
Inca: A Framework for Monitoring Grid Functionality and Performance

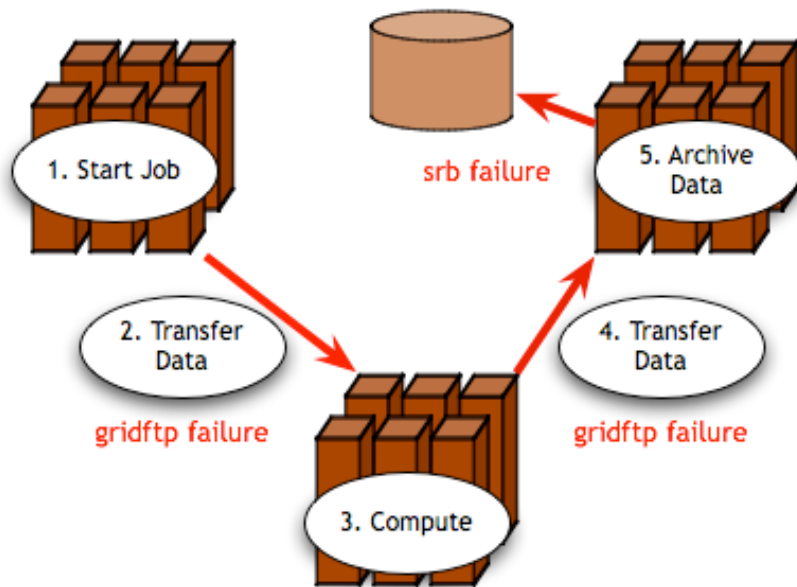
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**Supercomputing 2005
November 15 & 16**

Grid Reliability

- **Grid computing:** The ability to dynamically link resources together as an ensemble to support the execution of large-scale, resource-intensive, and distributed applications

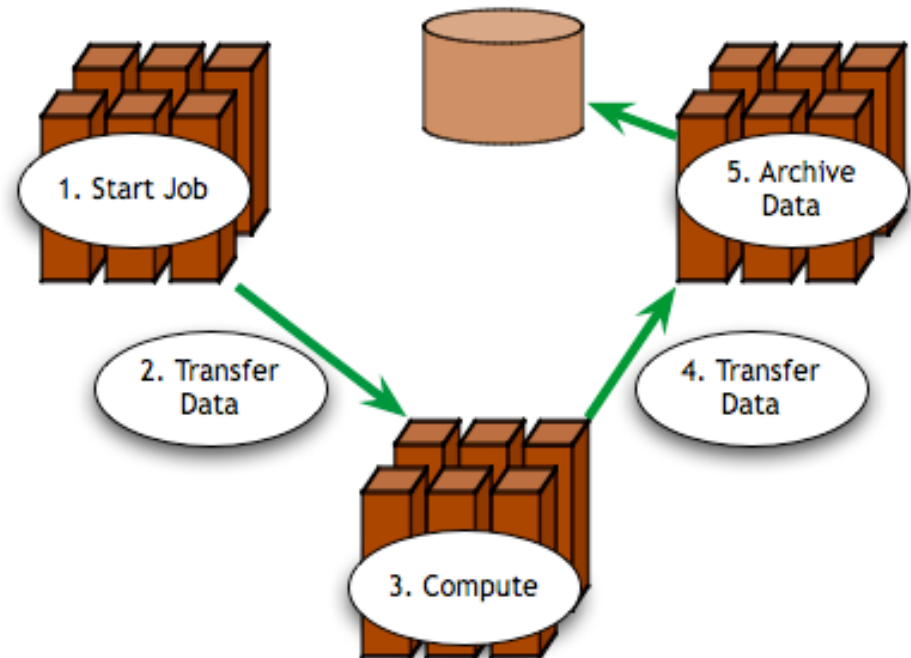


Simple Grid application

"You know you have [a distributed system] when the crash of a computer you've never heard of stops you from getting any work done." -- Leslie Lamport

Is the Grid up?

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



Testing a Grid

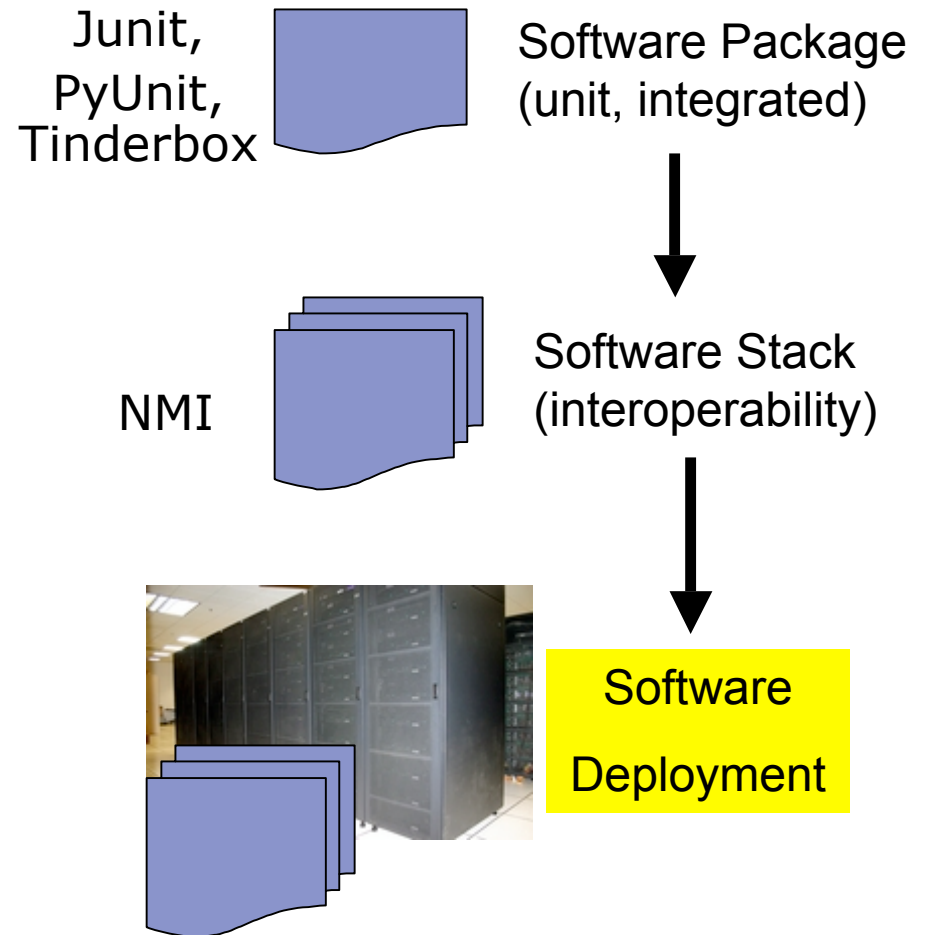
- 1. Iteratively define a set of concrete requirements**
- 2. Write tests to verify requirements**
- 3. Periodically run tests and collect data**
- 4. Publish data**

