User-level Grid Functionality Testing with Inca v2.0

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Is the User’s Grid Working?

- Can user X run application[s] Y on Grid[s] Z? Access dataset[s] N?
  - Can user login?
  - Are Grid services the application[s] use available? Compatible versions?
  - Are dataset[s] N accessible to user X? Credentials?
  - …
Testing a Grid

1. Iteratively define a set of concrete requirements
2. Write tests to verify requirements
3. Periodically run tests and collect data
4. Publish data

Inca aims to automate steps 3 and 4
What type of testing?

- **Deployment testing**
  - Automated, continuous checking of Grid services, software, and environment
  - E.g., gatekeeper ping or scaled down application
Who are the consumers?

- **Grid/VO management**
  - Responsible for designing & maintaining requirements
  - Verify requirements are fulfilled by resource providers
- **System administrators**
  - Notified of problems
  - Enough information to understand context of problem
- **End users**
  - View results and compare to problems they are having
  - Debug user account/environment issues
  - Feedback to Grid/VO
Inca is a framework for the automated testing, benchmarking and monitoring of Grid resources.

Inca:
- schedules execution of information gathering programs (reporters)
- collects, archives, publishes data

Data can be queried and transformed for custom views.

Data collection can be easily customized.
Related Grid monitoring tools

- BIG BROTHER™
- CLUMON
- Ganglia
- MDS
- Hawkeye
- GridICE
- MonALISA
- Nagios

Inca’s primary objective: user-level Grid functionality testing and performance measurement
Unique features of Inca

• Debugging a deployment
  – Runs under a regular user account
  – Flexibly expresses results
  – Captures test context
  – Securely re-runs tests
  – Archives full reports
  – Tests can be run outside Inca framework
Unique features of Inca (cont.)

• Compares results to a specification
• Easily and securely configured
  – Data collection
  – Installation
• Profiles and logs Inca component resource use
Outline

- Inca in use
- Architecture overview
- Project status
Inca In Use

• Inca Version 1 first put into production in 2004

• Inca Version 2 currently beta

• Both versions of Inca used in production environments
Inca in use: TeraGrid software stack V&V

- **TeraGrid** - an “enabling cyberinfrastructure” for scientific research
  - ANL, Indiana Univ., NCSA, ORNL, PSC, Purdue Univ., SDSC, TACC
  - 40+ TF, 1+ PB, 40Gb/s net

- **Common TeraGrid Software & Services**
  - Common user environment across heterogeneous resources
  - TeraGrid VO service agreement
Inca 2 TeraGrid Deployment: CTSSv3

32 packages:
Globus, SRB, Condor-G, MPICH, Softenv, etc.

123 Inca tests:
45 unit/functionality tests
  – Services: BLAS, uberftp, etc.

29 compatible version tests
  – Version: HDF, Condor-g, etc.

49 cross-site functionality tests
  – Cross-site: Globus GRAM, GridFTP, gsissh
## Software Stack Summary View

### ctssv3 (summary)

<table>
<thead>
<tr>
<th>resource</th>
<th>95% passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>resourceA</td>
<td></td>
</tr>
<tr>
<td>resourceB</td>
<td></td>
</tr>
<tr>
<td>resourceC</td>
<td></td>
</tr>
<tr>
<td>resourceD</td>
<td></td>
</tr>
</tbody>
</table>

### 123 possible tests (45 unit, 29 version, 49 cross-site)

<table>
<thead>
<tr>
<th>resource</th>
<th>95% passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>resourceA</td>
<td></td>
</tr>
</tbody>
</table>

**Tests:** 118  
(41 unit, 28 version, 49 cross-site)

**Errors:** 6  
(2 unit/version)

1. mpich2-intel-version
2. phdf3-unit

(4 cross-site)

1. gram_to_grid-cu.ncsa.teragrid.org
2. gridftp_to_gridftp-cu.ncsa.teragrid.org
3. ssh_to_login-cu.ncsa.teragrid.org
4. ssh_to_login-w.ncsa.teragrid.org

<table>
<thead>
<tr>
<th>resourceB</th>
<th>95% passed</th>
</tr>
</thead>
</table>
Software Stack Detail View

ctssv3
Page loaded: 11-11-2006 04:22 PM (PST)

Resources

- ant
- blas
- compiler-gcc
- compiler-intel
- compiler-xlc
- condor-g
- gridshell
- gt4
- gt4-gram-cross-site
- gt4-gridftp-cross-site
- gx-map
- hdf4
- hdf5
- java
- mpich2-intel
- mpich-g2-gcc
- mpich-gm-gcc
- mpich-gm-intel
- mpich-p4-gcc
- pacman
- phdf5
- python

SW packages

<table>
<thead>
<tr>
<th>APPS</th>
<th>resourceA</th>
<th>resourceB</th>
<th>resourceC</th>
<th>resourceD</th>
<th>resourceE</th>
<th>resourceF</th>
<th>resourceG</th>
<th>resourceH</th>
<th>resourceI</th>
<th>resourceJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ant</td>
<td>1.6.5</td>
<td>1.6.5</td>
<td>1.6.5</td>
<td>1.6.5</td>
<td>1.6.5</td>
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<td>1.6.5</td>
<td>1.6.5</td>
<td>1.6.5</td>
</tr>
<tr>
<td>ant-unit</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
<td>error</td>
<td>error</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
</tr>
<tr>
<td>blas</td>
<td>resourceA</td>
<td>resourceB</td>
<td>resourceC</td>
<td>resourceD</td>
<td>resourceE</td>
<td>resourceF</td>
<td>resourceG</td>
<td>resourceH</td>
<td>resourceI</td>
<td>resourceJ</td>
</tr>
<tr>
<td>3 tests</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
<td>3 errors</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
<td>3 errors</td>
<td>pass</td>
<td>pass</td>
</tr>
<tr>
<td>condor-g</td>
<td>resourceA</td>
<td>resourceB</td>
<td>resourceC</td>
<td>resourceD</td>
<td>resourceE</td>
<td>resourceF</td>
<td>resourceG</td>
<td>resourceH</td>
<td>resourceI</td>
<td>resourceJ</td>
</tr>
<tr>
<td>version:</td>
<td>&gt;=6.7.18</td>
<td>6.7.18</td>
<td>6.7.18</td>
<td>error</td>
<td>6.7.18</td>
<td>6.7.18</td>
<td>6.7.18</td>
<td>6.7.18</td>
<td>6.7.18</td>
<td>6.7.18</td>
</tr>
</tbody>
</table>
Result:
did not complete

