Exported Batch Environment Variables ................................................................. 67
Enabling Trusted Submit Hosts .................................................................................. 69
Example Submit Scripts ........................................................................................... 70
Job Files ..................................................................................................................... 70
Monitoring Jobs ......................................................................................................... 72
Canceling Jobs ............................................................................................................ 72
Job Preemption .......................................................................................................... 73
Keeping Completed Jobs ......................................................................................... 73
Job Checkpoint And Restart .................................................................................... 74
  Introduction To BLCR ............................................................................................... 75
  Configuration Files And Scripts ................................................................................. 75
  Starting A Checkpointable Job .................................................................................. 82
  Checkpointing A Job ................................................................................................. 83
  Restarting A Job ....................................................................................................... 84
  Acceptance Tests ..................................................................................................... 84
Job Exit Status ........................................................................................................... 84
Service Jobs ............................................................................................................... 88
  Submitting Service Jobs ........................................................................................... 89
  Submitting Service Jobs In MCM ............................................................................ 89
  Managing Service Jobs ............................................................................................. 90

Chapter 4 Managing Nodes ...................................................................................... 91
  Adding Nodes ......................................................................................................... 91
  Node Properties ...................................................................................................... 92
  Changing Node State ............................................................................................... 93
  Changing Node Power States .................................................................................. 94
  Host Security ........................................................................................................... 96
  Linux Cpuset Support ............................................................................................. 98
  Scheduling Cores .................................................................................................... 100
    Geometry Request Configuration ............................................................................ 100
    Geometry Request Usage ....................................................................................... 100
    Geometry Request Considerations ....................................................................... 101
  Scheduling Accelerator Hardware .......................................................................... 101

Chapter 5 Setting Server Policies ............................................................................ 103
  Queue Configuration ............................................................................................... 103
    Queue Attributes .................................................................................................. 103
    Example Queue Configuration ............................................................................... 104
    Setting A Default Queue ....................................................................................... 114
    Mapping A Queue To Subset Of Resources ............................................................ 115
    Creating A Routing Queue ..................................................................................... 116
  Server High Availability ......................................................................................... 117
  Setting Min_threads And Max_threads .................................................................... 131
Chapter 6 Integrating Schedulers For TORQUE ................................................................. 133

Chapter 7 Configuring Data Management ........................................................................... 135
SCP Setup .......................................................................................................................... 135
  Generating SSH Key On Source Host ................................................................. 135
  Copying Public SSH Key To Each Destination Host ........................................ 136
  Configuring The SSH Daemon On Each Destination Host .................................. 136
  Validating Correct SSH Configuration .................................................................. 137
  Enabling Bi-Directional SCP Access ..................................................................... 137
  Compiling TORQUE To Support SCP ..................................................................... 137
  Troubleshooting ....................................................................................................... 138
NFS And Other Networked Filesystems ......................................................................... 138
File Stage-in/stage-out .................................................................................................. 139

Chapter 8 MPI (Message Passing Interface) Support .......................................................... 141
  MPICH ....................................................................................................................... 141
  Open MPI .................................................................................................................. 142

Chapter 9 Resources ......................................................................................................... 145

Chapter 10 Accounting Records ....................................................................................... 149

Chapter 11 Job Logging .................................................................................................... 151
  Job Log Location And Name .................................................................................. 151
  Enabling Job Logs ................................................................................................. 151

Chapter 12 Troubleshooting .............................................................................................. 153
  Host Resolution ....................................................................................................... 153
  Firewall Configuration ............................................................................................. 153
  TORQUE Log Files .................................................................................................. 154
  Using "tracejob" To Locate Job Failures .................................................................. 155
  Using GDB To Locate Job Failures ......................................................................... 158
  Other Diagnostic Options ....................................................................................... 158
  Stuck Jobs ............................................................................................................... 159
  Frequently Asked Questions (FAQ) ...................................................................... 160
  Compute Node Health Check ................................................................................. 166
    Configuring MOMs To Launch A Health Check .................................................. 166
    Creating The Health Check Script .................................................................... 167
    Adjusting Node State Based On The Health Check Output ............................. 168
    Example Health Check Script ............................................................................ 168
  Debugging ............................................................................................................... 168

Appendices ....................................................................................................................... 175
  Commands Overview ........................................................................................------- 177
    Momctl .................................................................................................................. 178
Job Submission Filter ("qsub Wrapper") ................................................................. 335
"torque.cfg" Configuration File .................................................................................. 337
Appendix L: TORQUE Quick Start Guide .................................................................... 343
BLCR Acceptance Tests .............................................................................................. 347
  Test Environment ......................................................................................................... 347
  Test 1 - Basic Operation ............................................................................................... 347
  Test 2 - Persistence Of Checkpoint Images ................................................................. 350
  Test 3 - Restart After Checkpoint ................................................................................ 351
  Test 4 - Multiple Checkpoint/Rerstart ........................................................................ 352
  Test 5 - Periodic Checkpoint ....................................................................................... 352
  Test 6 - Restart From Previous Image .......................................................................... 353
Welcome to TORQUE Resource Manager

Welcome to the *TORQUE Resource Manager Administrator Guide 5.1.1*. This guide is intended as a reference for system administrators. For more information about this guide, see these topics:

- [TORQUE Administrator Guide Overview](#) on page 3
- [Introduction](#) on page 5
TORQUE Administrator Guide Overview

**Installation and Configuration on page 9** provides the details for installation and initialization, advanced configuration options, and (optional) qmgr option necessary to get the system up and running. System testing is also covered.

**Submitting and Managing Jobs on page 55** covers different actions applicable to jobs. The first section details how to submit a job and request resources (nodes, software licenses, and so forth), and provides several examples. Other actions include monitoring, canceling, preemption, and keeping completed jobs.

**Managing Nodes on page 91** covers administrator tasks relating to nodes, which include the following: adding nodes, changing node properties, and identifying state. Also an explanation of how to configure restricted user access to nodes is covered in **Host Security on page 96**.

**Setting Server Policies on page 103** details server-side configurations of queue and high availability.

**Integrating Schedulers for TORQUE on page 133** offers information about using the native scheduler versus an advanced scheduler.

**Configuring Data Management on page 135** deals with issues of data management. For non-network file systems, **SCP Setup on page 135** details setting up SSH keys and nodes to automate transferring data. **NFS and Other Networked Filesystems on page 138** covers configuration for these file systems. This chapter also addresses the use of file staging using the **stagein** and **stageout** directives of the **qsub** command.

**MPI (Message Passing Interface) Support on page 141** offers details supporting MPI.

**Resources on page 145** covers configuration, utilization, and states of resources.

**Accounting Records on page 149** explains how jobs are tracked by TORQUE for accounting purposes.

**Job Logging on page 151** explains how to enable job logs that contain information for completed jobs.

**Troubleshooting on page 153** is a guide that offers help with general problems. It includes FAQ and instructions for how to set up and use compute node checks. It also explains how to debug TORQUE.

The appendices provide tables of commands, parameters, configuration options, error codes, the Quick Start Guide, and so forth.

- **Commands Overview on page 177**
- **Server Parameters on page 261**
- **Node Manager (MOM) Configuration** on page 283
- **Diagnostics and Error Codes** on page 305
- **Considerations Before Upgrading** on page 313
- **Large Cluster Considerations** on page 315
- **Prologue and Epilogue Scripts** on page 323
- **Running Multiple TORQUE Servers and MOMs on the Same Node** on page 331
- **Security Overview** on page 333
- **Job Submission Filter** ("qsub Wrapper") on page 335
- **"torque.cfg" Configuration File** on page 337
- **Appendix L: TORQUE Quick Start Guide** on page 343
- **BLCR Acceptance Tests** on page 347

Related Topics

[Introduction on page 5]
Chapter 1 Introduction

This section contains some basic introduction information to help you get started using TORQUE. It contains these topics:

- What is a Resource Manager? on page 5
- What are Batch Systems? on page 5
- Basic Job Flow on page 6

What is a Resource Manager?

While TORQUE has a built-in scheduler, \texttt{pbs\_sched}, it is typically used solely as a resource manager with a scheduler making requests to it. Resources managers provide the low-level functionality to start, hold, cancel, and monitor jobs. Without these capabilities, a scheduler alone cannot control jobs.

What are Batch Systems?

While TORQUE is flexible enough to handle scheduling a conference room, it is primarily used in batch systems. Batch systems are a collection of computers and other resources (networks, storage systems, license servers, and so forth) that operate under the notion that the whole is greater than the sum of the parts. Some batch systems consist of just a handful of machines running single-processor jobs, minimally managed by the users themselves. Other systems have thousands and thousands of machines executing users' jobs simultaneously while tracking software licenses and access to hardware equipment and storage systems.

Pooling resources in a batch system typically reduces technical administration of resources while offering a uniform view to users. Once configured properly, batch systems abstract away many of the details involved with running and managing jobs, allowing higher resource utilization. For example, users typically only need to specify the minimal constraints of a job and do not need to know the individual machine names of each host on which they are running. With this uniform abstracted view, batch systems can execute thousands and thousands of jobs simultaneously.

Batch systems are comprised of four different components: (1) Master Node, (2) Submit/Interactive Nodes, (3) Compute Nodes, and (4) Resources.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Node</td>
<td>A batch system will have a master node where \texttt{pbs_server} runs. Depending on the needs of the systems, a master node may be dedicated to this task, or it may fulfill the roles of other components as well.</td>
</tr>
</tbody>
</table>
Submit/Interactive Nodes

Submit or interactive nodes provide an entry point to the system for users to manage their workload. For these nodes, users are able to submit and track their jobs. Additionally, some sites have one or more nodes reserved for interactive use, such as testing and troubleshooting environment problems. These nodes have client commands (such as qsub and qhold).

Computer Nodes

Compute nodes are the workhorses of the system. Their role is to execute submitted jobs. On each compute node, pbs_mom runs to start, kill, and manage submitted jobs. It communicates with pbs_server on the master node. Depending on the needs of the systems, a compute node may double as the master node (or more).

Resources

Some systems are organized for the express purpose of managing a collection of resources beyond compute nodes. Resources can include high-speed networks, storage systems, license managers, and so forth. Availability of these resources is limited and needs to be managed intelligently to promote fairness and increased utilization.

## Basic Job Flow

The life cycle of a job can be divided into four stages: (1) creation, (2) submission, (3) execution, and (4) finalization.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation</td>
<td>Typically, a submit script is written to hold all of the parameters of a job. These parameters could include how long a job should run (walltime), what resources are necessary to run, and what to execute. The following is an example submit file:</td>
</tr>
</tbody>
</table>

```
#PBS -N localBlast
#PBS -S /bin/sh
#PBS -l nodes=1:ppn=2,walltime=240:00:00
#PBS -M user@my.organization.com
#PBS -m ea
cd $HOME/work/dir
sh myBlast.sh -i -v
```

This submit script specifies the name of the job (localBlast), what environment to use (/bin/sh), that it needs both processors on a single node (nodes=1:ppn=2), that it will run for at most 10 days, and that TORQUE should email "user@my.organization.com" when the job exits or aborts. Additionally, the user specifies where and what to execute. |
<p>| Submission | A job is submitted with the qsub command. Once submitted, the policies set by the administration and technical staff of the site dictate the priority of the job and therefore, when it will start executing. |
| Execution  | Jobs often spend most of their lifecycle executing. While a job is running, its status can be queried with qstat. |</p>
<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finalization</td>
<td>When a job completes, by default, the stdout and stderr files are copied to the directory where the job was submitted.</td>
</tr>
</tbody>
</table>
Chapter 2 Installation and Configuration

This chapter contains some basic information about TORQUE, including how to install and configure it on your system.

In this chapter:
- TORQUE Installation Overview on page 9
- Initializing/Configuring TORQUE on the Server (pbs_server) on page 19
- Advanced Configuration on page 26
- Manual Setup of Initial Server Configuration on page 42
- Server Node File Configuration on page 43
- Testing Server Configuration on page 45
- TORQUE on NUMA Systems on page 47
- TORQUE Multi-MOM on page 51

TORQUE Installation Overview

This section contains information about TORQUE architecture and explains how to install TORQUE. It also describes how to install TORQUE packages on compute nodes and how to enable TORQUE as a service.

In this section:
- TORQUE Architecture on page 9
- Installing TORQUE on page 10
- Compute Nodes on page 16
- Enabling TORQUE as a Service on page 18

Related Topics
- Troubleshooting on page 153

TORQUE Architecture

A TORQUE cluster consists of one head node and many compute nodes. The head node runs the pbs_server daemon and the compute nodes run the pbs_mom daemon. Client commands for submitting and managing jobs can be installed on any host (including hosts not running pbs_server or pbs_mom).
The head node also runs a scheduler daemon. The scheduler interacts with pbs_server to make local policy decisions for resource usage and allocate nodes to jobs. A simple FIFO scheduler, and code to construct more advanced schedulers, is provided in the TORQUE source distribution. Most TORQUE users choose to use a packaged, advanced scheduler such as Maui or Moab.

Users submit jobs to pbs_server using the qsub command. When pbs_server receives a new job, it informs the scheduler. When the scheduler finds nodes for the job, it sends instructions to run the job with the node list to pbs_server. Then, pbs_server sends the new job to the first node in the node list and instructs it to launch the job. This node is designated the execution host and is called Mother Superior. Other nodes in a job are called sister MOMs.

Related Topics
- TORQUE Installation Overview on page 9
- Installing TORQUE on page 10

Installing TORQUE

This topic contains instructions on how to install and start TORQUE.

In this topic:
- Requirements on page 10
- Prerequisites on page 11
- Install Dependencies and Packages on page 12
- Install TORQUE on page 13

Requirements

Supported Operating Systems
- CentOS 6.x, 7.x
- RHEL 6.x, 7.x
- Scientific Linux 6.x, 7.x
- SUSE Linux Enterprise Server 11, 12

CentOS 5.9, RHEL 5.9 and Scientific Linux 5.9 are supported, largely to continue support for clusters where the compute nodes operating systems cannot be upgraded. We recommend that the TORQUE head node run on the supported operating systems listed above.

Software Requirements
• libxml2-devel package (package name may vary)
• openssl-devel package (package name may vary)
• Tcl/Tk version 8 or later if you plan to build the GUI portion of TORQUE or use a Tcl based scheduler
• If your configuration uses cpusets, you must install libhwloc; the corresponding hwloc-devel package is also required. See Linux Cpuset Support on page 98.

| libwloc 1.2 is required for TORQUE 5.1.x or 5.0.x; 1.1 is required for TORQUE 4.2.x. |

If you intend to use TORQUE 5.1.1 with Moab Workload Manager, you must run Moab version 8.1.1 or 8.0.x. TORQUE 5.1.1 will not work with versions earlier than Moab 8.0.

If you build TORQUE from source (i.e. clone from github), the following additional software is required:
• gcc
• gcc-c++
• A posix compatible version of make
• libtool 1.5.22
• boost-devel 1.36.0

| Version 1.36.0 or newer is supported. Red Hat 5 systems come packaged with an unsupported version. Red Hat 6 systems come packaged with 1.41.0 and Red Hat 7 systems packaged with 1.53.0. If needed, use the --with-boost-path=DIR option to change the packaged boost version. See Customizing the Install on page 27. |

Prerequisites

Open Necessary Ports
TORQUE requires certain ports to be open for essential communication:
• For client and pbs_mom communication to pbs_server, the default port is 15001.
• For pbs_server communication to pbs_mom, the default port is 15002.
• For pbs_mom communication to pbs_mom, the default port is 15003.

For more information on how to configure the ports that TORQUE uses for communication, see Configuring Ports on page 22.

If you have a firewall enabled, do the following:
Chapter 2 Installation and Configuration

- Red Hat 6-based systems using iptables

```bash
[root]# iptables-save > /tmp/iptables.mod
[root]# vi /tmp/iptables.mod
# Add the following lines immediately before the line matching
# "-A INPUT -j REJECT --reject-with icmp-host-prohibited"

# Needed on the TORQUE server for client and MOM communication
-A INPUT -p tcp --dport 15001 -j ACCEPT

# Needed on the TORQUE MOM for server and MOM communication
-A INPUT -p tcp --dport 15002 -j ACCEPT
-A INPUT -p tcp --dport 15003 -j ACCEPT
[root]# iptables-restore < /tmp/iptables.mod
```

- Red Hat 7-based systems using firewalld

```bash
[root]# firewall-cmd --add-port=15001/tcp --permanent
[root]# firewall-cmd --add-port=15002/tcp --permanent
[root]# firewall-cmd --add-port=15003/tcp --permanent
[root]# firewall-cmd --reload
```

- SUSE 11-based and SUSE 12-based systems using SuSEfirewall2

```bash
[root]# vi /etc/sysconfig/SuSEfirewall2
# Add the following ports to the FW_SERVICES_EXT_TCP parameter as required

# Needed on the TORQUE server for client and MOM communication
FW_SERVICES_EXT_TCP="15001"

# Needed on the TORQUE MOM for server and MOM communication
FW_SERVICES_EXT_TCP="15002 15003"
[root]# service SuSEfirewall2_setup restart
```

Verify the hostname

Make sure your host (with the correct IP address) is in your `/etc/hosts` file. To verify that the hostname resolves correctly, make sure that `hostname -f` report the correct name for the host.

Install Dependencies and Packages

Install the `libxml2-devel`, `openssl-devel`, and `boost-devel` packages.

- Red Hat 6-based and Red Hat 7-based systems

```bash
[root]# yum install libtool openssl-devel libxml2-devel boost-devel gcc gcc-c++
```

- SUSE 11-based and SUSE 12-based systems

```bash
[root]# zypper install libopenssl-devel libtool libxml2-devel boost-devel gcc
gcc-c++ make gmake
```
• Red Hat-5 based systems

Use these instructions for installing `libtool`:

```
[root]# cd /tmp
[root]# wget http://ftpmirror.gnu.org/libtool/libtool-2.4.2.tar.gz
[root]# tar -xzf libtool-2.4.2.tar.gz
[root]# cd libtool-2.4.2
[root]# ./configure --prefix=/usr
[root]# make
[root]# make install
```

TORQUE requires Boost version 1.36.0 or greater. The boost-devel package provided with Red Hat 5-based systems is older than this requirement. A new option, `--with-boost-path` has been added to configure (see Customizing the Install on page 27 for more information). This allows you to point TORQUE to a specific version of boost during make. One way to compile TORQUE without installing Boost is to simply download the Boost version you plan to use from: http://www.boost.org/users/history/. Next, untar Boost (you do not need to build it or install it). When you run TORQUE configure, use the `--with-boost-path` option pointed to the extracted Boost directory.

Install TORQUE

Do the following:

1. Switch the user to root.

```
[user]$ su
```

2. Download the latest 5.1 build from the Adaptive Computing website. It can also be downloaded via command line (github method or the tarball distribution).

    • Clone the source from github.

If git is not installed:

```
# Red Hat-based systems
[root]# yum install git
# SUSE-based systems
[root]# zypper install git
```

```
[root]# git clone https://github.com/adaptivecomputing/torque.git -b 5.1.1
[root]# cd 5.1.1
[root]# ./autogen.sh
```
Chapter 2 Installation and Configuration

- Get the tarball source distribution.
  - Red Hat-based systems
    ```
    [root]# yum install wget
    [root]# wget http://www.adaptivecomputing.com/download/torque/torque-5.1.1.tar.gz
    [root]# tar -xzvf torque-5.1.1.tar.gz
    [root]# cd torque-5.1.1/
    ```
  - SUSE-based systems
    ```
    [root]# zypper install wget
    [root]# wget http://www.adaptivecomputing.com/download/torque/torque-5.1.1.tar.gz
    [root]# tar -xzvf torque-5.1.1.tar.gz
    [root]# cd torque-5.1.1/
    ```

3. Run each of the following commands in order.
   ```
   [root]# ./configure
   [root]# make
   [root]# make install
   ```

   For information on what options are available to customize the ./configure command, see Customizing the Install on page 27.

4. Configure the trqauthd daemon to start automatically at system boot.
   - Red Hat 6-based systems
     ```
     [root]# cp contrib/init.d/trqauthd /etc/init.d/
     [root]# chkconfig --add trqauthd
     [root]# echo /usr/local/lib > /etc/ld.so.conf.d/torque.conf
     [root]# ldconfig
     [root]# service trqauthd start
     ```
   - SUSE 11-based systems
     ```
     [root]# cp contrib/init.d/suse.trqauthd /etc/init.d/trqauthd
     [root]# chkconfig --add trqauthd
     [root]# echo /usr/local/lib > /etc/ld.so.conf.d/torque.conf
     [root]# ldconfig
     [root]# service trqauthd start
     ```
   - Red Hat 7-based and SUSE 12-based systems
     ```
     [root]# cp contrib/systemd/trqauthd.service /usr/lib/systemd/system/
     [root]# systemctl enable trqauthd.service
     [root]# echo /usr/local/lib > /etc/ld.so.conf.d/torque.conf
     [root]# ldconfig
     [root]# systemctl start trqauthd.service
     ```

5. Verify that the /var/spool/torque/server_name file exists and contains the correct name of the server.
   ```
   [root]# echo <pbs_server's_hostname> > /var/spool/torque/server_name
   ```
6. By default, TORQUE installs all binary files to `/usr/local/bin` and `/usr/local/sbin`. Make sure the path environment variable includes these directories for both the installation user and the root user.

   ```bash
   [root]# export PATH=/usr/local/bin:/usr/local/sbin:$PATH
   ```

7. Initialize `serverdb` by executing the `torque.setup` script.

   ```bash
   [root]# ./torque.setup root
   ```

8. Add nodes to the `/var/spool/torque/server_priv/nodes` file. For information on syntax and options for specifying compute nodes, see Specifying Compute Nodes on page 21.

9. Configure the MOMs if necessary. See Configuring TORQUE on Compute Nodes on page 22.

   The `make packages` command can be used to create self-extracting packages that can be copied and executed on your nodes. For information on creating packages and deploying them, see Compute Nodes on page 16.

10. On the TORQUE Server, configure `pbs_server` to start automatically at system boot, and then start the daemon.

    - Red Hat 6-based systems
      ```bash
      [root]# cp contrib/init.d/pbs_server /etc/init.d
      [root]# chkconfig --add pbs_server
      [root]# service pbs_server restart
      ```

    - SUSE 11-based systems
      ```bash
      [root]# cp contrib/init.d/suse.pbs_server /etc/init.d/pbs_server
      [root]# chkconfig --add pbs_server
      [root]# service pbs_server restart
      ```

    - Red Hat 7-based and SUSE 12-based systems
      ```bash
      [root]# qterm
      [root]# cp contrib/systemd/pbs_server.service /usr/lib/systemd/system/
      [root]# systemctl enable pbs_server.service
      ```

11. Configure `pbs_mom` to start automatically at system boot on each compute node, and then start the daemon.

    There are several methods to get the following init.d scripts on to each node. The following instructions assume the entire contents of contrib/init.d in the TORQUE git repository or source tarball are copied (scp)/cloned to the compute node.
These options can be added to the self-extracting packages.

On the TORQUE MOM, do the following:

- **Red Hat 6-based systems**

```
[root]# cp contrib/init.d/pbs_mom /etc/init.d
[root]# chkconfig --add pbs_mom
[root]# service pbs_mom start
```

- **SUSE 11-based systems**

```
[root]# cp contrib/init.d/suse.pbs_mom /etc/init.d/pbs_mom
[root]# chkconfig --add pbs_mom
[root]# service pbs_mom start
```

- **Red Hat 7-based and SUSE 12-based systems**

```
[root]# cp contrib/systemd/pbs_mom.service /usr/lib/systemd/system/
[root]# systemctl enable pbs_mom.service
[root]# systemctl start pbs_mom.service
```

## Compute Nodes

Use the Adaptive Computing TORQUE package system to create self-extracting tarballs which can be distributed and installed on compute nodes. The TORQUE package are customizable. See the `INSTALL` file for additional options and features.

**If you installed TORQUE using the RPMs, you must install and configure your nodes manually by modifying the `/var/spool/torque/mom_priv/config` file of each one. This file is identical for all compute nodes and can be created on the head node and distributed in parallel to all systems.**

```
[root]# vi /var/spool/torque/mom_priv/config
$pbsserver headnode   # hostname running pbs server
$logevent 225         # bitmap of which events to log
[root]# service pbs_mom restart
```
To create TORQUE packages

1. Configure and make as normal, and then run `make packages`.

```
> make packages
Building ./torque-package-clients-linux-i686.sh ...
Building ./torque-package-mom-linux-i686.sh ...
Building ./torque-package-server-linux-i686.sh ...
Building ./torque-package-gui-linux-i686.sh ...
Building ./torque-package-devel-linux-i686.sh ...
Done.
```

The package files are self-extracting packages that can be copied and executed on your production machines. Use --help for options.

2. Copy the desired packages to a shared location.

```
> cp torque-package-mom-linux-i686.sh /shared/storage/
> cp torque-package-clients-linux-i686.sh /shared/storage/
```

3. Install the TORQUE packages on the compute nodes.

Adaptive Computing recommends that you use a remote shell, such as SSH, to install TORQUE packages on remote systems. Set up shared SSH keys if you do not want to supply a password for each host.

```

The only required package for the compute node is mom-linux. Additional packages are recommended so you can use client commands and submit jobs from compute nodes.
```

The following is an example of how to copy and install mom-linux in a distributed fashion.

```
> for i in node01 node02 node03 node04 ; do scp torque-package-mom-linux-i686.sh ${i}:/tmp/ ; done
> for i in node01 node02 node03 node04 ; do scp torque-package-clients-linux-i686.sh ${i}:/tmp/ ; done
> for i in node01 node02 node03 node04 ; do ssh ${i} /tmp/torque-package-mom-linux-i686.sh --install ; done
> for i in node01 node02 node03 node04 ; do ssh ${i} /tmp/torque-package-clients-linux-i686.sh --install ; done
```

Alternatively, you can use a tool like xCAT instead of dsh.

To use a tool like xCAT

1. Copy the TORQUE package to the nodes.

```
> prcp torque-package-linux-i686.sh noderange:/destinationdirectory/
```

2. Install the TORQUE package.

```
> psh noderange /tmp/torque-package-linux-i686.sh --install
```

Although optional, it is possible to use the TORQUE server as a compute node and install a `pbs_mom` with the `pbs_server` daemon.
Related Topics

Installing TORQUE on page 10
TORQUE Installation Overview on page 9

Enabling TORQUE as a Service

Enabling TORQUE as a service is optional. In order to run TORQUE as a service, you must enable trqauthd. (see Configuring trqauthd for Client Commands on page 25).

The method for enabling TORQUE as a service is dependent on the Linux variant you are using. Startup scripts are provided in the contrib/init.d/ directory of the source package. To enable TORQUE as a service, run the following on the host for the appropriate TORQUE daemon:

- **RedHat (as root)**
  
  ```
  > cp contrib/init.d/pbs_mom /etc/init.d/pbs_mom
  > chkconfig --add pbs_mom
  > cp contrib/init.d/pbs_server /etc/init.d/pbs_server
  > chkconfig --add pbs_server
  ```

- **SUSE (as root)**
  
  ```
  > cp contrib/init.d/suse.pbs_mom /etc/init.d/pbs_mom
  > insserv -d pbs_mom
  > cp contrib/init.d/suse.pbs_server /etc/init.d/pbs_server
  > insserv -d pbs_server
  ```

- **Debian (as root)**
  
  ```
  > cp contrib/init.d/debian.pbs_mom /etc/init.d/pbs_mom
  > update-rc.d pbs_mom defaults
  > cp contrib/init.d/debian.pbs_server /etc/init.d/pbs_server
  > update-rc.d pbs_server defaults
  ```

You will need to customize these scripts to match your system.

These options can be added to the self-extracting packages. For more details, see the INSTALL file.

Related Topics

TORQUE Installation Overview on page 9
Installing TORQUE on page 10
Configuring trqauthd for Client Commands on page 25
The TORQUE server (pbs_server) contains all the information about a cluster. It knows about all of the MOM nodes in the cluster based on the information in the $TORQUE_HOME/server_priv/nodes file (See Configuring TORQUE on Compute Nodes on page 22). It also maintains the status of each MOM node through updates from the MOMs in the cluster (see pbsnodes on page 196). All jobs are submitted via qsub to the server, which maintains a master database of all jobs and their states.

Schedulers such as Moab Workload Manager receive job, queue, and node information from pbs_server and submit all jobs to be run to pbs_server.

The server configuration is maintained in a file named serverdb, located in $TORQUE_HOME/server_priv. The serverdb file contains all parameters pertaining to the operation of TORQUE plus all of the queues which are in the configuration. For pbs_server to run, serverdb must be initialized.

You can initialize serverdb in two different ways, but the recommended way is to use the ./torque.setup script:

- As root, execute ./torque.setup from the build directory (see ./torque.setup on page 19).
- Use pbs_server -t create (see pbs_server -t create on page 20).

Restart pbs_server after initializing serverdb.

```
> qterm
> pbs_server
```

**./torque.setup**

The torque.setup script uses pbs_server -t create to initialize serverdb and then adds a user as a manager and operator of TORQUE and other commonly used attributes. The syntax is as follows:

```
/torque.setup username
```
> ./torque.setup ken
> qmgr -c 'p s'

# Create queues and set their attributes.
# Create and define queue batch
create queue batch
set queue batch queue_type = Execution
set queue batch resources_default.nodes = 1
set queue batch resources_default.walltime = 01:00:00
set queue batch enabled = True
set queue batch started = True

# Set server attributes.
set server scheduling = True
set server acl_hosts = kmn
set server managers = ken@knn
set server operators = ken@knn
set server default_queue = batch
set server log_events = 511
set server mail_from = adm
set server node_check_rate = 150
set server tcp_timeout = 6
set server mom_job_sync = True
set server keep_completed = 300

**pbs_server -t create**

The `-t create` option instructs `pbs_server` to create the `serverdb` file and initialize it with a minimum configuration to run `pbs_server`.

> pbs_server -t create

To see the configuration and verify that TORQUE is configured correctly, use `qmgr`:

> qmgr -c 'p s'

# Set server attributes.
set server acl_hosts = kmn
set server log_events = 511
set server mail_from =adm
set server node_check_rate = 150
set server tcp_timeout = 6

A single queue named batch and a few needed server attributes are created.

This section contains these topics:

- [Specifying Compute Nodes on page 21](#)
- [Configuring TORQUE on Compute Nodes on page 22](#)
- [Finalizing Configurations on page 26](#)
Specifying Compute Nodes

The environment variable `TORQUE_HOME` is where configuration files are stored. If you used the default locations during installation, you do not need to specify the `TORQUE_HOME` environment variable.

The `pbs_server` must recognize which systems on the network are its compute nodes. Specify each node on a line in the server's nodes file. This file is located at `TORQUE_HOME/server_priv/nodes`. In most cases, it is sufficient to specify just the names of the nodes on individual lines; however, various properties can be applied to each node.

```
node-name[:ts] [np=] [gpus=] [properties]
```

- The `node-name` must match the hostname on the node itself, including whether it is fully qualified or shortened.
- The `[ts]` option marks the node as timeshared. Timeshared nodes are listed by the server in the node status report, but the server does not allocate jobs to them.
- The `[np=]` option specifies the number of virtual processors for a given node. The value can be less than, equal to, or greater than the number of physical processors on any given node.
- The `[gpus=]` option specifies the number of GPUs for a given node. The value can be less than, equal to, or greater than the number of physical GPUs on any given node.
- The node processor count can be automatically detected by the TORQUE server if `auto_node_np` is set to TRUE. This can be set using this command:
  ```
  qmgr -c set server auto_node_np = True
  ```
  Setting `auto_node_np` to TRUE overwrites the value of `np` set in `TORQUE_HOME/server_priv/nodes`.
- The `[properties]` option allows you to specify arbitrary strings to identify the node. Property strings are alphanumeric characters only and must begin with an alphabetic character.

Only a root user can access the `server_priv` directory.
Comment lines are allowed in the nodes file if the first non-white space character is the pound sign (#).

The following example shows a possible node file listing.

```
TORQUE_HOME/server_priv/nodes:

```

# Nodes 001 and 003-005 are cluster nodes
node001 np=2 cluster01 rackNumber22
#
# node002 will be replaced soon
node002:ts waitingToBeReplaced
# node002 will be replaced soon
#
node003 np=4 cluster01 rackNumber24
node004 cluster01 rackNumber25
node005 np=2 cluster01 rackNumber26 RAM16GB
node006
node007 np=2
node008:ts np=4
```

Related Topics

Initializing/Configuring TORQUE on the Server (pbs_server) on page 19

### Configuring TORQUE on Compute Nodes

If using TORQUE self-extracting packages with default compute node configuration, no additional steps are required and you can skip this section.

If installing manually, or advanced compute node configuration is needed, edit the `TORQUE_HOME/mom_priv/config` file on each node. The recommended settings follow.

```
TORQUE_HOME/mom_priv/config:

```

```
$pbsserver headnode     # hostname running pbs server
$logevent 225           # bitmap of which events to log
```

This file is identical for all compute nodes and can be created on the head node and distributed in parallel to all systems.

Related Topics

Initializing/Configuring TORQUE on the Server (pbs_server) on page 19

### Configuring Ports

You can optionally configure the various ports that TORQUE uses for communication. Most ports can be configured multiple ways. The ports you can configure are:
• pbs_server listening port
• pbs_mom listening port
• port pbs_server uses to communicate to the pbs_mom
• port pbs_mom uses to communicate to the pbs_server
• port client commands use to communicate to the pbs_server
• port trqauthd uses to communicate to the pbs_server

If you are running pbspro on the same system, be aware that it uses the same environment variables and /etc/services entries.

Configuring the pbs_server Listening Port
To configure the port the pbs_server listens on, follow any of these steps:

• Set an environment variable called PBS_BATCH_SERVICE_PORT to the port desired.
• Edit the /etc/services file and set pbs port_num/tcp.
• Start pbs_server with the -p option.
  
  ```bash
  $ pbs_server -p port_num
  ```
• Edit the $PBS_HOME/server_name file and change server_name to server_name:<port_num>
• Start pbs_server with the -H option.
  
  ```bash
  $ pbs_server -H server_name:port_num
  ```

Configuring the pbs_mom Listening Port
To configure the port the pbs_mom listens on, follow any of these steps:

• Set an environment variable called PBS_MOM_SERVICE_PORT to the port desired.
• Edit the /etc/services file and set pbs_mom port_num/tcp.
• Start pbs_mom with the -M option.
  
  ```bash
  $ pbs_mom -M port_num
  ```
• Edit the nodes file entry for that list: add mom_service_port=port_num.

Configuring the Port pbs_server Uses to Communicate with pbs_mom
To configure the port the `pbs_server` uses to communicate with `pbs_mom`, follow any of these steps:

- Set an environment variable called `PBS_MOM_SERVICE_PORT` to the port desired.
- Edit the `/etc/services` file and set `pbs_mom port_num/tcp`.
- Start `pbs_mom` with the `-M` option.

```bash
$ pbs_server -M port_num
```

**Configuring the Port `pbs_mom` Uses to Communicate with `pbs_server`**

To configure the port the `pbs_mom` uses to communicate with `pbs_server`, follow any of these steps:

- Set an environment variable called `PBS_BATCH_SERVICE_PORT` to the port desired.
- Edit the `/etc/services` file and set `pbs port_num/tcp`.
- Start `pbs_mom` with the `-S` option.