Automate Steps 3 and 4

What type of testing?

- **Deployment testing**

- Automated, continuous checking of Grid services, software, and environment
- Installed? Configured correctly? Running? Accessible to users? Acceptable performance?
- E.g., gatekeeper ping or scaled down application



Who are the consumers?

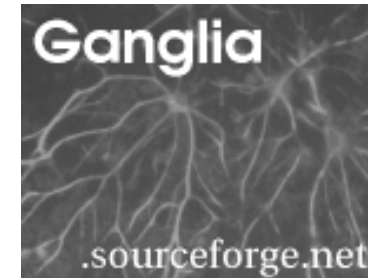
- **Grid/VO management**
 - Responsible for designing & maintaining requirements
 - Verify requirements are fulfilled by resource providers
- **System administrators**
 - Notified of problems
 - Enough information to understand context of problem
- **End users**
 - View results and compare to problems they are having
 - Debug user account/environment issues
 - Advanced users: feedback to Grid/VO

Inca

- **Inca is a framework for the automated testing, benchmarking and monitoring of Grid resources**
- **Inca provides:**
 - Scheduled execution of information gathering scripts (reporters)
 - Data management
 - collection
 - archiving
 - publishing

Related Grid monitoring tools

BIG BROTHER™



Hawkeye



MDS



Nagios

Inca's primary objective: user-level Grid functionality testing and performance measurement

Unique features of Inca

- **Debugging**
 - Runs under a regular user account
 - Flexibly expresses results
 - Captures reporter execution context
 - Securely re-runs reporters (v2)
 - Archives full reports (v2)
 - Reporters can be run outside framework

Unique features of Inca (cont.)

- **Compares results to a specification (v2)**
- **Easily and securely configured (v2)**
 - Data collection
 - Installation
- **Profiles and logs reporter resource use (v2)**

Outline

- **Inca in use**
- **Architecture overview**
- **Project plans**

Inca today

- **Version 1**
 - aka 0.10.3
 - available from website and NMI distribution
- **Version 2**
 - scheduled for release early 2006
- ***Both versions of Inca are currently being used in production environments***



TeraGrid™



Inca in use

- 1) Software stack
validation and verification (v1)**
- 2) Network bandwidth
measurements (v1)**
- 3) Grid benchmarking (v2)**

