NorduGrid — a Nordic Grid

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NorduGrid
The Grid Idea

- A user should be able to submit a computing job to the “grid” and get the result back without caring about where the job is being executed.
- Such a computational grid would use many computer resources distributed over a large area.
- The term “grid” originates from the analogy with the electrical power grid, where consumers plug their machines to the outlets and don’t need to care about where the electricity is being produced.
Why Grids?

- Uniform access to many resources — easier to use.
- No need to remember different usernames and passwords for different sites.
- Automatic search for resources that satisfy the requested criteria.
- More efficient use of available resources.
The NorduGrid Project

- The NorduGrid project was launched in May 2001.
- The project is funded by the NorduNet 2 research programme.
- The project aims at creating a grid infrastructure in the Nordic countries.
- Initiated by High Energy Physicists in order to cope with the computing needs of the experiments at the LHC collider at CERN, but intended to serve other fields as well (biology, astronomy, geoscience, ...).
The NorduGrid Project (cont)

- Project partners:
  - Uppsala University
  - Lund University
  - Stockholm University
  - Royal Inst. of Technology
  - University of Oslo
  - University of Bergen
  - Niels Bohr Institute
  - Helsinki Inst. of Physics
The computing resources available in NorduGrid are scattered around the Nordic countries.
Hardware

• The computing resources that can be accessed through NorduGrid are clusters of different sizes at many different locations in the Nordic countries.
• There are small dedicated test clusters (3–5 CPU’s) at the various university departments.
• Some larger computing facilities at the departments accept jobs (e.g. NBI & SCFAB).
• Clusters at the national computing centres accept submission through NorduGrid (e.g. Ingvar at NSC, Seth at HPC2N and Fire at Parallab).
Software

- The software environment is heterogeneous since different clusters run different operating systems
  - Most clusters connected to the system run some Linux distribution on Intel or AMD processors
    - RedHat (different releases)
    - Debian
    - Mandrake
    - Slackware
  - There are also some other systems being tested
    - RedHat on alpha processors
    - HP-UX
• In order to build a grid from a set of geographically distributed clusters you need:
  • Secure authentication and authorization.
  • Access to information about available resources.
  • Fast and reliable file transfers.
• These services are provided by the so called middleware.
The basic middleware is provided by the Globus toolkit:

- The Globus Security Infrastructure (GSI)
  - Authentication and authorization using certificates
  - Proxy certificates allow single sign on
- The Metadata Directory Service (MDS)
  - LDAP based information system with caching
- The GridFTP protocol for fast file transfers
- The Replica Catalog
  - LDAP based database that keeps track of where physical copies of a given logical file are available
The NorduGrid Toolkit

• The NorduGrid toolkit is built on top of the Globus toolkit’s services and protocols:
  • Information providers that publish information about the state of computing resources and jobs in the Globus MDS.
  • A user interface that uses the information to select a suitable cluster to submit the job to.
  • A grid-manager daemon that accepts the job at the cluster and submits it to the local resource management system.
  • A GridFTP server for file transfers.
The Load Monitor

http://www.nordugrid.org/ — then press ‘Load Monitor’
The Load Monitor (cont)

