NorduGrid Tutorial

Client Installation and Job Examples

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Steps to Start Using NorduGrid

1) Install the client software
2) Request a certificate from a Certificate Authority (CA)
3) Install the certificate
4) Log in to the Grid
5) Test the installation
6) Write a job description using xRSL language
7) Submit the job
8) Monitor the progress of the job
9) Fetch the results

Installing the NorduGrid Client

- Required to submit jobs to NorduGrid
- Download from http://ftp.nordugrid.org/download/
  - Binaries for various Linux distributions, source code also available
- Easiest way to get started is to install the standalone client
  - Uncompress in a directory (no root privileges required):
    ```
    $ tar -zxvf nordugrid-standalone-0.3.36-1.i386.tgz
    ```
  - Run the environment setup script:
    ```
    $ cd nordugrid-standalone-0.3.36
    $ . ./setup.sh
    ```
- RPM packages are recommended for multi-user installations

Requesting and Installing the Certificate

- Create a certificate request

```
$ grid-cert-request -int
```

- This generates directory `.globus` in your home directory and inside it a file named `usercert_request.pem` which should be sent to a Certification Authority
  - Finnish users should email to NorduGrid CA `<ca@nbi.dk>` (this may change in the future)
- Wait for an answer from the CA
  - Signed certificate sent by the Certificate Authority should be saved as file `.globus/usercert.pem`

What Does a Certificate Look Like?

- Consists of two files:
  - Private key is protected by a password and kept secret
  - Public key is given out to third parties
  - Certificate Authorities sign the public key, even they never see the private key
- Look like a string of random numbers and letters, but tools can be used to convert the information in readable form

```
$ grid-cert-info -file <certificate file>
```

  - For example, my identity stored in my NorduGrid certificate is ”O=Grid, O=NorduGrid, OU=csc.fi, CN=Arto Teras”

Logging in and Testing the Installation

- Log in to the Grid

  `$ grid-proxy-init`

- Use command **`ngtest`** to test the installation

  `$ ngtest 1 -d 1` (send test job 1, show level 1 debug info)

  `$ ngget ngtest-job-1` (fetch result files of the test job)

- In case of problems, read the manual and frequently asked questions list (FAQ), ask the mailing list ...

NorduGrid User Interface

- Set of command line utilities:

`ngsub`	to submit a task
`ngstat`	to obtain the status of jobs and clusters
`ngcat`	to display the stdout or stderr of a running job
`ngget`	to retrieve the result from a finished job
`ngkill`	to cancel a job request
`ngclean`	to delete a job from a remote cluster
`ngrenew`	to renew user's proxy
`ngsync`	to synchronize the local job info with the MDS
`ngcopy`	to transfer files to, from and between clusters
`ngremove`	to remove files

Writing a Job Description File

- Resource Specification Language (RSL) files are used to specify job requirements and parameters for submission
  - NorduGrid uses an extended language (xRSL) based on the Globus RSL
- Similar to scripts for local queueing systems, but include some additional attributes
  - Job name
  - Executable location and parameters
  - Location of input and output files of the job
  - Architecture, memory, disk and CPU time requirements
  - Library dependencies and version requirements

xRSL example

```
& (executable=hellogrid.sh)
  (jobname=hellogrid)
  (stdout=hello.out)
  (stderr=hello.err)
  (gmlog=gridlog)
  (architecture=i686)
  (cputime=10)
  (memory=32)
  (disk=1)
```

Submitting a Job

- Submit the job

```
$ ngsub -f hellogrid.xrsl
=> Job submitted with jobid gsiftp://morpheus.
     dcgc.dk:2811/jobs/1757591474592630108
```

- Fetch the results

```
$ ngget hellogrid
=> ngget: downloading files to
     /home/ajt/175759147459263010８
   ngget: download successful - deleting job
     from gatekeeper.
```

Monitoring the Jobs

- Status of jobs can be queried with command ngstat

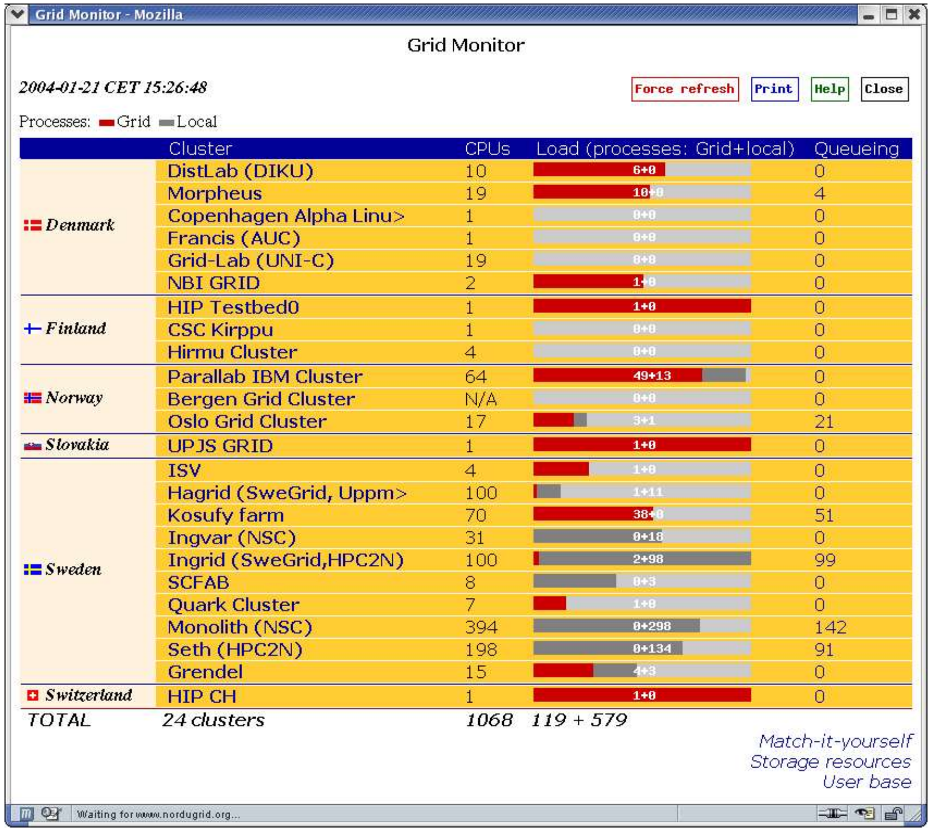
```
$ ngstat hellogrid

=> Job gsiftp://ingvar.nsc.liu.se:2811/jobs/5436235811735113812
     Jobname: hellogrid
     Status: FINISHING

   Job gsiftp://datagrid3.csc.fi:2811/jobs/1593889897762957743
     Jobname: hellogrid
     Status: ACCEPTED
```