1) 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



1) Inca in use: TeraGrid software stack V&V

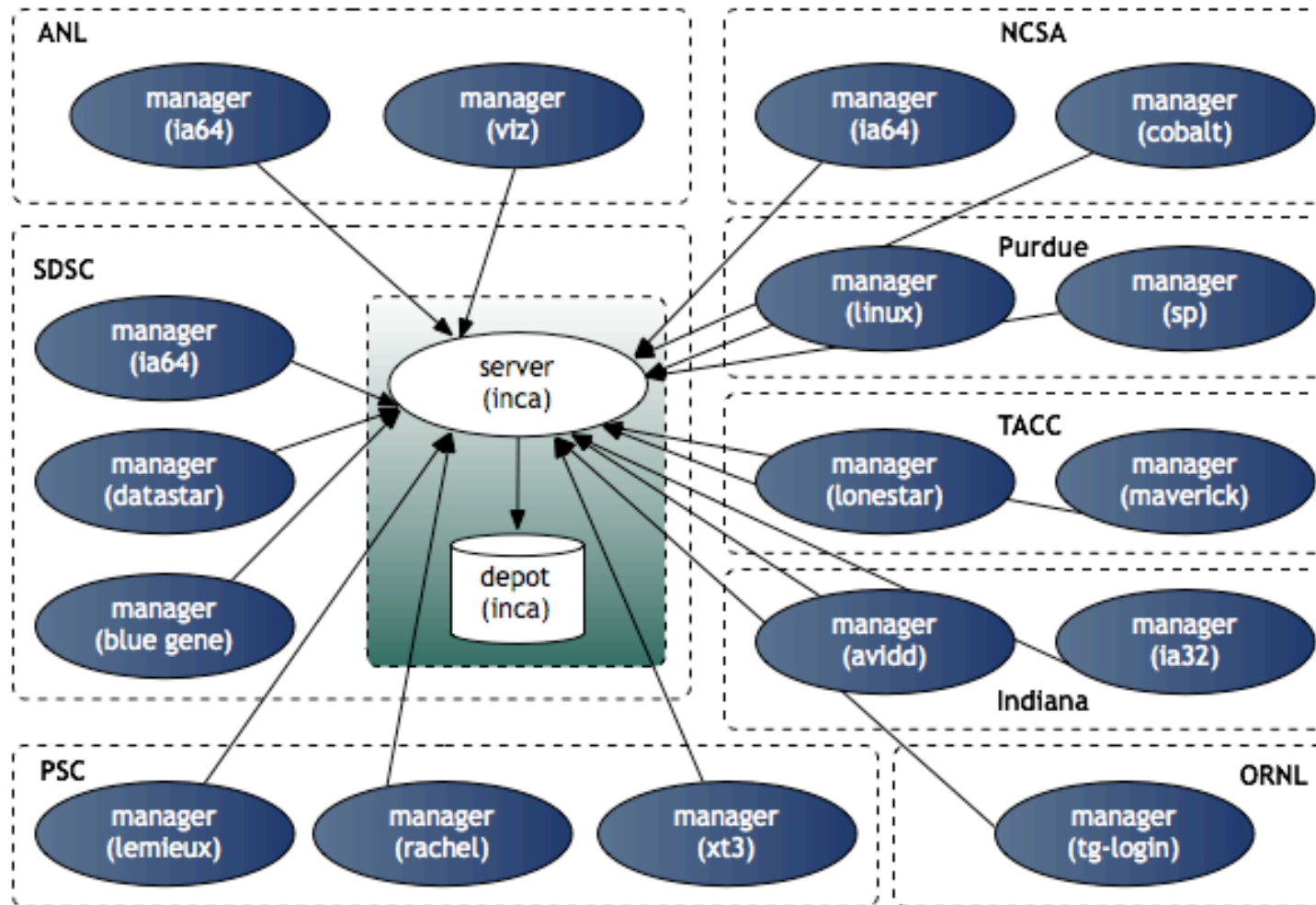
- **Common software stack:**
 - **20 core packages:** Globus, SRB, Condor-G, MPICH-G2, OpenSSH, SoftEnv, etc.
 - **9 viz package/builds:** Chromium, ImageMagick, Mesa, VTK, NetPBM, etc.
 - **21 IA-64/Intel/Linux packages:** glibc, GPFS, PVFS, OpenPBS, intel compilers, etc.

➡ **50 version reporters: compatible versions of SW**

➡ **123 tests/resource: package functionality**

- **Services:** Globus GRAM, GridFTP, MDS, SRB, DB2, MyProxy, OpenSSH
- **Cross-site:** Globus GRAM, GridFTP, OpenSSH

1) Inca in use: TeraGrid deployment



- 8 sites/17 resources
- Run under user account **inca**

1) Inca in use: Summary status page

TERAGRID [Summary](#) * [CTSS](#) * [SoftEnv \(detail\)](#) * [Default User Environment](#)

Summary of Common TeraGrid Software and Services 2.0

Page generated by [Inca](#): 07/13/04 18:39 CDT

This page offers a summary of results for critical grid, development, and cluster tests ([view list of tests](#)). Details about a resource's test results are available by clicking on the resource name in the "Site-Resource" column of the table.

Site-Resource	Grid	Development	Cluster	Total Pass
site1-resource1	Pass: 32 Fail: 1 96% passed	Pass: 23 Fail: 0 100% passed	Pass: 1 Fail: 1 50% passed	Pass: 56 Fail: 2 96% passed
site1-resource2	Pass: 22 Fail: 7 75% passed	Pass: 23 Fail: 0 100% passed	Pass: 1 Fail: 1 50% passed	Pass: 46 Fail: 8 85% passed
site2-resource1	Pass: 1 Fail: 18 5% passed	Pass: 2 Fail: 10 16% passed	n/a	Pass: 3 Fail: 28 9% passed

Expanded View of Errors

site1-resource1

Grid

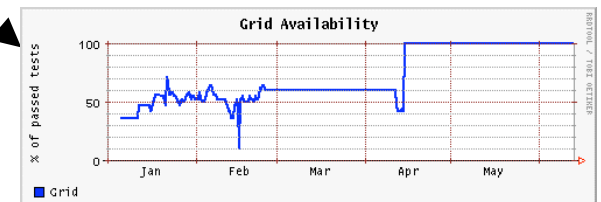
- globus-2.4.3-intel-r3: [failed: duroc_mpi_helloworld_to_jobmanager-pbs test](#)

All tests passed: 100%

One or more tests failed: < 100%

Tests not applicable to machine or have not yet been ported

Key



History of percentage of tests passed in "Grid" category for a 6 month period

1) Inca in use: Detailed Status View

[illegible]

Resources



SW
packages



1) Inca in use: Detailed view

Reporter details:

reporter name [grid.middleware.globus.unit.gatekeeper](#) (click on reporter name to view reporter script)
description This test runs globusrun -a [hostname] to check that the gatekeeper at the host is accessible from the local machine
version 1.4
status production
url <http://www.ncsa.uiuc.edu/People/jbasney/teragrid-setup-test.html>

Execution information:

inputs
 verbose 1
 help no
 log 3
 host test_hostname
ran at (GMT) Wed Jun 15 00:13:02 2005
age 27 mins
runs every 1 hour(s)

Reporter system command log:

The following are the *system* commands executed by the reporter. Note that the reporter may execute other actions in between system commands (e.g., change directories). Please click the on reporter name above for the full reporter code.

```
% globusrun -a -r test_hostname 2>&1
```

Host information:

