 2.2.4)
  - Application specific components

- Centrally controlled
  - Full suite of tests runs every hour
  - Results are displayed on the portal page(s)
  - Reasons of failure also provided

- Test interdependencies
Individual tests

- Specific test for each component
- Java implementation
- Tested services:
  - Gatekeeper, GIIS, GRIS
  - MDS service (GridLab)
  - Monitoring (GridLab)
  - GSIFTP, GSISSH
  - Software
  - CA
  - Jobmanagers
  - MPI availability
Current status


18 machines/clusters
  9 countries
  13 institutions
**Testbed status**

Generated: Tuesday, October 29, 2003 5:22:25 AM UTC

### Test results

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### Machine list

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</table>

**Cracow, Poland**

October 29th, 2003
Status—Error messages

- eltoro.pcz.pl
  - MDS WS:
    - ; nested exception is:
    - java.net.ConnectException: Connection refused

- fs0.das2.cs.vu.nl
  - GRMS:
    - ; nested exception is:
    - java.net.SocketTimeoutException: Read timed out
Web Services Tests

- Calls a method on each service
  - OK: the SOAP call succeeded and a value was returned
  - FAIL: the SOAP call was not successful (reason is displayed)
- Needs correct WSDL to include a new service
## Tested web services

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<td>urn:DATA_movement_services</td>
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Cracow, Poland 16 October 29th, 2003
Data movement service

- $n^2$ problem
- Currently full mesh really tested
  - Not a scalable solution
- In fact many dependencies automatically tested
  - Accessibility/Firewalls
  - Credentials
  - Authentication services

Cracow, Poland 17 October 29th, 2003
### Results for DATA movement service:

**Tue Oct 28 05:42:30 CET 2003**

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init->hitcross.lrz-muenchen.de
init->sr8000.lrz-muenchen.de
init->onyx3.zib.de
init->lrz-supercluster.de
init->unica.it
init->mike.lsu.edu
init->minimike.lsu.edu
SC2002 Demo

- Largest heterogeneous Grid
- Some statistics
  - 69 sites, 14 countries, 4 continents
  - 7345 CPUs, 3469 actually available for the demo
- Status monitoring
  - Centralized
  - Simplified GridLab tests
- Manual management
Job centric monitoring

- Part of the DataGrid Workload Management System
- Logging and bookkeeping service
  - Monitors flow of a job through the Grid
  - Requires instrumentation of all components
- Independent infrastructure
  - Preceded (R-)GMA implementation
  - Strong security requirements
  - Reliability/persistence
  - Data repository part of the design
Logging and Bookkeeping Service

- Event based
  - Generated by individual WMS components
  - Reliably transmitted into a database

- Job state constructed on the fly
  - State automaton

- Analogous to the GMA
LB components

Basic components
- Local logger
- Inter logger
- Bookkeeping server

Asynchronous delivery
- non-blocking calls
- persistence through local logger’s files

Synchronous (blocking) calls for special purposes
LB security

- All transmission encrypted
  - Extensive use of SSL
  - Sessions for efficiency improvement
- Authentication based on certificates
  - Anyone with a valid certificate can log events
Authorization control in LB

- First event defines job owner
- Only this “person” can log events for this job
- Exception—certificate expired within the WMS
  - Host certificates used to log last (abort) event(s)
LB and R-GMA

- R-GMA not a replacement
  - Lack of security
  - Untested reliability
  - Rather heavy-weight components

- Job state delivery to users
  - Decreases load on the bookkeeping server
  - Notification support
  - Still limited use due to the security constraints
LB architecture

- Local logger
- Inter-logger
- Bookkeeping server
- Logging server
- Storage

Logging API

L&B API (internal)

User Interface

Resource Broker

JSS

JobManager

R-GMA

infra

clients

R-GMA

producer API

R-GMA

consumer API

clients

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Open Problems

- Monitoring—Centralized approach
  - Does not scale, overloads the collecting site
  - Creates a single point of failure
  - Potentially long reaction time

- Identity of the monitoring entity

- Reliability of collected data

- Management—VO site management
  - Integration of local escalation procedures
Some solutions

- Monitoring worm
  - Check for interdependencies
  - Application-like view of the Grid

- Test service certificates
  - Special certificates
  - All tests must be able to run under any identity
  - Application instrumentation
Monitoring Worm

- An application-like monitoring tool
  - Uses the same APIs and environment as any application
  - Re-spawns itself through the resource broker
  - Migrates (randomly or using a regular pattern) through the Grid
  - “Knows” services and tries to use them
  - Filters and post-process results and sends them to the collecting site(s)
  - Checks on monitors (an independent monitoring tool)
  - If available, connects to the local monitoring infrastructure and compares its own results
Monitoring Worm—features

- Build on top of GAT (Grid Application Toolkit)
- Runs under service/test certificate or on user request (with user certificate)
  - Initiated through the portal
  - Users can trigger its run to help localize a problem (worm checks the environment on behalf of user)
- Always reports to the collecting site (even from users’ runs)
Lessons Learned—Monitoring

- Cannot rely on local setup
  - Needs more independent monitoring info sources
  - Needs models and frameworks for monitoring info correlation and cross checking

- Relationship with information services
  - Some overlap may be advantageous
Lessons Learned—Security

- Essential, but often underrated

- Missing truly scalable solutions (SSL/TSL does not scale)

- Authorization
  - What a user can see?
  - Are all administrators equal?

- Virtual organizations support
Lessons Learned—Management

- Grid ticket tracking system missing
- Escalation procedures must be automated and integrated with local usage
- Access to local resources for developers looking for an error
  - Logs usually are not enough
  - Site setup restoration
    - How to find slight differences in setup?
  - Alternative approaches must be looked for

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Lessons Learned—Other

Firewalls
- Must find a way to integrate firewalls into Grid setup
- Firewall status monitoring—is it possible?

Reliable repositories
- How long to store the monitoring data and managerial decisions
- Need for a Grid solution? :-)

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Future Work—Resource centric monitoring

- Hierarchical setup
  - Information processed locally
  - Only digests and anomalies sent to higher levels
  - Better test interdependency specification (semi-automatic?)

- Monitoring worm
  - Modular structure (extensibility)
  - (Semi)automatic service discovery
  - Use of monitoring APIs on services (when they will be available)
Future work—GAT Instrumentation

- GAT = Grid Application Toolkit
  - To “hide” Grid from the developer
- Ideal for automatic monitoring
  - Instrumentation of GAT calls
  - GAT services with monitoring API
- Use GMA to collect the produced data
Future work—Job centric monitoring

- Better integration with the (R-)GMA
- Full authorization
- Full notification service (with dynamic authorization)
- Collective operations (sets of jobs)
- Full logging support (i.e. long term searchable repositories)
- Grid performance monitoring
Future Work—Management

- Grid quality and performance estimation
- SLAs (Service Level Agreement) definition and monitoring
- Locality and subsidiarity, i.e. hierarchical decision support
- Better integration of monitoring and management/steering infrastructures
  - Each decision should be logged
  - Grid state roll back? (per site)
The research group

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- Charles University (Prague)
  - Michal Vocičů

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Questions?