- Grid monitor on the NorduGrid website is also a useful monitoring tool

Grid Monitor on NorduGrid Website


Grid Monitor

2004-01-21 CET 15:26:48

Processes: 🟥 Grid ▬ Local

	Cluster	CPUs	Load (processes: Grid+local)	Queueing
Denmark	DistLab (DIKU)	10	6+0	0
	Morpheus	19	10+0	4
	Copenhagen Alpha Linu>	1	0+0	0
	Francis (AUC)	1	0+0	0
	Grid-Lab (UNI-C)	19	0+0	0
	NBI GRID	2	1+0	0
Finland	HIP Testbed0	1	1+0	0
	CSC Kirppu	1	0+0	0
	Hirmu Cluster	4	0+0	0
Norway	Parallab IBM Cluster	64	49+13	0
	Bergen Grid Cluster	N/A	0+0	0
	Oslo Grid Cluster	17	3+1	21
Slovakia	UPJS GRID	1	1+0	0
Sweden	ISV	4	1+0	0
	Hagrid (SweGrid, Uppm>	100	1+11	0
	Kosufy farm	70	38+0	51
	Ingvar (NSC)	31	0+18	0
	Ingrid (SweGrid,HPC2N)	100	2+98	99
	SCFAB	8	0+3	0
	Quark Cluster	7	1+0	0
	Monolith (NSC)	394	0+298	142
	Seth (HPC2N)	198	0+134	91
	Grendel	15	4+3	0
Switzerland	HIP CH	1	1+0	0
TOTAL	24 clusters	1068	119 + 579	

Match-it-yourself
Storage resources
User base

Waiting for www.nordugrid.org...

- Shows currently connected resources
- Almost all elements "clickable"
  - browse queues and job states by cluster
  - list jobs belonging to a certain user
- No authentication, anyone can browse the info

Using a Storage Element

- Storage Elements are disk servers accessible via the Grid
- Allows to store input files close to the cluster where the program is executed, on a high bandwith network
- Possibility to upload output files at a desired place:

```
(inputFiles=
   (''input1''. ''/home/user/myexperiment''
   (''input2'', ''gsiftp://se.somewhere.ee/files/commondata''))

(outputFiles=
   (''output'', ''gsiftp://se.somewhere.fi/mydir/result1'')
   (''prog.out'', ''gsiftp://se.somewhere.fi/mydir/stdout''))

(stdout=''prog.out'')
```

xRSL Example Using a Storage Element

- xRSL file for the **`hellogrid`** example, uploading the job results to a storage element:

```
& (executable=hellogrid.sh)
(jobname=hellogrid-se)
(stdout=gsiftp://grid.tsl.uu.se/tutorial/hello.out)
(stderr=gsiftp://grid.tsl.uu.se/tutorial/hello.err)
(gmlog=gridlog)
(architecture=i686)
(cputime=10)
(memory=32)
(disk=1)
```

Gsincftp

- Can be used to transfer files to and from storage elements
  - Based on the popular **`ncftp`** ftp client, but uses certificate based authentication instead of standard ftp authentication
- Example session:

```
$ gsincftp grid.tsl.uu.se
  ...Logged in to grid.tsl.uu.se.

$ cd tutorial

$ get hello.out
```

- Already deprecated by the Globus project, does not work with their newest GridFTP server
  - replacement: UberFTP (http://dims.ncsa.uiuc.edu/set/uberftp/)

Runtime Environments

- Software packages which are preinstalled on a computing resource
  - Avoid the need of sending the binary at the start of executing a job
  - Allow local optimizations (e.g. compiling to the installed architecture using optimized compiler flags)
- Very useful if there are many users of the same software or if the same program is used frequently
- Required runtime environment(s) can be specified in the job description file (xRSL file), for example:

```
(runtimeenvironment=povray-3.5)
```

Real Jobs

- Real jobs usually send several subjobs to the Grid to solve a larger problem
- Parallel MPI jobs to a single cluster supported (if correct runtime environment installed), but no MPI between clusters
- Splitting the job to suitable parts and gathering the parts together is left to the user
  - More error prone environment than traditional local systems => error checking and recovery important
  - Fault reporting and debugging has room for improvements
- Leif Nixon's example: Rendering an image in slices using the **`povray`** tool

References

- NorduGrid website: http://www.nordugrid.org
- The NorduGrid User Guide: http://www.nordugrid.org/documents/userguide.pdf
- Balazs Konya's presentation at the 4th International Workshop on Grid Computing: http://www.nordugrid.org/slides/20031117-balazs.pdf
- Povray example by Leif Nixon: http://www.nsc.liu.se/~nixon/ng-povray/

Thank you!