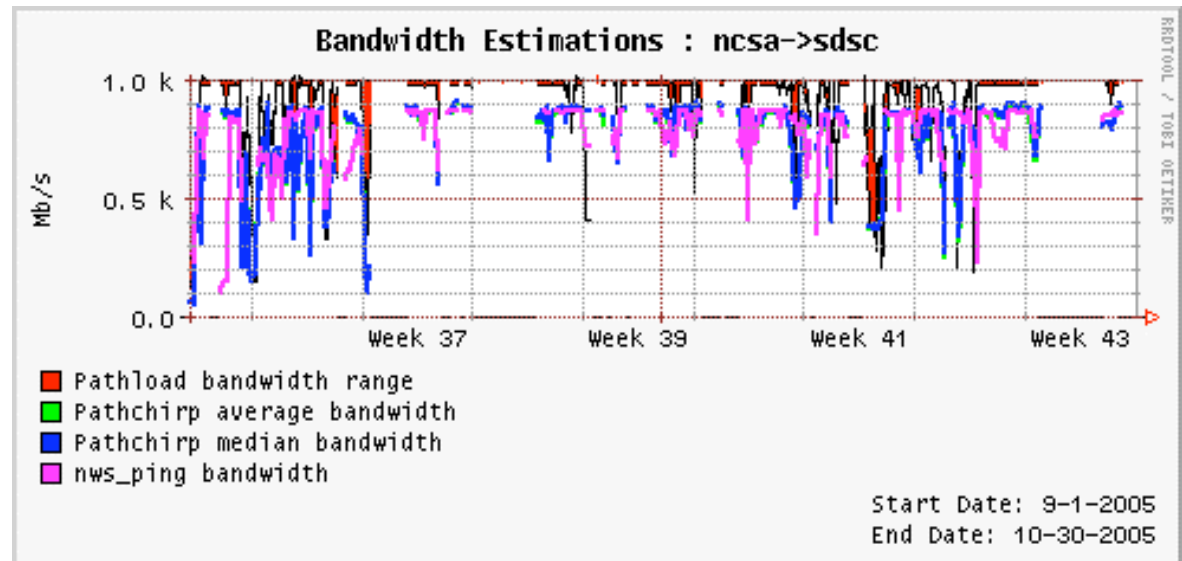
hostname ran_on_hostname
ipaddr 192.100.00.000
uname Linux ##### SMP Fri Jun 3 11:44:48 EST 2005 i686 i686 i386 GNU/Linux

2) Inca in use: Comparison of end-to-end bandwidth measurement tools

- Joint work with Margaret Murray (TACC) and Martin Swamy (UDel)

- **Compare bandwidth measurement tools:**

- Pathload [Dovrolis]
- Pathchirp [Ribeiro]
- NWS ping [Wolski]

