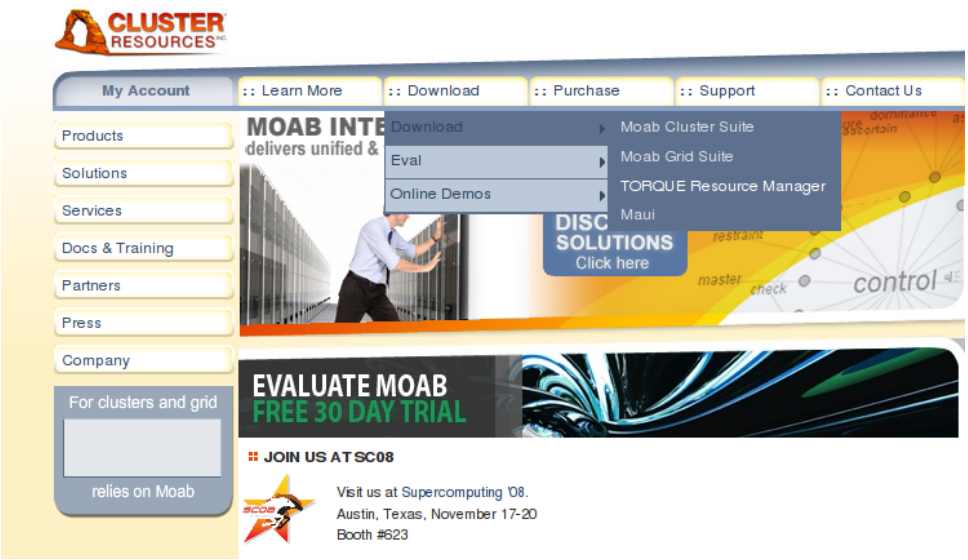
1 Obtaining and compiling TORQUE and Maui

Obtaining and compiling TORQUE

TORQUE Source Code

TORQUE is available from `www.clusterresources.com`



Building TORQUE

- **`configure --prefix=/whatever/you/likemakemake install`**
- not very clean, actually: quite a lot of important files go into `/var/spool` — including configuration files!

You can build only the server or MOM components, just tell **`--disable-mom`** or **`--disable-server`**

My favorite install uses a directory that is shared among the masternode and the computing nodes, so that I need to build only once.

TORQUE install uses 700 permission for `pbs_mom`, so you need to

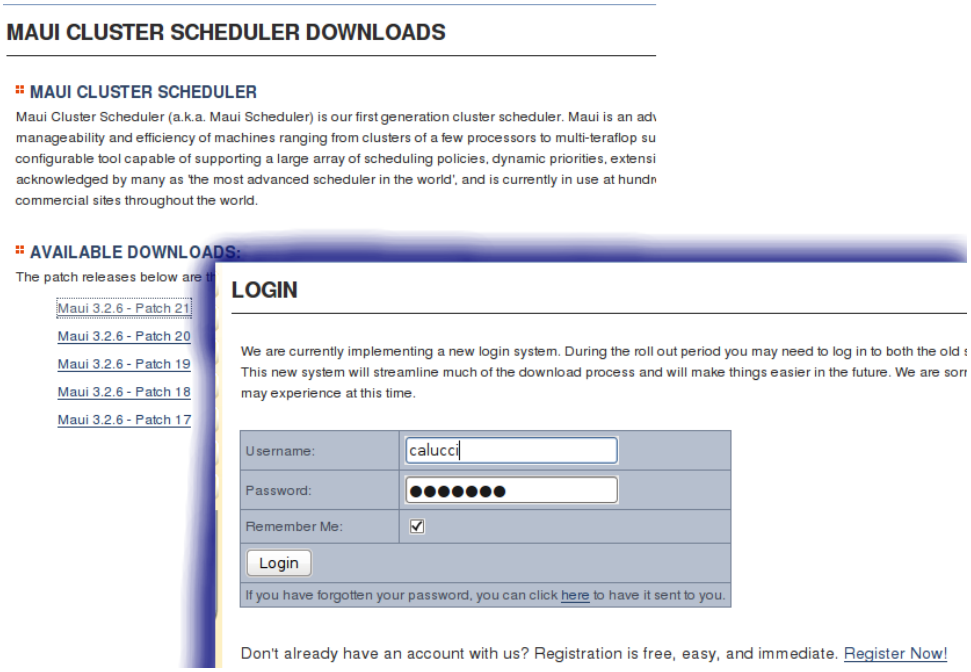
- share the install directory with `no_root_squash` **or**
- `chgrp nfsnobody pbs_mom ; chmod 710 pbs_mom`