```bash
$ pbs_mom -p port_num
```

- Edit the `nodes` file entry for that list: add `mom_service_port=port_num`.

**Configuring the Port `pbs_server` Commands Use to Communicate with `pbs_server`**

To configure the port client commands use to communicate with `pbs_server`, follow any of these steps:

- Edit the `/etc/services` file and set `pbs port_num/tcp`.
- Edit the `$PBS_HOME/server_name` file and change `server_name: <port_num>` to

**Configuring the Port `trqauthd` Uses to Communicate with `pbs_server`**

To configure the port `trqauthd` uses to communicate with `pbs_server`, follow any of these steps:

- Edit the `$PBS_HOME/server_name` file and change `server_name: <port_num>`

Related Topics

- Initializing/Configuring TORQUE on the Server (`pbs_server`) on page 19

`pbs_server`
Configuring trqauthd for Client Commands

trqauthd is a daemon used by TORQUE client utilities to authorize user connections to pbs_server. Once started, it remains resident. TORQUE client utilities then communicate with trqauthd on port 15005 on the loopback interface. It is multi-threaded and can handle large volumes of simultaneous requests.

Running trqauthd

trqauthd must be run as root. It must also be running on any host where TORQUE client commands will execute.

By default, trqauthd is installed to /usr/local/bin.

trqauthd can be invoked directly from the command line or by the use of init.d scripts which are located in the contrib/init.d directory of the TORQUE source.

There are three init.d scripts for trqauthd in the contrib/init.d directory of the TORQUE source tree:

<table>
<thead>
<tr>
<th>Script</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>debian.trqauthd</td>
<td>Used for apt-based systems (debian, ubuntu are the most common variations of this)</td>
</tr>
<tr>
<td>suse.trqauthd</td>
<td>Used for suse-based systems</td>
</tr>
<tr>
<td>trqauthd</td>
<td>An example for other package managers (Redhat, Scientific, CentOS, and Fedora are some common examples)</td>
</tr>
</tbody>
</table>

You should edit these scripts to be sure they will work for your site.

Inside each of the scripts are the variables PBS_DAEMON and PBS_HOME. These two variables should be updated to match your TORQUE installation. PBS_DAEMON needs to point to the location of trqauthd. PBS_HOME needs to match your TORQUE installation.

Choose the script that matches your dist system and copy it to /etc/init.d. If needed, rename it to trqauthd.
To start the daemon

```
/etc/init.d/trqauthd start
```

To stop the daemon

```
/etc/init.d/trqauthd stop
```

OR

```
service trqauthd start/stop
```

If you receive an error that says "Could not open socket in trq_simple_connect. error 97" and you use a CentOS, RedHat, or Scientific Linux 6+ operating system, check your `/etc/hosts` file for multiple entries of a single host name pointing to the same IP address. Delete the duplicate(s), save the file, and launch trqauthd again.

Related Topics

- Initializing/Configuring TORQUE on the Server (pbs_server) on page 19

**Finalizing Configurations**

After configuring the `serverdb` and the `server_priv/nodes` files, and after ensuring minimal MOM configuration, restart the `pbs_server` on the server node and the `pbs_mom` on the compute nodes.

**Compute Nodes:**

```
> pbs_mom
```

**Server Node:**

```
> qterm -t quick
> pbs_server
```

After waiting several seconds, the `pbsnodes -a` command should list all nodes in state `free`.

Related Topics

- Initializing/Configuring TORQUE on the Server (pbs_server) on page 19

**Advanced Configuration**

This section contains information about how you can customize the installation and configure the server to ensure that the server and nodes are communicating correctly. For details, see these topics:
Customizing the Install

The TORQUE `configure` command has several options available. Listed below are some suggested options to use when running `./configure`.

- By default, TORQUE does not install the admin manuals. To enable this, use `--enable-docs`.
- By default, only children MOM processes use syslog. To enable syslog for all of TORQUE, use `--enable-syslog`.

### Table 2-1: Optional Features

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--disable-clients</code></td>
<td>Directs TORQUE not to build and install the TORQUE client utilities such as qsub, qstat, qdel, etc.</td>
</tr>
<tr>
<td><code>--disable-feature</code></td>
<td>Do not include FEATURE (same as <code>--enable FEATURE=no</code>).</td>
</tr>
<tr>
<td><code>--disable-libtool-lock</code></td>
<td>Avoid locking (might break parallel builds).</td>
</tr>
<tr>
<td><code>--disable-mom</code></td>
<td>Do not include the MOM daemon.</td>
</tr>
<tr>
<td><code>--disable-mom-checkspool</code></td>
<td>Don’t check free space on spool directory and set an error.</td>
</tr>
<tr>
<td><code>--disable-posixmemlock</code></td>
<td>Disable the MOM’s use of mlockall. Some versions of OSs seem to have buggy POSIX MEMLOCK.</td>
</tr>
<tr>
<td><code>--disable-privports</code></td>
<td>Disable the use of privileged ports for authentication. Some versions of OSX have a buggy bind () and cannot bind to privileged ports.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><code>--disable-qsub-keep-override</code></td>
<td>Do not allow the qsub -k flag to override -o -e.</td>
</tr>
<tr>
<td><code>--disable-server</code></td>
<td>Do not include server and scheduler.</td>
</tr>
<tr>
<td><code>--disable-shell-pipe</code></td>
<td>Give the job script file as standard input to the shell instead of passing its name via a pipe.</td>
</tr>
<tr>
<td><code>--disable-spool</code></td>
<td>If disabled, TORQUE will create output and error files directly in $HOME/pbs_spool if it exists or in $HOME otherwise. By default, TORQUE will spool files in TORQUE_HOME/spool and copy them to the users home directory when the job completes.</td>
</tr>
<tr>
<td><code>--disable-xopen-networking</code></td>
<td>With HPUX and GCC, don’t force usage of XOPEN and libxnet</td>
</tr>
<tr>
<td><code>--enable-acct-x</code></td>
<td>Enable adding x attributes to accounting log.</td>
</tr>
<tr>
<td><code>--enable-array</code></td>
<td>Setting this under IRIX enables the SGI Origin 2000 parallel support. Normally autodetected from the /etc/config/array file.</td>
</tr>
<tr>
<td><code>--enable-blcrc</code></td>
<td>Enable BLCR support.</td>
</tr>
<tr>
<td><code>--enable-cpa</code></td>
<td>Enable Cray’s CPA support.</td>
</tr>
<tr>
<td><code>--enable-cpuset</code></td>
<td>Enable Linux 2.6 kernel cpusets.</td>
</tr>
<tr>
<td></td>
<td>![Note](It is recommended that you turn on this feature to prevent a job from expanding across more CPU cores than it is assigned.)</td>
</tr>
<tr>
<td><code>--enable-debug</code></td>
<td>Prints debug information to the console for pbs_server and pbs_mom while they are running. (This is different than <code>--with-debug</code> which will compile with debugging symbols.)</td>
</tr>
<tr>
<td><code>--enable-dependency-tracking</code></td>
<td>Do not reject slow dependency extractors.</td>
</tr>
<tr>
<td><code>--enable-fast-install[=PKGS]</code></td>
<td>Optimize for fast installation [default=yes].</td>
</tr>
</tbody>
</table>
### Chapter 2 Installation and Configuration

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--enable FEATURE [=ARG]</code></td>
<td>Include FEATURE [ARG=yes].</td>
</tr>
<tr>
<td><code>--enable-file-sync</code></td>
<td>Open files with sync on each write operation. This has a negative impact on TORQUE performance. This is disabled by default.</td>
</tr>
<tr>
<td><code>--enable-force-nodefile</code></td>
<td>Forces creation of nodefile regardless of job submission parameters. Not on by default.</td>
</tr>
<tr>
<td><code>--enable-gcc-warnings</code></td>
<td>Enable gcc strictness and warnings. If using gcc, default is to error on any warning.</td>
</tr>
<tr>
<td><code>--enable-geometry-requests</code></td>
<td>TORQUE is compiled to use <code>procs bitmap</code> during job submission.</td>
</tr>
<tr>
<td></td>
<td><strong>When using <code>--enable-geometry-requests</code>, do not disable cpusets.</strong> TORQUE looks at the cpuset when killing jobs.</td>
</tr>
<tr>
<td><code>--enable-gui</code></td>
<td>Include the GUI-clients.</td>
</tr>
<tr>
<td><code>--enable-main-tainer-mode</code></td>
<td>This is for the autoconf utility and tells autoconf to enable so called rebuild rules. See <a href="#">maintainer mode</a> for more information.</td>
</tr>
<tr>
<td><code>--enable-maxdefault</code></td>
<td>Turn on the RESOURCE_MAX_DEFAULT flag.</td>
</tr>
<tr>
<td></td>
<td><strong>Versions of TORQUE earlier than 2.4.5 attempted to apply queue and server defaults to a job that didn’t have defaults specified. If a setting still did not have a value after that, TORQUE applied the queue and server maximum values to a job (meaning, the maximum values for an applicable setting were applied to jobs that had no specified or default value).</strong></td>
</tr>
<tr>
<td></td>
<td><strong>In TORQUE 2.4.5 and later, the queue and server maximum values are no longer used as a value for missing settings. To re-enable this behavior in TORQUE 2.4.5 and later, use <code>--enable-maxdefault</code>.</strong></td>
</tr>
<tr>
<td><code>--enable-nochildsignal</code></td>
<td>Turn on the NO_SIGCHLD flag.</td>
</tr>
</tbody>
</table>
### Table 2-2: Optional Packages

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>--with-blc=DIR</td>
<td>BLCR installation prefix (Available in versions 2.5.6 and 3.0.2 and later).</td>
</tr>
<tr>
<td>--with-blc-inclu=DIR</td>
<td>Include path for libcr.h (Available in versions 2.5.6 and 3.0.2 and later).</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>--with-bcr-lib=DIR</td>
<td>Lib path for libcr (Available in versions 2.5.6 and 3.0.2 and later).</td>
</tr>
<tr>
<td>--with-bcr-bin=DIR</td>
<td>Bin path for BLCR utilities (Available in versions 2.5.6 and 3.0.2 and later).</td>
</tr>
<tr>
<td>--with-boost-path=DIR</td>
<td>Set the path to the Boost header files to be used during make. This option does not require Boost to be built or installed. Version 1.36.0 or newer is supported. RHEL 5, CentOS 5, and Scientific Linux 5 come packaged with an unsupported version. RHEL 6, CentOS 6, and Scientific Linux 6 come packaged with 1.41.0 and RHEL 7, CentOS 7, and Scientific Linux 7 come packaged with 1.53.0.</td>
</tr>
<tr>
<td>--with-cpa-include=DIR</td>
<td>Include path for cpalib.h.</td>
</tr>
<tr>
<td>--with-cpa-lib=DIR</td>
<td>Lib path for libcpalib.</td>
</tr>
<tr>
<td>--with-debug=no</td>
<td>Do not compile with debugging symbols.</td>
</tr>
<tr>
<td>--with-default-server-r=HOSTNAME</td>
<td>Set the name of the computer that clients will access when no machine name is specified as part of the queue name. It defaults to the hostname of the machine on which PBS is being compiled.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>--with-environ=PATH</td>
<td>Set the path containing the environment variables for the daemons. For SP2 and AIX systems, suggested setting is to <code>/etc/environment</code>. Defaults to the file &quot;pbs_environment&quot; in the server-home. Relative paths are interpreted within the context of the server-home.</td>
</tr>
<tr>
<td>--with-gnu-ld</td>
<td>Assume the C compiler uses GNU ld [default=no].</td>
</tr>
<tr>
<td>--with-maildomain=MAILDOMAIN</td>
<td>Override the default domain for outgoing mail messages, i.e. &quot;user@maildomain&quot;. The default maildomain is the hostname where the job was submitted from.</td>
</tr>
<tr>
<td>--with-modulefiles[=DIR]</td>
<td>Use module files in specified directory <code>/etc/modulefiles</code>.</td>
</tr>
<tr>
<td>--with-momlogdir</td>
<td>Use this directory for MOM logs.</td>
</tr>
<tr>
<td>--with-momlogsuffix</td>
<td>Use this suffix for MOM logs.</td>
</tr>
<tr>
<td>--without-PACKAGE</td>
<td>Do not use PACKAGE (same as <code>--with-PACKAGE=no</code>).</td>
</tr>
<tr>
<td>--without-readline</td>
<td>Do not include readline support (default: included if found).</td>
</tr>
<tr>
<td>--with-PACKAGE[=ARG]</td>
<td>Use PACKAGE [ARG=yes].</td>
</tr>
<tr>
<td>--with-pam=DIR</td>
<td>Directory that holds the system PAM modules. Defaults to <code>/lib(64)/security</code> on Linux.</td>
</tr>
<tr>
<td>--with-pic</td>
<td>Try to use only PIC/non-PIC objects [default=use both].</td>
</tr>
<tr>
<td>--with-qstatrc-file=FILE</td>
<td>Set the name of the file that qstat will use if there is no &quot;.qstatrc&quot; file in the directory where it is being invoked. Relative path names will be evaluated relative to the server home directory (see above). If this option is not specified, the default name for this file will be set to &quot;qstatrc&quot; (no dot) in the server home directory.</td>
</tr>
<tr>
<td>--with-rcp</td>
<td>One of &quot;scp&quot;, &quot;rcp&quot;, &quot;mom_rcp&quot;, or the full path of a remote file copy program. scp is the default if found, otherwise mom_rcp is used. Some rcp programs don't always exit with valid error codes in case of failure. mom_rcp is a copy of BSD rcp included with this source that has correct error codes, but it is also old, unmaintained, and doesn't have large file support.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>--with-sched=TYPE</td>
<td>Sets the scheduler type. If TYPE is &quot;c&quot;, the scheduler will be written in C. If TYPE is &quot;tcl&quot; the server will use a Tcl based scheduler. If TYPE is &quot;basl&quot;, TORQUE will use the rule based scheduler. If TYPE is &quot;no&quot;, then no scheduling is done. &quot;c&quot; is the default.</td>
</tr>
<tr>
<td>--with-sched-code=PATH</td>
<td>Sets the name of the scheduler to use. This only applies to BASL schedulers and those written in the C language. For C schedulers this should be a directory name and for BASL schedulers a filename ending in &quot;.basl&quot;. It will be interpreted relative to <code>srtree/src/schedulers.SCHD_TYPE/samples</code>. As an example, an appropriate BASL scheduler relative path would be &quot;nas.basl&quot;. The default scheduler code for &quot;C&quot; schedulers is &quot;fifo&quot;.</td>
</tr>
<tr>
<td>--with-scp</td>
<td>In TORQUE 2.1 and later, SCP is the default remote copy protocol. See --with-rcp if a different protocol is desired.</td>
</tr>
<tr>
<td>--with-sendmail[=FILE]</td>
<td>Sendmail executable to use.</td>
</tr>
<tr>
<td>--with-server-home=DIR</td>
<td>Set the server home/spool directory for PBS use. Defaults to <code>/var/spool/torque</code>.</td>
</tr>
<tr>
<td>--with-server-name-file=FILE</td>
<td>Set the file that will contain the name of the default server for clients to use. If this is not an absolute pathname, it will be evaluated relative to the server home directory that either defaults to <code>/usr/spool/PBS</code> or is set using the --with-server-home option to configure. If this option is not specified, the default name for this file will be set to &quot;server_name&quot;.</td>
</tr>
<tr>
<td>--with-tcl</td>
<td>Directory containing tcl configuration (<code>tclConfig.sh</code>).</td>
</tr>
<tr>
<td>--with-tclatrssep=CHAR</td>
<td>Set the Tcl attribute separator character this will default to &quot;,&quot; if unspecified.</td>
</tr>
<tr>
<td>--with-tclinclude</td>
<td>Directory containing the public Tcl header files.</td>
</tr>
<tr>
<td>--with-tclx</td>
<td>Directory containing tclx configuration (<code>tclxConfig.sh</code>).</td>
</tr>
<tr>
<td>--with-tk</td>
<td>Directory containing tk configuration (<code>tkConfig.sh</code>).</td>
</tr>
<tr>
<td>--with-tkinclude</td>
<td>Directory containing the public Tk header files.</td>
</tr>
<tr>
<td>--with-tkx</td>
<td>Directory containing tkx configuration (<code>tkxConfig.sh</code>).</td>
</tr>
<tr>
<td>--with-tmpdir=DIR</td>
<td>Set the tmp directory that pbs_mom will use. Defaults to &quot;/tmp&quot;. This is a Cray-specific feature.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>--with-xauth=PATH</td>
<td>Specify path to xauth program.</td>
</tr>
</tbody>
</table>

**HAVE_WORDEXP**

Wordxp() performs a shell-like expansion, including environment variables. By default, HAVE_WORDEXP is set to 1 in src/pbs_config.h. If set to 1, will limit the characters that can be used in a job name to those allowed for a file in the current environment, such as BASH. If set to 0, any valid character for the file system can be used.

If a user would like to disable this feature by setting HAVE_WORDEXP to 0 in src/include/pbs_config.h, it is important to note that the error and the output file names will not expand environment variables, including $PBS_JOBID. The other important consideration is that characters that BASH dislikes, such as (), will not be allowed in the output and error file names for jobs by default.

Related Topics

- Advanced Configuration on page 26
- Server Configuration on page 34

**Server Configuration**

This topic contains information and instructions to configure your server.

In this topic:

- Server Configuration Overview on page 34
- Name Service Configuration on page 35
- Configuring Job Submission Hosts on page 35
- Configuring TORQUE on a Multi-Homed Server on page 36
- Architecture Specific Notes on page 36
- Specifying Non-Root Administrators on page 36
- Setting Up Email on page 37
- Using MUNGE Authentication on page 37

Also see Setting Up the MOM Hierarchy (Optional) on page 39

**Server Configuration Overview**
There are several steps to ensure that the server and the nodes are completely aware of each other and able to communicate directly. Some of this configuration takes place within TORQUE directly using the `qmgr` command. Other configuration settings are managed using the `pbs_server` nodes file, DNS files such as `/etc/hosts` and the `/etc/hosts.equiv` file.

**Name Service Configuration**

Each node, as well as the server, must be able to resolve the name of every node with which it will interact. This can be accomplished using `/etc/hosts`, DNS, NIS, or other mechanisms. In the case of `/etc/hosts`, the file can be shared across systems in most cases.

A simple method of checking proper name service configuration is to verify that the server and the nodes can "ping" each other.

**Configuring Job Submission Hosts**

**Using RCmd authentication**

When jobs can be submitted from several different hosts, these hosts should be trusted via the R* commands (such as rsh and rcp). This can be enabled by adding the hosts to the `/etc/hosts.equiv` file of the machine executing the `pbs_server` daemon or using other R* command authorization methods. The exact specification can vary from OS to OS (see the man page for `ruserok` to find out how your OS validates remote users). In most cases, configuring this file is as simple as adding a line to your `/etc/hosts.equiv` file, as in the following:

```
/etc/hosts.equiv:

# [+ | -] [hostname] [username]
mynode.myorganization.com
.....
```

Either of the hostname or username fields may be replaced with a wildcard symbol (+). The (+) may be used as a stand-alone wildcard but not connected to a username or hostname, e.g., `+node01` or `+user01`. However, a (-) may be used in that manner to specifically exclude a user.

⚠️ Following the Linux man page instructions for hosts.equiv may result in a failure. You cannot precede the user or hostname with a (+). To clarify, `node1 +user1` will not work and `user1` will not be able to submit jobs.

For example, the following lines will not work or will not have the desired effect:

```
+node02 user1
node02 +user1
```

These lines will work:
The most restrictive rules must precede more permissive rules. For example, to restrict user tsmith but allow all others, follow this format:

```
node01 -tsmith
node01 +
```

Please note that when a hostname is specified, it must be the fully qualified domain name (FQDN) of the host. Job submission can be further secured using the server or queue `acl_hosts` and `acl_host_enabled` parameters (for details, see Queue Attributes on page 103).

Using the "submit_hosts" service parameter

Trusted submit host access may be directly specified without using RCmd authentication by setting the server `submit_hosts` parameter via qmgr as in the following example:

```
> qmgr -c 'set server submit_hosts = host1'
> qmgr -c 'set server submit_hosts += host2'
> qmgr -c 'set server submit_hosts += host3'
```

Use of `submit_hosts` is potentially subject to DNS spoofing and should not be used outside of controlled and trusted environments.

Allowing job submission from compute hosts

If preferred, all compute nodes can be enabled as job submit hosts without setting `.rhosts` or `hosts.equiv` by setting the `allow_node_submit` parameter to `true`.

Configuring TORQUE on a Multi-Homed Server

If the `pbs_server` daemon is to be run on a multi-homed host (a host possessing multiple network interfaces), the interface to be used can be explicitly set using the `SERVERHOST` parameter.

Architecture Specific Notes

With some versions of Mac OS/X, it is required to add the line `$restricted` *..<DOMAIN> to the `pbs_mom` configuration file. This is required to work around some socket bind bugs in the OS.

Specifying Non-Root Administrators

By default, only root is allowed to start, configure and manage the `pbs_server` daemon. Additional trusted users can be authorized using the parameters
managers and operators. To configure these parameters use the qmgr command, as in the following example:

```bash
> qmgr
qmgr: set server managers += josh@*.fsc.com
qmgr: set server operators += josh@*.fsc.com
```

All manager and operator specifications must include a user name and either a fully qualified domain name or a host expression.

To enable all users to be trusted as both operators and administrators, place the + (plus) character on its own line in the server_priv/acl_svr/operators and server_priv/acl_svr/managers files.

### Setting Up Email

Moab relies on emails from TORQUE about job events. To set up email, do the following:

**To set up email**

1. Use the `--with-sendmail` configure option at configure time. TORQUE needs to know where the email application is. If this option is not used, TORQUE tries to find the sendmail executable. If it isn't found, TORQUE cannot send emails.

   ```bash
   > ./configure --with-sendmail=<path_to_executable>
   ```

2. Set `mail_domain` in your server settings. If your domain is `clusterresources.com`, execute:

   ```bash
   > qmgr -c 'set server mail_domain=clusterresources.com'
   ```

3. (Optional) You can override the default `mail_body_fmt` and `mail_subject_fmt` values via qmgr:

   ```bash
   > qmgr -c 'set server mail_body_fmt=Job: %i 
\n Name: %j 
\n On host: %h 
\n %m 
\n %d'
   > qmgr -c 'set server mail_subject_fmt=Job %i - %r'
   ```

By default, users receive e-mails on job aborts. Each user can select which kind of e-mails to receive by using the `gsub -m` option when submitting the job. If you want to dictate when each user should receive e-mails, use a submit filter (for details, see Job Submission Filter (“qsub Wrapper”) on page 335).

### Using MUNGE Authentication

MUNGE is an authentication service that creates and validates user credentials. It was developed by Lawrence Livermore National Laboratory (LLNL) to be highly scalable so it can be used in large environments such as HPC clusters. To
learn more about MUNGE and how to install it, see http://code.google.com/p/munge/.

Configuring TORQUE to use MUNGE is a compile time operation. When you are building TORQUE, use --enable-munge-auth as a command line option with .configure.

```bash
> ./configure --enable-munge-auth
```

You can use only one authorization method at a time. If --enable-munge-auth is configured, the privileged port ruserok method is disabled.

TORQUE does not link any part of the MUNGE library into its executables. It calls the MUNGE and UNMUNGE utilities which are part of the MUNGE daemon. The MUNGE daemon must be running on the server and all submission hosts. The TORQUE client utilities call MUNGE and then deliver the encrypted credential to pbs_server where the credential is then unmunged and the server verifies the user and host against the authorized users configured in serverdb.

Authorized users are added to serverdb using qmgr and the `authorized_users` parameter. The syntax for `authorized_users` is `authorized_users=<user>@<host>`. To add an authorized user to the server you can use the following qmgr command:

```bash
> qmgr -c 'set server authorized_users=user1@hosta
> qmgr -c 'set server authorized_users+=user2@hosta
```

The previous example adds user1 and user2 from hosta to the list of authorized users on the server. Users can be removed from the list of authorized users by using the `-=` syntax as follows:

```bash
> qmgr -c 'set server authorized_users-=user1@hosta
```

Users must be added with the `<user>@<host>` syntax. The user and the host portion can use the `'*'` wildcard to allow multiple names to be accepted with a single entry. A range of user or host names can be specified using a `[a-b]` syntax where `a` is the beginning of the range and `b` is the end.

```bash
> qmgr -c 'set server authorized_users=user[1-10]@hosta
```

This allows user1 through user10 on hosta to run client commands on the server.

Related Topics

- Setting Up the MOM Hierarchy (Optional) on page 39
- Advanced Configuration on page 26
Setting Up the MOM Hierarchy (Optional)

Mom hierarchy is designed for large systems to configure how information is passed directly to the pbs_server.

The MOM hierarchy allows you to override the compute nodes’ default behavior of reporting status updates directly to the pbs_server. Instead, you configure compute nodes so that each node sends its status update information to another compute node. The compute nodes pass the information up a tree or hierarchy until eventually the information reaches a node that will pass the information directly to pbs_server. This can significantly reduce network traffic and ease the load on the pbs_server in a large system.

Adaptive Computing recommends approximately 25 nodes per path. Numbers larger than this may reduce the system performance.

MOM Hierarchy Example

The following example illustrates how information is passed to the pbs_server without and with mom_hierarchy.
Without mom_hierarchy

With mom_hierarchy

The dotted lines indicates an alternate path if the hierarchy-designated node goes down.

The following is the mom_hierarchy_file for the with mom_hierarchy example:

```
<path>
  <level>hostA,hostB</level>
  <level>hostB,hostC,hostD</level>
</path>
<path>
  <level>hostE,hostF</level>
  <level>hostE,hostF,hostG</level>
</path>
```

Setting Up the MOM Hierarchy
The name of the file that contains the configuration information is named \texttt{mom_hierarchy}. By default, it is located in the \texttt{/var/spool/torque/server\_priv} directory. The file uses syntax similar to XML:

```
<path>
  <level>comma-separated node list</level>
  <level>comma-separated node list</level>
  ...
</path>
```

The \texttt{<path>}</texttt{path}> tag pair identifies a group of compute nodes. The \texttt{<level>}</texttt{level}> tag pair contains a comma-separated list of compute node names listed by their hostnames. Multiple paths can be defined with multiple levels within each path.

Within a \texttt{<path>}</texttt{path}> tag pair the levels define the hierarchy. All nodes in the top level communicate directly with the server. All nodes in lower levels communicate to the first available node in the level directly above it. If the first node in the upper level goes down, the nodes in the subordinate level will then communicate to the next node in the upper level. If no nodes are available in an upper level then the node will communicate directly to the server.

If an upper level node has gone down and then becomes available, the lower level nodes will eventually find that the node is available and start sending their updates to that node.

If you want to specify MOMs on a different port than the default, you must list the node in the form: \texttt{hostname:mmom\_manager\_port}.

For example:

```
<path>
  <level>hostname:mmom\_manager\_port,...</level>
  ...
</path>
```

Putting the MOM Hierarchy on the MOMs

You can put the MOM hierarchy file directly on the MOMs. The default location is \texttt{/var/spool/torque/mom\_priv/mom\_hierarchy}. This way, the \texttt{pbs\_server} doesn't have to send the hierarchy to all the MOMs during each \texttt{pbs\_server} startup. The hierarchy file still has to exist on the \texttt{pbs\_server} and if the file versions conflict, the \texttt{pbs\_server} version overwrites the local MOM file. When using a global file system accessible from both the MOMs and the \texttt{pbs\_server}, it is recommended that the hierarchy file be symbolically linked to the MOMs.

Once the hierarchy file exists on the MOMs, start \texttt{pbs\_server} with the \texttt{-n} option which tells \texttt{pbs\_server} to not send the hierarchy file on startup. Instead, \texttt{pbs\_server} waits until a MOM requests it.
Chapter 2 Installation and Configuration

Manual Setup of Initial Server Configuration

On a new installation of TORQUE, the server database must be initialized using the command `pbs_server -t create`. This command creates a file in `$TORQUEHOME/server_priv` named `serverdb` which contains the server configuration information.

The following output from qmgr shows the base configuration created by the command `pbs_server -t create`:

```
qmgr -c 'p s'
  # Set server attributes.
  # set server acl_hosts = kmn
  set server log_events = 511
  set server mail_from = adm
  set server node_check_rate = 150
  set server tcp_timeout = 6
```

This is a bare minimum configuration and it is not very useful. By using qmgr, the server configuration can be modified to set up TORQUE to do useful work. The following qmgr commands will create a queue and enable the server to accept and run jobs. These commands must be executed by root.

```
pbs_server -t create
qmgr -c "set server scheduling=true"
qmgr -c "create queue batch queue_type=execution"
qmgr -c "set queue batch started=true"
qmgr -c "set queue batch enabled=true"
qmgr -c "set queue batch resources_default.nodes=1"
qmgr -c "set queue batch resources_default.walltime=3600"
qmgr -c "set server default_queue=Batch"
```

> When TORQUE reports a new queue to Moab a class of the same name is automatically applied to all nodes.

In this example, the configuration database is initialized and the scheduling interface is activated using (`scheduling=true`). This option allows the scheduler to receive job and node events which allow it to be more responsive (See scheduling on page 279 for more information). The next command creates a queue and specifies the queue type. Within PBS, the queue must be declared an `execution` queue in order for it to run jobs. Additional configuration (i.e., setting the queue to `started` and `enabled`) allows the queue to accept job submissions, and `launch` queued jobs.

The next two lines are optional, setting `default node` and `walltime` attributes for a submitted job. These defaults will be picked up by a job if values are not explicitly set by the submitting user. The final line, `default queue=batch`, is also a convenience line and indicates that a job should be placed in the `batch` queue unless explicitly assigned to another queue.

Additional information on configuration can be found in the admin manual and in the qmgr main page.
Server Node File Configuration

This section contains information about configuring server node files. It explains how to specify node virtual processor counts and GPU counts, as well as how to specify node features or properties. See these topics for details:

- Basic Node Specification on page 43
- Specifying Virtual Processor Count for a Node on page 44
- Specifying GPU Count for a Node on page 44
- Specifying Node Features (Node Properties) on page 45

### Basic Node Specification

For the `pbs_server` to communicate with each of the MOMs, it needs to know which machines to contact. Each node that is to be a part of the batch system must be specified on a line in the `server nodes` file. This file is located at `TORQUE_HOME/server_priv/nodes`. In most cases, it is sufficient to specify just the node name on a line as in the following example:

```
server_priv/nodes:

node001
node002
node003
node004
```

The `server nodes` file also displays the parameters applied to the node. See Adding nodes for more information on the parameters.

### Related Topics

- TORQUE Installation Overview on page 9
- Server Parameters on page 261
- Node Features/Node Properties in the Moab Workload Manager Administrator Guide

Related Topics

- Server Node File Configuration on page 43
Specifying Virtual Processor Count for a Node

By default each node has one virtual processor. Increase the number using the \texttt{np} attribute in the nodes file. The value of \texttt{np} can be equal to the number of physical cores on the node or it can be set to a value which represents available "execution slots" for the node. The value used is determined by the administrator based on hardware, system, and site criteria.

The following example shows how to set the \texttt{np} value in the nodes file. In this example, we are assuming that node001 and node002 have four physical cores. The administrator wants the value of \texttt{np} for node001 to reflect that it has four cores. However, node002 will be set up to handle multiple virtual processors without regard to the number of physical cores on the system.

\begin{verbatim}
server_priv/nodes:
  node001 np=4
  node002 np=12
  ...
\end{verbatim}

Related Topics

Server Node File Configuration on page 43

Specifying GPU Count for a Node

Administrators can manually set the number of GPUs on a node or if they are using NVIDIA GPUs and drivers, they can have them detected automatically. For more information about how to set up TORQUE with GPUs, see Accelerators in the Moab Workload Manager Administrator Guide.

To manually set the number of GPUs on a node, use the \texttt{gpus} attribute in the nodes file. The value of GPUs is determined by the administrator based on hardware, system, and site criteria.

The following example shows how to set the GPU value in the nodes file. In the example, we assume node01 and node002 each have two physical GPUs. The administrator wants the value of node001 to reflect the physical GPUs available on that system and adds \texttt{gpus=2} to the nodes file entry for node001. However, node002 will be set up to handle multiple virtual GPUs without regard to the number of physical GPUs on the system.

\begin{verbatim}
server_priv/nodes:
  node001 gpus=1
  node002 gpus=4
  ...
\end{verbatim}

Related Topics

Server Node File Configuration on page 43
Specifying Node Features (Node Properties)

Node features can be specified by placing one or more white space-delimited strings on the line for the associated host as in the following example:

```
server_priv/nodes:

    node001 np=2 fast ia64
    node002 np=4 bigmem fast ia64 smp
    ...
```

These features can be used by users to request specific nodes when submitting jobs. For example:

```
qsub -l nodes=1:bigmem+1:fast job.sh
```

This job submission will look for a node with the bigmem feature (node002) and a node with the fast feature (either node001 or node002).

Related Topics

Server Node File Configuration on page 43

Testing Server Configuration

If you have initialized TORQUE using the torque.setup script or started TORQUE using pbs_server -t create and pbs_server is still running, terminate the server by calling qterm. Next, start pbs_server again without the -t create arguments. Follow the script below to verify your server configuration. The output for the examples below is based on the nodes file example in Specifying node features and Server configuration.
# verify all queues are properly configured
> qstat -q

server:kmn

<table>
<thead>
<tr>
<th>Queue</th>
<th>Memory</th>
<th>CPU Time</th>
<th>Walltime</th>
<th>Node</th>
<th>Run</th>
<th>Que</th>
<th>Lm</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>batch</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0</td>
<td>0</td>
<td>--</td>
<td>ER</td>
</tr>
</tbody>
</table>

# view additional server configuration
> qmgr -c 'p s'

# Create queues and set their attributes
#
# # Create and define queue batch
# create queue batch
set queue batch queue_type = Execution
set queue batch resources_default.nodes = 1
set queue batch resources_default.walltime = 01:00:00
set queue batch enabled = True
set queue batch started = True

# Set server attributes.
#
set server acl_hosts = kmn
set server managers = user1@kmn
set server operators = user1@kmn
set server default_queue = batch
set server log_events = 511
set server mail_from = adm
set server node_check_rate = 150
set server tcp_timeout = 300
set server job_stat_rate = 45
set server poll_jobs = True
set server mom_job_sync = True
set server keep_completed = 300
set server next_job_number = 0

# verify all nodes are correctly reporting
> pbsnodes -a
node001
  state=free
  np=2
  properties=bigmem,fast,ia64,smp
  ntype=cluster
  status=rectime=1328810402,varsattr=,jobs=,state=free,netload=6814326158,gres=,loadave =0.21,ncpus=6,physmem=8193724kb,
  availmem=13922548kb,totmem=16581304kb,idletime=3,nusers=3,nsessions=18,sessions=1876
  1120 1912 1926 1937 1951 2019 2057 28399 2126 2140 2323 5419 17948 19356 27726 22254
  29569,uname=Linux kmn 2.6.38-11-generic #48-Ubuntu SMP Fri Jul 29 19:02:55 UTC 2011
  x86_64,opsys=linux
  mom_service_port = 15002
  mom_manager_port = 15003
  gpus = 0

# submit a basic job - DO NOT RUN AS ROOT
> su - testuser
> echo "sleep 30" | qsub

# verify jobs display
> qstat

<table>
<thead>
<tr>
<th>Job id</th>
<th>Name</th>
<th>User</th>
<th>Time Use</th>
<th>S</th>
<th>Queue</th>
</tr>
</thead>
<tbody>
<tr>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>----------</td>
<td>--</td>
<td>-------</td>
</tr>
</tbody>
</table>
At this point, the job should be in the Q state and will not run because a scheduler is not running yet. TORQUE can use its native scheduler by running pbs_sched or an advanced scheduler (such as Moab Workload Manager). See Integrating schedulers for details on setting up an advanced scheduler.

Related Topics
- TORQUE Installation Overview on page 9

TORQUE on NUMA Systems

Starting in TORQUE version 3.0, TORQUE can be configured to take full advantage of Non-Uniform Memory Architecture (NUMA) systems. The following instructions are a result of development on SGI Altix and UV hardware.

For details, see these topics:
- TORQUE NUMA Configuration on page 47
- Building TORQUE with NUMA Support on page 47

TORQUE NUMA Configuration

There are three steps to configure TORQUE to take advantage of NUMA architectures:

1. Configure TORQUE with `--enable-numa-support`.
2. Create the mom_priv/mom.layout file.
3. Configure server_priv/nodes.

Related Topics
- TORQUE on NUMA Systems on page 47

Building TORQUE with NUMA Support

To turn on NUMA support for TORQUE the `--enable-numa-support` option must be used during the configure portion of the installation. In addition to any other configuration options, add the `--enable-numa-support` option as indicated in the following example:

```bash
$ ./configure --enable-numa-support
```
Don't use MOM hierarchy with NUMA.

When TORQUE is enabled to run with NUMA support, there is only a single instance of pbs_mom (MOM) that is run on the system. However, TORQUE will report that there are multiple nodes running in the cluster. While pbs_mom and pbs_server both know there is only one instance of pbs_mom, they manage the cluster as if there were multiple separate MOM nodes.

The mom.layout file is a virtual mapping between the system hardware configuration and how the administrator wants TORQUE to view the system. Each line in mom.layout equates to a node in the cluster and is referred to as a NUMA node.

Automatically Creating mom.layout (Recommended)

A perl script named mom_gencfg is provided in the contrib/ directory that generates the mom.layout file for you. The script can be customized by setting a few variables in it. To automatically create the mom.layout file, follow these instructions (these instructions are also included in the script):

1. Verify hwloc library and corresponding hwloc-devel package are installed. See Installing TORQUE on page 10 for more information.
2. Install Sys::Hwloc from CPAN.
3. Verify $PBS_HOME is set to the proper value.
4. Update the variables in the 'Config Definitions' section of the script. Especially update firstNodeId and nodesPerBoard if desired. The firstNodeId variable should be set above 0 if you have a root cpuset that you wish to exclude and the nodesPerBoard variable is the number of NUMA nodes per board. Each node is defined in /sys/devices/system/node, in a subdirectory node<node_index>
5. Back up your current file in case a variable is set incorrectly or neglected.
6. Run the script.
7. $ ./mom_gencfg

Manually Creating mom.layout

To properly set up the mom.layout file, it is important to know how the hardware is configured. Use the topology command line utility and inspect the contents of /sys/devices/system/node. The hwloc library can also be used to create a custom discovery tool.

Typing topology on the command line of a NUMA system produces something similar to the following:
Chapter 2 Installation and Configuration

From this partial output, note that this system has 72 CPUs on 6 blades. Each blade has 12 CPUs grouped into clusters of 6 CPUs. If the entire content of this command were printed you would see each Blade ID and the CPU ID assigned to each blade.

The topology command shows how the CPUs are distributed, but you likely also need to know where memory is located relative to CPUs, so go to /sys/devices/system/node. If you list the node directory you will see something similar to the following:

```
# ls -al
total 0
drwxr-xr-x 14 root root 0 Dec  3 12:14 .
drwxr-xr-x 14 root root 0 Dec  3 12:13 ..
-r-r--r--  1 root root 4096 Dec  3 14:58 has_cpu
-r-r--r--  1 root root 4096 Dec  3 14:58 has_normal_memory
drwxr-xr-x  2 root root 0 Dec  3 12:14 node0
drwxr-xr-x  2 root root 0 Dec  3 12:14 node1
drwxr-xr-x  2 root root 0 Dec  3 12:14 node10
drwxr-xr-x  2 root root 0 Dec  3 12:14 node11
drwxr-xr-x  2 root root 0 Dec  3 12:14 node2
drwxr-xr-x  2 root root 0 Dec  3 12:14 node3
drwxr-xr-x  2 root root 0 Dec  3 12:14 node4
drwxr-xr-x  2 root root 0 Dec  3 12:14 node5
drwxr-xr-x  2 root root 0 Dec  3 12:14 node6
drwxr-xr-x  2 root root 0 Dec  3 12:14 node7
drwxr-xr-x  2 root root 0 Dec  3 12:14 node8
drwxr-xr-x  2 root root 0 Dec  3 12:14 node9
-r-r--r--  1 root root 4096 Dec  3 14:58 online
-r-r--r--  1 root root 4096 Dec  3 14:58 possible
```
The directory entries node0, node1,...node11 represent groups of memory and CPUs local to each other. These groups are a node board, a grouping of resources that are close together. In most cases, a node board is made up of memory and processor cores. Each bank of memory is called a memory node by the operating system, and there are certain CPUs that can access that memory very rapidly. Note under the directory for node board node0 that there is an entry called cpulist. This contains the CPU IDs of all CPUs local to the memory in node board 0.

Now create the mom.layout file. The content of cpulist 0-5 are local to the memory of node board 0, and the memory and cpus for that node are specified in the layout file by saying nodes=0. The cpulist for node board 1 shows 6-11 and memory node index 1. To specify this, simply write nodes=1. Repeat this for all twelve node boards and create the following mom.layout file for the 72 CPU system.