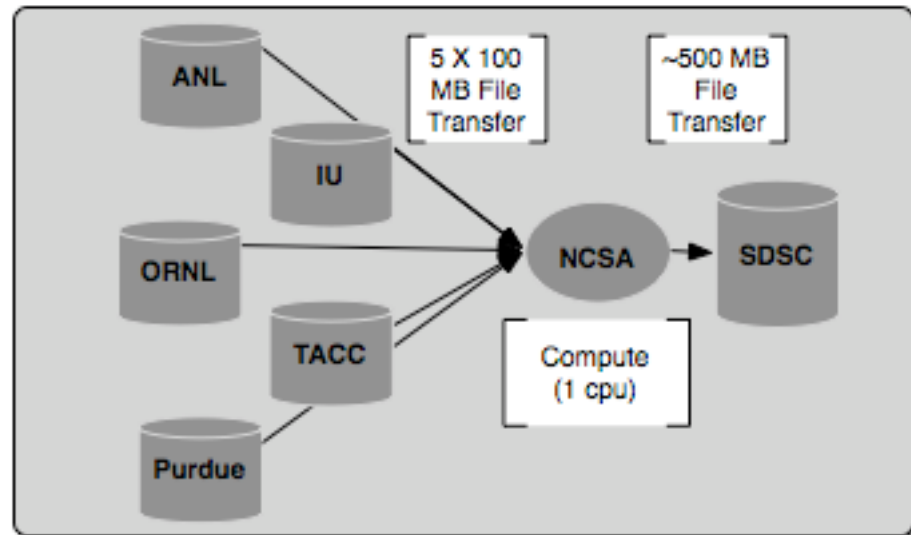


- Deployed to TeraGrid, GEON
- Poster presented at Grid 2005

3) Inca in use: Grid benchmarks

- **GrASP: Grid Assessment Probes**

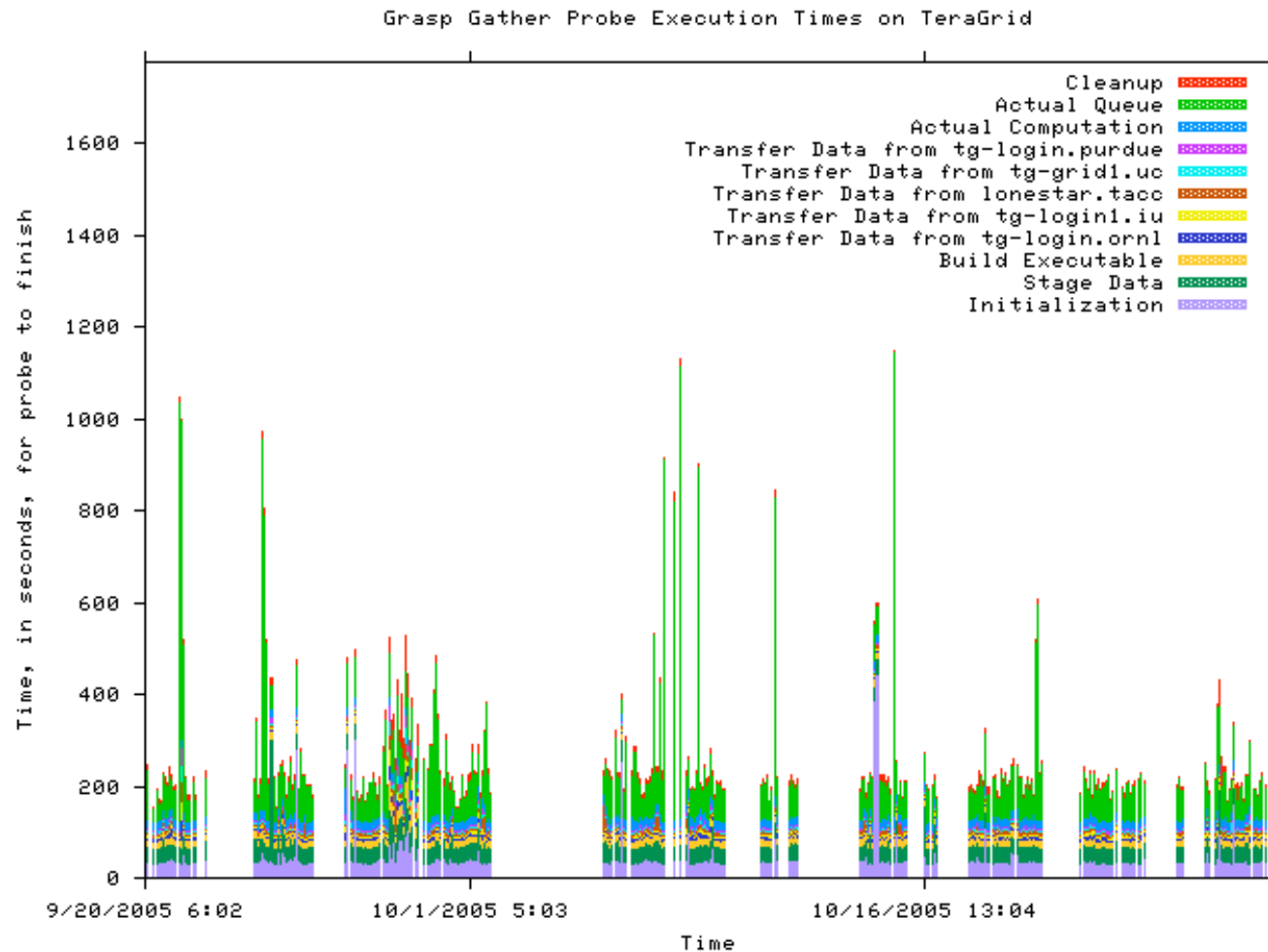
- Set of probes designed to emulate Grid applications
- Deployed to GEON and TeraGrid