globusrun failed:
GRAM Authentication test failure: connecting to the job manager failed. Possible reasons: job terminated, invalid job contact, network problems, ...

Reporter details:
reporter name grid.middleware.globus.unit.gatekeeper
(click name for more info)

Execution information:
ran at 11-10-2006 12:39 PM (PST)
age 22 hours 44 minutes
cron ?=36 ?=14 ***
ran on (hostname) resource.teragrid.org
memory usage (MB) 19.1094
cpu time (secs) 3.46289
wall clock time (secs) 183.855
Outline

• Inca in use
• Architecture overview
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Inca Components

- **Inca Control System**
  - Reporter Managers manage Inca on a single host
  - Agent installs and oversees Reporter Managers
  - Incat provides an administration GUI

- **Inca Data System**
  - Reporters perform tests; collected in external repositories
  - Depot stores and retrieves test results (DB)
  - Consumer provides web-based access to test results
1. The user creates a *suite* using *incat* and submits it to the *agent*

2. The *agent*
   - fetches *reporters* from the *reporter repository*
   - creates a *reporter manager* on each resource
   - sends the suite and reporters to each reporter manager.

3. Each *reporter manager* executes *reporters* according to its schedule and sends results (*reports*) to the *depot*.

4. *Data consumers* display collected data (*reports*) by querying the *depot*.
Inca Component Design Goals

• **Minimal impact on monitored resources**
  – Most administrative duties handled by Agent
  – Component profiling; Reporter profiling/limits

• **Easy installation and maintenance**
  – Centralized administration control
  – Automated staging of Reporter Managers and Reporters

• **Flexible reporter scheduling and configuration**
  – On-demand and periodic scheduling
  – Reporters independent of Inca deployment
Inca Component Design Goals (cont.)

- **Security**
  - Certificate-based authentication by all components
  - Provide credentials to reporters that need it
- **Flexible data content**
  - No required schema for test output
- **Efficient storage and retrieval of data**
  - Storage in a selection of databases via Hibernate
  - Schema designed to reduce redundant data
- **Flexible access to data**
  - Access to all data via SQL queries
  - Depot protocol provides predefined queries; extensible
  - Depot retains history of reporter output
  - Queries via Inca protocol and web service interface
# Inca Data Consumer

### ctssv3 (summary)

- resourceA
- resourceB
- resourceC
- resourceD
- resourceE
- resourceF
- resourceG
- resourceH
- resourceI
- resourceJ
- resourceK
- resourceL
- resourceM
- resourceN
- resourceO
- resourceP
- resourceQ
- resourceR
- resourceS

<table>
<thead>
<tr>
<th>resource</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>resourceA</td>
<td>95% passed</td>
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  3. ssh_to_login-cu.ncsa.teragrid.org
  4. ssh_to_login-w.ncsa.teragrid.org
Inca Reporter

- Executable program that measures some aspect of the system or installed software
- Requirements:
  - Supports specific command-line options
  - Writes XML (Inca Reporter schema) to stdout
- Extensive Library support for perl scripts
Example: openssh version

use Inca::Reporter::Version;
my $reporter = new Inca::Reporter::Version(
  version => 1.8,
  description => 'Reports the version of openssh',
  url => 'http://www.openssh.org',
  package_name => 'openssh'
);
$reporter->processArgv(@ARGV);
$reporter->setVersionByExecutable('ssh -V', 'OpenSSH_(\w\.|)+|GSI (\w\.|)+');
$reporter->print();
Incat Administration Tool

- Centralized configuration of Inca installation
- Reporter repositories, resources.hosts, suites
Outline

• Inca in use
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Inca v2 Development

- Version 1 being phased out
- Version 2 beta released 11/06
- Production version available “soon”
- Future work
  - Scalable design
  - Improved displays
  - Extended package support
Scalable design

VO A

VO B

Incat

Reporter Repository

Reporter Agent

Depot

Forward suite

Forward results

Resource 1

Resource 2

Resource 3

Resource 4

Resource 5
Historical Graphs

SC|06 Tampa, Florida, November 12-17, 2006
Historical Graphs
Error tracking over time

Errors on TeraGrid Over Time

- No valid proxy found
- Transport endpoint is not connected
- Error code 23
- Error code 70
- Error code 69
- SoftEnv
- Error code 10
- Error code 5
- Assertion GLOBUS FALSE
- Network is unreachable
- No such file or directory
- Error with GSI credential
- Error code 43
- Error code 7
- Stale NFS file handle
- Unexpected Gatekeeper or Service Name
- Error code 75

Time in Seconds

SC|06 Tampa, Florida, November 12-17, 2006
Extended Package Support

- Reporter Repositories can presently contain scripts, perl modules, and .tar.gz packages
- Add support for .rpm, other formats
- Support retrieval from CPAN
More information

• Inca Web Page:  
  http://inca.sdsc.edu

• Email
  – inca@sdsc.edu