```
nodes=0
nodes=1
nodes=2
nodes=3
nodes=4
nodes=5
nodes=6
nodes=7
nodes=8
nodes=9
nodes=10
nodes=11
```

Each line in the mom.layout file is reported as a node to pbs_server by the pbs_mom daemon.

The mom.layout file does not need to match the hardware layout exactly. It is possible to combine node boards and create larger NUMA nodes. The following example shows how to do this:

```
nodes=0-1
```

The memory nodes can be combined the same as CPUs. The memory nodes combined must be contiguous. You cannot combine mem 0 and 2.

**Configuring server_priv/nodes**

The pbs_server requires awareness of how the MOM is reporting nodes since there is only one MOM daemon and multiple MOM nodes. So, configure the server_priv/nodes file with the num_node_boards and numa_board_str attributes. The attribute num_node_boards tells pbs_server how many numa nodes are reported by the MOM. Following is an example of how to configure the nodes file with num_node_boards:

```
numa-10 np=72 num_node_boards=12
```

This line in the nodes file tells pbs_server there is a host named numa-10 and that it has 72 processors and 12 nodes. The pbs_server divides the value of np
(72) by the value for num_node_boards (12) and determines there are 6 CPUs per NUMA node.

In this example, the NUMA system is uniform in its configuration of CPUs per node board, but a system does not need to be configured with the same number of CPUs per node board. For systems with non-uniform CPU distributions, use the attribute numa_board_str to let pbs_server know where CPUs are located in the cluster.

The following is an example of how to configure the server_priv/nodes file for non-uniformly distributed CPUs:

```
Numa-11 numa_board_str=6,8,12
```

In this configuration, pbs_server knows it has three MOM nodes and the nodes have 6, 8, and 12 CPUs respectively. Note that the attribute np is not used. The np attribute is ignored because the number of CPUs per node is expressly given.

**Enforcement of memory resource limits**

TORQUE can better enforce memory limits with the use of the utility memaccd. The memaccd utility is provided by SGI on SuSe Linux Enterprise Edition (SLES). It is a daemon that caches memory footprints when it is queried. When configured to use the memory monitor, TORQUE queries memaccd. It is up to the user to make sure memaccd is installed. See the SGI memaccd man page for more information.

**To configure TORQUE to use memaccd for memory enforcement**

1. Start memaccd as instructed by SGI.
2. Reconfigure TORQUE with --enable-memacct. This will link in the necessary library when TORQUE is recompiled.
3. Recompile and reinstall TORQUE.
4. Restart all MOM nodes.
5. (Optional) Alter the qsub filter to include a default memory limit for all jobs that are not submitted with memory limit.

**Related Topics**

TORQUE NUMA Configuration on page 47
TORQUE on NUMA Systems on page 47

**TORQUE Multi-MOM**
Starting in TORQUE version 3.0 users can run multiple MOMs on a single node. The initial reason to develop a multiple MOM capability was for testing purposes. A small cluster can be made to look larger since each MOM instance is treated as a separate node.

When running multiple MOMs on a node each MOM must have its own service and manager ports assigned. The default ports used by the MOM are 15002 and 15003. With the multi-mom alternate ports can be used without the need to change the default ports for `pbs_server` even when running a single instance of the MOM.

For details, see these topics:
- Multi-MOM Configuration on page 52
- Stopping pbs_mom in Multi-MOM Mode on page 53

**Multi-MOM Configuration**

There are three steps to setting up multi-MOM capability:
1. Configure server_priv/nodes on page 52
2. `/etc/hosts` file on page 52
3. Starting pbs_mom with Multi-MOM Options on page 53

**Configure server_priv/nodes**

The attributes `mom_service_port` and `mom_manager_port` were added to the nodes file syntax to accommodate multiple MOMs on a single node. By default `pbs_mom` opens ports 15002 and 15003 for the service and management ports respectively. For multiple MOMs to run on the same IP address they need to have their own port values so they can be distinguished from each other. `pbs_server` learns about the port addresses of the different MOMs from entries in the `server_priv/nodes` file. The following is an example of a nodes file configured for multiple MOMs:

```plaintext
hosta   np=2
hosta-1 np=2 mom_service_port=30001 mom_manager_port=30002
hosta-2 np=2 mom_service_port=31001 mom_manager_port=31002
hosta-3 np=2 mom_service_port=32001 mom_manager_port=32002
```

Note that all entries have a unique host name and that all port values are also unique. The entry `hosta` does not have a `mom_service_port` or `mom_manager_port` given. If unspecified, then the MOM defaults to ports 15002 and 15003.

**/etc/hosts file**

Host names in the `server_priv/nodes` file must be resolvable. Creating an alias for each host enables the server to find the IP address for each MOM; the
server uses the port values from the `server_priv/nodes` file to contact the correct MOM. An example `/etc/hosts` entry for the previous `server_priv/nodes` example might look like the following:

```
192.65.73.10 hosta hosta-1 hosta-2 hosta-3
```

Even though the host name and all the aliases resolve to the same IP address, each MOM instance can still be distinguished from the others because of the unique port value assigned in the `server_priv/nodes` file.

**Starting pbs_mom with Multi-MOM Options**

To start multiple instances of `pbs_mom` on the same node, use the following syntax (see `pbs_mom` on page 183 for details):

```
pbs_mom -m -M <port value of MOM_service_port> -R <port value of MOM_manager_port> -A <name of MOM alias>
```

Continuing based on the earlier example, if you want to create four MOMs on `hosta`, type the following at the command line:

```
# pbs_mom -m -M 30001 -R 30002 -A hosta-1
# pbs_mom -m -M 31001 -R 31002 -A hosta-2
# pbs_mom -m -M 32001 -R 32002 -A hosta-3
# pbs_mom
```

Notice that the last call to `pbs_mom` uses no arguments. By default `pbs_mom` opens on ports 15002 and 15003. No arguments are necessary because there are no conflicts.

**Related Topics**

- [TORQUE Multi-MOM on page 51](#)
- [Stopping pbs_mom in Multi-MOM Mode on page 53](#)

**Stopping pbs_mom in Multi-MOM Mode**

Terminate `pbs_mom` by using the `momctl -s` command (for details, see `momctl`). For any MOM using the default manager port 15003, the `momctl -s` command stops the MOM. However, to terminate MOMs with a manager port value not equal to 15003, you must use the following syntax:

```
momctl -s -p <port value of MOM_manager_port>
```

The `-p` option sends the terminating signal to the MOM manager port and the MOM is terminated.

**Related Topics**

- [TORQUE Multi-MOM on page 51](#)
- [Multi-MOM Configuration on page 52](#)
Chapter 2 Installation and Configuration
Chapter 3 Submitting and Managing Jobs

This section contains information about how you can submit and manage jobs with TORQUE.

In this section:

- Job Submission on page 55
- Monitoring Jobs on page 72
- Canceling Jobs on page 72
- Job Preemption on page 73
- Keeping Completed Jobs on page 73
- Job Checkpoint and Restart on page 74
- Job Exit Status on page 84
- Service Jobs on page 88

Job Submission

Job submission is accomplished using the qsub command, which takes a number of command line arguments and integrates such into the specified PBS command file. The PBS command file may be specified as a filename on the qsub command line or may be entered via STDIN.

- The PBS command file does not need to be executable.
- The PBS command file may be piped into qsub (i.e., cat pbs.cmd | qsub).
- In the case of parallel jobs, the PBS command file is staged to, and executed on, the first allocated compute node only. (Use pbsdsh to run actions on multiple nodes.)
- The command script is executed from the user's home directory in all cases. (The script may determine the submission directory by using the $PBS_O_WORKDIR environment variable)
- The command script will be executed using the default set of user environment variables unless the -V or -v flags are specified to include aspects of the job submission environment.
- PBS directives should be declared first in the job script.
By default, job submission is allowed only on the TORQUE server host (host on which \texttt{pbs\_server} is running). Enablement of job submission from other hosts is documented in Server Configuration on page 34.

Versions of TORQUE earlier than 2.4.5 attempted to apply queue and server defaults to a job that didn't have defaults specified. If a setting still did not have a value after that, TORQUE applied the queue and server maximum values to a job (meaning, the maximum values for an applicable setting were applied to jobs that had no specified or default value).

In TORQUE 2.4.5 and later, the queue and server maximum values are no longer used as a value for missing settings.

This section contains these topics:

- Multiple Job Submission on page 57
- Requesting Resources on page 59
- Requesting Generic Resources on page 66
- Requesting Floating Resources on page 67
- Requesting Other Resources on page 67
- Exported Batch Environment Variables on page 67
- Enabling Trusted Submit Hosts on page 69
- Example Submit Scripts on page 70

Related Topics

Maui Documentation
http://www.lunarc.lsu.ee
http://www.clusters.umaine.edu/wiki/index.php/Example_Submission_Scripts
Job Submission Filter (“\texttt{qsub Wrapper}”) on page 335 – Allow local checking and modification of submitted job
Multiple Job Submission

Sometimes users will want to submit large numbers of jobs based on the same job script. Rather than using a script to repeatedly call `qsub`, a feature known as job arrays now exists to allow the creation of multiple jobs with one `qsub` command. Additionally, this feature includes a new job naming convention that allows users to reference the entire set of jobs as a unit, or to reference one particular job from the set.

Job arrays are submitted through the `-t` option to `qsub`, or by using `#PBS -t` in your batch script. This option takes a comma-separated list consisting of either a single job ID number, or a pair of numbers separated by a dash. Each of these jobs created will use the same script and will be running in a nearly identical environment.

```bash
> qsub -t 0-4 job_script
1098[0].hostname
> qstat -t
1098[0].hostname ...
1098[1].hostname ...
1098[2].hostname ...
1098[3].hostname ...
1098[4].hostname ...
```

Versions of TORQUE earlier than 2.3 had different semantics for the `-t` argument. In these versions, `-t` took a single integer number—a count of the number of jobs to be created.

Each `1098[x]` job has an environment variable called `PBS_ARRAYID`, which is set to the value of the array index of the job, so `1098[0].hostname` would have `PBS_ARRAYID` set to 0. This allows you to create job arrays where each job in the array performs slightly different actions based on the value of this variable, such as performing the same tasks on different input files. One other difference in the environment between jobs in the same array is the value of the `PBS_JOBNAME` variable.

```bash
# These two examples are equivalent in TORQUE 2.2
> qsub -t 0-99
> qsub -t 100

# You can also pass comma delimited lists of ids and ranges:
> qsub -t 0,10,20,30,40
> qsub -t 0-50,60,70,80
```

Running `qstat` displays a job summary, which provides an overview of the array's state. To see each job in the array, run `qstat -t`.

The `qalter`, `qdel`, `qhold`, and `qrls` commands can operate on arrays—either the entire array or a range of that array. Additionally, any job in the array may be accessed normally by using that job's ID, just as you would with any other job. For example, running the following command would run only the specified job:

```bash
qrun 1098[0].hostname
```
Slot Limit

The slot limit is a way for administrators to limit the number of jobs from a job array that can be eligible for scheduling at the same time. When a slot limit is used, TORQUE puts a hold on all jobs in the array that exceed the slot limit. When an eligible job in the array completes, TORQUE removes the hold flag from the next job in the array. Slot limits can be declared globally with the \texttt{max\_slot\_limit} parameter, or on a per-job basis with \texttt{qsub -t}.

Related Topics

Job Submission on page 55

Managing Multi-Node Jobs

By default, when a multi-node job runs, the Mother Superior manages the job across all the sister nodes by communicating with each of them and updating \texttt{pbs\_server}. Each of the sister nodes sends its updates and stdout and stderr directly to the Mother Superior. When you run an extremely large job using hundreds or thousands of nodes, you may want to reduce the amount of network traffic sent from the sisters to the Mother Superior by specifying a job radix. Job radix sets a maximum number of nodes with which the Mother Superior and resulting intermediate MOMs communicate and is specified using the \texttt{-W on page 248} option for \texttt{qsub}.

For example, if you submit a smaller, 12-node job and specify \texttt{job\_radix=3}, Mother Superior and each resulting intermediate MOM is only allowed to receive communication from 3 subordinate nodes.

Image 3-1: Job radix example

The Mother Superior picks three sister nodes with which to communicate the job information. Each of those nodes (intermediate MOMs) receives a list of all sister nodes that will be subordinate to it. They each contact up to three nodes and pass the job information on to those nodes. This pattern continues until the bottom level is reached. All communication is now passed across this new hierarchy. The stdout and stderr data is aggregated and sent up the tree until it reaches the Mother Superior, where it is saved and copied to the \texttt{.o} and \texttt{.e} files.
Job radix is meant for extremely large jobs only. It is a tunable parameter and should be adjusted according to local conditions in order to produce the best results.

### Requesting Resources

Various resources can be requested at the time of job submission. A job can request a particular node, a particular node attribute, or even a number of nodes with particular attributes. Either native TORQUE resources or external scheduler resource extensions may be specified. The native TORQUE resources are listed in the following table:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>arch</td>
<td>string</td>
<td>Specifies the administrator defined system architecture required. This defaults to whatever the PBS_MACH string is set to in &quot;local.mk&quot;.</td>
</tr>
<tr>
<td>cput</td>
<td>seconds, or [[HH:]MM:]SS</td>
<td>Maximum amount of CPU time used by all processes in the job.</td>
</tr>
<tr>
<td>Resource</td>
<td>Format</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| cpuclock | string | Specify the CPU clock frequency for each node requested for this job. A `cpuclock` request applies to every processor on every node in the request. Specifying varying CPU frequencies for different nodes or different processors on nodes in a single job request is not supported.

Not all processors support all possible frequencies or ACPI states. If the requested frequency is not supported by the CPU, the nearest frequency is used.

ALPS 1.4 or later is required when using `cpuclock` on Cray.

The clock frequency can be specified via:

- a number that indicates the clock frequency (with or without the SI unit suffix).

```bash
qsub -l cpuclock=1800, nodes=2 script.sh
qsub -l cpuclock=1800mhz, nodes=2 script.sh
```

This job requests 2 nodes and specifies their CPU frequencies should be set to 1800 MHz.

- a Linux power governor policy name. The governor names are:
  - **performance**: This governor instructs Linux to operate each logical processor at its maximum clock frequency. This setting consumes the most power and workload executes at the fastest possible speed.
  - **powersave**: This governor instructs Linux to operate each logical processor at its minimum clock frequency. This setting executes workload at the slowest possible speed. This setting does not necessarily consume the least amount of power since applications execute slower, and may actually consume more energy because of the additional time needed to complete the workload’s execution.
  - **ondemand**: This governor dynamically switches the logical processor’s clock frequency to the maximum value when system load is high and to the minimum value when the system load is low.

This setting causes workload to execute at the fastest possible speed or the slowest possible speed, depending on OS load. The system switches between consuming the most power and the least power.
The power saving benefits of ondemand might be non-existent due to frequency switching latency if the system load causes clock frequency changes too often. This has been true for older processors since changing the clock frequency required putting the processor into the C3 “sleep” state, changing its clock frequency, and then waking it up, all of which required a significant amount of time.

Newer processors, such as the Intel Xeon E5-2600 Sandy Bridge processors, can change clock frequency dynamically and much faster.

- conservative: This governor operates like the ondemand governor but is more conservative in switching between frequencies. It switches more gradually and uses all possible clock frequencies.

  This governor can switch to an intermediate clock frequency if it seems appropriate to the system load and usage, which the ondemand governor does not.

  ```bash
  qsub -l cpuclock=performance,nodes=2 script.sh
  ```

  This job requests 2 nodes and specifies their CPU frequencies should be set to the performance power governor policy.

  ```bash
  qsub -l cpuclock=3,nodes=2 script.sh
  qsub -l cpuclock=p3,nodes=2 script.sh
  ```

  This job requests 2 nodes and specifies their CPU frequencies should be set to a performance state of 3.

  When reviewing job or node properties when cpuclock was used, be mindful of unit conversion. The OS reports frequency in Hz, not MHz or GHz.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource</td>
<td>Format</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>--------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>epilogue</td>
<td>string</td>
<td>Specifies a user owned epilogue script which will be run before the system epilogue and epilogue.user scripts at the completion of a job. The syntax is <code>epilogue=&lt;file&gt;</code>. The file can be designated with an absolute or relative path. For more information, see Prologue and Epilogue Scripts on page 323.</td>
</tr>
<tr>
<td>feature</td>
<td>string</td>
<td>Specifies a property or feature for the job. Feature corresponds to TORQUE node properties and Moab features.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><code>{qsub script.sh -l procs=10,feature=bigmem...}</code></td>
</tr>
<tr>
<td>file</td>
<td>size</td>
<td>Sets RLIMITFSIZE for each process launched through the TM interface. For information on how Moab schedules this, see FILEREQUESTISJOBCENTRIC.</td>
</tr>
<tr>
<td>host</td>
<td>string</td>
<td>Name of the host on which the job should be run. This resource is provided for use by the site’s scheduling policy. The allowable values and effect on job placement is site dependent.</td>
</tr>
<tr>
<td>mem</td>
<td>size</td>
<td>Maximum amount of physical memory used by the job. Ignored on Darwin, Digital Unix, FreeBSD, HPUX 11, IRIX, NetBSD, and SunOS. Not implemented on AIX and HPUX 10. The <code>mem</code> resource will only work for single-node jobs. If your job requires multiple nodes, use <code>pmem</code> instead.</td>
</tr>
<tr>
<td>ncpus</td>
<td>integer</td>
<td>The number of processors in one task where a task cannot span nodes. <code>You cannot request both ncpus and nodes in the same job.</code></td>
</tr>
<tr>
<td>nice</td>
<td>integer</td>
<td>Number between -20 (highest priority) and 19 (lowest priority). Adjust the process execution priority.</td>
</tr>
<tr>
<td>Resource</td>
<td>Format</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| **nodes** | `{<node_count> | <hostname>} [ppn=<ppn>] [gpus=<gpu>] [:<property> [:<property>...] [+]` | Number and/or type of nodes to be reserved for exclusive use by the job. The value is one or more node_specs joined with the + (plus) character: node_spec [node_spec...]. Each node_spec is a number of nodes required of the type declared in the node_spec and a name of one or more properties desired for the nodes. The number, the name, and each property in the node_spec are separated by a : (colon). If no number is specified, one (1) is assumed. The name of a node is its hostname. The properties of nodes are:  
- **ppn=#** - Specify the number of virtual processors per node requested for this job.  
  The number of virtual processors available on a node by default is 1, but it can be configured in the $TORQUE_HOME/server_priv/nodes file using the np attribute (see Server Node File Configuration on page 43). The virtual processor can relate to a physical core on the node or it can be interpreted as an "execution slot" such as on sites that set the node np value greater than the number of physical cores (or hyper-thread contexts). The ppn value is a characteristic of the hardware, system, and site, and its value is to be determined by the administrator.  
- **gpus=#** - Specify the number of GPUs per node requested for this job.  
  The number of GPUs available on a node can be configured in the $TORQUE_HOME/server_priv/nodes file using the gpu attribute (see Server Node File Configuration on page 43). The GPU value is a characteristic of the hardware, system, and site, and its value is to be determined by the administrator.  
- **property** - A string assigned by the system administrator specifying a node's features. Check with your administrator as to the node names and properties available to you.  

TORQUE does not have a TPN (tasks per node) property. You can specify TPN in Moab Workload Manager with TORQUE as your resource manager, but TORQUE does not recognize the property when it is submitted directly to it via qsub. See `qsub -l nodes` on page 65 for examples.  

By default, the node resource is mapped to a virtual node (that is, directly to a processor, not a full physical compute node). This behavior can be changed within Maui or Moab by setting the JOBNODEMATCHPOLICY parameter (see the Moab Workload Manager Administrator Guide). |
<p>| <strong>opsys</strong> | string | Specifies the administrator defined operating system as defined in the MOM configuration file. |</p>
<table>
<thead>
<tr>
<th>Resource</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>other</td>
<td>string</td>
<td>Allows a user to specify site specific information. This resource is provided for use by the site’s scheduling policy. The allowable values and effect on job placement is site dependent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>This does not work for msub using Moab and Maui.</em></td>
</tr>
<tr>
<td>pcput</td>
<td>seconds, or</td>
<td>Maximum amount of CPU time used by any single process in the job.</td>
</tr>
<tr>
<td></td>
<td>[HH:]MM:SS</td>
<td></td>
</tr>
<tr>
<td>pmem</td>
<td>size</td>
<td>Maximum amount of physical memory used by any single process of the job. (Ignored on Fujitsu. Not implemented on Digital Unix and HPUX)</td>
</tr>
<tr>
<td>procs</td>
<td>procs=&lt;integer&gt;</td>
<td><em>(Applicable in version 2.5.0 and later.) The number of processors to be allocated to a job. The processors can come from one or more qualified node(s). Only one procs declaration may be used per submitted qsub command.</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; qsub -l nodes=3 -1 procs=2</td>
</tr>
<tr>
<td>procs_bitmap</td>
<td>string</td>
<td>A string made up of 1’s and 0’s in reverse order of the processor cores requested. A <strong>procs_bitmap=1110</strong> means the job requests a node that has four available cores, but the job runs exclusively on cores two, three, and four. With this bitmap, core one is not used. For more information, see <a href="#">Scheduling Cores on page 100</a>.</td>
</tr>
<tr>
<td>prologue</td>
<td>string</td>
<td>Specifies a user owned prologue script which will be run after the system prologue and prologue.user scripts at the beginning of a job. The syntax is prologue=&lt;file&gt;. The file can be designated with an absolute or relative path. For more information, see <a href="#">Prologue and Epilogue Scripts on page 323</a>.</td>
</tr>
<tr>
<td>pvmem</td>
<td>size</td>
<td>Maximum amount of virtual memory used by any single process in the job. (Ignored on Unicos.)</td>
</tr>
<tr>
<td>size</td>
<td>integer</td>
<td>For TORQUE, this resource has no meaning. It is passed on to the scheduler for interpretation. In the Moab scheduler, the size resource is intended for use in Cray installations only.</td>
</tr>
<tr>
<td>software</td>
<td>string</td>
<td>Allows a user to specify software required by the job. This is useful if certain software packages are only available on certain systems in the site. This resource is provided for use by the site’s scheduling policy. The allowable values and effect on job placement is site dependent. See License Management in the <a href="#">Moab Workload Manager Administrator Guide</a> for more information.</td>
</tr>
</tbody>
</table>
### Resource, Format, Description

<table>
<thead>
<tr>
<th>Resource</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmem</td>
<td>size</td>
<td>Maximum amount of virtual memory used by all concurrent processes in the job. (Ignored on Unicos.)</td>
</tr>
<tr>
<td>walltime</td>
<td>seconds, or [HH]:MM:SS</td>
<td>Maximum amount of real time during which the job can be in the running state.</td>
</tr>
</tbody>
</table>

### size

The size format specifies the maximum amount in terms of bytes or words. It is expressed in the form integer[suffix]. The suffix is a multiplier defined in the following table ("b" means bytes [the default] and "w" means words). The size of a word is calculated on the execution server as its word size.

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>w</td>
</tr>
<tr>
<td>kb</td>
<td>kw</td>
</tr>
<tr>
<td>mb</td>
<td>mw</td>
</tr>
<tr>
<td>gb</td>
<td>gw</td>
</tr>
<tr>
<td>tb</td>
<td>tw</td>
</tr>
</tbody>
</table>

**Example 3.1: qsub -l nodes**

<table>
<thead>
<tr>
<th>Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; qsub -l nodes=12</td>
<td>Request 12 nodes of any type</td>
</tr>
<tr>
<td>&gt; qsub -l nodes=2:server+14</td>
<td>Request 2 &quot;server&quot; nodes and 14 other nodes (a total of 16) - this specifies two node specs, &quot;2:server&quot; and &quot;14&quot;</td>
</tr>
<tr>
<td>&gt; qsub -l nodes=s=server:hippi+10:noserver+3:bigmem:hippi</td>
<td>Request (a) 1 node that is a &quot;server&quot; and has a &quot;hippi&quot; interface, (b) 10 nodes that are not servers, and (c) 3 nodes that have a large amount of memory and have hippi</td>
</tr>
<tr>
<td>&gt; qsub -l nodes=b2005+b1803+b1813</td>
<td>Request 3 specific nodes by hostname</td>
</tr>
</tbody>
</table>
### Usage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&gt; qsub -l nodes=4:ppn=2</code></td>
<td>Request 2 processors on each of four nodes</td>
</tr>
<tr>
<td><code>&gt; qsub -l nodes=1:ppn=4</code></td>
<td>Request 4 processors on one node</td>
</tr>
<tr>
<td><code>&gt; qsub -l nodes=2:blue:ppn=2+red:ppn=3+b1014</code></td>
<td>Request 2 processors on each of two blue nodes, three processors on one red node, and the compute node &quot;b1014&quot;</td>
</tr>
</tbody>
</table>

#### Example 3.2:

This job requests a node with 200MB of available memory:

```
> qsub -l mem=200mb /home/user/script.sh
```

#### Example 3.3:

This job will wait until node01 is free with 200MB of available memory:

```
> qsub -l nodes=node01,mem=200mb /home/user/script.sh
```

### Requesting Generic Resources

When **generic** resources have been assigned to nodes using the server's nodes file, these resources can be requested at the time of job submission using the `other` field. See Managing Consumable Generic Resources in the *Moab Workload Manager Administrator Guide* for details on configuration within Moab).

#### Example 3.4: Generic

This job will run on any node that has the generic resource **matlab**.

```
> qsub -l other=matlab /home/user/script.sh
```

This can also be requested at the time of job submission using the `-W x=GRES:matlab` flag.

### Related Topics

- [Job Submission on page 55](#)
- [Requesting Resources on page 59](#)
Requesting Floating Resources

When floating resources have been set up inside Moab, they can be requested in the same way as generic resources. Moab will automatically understand that these resources are floating and will schedule the job accordingly. See Managing Shared Cluster Resources (Floating Resources) in the Moab Workload Manager Administrator Guide for details on configuration within Moab.

Example 3-5: Floating

This job will run on any node when there are enough floating resources available.

```
> qsub -l other=matlab /home/user/script.sh
```

This can also be requested at the time of job submission using the -W x=GRES:matlab flag.

Related Topics

- Requesting Resources on page 59
- Job Submission on page 55

Requesting Other Resources

Many other resources can be requested at the time of job submission using the Moab Workload Manager. See Resource Manager Extensions in the Moab Workload Manager Administrator Guide for a list of these supported requests and correct syntax.

Related Topics

- Requesting Resources on page 59
- Job Submission on page 55

Exported Batch Environment Variables

When a batch job is started, a number of variables are introduced into the job's environment that can be used by the batch script in making decisions, creating output files, and so forth. These variables are listed in the following table:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_JOBNAME</td>
<td>User specified jobname</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PBS_ARRAYID</td>
<td>Zero-based value of job array index for this job (in version 2.2.0 and later)</td>
</tr>
<tr>
<td>PBS_GPUFILE</td>
<td>Line-delimited list of GPUs allocated to the job located in $TORQUE_HOME/aux/jobidgpu. Each line follows the following format: &lt;host&gt;-gpu&lt;number&gt; For example, myhost-gpu1.</td>
</tr>
<tr>
<td>PBS_O_WORKDIR</td>
<td>Job's submission directory</td>
</tr>
<tr>
<td>PBS_ENVIRONMENT</td>
<td>N/A</td>
</tr>
<tr>
<td>PBS_TASKNUM</td>
<td>Number of tasks requested</td>
</tr>
<tr>
<td>PBS_O_HOME</td>
<td>Home directory of submitting user</td>
</tr>
<tr>
<td>PBS_MOMPORT</td>
<td>Active port for MOM daemon</td>
</tr>
<tr>
<td>PBS_O_LOGNAME</td>
<td>Name of submitting user</td>
</tr>
<tr>
<td>PBS_O_LANG</td>
<td>Language variable for job</td>
</tr>
<tr>
<td>PBS_JOBCOOKIE</td>
<td>Job cookie</td>
</tr>
<tr>
<td>PBS_JOBID</td>
<td>Unique pbs job id</td>
</tr>
<tr>
<td>PBS_NODENUM</td>
<td>Node offset number</td>
</tr>
<tr>
<td>PBS_NUM_NODES</td>
<td>Number of nodes allocated to the job</td>
</tr>
<tr>
<td>PBS_NUM_PPN</td>
<td>Number of procs per node allocated to the job</td>
</tr>
<tr>
<td>PBS_O_SHELL</td>
<td>Script shell</td>
</tr>
<tr>
<td>PBS_O_HOST</td>
<td>Host on which job script is currently running</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PBS_QUEUE</td>
<td>Job queue</td>
</tr>
<tr>
<td>PBS_NODEFILE</td>
<td>File containing line delimited list of nodes allocated to the job</td>
</tr>
<tr>
<td>PBS_NP</td>
<td>Number of execution slots (cores) for the job</td>
</tr>
<tr>
<td>PBS_O_PATH</td>
<td>Path variable used to locate executables within job script</td>
</tr>
</tbody>
</table>

Related Topics

- Requesting Resources on page 59
- Job Submission on page 55

### Enabling Trusted Submit Hosts

By default, only the node running the pbs_server daemon is allowed to submit jobs. Additional nodes can be trusted as submit hosts by taking any of the following steps:

- Set the allow_node_submit server parameter (see Allowing job submission from compute hosts on page 36).
  
  Allows any host trusted as a compute host to also be trusted as a submit host.

- Set the submit_hosts server parameter (see Using the "submit_hosts" service parameter on page 36).
  
  Allows specified hosts to be trusted as a submit host.

- Use .rhosts to enable ruserok() based authentication (see Using RCmd authentication on page 35).

See Configuring Job Submission Hosts on page 35 for more information.

> When you enable allow_node_submit on page 263, you must also enable the allow_proxy_user on page 263 parameter to allow user proxying when submitting and running jobs.

Related Topics

- Job Submission on page 55
Example Submit Scripts

The following is an example job test script:

```bash
#!/bin/sh
#
# This is an example script example.sh
#
# These commands set up the Grid Environment for your job:
#PBS -N ExampleJob
#PBS -l nodes=1,walltime=00:01:00
#PBS -q np_workq
#PBS -M YOURUNIQNAME@umich.edu
#PBS -m abe

# print the time and date
date

# wait 10 seconds
sleep 10

# print the time and date again
date
```

Related Topics

[Job Submission on page 55](#)

Job Files

TORQUE 4.5.0 was updated to accept XML-based job files in addition to the binary job files. The change allows job files to be more human-readable and easier to parse. Below is a sample job file in the new XML format:
<?xml version="1.0"?>
<job>
  <version>131842</version>
  <state>1</state>
  <substate>10</substate>
  <server_flags>33</server_flags>
  <start_time>0</start_time>
  <jobid>340</jobid>
  <fileprefix>340</fileprefix>
  <queue>batch</queue>
  <destination_queue>batch</destination_queue>
  <record_type>1</record_type>
  <mom_address>0</mom_address>
  <mom_port>11</mom_port>
  <mom_rmport>0</mom_rmport>
  <attributes>
    <Job_Name flags="1">job2.sh</Job_Name>
    <Job_Owner flags="1">echan@moabServer.cn</Job_Owner>
    <job_state flags="1">Q</job_state>
    <queue flags="3">batch</queue>
    <Checkpoint flags="1">u</Checkpoint>
    <ctime flags="1">1384292754</ctime>
    <Error_Path flags="1">moabServer.cn:/home/echan/work/job2.sh.e340</Error_Path>
    <Hold_Types flags="1">n</Hold_Types>
    <Join_Path flags="1">n</Join_Path>
    <Keep_Files flags="1">n</Keep_Files>
    <Mail_Points flags="1">n</Mail_Points>
    <mtime flags="1">1384292754</mtime>
    <Output_Path flags="1">moabServer.cn:/home/echan/work/job2.sh.o340</Output_Path>
    <Priority flags="1">0</Priority>
    <qtime flags="1">1384292754</qtime>
    <Rerunable flags="1">True</Rerunable>
    <Resource_List>
      <epilogue flags="1">/tmp/epilogue.sh</epilogue>
      <neednodes flags="1">moabServer:ppn=1</neednodes>
      <nodes flags="1">moabServer:ppn=1</nodes>
    </Resource_List>
    <substate flags="1">10</substate>
    <Variable_List flags="1">PBS_O_HOME=/home/echan
PBS_O_LOGNAME=echan
PBS_O_PATH=/home/echan/eclipse/usr/lib/lightdm/lightdm/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/opt/moab/bin:/opt/moab/sbin
PBS_O_SHELL=/bin/bash
PBS_O_LANG=en_US
PBS_O_WORKDIR=/home/echan/work
PBS_O_HOST=moabServer.cn
PBS_O_SERVER=moabServer</Variable_List>
    <euser flags="1">echan</euser>
    <egroup flags="5">company</egroup>
    <hop_count flags="1">1</hop_count>
    <queue_rank flags="1">2</queue_rank>
    <queue_type flags="1">E</queue_type>
    <etime flags="1">1384292754</etime>
    <submit_args flags="1">-l nodes=lei:ppn=1 -l epilogue=/tmp/epilogue.sh
./job2.sh</submit_args>
    <fault_tolerant flags="1">False</fault_tolerant>
    <job_radix flags="1">0</job_radix>
  </attributes>
</job>
The above job was submitted with this submit command:

```
qsub -l nodes=moabServer:ppn=1 -l epilogue=/tmp/epilogue.sh ./job2.sh
```

Related Topics

Job Submission on page 55

**Monitoring Jobs**

TORQUE allows users and administrators to monitor submitted jobs with the `qstat` command. If the command is run by a non-administrative user, it will output just that user's jobs. For example:

```
> qstat
Job id   Name     User      Time       Use S Queue
4807     scatter   user01   12:56:34   R batch
...
```

Related Topics

Submitting and Managing Jobs on page 55

**Canceling Jobs**

TORQUE allows users and administrators to cancel submitted jobs with the `qdel` command. The job will be sent TERM and KILL signals killing the running processes. When the top-level job script exits, the job will exit. The only parameter is the ID of the job to be canceled.

If a job is canceled by an operator or manager, an email notification will be sent to the user. Operators and managers may add a comment to this email with the `-m` option.