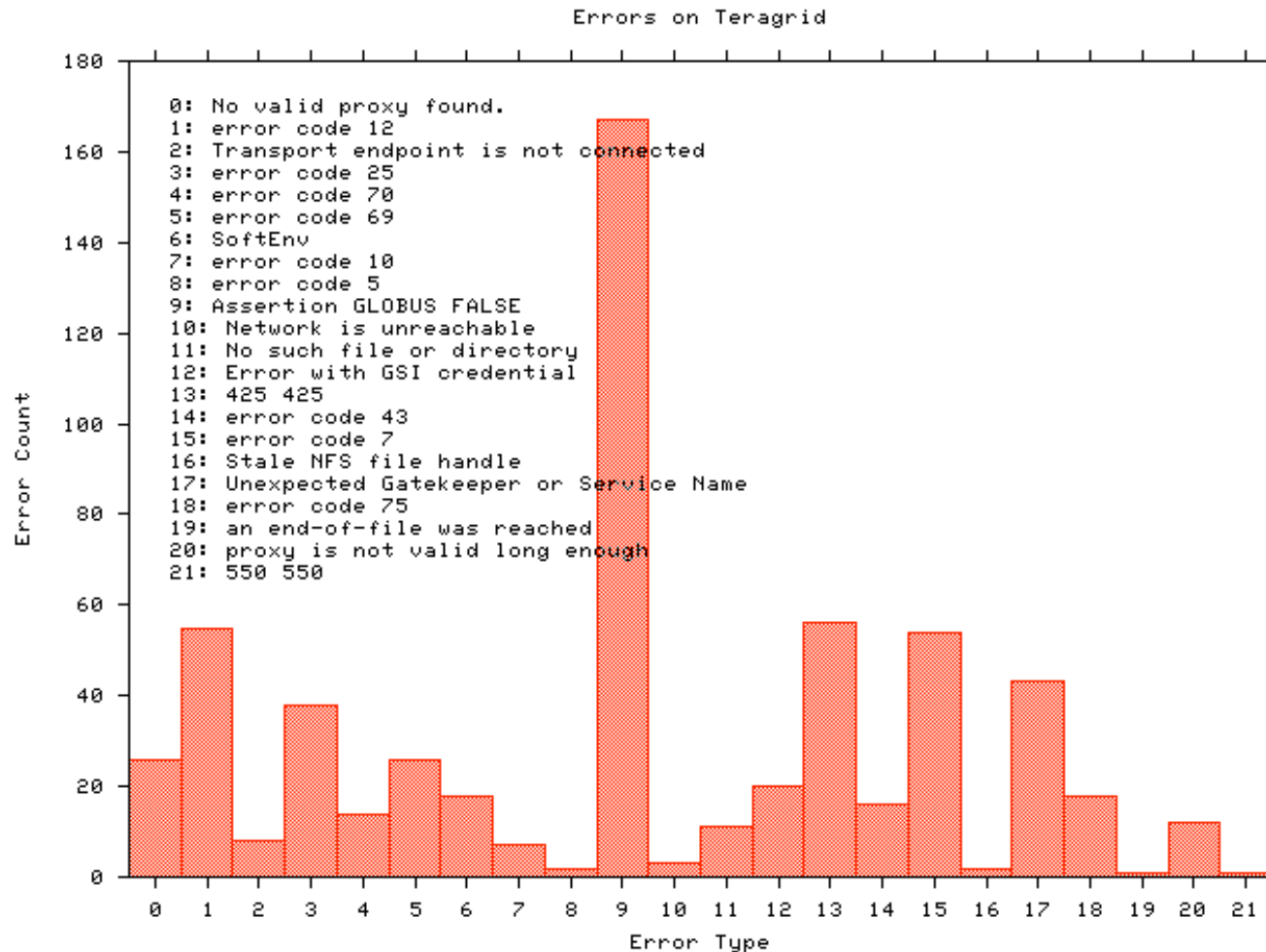
Gather probe on TeraGrid

- C. Olschanowsky, O. Khalili, J. He, H. Casanova, A. Snaveley. Acquiring and Using Benchmark Data from Computational Grids, *submitted for publication*

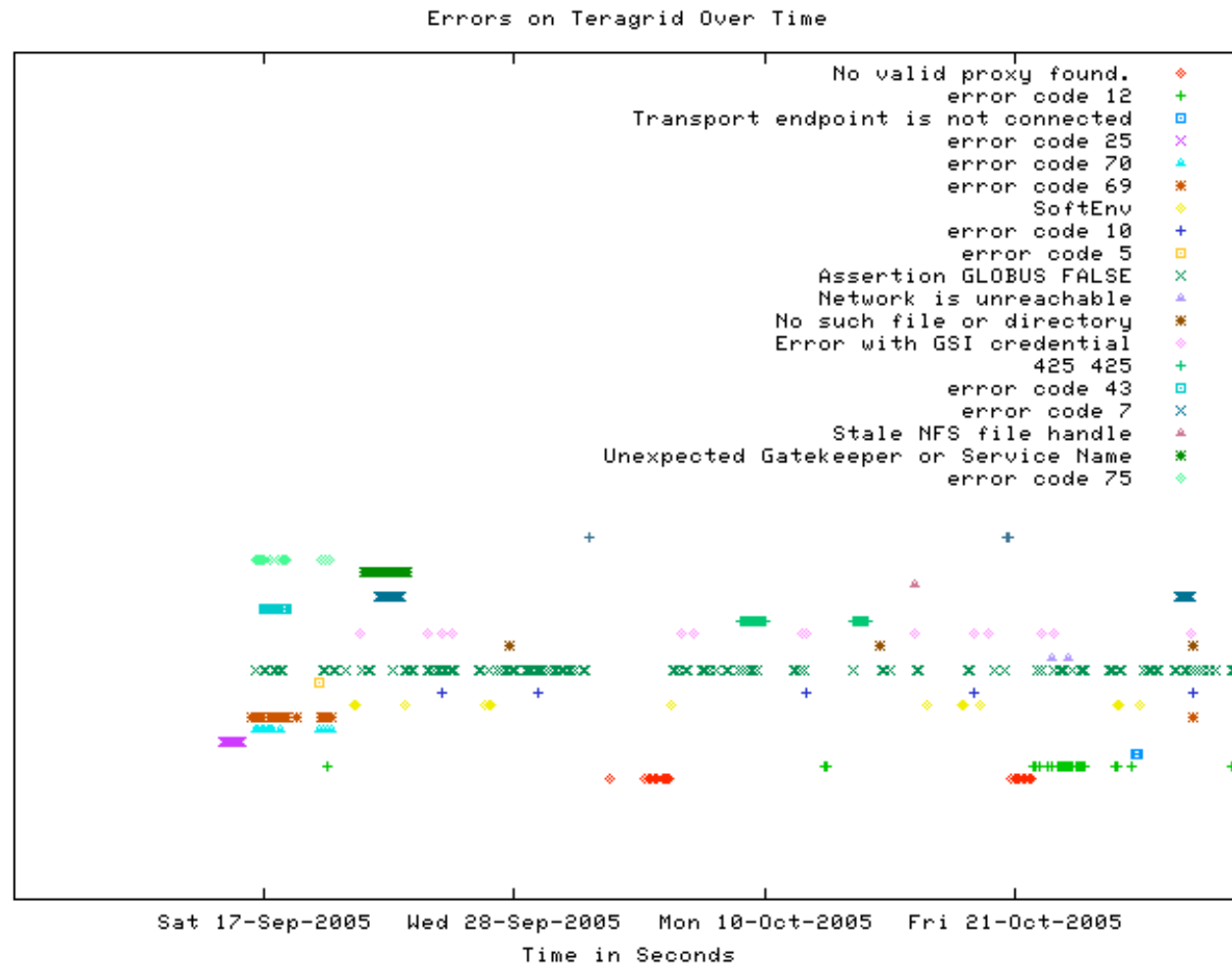
3) *Inca in use: Measuring Grid middleware performance*



