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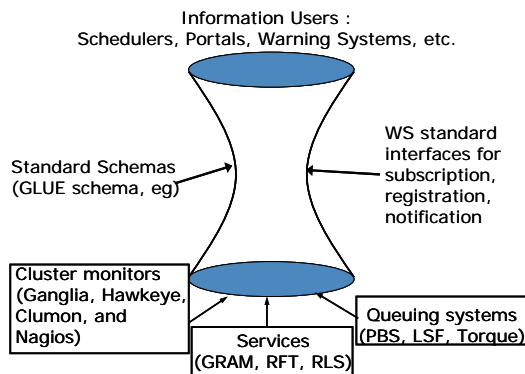
# MDS4: The GT4 Monitoring and Discovery System

Contact email: [jms@mcs.anl.gov](mailto:jms@mcs.anl.gov)

Contact web: <http://www.globus.org/toolkit/mds>

The Globus Toolkit's Monitoring and Discovery System (MDS4) implements a standard Web services interface to a variety of local monitoring tools and other information sources.

MDS4 is a "protocol hourglass," defining standard protocols for information access and delivery and standard schemas for information representation. Below the neck of the hourglass, MDS4 interfaces to different local information sources, translating their diverse schemas into appropriate XML schema (based on standards such as the GLUE schema whenever possible). Above the neck of the hourglass, various tools and applications can be constructed that take advantage of the uniform Web service interfaces to those information source the MDS4 interacts with.



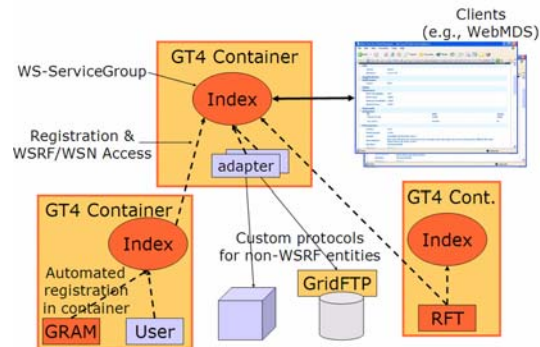
MDS4 builds on query, subscription, and notification protocols and interfaces defined by the WS Resource Framework (WSRF) and WS-Notification families for specifications and implemented by the GT4 Web Services Core.

Building on this base, we have implemented a range of *information providers* used to collect information from specific sources. These components often interface to other tools and systems, such as the Ganglia cluster monitor and the PBS and Condor schedulers.

MDS4 also provides two higher-level services: an *Index* service, which collects and publishes aggregated information about information sources, and a *Trigger* service, which collects resource information and performs actions when certain conditions are met. These services are built upon the *Aggregation Framework* infrastructure that provides common mechanisms to collect

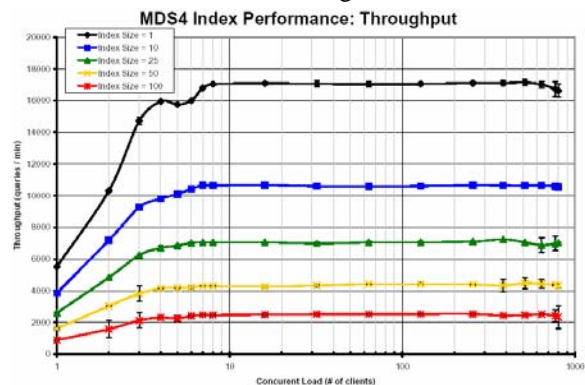
information, be configured, self-clean and provide a soft consistency.

Finally, a Web-based user interface called *WebMDS* provides a simple XSLT-transform based visual interface to the data. The figure below depicts a typical MDS4 project deployment.



The GT 4.0.1 Index server has shown a high degree of stability and scalability with respect to the number of concurrent queries. A long running Index service test ran over 96 days, processing over 623 million queries, averaging 74 per second, with no noticeable performance or usability degradation.

We have also examined the general scalability of the MDS4 Index server with respect to numbers of clients and Index size. We have run LAN experiments on the UC TeraGrid cluster (dual 2.4GHz Xeon processors, 3.5 GB RAM, 1GB.s network) examining index sizes of 1, 10, 25, 50 and 100 and clients, distributed evenly over 20 nodes, from 1 to 800. The figure below shows 8 minute averages of these results.



