TeraGrid Information Services: Architecture, Current Capabilities, and Plans

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SC07
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What is the TeraGrid?

1 NSF funded facility with 11 resource providers and several other partners
What is the TeraGrid?

Operating a **coordinated** high-performance compute, network, storage, and visualization infrastructure.
What is the TeraGrid?

To enable Open Scientific Discover

Resource Provider (RP)

Software Integration Partner

Network Hub

SDSC

SC 07

November 14, 2007
(Tera)Grid in what sense?

Example Standard People Interfaces
- Request allocations & accounts
- Identify available resources
- Learn how to use resources
- Find resource status
- Ask for help
- Interact with the community

Proposal System “POPS”

User Portal

User Documentation & Knowledge Base

Events

Helpdesk
(Tera)Grid in what sense?

Coordinated/Standard (User) Software Interactions

- Coordinated software
- Coordinated development & runtime Unix environment
- Standardized (Grid) service interfaces

Coordinated Software

<table>
<thead>
<tr>
<th>Grid clients &amp; tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development tools &amp; languages</td>
</tr>
<tr>
<td>Communication, Data, and Math tools &amp; libraries</td>
</tr>
</tbody>
</table>

Unix Environment

Grid Services

- Remote Login
- Data Movement
- Data Management
- Remote Execution
- Information
Motivation for Information Services

Significant growth in size, diversity, and complexity of infrastructure

<table>
<thead>
<tr>
<th></th>
<th>Initially</th>
<th>Today</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource Providers</strong></td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td><strong>Compute Resources</strong></td>
<td>4 clusters</td>
<td>19 clusters, and SMPs, MPPs</td>
</tr>
<tr>
<td><strong>Resource Types</strong></td>
<td>compute, viz, storage</td>
<td>plus instruments, gateways,..</td>
</tr>
<tr>
<td><strong>Interconnects+MPI</strong></td>
<td>3 types</td>
<td>many types</td>
</tr>
<tr>
<td><strong>Processors Types</strong></td>
<td>2 (IA-64, IA-32)</td>
<td>7 types (w/ non-Intel)</td>
</tr>
<tr>
<td><strong>Operating Systems</strong></td>
<td>Linux SLES8</td>
<td>~12 Unix OSs</td>
</tr>
<tr>
<td><strong>Coordinated Software</strong></td>
<td>CTSS v1</td>
<td>CTSS v4</td>
</tr>
</tbody>
</table>
Challenges

Integrating many more types of infrastructure resources,
Including more services providers,
Providing more types of services,
With more resources, providers, and services diversity,
Supporting specialization.

How can users keep it all straight?
Meeting the Challenge
Re-architect CTSS

Took Coordinated TeraGrid Software and Services “CTSS” v3:
Monolithic coordinated capabilities
In production since mid 2006

Re-architected into CTSS v4 “capability kits”:
Small required core integration kit with minimum needed to integrate resources
Plus ~10 optional user capability kits (at least 1 required)
Meeting the Challenge
Information Services

Information Services Vision:
1) Create a **coordinated way** for TeraGrid participants to publish about the services they offer,
2) Create a **way for the TeraGrid** to aggregate and **index** the information from TeraGrid participants, and
3) to **publish this information** to the public in a form that can easily **be used** by user software, user interfaces, and TeraGrid service providers themselves to **discover capabilities and how to access them**
## TG Information Services IS [NOT]

<table>
<thead>
<tr>
<th>IS NOT</th>
<th>IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A central database (Data Warehouse)</td>
<td>A central index/aggregation (Google)</td>
</tr>
<tr>
<td>A new user interface</td>
<td>A way software (user interfaces) can access information</td>
</tr>
<tr>
<td>A single implementation/tool</td>
<td>Evolving set of software tools</td>
</tr>
<tr>
<td>A single software interface</td>
<td>Several useful interfaces (small set)</td>
</tr>
<tr>
<td>A specific set of information</td>
<td>Phased growing collection of information</td>
</tr>
<tr>
<td>Changed data ownership</td>
<td>Ownership maintained as appropriate</td>
</tr>
<tr>
<td>Way to manage scientific information</td>
<td>Way to manage Grid meta-data</td>
</tr>
<tr>
<td>A data management system (database)</td>
<td>An information publishing system</td>
</tr>
</tbody>
</table>

A coordinated way to index and publish public [Tera]Grid information thru software interfaces.
Service Provider vs TG Wide Services

Content:
Locally owned and maintained information
Originates anywhere the service provider wishes

Services:
1 general purpose MDS service
2 scheduling MDS services: authenticated and public (merging)
Service Provider vs TG Wide Services

Content:
- Aggregate/index service provider information
- Additional central information (TGCDB, GIG operated services, ...)
- Cached (service providers services can be down)
- Authenticated registrations

Services:
- Several redundant servers (99.5% plus availability)
- Information caching (persistence)
- Several MDS4 services (WS/SOAP)
- WebMDS/Tomcat, Apache 2.0, ... services (WS/REST)
- Content published in: HTML, XHTML/XML, XML, Atom, RSS, ...
Information Services Tooling

WS/* (Tomcat 5.0, Apache 2.0)

Benefits
- Very common web services platform
- Supports several web service interfaces (including simple)
- Supports multiple styles like REST, Web 2.0
- Can be highly scalable

Content
- Many formats: HTML, XHTML/XML, XML, RSS/Atom, ...