3) *Inca in use: Monitoring Grid middleware reliability*



3) Inca in use: Error tracking over time

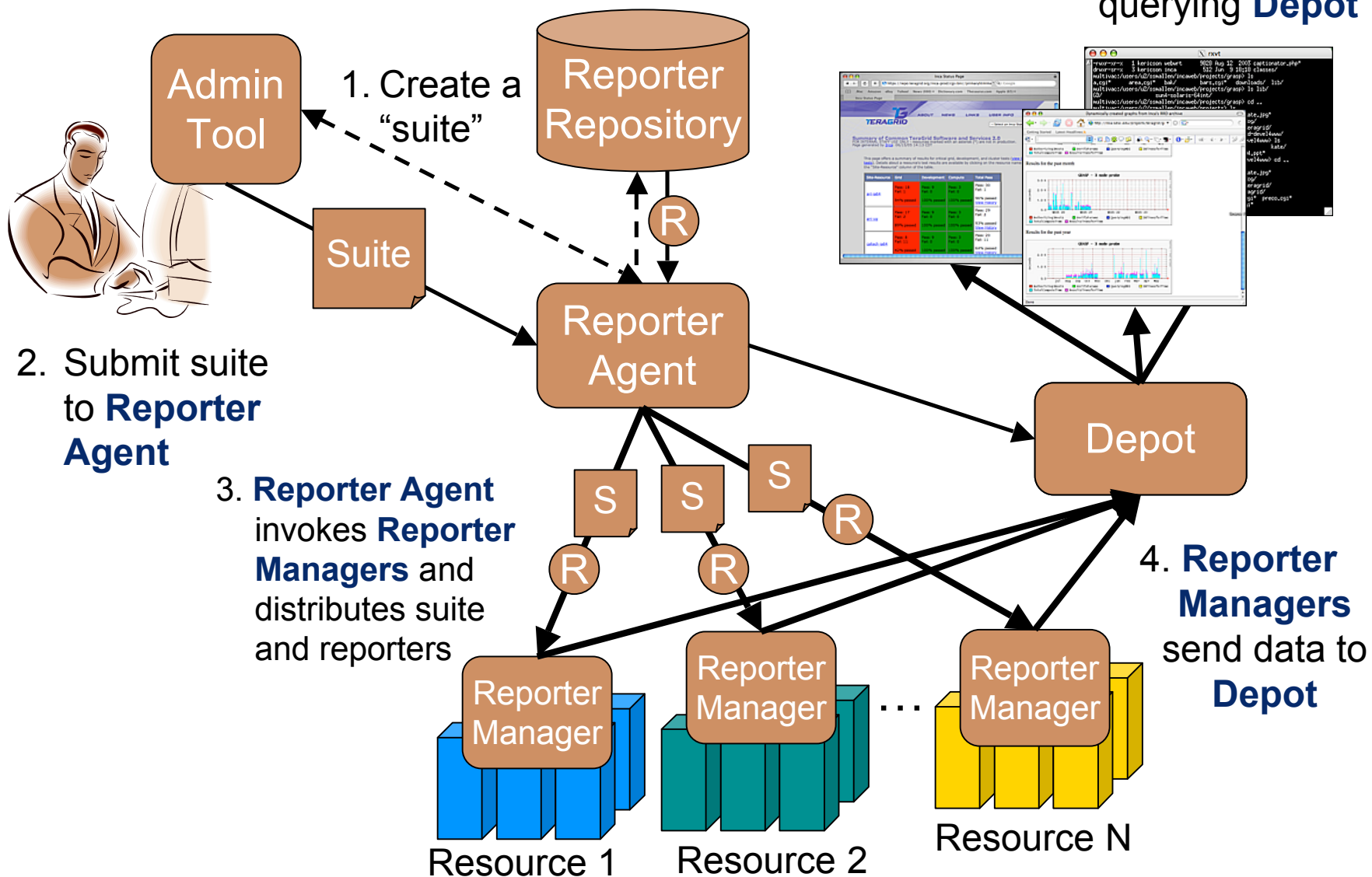


Outline

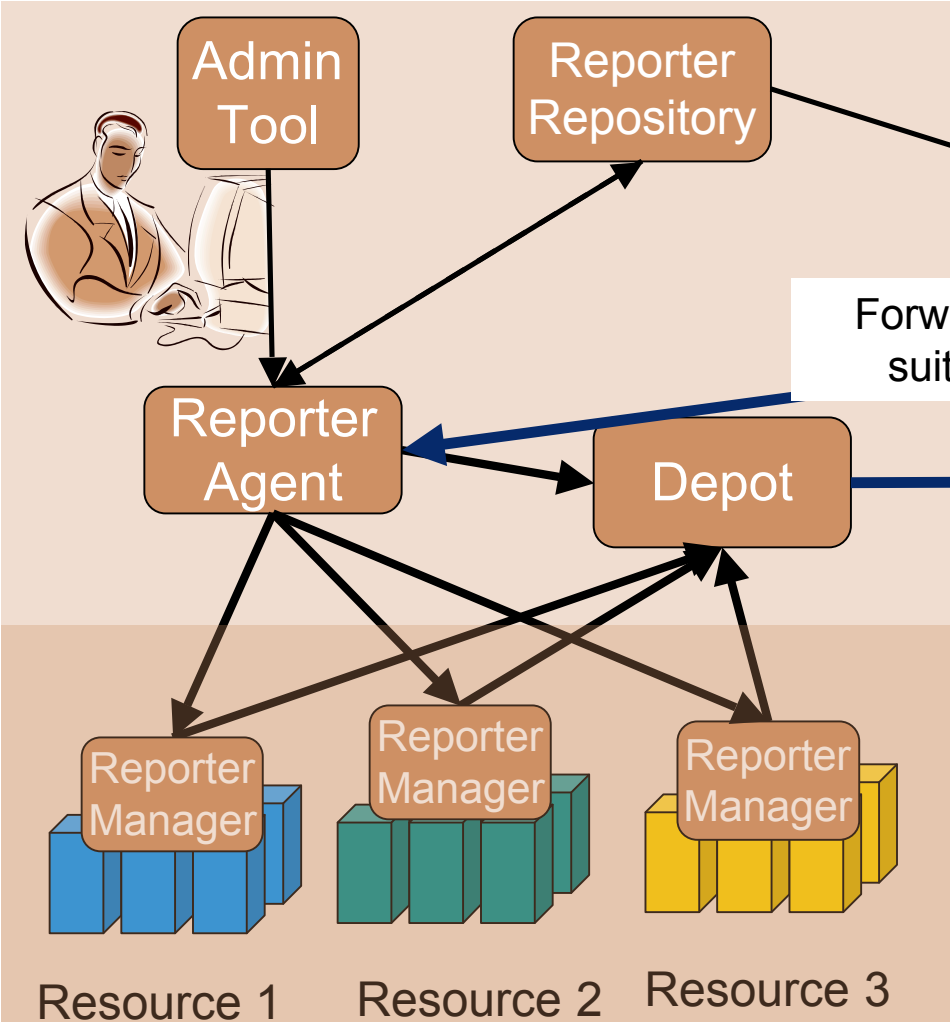
- Inca in use
- **Architecture overview**
- **Project plans**