```
$ qstat
Job id   Name     User      Time       Use S Queue
4807     scatter   user01   12:56:34   R batch
...
$ qdel -m "hey! Stop abusing the NFS servers" 4807
```

Related Topics

Submitting and Managing Jobs on page 55
Job Preemption

TORQUE supports job preemption by allowing authorized users to suspend and resume jobs. This is supported using one of two methods. If the node supports OS-level preemption, TORQUE will recognize that during the configure process and enable it. Otherwise, the MOM may be configured to launch a custom checkpoint script in order to support preempting a job. Using a custom checkpoint script requires that the job understand how to resume itself from a checkpoint after the preemption occurs.

Configuring a Checkpoint Script on a MOM

To configure the MOM to support a checkpoint script, the $checkpoint_script parameter must be set in the MOM’s configuration file found in TORQUE_HOME/mom_priv/config. The checkpoint script should have execute permissions set. A typical configuration file might look as follows:

```
mom_priv/config:

$pbsserver      node06
$logevent       255
$restricted     *.mycluster.org
$checkpoint_script /opt/moab/tools/mom-checkpoint.sh
```

The second thing that must be done to enable the checkpoint script is to change the value of MOM_CHECKPOINT to 1 in /src/include/pbs_config.h. (In some instances, MOM_CHECKPOINT may already be defined as 1.) The new line should be as follows:

```
/src/include/pbs_config.h:

#define MOM_CHECKPOINT 1
```

Related Topics

[Submitting and Managing Jobs on page 55](#)

Keeping Completed Jobs

TORQUE provides the ability to report on the status of completed jobs for a configurable duration after the job has completed. This can be enabled by setting the keep_completed on page 108 attribute on the job execution queue or the keep_completed on page 269 parameter on the server. This should be set to the number of seconds that jobs should be held in the queue. If you set keep_completed on the job execution queue, completed jobs will be reported in the C state and the exit status is seen in the exit_status job attribute.
If the Mother Superior and TORQUE server are on the same server, expect the following behavior:

- When keep_completed is set, the job spool files will be deleted when the specified time arrives and TORQUE purges the job from memory.
- When keep_completed is not set, TORQUE deletes the job spool files upon job completion.
- If you manually purge a job (qdel -p) before the job completes or time runs out, TORQUE will never delete the spool files.

By maintaining status information about completed (or canceled, failed, etc.) jobs, administrators can better track failures and improve system performance. This allows TORQUE to better communicate with Moab Workload Manager and track the status of jobs. This gives Moab the ability to track specific failures and to schedule the workload around possible hazards. See NODEFAILURERESERVETIME in the Moab Workload Manager Administrator Guide for more information.

Related Topics

Submitting and Managing Jobs on page 55

Job Checkpoint and Restart

While TORQUE has had a job checkpoint and restart capability for many years, this was tied to machine specific features. Now TORQUE supports BLCR—an architecture independent package that provides for process checkpoint and restart.

The support for BLCR is only for serial jobs, not for any MPI type jobs.

This section contains these topics:

- Introduction to BLCR on page 75
- Configuration Files and Scripts on page 75
- Starting a Checkpointable Job on page 82
- Checkpointing a Job on page 83
- Restarting a Job on page 84
- Acceptance Tests on page 84

Related Topics

Submitting and Managing Jobs on page 55
Introduction to BLCR

BLCR is a kernel level package. It must be downloaded and installed from BLCR.

After building and making the package, it must be installed into the kernel with commands as follows. These can be installed into the file /etc/modules but all of the testing was done with explicit invocations of modprobe.

Installing BLCR into the kernel:

```
# /sbin/insmod /usr/local/lib/blcr/2.6.12-1.234/blcr_imports.ko
# /sbin/insmod /usr/local/lib/blcr/2.6.12-1.234/blcr_vmadump.ko
# /sbin/insmod /usr/local/lib/blcr/2.6.12-1.234/blcr.ko
```

The BLCR system provides four command line utilities:

- `cr_checkpoint`
- `cr_info`
- `cr_restart`
- `cr_run`

For more information about BLCR, see the BLCR Administrator's Guide.

Related Topics

Job Checkpoint and Restart on page 74

Configuration Files and Scripts

Configuring and Building TORQUE for BLCR:

```
> ./configure --enable-unixsockets=no --enable-blcr
> make
> sudo make install
```

Depending on where BLCR is installed you may also need to use the following configure options to specify BLCR paths:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>--with-blcr-include=DIR</td>
<td>include path for libcr.h</td>
</tr>
<tr>
<td>--with-blcr-lib=DIR</td>
<td>lib path for libcr</td>
</tr>
<tr>
<td>--with-blcr-bin=DIR</td>
<td>bin path for BLCR utilities</td>
</tr>
</tbody>
</table>

The pbs_mom configuration file located in /var/spool/torque/mom_priv must be modified to identify the script names associated with invoking the
BLCR commands. The following variables should be used in the configuration file when using BLCR checkpointing.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$checkpoint_interval</td>
<td>How often periodic job checkpoints will be taken (minutes)</td>
</tr>
<tr>
<td>$checkpoint_script</td>
<td>The name of the script file to execute to perform a job checkpoint</td>
</tr>
<tr>
<td>$restart_script</td>
<td>The name of the script file to execute to perform a job restart</td>
</tr>
<tr>
<td>$checkpoint_run_exe</td>
<td>The name of an executable program to be run when starting a checkpointable job (for BLCR, cr_run)</td>
</tr>
</tbody>
</table>

The following example shows the contents of the configuration file used for testing the BLCR feature in TORQUE.

The script files below must be executable by the user. Be sure to use `chmod` to set the permissions to 754.

**Example 3-6: Script file permissions**

```bash
# chmod 754 blcr*
# ls -l
total 20
-rwxr-xr-- 1 root root 2112 2008-03-11 13:14 blcr_checkpoint_script
-rw-r-r-- 1 root root 215 2008-03-11 13:13 config
drwxr-x-x 2 root root 4096 2008-03-11 13:21 jobs
-rw-r-r-- 1 root root 7 2008-03-11 13:15 mom.lock
```

**Example 3-7: mom_priv/config**

```bash
$checkpoint_script /var/spool/torque/mom_priv/blcr_checkpoint_script
$restart_script /var/spool/torque/mom_priv/blcr_restart_script
$checkpoint_run_exe /usr/local/bin/cr_run
$pbsserver makua.cridomain
$loglevel 7
```
Example 3-8: mom_priv/blcr_checkpoint_script
#!/usr/bin/perl
# Usage: checkpoint_script
# This script is invoked by pbs_mom to checkpoint a job.
use strict;
use Sys::Syslog;

# Log levels:
# 0 = none -- no logging
# 1 = fail -- log only failures
# 2 = info -- log invocations
# 3 = debug -- log all subcommands
my $logLevel = 3;

my ($sessionId, $jobId, $userId, $signalNum, $checkpointDir, $checkpointName);

logPrint(2, "Invoked: $0 " . join(' ', @ARGV) . "\n");

my ($usage = "Usage: $0 \
");

# Note that depth is not used in this script but could control a limit to the number
# image files that are preserved on the disk.
# Note also that a request was made to identify whether this script was invoked by the
# owner or by a system administrator. While this information is known to pbs_server,
it # is not propagated to pbs_mom and thus it is not possible to pass this to the script.
# Therefore, a workaround is to invoke qmgr and attempt to set a trivial variable.
# This will fail if the invoker is not a manager.
if (@ARGV == 7)
{
  ($sessionId, $jobId, $userId, $checkpointDir, $checkpointName, $signalNum, $depth) = @ARGV;
}
else { logDie(1, $usage); }

# Change to the checkpoint directory where we want the checkpoint to be created
chdir $checkpointDir
  or logDie(1, "Unable to cd to checkpoint dir ($checkpointDir): $!");
if $logLevel;

my $cmd = "cr_checkpoint";
$cmd .= " --signal $signalNum" if $signalNum;
$cmd .= " --tree $sessionId";
$cmd .= " --file $checkpointName";
my $output = `"$cmd 2>&1"';
my $rc = $? >> 8;
logDie(1, "Subcommand ($cmd) failed with rc=$rc: $\n$output")
  if $rc && $logLevel >= 1;
logPrint(3, "Subcommand ($cmd) yielded rc=$rc: $\n$output")
  if $logLevel >= 3;
exit 0;

# Write a message (to syslog) and die
sub logPrint
{
  ...
my ($level, $message) = @_;  
my @severity = ('none', 'warning', 'info', 'debug');  
    return if $level > $logLevel;  
        openlog('checkpoint_script', '', 'user');  
        syslog($severity[$level], $message);  
        closelog();  
    }

###############################################################################
# logDie($message)  
# Write a message (to syslog) and die  
###############################################################################
sub logDie  
{
    my ($level, $message) = @_;  
    logPrint($level, $message);  
    die($message);  
}
Chapter 3 Submitting and Managing Jobs

Example 3-9: mom_priv/blcr_restart_script
# /usr/bin/perl

Usage: restart_script

This script is invoked by pbs_mom to restart a job.

```
use strict;
use Sys::Syslog;

# Log levels:
# 0 = none -- no logging
# 1 = fail -- log only failures
# 2 = info -- log invocations
# 3 = debug -- log all subcommands
my $logLevel = 3;
```

my ($sessionId, $jobId, $userId, $checkpointDir, $restartName);

```
my ($usage) = "Usage: $0 
"
```

```
if (@ARGV == 5)
{
    ($sessionId, $jobId, $userId, $checkpointDir, $restartName) = @ARGV;
}
```

```
else { logDie(1, $usage); }
```

```
# Change to the checkpoint directory where we want the checkpoint to be created
```

```
chdir $checkpointDir
```

```
or logDie(1, "Unable to cd to checkpoint dir ($checkpointDir): $!
")
```

```
if $logLevel;
```

```
my $cmd = "cr_restart";
```

```
$cmd .= "$restartName"
```

```
my $output = `$cmd 2>&1`
```

```
my $rc = $? >> 8;
```

```
logDie(1, "Subcommand ($cmd) failed with rc=$rc:
output")
```

```
if $rc && $logLevel >= 1;
```

```
logPrint(3, "Subcommand ($cmd) yielded rc=$rc:
output")
```

```
if $logLevel >= 3;
```

```
exit 0;
```

```
logPrint($message)
```

```
# logPrint($message)
```

```
# logDie($message)
```

```
``
Starting a Checkpointable Job

Not every job is checkpointable. A job for which checkpointing is desirable must be started with the `-c` command line option. This option takes a comma-separated list of arguments that are used to control checkpointing behavior. The list of valid options available in the 2.4 version of TORQUE is show below.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>No checkpointing (not highly useful, but included for completeness).</td>
</tr>
<tr>
<td>enabled</td>
<td>Specify that checkpointing is allowed, but must be explicitly invoked by either the <code>qhold</code> or <code>qchkpt</code> commands.</td>
</tr>
<tr>
<td>shutdown</td>
<td>Specify that checkpointing is to be done on a job at pbs_mom shutdown.</td>
</tr>
<tr>
<td>periodic</td>
<td>Specify that periodic checkpointing is enabled. The default interval is 10 minutes and can be changed by the <code>checkpoint_interval</code> option in the MOM configuration file, or by specifying an interval when the job is submitted.</td>
</tr>
<tr>
<td>interval=minutes</td>
<td>Specify the checkpoint interval in minutes.</td>
</tr>
<tr>
<td>depth=number</td>
<td>Specify a number (depth) of checkpoint images to be kept in the checkpoint directory.</td>
</tr>
<tr>
<td>dir=path</td>
<td>Specify a checkpoint directory (default is <code>/var/spool/torque/checkpoint</code>).</td>
</tr>
</tbody>
</table>

Example 3-10: Sample test program

```c
#include "stdio.h"
int main( int argc, char *argv[] )
{
    int i;
    for (i=0; i<100; i++)
    {
        printf("i = %d\n", i);
        fflush(stdout);
        sleep(1);
    }
}
```

Example 3-11: Instructions for building test program

```
> gcc -o test test.c
```
Example 3-12: Sample test script

```bash
#!/bin/bash
./test
```

Example 3-13: Starting the test job

```
> qstat
> qsub -c enabled,periodic,shutdown,interval=1 test.sh
77.jakaa.cridomain
> qstat
Job id            Name            User        Time Use S Queue
```

If you have no scheduler running, you might need to start the job with qrun.

As this program runs, it writes its output to a file in `/var/spool/torque/spool. This file can be observed with the command `tail -f`.

Related Topics

[Job Checkpoint and Restart on page 74](#)

---

### Checkpointing a Job

Jobs are checkpointed by issuing a `qhold` command. This causes an image file representing the state of the process to be written to disk. The directory by default is `/var/spool/torque/checkpoint`.

This default can be altered at the queue level with the `qmgr` command. For example, the command `qmgr -c set queue batch checkpoint_dir=/tmp` would change the checkpoint directory to `/tmp` for the queue 'batch'.

The default directory can also be altered at job submission time with the `-c dir=/tmp` command line option.

The name of the checkpoint directory and the name of the checkpoint image file become attributes of the job and can be observed with the command `qstat -f`. Notice in the output the names `checkpoint_dir` and `checkpoint_name`. The variable `checkpoint_name` is set when the image file is created and will not exist if no checkpoint has been taken.

A job can also be checkpointed without stopping or holding the job with the command `qchkpt`.

Related Topics

[Job Checkpoint and Restart on page 74](#)
Restarting a Job

Restarting a Job in the Held State

The `qrls` command is used to restart the hibernated job. If you were using the `tail -f` command to watch the output file, you will see the test program start counting again.

It is possible to use the `qalter` command to change the name of the checkpoint file associated with a job. This could be useful if there were several job checkpoints and it restarting the job from an older image was specified.

Restarting a Job in the Completed State

In this case, the job must be moved to the Queued state with the `qrerun` command. Then the job must go to the Run state either by action of the scheduler or if there is no scheduler, through using the `qrun` command.

**Related Topics**
- Job Checkpoint and Restart on page 74

Acceptance Tests

A number of tests were made to verify the functioning of the BLCR implementation. See BLCR Acceptance Tests on page 347 for a description of the testing.

**Related Topics**
- Job Checkpoint and Restart on page 74

Job Exit Status

Once a job under TORQUE has completed, the `exit_status` attribute will contain the result code returned by the job script. This attribute can be seen by submitting a `qstat -f` command to show the entire set of information associated with a job. The `exit_status` field is found near the bottom of the set of output lines.
Example 3-14: qstat -f (job failure)

```
Job Id: 179.host
Job_Name  = STDIN
Job_Owner = user@host
job_state = C
Error_Path = host:/opt/moab/STDIN.e179
exec_host = node1/0
Hold_Types = n
Join_Path = n
Keep_Files = n
Mail_Points = a
Output_Path = host:/opt/moab/STDIN.o179
Priority = 0
time = Fri Aug 29 14:55:55 2008
Rerunnable = True
Resource_List.nodect = 1
Resource_List.nodes = node1
Resource_List.ncpus = 2
Variable_List = PBS_O_HOME=/home/user,PBS_O_LOGNAME=user,
PBS_O_PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:,PBS_O_SHELL=/bin/bash,PBS_O_HOST=host,
PBS_O_WORKDIR=/opt/moab,PBS_O_QUEUE=batchq
sched_hint = Post job file processing error; job 179.host on host node1/0

```

The value of Resource_List.* is the amount of resources requested.

This code can be useful in diagnosing problems with jobs that may have unexpectedly terminated.

If TORQUE was unable to start the job, this field will contain a negative number produced by the pbs_mom. Otherwise, if the job script was successfully started, the value in this field will be the return value of the script.

Example 3-15: TORQUE supplied exit codes

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB_EXEC_OK</td>
<td>0</td>
<td>Job execution successful</td>
</tr>
<tr>
<td>JOB_EXEC_FAIL1</td>
<td>-1</td>
<td>Job execution failed, before files, no retry</td>
</tr>
<tr>
<td>JOB_EXEC_FAIL2</td>
<td>-2</td>
<td>Job execution failed, after files, no retry</td>
</tr>
<tr>
<td>JOB_EXEC_RETRY</td>
<td>-3</td>
<td>Job execution failed, do retry</td>
</tr>
<tr>
<td>JOB_EXEC_INITABT</td>
<td>-4</td>
<td>Job aborted on MOM initialization</td>
</tr>
</tbody>
</table>
### Chapter 3 Submitting and Managing Jobs

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB_EXEC_INITRST</td>
<td>-5</td>
<td>Job aborted on MOM init, chkpt, no migrate</td>
</tr>
<tr>
<td>JOB_EXEC_INITRMG</td>
<td>-6</td>
<td>Job aborted on MOM init, chkpt, ok migrate</td>
</tr>
<tr>
<td>JOB_EXEC_BADRESRT</td>
<td>-7</td>
<td>Job restart failed</td>
</tr>
<tr>
<td>JOB_EXEC_CMDFAIL</td>
<td>-8</td>
<td>Exec() of user command failed</td>
</tr>
<tr>
<td>JOB_EXECSTDOUTFAIL</td>
<td>-9</td>
<td>Could not create/open stdout stderr files</td>
</tr>
<tr>
<td>JOB_EXECOVERLIMIT_MEM</td>
<td>-10</td>
<td>Job exceeded a memory limit</td>
</tr>
<tr>
<td>JOB_EXECOVERLIMIT_WT</td>
<td>-11</td>
<td>Job exceeded a walltime limit</td>
</tr>
<tr>
<td>JOB_EXECOVERLIMIT_CPUT</td>
<td>-12</td>
<td>Job exceeded a CPU time limit</td>
</tr>
</tbody>
</table>
Example 3.16: Exit code from C program

```c
#include

int main(int argc, char *argv)
{
    exit(256+11);
}

$ gcc -o error error.c

$ echo ./error | qsub 180.xxx.yyy

$ qstat -f
Job Id: 180.xxx.yyy
Job_Name = STDIN
Job_Owner = test.xxx.yyy
resources_used.cput = 00:00:00
resources_used.mem = 0kb
resources_used.vmem = 0kb
resources_used.walltime = 00:00:00
job_state = C
queue = batch
server = xxx.yyy
Checkpoint = u
ctime = Wed Apr 30 11:29:37 2008
Error_Path = xxx.yyy:/home/test/STDIN.e180
exec_host = node01/0
Hold_Types = n
Join_Path = n
Keep_Files = n
Mail_Points = a
mtime = Wed Apr 30 11:29:37 2008
Output_Path = xxx.yyy:/home/test/STDIN.o180
Priority = 0
qtime = Wed Apr 30 11:29:37 2008
Rerunable = True
Resource_List.neednodes = 1
Resource_List.nodect = 1
Resource_List.nodes = 1
Resource_List.walltime = 01:00:00
session_Id = 14107
substate = 59
Variable_List = PBS_O_HOME=/home/test, PBS_O_LANG=en_US.UTF-8,
                 PBS_O_LOGNAME=test,
                 PBS_O_PATH=/usr/local/perltests/bin:/home/test/bin:/usr/local/s
                 bin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games,
                 PBS_O_SHELL=/bin/bash, PBS_SERVER=xxx.yyy,
                 PBS_O_HOST=xxx.yyy, PBS_O_WORKDIR=/home/test,
                 PBS_O_QUEUE=batch
euser = test
egroup = test
hashname = 180.xxx.yyy
queue_rank = 8
queue_type = E
comment = Job started on Wed Apr 30 at 11:29
etime = Wed Apr 30 11:29:37 2008
exit_status = 11
start_time = Wed Apr 30 11:29:37 2008
start_count = 1
```
Notice that the C routine `exit` passes only the low order byte of its argument. In this case, 256+11 is really 267 but the resulting exit code is only 11 as seen in the output.

Related Topics

- Job Checkpoint and Restart on page 74
- Submitting and Managing Jobs on page 55

Service Jobs

TORQUE service jobs are a special kind of job that is treated differently by TORQUE than normal batch jobs. TORQUE service jobs are not related to Moab’s dynamic service jobs. A TORQUE service job cannot dynamically grow and shrink in size over time.

Jobs are marked as service jobs at the time they are submitted to Moab or TORQUE. Just like a normal job, a script file is specified with the job. In a batch job, the contents of the script file are taken by TORQUE and executed on the compute nodes. For a service job, however, the script file is assumed to respond to certain command-line arguments. Instead of just executing the script, TORQUE will use these command-line arguments to start, stop, and check on the status of the job. Listed below are the three command-line arguments that must be supported by any script submitted as part of a TORQUE service job:

- `start`: The script should take this argument and launch its service/workload. The script should remain executing/running until the service stops.
- `stop`: The script should take this argument and stop the service/workload that was earlier started.
- `status`: The script should take this argument and return, via standard out, either "running" if the service/workload is running as expected or "stopped" if the service is not running.

This feature was created with long-running services in mind. The command-line arguments should be familiar to users who interact with Unix services, as each of the service scripts found in `/etc/init.d/` also accept and respond to the arguments as explained above.

For example, if a user wants to start the Apache 2 server on a compute node, they can use a TORQUE service job and specify a script which will start, stop, and check on the status of the "httpd" daemon--possibly by using the already present `/etc/init.d/httpd` script.
If you wish to submit service jobs only through TORQUE, no special version of Moab is required. If you wish to submit service jobs using Moab's msub, then Moab 5.4 is required.

For details, see these topics:
- Submitting Service Jobs on page 89
- Submitting Service Jobs in MCM on page 89
- Managing Service Jobs on page 90

### Submitting Service Jobs

There is a new option to qsub, "-s" which can take either a 'y' or 'n' (yes or no, respectively). When "-s y" is present, then the job is marked as a service job.

```bash
qsub -l walltime=100:00:00, nodes=1 -s y service_job.py
```

The example above submits a job to TORQUE with a walltime of 100 hours, one node, and it is marked as a service job. The script "service_job.py" will be used to start, stop, and check the status of the service/workload started on the compute nodes.

Moab, as of version 5.4, is able to accept the "-s y" option when msub is used for submission. Moab will then pass this information to TORQUE when the job is migrated.

Related Topics
- Service Jobs on page 88

### Submitting Service Jobs in MCM

Submitting a service job in MCM requires the latest Adaptive Computing Suite snapshot of MCM. It also requires MCM to be started with the "--future=2" option.

Once MCM is started, open the **Create Workload** window and verify **Show Advanced Options** is checked. Notice that there is a **Service** checkbox that can be selected in the **Flags/Options** area. Use this to specify the job is a service job.

Related Topics
- Service Jobs on page 88
Managing Service Jobs

Managing a service job is done much like any other job; only a few differences exist.

Examining the job with qstat -f will reveal that the job has the service = True attribute. Non-service jobs will not make any mention of the "service" attribute.

Canceling a service job is done with qdel, mjobctl -c, or through any of the GUI's as with any other job. TORQUE, however, cancels the job by calling the service script with the "stop" argument instead of killing it directly. This behavior also occurs if the job runs over its wallclock and TORQUE/Moab is configured to cancel the job.

If a service job completes when the script exits after calling it with "start," or if TORQUE invokes the script with "status" and does not get back "running," it will not be terminated by using the "stop" argument.

Related Topics

Service Jobs on page 88
Chapter 4 Managing Nodes

This section contains information about adding and configuring compute nodes. It explains how to work with host security for systems that require dedicated access to compute nodes. It also contains information about scheduling specific cores on a node at job submission.

For details, see these topics:

- Adding Nodes on page 91
- Node Properties on page 92
- Changing Node State on page 93
- Host Security on page 96
- Linux Cpuset Support on page 98
- Scheduling Cores on page 100

Adding Nodes

TORQUE can add and remove nodes either dynamically with qmgr or by manually editing the TORQUE_HOME/server_priv/nodes file. See Initializing/Configuring TORQUE on the Server (pbs_server) on page 19.

Be aware of the following:

- Nodes cannot be added or deleted dynamically if there is a mom_hierarchy file in the server_priv directory.
- When you make changes to nodes by directly editing the nodes file, you must restart pbs_server for those changes to take effect. Changes made using qmgr do not require a restart.
- When you make changes to a node's ip address, you must clear the pbs_server cache. Either restart pbs_server or delete the changed node and then re-add it.
- Before a newly added node is set to a free state, the cluster must be informed that the new node is valid and they can trust it for running jobs. Once this is done, the node will automatically transition to free.

Run-time Node Changes

TORQUE can dynamically add nodes with the qmgr command. For example, the following command will add node node003:
The optional parameters are used as follows:

- **np** – Number of virtual processors.
- **TTL** – (Time to Live) Specifies the time in UTC format that the node is supposed to be retired by Moab. Moab will not schedule any jobs on a node after its time to live has passed.
- **acl** – (Access control list) Can be used to control which users have access to the node in Moab.
- **requestid** – An ID that can be used to track the request that created the node.

You can alter the parameters of a node using a set command as follows:

```bash
> qmgr -c 'create node node003[,node004,node005...] [np=n,[TTL=yyyy-mm-ddThh:mm:ssZ,] [acl="user==user1:user2:user3",][requestid=n]'
```

TORQUE does not use the TTL, acl, and requestid parameters. Information for those parameters are simply passed to Moab.

The above command appends the `$TORQUE_HOME/server_priv/nodes` file with:

```bash
node003 np=3 TTL=2014-08-06T14:30:00Z acl=user1,user2,user3 requestid=3210
```

Nodes can also be removed with a similar command:

```bash
> qmgr -c 'delete node node003[,node004,node005...]'`
```

Related Topics

- [Changing Node State on page 93](#)
- [Managing Nodes on page 91](#)

---

**Node Properties**

TORQUE can associate properties with nodes to aid in identifying groups of nodes. It's typical for a site to conglomerate a heterogeneous set of resources. To identify the different sets, properties can be given to each node in a set. For example, a group of nodes that has a higher speed network connection could have the property "ib". TORQUE can set, update, or remove properties either dynamically with `qmgr` or by manually editing the `nodes` file.
Run-time Node Changes

TORQUE can dynamically change the properties of a node with the `qmgr` command. For example, note the following to give `node001` the properties of "bigmem" and "dualcore":

```
> qmgr -c "set node node001 properties = bigmem"
> qmgr -c "set node node001 properties += dualcore"
```

To relinquish a stated property, use the "-=" operator.

Manual Node Changes

The properties of each node are enumerated in `TORQUE_HOME/server_priv/nodes`. The feature(s) must be in a space delimited list after the node name. For example, to give `node001` the properties of "bigmem" and "dualcore" and `node002` the properties of "bigmem" and "matlab," edit the nodes file to contain the following:

```
server_priv/nodes:
```

```
node001 bigmem dualcore
node002 np=4 bigmem matlab
```

For changes to the nodes file to be activated, `pbs_server` must be restarted.

For a full description of this file, please see the PBS Administrator Guide.

Related Topics
- Job Submission on page 55
- Managing Nodes on page 91

Changing Node State

A common task is to prevent jobs from running on a particular node by marking it `offline` with `pbsnodes -o nodename`. Once a node has been marked offline, the scheduler will no longer consider it available for new jobs. Simply use `pbsnodes -c nodename` when the node is returned to service.

Also useful is `pbsnodes -l`, which lists all nodes with an interesting state, such as down, unknown, or offline. This provides a quick glance at nodes that might be having a problem. (See `pbsnodes` for details.)

Related Topics
- Managing Nodes on page 91
## Changing Node Power States

In TORQUE 5.0 and later, the `pbsnodes -m` command can modify the power state of nodes. Node cannot go from one low-power state to another low-power state. They must be brought up to the Running state and then moved to the new low-power state. The supported power states are:

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Running** | *Physical machine is actively working*  
            *Power conservation is on a per-device basis*  
            *Processor power consumption controlled by P-states* |
| **Standby** | *System appears off*  
            *Processor halted (OS executes a "halt" instruction)*  
            *Processor maintains CPU and system cache state*  
            *RAM refreshed to maintain memory state*  
            *Machine in low-power mode*  
            *Requires interrupt to exit state*  
            *Lowest-latency sleep state - has no effect on software* |
| **Suspend** | *System appears off*  
             *Processor and support chipset have no power*  
             *OS maintains CPU, system cache, and support chipset state in memory*  
             *RAM in slow refresh*  
             *Machine in lowest-power state*  
             *Usually requires specific interrupt (keyboard, mouse) to exit state*  
             *Third lowest-latency sleep state - system must restore power to processor and support chipset* |
| **Hibernate** | *System is off*  
               *Physical machine state and memory saved to disk*  
               *Requires restoration of power and machine state to exit state*  
               *Second highest-latency sleep state - system performs faster boot using saved machine state and copy of memory* |
| **Shutdown** | *Equivalent to `shutdown now` command as root* |

In order to wake nodes and bring them up to a running state:

- the nodes must support, and be configured to use, Wake-on-LAN (WOL).
- the `pbsnodes` command must report the node's MAC address correctly.
To configure nodes to use Wake-on-LAN

1. Enable WOL in the BIOS for each node. If needed, contact your hardware manufacturer for details.

2. Use the `ethtool` command to determine what types of WOL packets your hardware supports. TORQUE uses the g packet. If the g packet is not listed, you cannot use WOL with TORQUE.

```
[root]# ethtool eth0
Settings for eth0:
 Supported ports: [ TP ]
 Supported link modes: 10baseT/Half 10baseT/Full
                        100baseT/Half 100baseT/Full
                        1000baseT/Full
 Supported pause frame use: No
 Supports auto-negotiation: Yes
 Advertised link modes: 10baseT/Half 10baseT/Full
                        100baseT/Half 100baseT/Full
                        1000baseT/Full
 Advertised pause frame use: No
 Advertised auto-negotiation: Yes
 Speed: 100Mb/s
 Duplex: Full
 Port: Twisted Pair
 PHYAD: 2
 Transceiver: internal
 Auto-negotiation: on
 MDI-X: off
 Supports Wake-on: pumbg
 Wake-on: p
 Current message level: 0x00000007 (7)
                        drv probe link
 Link detected: yes
```

This Ethernet interface supports the g WOL packet, but is currently set to use the p packet.

3. If your Ethernet interface supports the g packet, but is configured for a different packet, use `ethtool -s <interface> wol g` to configure it to use g.
Now the power state of your nodes can be modified and they can be woken up from power-saving states.

Related Topics

pbsnodes on page 196

Host Security

Enabling PAM with TORQUE

TORQUE is able to take advantage of the authentication services provided through Pluggable Authentication Modules (PAM) to help administrators manage access to compute nodes by users. The PAM module available in TORQUE is located in the PAM security directory. This module, when used in conjunction with other PAM modules, restricts access to the compute node unless the user has a job currently running on the node. The following configurations are examples only. For more information about PAM, see the PAM (Pluggable Authentication Modules) documentation from LinuxDocs.

To enable TORQUE PAM configure TORQUE using the --with-pam option. Using --with-pam is sufficient but if your PAM security modules are not in the default /lib/security or /lib64/security directory, you can specify the location using --with-pam=<DIR> where <DIR> is the directory where you want the modules to be installed. When TORQUE is installed the files
pbssimpleauth.la and pam_pbssimpleauth.so appear in /lib/security, /lib64/security, or the directory designated on the configuration line.

PAM is very flexible and policies vary greatly from one site to another. The following example restricts users trying to access a node using SSH. Administrators need to assess their own installations and decide how to apply the TORQUE PAM restrictions.

In this example, after installing TORQUE with PAM enabled, you would add the following two lines to /etc/pam.d/sshd:

```
account required pam_pbssimpleauth.so
account required pam_access.so
```

In /etc/security/access.conf make sure all users who access the compute node are added to the configuration. This is an example which allows the users root, george, allen, and michael access.

```
-:ALL EXCEPT root george allen michael torque:ALL
```

With this configuration, if user george has a job currently running on the compute node, george can use ssh to login to the node. If there are currently no jobs running, george is disconnected when attempting to login.

TORQUE PAM is good at keeping users out who do not have jobs running on a compute node. However, it does not have the ability to force a user to log out once they are in. To accomplish this use epilogue or prologue scripts to force users off the system.

### Legacy TORQUE PAM Configuration

There is an alternative PAM configuration for TORQUE that has been available since 2006. It can be found in the contrib/pam_authuser directory of the source tree. Adaptive Computing does not currently support this method but the instructions are given here for those who are currently using it and for those who wish to use it.

For systems requiring dedicated access to compute nodes (for example, users with sensitive data), TORQUE prologue and epilogue scripts provide a vehicle to leverage the authentication provided by linux-PAM modules. (See [Prologue and Epilogue Scripts on page 323](#) for more information.)

To allow only users with running jobs (and root) to access compute nodes

1. Untar contrib/pam_authuser.tar.gz (found in the src tar ball).
2. Compile pam_authuser.c with make and make install on every compute node.
3. Edit /etc/system-auth as described in README.pam_authuser, again on every compute node.
4. Either make a tarball of the epilogue* and prologue* scripts (to preserve the symbolic link) and untar it in the mom_priv directory, or just copy epilogue* and prologue* to mom_priv/.

The prologue* scripts are Perl scripts that add the user of the job to /etc/authuser. The epilogue* scripts then remove the first occurrence of the user from /etc/authuser. File locking is employed in all scripts to eliminate the chance of race conditions. There is also some commented code in the epilogue* scripts, which, if uncommented, kills all processes owned by the user (using pkill), provided that the user doesn't have another valid job on the same node.

prologue and epilogue scripts were added to the pam_authuser tarball in version 2.1 of TORQUE.

Related Topics

Managing Nodes on page 91

---

**Linux Cpuset Support**

- **Cpuset Overview on page 98**
- **Cpuset Support on page 98**
- **Configuring Cpuset on page 99**
- **Cpuset Advantages/Disadvantages on page 99**

**Cpuset Overview**

Linux kernel 2.6 Cpusets are logical, hierarchical groupings of CPUs and units of memory. Once created, individual processes can be placed within a cpuset. The processes will only be allowed to run/access the specified CPUs and memory. Cpusets are managed in a virtual file system mounted at /dev/cpuset. New cpusets are created by simply making new directories. Cpusets gain CPUs and memory units by simply writing the unit number to files within the cpuset.

**Cpuset Support**

> All nodes using cpusets must have the hwloc library and corresponding hwloc-devel package installed. See Installing TORQUE on page 10 for more information.

When started, pbs_mom will create an initial top-level cpuset at /dev/cpuset/torque. This cpuset contains all CPUs and memory of the host machine. If this "torqueset" already exists, it will be left unchanged to allow the
administrator to override the default behavior. All subsequent cpusets are created within the torque set.

When a job is started, the jobset is created at /dev/cpuset/torque/$jobid and populated with the CPUs listed in the `exec_host` job attribute. Also created are individual tasksets for each CPU within the jobset. This happens before prologue, which allows it to be easily modified, and it happens on all nodes.

The top-level batch script process is executed in the jobset. Tasks launched through the TM interface (pbsdsh and PW’s mpiexec) will be executed within the appropriate taskset.

On job exit, all tasksets and the jobset are deleted.

## Configuring Cpuset

### To configure cpuset

1. As root, mount the virtual filesystem for cpusets:

   ```
   mkdir /dev/cpuset
   mount -t cpuset none /dev/cpuset
   ```

   *Do this for each MOM that is to use cpusets.*

2. Because cpuset usage is a build-time option in TORQUE, you must add `--enable-cpuset` to your configure options:

   ```
   ./configure --enable-cpuset
   ```

3. Use this configuration for the MOMs across your system.

## Cpuset Advantages/Disadvantages

Presently, any job can request a single CPU and proceed to use everything available in the machine. This is occasionally done to circumvent policy, but most often is simply an error on the part of the user. Cpuset support will easily constrain the processes to not interfere with other jobs.

Jobs on larger NUMA systems may see a performance boost if jobs can be intelligently assigned to specific CPUs. Jobs may perform better if striped across physical processors, or contained within the fewest number of memory controllers.

TM tasks are constrained to a single core, thus a multi-threaded process could seriously suffer.

Related Topics

- [Managing Nodes on page 91](#)
- [Geometry Request Configuration on page 100](#)
Scheduling Cores

In TORQUE 2.4 and later, you can request specific cores on a node at job submission by using geometry requests. To use this feature, specify the procs_bitmap resource request of qsub-1 (see qsub) at job submission.

See these topics for details:

- Geometry Request Configuration on page 100
- Geometry Request Usage on page 100
- Geometry Request Considerations on page 101

Geometry Request Configuration

A Linux kernel of 2.6 or later is required to use geometry requests, because this feature uses Linux cpuset in its implementation. In order to use this feature, the cpuset directory has to be mounted. For more information on how to mount the cpuset directory, see Linux Cpuset Support on page 98. If the operating environment is suitable for geometry requests, configure TORQUE with the --enable-geometry-requests option.

```
> ./configure --prefix=/home/john/torque --enable-geometry-requests
```

TORQUE is configured to install to /home/john/torque and to enable the geometry requests feature.