See also the journal paper available from [www.mcs.anl.gov/~jms/Pubs/mds4-scidac.pdf](http://www.mcs.anl.gov/~jms/Pubs/mds4-scidac.pdf)

## Finding the Right Resource to Use: Work with TeraGrid

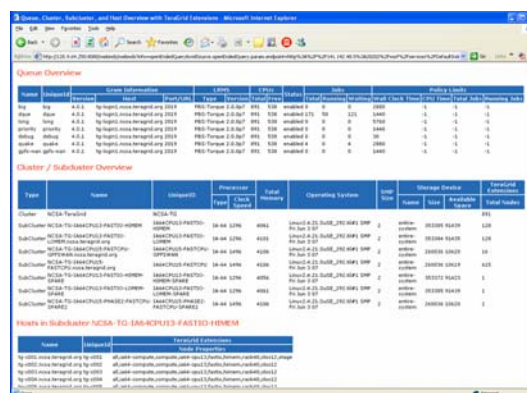
As an example of an MDS4 deployment, we are working with the TeraGrid project to provide data relevant to selecting the appropriate set of resources to use for a particular job. End-users (via a Web interface), metascheduling systems, and other applications will be able to use this deployment to find the resources that best meet their needs.

Information relevant to resource selection is currently available from a variety of sources: cluster monitoring systems, including Ganglia, Clumon, Nagios, and Hawkeye; resource management and scheduling systems, including PBS, Torque and LSF; and common services, including GRAM, GridFTP, RFT, CAS, and RLS, all part of GT4.

As a result of the current MDS4 deployment, users will have access to a simple Web interface (shown right) to examine resource selection decisions, and metaschedulers will have a common interface to the data they need across the TeraGrid, through either command line or Java APIs.

By providing a protocol hourglass, and therefore a level of indirection, we can easily accommodate additional data or changes in the TeraGrid sites simply by adding information providers with no client-level changes needed.

Current information about the MDS4 deployment on TeraGrid is available from <http://mds.teragrid.org/>.



The screenshot shows a web browser displaying the TeraGrid MDS4 deployment interface. It features a table with columns for 'Cluster', 'Name', 'Platform', 'Architecture', 'Operating System', 'Storage', 'Network', and 'Status'. The table lists various clusters and their associated resources, including details like 'Platform: x86\_64', 'Architecture: x86\_64', 'Operating System: Linux', and 'Storage: 10000 GB'. The interface also includes a 'Cluster / Subcluster Overview' section and a 'Nodes in Subcluster' section.

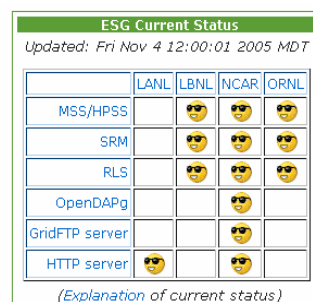
## Discovering Errors: Work with the Earth Sciences Grid

The MDS4 Trigger service collects information and compares that data against a set of conditions defined in a configuration file. When a condition is met, an action takes place, such as emailing a system administrator when the disk space on a server reaches a threshold. This functionality was inspired by a similar capacity in Condor's Hawkeye monitor.

Currently, the Earth Sciences Grid is using the MDS4 Trigger service to monitor the states of integral service components in that Grid, such as RLS, SRM, OpenDAP, and HTTP and GridFTP file servers. The Trigger service periodically checks that the aforementioned services are up and running, and if any one of these services has gone down or is unavailable for any reason, an action script is executed which sends email to administrators notifying them of the service that is unavailable.

The status provided by the Trigger service in ESG is also reflected in the ESG portal Web page, where users can view at a glance the current up/down status of the various component services.

See <https://www.earthsystemgrid.org/> to explore the ESG portal page further and view the current system status.



The screenshot shows the 'ESG Current Status' page, updated on Fri Nov 4 12:00:01 2005 MDT. It displays a table with columns for 'Service' and 'Status'. The services listed are MSS/HPSS, SRM, RLS, OpenDAPg, GridFTP server, and HTTP server. The status for each service is indicated by a yellow smiley face icon, suggesting they are all currently up and running. Below the table, there is a note: '(Explanation of current status)'.

ESG allows access to data that is stored either on rotating storage (currently at NCAR) or on deep storage (at NCAR MSS, NERSC HPSS and ORNL HPSS). A deep storage archive may occasionally be offline for scheduled maintenance or other administrative task.

The Storage Resource Manager (SRM) middleware is used to retrieve data from the deep archives and transfer it (via GridFTP) to the NCAR dataportal, where it is made available to HTTP requests.

The Replica Location Service (RLS) is a system of cross-updating databases that keeps track of files copied stored anywhere on the Grid. The RLS is used when publishing data to the ESG system.

The OpenDAPg server is used when requesting subsets of virtually aggregated datasets. The data is extracted from multiple files, stored into a single file, and made available to HTTP requests.