WebMDS (Globus 4.0.5/VDT 1.7.1)

Benefits
- Live MDS4 content access
- XPath support
- XSLT transforms

Content
- Many formats: HTML, XHTML/XML, XML, RSS/Atom

WS/SOAP (Globus 4.0.5/VDT 1.7.1 MDS4)

Benefits
- Indexing, Trigger
- Registration, Publish, Subscribe
- Security/Authorization
- Robust WSRF interface

Content
- XML
High-Availability Design

Service Provider
Information Services

TG wide information services

info.teragrid.org

Clients

info.dyn.teragrid.org

TeraGrid Dynamic DNS

Information Services administrators select servers
Changes propagate globally with a 15 minute TTL

Dynamically Changes

Doesn’t Change
What’s in Production?

Services
– TeraGrid Resource Provider Information Services
– TeraGrid Wide Aggregating/Indexing Information Services

Content (since when)
– Scheduling information for User Portal (Spring)
  • Scheduler load, Queue contents (restricted)
– CTSS 4 capabilities kits (August)
  • Which capability kits are available on each resource
  • What software is available in each kit on each resource
  • What services are available from each kit on each resource
– TeraGrid Central Database (tgcdb) keys and descriptions (October)
Queue Contents in User Portal

![TeraGrid User Portal](https://portal.teragrid.org:443/gridsphere/gridsphere?cid=systems-monitor&gs_act)

**Job summary for login-abe.ncsa.teragrid.org:**

- **47 Running Jobs**
- **68 Queued Jobs**
- **50 Other Jobs**

### 47 Running Jobs on login-abe.ncsa.teragrid.org

<table>
<thead>
<tr>
<th>Status</th>
<th>Job Id</th>
<th>Name</th>
<th>Owner</th>
<th>Queue</th>
<th>Submission Time</th>
<th>Processors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running</td>
<td>35721.abem5.ncsa.uiu</td>
<td>d_1-40</td>
<td>petefred</td>
<td>normal</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Running</td>
<td>35730.abem5.ncsa.uiu</td>
<td>_1-1-39</td>
<td>petefred</td>
<td>normal</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Running</td>
<td>36071.abem5.ncsa.uiu</td>
<td>rturb</td>
<td>pakshing</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36518.abem5.ncsa.uiu</td>
<td>A2Q_8-8</td>
<td>seabra</td>
<td>normal</td>
<td></td>
<td>4</td>
</tr>
<tr>
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<td>A2Q_8-12</td>
<td>seabra</td>
<td>normal</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Running</td>
<td>36523.abem5.ncsa.uiu</td>
<td>A2Q_12-12</td>
<td>seabra</td>
<td>normal</td>
<td></td>
<td>4</td>
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<tr>
<td>Running</td>
<td>36563.abem5.ncsa.uiu</td>
<td>AirNoFSTur</td>
<td>auzun</td>
<td>normal</td>
<td></td>
<td>30</td>
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<tr>
<td>Running</td>
<td>36584.abem5.ncsa.uiu</td>
<td>DI14</td>
<td>jhsin</td>
<td>normal</td>
<td></td>
<td>128</td>
</tr>
<tr>
<td>Running</td>
<td>36627.abem5.ncsa.uiu</td>
<td>rturb</td>
<td>pakshing</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36647.abem5.ncsa.uiu</td>
<td>P3</td>
<td>amyshih</td>
<td>normal</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Running</td>
<td>36690.abem5.ncsa.uiu</td>
<td>rturb</td>
<td>pakshing</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36718.abem5.ncsa.uiu</td>
<td>cr-323-02</td>
<td>kjjin</td>
<td>normal</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Running</td>
<td>36828.abem5.ncsa.uiu</td>
<td>m0r8_RC0s</td>
<td>moo</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36833.abem5.ncsa.uiu</td>
<td>Estr_Prod</td>
<td>seabra</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36842.abem5.ncsa.uiu</td>
<td>Script.abe</td>
<td>dcollins</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36900.abem5.ncsa.uiu</td>
<td>L10_N64_4I</td>
<td>gbryan</td>
<td>normal</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Running</td>
<td>36903.abem5.ncsa.uiu</td>
<td>frthali</td>
<td>zetienne</td>
<td>normal</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>
CTSS 4 Capability Kits