The geometry request feature uses a subset of the cpuset feature. When you configure TORQUE using --enable-cpuset and --enable-geometry-requests at the same time, and use -I procs_bitmap=X, the job will get the requested cpuset. Otherwise, the job is treated as if only --enable-cpuset was configured.

Related Topics

- Scheduling Cores on page 100

Geometry Request Usage

Once enabled, users can submit jobs with a geometry request by using the procs_bitmap=<string> resource request. procs_bitmap requires a numerical string made up of 1's and 0's. A 0 in the bitmap means the job cannot run on the core that matches the 0's index in the bitmap. The index is in reverse order of the number of cores available. If a job is submitted with procs_bitmap=1011, then the job requests a node with four free cores, and uses only cores one, two, and four.
The geometry request feature requires a node that has all cores free. A job with a geometry request cannot run on a node that has cores that are busy, even if the node has more than enough cores available to run the job.

The job `ossi.sh` is submitted with a geometry request of `0011`.

In the above example, the submitted job can run only on a node that has four cores. When a suitable node is found, the job runs exclusively on cores one and two.

Related Topics

Scheduling Cores on page 100

Geometry Request Considerations

As previously stated, jobs with geometry requests require a node with all of its cores available. After the job starts running on the requested cores, the node cannot run other jobs, even if the node has enough free cores to meet the requirements of the other jobs. Once the geometry requesting job is done, the node is available to other jobs again.

Related Topics

Scheduling Cores on page 100

Scheduling Accelerator Hardware

TORQUE works with accelerators (such as NVIDIA GPUs and Intel MICs) and can collect and report metrics from them or submit workload to them. This feature requires the use of the Moab scheduler. See Accelerators in the Moab Workload Manager Administrator Guide for information on configuring accelerators in TORQUE.
Chapter 5 Setting Server Policies

This section explains how to set up and configure your queue. It lists the queue attributes and describes how to set up a routing queue. This section also explains how to set up TORQUE to run in high availability mode. For details, see these topics:

- Queue Configuration on page 103
- Server High Availability on page 117

Queue Configuration

Under TORQUE, queue configuration is accomplished using the Server High Availability command. With this tool, the first step is to create the queue. This is accomplished using the create subcommand of qmgr as in the following example:

```
> qmgr -c "create queue batch queue_type=execution"
```

Once created, the queue must be configured to be operational. At a minimum, this includes setting the options started and enabled. Further configuration is possible using any combination of the attributes listed in what follows.

For Boolean attributes, T, t, I, Y, and y are all synonymous with "TRUE," and F, f, 0, N, and n all mean "FALSE."

For queue_type, E and R are synonymous with "Execution" and "Routing" (respectively).

See these topics for more details:

- Queue Attributes on page 103
- Example Queue Configuration on page 114
- Setting a Default Queue on page 115
- Mapping a Queue to Subset of Resources on page 115
- Creating a Routing Queue on page 116

Related Topics

- Server Parameters on page 261
- qalter on page 200 - command which can move jobs from one queue to another

Queue Attributes

This section lists the following queue attributes:
This section also lists some queue resource limits (see Assigning Queue Resource Limits on page 113).

For Boolean attributes, T, t, 1, Y, and y are all synonymous with "TRUE," and F, f, 0, N, and n all mean "FALSE."
### acl_groups

<table>
<thead>
<tr>
<th>Format</th>
<th><code>&lt;GROUP&gt;[@&lt;HOST&gt;]+&lt;USER&gt;[@&lt;HOST&gt;]</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the list of groups which may submit jobs to the queue. If acl_group_enable is set to true, only users with a primary group listed in acl_groups may utilize the queue.</td>
</tr>
</tbody>
</table>

- **Info:** If the PBSACLUSEGROUPLIST variable is set in the pbs_server environment, acl_groups checks against all groups of which the job user is a member.

- **Example:**
  ```
  qmgr -c "set queue batch acl_groups=staff"
  qmgr -c "set queue batch acl_groups+=ops@h1"
  qmgr -c "set queue batch acl_groups+=staff@h1"
  ```

  **Info:** Used in conjunction with acl_group_enable.

### acl_group_enable

<table>
<thead>
<tr>
<th>Format</th>
<th><code>&lt;BOOLEAN&gt;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>If TRUE, constrains TORQUE to only allow jobs submitted from groups specified by the acl_groups parameter.</td>
</tr>
</tbody>
</table>

- **Example:**
  ```
  qmgr -c "set queue batch acl_group_enable=true"
  ```

### acl_group_sloppy

<table>
<thead>
<tr>
<th>Format</th>
<th><code>&lt;BOOLEAN&gt;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>If TRUE, acl_groups will be checked against all groups of which the job users is a member.</td>
</tr>
</tbody>
</table>

- **Example:** ---
### acl_hosts

**Format**

```
<HOST>[+<HOST>]
```

**Default**

---

**Description**

Specifies the list of hosts that may submit jobs to the queue.

**Example**

```
$qmgr -c "set queue batch acl_hosts=h1+h1+h1"
```

*Used in conjunction with acl_host_enable.*

### acl_host_enable

**Format**

```
<BOOLEAN>
```

**Default**

FALSE

**Description**

If TRUE, constrains TORQUE to only allow jobs submitted from hosts specified by the acl_hosts parameter.

**Example**

```
$qmgr -c "set queue batch acl_host_enable=true"
```

### acl_logic_or

**Format**

```
<BOOLEAN>
```

**Default**

FALSE

**Description**

If TRUE, user and group acls are logically OR'd together, meaning that either acl may be met to allow access. If FALSE or unset, then both acls are AND'd, meaning that both acls must be satisfied.

**Example**

```
$qmgr -c "set queue batch acl_logic_or=true"
```

### acl_users

**Format**

```
<USER>[@<HOST>][+<USER>@<HOST>]
```

**Default**

---
### acl_users

**Description**
Specifies the list of users who may submit jobs to the queue. If acl_user_enable is set to **TRUE**, only users listed in acl_users may use the queue.

**Example**

```
> qmgr -c "set queue batch acl_users=john"
> qmgr -c "set queue batch acl_users+=steve@h1"
> qmgr -c "set queue batch acl_users+=stevek@h1"
```

*Used in conjunction with acl_user_enable.*

### acl_user_enable

**Format**

<BOOLEAN>

**Default**
FALSE

**Description**
If **TRUE**, constrains TORQUE to only allow jobs submitted from users specified by the acl_users parameter.

**Example**

```
> qmgr -c "set queue batch acl_user_enable=true"
```

### disallowed_types

**Format**

<type>[+<type>].

**Default**
---

**Description**
Specifies classes of jobs that are not allowed to be submitted to this queue. Valid types are interactive, batch, rerunnable, nonrerunnable, fault_tolerant (as of version 2.4.0 and later), fault_intolerant (as of version 2.4.0 and later), and job_array (as of version 2.4.1 and later).

**Example**

```
> qmgr -c "set queue batch disallowed_types = interactive"
> qmgr -c "set queue batch disallowed_types += job_array"
```

### enabled

**Format**

<BOOLEAN>

**Default**
FALSE
### enabled

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies whether the queue accepts new job submissions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td><code>qmgr -c &quot;set queue batch enabled=true&quot;</code></td>
</tr>
</tbody>
</table>

### features_required

<table>
<thead>
<tr>
<th>Format</th>
<th>feature1[feature2[feature3...]]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies that all jobs in this queue will require these features in addition to any they may have requested. A feature is a synonym for a property.</td>
</tr>
<tr>
<td>Example</td>
<td><code>qmgr -c 'q batch features_required=fast'</code></td>
</tr>
</tbody>
</table>

### keep_completed

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the number of seconds jobs should be held in the Completed state after exiting. For more information, see Keeping Completed Jobs on page 73.</td>
</tr>
<tr>
<td>Example</td>
<td><code>qmgr -c &quot;set queue batch keep_completed=120&quot;</code></td>
</tr>
</tbody>
</table>

### kill_delay

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>If using <code>qdel</code>, 2 seconds</td>
</tr>
<tr>
<td></td>
<td>If using <code>qrerun</code>, 0 (no wait)</td>
</tr>
</tbody>
</table>
### kill_delay

**Description**
Specifies the number of seconds between sending a SIGTERM and a SIGKILL to a job in a specific queue that you want to cancel. It is possible that the job script, and any child processes it spawns, can receive several SIGTERM signals before the SIGKILL signal is received.

- **Info** All MOMs must be configured with `$exec with_exec true` in order for `kill_delay` to work, even when relying on default `kill_delay` settings.
- **Info** This setting overrides the server setting. See `kill_delay` in Server Parameters on page 261.

**Example**
```
qmgr -c "set queue batch kill_delay=30"
```

### max_queuable

**Format**
`<INTEGER>`

**Default**
unlimited

**Description**
Specifies the maximum number of jobs allowed in the queue at any given time (includes idle, running, and blocked jobs).

**Example**
```
qmgr -c "set queue batch max_queuable=20"
```

### max_running

**Format**
`<INTEGER>`

**Default**
unlimited

**Description**
Specifies the maximum number of jobs in the queue allowed to run at any given time.

**Example**
```
qmgr -c "set queue batch max_running=20"
```

### max_user_queuable

**Format**
`<INTEGER>`

**Default**
unlimited
### max_user_queuable

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies the maximum number of jobs, per user, allowed in the queue at any given time (includes idle, running, and blocked jobs). Version 2.1.3 and greater.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td><code>qmgr -c &quot;set queue batch max_user_queuable=20&quot;</code></td>
</tr>
</tbody>
</table>

### max_user_run

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>unlimited</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the maximum number of jobs, per user, in the queue allowed to run at any given time.</td>
</tr>
<tr>
<td>Example</td>
<td><code>qmgr -c &quot;set queue batch max_user_run=10&quot;</code></td>
</tr>
</tbody>
</table>

### priority

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the priority value associated with the queue.</td>
</tr>
<tr>
<td>Example</td>
<td><code>qmgr -c &quot;set queue batch priority=20&quot;</code></td>
</tr>
</tbody>
</table>

### queue_type

<table>
<thead>
<tr>
<th>Format</th>
<th>One of e, execution, r, or route (see <a href="#">Creating a Routing Queue on page 116</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>--</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the queue type.</td>
</tr>
<tr>
<td>Example</td>
<td><code>qmgr -c &quot;set queue batch queue_type=execution&quot;</code></td>
</tr>
</tbody>
</table>
### required_login_property

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Adds the specified login property as a requirement for all jobs in this queue.</td>
</tr>
<tr>
<td>Example</td>
<td>qmgr -c 's q &lt;queuename&gt; required_login_property=INDUSTRIAL'</td>
</tr>
</tbody>
</table>

### resources_available

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies to cumulative resources available to all jobs running in the queue. See <a href="#">qsub will not allow the submission of jobs requesting many processors on page 163</a> for more information.</td>
</tr>
</tbody>
</table>
| Example  | qmgr -c "set queue batch resources_available.nodect=20"

You must restart pbs_server for changes to take effect.

Also, resources_available is constrained by the smallest of queue.resources_available and server.resources_available.

### resources_default

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies default resource requirements for jobs submitted to the queue.</td>
</tr>
<tr>
<td>Example</td>
<td>qmgr -c &quot;set queue batch resources_default.walltime=3600&quot;</td>
</tr>
</tbody>
</table>

### resources_max

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
</tbody>
</table>
### resources_max

**Default** ---

**Description** Specifies the maximum resource limits for jobs submitted to the queue.

**Example**

```
qmgr -c "set queue batch resources_max.nodect=16"
```

### resources_min

**Format** <STRING>

**Default** ---

**Description** Specifies the minimum resource limits for jobs submitted to the queue.

**Example**

```
qmgr -c "set queue batch resources_min.nodect=2"
```

### route_destinations

**Format** `<queue>[[@<host>]]`

**Default** ---

**Description** Specifies the potential destination queues for jobs submitted to the associated routing queue.

> **This attribute is only valid for routing queues (see Creating a Routing Queue on page 116).**

**Example**

```
> qmgr -c "set queue route route_destinations=fast"
> qmgr -c "set queue route route_destinations=slow"
> qmgr -c "set queue route route_destinations=medium@hostname"
```

To set multiple queue specifications, use multiple commands:

```
> qmgr -c 's s route_destinations=batch'
> qmgr -c 's s route_destinations=long'
> qmgr -c 's s route_destinations=short'
```
Assigning Queue Resource Limits

Administrators can use resources limits to help direct what kind of jobs go to different queues. There are four queue attributes where resource limits can be set: resources_available, resources_default, resources_max, and resources_min. The list of supported resources that can be limited with these attributes are arch, mem, nodect, nodes, procct, pvmem, vmem, and walltime.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>arch</td>
<td>string</td>
<td>Specifies the administrator defined system architecture required.</td>
</tr>
<tr>
<td>mem</td>
<td>size</td>
<td>Amount of physical memory used by the job. (Ignored on Darwin, Digital Unix, Free BSD, HPUX 11, IRIX, NetBSD, and SunOS. Also ignored on Linux if number of nodes is not 1. Not implemented on AIX and HPUX 10.)</td>
</tr>
<tr>
<td>ncpus</td>
<td>integer</td>
<td>Sets the number of processors in one task where a task cannot span nodes.</td>
</tr>
<tr>
<td>nodect</td>
<td>integer</td>
<td>Sets the number of nodes available. By default, TORQUE will set the number of nodes available to the number of nodes listed in the $TORQUE_HOME/server_priv/nodes file. nodect can be set to be greater than or less than that number. Generally, it is used to set the node count higher than the number of physical nodes in the cluster.</td>
</tr>
<tr>
<td>nodes</td>
<td>integer</td>
<td>Specifies the number of nodes.</td>
</tr>
</tbody>
</table>
### Resource

<table>
<thead>
<tr>
<th>Resource</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>proct</td>
<td>integer</td>
<td>Sets limits on the total number of execution slots (procs) allocated to a job. The number of procs is calculated by summing the products of all node and ppn entries for a job. For example <code>qsub -l nodes=2:ppn=2+3:ppn=4 job.sh</code> would yield a <code>proct</code> of 16. (2 \times 2 + 3 \times 4).</td>
</tr>
<tr>
<td>pvmem</td>
<td>size</td>
<td>Amount of virtual memory used by any single process in a job.</td>
</tr>
<tr>
<td>vmem</td>
<td>size</td>
<td>Amount of virtual memory used by all concurrent processes in the job.</td>
</tr>
<tr>
<td>walltime</td>
<td>seconds, or [[HH:]MM:]SS</td>
<td>Amount of real time during which a job can be in a running state.</td>
</tr>
</tbody>
</table>

### size

The `size` format specifies the maximum amount in terms of bytes or words. It is expressed in the form `integer[suffix]`. The suffix is a multiplier defined in the following table ("b" means bytes [the default] and "w" means words). The size of a word is calculated on the execution server as its word size.

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>w</td>
</tr>
<tr>
<td>kb</td>
<td>kw</td>
</tr>
<tr>
<td>mb</td>
<td>mw</td>
</tr>
<tr>
<td>gb</td>
<td>gw</td>
</tr>
<tr>
<td>tb</td>
<td>tw</td>
</tr>
</tbody>
</table>

### Related Topics

- [Queue Configuration on page 103](#)
- [Example Queue Configuration on page 114](#)

### Example Queue Configuration

The following series of `qmgr` commands will create and configure a queue named `batch`:
This queue will accept new jobs and, if not explicitly specified in the job, will assign a nodecount of 1 and a walltime of 1 hour to each job.

Related Topics

Queue Configuration on page 103

Setting a Default Queue

By default, a job must explicitly specify which queue it is to run in. To change this behavior, the server parameter default_queue may be specified as in the following example:

```
qmgr -c "set server default_queue=batch"
```

Related Topics

Queue Configuration on page 103

Mapping a Queue to Subset of Resources

TORQUE does not currently provide a simple mechanism for mapping queues to nodes. However, schedulers such as Moab and Maui can provide this functionality.

The simplest method is using default_resources.neednodes on an execution queue, setting it to a particular node attribute. Maui/Moab will use this information to ensure that jobs in that queue will be assigned nodes with that attribute. For example, suppose we have some nodes bought with money from the chemistry department, and some nodes paid by the biology department.

```
$TORQUE_HOME/server_priv/nodes:
  node01 np=2 chem
  node02 np=2 chem
  node03 np=2 bio
  node04 np=2 bio

qmgr:
  set queue chem resources_default.neednodes=chem
  set queue bio resources_default.neednodes=bio
```

| This example does not preclude other queues from accessing those nodes. One solution is to use some other generic attribute with all other nodes and queues. |
More advanced configurations can be made with standing reservations and QoSs.

Related Topics
Queue Configuration on page 103

Creating a Routing Queue

A routing queue will steer a job to a destination queue based on job attributes and queue constraints. It is set up by creating a queue of queue_type "Route" with a route_destinations attribute set, as in the following example.

```
qmgr
    # routing queue
    create queue route
    set queue route queue_type = Route
    set queue route route_destinations = reg_64
    set queue route route_destinations += reg_32
    set queue route enabled = True
    set queue route started = True

    # queue for jobs using 1-15 nodes
    create queue reg
    set queue reg queue_type = Execution
    set queue reg resources_min.ncpus = 1
    set queue reg resources_min.nodect = 1
    set queue reg resources_default.ncpus = 1
    set queue reg resources_default.nodes = 1
    set queue reg enabled = True
    set queue reg started = True

    # queue for jobs using 16-31 nodes
    create queue reg_32
    set queue reg_32 queue_type = Execution
    set queue reg_32 resources_min.ncpus = 31
    set queue reg_32 resources_min.nodect = 16
    set queue reg_32 resources_default.walltime = 12:00:00
    set queue reg_32 enabled = True
    set queue reg_32 started = True

    # queue for jobs using 32+ nodes
    create queue reg_64
    set queue reg_64 queue_type = Execution
    set queue reg_64 resources_min.ncpus = 63
    set queue reg_64 resources_min.nodect = 32
    set queue reg_64 resources_default.walltime = 06:00:00
    set queue reg_64 enabled = True
    set queue reg_64 started = True

    # have all jobs go through the routing queue
    set server default_queue = batch
    set server resources_default.ncpus = 1
    set server resources_default.walltime = 24:00:00
    ...
```

In this example, the compute nodes are dual processors and default walltimes are set according to the number of processors/nodes of a job. Jobs with 32 nodes (63 processors) or more will be given a default walltime of 6 hours. Also,
jobs with 16-31 nodes (31-62 processors) will be given a default walltime of 12 hours. All other jobs will have the server default walltime of 24 hours.

The ordering of the route_destinations is important. In a routing queue, a job is assigned to the first possible destination queue based on the resources_max, resources_min, acl_users, and acl_groups attributes. In the preceding example, the attributes of a single processor job would first be checked against the reg_64 queue, then the reg_32 queue, and finally the reg queue.

Adding the following settings to the earlier configuration elucidates the queue resource requirements:

```
qmgr
set queue reg resources_max.ncpus = 30
set queue reg resources_max.nodect = 15
set queue reg_16 resources_max.ncpus = 62
set queue reg_16 resources_max.nodect = 31
```

TORQUE waits to apply the server and queue defaults until the job is assigned to its final execution queue. Queue defaults override the server defaults. If a job does not have an attribute set, the server and routing queue defaults are not applied when queue resource limits are checked. Consequently, a job that requests 32 nodes (not ncpus=32) will not be checked against a min_resource.ncpus limit. Also, for the preceding example, a job without any attributes set will be placed in the reg_64 queue, since the server ncpus default will be applied after the job is assigned to an execution queue.

- Routine queue defaults are not applied to job attributes in versions 2.1.0 and before.

- If the error message "qsub: Job rejected by all possible destinations" is reported when submitting a job, it may be necessary to add queue location information, (i.e., in the routing queue's route_destinations attribute, change "batch" to "batch@localhost").

Related Topics
- Queue Configuration on page 103
- Queue Attributes on page 103

**Server High Availability**

You can now run TORQUE in a redundant or high availability mode. This means that there can be multiple instances of the server running and waiting to take over processing in the event that the currently running server fails.
The high availability feature is available in the 2.3 and later versions of TORQUE. TORQUE 2.4 includes several enhancements to high availability (see Server High Availability on page 117).

Contact Adaptive Computing before attempting to implement any type of high availability.

The "native" high availability implementation, as described here, is only suitable for Moab Basic Edition. Contact Adaptive Computing for information on high availability for Enterprise Edition.

For more details, see these sections:

- Redundant server host machines on page 118
- Server High Availability on page 117
- Enhanced High Availability with Moab on page 120
- How Commands Select the Correct Server Host on page 120
- Job Names on page 121
- Persistence of the pbs_server Process on page 121
- High Availability of the NFS Server on page 121
- Installing TORQUE in High Availability Mode on page 121
- Installing TORQUE in High Availability Mode on Headless Nodes on page 126
- Example Setup of High Availability on page 130

Redundant server host machines

High availability enables Moab HPC Suite to continue running even if pbs_server is brought down. This is done by running multiple copies of pbs_server which have their torque/server_priv directory mounted on a shared file system.

Do not use symlinks when sharing the TORQUE home directory or server_priv directories. A workaround for this is to use `mount --bind /path/to/share /var/spool/torque`. Also, it is highly recommended that you only share the server_priv and not the entire $TORQUEHOMEDIR.

The torque/server_name must include the host names of all nodes that run pbs_server. All MOM nodes also must include the host names of all nodes running pbs_server in their torque/server_name file. The syntax of the torque/server_name is a comma delimited list of host names.

For example:
Chapter 5 Setting Server Policies

When configuring high availability, do not use $pbsserver to specify the host names. You must use the $TORQUEHOMEDIR/server_name file.

All instances of pbs_server need to be started with the --ha command line option that allows the servers to run at the same time. Only the first server to start will complete the full startup. The second server to start will block very early in the startup when it tries to lock the file torque/server_priv/server.lock. When the second server cannot obtain the lock, it will spin in a loop and wait for the lock to clear. The sleep time between checks of the lock file is one second.

Notice that not only can the servers run on independent server hardware, there can also be multiple instances of the pbs_server running on the same machine. This was not possible before as the second one to start would always write an error and quit when it could not obtain the lock.

Enabling High Availability

To use high availability, you must start each instance of pbs_server with the --ha option.

Prior to version 4.0, TORQUE with HA was configured with an --enable-high-availability option. That option is no longer required.

Three server options help manage high availability. The server parameters are lock_file, lock_file_update_time, and lock_file_check_time.

The lock_file option allows the administrator to change the location of the lock file. The default location is torque/server_priv. If the lock_file option is used, the new location must be on the shared partition so all servers have access.

The lock_file_update_time and lock_file_check_time parameters are used by the servers to determine if the primary server is active. The primary pbs_server will update the lock file based on the lock_file_update_time (default value of 3 seconds). All backup pbs_servers will check the lock file as indicated by the lock_file_check_time parameter (default value of 9 seconds). The lock_file_update_time must be less than the lock_file_check_time. When a failure occurs, the backup pbs_server takes up to the lock_file_check_time value to take over.

```
> qmgr -c "set_server lock_file_check_time=5"
```

In the above example, after the primary pbs_server goes down, the backup pbs_server takes up to 5 seconds to take over. It takes additional time for all MOMs to switch over to the new pbs_server.
The clock on the primary and redundant servers must be synchronized in order for high availability to work. Use a utility such as NTP to ensure your servers have a synchronized time.

Do not use anything but a plain simple NFS fileshare that is not used by anybody or anything else (i.e., only Moab can use the fileshare).

Do not use any general-purpose NAS, do not use any parallel file system, and do not use company-wide shared infrastructure to set up Moab high availability using "native" high availability.

Enhanced High Availability with Moab

When TORQUE is run with an external scheduler such as Moab, and the pbs_server is not running on the same host as Moab, pbs_server needs to know where to find the scheduler. To do this, use the -l option as demonstrated in the example below (the port is required and the default is 15004).

```
> pbs_server -l <moabhost:port>
```

If Moab is running in HA mode, add a -l option for each redundant server.

```
> pbs_server -l <moabhost1:port> -l <moabhost2:port>
```

If pbs_server and Moab run on the same host, use the --ha option as demonstrated in the example below.

```
> pbs_server --ha
```

The root user of each Moab host must be added to the operators and managers lists of the server. This enables Moab to execute root level operations in TORQUE.

How Commands Select the Correct Server Host

The various commands that send messages to pbs_server usually have an option of specifying the server name on the command line, or if none is specified will use the default server name. The default server name comes either from the environment variable PBS_DEFAULT or from the file torque/server_name.

When a command is executed and no explicit server is mentioned, an attempt is made to connect to the first server name in the list of hosts from PBS_DEFAULT or torque/server_name. If this fails, the next server name is tried. If all servers in the list are unreachable, an error is returned and the command fails.
Note that there is a period of time after the failure of the current server during which the new server is starting up where it is unable to process commands. The new server must read the existing configuration and job information from the disk, so the length of time that commands cannot be received varies. Commands issued during this period of time might fail due to timeouts expiring.

**Job Names**

Job names normally contain the name of the host machine where pbs_server is running. When job names are constructed, only the server name in $PBS_DEFAULT or the first name from the server specification list, $TORQUE_HOME/server_name, is used in building the job name.

**Persistence of the pbs_server Process**

The system administrator must ensure that pbs_server continues to run on the server nodes. This could be as simple as a cron job that counts the number of pbs_server's in the process table and starts some more if needed.

**High Availability of the NFS Server**

Before installing a specific NFS HA solution please contact Adaptive Computing Support for a detailed discussion on NFS HA type and implementation path.

One consideration of this implementation is that it depends on NFS file system also being redundant. NFS can be set up as a redundant service. See the following:

- Setting Up A Highly Available NFS Server
- Making NFS Work On Your Network
- Sourceforge Linux NFS FAQ
- NFS v4 main site

There are also other ways to set up a shared file system. See the following:

- Red Hat Global File System
- Data sharing with a GFS storage cluster

**Installing TORQUE in High Availability Mode**

The following procedure demonstrates a TORQUE installation in high availability (HA) mode.
Requirements

- gcc (GCC) 4.1.2
- BASH shell
- Servers configured the following way:
  - 2 main servers with identical architecture:
    - server1 — Primary server running TORQUE with a shared file system (this example uses NFS)
    - server2 — Secondary server running with TORQUE with a shared file system (this example uses NFS)
  - fileServer — Shared file system (this example uses NFS)
  - Compute nodes

To install TORQUE in HA mode

1. Stop all firewalls or update your firewall to allow traffic from TORQUE services.
   ```
   > service iptables stop
   > chkconfig iptables off
   ```
   If you are unable to stop the firewall due to infrastructure restriction, open the following ports:
   - 15001[tcp,udp]
   - 15002[tcp,udp]
   - 15003[tcp,udp]

2. Disable SELinux
   ```
   > vi /etc/sysconfig/selinux
   SELINUX=disabled
   ```

3. Update your main ~/.bashrc profile to ensure you are always referencing the applications to be installed on all servers.
   ```
   # TORQUE
   export TORQUEHOME=/var/spool/torque
   # Library Path
   export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$TORQUEHOME/lib
   # Update system paths
   export PATH=${TORQUEHOME}/bin:${TORQUEHOME}/sbin:$PATH
   ```

4. Verify server1 and server2 are resolvable via either DNS or looking for an entry in the /etc/hosts file.

5. Configure the NFS Mounts by following these steps:
Chapter 5 Setting Server Policies

a. Create mount point folders on fileServer.

```
fileServer# mkdir -m 0755 /var/spool/torque
fileServer# mkdir -m 0750 /var/spool/torque/server_priv
```

b. Update /etc/exports on fileServer. The IP addresses should be that of server2.

```
/var/spool/torque/server_priv 192.168.0.0/255.255.255.0(rw,sync,no_root_squash)
```

c. Update the list of NFS exported file systems.

```
fileServer# exportfs -r
```

6. If the NFS daemons are not already running on fileServer, start them.

```
> systemctl restart rpcbind.service
> systemctl start nfs-server.service
> systemctl start nfs-lock.service
> systemctl start nfs-idmap.service
```

7. Mount the exported file systems on server1 by following these steps:
   a. Create the directory reference and mount them.

```
server1# mkdir /var/spool/torque/server_priv
```

Repeat this process for server2.

b. Update /etc/fstab on server1 to ensure that NFS mount is performed on startup.

```
fileServer:/var/spool/torque/server_priv /var/spool/torque/server_priv nfs rsize=8192,wsize=8192,timeo=14,intr
```

Repeat this step for server2.

8. Install TORQUE by following these steps:
   a. Download and extract TORQUE 5.1.1 on server1.

```
server1# wget http://github.com/adaptivecomputing/torque/branches/5.1.1/torque-5.1.1.tar.gz
server1# tar -xvzf torque-5.1.1.tar.gz
```

b. Navigate to the TORQUE directory and compile TORQUE on server1.

```
server1# configure
server1# make
server1# make install
server1# make packages
```

c. If the installation directory is shared on both head nodes, then run make install on server1.

```
server1# make install
```
If the installation directory is not shared, repeat step 8a-b (downloading and installing TORQUE) on server2.


```
server1# /etc/init.d/trqauthd start
```

10. Configure TORQUE for HA.

   a. List the host names of all nodes that run pbs_server in the `torque/server_name` file. You must also include the host names of all nodes running pbs_server in the `torque/server_name` file of each MOM node. The syntax of `torque/server_name` is a comma-delimited list of host names.

```
server1
server2
```

   b. Create a simple queue configuration for TORQUE job queues on server1.

```
server1# pbs_server -t create
server1# qmgr -c "set server scheduling=true"
server1# qmgr -c "create queue batch queue_type=execution"
server1# qmgr -c "set queue batch started=true"
server1# qmgr -c "set queue batch enabled=true"
server1# qmgr -c "set queue batch resources_default.nodes=1"
server1# qmgr -c "set queue batch resources_default.walltime=3600"
```

   c. Add the root users of TORQUE to the TORQUE configuration as an operator and manager.

```
server1# qmgr -c "set server managers += root@server1"
server1# qmgr -c "set server managers += root@server2"
server1# qmgr -c "set server operators += root@server1"
server1# qmgr -c "set server operators += root@server2"
```

   d. You must update the lock file mechanism for TORQUE in order to determine which server is the primary. To do so, use the `lock_file_update_time` and `lock_file_check_time` parameters. The primary pbs_server will update the lock file based on the specified `lock_file_update_time` (default value of 3 seconds). All backup pbs_servers will check the lock file as indicated by the `lock_file_check_time` parameter (default value of 9 seconds). The `lock_file_update_time` must be less than the `lock_file_check_time`. When a failure occurs,
the backup pbs_server takes up to the `lock_file_check_time` value to take over.

```bash
server1# qmgr -c "set server lock_file_check_time=5"
server1# qmgr -c "set server lock_file_update_time=3"
```

ℹ️ **Because `server_priv/*` is a shared drive, you do not need to repeat this step on `server2`.**

e. List the servers running pbs_server in the TORQUE `acl_hosts` file.

```bash
server1# qmgr -c "set server acl_hosts += server1"
server1# qmgr -c "set server acl_hosts += server2"
```

ℹ️ **Because `server_priv/*` is a shared drive, you do not need to repeat this step on `server2`.**

f. Restart the running pbs_server in HA mode.

```bash
server1# qterm
```

*g. Start the pbs_server on the secondary server.*

```bash
server1# pbs_server --ha -l server2:port
server2# pbs_server --ha -l server1:port
```

11. Check the status of TORQUE in HA mode.

```bash
server1# qmgr -c "p s"
server2# qmgr -c "p s"
```

The commands above returns all settings from the active TORQUE server from either node.

Drop one of the pbs_servers to verify that the secondary server picks up the request.

```bash
server1# qterm
server2# qmgr -c "p s"
```

Stop the pbs_server on `server2` and restart pbs_server on `server1` to verify that both nodes can handle a request from the other.

12. Install a pbs_mom on the compute nodes.

   a. Copy the install scripts to the compute nodes and install.

   b. Navigate to the shared source directory of TORQUE and run the following:

```bash
node1# torque-package-mom-linux-x86_64.sh --install
node2# torque-package-clients-linux-x86_64.sh --install
```

Repeat this for each compute node. Verify that the `/var/spool/torque/server-name` file shows all your compute nodes.
c. On server1 or server2, configure the nodes file to identify all available MOMs. To do so, edit the /var/spool/torque/server_priv/nodes file.

```
node1 np=2
node2 np=2
```

![Change the np flag to reflect number of available processors on that node.](image)

d. Recycle the pbs_servers to verify that they pick up the MOM configuration.

```
server1# qterm; pbs_server --ha -l server2:port
server2# qterm; pbs_server --ha -l server1:port
```

e. Start the pbs_mom on each execution node.

```
node5# pbs_mom
node6# pbs_mom
```

### Installing TORQUE in High Availability Mode on Headless Nodes

The following procedure demonstrates a TORQUE installation in high availability (HA) mode on nodes with no local hard drive.

#### Requirements

- gcc (GCC) 4.1.2
- BASH shell
- Servers (these cannot be two VMs on the same hypervisor) configured the following way:
  - 2 main servers with identical architecture
    - server1 — Primary server running TORQUE with a file system share (this example uses NFS)
    - server2 — Secondary server running with TORQUE with a file system share (this example uses NFS)
  - Compute nodes
  - fileServer — A shared file system server (this example uses NFS)

#### To install TORQUE in HA mode on a node with no local hard drive

1. Stop all firewalls or update your firewall to allow traffic from TORQUE services.

```
> service iptables stop
> chkconfig iptables off
```
If you are unable to stop the firewall due to infrastructure restriction, open the following ports:

- 15001 [tcp,udp]
- 15002 [tcp,udp]
- 15003 [tcp,udp]

2. Disable SELinux

   ```
   > vi /etc/sysconfig/selinux
   SELINUX=disabled
   ```

3. Update your main ~/.bashrc profile to ensure you are always referencing the applications to be installed on all servers.

   ```
   # TORQUE
   export TORQUEHOME=/var/spool/torque
   # Library Path
   export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:${TORQUEHOME}/lib
   # Update system paths
   export PATH=${TORQUEHOME}/bin:${TORQUEHOME}/sbin:${PATH}
   ```

4. Verify server1 and server2 are resolvable via either DNS or looking for an entry in the /etc/hosts file.

5. Configure the NFS Mounts by following these steps:
   a. Create mount point folders on fileServer.
      ```
      fileServer# mkdir -m 0755 /var/spool/torque
      ```
   b. Update /etc/exports on fileServer. The IP addresses should be that of server2.
      ```
      /var/spool/torque/ 192.168.0.0/255.255.255.0 (rw, sync, no_root_squash)
      ```
   c. Update the list of NFS exported file systems.
      ```
      fileServer# exportfs -r
      ```

6. If the NFS daemons are not already running on fileServer, start them.

   ```
   > systemctl restart rpcbind.service
   > systemctl start nfs-server.service
   > systemctl start nfs-lock.service
   > systemctl start nfs-idmap.service
   ```

7. Mount the exported file systems on server1 by following these steps:
   a. Create the directory reference and mount them.
      ```
      server1# mkdir /var/spool/torque
      ```
Repeat this process for server2.

b. Update `/etc/fstab` on server1 to ensure that NFS mount is performed on startup.

```
fileServer:/var/spool/torque/server_priv /var/spool/torque/server_priv nfs
rsize=8192,wsize=8192,timeo=14,intr
```

Repeat this step for server2.