Architecture overview

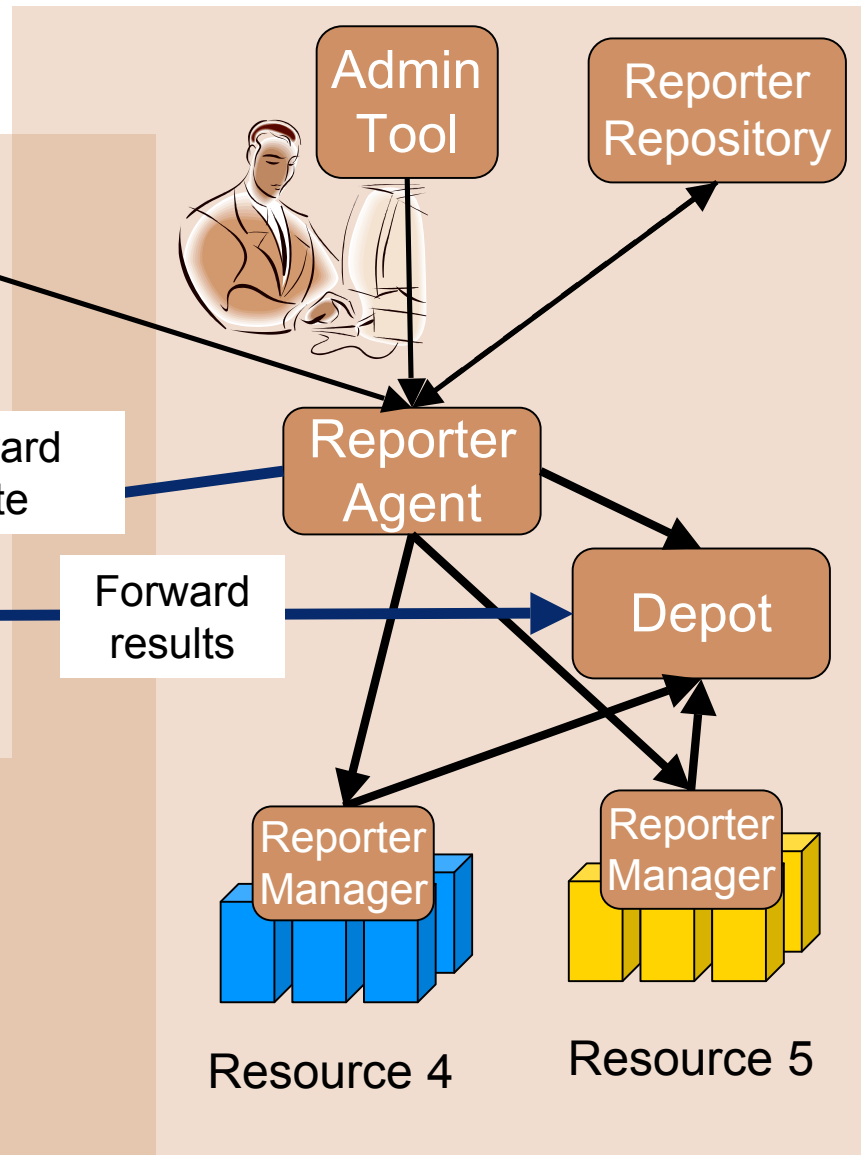
5. GUIs can display collected data by querying **Depot**



VO A



VO B



Outline

- Inca in use
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Inca 2.0

- **Initial version of Inca focused on basic functionality**
- **New features:**
 - Improved archiving capabilities
 - Scalability - control and data storage
 - Usability - improved installation and configuration control
 - Monitor system impact (self-monitoring)
 - Security - SSL, proxy delegation
 - Condor integration
- **Release early 2006**

Improvements for TeraGrid

- **Improved GUIs**
 - User can select only information interested in
- **Historical Non-numerical data**
 - Error messages
 - Resource usage (CPU/memory used by reporters)
- **Additional reporters** - file transfer, batch queue and scheduler, compilers, HPSS, ...

Summary

- **Periodic, user-level functionality testing needed to monitor Grid reliability**
- **Inca provides a unique, automated framework for functionality testing and performance measurement**
- **Inca is successfully deployed on several Grids today**

Future work

- **Integration with knowledge base**
- **Standardized suites**
- **Automatic tuning of reporter execution frequencies to ensure low impact on resources**



More information

Inca 2.0 to be released January 2006

Inca workshop tentatively scheduled for February 2006

- **Email:**
inca@sdsc.edu

- **Website:**
<http://inca.sdsc.edu>

- **Supported by:**

SDSC



TeraGrid[™]



NMI

PMaC

Performance Modeling and Characterization