For each capability kit on each resource
- Current support level, and target support level
  - Development, Testing, Production
- Support organization and contact
- Inca status URL
- Multiple version of a kit with different support levels
CTSS 4 Capability Kit Software

For each kit software component on each resource
- Name, version, how to access it
- Multiple versions of a single component
CTSS 4 Capability Kit Services

For each kit service on each resource

- Name, type, version, and Endpoint (contact location)
- GSI OpenSSH, GridFTP, SRB servers, PreWS & WS GRAM, MDS4
- Multiple services of the same type
## CTSS Capability Kit Availability

[View CTSS Kits Available on TeraGrid](http://www.teragrid.org/userinfo/software/ctss_results.php)

### CTSS Resources and Available Kits

(Read the Kit Definitions)

<table>
<thead>
<tr>
<th>Site/Resource</th>
<th>TeraGrid Core Integration Kit</th>
<th>Remote Login Capability Kit</th>
<th>TeraGrid Remote Compute Kit</th>
<th>Application Development and Runtime Support Capability Kit</th>
<th>TeraGrid Data Movement Kit</th>
<th>Parallel Application Capability Kit</th>
<th>Science Workflow Support Kit</th>
<th>TeraGrid Data Management Capability Kit</th>
<th>Data Visualization Support Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCAR: Frost</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>PSC: Big Ben</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>currently available</td>
<td>Not Installed</td>
</tr>
<tr>
<td>PSC: Rachel</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>Purdue: Condor</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>Purdue: Lear</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>TACC: Lonestar</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>TACC: Maverick</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>currently available</td>
<td></td>
</tr>
<tr>
<td>NCSA: Cobalt</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>NCSA: Abe</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
<tr>
<td>NCSA: UI-UCSD Cluster</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>currently available</td>
<td>Not Installed</td>
<td>Not Installed</td>
<td></td>
</tr>
</tbody>
</table>
Where are the GridFTP services?

<table>
<thead>
<tr>
<th>Service selection</th>
<th>Type</th>
<th>Version</th>
<th>Endpoint</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCAR Blue Gene/L (Frost)</td>
<td>gridftp</td>
<td>4.0.3</td>
<td>gsiftp://gridftp.frost.ncar.teragrid.org:2811/</td>
<td>globus-gridftp-server</td>
</tr>
<tr>
<td>PSC XT3 (BigBen)</td>
<td>gridftp</td>
<td>4.0.3</td>
<td>gsiftp://gridftp.bigben.psc.teragrid.org:2811/</td>
<td>globus-gridftp-server</td>
</tr>
<tr>
<td>PSC Alpha E7 (Rachel)</td>
<td>gridftp</td>
<td>4.0.3</td>
<td>gsiftp://gridftp.psc.teragrid.org:2811/</td>
<td>globus-gridftp-server</td>
</tr>
<tr>
<td>Purdue Condor Pool</td>
<td>gridftp</td>
<td>4.0.3</td>
<td>gsiftp://tg-data.purdue.teragrid.org:2811/</td>
<td>globus-gridftp-server</td>
</tr>
<tr>
<td>Purdue EM64T Cluster (Lear)</td>
<td>gridftp</td>
<td>4.0.3</td>
<td>gsiftp://tg-data.purdue.teragrid.org:2811/</td>
<td>globus-gridftp-server</td>
</tr>
</tbody>
</table>
What’s in Development?

Expanded content
- Local HPC Software
- Extended GridFTP service information
- (Meta)Scheduling support information

Core Extension
- Information Services Metadata (registration w/o aggregation)

Information Access
- tginfo, universal command line query tool
- WS/REST, Web 2.0 style information access
- Multiple formats: CSV TEXT, RSS/Atom, XML, ...
- GLUE 2.0

Community publishing
- Community supported capabilities
- Community information services registration
[Not so] Farfetched Possibilities

Gateways
Publish or register to TeraGrid Wide Information Services

Data collections
Data collections register to TeraGrid Wide Information Services
- Access method, service Endpoint, paths

Community software areas
Which resources have each CSA
What software is available in each CSA, how to access it

Service Provider
Planned and unplanned outage information
Policies

Peer grids/interoperability
Resources, services available on peer grids (OSG, EGEE, ...)

......
More Information

Information Services Documentation:
http://info.teragrid.org/ (links to content and documentation)

View Information Services Content:
User Portal (scheduler load & queue contents):
https://portal.teragrid.org:443/gridsphere/gridsphere?cid=resources
User Documentation (CTSS 4 kits, software, services):
http://www.teragrid.org/userinfo/software/ctss.php
Information Service Main Page:
http://info.teragrid.org/