8. Install TORQUE by following these steps:

a. Download and extract TORQUE 5.1.1 on server1.

```
server1# wget http://github.com/adaptivecomputing/torque/branches/5.1.1/torque-5.1.1.tar.gz
server1# tar -xvzf torque-5.1.1.tar.gz
```

b. Navigate to the TORQUE directory and compile TORQUE with the HA flag on server1.

```
server1# configure --prefix=/var/spool/torque
server1# make
server1# make install
server1# make packages
```

c. If the installation directory is shared on both head nodes, then run `make install` on server1.

```
server1# make install
```

If the installation directory is not shared, repeat step 8a-b (downloading and installing TORQUE) on server2.


```
server1#/etc/init.d/trqauthd start
```

10. Configure TORQUE for HA.

a. List the host names of all nodes that run `pbs_server` in the `torque/server_name` file. You must also include the host names of all nodes running `pbs_server` in the `torque/server_name` file of each MOM node. The syntax of `torque/server_name` is a comma-delimited list of host names.

```
server1,server2
```

b. Create a simple queue configuration for TORQUE job queues on server1.
c. Add the root users of TORQUE to the TORQUE configuration as an operator and manager.

```
server1# qmgr -c "set server managers += root@server1"
server1# qmgr -c "set server managers += root@server2"
server1# qmgr -c "set server operators += root@server1"
server1# qmgr -c "set server operators += root@server2"
```

Because TORQUEHOME is a shared drive, you do not need to repeat this step on server2.

d. You must update the lock file mechanism for TORQUE in order to determine which server is the primary. To do so, use the `lock_file_update_time` and `lock_file_check_time` parameters. The primary `pbs_server` will update the lock file based on the specified `lock_file_update_time` (default value of 3 seconds). All backup `pbs_servers` will check the lock file as indicated by the `lock_file_check_time` parameter (default value of 9 seconds). The `lock_file_update_time` must be less than the `lock_file_check_time`. When a failure occurs, the backup `pbs_server` takes up to the `lock_file_check_time` value to take over.

```
server1# qmgr -c "set server lock_file_check_time=5"
server1# qmgr -c "set server lock_file_update_time=3"
```

Because TORQUEHOME is a shared drive, you do not need to repeat this step on server2.

e. List the servers running `pbs_server` in the TORQUE `acl_hosts` file.

```
server1# qmgr -c "set server acl_hosts += server1"
server1# qmgr -c "set server acl_hosts += server2"
```

Because TORQUEHOME is a shared drive, you do not need to repeat this step on server2.

f. Restart the running `pbs_server` in HA mode.
1. The machines running pbs_server must have access to a shared server_priv/ directory (usually an NFS share on a MoM).

2. All MoMs must have the same content in their server_name file. This can be done manually or via an NFS share. The server_name file contains a comma-delimited list of the hosts that run pbs_server.
Chapter 5 Setting Server Policies

There are two threadpools in TORQUE, one for background tasks and one for incoming requests from the MOMs and through the API (client commands, Moab, and so forth). The min_threads on page 275 and max_threads on page 274 parameters control the number of total threads used for both, not for each individually. The incoming requests' threadpool has three-quarters of min_threads for its minimum, and three-quarters of max_threads for its maximum, with the background pool receiving the other one-quarter.

Additionally, pbs_server no longer allows incoming requests to pile up indefinitely. When the threadpool is too busy for incoming requests, it indicates such, returning PBSE_SERVER_BUSY with the accompanying message that "Pbs Server is currently too busy to service this request. Please retry this request." The threshold for this message, if the request is from a manager, is that at least two threads be available in the threadpool. If the request comes from a non-manager, 5% of the threadpool must be available for the request to be serviced. Note that availability is calculated based on the maximum threads and not based on the current number of threads allocated.

If an undesirably large number of requests are given a busy response, one option is to increase the number of maximum threads for the threadpool. If the load on the server is already very high, then this is probably not going to help, but if the CPU load is lower, then it may help. Remember that by default the threadpool shrinks down once the extra threads are no longer needed. This is controlled via the thread_idle_seconds on page 280 server parameter.

Any change in the min_threads, max_threads, or thread_idle_seconds parameters requires a restart of pbs_server to take effect.
Setting min_threads and max_threads
Chapter 6 Integrating Schedulers for TORQUE

Selecting the cluster scheduler is an important decision and significantly affects cluster utilization, responsiveness, availability, and intelligence. The default TORQUE scheduler, pbs_sched, is very basic and will provide poor utilization of your cluster's resources. Other options, such as Maui Scheduler or Moab Workload Manager, are highly recommended. If you are using Maui or Moab, see Moab-TORQUE Integration Guide in the Moab Workload Manager Administrator Guide. If using pbs_sched, simply start the pbs_sched daemon.

If you are installing Moab Cluster Manager, TORQUE and Moab were configured at installation for interoperability and no further action is required.
Chapter 7 Configuring Data Management

This section contains information about SCP-based data management with TORQUE. It describes how to use TORQUE with NFS and other networked filesystems. It also outlines file staging requirements. For details, see these topics:

- SCP Setup on page 135
- NFS and Other Networked Filesystems on page 138
- File stage-in/stage-out on page 139

SCP Setup

To use SCP-based data management, TORQUE must be authorized to migrate data to any of the compute nodes. If this is not already enabled within the cluster, this can be achieved with the process described below. This process enables uni-directional access for a particular user from a source host to a destination host.

> These directions were written using OpenSSH version 3.6 and may not transfer correctly to older versions.

To set up TORQUE for SCP, follow the directions in each of these topics:

- Generating SSH Key on Source Host on page 135
- Copying Public SSH Key to Each Destination Host on page 136
- Configuring the SSH Daemon on Each Destination Host on page 136
- Validating Correct SSH Configuration on page 137
- Enabling Bi-Directional SCP Access on page 137
- Compiling TORQUE to Support SCP on page 137
- Troubleshooting on page 138

Related Topics

Configuring Data Management on page 135

Generating SSH Key on Source Host

On the source host as the transfer user, execute the following:

```
> ssh-keygen -t rsa
```
This will prompt for a passphrase (optional) and create two files (id_rsa and id_rsa.pub) inside ~/.ssh/.

Related Topics
  SCP Setup on page 135
  Copying Public SSH Key to Each Destination Host on page 136

Copying Public SSH Key to Each Destination Host

Transfer public key to each destination host as the transfer user:

Easy key copy:
```
ssh-copy-id [-i [identity_file]] [user@]machine
```

Manual steps to copy keys:
```
> scp ~/.ssh/id_rsa.pub destHost:~ (enter password)
```

Create an authorized_keys file on each destination host:
```
> ssh destHost (enter password)
> cat id_rsa.pub >> .ssh/authorized_keys
```

If the .ssh directory does not exist, create it with 700 privileges (mkdir .ssh; chmod 700 .ssh):
```
> chmod 700 .ssh/authorized_keys
```

Related Topics
  Generating SSH Key on Source Host on page 135
  SCP Setup on page 135

Configuring the SSH Daemons on Each Destination Host

Some configuration of the SSH daemon may be required on the destination host. (Because this is not always the case, see Validating Correct SSH Configuration on page 137 and test the changes made to this point. If the tests fail, proceed with this step and then try testing again.) Typically, this is done by editing the /etc/ssh/sshd_config file (root access needed). To verify correct configuration, see that the following attributes are set (not commented):
```
RSAAuthentication yes
PubkeyAuthentication yes
```

If configuration changes were required, the SSH daemon will need to be restarted (root access needed):
```
> /etc/init.d/sshd restart
```
Validating Correct SSH Configuration

If all is properly configured, the following command issued on the source host should succeed and not prompt for a password:

```
> scp destHost:/etc/motd /tmp
```

If this is your first time accessing destination from source, it may ask you if you want to add the fingerprint to a file of known hosts. If you specify yes, this message should no longer appear and should not interfere with scp copying via TORQUE. Also, it is important that the full hostname appear in the known_hosts file. To do this, use the full hostname for destHost, as in machine.domain.org instead of just machine.

Related Topics
SCP Setup on page 135

Enabling Bi-Directional SCP Access

The preceding steps allow source access to destination without prompting for a password. The reverse, however, is not true. Repeat the steps, but this time using the destination as the source, etc. to enable bi-directional SCP access (i.e. source can send to destination and destination can send to source without password prompts.)

Related Topics
SCP Setup on page 135

Compiling TORQUE to Support SCP

In TORQUE 2.1 and later, SCP is the default remote copy protocol. These instructions are only necessary for earlier versions.

TORQUE must be re-configured (and then rebuilt) to use SCP by passing in the --with-scp flag to the configure script:

```
> ./configure --prefix=xxx --with-scp
> make
```
If special SCP flags are required in your local setup, these can be specified using the $rcpcmd parameter.

Related Topics
SCP Setup on page 135

Troubleshooting
If, after following all of the instructions in this section (see SCP Setup on page 135), TORQUE is still having problems transferring data with SCP, set the PBSDEBUG environment variable and restart the pbs_mom for details about copying. Also check the MOM log files for more details.

Related Topics
SCP Setup on page 135

NFS and Other Networked Filesystems

When a batch job starts, its stdin file (if specified) is copied from the submission directory on the remote submission host. This file is placed in the $PBSMOMHOME directory on the mother superior node (i.e., /usr/spool/PBS/spool). As the job runs, stdout and stderr files are generated and placed in this directory using the naming convention $JOBID.OU and $JOBID.ER.

When the job completes, the MOM copies the files into the directory from which the job was submitted. By default, this file copying will be accomplished using a remote copy facility such as rcp or scp.

If a shared file system such as NFS, DFS, or AFS is available, a site can specify that the MOM should take advantage of this by specifying the $usecp directive inside the MOM configuration file (located in the $PBSMOMHOME/mom_priv directory) using the following format:

$usecp <HOST>:<SRCDIR> <DSTDIR>

<HOST> can be specified with a leading wildcard ('*') character. The following example demonstrates this directive:

```bash
mom_priv/config
# /home is NFS mounted on all hosts
$usecp *:/home
# submission hosts in domain fte.com should map '/data' directory on submit host to
# '/usr/local/data' on compute host
$usecp *.fte.com:/data /usr/local/data
```
If for any reason the MOM daemon is unable to copy the output or error files to the submission directory, these files are instead copied to the undelivered directory also located in $PBSMOMHOME.

Related Topics

Configuring Data Management on page 135

File stage-in/stage-out

File staging requirements are specified using the `stagein` and `stageout` directives of the `qsub` command. Stagein requests occur before the job starts execution, while stageout requests happen after a job completes.

On completion of the job, all staged-in and staged-out files are removed from the execution system. The `file_list` is in the form `local_file@hostname:remote_file[, ...]` regardless of the direction of the copy. The name `local_file` is the name of the file on the system where the job executed. It may be an absolute path or relative to the home directory of the user. The name `remote_file` is the destination name on the host specified by hostname. The name may be absolute or relative to the user's home directory on the destination host. The use of wildcards in the file name is not recommended.

The file names map to a remote copy program (rcp/scp/cp, depending on configuration) called on the execution system in the following manner:

For stagein: `rcp/scp hostname:remote_file local_file`

For stageout: `rcp/scp local_file hostname:remote_file`

Examples

```bash
# stage /home/john/input_source.txt from node13.fsc to /home/john/input_
# destination.txt on master compute node
> qsub -l nodes=1,walltime=100 -W stagein=input_
# source.txt@node13.fsc:/home/john/input_destination.txt

# stage /home/bill/output_source.txt on master compute node to /tmp/output_
# destination.txt on node15.fsc
> qsub -l nodes=1,walltime=100 -W stageout=/tmp/output_
# source.txt@node15.fsc:/home/bill/output_destination.txt

$ fortune >xxx;echo cat xxx|qsub -W stagein=xxx@`hostname`:xxx
199.myhost.mydomain
$ cat STDIN*199
Anyone who has had a bull by the tail knows five or six more things
than someone who hasn't.
-- Mark Twain
```

Related Topics

Configuring Data Management on page 135

Chapter 7 Configuring Data Management
Chapter 8 MPI (Message Passing Interface) Support

A message passing library is used by parallel jobs to augment communication between the tasks distributed across the cluster. TORQUE can run with any message passing library and provides limited integration with some MPI libraries.

For more information, see these topics:
- [MPICH on page 141](#)
- [Open MPI on page 142](#)

### MPICH

One of the most popular MPI libraries is MPICH available from Argonne National Lab. If using this release, you may want to consider also using the mpiexec tool for launching MPI applications. Support for mpiexec has been integrated into TORQUE.

#### MPIExec Overview

mpiexec is a replacement program for the script mpirun, which is part of the mpich package. It is used to initialize a parallel job from within a PBS batch or interactive environment. mpiexec uses the task manager library of PBS to spawn copies of the executable on the nodes in a PBS allocation.

Reasons to use mpiexec rather than a script (mpirun) or an external daemon (mpd):

- Starting tasks with the task manager (TM) interface is much faster than invoking a separate rsh * once for each process.
- Resources used by the spawned processes are accounted correctly with mpiexec, and reported in the PBS logs, because all the processes of a parallel job remain under the control of PBS, unlike when using mpirun-like scripts.
- Tasks that exceed their assigned limits of CPU time, wallclock time, memory usage, or disk space are killed cleanly by PBS. It is quite hard for processes to escape control of the resource manager when using mpiexec.
- You can use mpiexec to enforce a security policy. If all jobs are forced to spawn using mpiexec and the PBS execution environment, it is not necessary to enable rsh or ssh access to the compute nodes in the cluster.

For more information, see the mpiexec homepage.
MPIExec Troubleshooting

Although problems with mpiexec are rare, if issues do occur, the following steps may be useful:

- Determine current version using mpiexec --version and review the change log available on the MPI homepage to determine if the reported issue has already been corrected.
- Send email to the mpiexec mailing list at mpiexec@osc.edu.
- Browse the mpiexec user list archives for similar problems and resolutions.
- Read the FAQ contained in the README file and the mpiexec man pages contained within the mpiexec distribution.
- Increase the logging of mpiexec operation with mpiexec --verbose (reports messages to stderr).
- Increase logging of the master and slave resource manager execution daemons associated with the job (with TORQUE, use $loglevel to 5 or higher in $TORQUEROOT/mom_priv/config and look for 'tm' messages after associated join job messages).
- Use tracejob (included with TORQUE) or qtracejob (included with OSC’s pbstools package) to isolate failures within the cluster.
- If the message 'exec: Error: get_hosts: pbs_connect: Access from host not allowed, or unknown host' appears, this indicates that mpiexec cannot communicate with the pbs_server daemon. In most cases, this indicates that the $TORQUEROOT/server_name file points to the wrong server or the node cannot resolve the server’s name. The qstat command can be run on the node to test this.

General MPI Troubleshooting

When using MPICH, some sites have issues with orphaned MPI child processes remaining on the system after the master MPI process has been terminated. To address this, TORQUE epilogue scripts can be created that properly clean up the orphaned processes (see Prologue and Epilogue Scripts on page 323).

Related Topics

  [MPI (Message Passing Interface) Support on page 141](#)

Open MPI

Open MPI is a new MPI implementation that combines technologies from multiple projects to create the best possible library. It supports the TM
interface for integration with TORQUE. More information is available in the FAQ.

**TM Aware**

To make use of Moab HPC Suite's TM interface, MPI must be configured to be TM aware.

Use these guidelines:

1. **If you have installed from source**, you need to use "./configure --with-tm" when you configure and make `openmpi`.

2. **Run `mpirun` without the -machinefile.** Moab HPC Suite will copy down the environment PATH and Library path down to each sister MOM. If -machinefile is used, `mpirun` will bypass the TM interface.

**Example 8-1: Without TM aware**

```bash
[jbooth@support-mpi1 ~]$ /usr/lib64/openmpi/bin/mpirun -np 4 -machinefile $PBS_NODEFILE echo.sh
=============
support-mpi1
==============
/usr/lib64/openmpi/bin:/usr/lib64/openmpi/bin:/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/root/bin:/opt/moab/bin:/opt/moab/sbin:/home/jbooth/bin
/usr/lib64/openmpi/lib:/usr/lib64/openmpi/lib
==============
support-mpi1
==============
/usr/lib64/openmpi/bin:/usr/lib64/openmpi/bin:/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/root/bin:/opt/moab/bin:/opt/moab/sbin:/home/jbooth/bin
/usr/lib64/openmpi/lib:/usr/lib64/openmpi/lib
==============
support-mpi2
==============
/usr/lib64/openmpi/bin:/usr/lib64/openmpi/bin:/usr/lib64/qt-3.3/bin:/usr/local/bin:/bin:/usr/bin
/usr/lib64/openmpi/lib:/usr/lib64/openmpi/lib:
==============
support-mpi2
==============
/usr/lib64/openmpi/bin:/usr/lib64/openmpi/bin:/usr/lib64/qt-3.3/bin:/usr/local/bin:/bin:/usr/bin
/usr/lib64/openmpi/lib:/usr/lib64/openmpi/lib:
```

The paths, /opt/moab/bin and /opt/moab/sbin, were not passed down to the sister MOMs.
Example 8-2: With TM aware

[jbooth@support-mpi1 ~]$ /usr/local/bin/mpirun -np 4 echo.sh

support-mpi
============
/usr/local/bin:/usr/local/bin:/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/root/bin:/opt/moab/bin:/opt/moab/sbin:/home/jbooth/bin

/usr/local/lib:/usr/local/lib

============= support-mpi =============
/usr/local/bin:/usr/local/bin:/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/root/bin:/opt/moab/bin:/opt/moab/sbin:/home/jbooth/bin

/usr/local/lib:/usr/local/lib

============= support-mpi2 =============
/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/root/bin:/opt/moab/bin:/opt/moab/sbin:/home/jbooth/bin

/usr/local/lib:/usr/local/lib:/usr/local/lib

============= support-mpi2 =============
/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/qt-3.3/bin:/usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/root/bin:/opt/moab/bin:/opt/moab/sbin:/home/jbooth/bin

/usr/local/lib:/usr/local/lib:/usr/local/lib

The paths, /opt/moab/bin and /opt/moab/sbin, were passed down to the sister MOMs.

Related Topics

MPI (Message Passing Interface) Support on page 141
Chapter 9 Resources

A primary task of any resource manager is to monitor the state, health, configuration, and utilization of managed resources. TORQUE is specifically designed to monitor compute hosts for use in a batch environment. TORQUE is not designed to monitor non-compute host resources such as software licenses, networks, file systems, and so forth, although these resources can be integrated into the cluster using some scheduling systems.

With regard to monitoring compute nodes, TORQUE reports about a number of attributes broken into three major categories:

- Configuration on page 145
- Utilization on page 146
- Node States on page 146

Configuration

Configuration includes both detected hardware configuration and specified batch attributes.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>operating system of the node</td>
<td>The value reported is a derivative of the operating system installed.</td>
</tr>
<tr>
<td>(arch)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Node Features</td>
<td>arbitrary string attributes associated with the node</td>
<td>No node features are specified by default. If required, they are set using the nodes file located in the TORQUE_HOME/server_priv directory. They may specify any string and are most commonly used to allow users to request certain subsets of nodes when submitting jobs.</td>
</tr>
<tr>
<td>(properties)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Disk</td>
<td>configured local disk</td>
<td>By default, local disk space is not monitored. If the MOM configuration size [fs=&lt;FS&gt;] parameter is set, TORQUE will report, in kilobytes, configured disk space within the specified directory.</td>
</tr>
<tr>
<td>(size)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>local memory/RAM</td>
<td>Local memory/RAM is monitored and reported in kilobytes.</td>
</tr>
<tr>
<td>(physmem)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Attribute Table

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Processors (ncpus/np)</strong></td>
<td>real/virtual processors</td>
<td>The number of processors detected by TORQUE is reported via the <code>ncpus</code> attribute. However, for scheduling purposes, other factors are taken into account. In its default configuration, TORQUE operates in &quot;dedicated&quot; mode with each node possessing a single virtual processor. In dedicated mode, each job task will consume one virtual processor and TORQUE will accept workload on each node until all virtual processors on that node are in use. While the number of virtual processors per node defaults to 1, this may be configured using the nodes file located in the <code>TORQUE_HOME/server_priv</code> directory. An alternative to dedicated mode is &quot;timeshared&quot; mode. If TORQUE's timeshared mode is enabled, TORQUE will accept additional workload on each node until the node's <code>maxload</code> limit is reached.</td>
</tr>
<tr>
<td><strong>Swap (tot-mem)</strong></td>
<td>virtual memory/swap</td>
<td>Virtual memory/swap is monitored and reported in kilobytes.</td>
</tr>
</tbody>
</table>

#### Utilization

Utilization includes information regarding the amount of node resources currently in use as well as information about who or what is consuming it.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disk (size)</strong></td>
<td>local disk availability</td>
<td>By default, local disk space is not monitored. If the MOM configuration <code>size [fs=&lt;FS&gt;]</code> parameter is set, TORQUE will report configured and currently available disk space within the specified directory in kilobytes.</td>
</tr>
<tr>
<td><strong>Memory (availmem)</strong></td>
<td>real memory/RAM</td>
<td>Available real memory/RAM is monitored and reported in kilobytes.</td>
</tr>
<tr>
<td><strong>Network (netload)</strong></td>
<td>local network adapter usage</td>
<td>Reports total number of bytes transferred in or out by the network adapter.</td>
</tr>
<tr>
<td><strong>Processor Utilization (loadave)</strong></td>
<td>node's cpu load average</td>
<td>Reports the node's 1 minute bsd load average.</td>
</tr>
</tbody>
</table>

#### Node States

State information includes administrative status, general node health information, and general usage status.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle Time</td>
<td>time since local keyboard/mouse activity has been detected</td>
<td>Time in seconds since local keyboard/mouse activity has been detected.</td>
</tr>
<tr>
<td>(idletime)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>monitored/admin node state</td>
<td>A node can be in one or more of the following states:</td>
</tr>
<tr>
<td>(state)</td>
<td></td>
<td>- <strong>busy</strong> - node is full and will not accept additional work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>down</strong> - node is failing to report, is detecting local failures with node</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>free</strong> - node is ready to accept additional work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>job-exclusive</strong> - all available virtual processors are assigned to jobs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>job-sharing</strong> - node has been allocated to run multiple shared jobs and will remain in this state until jobs are complete</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>offline</strong> - node has been instructed by an admin to no longer accept work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>reserve</strong> - node has been reserved by the server</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>time-shared</strong> - node always allows multiple jobs to run concurrently</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <strong>unknown</strong> - node has not been detected</td>
</tr>
</tbody>
</table>
Chapter 10 Accounting Records

TORQUE maintains accounting records for batch jobs in the following directory:
$TORQUEROOT/server_priv/accounting/<TIMESTAMP>
$TORQUEROOT defaults to /usr/spool/PBS and <TIMESTAMP> is in the format: YYYYMMDD.

These records include events, time stamps, and information on resources requested and used.

Records for four different event types are produced and are described in the following table:

<table>
<thead>
<tr>
<th>Record marker</th>
<th>Record type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>abort</td>
<td>Job has been aborted by the server</td>
</tr>
<tr>
<td>C</td>
<td>checkpoint</td>
<td>Job has been checkpointed and held</td>
</tr>
<tr>
<td>D</td>
<td>delete</td>
<td>Job has been deleted</td>
</tr>
<tr>
<td>E</td>
<td>exit</td>
<td>Job has exited (either successfully or unsuccessfully)</td>
</tr>
<tr>
<td>Q</td>
<td>queue</td>
<td>Job has been submitted/queued</td>
</tr>
<tr>
<td>R</td>
<td>rerun</td>
<td>Attempt to rerun the job has been made</td>
</tr>
<tr>
<td>S</td>
<td>start</td>
<td>Attempt to start the job has been made (if the job fails to properly start, it may have multiple job start records)</td>
</tr>
<tr>
<td>T</td>
<td>restart</td>
<td>Attempt to restart the job (from checkpoint) has been made (if the job fails to properly start, it may have multiple job start records)</td>
</tr>
</tbody>
</table>

Accounting Variables

The following table offers accounting variable descriptions. Descriptions for accounting variables not indicated in the table, particularly those prefixed with Resources_List, are available at Job Submission on page 55.
### Chapter 10 Accounting Records

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ctime</td>
<td>Time job was created</td>
</tr>
<tr>
<td>etime</td>
<td>Time job became eligible to run</td>
</tr>
<tr>
<td>qtime</td>
<td>Time job was queued</td>
</tr>
<tr>
<td>start</td>
<td>Time job started to run</td>
</tr>
</tbody>
</table>

A sample record in this file can look like the following:

```
08/26/2014 17:07:44;Q;11923.napali;queue=batch
columns
ctime=1409094464 qtime=1409094464 etime=1409094464 start=1409094470 owner=dbeer
exec_host=napali/0+napali/1+napali/2+napali/3+napali/4+napali/5+torque-devtest-03/0+torque-devtest-03/1+torque-devtest-03/2+torque-devtest-03/3+torque-devtest-03/4+torque-devtest-03/5 Resource_List.nodes=2:ppn=6
Resource_List.neednodes=2:ppn=6
Resource_List.nodect=2
Resource_List.nodes=2:ppn=6
session=11352 total_execution_slots=12 unique_node_count=2
end=1409094484 Exit_status=265 resources_used.cput=00:00:00 resources_used.mem=82700kb resources_used.vmem=208960kb resources_used.walltime=00:00:14 Error_Path=/dev/pts/11
Output_Path=/dev/pts/11
```

**The value of Resource_List.* is the amount of resources requested, and the value of resources_used.* is the amount of resources actually used.**

**total_execution_slots and unique_node_count display additional information regarding the job resource usage.**
Chapter 11 Job Logging

New in TORQUE 2.5.3 is the ability to log job information for completed jobs. The information stored in the log file is the same information produced with the command `qstat -f`. The log file data is stored using an XML format. Data can be extracted from the log using the utility `showjobs` found in the `contrib` directory of the TORQUE source tree. Custom scripts that can parse the XML data can also be used.

For details about job logging, see these topics:

- [Job Log Location and Name on page 151](#)
- [Enabling Job Logs on page 151](#)

### Job Log Location and Name

When job logging is enabled (See [Enabling Job Logs on page 151](#).), the job log is kept at `$TORQUE_HOME/job_logs`. The naming convention for the job log is the same as for the server log or MOM log. The log name is created from the current year/month/day.

For example, if today's date is 26 October, 2010 the log file is named `20101026`.

A new log file is created each new day that data is written to the log.

Related Topics

- [Enabling Job Logs on page 151](#)
- [Job Logging on page 151](#)

### Enabling Job Logs

There are five new server parameters used to enable job logging. These parameters control what information is stored in the log and manage the log files.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>record_job_info</code></td>
<td>This must be set to true in order for job logging to be enabled. If not set to true, the remaining server parameters are ignored.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>record_job_script</td>
<td>If set to true, this adds the contents of the script executed by a job to the log.</td>
</tr>
<tr>
<td>job_log_file_max_size</td>
<td>This specifies a soft limit (in kilobytes) for the job log’s maximum size. The file size is checked every five minutes and if the current day file size is greater than or equal to this value, it is rolled from <code>&lt;filename&gt;</code> to <code>&lt;filename.1&gt;</code> and a new empty log is opened. If the current day file size exceeds the maximum size a second time, the <code>&lt;filename.1&gt;</code> log file is rolled to <code>&lt;filename.2&gt;</code>, the current log is rolled to <code>&lt;filename.1&gt;</code>, and a new empty log is opened. Each new log causes all other logs to roll to an extension that is one greater than its current number. Any value less than 0 is ignored by pbs_server (meaning the log will not be rolled).</td>
</tr>
<tr>
<td>job_log_file_roll_depth</td>
<td>This sets the maximum number of new log files that are kept in a day if the job_log_file_max_size parameter is set. For example, if the roll depth is set to 3, no file can roll higher than <code>&lt;filename.3&gt;</code>. If a file is already at the specified depth, such as <code>&lt;filename.3&gt;</code>, the file is deleted so it can be replaced by the incoming file roll, <code>&lt;filename.2&gt;</code>.</td>
</tr>
<tr>
<td>job_log_keep_days</td>
<td>This maintains logs for the number of days designated. If set to 4, any log file older than 4 days old is deleted.</td>
</tr>
</tbody>
</table>

Related Topics

- [Job Log Location and Name on page 151](#)
- [Job Logging on page 151](#)
Chapter 12 Troubleshooting

There are a few general strategies that can be followed to determine the cause of unexpected behavior. These are a few of the tools available to help determine where problems occur. See these topics for details:

- Host Resolution on page 153
- Firewall Configuration on page 153
- TORQUE Log Files on page 154
- Using "tracejob" to Locate Job Failures on page 155
- Using GDB to Locate Job Failures on page 158
- Other Diagnostic Options on page 158
- Stuck Jobs on page 159
- Frequently Asked Questions (FAQ) on page 160
- Compute Node Health Check on page 166
- Debugging on page 168

Host Resolution

The TORQUE server host must be able to perform both forward and reverse name lookup on itself and on all compute nodes. Likewise, each compute node must be able to perform forward and reverse name lookup on itself, the TORQUE server host, and all other compute nodes. In many cases, name resolution is handled by configuring the node's /etc/hosts file although DNS and NIS services may also be used. Commands such as nslookup or dig can be used to verify proper host resolution.

Invalid host resolution may exhibit itself with compute nodes reporting as down within the output of pbsnodes -a and with failure of the momctl -d3 command.

Related Topics
- Troubleshooting on page 153

Firewall Configuration
Be sure that, if you have firewalls running on the server or node machines, you allow connections on the appropriate ports for each machine. TORQUE pbs_mom daemons use UDP ports 1023 and below if privileged ports are configured (privileged ports is the default). The pbs_server and pbs_mom daemons use TCP and UDP ports 15001-15004 by default.

Firewall based issues are often associated with server to MOM communication failures and messages such as 'premature end of message' in the log files.

Also, the tcpdump program can be used to verify the correct network packets are being sent.

**Related Topics**

[Troubleshooting on page 153](#)

---

## TORQUE Log Files

### pbs_server and pbs_mom Log Files

The pbs_server keeps a daily log of all activity in the `TORQUE_HOME/server_logs` directory. The pbs_mom also keeps a daily log of all activity in the `TORQUE_HOME/mom_logs` directory. These logs contain information on communication between server and MOM as well as information on jobs as they enter the queue and as they are dispatched, run, and terminated. These logs can be very helpful in determining general job failures. For MOM logs, the verbosity of the logging can be adjusted by setting the `$loglevel` parameter in the `mom_priv/config` file. For server logs, the verbosity of the logging can be adjusted by setting the server `log_level` attribute in qmgr.

For both pbs_mom and pbs_server daemons, the log verbosity level can also be adjusted by setting the environment variable `PBSLOGLEVEL` to a value between 0 and 7. Further, to dynamically change the log level of a running daemon, use the `SIGUSR1` and `SIGUSR2` signals to increase and decrease the active loglevel by one. Signals are sent to a process using the `kill` command.

For example, `kill -USR1 `pgrep pbs_mom` would raise the log level up by one.

The current loglevel for pbs_mom can be displayed with the command `momctl -d3`.

### trqauthd Log Files

As of TORQUE 4.1.3, trqauthd logs its events in the `$TORQUE_HOME/client_logs` directory. It names the log files in the format `<YYYYMMDD>`, creating a new log daily as events occur.
You might see some peculiar behavior if you mount the `client_logs` directory for shared access via network-attached storage.

When `trqauthd` first gets access on a particular day, it writes an "open" message to the day's log file. It also writes a "close" message to the last log file it accessed prior to that, which is usually the previous day's log file, but not always. For example, if it is Monday and no client commands were executed over the weekend, `trqauthd` writes the "close" message to Friday's file.

Since the various `trqauthd` binaries on the submit hosts (and potentially, the compute nodes) each write an "open" and "close" message on the first access of a new day, you'll see multiple (seemingly random) accesses when you have a shared log.

The `trqauthd` records the following events along with the date and time of the occurrence:

- When `trqauthd` successfully starts. It logs the event with the IP address and port.
- When a user successfully authenticates with `trqauthd`.
- When a user fails to authenticate with `trqauthd`.
- When `trqauthd` encounters any unexpected errors.

**Example 12-1: trqauthd logging sample**

```
2012-10-05 15:05:51.8404 Log opened
2012-10-05 15:05:51.8405 TORQUE authd daemon started and listening on IP:port 101.0.1.0:12345
2012-10-10 14:48:05.5688 User hfrye at IP:port abc:12345 logged in
```

### Related Topics

[Troubleshooting on page 153](#)

## Using "tracejob" to Locate Job Failures

### Overview

The `tracejob` utility extracts job status and job events from accounting records, MOM log files, server log files, and scheduler log files. Using it can help identify where, how, and why a job failed. This tool takes a job id as a parameter as well as arguments to specify which logs to search, how far into the past to search, and other conditions.

### Syntax
tracejob [-a|s|l|m|q|v|z] [-c count] [-w size] [-p path] [ -n <DAYS>] [-f filter_type] <JOBID>

-p : path to PBS_SERVER_HOME
-w : number of columns of your terminal
-n : number of days in the past to look for job(s) [default 1]
-f : filter out types of log entries, multiple -f's can be specified
  error, system, admin, job, job_usage, security, sched, debug,
    debug2, or absolute numeric hex equivalent
-z : toggle filtering excessive messages
-c : what message count is considered excessive
-a : don't use accounting log files
-s : don't use server log files
-l : don't use scheduler log files
-m : don't use MOM log files
-q : quiet mode - hide all error messages
-v : verbose mode - show more error messages

Example
The tracejob command operates by searching the pbs_server accounting records and the pbs_server, MOM, and scheduler logs. To function properly, it must be run on a node and as a user which can access these files. By default, these files are all accessible by the user root and only available on the cluster management node. In particular, the files required by tracejob are located in the following directories:

```
TORQUE_HOME/server_priv/accounting
TORQUE_HOME/server_logs
TORQUE_HOME/mom_logs
TORQUE_HOME/sched_logs
```
tracejob may only be used on systems where these files are made available. Non-root users may be able to use this command if the permissions on these directories or files are changed appropriately.

The value of Resource_List.* is the amount of resources requested, and the value of resources_used.* is the amount of resources actually used.

Using GDB to Locate Job Failures

If either the pbs_mom or pbs_server fail unexpectedly (and the log files contain no information on the failure) gdb can be used to determine whether or not the program is crashing. To start pbs_mom or pbs_server under GDB export the environment variable PBSDEBUG=yes and start the program (i.e., gdb pbs_mom and then issue the run subcommand at the gdb prompt).

GDB may run for some time until a failure occurs and at which point, a message will be printed to the screen and a gdb prompt again made available. If this occurs, use the gdb where subcommand to determine the exact location in the code. The information provided may be adequate to allow local diagnosis and correction. If not, this output may be sent to the mailing list or to help for further assistance.

See the PBSCOREDUMP parameter for enabling creation of core files (see Debugging on page 168).

Related Topics
Troubleshooting on page 153

Other Diagnostic Options

When PBSDEBUG is set, some client commands will print additional diagnostic information.

```
$ export PBSDEBUG=yes
$ cmd
```

To debug different kinds of problems, it can be useful to see where in the code time is being spent. This is called profiling and there is a Linux utility "gprof" that
will output a listing of routines and the amount of time spent in these routines. This does require that the code be compiled with special options to instrument the code and to produce a file, gmon.out, that will be written at the end of program execution.

The following listing shows how to build TORQUE with profiling enabled. Notice that the output file for pbs_mom will end up in the mom_priv directory because its startup code changes the default directory to this location.

```bash
# ./configure "CFLAGS=-pg -lgcov -fpIC"
# make -j5
# make install
# pbs_mom ... do some stuff for a while ...
# momctl -s
# cd /var/spool/torque/mom_priv
# gprof -b `which pbs_mom` gmon.out | less
```

Another way to see areas where a program is spending most of its time is with the valgrind program. The advantage of using valgrind is that the programs do not have to be specially compiled.

```bash
# valgrind --tool=callgrind pbs_mom
```

Related Topics

Troubleshooting on page 153

# Stuck Jobs

If a job gets stuck in TORQUE, try these suggestions to resolve the issue:

- Use the qdel command to cancel the job.
- Force the MOM to send an obituary of the job ID to the server.
  ```bash
  > qsig -s 0 <JOBID>
  ```
- You can try clearing the stale jobs by using the momctl command on the compute nodes where the jobs are still listed.
  ```bash
  > momctl -c 58925 -h compute-5-20
  ```
- Setting the qmgr server setting mom_job_sync to True might help prevent jobs from hanging.
  ```bash
  > qmgr -c "set server mom_job_sync = True"
  ```

To check and see if this is already set, use:

```bash
> qmgr -c "p s"
```
If the suggestions above cannot remove the stuck job, you can try `qdel -p`. However, since the `-p` option purges all information generated by the job, this is not a recommended option unless the above suggestions fail to remove the stuck job.

```
> qdel -p <JOBID>
```

The last suggestion for removing stuck jobs from compute nodes is to restart the `pbs_mom`.

For additional troubleshooting, run a `tracejob` on one of the stuck jobs. You can then create an [online support ticket](#) with the full server log for the time period displayed in the trace job.