Obtaining and compiling Maui

Maui Source Code

Maui too is available from `www.clusterresources.com`

You need to register to their site to download the code, and they *may* contact you later and ask what are you going to do with their software (and offer commercial support for it)



Building Maui

- same «`configure; make; make install`»
- maui build system need to know where TORQUE has been installed
- again, important files go into `/var/spool`

2 Configuration

TORQUE Configuration

TORQUE Common Configuration Files

- `pbs_environment` contains the environment variables for TORQUE; any minimal set will do e.g.

  ```
  PATH=/bin:/usr/bin
  LANG=en_US
  ```

- `server_name` contains the «official» name of the machine where `pbs_server` runs (this is usually your master node) The server name *must* be identical to the FQDN e.g.

  ```
  cerbero.hpc.sissa.it
  ```

Both these files reside in the spool directory (`/var/spool/torque`)

`pbs_server` configuration The `nodes` file

`server_priv/nodes` contains the list of available computing nodes and a list of attributes for each node.

node name	*# of CPUs*	*«features» (list of arbitrary strings, can be used later to select a node type)*
node01	np=2	opteron myri
node02	np=2	opteron myri
...		
node51	np=4	opteron IB
node52	np=4	opteron IB

pbs_server configuration Creating the Configuration Database

The bulk of pbs_server configuration is written in a (binary) database. You first need to create the empty database with

```
pbs_server -t create
```

This will *destroy any existing configuration*, create the empty database and start a pbs_server.

Configuration can then be edited using the qmgr tool. Configuration data are written to server_priv/serverdb as well as in various other files.

- if you are running postfix, you already have a qmgr somewhere in your system, so you may need to adjust some paths
- TORQUE qmgr needs a running pbs_server to actually write the configuration; this is because the configuration database is written by the server itself, and this in turn means that the server needs to have write permission on its own configuration

pbs_server configuration Security Note

qmgr doesn't actually edit the configuration database. It only sends configuration commands to pbs_server which in turn writes the configuration.

This means that:

- you need a running **pbs_server** to use **qmgr** (no big issue)
- the pbs_server process needs write access to its own configuration files this is usually considered very *bad* in any security-conscious environment – unfortunately no easy workarounds are available

pbs_server configuration Sample Configuration

```
[root@borg]# qmgr
Qmgr:  create queue batch
Qmgr:  set queue batch queue_type = Execution
Qmgr:  set queue batch resources_max.walltime = 01:00:00
Qmgr:  set queue batch resources_default.nodes = 1
Qmgr:  set queue batch resources_default.walltime = 00:01:00
Qmgr:  set queue batch enabled = True
Qmgr:  set queue batch started = True
Qmgr:  set server managers = maui@borg.cluster
Qmgr:  set server managers += root@borg.cluster
Qmgr:  set server operators = maui@borg.cluster
Qmgr:  set server operators += root@borg.cluster
```

One of the most common configuration issues, that prevents the batch system from running any job, involves missing or incorrect set server managers and/or set server operators lines.

pbs_mom configuration

pbs_mom configuration can be fairly minimal, the only thing the Mom needs to know is the hostname where pbs_server is running on.

Useful additions include log configuration, how to handle user file copy and which filesystem to monitor for available space.

mom_priv/config:

```
$clienthost  master.hpc
$logevent    0x7f            size[fs=/local_scratch]
$usecp       *:/home /home
```

Maui Configuration

Maui Configuration How to Connect to Resource Manager

- simpler approach: a single configuration file (`maui.cfg`)
- Maui needs to know what RM to connect to and how

```
SERVERHOST            borg.cluster
RMCFG[BORG.CLUSTER]   TYPE=PBS
RMPOLLINTERVAL        00:00:30
SERVERPORT            42559
SERVERMODE            NORMAL
ADMIN1                root
```

`SERVERHOST` is the same we defined for TORQUE.

User(s) listed as `ADMIN1` have full control over Maui. The first user in the list must be used to run Maui itself; if you want to run Maui as a non-privileged user, put this username here. The user Maui is running as needs to be able to control `pbs_server`.

Maui Configuration Job Prioritization

Job priority is recomputed at each scheduler iteration, according to site-defined parameters. If no parameters are set only queue time is taken into account, i.e. the scheduling is strictly FIFO.