### NorduGrid Cluster Details - Mozilla (Build ID: 2002051319)

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<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distinguished name</td>
<td>nordugrid-cluster-name=ingvar.nsc.liu.se,Mds-Vo-name=local,0=grid</td>
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<tr>
<td>objectClass</td>
<td>Mds</td>
</tr>
<tr>
<td>Front-end domain name</td>
<td>ingvar.nsc.liu.se</td>
</tr>
<tr>
<td>Cluster alias</td>
<td>Ingvar (NSC)</td>
</tr>
<tr>
<td>Contact string</td>
<td>gsfftp://ingvar.nsc.liu.se:2811/jobs</td>
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<tr>
<td>E-mail contact</td>
<td><a href="mailto:grid-admin@nsc.liu.se">grid-admin@nsc.liu.se</a></td>
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<tr>
<td>LRMS type</td>
<td>OpenPBS</td>
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<tr>
<td>LRMS version</td>
<td>2.3</td>
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<tr>
<td>LRMS details</td>
<td>single job per processors</td>
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<tr>
<td>Architecture</td>
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<tr>
<td>Operating system</td>
<td>Linux 2.2.16</td>
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</tr>
<tr>
<td>CPU type (slowest)</td>
<td>AMD Athlon(tm) Processor 908 MHz</td>
</tr>
<tr>
<td>Memory (MB, smallest)</td>
<td>512</td>
</tr>
<tr>
<td>Total CPUs</td>
<td>32</td>
</tr>
<tr>
<td>CPU:machines</td>
<td>1 cpu:32</td>
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<tr>
<td>Occupied CPUs</td>
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<tr>
<td>Queued jobs</td>
<td>0</td>
</tr>
<tr>
<td>Total amount of jobs</td>
<td>15</td>
</tr>
<tr>
<td>Session directories area</td>
<td>/jobs</td>
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<td>Unallocated disk space (MB)</td>
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<tr>
<td>Grid middleware</td>
<td>globus-2.2.2-1ng6.2, nordugrid-0.3.8 updated</td>
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<tr>
<td>Runtime environment</td>
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<td>Mds-validfrom</td>
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<td>Mds-validto</td>
<td>21-10-2002 07:50:42</td>
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</table>

<table>
<thead>
<tr>
<th>Queue</th>
<th>Status</th>
<th>CPU (min)</th>
<th>CPUs</th>
<th>Running</th>
<th>Queueing</th>
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</thead>
<tbody>
<tr>
<td>norduGRID</td>
<td>active</td>
<td>0 to inf</td>
<td>N/A</td>
<td>13 (Grid: 13)</td>
<td>0 (Grid: 0)</td>
</tr>
</tbody>
</table>
The NorduGrid Toolkit provides a set of commands for submitting jobs to NorduGrid:

- `ngsub` — for submission
- `ngstat` — for status of jobs and clusters
- `ngcat` — to see stdout/stderr while the job is running
- `ngget` — to retrieve the results
- `ngkill` — to kill a job
- `ngclean` — to delete a finished job from the system
- `ngsync` — to synchronise the local info with the MDS
The ATLAS Experiment at LHC

• The ATLAS experiment is a detector being built at the Large Hadron Collider at CERN.
• It will start collecting data in 2007.
The ATLAS Data Challenge

• The LHC experiments will need a lot of computing resources. All computing can not be done at the CERN computing centre.

• The aims of the so called ATLAS data challenges are:
  • to validate that the simulation software works on different sites — especially sites outside CERN.
  • to provide simulations needed for designing the trigger system and for preparing physics analysis.
• The part of the simulation that was assigned to the Nordic countries in Data Challenge 1 has been performed by submitting the jobs to NorduGrid.

• The information system contains information about what clusters have the necessary hardware and software needed to execute the job and the Replica Catalog keeps track of the availability of input files on the different clusters.

• The resource broker in the user interface uses this information to select a suitable cluster.
The ATLAS Data Challenge (cont)

• The Nordic part of the Data Challenge 1, phase 1
  • 1,300 submitted jobs
  • 200 GB of input data
  • 765 GB of output data
  • 530 CPU days
• Phase 2 is about to start...
Future Plans

- Support for multi-processor jobs.
- Support for different local resource management systems.
- Runtime access to data.
Yesterday’s Tutorial

- Instructions at http://www.nordugrid.org/tutorial/
- The tutorial accounts at testarossa.nsc.liu.se will be available for some time.
- These accounts have tutorial certificates installed.
- For usernames and passwords for these accounts contact Mattias Ellert (mattias.ellert@tsl.uu.se) or Balázs Kónya (balazs.konya@quark.lu.se).
Summary

• The NorduGrid project have successfully provided a working grid testbed environment.
• The number of users is steadily increasing.
• This testbed has been successfully used to submit the computing jobs needed for the ATLAS data challenge.
More Information

• NorduGrid — http://www.nordugrid.org/
• NorduNet 2 — http://www.nordunet2.org/
• Globus — http://www.globus.org/
• The ATLAS experiment — http://www.cern.ch/atlas/
• Or contact me — mattias.ellert@tsl.uu.se

NorduGrid developers:
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