Related Topics

[Troubleshooting on page 153](#)

**Frequently Asked Questions (FAQ)**

- [Cannot connect to server: error=15034 on page 161](#)
- [Deleting 'stuck' jobs on page 161](#)
- [Which user must run TORQUE? on page 161](#)
- [Scheduler cannot run jobs - rc: 15003 on page 161](#)
- [PBS_Server: pbsd_init, Unable to read server database on page 162](#)
- [`qsub` will not allow the submission of jobs requesting many processors on page 163](#)
- [`qsub` reports 'Bad UID for job execution' on page 163](#)
- [Why does my job keep bouncing from running to queued? on page 163](#)
- [How do I use PVM with TORQUE? on page 164](#)
- [My build fails attempting to use the TCL library on page 164](#)
- [My job will not start, failing with the message 'cannot send job to mom, state=PRERUN' on page 164](#)
- [How do I determine what version of TORQUE I am using? on page 165](#)
- [How do I resolve `autogen.sh` errors that contain "error: possibly undefined macro: AC_MSG_ERROR"? on page 165](#)
- [How do I resolve compile errors with `libssl` or `libcrypto` for TORQUE 4.0 on Ubuntu 10.04? on page 165](#)
- [Why are there so many error messages in the client logs (`trqauthd` logs) when I don't notice client commands failing? on page 165](#)
Cannot connect to server: error=15034

This error occurs in TORQUE clients (or their APIs) because TORQUE cannot find the `server_name` file and/or the PBS_DEFAULT environment variable is not set. The `server_name` file or PBS_DEFAULT variable indicate the pbs_server's hostname that the client tools should communicate with. The `server_name` file is usually located in TORQUE's local state directory. Make sure the file exists, has proper permissions, and that the version of TORQUE you are running was built with the proper directory settings. Alternatively you can set the PBS_DEFAULT environment variable. Restart TORQUE daemons if you make changes to these settings.

Deleting 'stuck' jobs

To manually delete a "stale" job which has no process, and for which the mother superior is still alive, sending a sig 0 with qsig will often cause MOM to realize the job is stale and issue the proper JobObit notice. Failing that, use momctl -c to forcefully cause MOM to purge the job. The following process should never be necessary:

- Shut down the MOM on the mother superior node.
- Delete all files and directories related to the job from `TORQUE_HOME/mom_priv/jobs`.
- Restart the MOM on the mother superior node.

If the mother superior MOM has been lost and cannot be recovered (i.e. hardware or disk failure), a job running on that node can be purged from the output of qstat using the `qdel` on page 210 -p command or can be removed manually using the following steps:

To remove job X

1. Shut down pbs_server.
   ```
   > qterm
   ```
2. Remove job spool files.
   ```
   > rm TORQUE_HOME/server_priv/jobs/X.SC TORQUE_HOME/server_priv/jobs/X.JB
   ```
3. Restart pbs_server
   ```
   > pbs_server
   ```

Which user must run TORQUE?

TORQUE (pbs_server & pbs_mom) must be started by a user with root privileges.

Scheduler cannot run jobs - rc: 15003
For a scheduler, such as Moab or Maui, to control jobs with TORQUE, the scheduler needs to be run by a user in the server operators / managers list (see qmgr). The default for the server operators / managers list is root@localhost. For TORQUE to be used in a grid setting with Silver, the scheduler needs to be run as root.

**PBS_Server: pbsd_init, Unable to read server database**

If this message is displayed upon starting pbs_server it means that the local database cannot be read. This can be for several reasons. The most likely is a version mismatch. Most versions of TORQUE can read each other’s databases. However, there are a few incompatibilities between OpenPBS and TORQUE. Because of enhancements to TORQUE, it cannot read the job database of an OpenPBS server (job structure sizes have been altered to increase functionality). Also, a compiled in 32-bit mode cannot read a database generated by a 64-bit pbs_server and vice versa.

**To reconstruct a database (excluding the job database)**

1. First, print out the old data with this command:

   ```
   %> qmgr -c "p s"
   # Create queues and set their attributes.
   # Create and define queue batch
   # create queue batch
   set queue batch queue_type = Execution
   set queue batch acl_host_enable = False
   set queue batch resources_max.nodect = 6
   set queue batch resources_default.nodes = 1
   set queue batch resources_default.walltime = 01:00:00
   set queue batch resources_available.nodect = 18
   set queue batch enabled = True
   set queue batch started = True
   # Set server attributes.
   # set server scheduling = True
   set server managers = griduser@oahu.icluster.org
   set server managers += scott@*.icluster.org
   set server managers += wightman@*.icluster.org
   set server operators = griduser@oahu.icluster.org
   set server operators += scott@*.icluster.org
   set server operators += wightman@*.icluster.org
   set server default_queue = batch
   set server log_events = 511
   set server mail_from = adm
   set server resources_available.nodect = 80
   set server node_ping_rate = 300
   set server node_check_rate = 600
   set server tcp_timeout = 6
   ``

2. Copy this information somewhere.

3. Restart pbs_server with the following command:

   ```
   > pbs_server -t create
   ```
4. When you are prompted to overwrite the previous database, enter y, then enter the data exported by the `qmgr` command as in this example:

```
> cat data | qmgr
```

5. Restart `pbs_server` without the flags:

```
> qterm
> pbs_server
```

This will reinitialize the database to the current version.

### Reinitializing the server database will reset the next jobid to 1

**qsub** will not allow the submission of jobs requesting many processors

TORQUE's definition of a node is context sensitive and can appear inconsistent. The `qsub -l nodes=<X>` expression can at times indicate a request for X processors and other time be interpreted as a request for X nodes. While `qsub` allows multiple interpretations of the keyword `nodes`, aspects of the TORQUE server's logic are not so flexible. Consequently, if a job is using `-l nodes` to specify processor count and the requested number of processors exceeds the available number of physical nodes, the server daemon will reject the job.

To get around this issue, the server can be told it has an inflated number of nodes using the `resources_available` attribute. To take effect, this attribute should be set on both the server and the associated queue as in the example below. (See `resources_available` for more information.)

```
> qmgr
Qmgr: set server resources_available.nodect=2048
Qmgr: set queue batch resources_available.nodect=2048
```

**The pbs_server daemon will need to be restarted before these changes will take effect.**

### qsub reports 'Bad UID for job execution'

```
[guest@login2]$ qsub test.job
qsub: Bad UID for job execution
```

Job submission hosts must be explicitly specified within TORQUE or enabled via RCmd security mechanisms in order to be trusted. In the example above, the host 'login2' is not configured to be trusted. This process is documented in Configuring Job Submission Hosts on page 35.

### Why does my job keep bouncing from running to queued?
There are several reasons why a job will fail to start. Do you see any errors in the MOM logs? Be sure to increase the loglevel on MOM if you don't see anything. Also be sure TORQUE is configured with \texttt{--enable-syslog} and look in \texttt{/var/log/messages} (or wherever your syslog writes).

Also verify the following on all machines:

- DNS resolution works correctly with matching forward and reverse
- Time is synchronized across the head and compute nodes
- User accounts exist on all compute nodes
- User home directories can be mounted on all compute nodes
- Prologue scripts (if specified) exit with 0

If using a scheduler such as Moab or Maui, use a scheduler tool such as \texttt{checkjob} to identify job start issues.

**How do I use PVM with TORQUE?**

- Start the master \texttt{pvmd} on a compute node and then add the slaves
- \texttt{mpiexec} can be used to launch slaves using \texttt{rsh} or \texttt{ssh} (use export \texttt{PVM\_RSH=/usr/bin/ssh} to use \texttt{ssh})

> Access can be managed by \texttt{rsh/ssh} without passwords between the batch nodes, but denying it from anywhere else, including the interactive nodes. This can be done with \texttt{xinetd} and \texttt{sshd} configuration (root is allowed to \texttt{ssh} everywhere). This way, the \texttt{pvm} daemons can be started and killed from the job script.

The problem is that this setup allows the users to bypass the batch system by writing a job script that uses \texttt{rsh/ssh} to launch processes on the batch nodes. If there are relatively few users and they can more or less be trusted, this setup can work.

**My build fails attempting to use the TCL library**

TORQUE builds can fail on TCL dependencies even if a version of TCL is available on the system. TCL is only utilized to support the \texttt{xpbsmon} client. If your site does not use this tool (most sites do not use \texttt{xpbsmon}), you can work around this failure by rerunning \texttt{configure} with the \texttt{--disable-gui} argument.

**My job will not start, failing with the message 'cannot send job to mom, state=PRERUN'**

If a node crashes or other major system failures occur, it is possible that a job may be stuck in a corrupt state on a compute node. TORQUE 2.2.0 and higher
automatically handle this when the `mom job sync` parameter is set via qmgr (the default). For earlier versions of TORQUE, set this parameter and restart the pbs_mom daemon.

This error can also occur if not enough free space is available on the partition that holds TORQUE.

**How do I determine what version of TORQUE I am using?**

There are times when you want to find out what version of TORQUE you are using. An easy way to do this is to run the following command:

```bash
qmgr
> qmgr -c "p s" | grep pbs_ver
```

**How do I resolve autogen.sh errors that contain "error: possibly undefined macro: AC_MSG_ERROR"?**

Verify the `pkg-config` package is installed.

**How do I resolve compile errors with libssl or libcrypto for TORQUE 4.0 on Ubuntu 10.04?**

When compiling TORQUE 4.0 on Ubuntu 10.04 the following errors might occur:

```bash
libtool: link: gcc -Wall -pthread -g -D_LARGEFILE64_SOURCE -o .libs/trqauthd trq_authdaemon.o trq_main.o -ldl -lssl -lcrypto -L/home/adaptive/torques/torque-4.0.0/src/lib/Libpbs/.libs /home/adaptive/torques/torque-4.0.0/src/lib/Libpbs/.libs/libtorque.so -lpthread -lrt -pthread
/usr/bin/ld: cannot find -lssl
collect2: ld returned 1 exit status
make[3]: *** [trqauthd] Error 1

libtool: link: gcc -Wall -pthread -g -D_LARGEFILE64_SOURCE -o .libs/trqauthd trq_authdaemon.o trq_main.o -ldl -lssl -lcrypto -L/home/adaptive/torques/torque-4.0.0/src/lib/Libpbs/.libs /home/adaptive/torques/torque-4.0.0/src/lib/Libpbs/.libs/libtorque.so -lpthread -lrt -pthread
/usr/bin/ld: cannot find -lcrypto
collect2: ld returned 1 exit status
make[3]: *** [trqauthd] Error 1
```

To resolve the compile issue, use these commands:

```bash
> cd /usr/lib
> ln -s /lib/libcrypto.so.0.9. libcrypto.so
> ln -s /lib/libssl.so.0.9.8 libssl.so
```

**Why are there so many error messages in the client logs (trqauthd logs) when I don't notice client commands failing?**
If a client makes a connection to the server and the trqauthd connection for that client command is authorized before the client's connection, the trqauthd connection is rejected. The connection is retried, but if all retry attempts are rejected, trqauthd logs a message indicating a failure. Some client commands then open a new connection to the server and try again. The client command fails only if all its retries fail.

Related Topics

Troubleshooting on page 153

Compute Node Health Check

TORQUE provides the ability to perform health checks on each compute node. If these checks fail, a failure message can be associated with the node and routed to the scheduler. Schedulers (such as Moab) can forward this information to administrators by way of scheduler triggers, make it available through scheduler diagnostic commands, and automatically mark the node down until the issue is resolved. See the RMMSGIGNORE parameter in the Moab Workload Manager Administrator Guide for more information.

Additionally, Michael Jennings at LBNL has authored an open-source bash node health check script project. It offers an easy way to perform some of the most common node health checking tasks, such as verifying network and filesystem functionality. More information is available on the project's page.

For more information about node health checks, see these topics:

- Configuring MOMs to Launch a Health Check on page 166
- Creating the Health Check Script on page 167
- Adjusting Node State Based on the Health Check Output on page 168
- Example Health Check Script on page 168

Related Topics

Troubleshooting on page 153

Configuring MOMs to Launch a Health Check

The health check feature is configured via the mom_priv/config file using the parameters described below:
### Creating the Health Check Script

The health check script is executed directly by the pbs_mom daemon under the root user id. It must be accessible from the compute node and may be a script or compile executable program. It may make any needed system calls and execute any combination of system utilities but should not execute resource manager client commands. Also, as of TORQUE 1.0.1, the pbs_mom daemon blocks until the health check is completed and does not possess a built-in timeout. Consequently, it is advisable to keep the launch script execution time short and verify that the script will not block even under failure conditions.

If the script detects a failure, it should return the keyword `ERROR` to stdout followed by an error message. When a failure is detected, the ERROR keyword should be printed to stdout before any other data. The message (up to 1024 characters) immediately following the ERROR keyword must all be contained on the same line. The message is assigned to the node attribute 'message' of the associated node.

### Related Topics

- [Compute Node Health Check on page 166](#)
Adjusting Node State Based on the Health Check Output

If the health check reports an error, the node attribute "message" is set to the error string returned. Cluster schedulers can be configured to adjust a given node's state based on this information. For example, by default, Moab sets a node's state to down if a node error message is detected. The node health script continues to run at the configured interval (see Configuring MOMs to Launch a Health Check on page 166 for more information), and if it does not generate the error message again during one of its later executions, Moab picks that up at the beginning of its next iteration and restores the node to an online state.

Related Topics

Compute Node Health Check on page 166

Example Health Check Script

As mentioned, the health check can be a shell script, PERL, Python, C-executable, or anything which can be executed from the command line capable of setting STDOUT. The example below demonstrates a very simple health check:

```bash
#!/bin/sh
/bin/mount | grep global
if [ $? != "0" ]
  then
    echo "ERROR cannot locate filesystem global"
fi
```

Related Topics

Compute Node Health Check on page 166

Debugging

TORQUE supports a number of diagnostic and debug options including the following:

PBSDEBUG environment variable - If set to 'yes', this variable will prevent pbs_server, pbs_mom, and/or pbs_sched from backgrounding themselves allowing direct launch under a debugger. Also, some client commands will provide additional diagnostic information when this value is set.

PBSLOGLEVEL environment variable - Can be set to any value between 0 and 7 and specifies the logging verbosity level (default = 0)

PBSSCOREDUMP environment variable - If set, it will cause the offending resource manager daemon to create a core file if a SIGSEGV, SIGILL, SIGFPE,
SIGSYS, or SIGTRAP signal is received. The core dump will be placed in the daemon's home directory ($PBSHOME/mom_priv for pbs_mom and $PBSHOME/server_priv for pbs_server).

To enable core dumping in a Red Hat system, you must add the following line to the /etc/init.d/pbs_mom and /etc/init.d/pbs_server scripts:

```
export DAEMON_COREFILE_LIMIT=unlimited
```

NDEBUG #define - if set at build time, will cause additional low-level logging information to be output to stdout for pbs_server and pbs_mom daemons.

tracejob reporting tool - can be used to collect and report logging and accounting information for specific jobs (See Using "tracejob" to Locate Job Failures on page 155) for more information.

PBSLOGLEVEL and PBSCOREDUMP must be added to the $PBSHOME/pbs_environment file, not just the current environment. To set these variables, add a line to the pbs_environment file as either "variable=value" or just "variable". In the case of "variable=value", the environment variable is set up as the value specified. In the case of "variable", the environment variable is set based upon its value in the current environment.

**TORQUE Error Codes**

<table>
<thead>
<tr>
<th>Error code name</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_FLOOR</td>
<td>15000</td>
<td>No error</td>
</tr>
<tr>
<td>PBSE_UNKJOBID</td>
<td>15001</td>
<td>Unknown job identifier</td>
</tr>
<tr>
<td>PBSE_NOATTR</td>
<td>15002</td>
<td>Undefined attribute</td>
</tr>
<tr>
<td>PBSE_ATTRRO</td>
<td>15003</td>
<td>Attempt to set READ ONLY attribute</td>
</tr>
<tr>
<td>PBSE_IVALREQ</td>
<td>15004</td>
<td>Invalid request</td>
</tr>
<tr>
<td>PBSE_UNKREQ</td>
<td>15005</td>
<td>Unknown batch request</td>
</tr>
<tr>
<td>PBSE_TOOMANY</td>
<td>15006</td>
<td>Too many submit retries</td>
</tr>
<tr>
<td>PBSE_PERM</td>
<td>15007</td>
<td>No permission</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_JFF_NOT_FOUND</td>
<td>15008</td>
<td>&quot;pbs_jff&quot; not found; unable to authenticate</td>
</tr>
<tr>
<td>PBSE_MUNGE_NOT_FOUND</td>
<td>15009</td>
<td>&quot;munge&quot; executable not found; unable to authenticate</td>
</tr>
<tr>
<td>PBSE_BADHOST</td>
<td>15010</td>
<td>Access from host not allowed</td>
</tr>
<tr>
<td>PBSE_JOBEXIST</td>
<td>15011</td>
<td>Job already exists</td>
</tr>
<tr>
<td>PBSE_SYSTEM</td>
<td>15012</td>
<td>System error occurred</td>
</tr>
<tr>
<td>PBSE_INTERNAL</td>
<td>15013</td>
<td>Internal server error occurred</td>
</tr>
<tr>
<td>PBSE_REGROUTE</td>
<td>15014</td>
<td>Parent job of dependent in rte queue</td>
</tr>
<tr>
<td>PBSE_UNKSIG</td>
<td>15015</td>
<td>Unknown signal name</td>
</tr>
<tr>
<td>PBSE_BADATVAL</td>
<td>15016</td>
<td>Bad attribute value</td>
</tr>
<tr>
<td>PBSE_MODATRRUN</td>
<td>15017</td>
<td>Cannot modify attribute in run state</td>
</tr>
<tr>
<td>PBSE_BADSTATE</td>
<td>15018</td>
<td>Request invalid for job state</td>
</tr>
<tr>
<td>PBSE_UNKQUE</td>
<td>15020</td>
<td>Unknown queue name</td>
</tr>
<tr>
<td>PBSE_BADCRED</td>
<td>15021</td>
<td>Invalid credential in request</td>
</tr>
<tr>
<td>PBSE_EXPIRED</td>
<td>15022</td>
<td>Expired credential in request</td>
</tr>
<tr>
<td>PBSE_QUNOENB</td>
<td>15023</td>
<td>Queue not enabled</td>
</tr>
<tr>
<td>PBSE_QACCESS</td>
<td>15024</td>
<td>No access permission for queue</td>
</tr>
<tr>
<td>PBSE_BADUSER</td>
<td>15025</td>
<td>Bad user - no password entry</td>
</tr>
<tr>
<td>PBSE_HOPCOUNT</td>
<td>15026</td>
<td>Max hop count exceeded</td>
</tr>
<tr>
<td>PBSE_QUEEXIST</td>
<td>15027</td>
<td>Queue already exists</td>
</tr>
<tr>
<td>PBSE_ATTRTYPE</td>
<td>15028</td>
<td>Incompatible queue attribute type</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_QUEBUSY</td>
<td>15029</td>
<td>Queue busy (not empty)</td>
</tr>
<tr>
<td>PBSE_QUENBIG</td>
<td>15030</td>
<td>Queue name too long</td>
</tr>
<tr>
<td>PBSE_NOSUP</td>
<td>15031</td>
<td>Feature/function not supported</td>
</tr>
<tr>
<td>PBSE_QUENOEN</td>
<td>15032</td>
<td>Cannot enable queue, needs add def</td>
</tr>
<tr>
<td>PBSE_PROTOCOL</td>
<td>15033</td>
<td>Protocol (ASN.1) error</td>
</tr>
<tr>
<td>PBSE_BADATLST</td>
<td>15034</td>
<td>Bad attribute list structure</td>
</tr>
<tr>
<td>PBSE_NOCONNECTS</td>
<td>15035</td>
<td>No free connections</td>
</tr>
<tr>
<td>PBSE_NOSERVER</td>
<td>15036</td>
<td>No server to connect to</td>
</tr>
<tr>
<td>PBSE_UNKESC</td>
<td>15037</td>
<td>Unknown resource</td>
</tr>
<tr>
<td>PBSE_EXCQRESC</td>
<td>15038</td>
<td>Job exceeds queue resource limits</td>
</tr>
<tr>
<td>PBSE_QUENODFLT</td>
<td>15039</td>
<td>No default queue defined</td>
</tr>
<tr>
<td>PBSE_NORERUN</td>
<td>15040</td>
<td>Job not rerunnable</td>
</tr>
<tr>
<td>PBSE_ROUTEREJ</td>
<td>15041</td>
<td>Route rejected by all destinations</td>
</tr>
<tr>
<td>PBSE_ROUTEEXPD</td>
<td>15042</td>
<td>Time in route queue expired</td>
</tr>
<tr>
<td>PBSE_MOMREJECT</td>
<td>15043</td>
<td>Request to MOM failed</td>
</tr>
<tr>
<td>PBSE_BADSCRIPT</td>
<td>15044</td>
<td>(qsub) Cannot access script file</td>
</tr>
<tr>
<td>PBSE_STAGEIN</td>
<td>15045</td>
<td>Stage-In of files failed</td>
</tr>
<tr>
<td>PBSE_RESCUNAV</td>
<td>15046</td>
<td>Resources temporarily unavailable</td>
</tr>
<tr>
<td>PBSE_BADGRP</td>
<td>15047</td>
<td>Bad group specified</td>
</tr>
<tr>
<td>PBSE_MAXQUED</td>
<td>15048</td>
<td>Max number of jobs in queue</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>PBSE_CKPBSY</td>
<td>15049</td>
<td>Checkpoint busy, may be retries</td>
</tr>
<tr>
<td>PBSE_EXLIMIT</td>
<td>15050</td>
<td>Limit exceeds allowable</td>
</tr>
<tr>
<td>PBSE_BADACCT</td>
<td>15051</td>
<td>Bad account attribute value</td>
</tr>
<tr>
<td>PBSE_ALRDYEXIT</td>
<td>15052</td>
<td>Job already in exit state</td>
</tr>
<tr>
<td>PBSE_NOCOPYFILE</td>
<td>15053</td>
<td>Job files not copied</td>
</tr>
<tr>
<td>PBSE_CLEANEDOUT</td>
<td>15054</td>
<td>Unknown job id after clean init</td>
</tr>
<tr>
<td>PBSE_NOSYNCMSTR</td>
<td>15055</td>
<td>No master in sync set</td>
</tr>
<tr>
<td>PBSE_BADDEPEND</td>
<td>15056</td>
<td>Invalid dependency</td>
</tr>
<tr>
<td>PBSE_DUPLIST</td>
<td>15057</td>
<td>Duplicate entry in list</td>
</tr>
<tr>
<td>PBSE_DISPROTO</td>
<td>15058</td>
<td>Bad DIS based request protocol</td>
</tr>
<tr>
<td>PBSE_EXECTHERE</td>
<td>15059</td>
<td>Cannot execute there</td>
</tr>
<tr>
<td>PBSE_SISREJECT</td>
<td>15060</td>
<td>Sister rejected</td>
</tr>
<tr>
<td>PBSE_SISCOMM</td>
<td>15061</td>
<td>Sister could not communicate</td>
</tr>
<tr>
<td>PBSE_SVRDOWN</td>
<td>15062</td>
<td>Requirement rejected -server shutting down</td>
</tr>
<tr>
<td>PBSE_CKPSHORT</td>
<td>15063</td>
<td>Not all tasks could checkpoint</td>
</tr>
<tr>
<td>PBSE_UNKNOODE</td>
<td>15064</td>
<td>Named node is not in the list</td>
</tr>
<tr>
<td>PBSE_UNKNODEATR</td>
<td>15065</td>
<td>Node-attribute not recognized</td>
</tr>
<tr>
<td>PBSE_NONODES</td>
<td>15066</td>
<td>Server has no node list</td>
</tr>
<tr>
<td>PBSE_NODENBIG</td>
<td>15067</td>
<td>Node name is too big</td>
</tr>
<tr>
<td>PBSE_NODEEXIST</td>
<td>15068</td>
<td>Node name already exists</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_BADNDATVAL</td>
<td>15069</td>
<td>Bad node-attribute value</td>
</tr>
<tr>
<td>PBSE_MUTUALEX</td>
<td>15070</td>
<td>State values are mutually exclusive</td>
</tr>
<tr>
<td>PBSE_GMODERR</td>
<td>15071</td>
<td>Error(s) during global modification of nodes</td>
</tr>
<tr>
<td>PBSE_NORELYMOM</td>
<td>15072</td>
<td>Could not contact MOM</td>
</tr>
<tr>
<td>PBSE_NOTSNODE</td>
<td>15073</td>
<td>No time-shared nodes</td>
</tr>
<tr>
<td>PBSE_JOBTYPE</td>
<td>15074</td>
<td>Wrong job type</td>
</tr>
<tr>
<td>PBSE_BADACLHOST</td>
<td>15075</td>
<td>Bad ACL entry in host list</td>
</tr>
<tr>
<td>PBSE_MAXUSERQUED</td>
<td>15076</td>
<td>Maximum number of jobs already in queue for user</td>
</tr>
<tr>
<td>PBSE_BADDISALLOWTYPE</td>
<td>15077</td>
<td>Bad type in &quot;disallowed_types&quot; list</td>
</tr>
<tr>
<td>PBSE_NOINTERACTIVE</td>
<td>15078</td>
<td>Interactive jobs not allowed in queue</td>
</tr>
<tr>
<td>PBSE_NOBATCH</td>
<td>15079</td>
<td>Batch jobs not allowed in queue</td>
</tr>
<tr>
<td>PBSE_NORERUNABLE</td>
<td>15080</td>
<td>Rerunable jobs not allowed in queue</td>
</tr>
<tr>
<td>PBSE_NONONRERUNABLE</td>
<td>15081</td>
<td>Non-rerunable jobs not allowed in queue</td>
</tr>
<tr>
<td>PBSE_UNKARRAYID</td>
<td>15082</td>
<td>Unknown array ID</td>
</tr>
<tr>
<td>PBSE_BAD_ARRAY_REQ</td>
<td>15083</td>
<td>Bad job array request</td>
</tr>
<tr>
<td>PBSE_TIMEOUT</td>
<td>15084</td>
<td>Time out</td>
</tr>
<tr>
<td>PBSEJOBNOTFOUND</td>
<td>15085</td>
<td>Job not found</td>
</tr>
<tr>
<td>PBSE_NOFAULTTOLERANT</td>
<td>15086</td>
<td>Fault tolerant jobs not allowed in queue</td>
</tr>
<tr>
<td>PBSE_NOFAULTINTOLERANT</td>
<td>15087</td>
<td>Only fault tolerant jobs allowed in queue</td>
</tr>
<tr>
<td>PBSE_NOJOBARRAYS</td>
<td>15088</td>
<td>Job arrays not allowed in queue</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_RELAYED_TO_MOM</td>
<td>15089</td>
<td>Request was relayed to a MOM</td>
</tr>
<tr>
<td>PBSE_MEM_MALLOC</td>
<td>15090</td>
<td>Failed to allocate memory for memmgr</td>
</tr>
<tr>
<td>PBSE_MUTEX</td>
<td>15091</td>
<td>Failed to allocate controlling mutex (lock/unlock)</td>
</tr>
<tr>
<td>PBSE_THREAD</td>
<td>15092</td>
<td>Failed to set thread attributes</td>
</tr>
<tr>
<td>PBSE_THREAD</td>
<td>15093</td>
<td>Failed to create thread</td>
</tr>
<tr>
<td>PBSE_SELECT</td>
<td>15094</td>
<td>Failed to select socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_FAULT</td>
<td>15095</td>
<td>Failed to get connection to socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_WRITE</td>
<td>15096</td>
<td>Failed to write data to socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_READ</td>
<td>15097</td>
<td>Failed to read data from socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_CLOSE</td>
<td>15098</td>
<td>Socket closed</td>
</tr>
<tr>
<td>PBSE_SOCKET_LISTEN</td>
<td>15099</td>
<td>Failed to listen in on socket</td>
</tr>
<tr>
<td>PBSE_AUTH_INVALID</td>
<td>15100</td>
<td>Invalid auth type in request</td>
</tr>
<tr>
<td>PBSE_NOTIMPLEMENTED</td>
<td>15101</td>
<td>Functionality not yet implemented</td>
</tr>
<tr>
<td>PBSE_QUENOTAVAILABLE</td>
<td>15102</td>
<td>Queue is not available</td>
</tr>
</tbody>
</table>

Related Topics

[Troubleshooting on page 153](#)
Appendices

The appendices provide tables of commands, parameters, configuration options, error codes, the Quick Start Guide, and so forth.

- Commands Overview on page 177
- Server Parameters on page 261
- Node Manager (MOM) Configuration on page 283
- Diagnostics and Error Codes on page 305
- Considerations Before Upgrading on page 313
- Large Cluster Considerations on page 315
- Prologue and Epilogue Scripts on page 323
- Running Multiple TORQUE Servers and MOMs on the Same Node on page 331
- Security Overview on page 333
- Job Submission Filter ("qsub Wrapper") on page 335
- "torque.cfg" Configuration File on page 337
- Appendix L: TORQUE Quick Start Guide on page 343
- BLCR Acceptance Tests on page 347
# Commands Overview

## Client Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>momctl</td>
<td>Manage/diagnose MOM (node execution) daemon</td>
</tr>
<tr>
<td>pbsdsh</td>
<td>Launch tasks within a parallel job</td>
</tr>
<tr>
<td>pbsnodes</td>
<td>View/modify batch status of compute nodes</td>
</tr>
<tr>
<td>qalter</td>
<td>Modify queued batch jobs</td>
</tr>
<tr>
<td>qchkpt</td>
<td>Checkpoint batch jobs</td>
</tr>
<tr>
<td>qdel</td>
<td>Delete/cancel batch jobs</td>
</tr>
<tr>
<td>qgpumode</td>
<td>Specifies new mode for GPU</td>
</tr>
<tr>
<td>qgpureset</td>
<td>Reset the GPU</td>
</tr>
<tr>
<td>qhold</td>
<td>Hold batch jobs</td>
</tr>
<tr>
<td>qmgr</td>
<td>Manage policies and other batch configuration</td>
</tr>
<tr>
<td>qmove on page 220</td>
<td>Move batch jobs</td>
</tr>
<tr>
<td>qorder on page 221</td>
<td>Exchange order of two batch jobs in any queue</td>
</tr>
<tr>
<td>qrerun</td>
<td>Rerun a batch job</td>
</tr>
<tr>
<td>qrls</td>
<td>Release batch job holds</td>
</tr>
<tr>
<td>qrun</td>
<td>Start a batch job</td>
</tr>
<tr>
<td>Command</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>qsig</td>
<td>Send a signal to a batch job</td>
</tr>
<tr>
<td>qstat</td>
<td>View queues and jobs</td>
</tr>
<tr>
<td>qsub</td>
<td>Submit jobs</td>
</tr>
<tr>
<td>qterm</td>
<td>Shutdown pbs server daemon</td>
</tr>
<tr>
<td>tracejob</td>
<td>Trace job actions and states recorded in TORQUE logs (see Using “tracejob” to Locate Job Failures on page 155)</td>
</tr>
</tbody>
</table>

**Binary Executables**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pbs_iff</td>
<td>Interprocess authentication service</td>
</tr>
<tr>
<td>pbs_mom</td>
<td>Start MOM (node execution) daemon</td>
</tr>
<tr>
<td>pbs_server</td>
<td>Start server daemon</td>
</tr>
<tr>
<td>pbs_track</td>
<td>Tell pbs_mom to track a new process</td>
</tr>
</tbody>
</table>

**Related Topics**
- Node Manager (MOM) Configuration on page 283
- Server Parameters on page 261

**momctl**

*PBS MOM Control*

**Synopsis**

```
momctl -c { <JOBID> | all }
momctl -C
momctl -d { <INTEGER> | <JOBID> }
momctl -f <FILE>
momctl -h <HOST>[,<HOST>]
momctl -p <PORT NUMBER>
momctl -q <ATTRIBUTE>
```
momctl  \( -r \{ <\text{FILE}> \mid \text{LOCAL:<FILE>>} \}
momctl  \( -s \)

**Overview**

The *momctl* command allows remote shutdown, reconfiguration, diagnostics, and querying of the *pbs_mom* daemon.

**Format**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( -c ) — Clear</td>
<td>Makes the MOM unaware of the job’s existence. It does not clean up any processes associated with the job.</td>
</tr>
<tr>
<td>Format</td>
<td>{ (&lt;\text{JOBID}&gt; \mid \text{all}&gt; )</td>
</tr>
<tr>
<td>Default</td>
<td>---</td>
</tr>
</tbody>
</table>
| Example | ```
momctl \ -n\ ode1 \ -c 15406
``` |
| \( -C \) — Cycle | Cycle *pbs_mom*(s) |
| Format | --- |
| Default | --- |
| Description | Cycle *pbs_mom* on node1. |
| Example | ```
momctl \ -n\ ode1 \ -C
``` |
| \( -d \) — Diagnose | Diagnose MOM(s) (For more details, see Diagnose detail on page 182 below.) |
| Format | \{ \(<\text{INTEGER}> \mid <\text{JOBID}> \) |
| Default | 0 |
| Description | --- |
### -d — Diagnose

<table>
<thead>
<tr>
<th>Example</th>
<th>momctl -n node1 -d 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Print level 2 and lower diagnose information for the MOM on node1.</td>
</tr>
</tbody>
</table>

### -f — Host File

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;FILE&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>A file containing only comma or whitespace (space, tab, or new line) delimited hostnames</td>
</tr>
<tr>
<td>Example</td>
<td>momctl -f hosts.txt -d</td>
</tr>
<tr>
<td></td>
<td>Print diagnose information for the MOMs running on the hosts specified in hosts.txt.</td>
</tr>
</tbody>
</table>

### -h — Host List

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;HOST&gt;[,&lt;HOST&gt;].</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>localhost</td>
</tr>
<tr>
<td>Description</td>
<td>A comma separated list of hosts</td>
</tr>
<tr>
<td>Example</td>
<td>momctl -h node1,node2,node3 -d</td>
</tr>
<tr>
<td></td>
<td>Print diagnose information for the MOMs running on node1, node2, and node3.</td>
</tr>
</tbody>
</table>

### -p — Port

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;PORT_NUMBER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>TORQUE’s default port number</td>
</tr>
<tr>
<td>Description</td>
<td>The port number for the specified MOM(s)</td>
</tr>
<tr>
<td>Example</td>
<td>momctl -p 5455 -h node1 -d</td>
</tr>
<tr>
<td></td>
<td>Request diagnose information over port 5455 on node1.</td>
</tr>
</tbody>
</table>
### -q — Query

<table>
<thead>
<tr>
<th>Format</th>
<th><code>&lt;ATTRIBUTE&gt;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td><code>---</code></td>
</tr>
<tr>
<td>Description</td>
<td>Query <code>&lt;ATTRIBUTE&gt;</code> on specified MOM, where <code>&lt;ATTRIBUTE&gt;</code> is a property listed by <code>pbsnodes -a</code> (see Query attributes on page 181 for a list of attributes)</td>
</tr>
<tr>
<td>Example</td>
<td><code>momctl -q phy mem</code></td>
</tr>
</tbody>
</table>

Print the amount of phy mem on localhost.

### -r — Reconfigure

| Format     | `{ <FILE> | LOCAL:<FILE> }` |
|------------|-------------------|
| Default    | `---`             |
| Description| Reconfigure MOM(s) with remote or local config file, `<FILE>`. This does not work if `$remote_reconfig` is not set to true when the MOM is started. |
| Example    | `momctl -r /home/user1/new.config -h node1` |

Reconfigure MOM on node1 with `/home/user1/new.config` on node1.

### -s — Shutdown

<table>
<thead>
<tr>
<th>Format</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td><code>---</code></td>
</tr>
<tr>
<td>Description</td>
<td>Shutdown <code>pbs_mom</code></td>
</tr>
<tr>
<td>Example</td>
<td><code>momctl -s</code></td>
</tr>
</tbody>
</table>

Terminates `pbs_mom` process on localhost.

### Query attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>arch</td>
<td>node hardware architecture</td>
</tr>
<tr>
<td>availmem</td>
<td>available RAM</td>
</tr>
<tr>
<td>loadave</td>
<td>1 minute load average</td>
</tr>
<tr>
<td>ncpus</td>
<td>number of CPUs available on the system</td>
</tr>
<tr>
<td>netload</td>
<td>total number of bytes transferred over all network interfaces</td>
</tr>
<tr>
<td>nsessions</td>
<td>number of sessions active</td>
</tr>
<tr>
<td>nusers</td>
<td>number of users active</td>
</tr>
<tr>
<td>physmem</td>
<td>configured RAM</td>
</tr>
<tr>
<td>sessions</td>
<td>list of active sessions</td>
</tr>
<tr>
<td>totmem</td>
<td>configured RAM plus configured swap</td>
</tr>
</tbody>
</table>

### Diagnose detail

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
</table>
| 0     | Display the following information:  
  - Local hostname  
  - Expected server hostname  
  - Execution version  
  - MOM home directory  
  - MOM config file version (if specified)  
  - Duration MOM has been executing  
  - Duration since last request from pbs_server daemon  
  - Duration since last request to pbs_server daemon  
  - RM failure messages (if any)  
  - Log verbosity level  
  - Local job list |
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1     | All information for level 0 plus the following:  
  - Interval between updates sent to server  
  - Number of initialization messages sent to `pbs_server` daemon  
  - Number of initialization messages received from `pbs_server` daemon  
  - Prolog/epilog alarm time  
  - List of trusted clients |
| 2     | All information from level 1 plus the following:  
  - PID  
  - Event alarm status |
| 3     | All information from level 2 plus the following:  
  - syslog enabled |

**Example A-1: MOM diagnostics**