Priority components include:

- ***Queue Time***: how long the job has been *idle* in the queue
- ***Credentials***: a static priority can be assigned on a user, group, queue basis
- ***Fair Share***: historical usage data
- ***Resources*** requested for the job

Maui Configuration Job Prioritization: Queue Time and Credentials

```
QUEUETIMEWEIGHT   1
XFACTORWEIGHT     10
CLASSCFG[batch]   PRIORITY=1
CLASSCFG[fast]    PRIORITY=1000
GROUPCFG[guests]  PRIORITY=1
GROUPCFG[users]   PRIORITY=1000
GROUPCFG[devel]   PRIORITY=10000
USERCFG[DEFAULT]  PRIORITY=2000
USERCFG[luser1]   PRIORITY=0
```

- a high `QUEUETIMEWEIGHT` makes the scheduling «more FIFO»
- $XFactor = \frac{QueueTime + WallClockLimit}{WallClockLimit}$ so a high `XFACTORWEIGHT` favors «short» jobs: this usually makes users happy in the short term, but can degrade overall cluster performance

Maui Configuration Job Prioritization: Fair Share

The FS priority component must be explicitly enabled by setting its weight to a non-zero value.

```
FSINTERVAL      86400   duration of each FS window
FSDEPTH         30      number of FS windows
FSDECAY         0.90    decay factor applied to older FS windows
FSWEIGHT        1
FSGROUPWEIGHT   240
FSUSERWEIGHT    10
```

Maui Configuration Job Prioritization: Fair Share

Usage targets can be set on a per-user, per-group and per-queue basis.

```
USERCFG[DEFAULT]   FSTARGET=1
GROUPCFG[users]    FSTARGET=30
GROUPCFG[devel]    FSTARGET=40
```

You can set also FS floors or caps so that priority is affected only when usage drops below the floor or goes above the cap:

```
GROUPCFG[guests]   FSTARGET=5-    give a negative priority component if usage
                                  is above 5%
USERCFG[master]    FSTARGET=20+   give a priority boost if usage is below 20%
```

Prologue and Epilogue

Prologue & Epilogue scripts

`pbs_mom` looks for scripts in its configuration directory `mom_priv`. If found, the *`prologue`* script is executed just before job start and the *`epilogue`* script at job termination.

The `prologue` script performs any initialization that is requered on the node for the job to run, while the `epilogue` undoes the modifications.

`/etc/security/access.conf`

before `prologue`		*after* `prologue`
`-:ALL EXCEPT root:ALL` *disallows login to everybody except root, from anywhere*	⟶	`-:ALL EXCEPT root someuser:ALL` *now allows* `someuser` *to login*

3 Diagnostics & Troubleshooting

TORQUE Diagnostics

`momctl`

Query and control remote `pbs_mom`:

```
# momctl -d3 -h i602
Host:  i602/i602.hpc Server:  master.hpc Version:  1.2.0p6
 HomeDirectory:           /var/spool/PBS/mom_priv
 MOM active:              6907718 seconds
 Last Msg From Server:    213582 seconds (DeleteJob)
 Last Msg To Server:      1 seconds
 Server Update Interval:  45 seconds
 Init Msgs Received:      10 hellos/2 cluster-addrs
 Init Msgs Sent:          190 hellos
 LOGLEVEL:                0 (use SIGUSR1/SIGUSR2 to adjust)
 Communication Model:     RPP
 TCP Timeout:             20 seconds
 Prolog Alarm Time:       300 seconds
 Alarm Time:              0 of 10 seconds
 Trusted Client List:     ...
 JobList:                 NONE
diagnostics complete
```

Maui Diagnostics

`checknode`

Check who is doing what on a node and show node capabilities

```
# checknode a034
checking node a034
State:  Busy (in current state for 1:13:38:12)
Configured Resources:  PROCS: 2 MEM: 3949M SWAP: 7242M DISK: 59G
Utilized Resources:  PROCS: 2 DISK: 10G
Dedicated Resources:  PROCS: 2
Opsys:  DEFAULT Arch:  [NONE]
Speed:  1.00 Load:  2.000 (ProcSpeed:  2600)
Network:  [DEFAULT]
Features:  [myri][opteron][opteron-sc]...
```

```
Attributes:  [Batch]
Classes:  [smp2 2:2][smp4 2:2][mpi4 0:2][mpi8 2:2]...
Total Time:  25:14:33:36 Active:  25:04:53:26 (98.43%)
Reservations:
Job '30069'(x2) -1:13:38:44 -> 2:10:20:16 (3:23:59:00)

JobList:  30069
```