```
momctl -d 1  
Host: nsnc/nsnc.fllcl.com  Server: 10.10.10.113  Version: torque_1.1.0p4  
HomeDirectory: /usr/spool/PBS/mom_priv  
ConfigVersion: 147  
MOM active: 7390 seconds  
Last Msg From Server: 7389 seconds (CLUSTER_ADDR)  
Server Update Interval: 20 seconds  
Server Update Interval: 20 seconds  
Init Msgs Received: 0 hellos/1 cluster-addr  
Init Msgs Sent: 1 hellos  
LOGLEVEL: 0 (use SIGUSR1/SIGUSR2 to adjust)  
Prolog Alarm Time: 300 seconds  
Trusted Client List: 12.14.213.113,127.0.0.1  
JobList: NONE  
diagnostics complete
```

**Example A-2: System shutdown**

```
> momctl -s -f /opt/clusterhostfile  
shutdown request successful on node001  
shutdown request successful on node002  
shutdown request successful on node003  
shutdown request successful on node004  
shutdown request successful on node005  
shutdown request successful on node006
```

**pbs_mom**

Start a pbs batch execution mini-server.
Synopsis


Description

The pbs_mom command is located within the TORQUE_HOME directory and starts the operation of a batch Machine Oriented Mini-server (MOM) on the execution host. To ensure that the pbs_mom command is not runnable by the general user community, the server will only execute if its real and effective uid is zero.

The first function of pbs_mom is to place jobs into execution as directed by the server, establish resource usage limits, monitor the job's usage, and notify the server when the job completes. If they exist, pbs_mom will execute a prologue script before executing a job and an epilogue script after executing the job.

The second function of pbs_mom is to respond to resource monitor requests. This was done by a separate process in previous versions of PBS but has now been combined into one process. It provides information about the status of running jobs, memory available, etc.

The last function of pbs_mom is to respond to task manager requests. This involves communicating with running tasks over a TCP socket as well as communicating with other MOMs within a job (a.k.a. a "sisterhood").

pbs_mom will record a diagnostic message in a log file for any error occurrence. The log files are maintained in the mom_logs directory below the home directory of the server. If the log file cannot be opened, the diagnostic message is written to the system console.

Options

<table>
<thead>
<tr>
<th>Flag</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>alarm</td>
<td>Specifies the alarm timeout in seconds for computing a resource. Every time a resource request is processed, an alarm is set for the given amount of time. If the request has not completed before the given time, an alarm signal is generated. The default is 5 seconds.</td>
</tr>
<tr>
<td>-A</td>
<td>alias</td>
<td>Specifies this multimom's alias name. The alias name needs to be the same name used in the mom_hierarchy file. It is only needed when running multiple MOMs on the same machine. For more information, see TORQUE Multi-MOM on page 51.</td>
</tr>
<tr>
<td>Flag</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>-C</td>
<td>chkdirectory</td>
<td>Specifies the path of the directory used to hold checkpoint files. (Currently this is only valid on Cray systems.) The default directory is TORQUE_HOME/spool/checkpoint (see the -d option). The directory specified with the -C option must be owned by root and accessible (rwx) only by root to protect the security of the checkpoint files.</td>
</tr>
<tr>
<td>-c</td>
<td>config</td>
<td>Specifies an alternative configuration file, see description below. If this is a relative file name it will be relative to TORQUE_HOME/mom_priv, (see the -d option). If the specified file cannot be opened, pbs_mom will abort. If the -C option is not supplied, pbs_mom will attempt to open the default configuration file &quot;config&quot; in TORQUE_HOME/mom_priv. If this file is not present, pbs_mom will log the fact and continue.</td>
</tr>
<tr>
<td>-d</td>
<td>directory</td>
<td>Specifies the path of the directory which is the home of the server's working files, TORQUE_HOME. This option is typically used along with -M when debugging MOM. The default directory is given by $PBS_SERVER_HOME which is typically /usr/spool/PBS.</td>
</tr>
<tr>
<td>-h</td>
<td>help</td>
<td>Displays the help/usage message.</td>
</tr>
<tr>
<td>-H</td>
<td>hostname</td>
<td>Sets the MOM's hostname. This can be useful on multi-homed networks.</td>
</tr>
<tr>
<td>-L</td>
<td>logfile</td>
<td>Specifies an absolute path name for use as the log file. If not specified, MOM will open a file named for the current date in the TORQUE_HOME/mom_logs directory (see the -d option).</td>
</tr>
<tr>
<td>-M</td>
<td>port</td>
<td>Specifies the port number on which the mini-server (MOM) will listen for batch requests.</td>
</tr>
<tr>
<td>-p</td>
<td>n/a</td>
<td>Specifies the impact on jobs which were in execution when the mini-server shut down. On any restart of MOM, the new mini-server will not be the parent of any running jobs, MOM has lost control of her offspring (not a new situation for a mother). With the -p option, MOM will allow the jobs to continue to run and monitor them indirectly via polling. This flag is redundant in that this is the default behavior when starting the server. The -p option is mutually exclusive with the -R and -q options.</td>
</tr>
<tr>
<td>-P</td>
<td>purge</td>
<td>Specifies the impact on jobs which were in execution when the mini-server shut down. With the -P option, it is assumed that either the entire system has been restarted or the MOM has been down so long that it can no longer guarantee that the pid of any running process is the same as the recorded job process pid of a recovering job. Unlike the -p option, no attempt is made to try and preserve or recover running jobs. All jobs are terminated and removed from the queue.</td>
</tr>
<tr>
<td>Flag</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>-q</td>
<td>n/a</td>
<td>Specifies the impact on jobs which were in execution when the mini-server shut down. With the <code>-q</code> option, MOM will allow the processes belonging to jobs to continue to run, but will not attempt to monitor them. The <code>-q</code> option is mutually exclusive with the <code>-p</code> and <code>-R</code> options.</td>
</tr>
<tr>
<td>-R</td>
<td>port</td>
<td>Specifies the port number on which the mini-server (MOM) will listen for resource monitor requests, task manager requests and inter-MOM messages. Both a UDP and a TCP port of this number will be used.</td>
</tr>
<tr>
<td>-r</td>
<td>n/a</td>
<td>Specifies the impact on jobs which were in execution when the mini-server shut down. With the <code>-r</code> option, MOM will kill any processes belonging to jobs, mark the jobs as terminated, and notify the batch server which owns the job. The <code>-r</code> option is mutually exclusive with the <code>-p</code> and <code>-q</code> options. Normally the mini-server is started from the system boot file without the <code>-p</code> or the <code>-r</code> option. The mini-server will make no attempt to signal the former session of any job which may have been running when the mini-server terminated. It is assumed that on reboot, all processes have been killed. If the <code>-r</code> option is used following a reboot, process IDs (pids) may be reused and MOM may kill a process that is not a batch session.</td>
</tr>
<tr>
<td>-w</td>
<td>wait_for_server</td>
<td>When started with <code>-w pbs_moms</code> wait until they get their MOM hierarchy file from <code>pbs_server</code> to send their first update, or until 10 minutes pass. This reduces network traffic on startup and can bring up clusters faster.</td>
</tr>
<tr>
<td>-x</td>
<td>n/a</td>
<td>Disables the check for privileged port resource monitor connections. This is used mainly for testing since the privileged port is the only mechanism used to prevent any ordinary user from connecting.</td>
</tr>
</tbody>
</table>

**Configuration file**

The configuration file, located at `mom_priv/config` by default, can be specified on the command line at program start with the `-C` flag. The use of this file is to provide several types of run time information to `pbs_mom`: static resource names and values, external resources provided by a program to be run on request via a shell escape, and values to pass to internal set up functions at initialization (and re-initialization).

See the [MOM Parameters on page 283](#) page for a full list of `pbs_mom` parameters.

Each item type is on a single line with the component parts separated by white space. If the line starts with a hash mark (pound sign, `#`), the line is considered to be a comment and is skipped.

*Static Resources*
For static resource names and values, the configuration file contains a list of resource names/values pairs, one pair per line and separated by white space. An example of static resource names and values could be the number of tape drives of different types and could be specified by:

- tape3480 4
- tape3420 2
- tapedat 1
- tape8mm 1

**Shell Commands**

If the first character of the value is an exclamation mark (!), the entire rest of the line is saved to be executed through the services of the system(3) standard library routine.

The shell escape provides a means for the resource monitor to yield arbitrary information to the scheduler. Parameter substitution is done such that the value of any qualifier sent with the query, as explained below, replaces a token with a percent sign (%) followed by the name of the qualifier. For example, here is a configuration file line which gives a resource name of "escape":

```
!echo %xxx %yyy
```

If a query for "escape" is sent with no qualifiers, the command executed would be `echo %xxx %yyy`.

If one qualifier is sent, `escape[xxx=hi there]`, the command executed would be `echo hi there %yyy`.

If two qualifiers are sent, `escape[xxx=hi][yyy=there]`, the command executed would be `echo hi there`.

If a qualifier is sent with no matching token in the command line, `escape [zzz=snafu]`, an error is reported.

**Resources**

Resource Manager queries can be made with `momctl -q` options to retrieve and set `pbs_mom` options. Any configured static resource may be retrieved with a request of the same name. These are resource requests not otherwise documented in the PBS ERS.

<table>
<thead>
<tr>
<th>Request</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cycle</td>
<td>Forces an immediate MOM cycle.</td>
</tr>
<tr>
<td>status_update_time</td>
<td>Retrieve or set the $status_update_time parameter.</td>
</tr>
<tr>
<td>Request</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>check_poll_time</td>
<td>Retrieve or set the $check_poll_time parameter.</td>
</tr>
<tr>
<td>configversion</td>
<td>Retrieve the config version.</td>
</tr>
<tr>
<td>jobstartblocktime</td>
<td>Retrieve or set the $jobstartblocktime parameter.</td>
</tr>
<tr>
<td>enablemomrestart</td>
<td>Retrieve or set the $enablemomrestart parameter.</td>
</tr>
<tr>
<td>loglevel</td>
<td>Retrieve or set the $loglevel parameter.</td>
</tr>
<tr>
<td>down_on_error</td>
<td>Retrieve or set the EXPERIMENTAL $down_on_error parameter.</td>
</tr>
<tr>
<td>diag0 - diag4</td>
<td>Retrieves varied diagnostic information.</td>
</tr>
<tr>
<td>rcpcmd</td>
<td>Retrieve or set the $rcpcmd parameter.</td>
</tr>
<tr>
<td>version</td>
<td>Retrieves the pbs_mom version.</td>
</tr>
</tbody>
</table>

**Health check**

The health check script is executed directly by the pbs_mom daemon under the root user id. It must be accessible from the compute node and may be a script or compiled executable program. It may make any needed system calls and execute any combination of system utilities but should not execute resource manager client commands. Also, the pbs_mom daemon blocks until the health check is completed and does not possess a built-in timeout. Consequently, it is advisable to keep the launch script execution time short and verify that the script will not block even under failure conditions.

If the script detects a failure, it should return the keyword "Error" to stdout followed by an error message. The message (up to 256 characters) immediately following the Error string will be assigned to the node attribute message of the associated node.

If the script detects a failure when run from "jobstart", then the job will be rejected. You can use this behavior with an advanced scheduler, such as Moab Workload Manager, to cause the job to be routed to another node. TORQUE currently ignores Error messages by default, but you can configure an advanced scheduler to react appropriately.

If the experimental $down_on_error MOM setting is enabled, the MOM will set itself to state down and report to pbs_server. Additionally, the experimental $down_on_error_server attribute can be enabled which has the same effect but moves the decision to pbs_server. It is redundant to have MOM's $down_
on_error and pbs_servers down on_error features enabled. See "down_on_error" in pbs_server_attributes(7B).

Files

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$PBS_SERVER_HOME/server_name</td>
<td>Contains the hostname running pbs_server</td>
</tr>
<tr>
<td>$PBS_SERVER_HOME/mom_priv</td>
<td>The default directory for configuration files, typically (/usr/spool/pbs)/mom_priv</td>
</tr>
<tr>
<td>$PBS_SERVER_HOME/mom_logs</td>
<td>Directory for log files recorded by the server</td>
</tr>
<tr>
<td>$PBS_SERVER_HOME/mom_priv/-prologue</td>
<td>The administrative script to be run before job execution</td>
</tr>
<tr>
<td>$PBS_SERVER_HOME/mom_priv/e-pilogue</td>
<td>The administrative script to be run after job execution</td>
</tr>
</tbody>
</table>

Signal handling

pbs_mom handles the following signals:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGHUP</td>
<td>Causes pbs_mom to re-read its configuration file, close and reopen the log file, and reinitialize resource structures.</td>
</tr>
<tr>
<td>SIGALRM</td>
<td>Results in a log file entry. The signal is used to limit the time taken by certain children processes, such as the prologue and epilogue.</td>
</tr>
<tr>
<td>SIGINT and SIGTERM</td>
<td>Results in pbs_mom exiting without terminating any running jobs. This is the action for the following signals as well: SIGCPU, SIGXFSZ, SIGCPULIM, and SIGSHUTDN.</td>
</tr>
<tr>
<td>SIGUSR1, SIGUSR2</td>
<td>Causes the MOM to increase and decrease logging levels, respectively.</td>
</tr>
<tr>
<td>SIGPIPE, SIGINFO</td>
<td>Are ignored.</td>
</tr>
<tr>
<td>SIGBUS, SIGFPE, SIGILL, SIGTRAP, and SIGSYS</td>
<td>Cause a core dump if the PBSCOREDUMP environmental variable is defined.</td>
</tr>
</tbody>
</table>

All other signals have their default behavior installed.
Exit status

If the `pbs_mom` command fails to begin operation, the server exits with a value greater than zero.

Related Topics

- `pbs_server`(8B)

Non-Adaptive Computing topics

- `pbs_scheduler_basl`(8B)
- `pbs_scheduler_tcl`(8B)
- PBS External Reference Specification
- PBS Administrators Guide

---

`pbs_server`

*B(PBS Server) pbs batch system manager*

**Synopsis**


**Description**

The `pbs_server` command starts the operation of a batch server on the local host. Typically, this command will be in a local boot file such as `/etc/rc.local`. If the batch server is already in execution, `pbs_server` will exit with an error. To ensure that the `pbs_server` command is not runnable by the general user community, the server will only execute if its real and effective uid is zero.

The server will record a diagnostic message in a log file for any error occurrence. The log files are maintained in the `server_logs` directory below the home directory of the server. If the log file cannot be opened, the diagnostic message is written to the system console.

As of TORQUE 4.0, the `pbs_server` is multi-threaded which leads to quicker response to client commands, is more robust, and allows for higher job throughput.

**Options**
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>active</td>
<td>Specifies if scheduling is active or not. This sets the server attribute scheduling. If the option argument is &quot;true&quot; (&quot;True&quot;, &quot;t&quot;, &quot;T&quot;, or &quot;1&quot;), the server is active and the PBS job scheduler will be called. If the argument is &quot;false&quot; (&quot;False&quot;, &quot;f&quot;, &quot;F&quot;, or &quot;0&quot;), the server is idle, and the scheduler will not be called and no jobs will be run. If this option is not specified, the server will retain the prior value of the scheduling attribute.</td>
</tr>
<tr>
<td>-A</td>
<td>actfile</td>
<td>Specifies an absolute path name of the file to use as the accounting file. If not specified, the file name will be the current date in the PBS_HOME/server_priv/accounting directory.</td>
</tr>
<tr>
<td>-c</td>
<td>wait_for_moms</td>
<td>Specifies the path of the directory which is home to the server's configuration files, PBS_HOME. A host may have multiple servers. Each server must have a different configuration directory. The default configuration directory is given by the symbol $PBS_SERVER_HOME which is typically var/spool/torque.</td>
</tr>
<tr>
<td>-d</td>
<td>config_directory</td>
<td>Specifies if scheduling is active or not. This sets the server attribute scheduling. If the option argument is &quot;true&quot; (&quot;True&quot;, &quot;t&quot;, &quot;T&quot;, or &quot;1&quot;), the server is active and the PBS job scheduler will be called. If the argument is &quot;false&quot; (&quot;False&quot;, &quot;f&quot;, &quot;F&quot;, or &quot;0&quot;), the server is idle, and the scheduler will not be called and no jobs will be run. If this option is not specified, the server will retain the prior value of the scheduling attribute.</td>
</tr>
<tr>
<td>--ha</td>
<td>high_availability</td>
<td>Starts server in high availability mode (for details, see Server High Availability on page 117).</td>
</tr>
<tr>
<td>-L</td>
<td>logfile</td>
<td>Specifies an absolute path name of the file to use as the log file. If not specified, the file name will be the current date in the PBS_HOME/server_logs directory (see the -d option).</td>
</tr>
<tr>
<td>-l</td>
<td>location</td>
<td>Specifies where to find Moab when it does not reside on the same host as TORQUE.</td>
</tr>
<tr>
<td>-n</td>
<td>no send</td>
<td>This directs pbs_server to not send the hierarchy to all the MOMs on startup. Instead, the hierarchy is only sent if a MOM requests it. This flag works only in conjunction with the local MOM hierarchy feature.</td>
</tr>
<tr>
<td>-f</td>
<td>force_overwrite</td>
<td>Forces an overwrite of the server database. This can be useful to bypass the yes/no prompt when running something like pbs_server -t create and can ease installation and configuration of TORQUE via scripts.</td>
</tr>
<tr>
<td>-H</td>
<td>hostname</td>
<td>Causes the server to start under a different hostname as obtained from gethostname (2). Useful for servers with multiple network interfaces to support connections from clients over an interface that has a hostname assigned that differs from the one that is returned by gethost name(2).</td>
</tr>
</tbody>
</table>

**Commands Overview**
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-p</td>
<td>port</td>
<td>Specifies the port number on which the server will listen for batch requests. If multiple servers are running on a single host, each must have its own unique port number. This option is for use in testing with multiple batch systems on a single host.</td>
</tr>
<tr>
<td>-S</td>
<td>scheduler_port</td>
<td>Specifies the port number to which the server should connect when contacting the scheduler. The argument scheduler_conn is of the same syntax as under the -M option.</td>
</tr>
<tr>
<td>-t</td>
<td>type</td>
<td>If the job is rerunnable or restartable, and -t create is specified, the server will discard any existing configuration files, queues, and jobs, and initialize configuration files to the default values. The server is idled.</td>
</tr>
</tbody>
</table>

**Files**

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TORQUE_HOME/server_priv</td>
<td>Default directory for configuration files, typically /usr/spool/pbs/server_priv</td>
</tr>
<tr>
<td>TORQUE_HOME/server_logs</td>
<td>Directory for log files recorded by the server</td>
</tr>
</tbody>
</table>

**Signal handling**

On receipt of the following signals, the server performs the defined action:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGHUP</td>
<td>The current server log and accounting log are closed and reopened. This allows for the prior log to be renamed and a new log started from the time of the signal.</td>
</tr>
<tr>
<td>SIGINT</td>
<td>Causes an orderly shutdown of pbs_server.</td>
</tr>
<tr>
<td>SIGUSR1, SIGUSR2</td>
<td>Causes server to increase and decrease logging levels, respectively.</td>
</tr>
<tr>
<td>SIGTERM</td>
<td>Causes an orderly shutdown of pbs_server.</td>
</tr>
<tr>
<td>Action</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SIGSHUTDN</td>
<td>On systems (Unicos) where SIGSHUTDN is defined, it also causes an orderly shutdown of the server.</td>
</tr>
<tr>
<td>SIGPIPE</td>
<td>This signal is ignored.</td>
</tr>
</tbody>
</table>

All other signals have their default behavior installed.

**Exit status**

If the server command fails to begin batch operation, the server exits with a value greater than zero.

Related Topics

- `pbs_mom`(8B)
- `pbsnodes`(8B)
- `qmgr`(1B)
- `qrun`(8B)
- `qsub`(1B)
- `qterm`(8B)

**Non-Adaptive Computing topics**

- `pbs_connect`(3B)
- `pbs_sched_basl`(8B)
- `pbs_sched_tcl`(8B)
- `qdisable`(8B)
- `qenable`(8B)
- `qstart`(8B)
- `qstop`(8B)
- PBS External Reference Specification

**pbs_track**

Starts a new process and informs pbs_mom to start tracking it.

**Synopsis**

```
pbs_track  -j <JOBID>  [-b]  <executable>  [args]
```

**Description**
The `pbs_track` command tells a `pbs_mom` daemon to monitor the lifecycle and resource usage of the process that it launches using `exec()`. The `pbs_mom` is told about this new process via the Task Manager API, using `tm_adopt()`. The process must also be associated with a job that already exists on the `pbs_mom`.

By default, `pbs_track` will send its PID to TORQUE via `tm_adopt()`. It will then perform an `exec()`, causing `<executable>` to run with the supplied arguments. `pbs_track` will not return until the launched process has completed because it becomes the launched process.

This command can be considered related to the `pbsdsh` command which uses the `tm_spawn()` API call. The `pbsdsh` command asks a `pbs_mom` to launch and track a new process on behalf of a job. When it is not desirable or possible for the `pbs_mom` to spawn processes for a job, `pbs_track` can be used to allow an external entity to launch a process and include it as part of a job.

This command improves integration with TORQUE and SGI’s MPT MPI implementation.

### Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-j &lt;JOBID&gt;</code></td>
<td>Job ID the new process should be associated with.</td>
</tr>
<tr>
<td><code>-b</code></td>
<td>Instead of having <code>pbs_track</code> send its PID to TORQUE, it will fork() first, send the child PID to TORQUE, and then execute from the forked child. This essentially &quot;backgrounds&quot; <code>pbs_track</code> so that it will return after the new process is launched.</td>
</tr>
</tbody>
</table>

### Operands

The `pbs_track` command accepts a path to a program/executable (`<executable>`) and, optionally, one or more arguments to pass to that program.

### Exit status

Because the `pbs_track` command becomes a new process (if used without `-b`), its exit status will match that of the new process. If the `-b` option is used, the exit status will be zero if no errors occurred before launching the new process.

If `pbs_track` fails, whether due to a bad argument or other error, the exit status will be set to a non-zero value.

Related Topics

`pbsdsh(1B)`
Non-Adaptive Computing topics

- tm_spawn(3B)

### pbsdsh

The *bsdsh* command distributes tasks to nodes under *pbs*.

- Some limitations exist in the way that *bsdsh* can be used. Please note the following situations are not currently supported:
  - Running multiple instances of *bsdsh* concurrently within a single job.
  - Using the `-o` and `-s` options concurrently; although requesting these options together is permitted, only the output from the first node is displayed rather than output from every node in the chain.

### Synopsis

```
pbsdsh [-h nodename] [-o] [-v] program [args]
```

### Description

Executes (spawns) a normal Unix program on one or more nodes under control of the Portable Batch System, PBS. *Pbsdsh* uses the Task Manager API (see *tm_spawn(3)*) to distribute the program on the allocated nodes.

When run without the `-c` or the `-n` option, *bsdsh* will spawn the program on all nodes allocated to the PBS job. The spawns take place concurrently – all execute at (about) the same time.

Users will find the `PBS_TASKNUM`, `PBS_NODENUM`, and the `PBS_VNODENUM` environmental variables useful. They contain the TM task id, the node identifier, and the cpu (virtual node) identifier.

- Note that under particularly high workloads, the *bsdsh* command may not function properly.

### Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-c</code></td>
<td>copies</td>
<td>The program is spawned on the first Copies nodes allocated. This option is mutually exclusive with <code>-n</code>.</td>
</tr>
<tr>
<td>Option</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>-h</td>
<td>hostname</td>
<td>The program is spawned on the node specified.</td>
</tr>
<tr>
<td>-n</td>
<td>node</td>
<td>The program is spawned on one node which is the n-th node allocated. This option is mutually exclusive with -c.</td>
</tr>
<tr>
<td>-o</td>
<td>---</td>
<td>Capture stdout of the spawned program. Normally stdout goes to the job's output.</td>
</tr>
<tr>
<td>-s</td>
<td>---</td>
<td>If this option is given, the program is run in turn on each node, one after the other.</td>
</tr>
<tr>
<td>-u</td>
<td>---</td>
<td>The program is run once on each node (unique). This ignores the number of allocated processors on a given node.</td>
</tr>
<tr>
<td>-v</td>
<td>---</td>
<td>Verbose output about error conditions and task exit status is produced.</td>
</tr>
</tbody>
</table>

**Operands**

The first operand, program, is the program to execute. Additional operands are passed as arguments to the program.

**Standard error**

The `pbsdsh` command will write a diagnostic message to standard error for each error occurrence.

**Exit status**

Upon successful processing of all the operands presented to the command, the exit status will be a value of zero.

If the `pbsdsh` command fails to process any operand, or fails to contact the MOM daemon on the localhost the command exits with a value greater than zero.

**Related Topics**

- `qsub`(1B)

**Non-Adaptive Computing topics**

- `tm_spawn`(3B)

**pbsnodes**

PBS node manipulation.
Syncpison

pbsnodes [-{a|x}] [-g] [-s server] [node|:property]
pbsnodes -l [-g] [-s server] [state] [nodename|:property ...]
pbsnodes -m <running|standby|suspend|hibernate|shutdown> <host list>
pbsnodes [-{c|d|o|r}] [-q] [-s server] [-n -l] [-N "note"]
[node|:property]

Description

The pbsnodes command is used to mark nodes down, free or offline. It can also
be used to list nodes and their state. Node information is obtained by sending a
request to the PBS job server. Sets of nodes can be operated on at once by
specifying a node property prefixed by a colon. (For more information, see
Node states.)

Nodes do not exist in a single state, but actually have a set of states. For
example, a node can be simultaneously "busy" and "offline". The "free" state is
the absence of all other states and so is never combined with other states.

In order to execute pbsnodes with other than the -a or -l options, the user must
have PBS Manager or Operator privilege.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>All attributes of a node or all nodes are listed. This is the default if no flag is given.</td>
</tr>
<tr>
<td>-x</td>
<td>Same as -a, but the output has an XML-like format.</td>
</tr>
<tr>
<td>-c</td>
<td>Clear OFFLINE from listed nodes.</td>
</tr>
<tr>
<td>-d</td>
<td>Print MOM diagnosis on the listed nodes. Not yet implemented. Use momctl instead.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>-m</td>
<td>Set the hosts in the specified host list to the requested power state. If a compute node does not support the energy-saving power state you request, the command returns an error and leaves the state unchanged. In order for the command to wake a node from a low-power state, Wake-on-LAN (WOL) must be enabled for the node.</td>
</tr>
<tr>
<td></td>
<td><strong>In order for the command to wake a node from a low-power state, Wake-on-LAN must be enabled for the node and it must support the g WOL packet. For more information, see Changing Node Power States on page 94.</strong></td>
</tr>
<tr>
<td></td>
<td>The allowable power states are:</td>
</tr>
<tr>
<td></td>
<td>- <strong>Running</strong>: The node is up and running.</td>
</tr>
<tr>
<td></td>
<td>- <strong>Standby</strong>: CPU is halted but still powered. Moderate power savings but low latency entering and leaving this state.</td>
</tr>
<tr>
<td></td>
<td>- <strong>Suspend</strong>: Also known as Suspend-to-RAM. Machine state is saved to RAM. RAM is put into self-refresh mode. Much more significant power savings with longer latency entering and leaving state.</td>
</tr>
<tr>
<td></td>
<td>- <strong>Hibernate</strong>: Also known as Suspend-to-disk. Machine state is saved to disk and then powered down. Significant power savings but very long latency entering and leaving state.</td>
</tr>
<tr>
<td></td>
<td>- <strong>Shutdown</strong>: Equivalent to <code>shutdown now</code> command as root.</td>
</tr>
<tr>
<td></td>
<td>The host list is a space-delimited list of node host names. See Examples on page 199.</td>
</tr>
<tr>
<td>-o</td>
<td>Add the OFFLINE state. This is different from being marked DOWN. OFFLINE prevents new jobs from running on the specified nodes. This gives the administrator a tool to hold a node out of service without changing anything else. The OFFLINE state will never be set or cleared automatically by pbs_server; it is purely for the manager or operator.</td>
</tr>
<tr>
<td>-p</td>
<td>Purge the node record from pbs_server. Not yet implemented.</td>
</tr>
<tr>
<td>-r</td>
<td>Reset the listed nodes by clearing OFFLINE and adding DOWN state. pbs_server will ping the node and, if they communicate correctly, free the node.</td>
</tr>
<tr>
<td>-l</td>
<td>List node names and their state. If no state is specified, only nodes in the DOWN, OFFLINE, or UNKNOWN states are listed. Specifying a state string acts as an output filter. Valid state strings are &quot;active&quot;, &quot;all&quot;, &quot;busy&quot;, &quot;down&quot;, &quot;free&quot;, &quot;job-exclusive&quot;, &quot;job-sharing&quot;, &quot;offline&quot;, &quot;reserve&quot;, &quot;state-unknown&quot;, &quot;time-shared&quot;, and &quot;up&quot;.</td>
</tr>
<tr>
<td></td>
<td>- Using <strong>all</strong> displays all nodes and their attributes.</td>
</tr>
<tr>
<td></td>
<td>- Using <strong>active</strong> displays all nodes which are job-exclusive, job-sharing, or busy.</td>
</tr>
<tr>
<td></td>
<td>- Using <strong>up</strong> displays all nodes in an &quot;up state&quot;. Up states include job-exclusive, job-sharing, reserve, free, busy and time-shared.</td>
</tr>
<tr>
<td></td>
<td>- All other strings display the nodes which are currently in the state indicated by the string.</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>-N</td>
<td>Specify a &quot;note&quot; attribute. This allows an administrator to add an arbitrary annotation to the listed nodes. To clear a note, use -N &quot;&quot; or -N &quot;n&quot;.</td>
</tr>
<tr>
<td>-n</td>
<td>Show the &quot;note&quot; attribute for nodes that are DOWN, OFFLINE, or UNKNOWN. This option requires -l.</td>
</tr>
<tr>
<td>-q</td>
<td>Suppress all error messages</td>
</tr>
<tr>
<td>-s</td>
<td>Specify the PBS server's hostname or IP address.</td>
</tr>
</tbody>
</table>

### Examples

**Example A-3: host list**

```
pbsnodes -m shutdown node01 node02 node03 node04
```

*With this command, pbs_server tells the pbs_mom associated with nodes01-04 to shut down the node.*

The `pbsnodes` output shows the current power state of nodes. In this example, note that `pbsnodes` returns the MAC addresses of the nodes.

```
pbsnodes
  nuc1
    state = free
    power_state = Running
    np = 4
    ntype = cluster
    status = rectime=1395765676,macaddr=0b:25:22:92:7b:26,
    cpuclock=Fixed,varattr=,jobs=,state=free,netload=1242652020,gres=,loadave=0.16,ncpus=6,physmem=16435852kb,availmem=24709056kb,totmem=33211016kb,idletime=4636,nusers=3,nssessions=12,nsessions=2758 999 1469 2708 2797 2845 2881 2946 4087 4154 4373 6385,uname=Linux bdaw 3.2.0-60-generic #91-Ubuntu SMP Wed Feb 19 03:54:44 UTC 2014
  x86_64,opsys=linux
    note = This is a node note
    mom_service_port = 15002
    mom_manager_port = 15003

  nuc2
    state = free
    power_state = Running
    np = 4
    ntype = cluster
    status = rectime=1395765678,macaddr=2c:a8:6b:f4:b9:35,
    cpuclock=OnDemand:800MHz,varattr=,jobs=,state=free,netload=12082362,gres=,loadave=0.00,ncpus=4,physmem=16300576kb,availmem=17561808kb,totmem=17861144kb,idletime=67538,nusers=2,nssessions=7,nsessions=2189 2183 2194 2220 2222 2248 2351,uname=Linux nuc2 2.6.32-431.el6.x86_64 #1 SMP Fri Nov 22 03:15:09 UTC 2013 x86_64,opsys=linux
    mom_service_port = 15002
    mom_manager_port = 15003
```

### Related Topics

- [pbs_server](8B)
Non-Adaptive Computing topics

- PBS External Reference Specification

qalter

Alter batch job.

Synopsis

qalter [-a date_time][-A account_string][-c interval][-e path_name]
   [-h hold_list][-j join_list][-k keep_list][-l resource_list]
   [-m mail_options][-M mail_list][-n][-N name][-o path_name]
   [-p priority][-r y|n][-S path_name_list][-u user_list]
   [-t array_range]
   job_identifier ...

Description

The qalter command modifies the attributes of the job or jobs specified by job_identifier on the command line. Only those attributes listed as options on the command will be modified. If any of the specified attributes cannot be modified for a job for any reason, none of that job's attributes will be modified.

The qalter command accomplishes the modifications by sending a Modify Job batch request to the batch server which owns each job.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>date_time</td>
<td>Replaces the time at which the job becomes eligible for execution. The date_time argument syntax is: [[CC]YY]MM/DD hhmm [.SS]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the month, MM, is not specified, it will default to the current month if the specified day DD, is in the future. Otherwise, the month will be set to next month. Likewise, if the day, DD, is not specified, it will default to today if the time hhmm is in the future. Otherwise, the day will be set to tomorrow.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This attribute can be altered once the job has begun execution, but it will not take effect unless the job is rerun.</td>
</tr>
<tr>
<td>-A</td>
<td>account_string</td>
<td>Replaces the account string associated with the job. This attribute cannot be altered once the job has begun execution.</td>
</tr>
<tr>
<td>Option</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| -c     | checkpoint_interval | Replaces the interval at which the job will be checkpointed. If the job executes upon a host which does not support checkpointing, this option will be ignored. The interval argument is specified as:  
  - \( n \) – No checkpointing is to be performed.  
  - \( s \) – Checkpointing is to be performed only when the server executing the job is shutdown.  
  - \( c \) – Checkpointing is to be performed at the default minimum cpu time for the queue from which the job is executing.  
  - \( c=\text{minutes} \) – Checkpointing is performed at intervals of the specified amount of time in minutes. Minutes are the number of minutes of CPU time used, not necessarily clock time.  
  This value must be greater than zero. If the number is less than the default checkpoint time, the default time will be used.  
  This attribute can be altered once the job has begun execution, but the new value does not take effect unless the job is rerun. |
| -e     | path_name     | Replaces the path to be used for the standard error stream of the batch job. The path argument is of the form:  
  \([\text{hostname}:]\text{path\_name}\)  
  where \( \text{hostname} \) is the name of a host to which the file will be returned and \( \text{path\_name} \) is the path name on that host in the syntax recognized by POSIX 1003.1. The argument will be interpreted as follows:  
  - \( \text{path\_name} \) – Where \( \text{path\_name} \) is not an absolute path name, then the qalter command will expand the path name relative to the current working directory of the command. The command will supply the name of the host upon which it is executing for the hostname component.  
  - \( \text{hostname}:\text{path\_name} \) – Where \( \text{path\_name} \) is not an absolute path name, then the qalter command will not expand the path name. The execution server will expand it relative to the home directory of the user on the system specified by hostname.  
  This attribute can be altered once the job has begun execution, but it will not take effect unless the job is rerun. |
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -h     | hold_list | Updates the types of holds on the job. The hold_list argument is a string of one or more of the following characters:  
- u – Add the USER type hold.  
- s – Add the SYSTEM type hold if the user has the appropriate level of privilege. (Typically reserved to the batch administrator.)  
- o – Add the OTHER (or OPERATOR ) type hold if the user has the appropriate level of privilege. (Typically reserved to the batch administrator and batch operator.)  
- n – Set to none and clear the hold types which could be applied with the user's level of privilege. Repetition of characters is permitted, but "n" may not appear in the same option argument with the other three characters.  
This attribute can be altered once the job has begun execution, but the hold will not take effect unless the job is rerun. |
| -j     | join   | Declares which standard streams of the job will be merged together. The join argument value may be the characters "oe" and "eo", or the single character "n".  
An argument value of oe directs that the standard output and standard error streams of the job will be merged, intermixed, and returned as the standard output. An argument value of eo directs that the standard output and standard error streams of the job will be merged, intermixed, and returned as the standard error.  
A value of n directs that the two streams will be two separate files. This attribute can be altered once the job has begun execution, but it will not take effect unless the job is rerun.  

**Note:**  
If using either the -e or the -o option and the -j eo|oe option, the -j option takes precedence and all standard error and output messages go to the chosen output file. |
### Option: -k

**Name:** keep

**Description:**
Defines which if either of standard output or standard error of the job will be retained on the execution host. If set for a stream, this option overrides the path name for that stream.

The argument is either the single letter "e", "o", or "n", or one or more of the letters "e" and "o" combined in either order.

- **n** – No streams are to be retained.
- **e** – The standard error stream is to be retained on the execution host. The stream will be placed in the home directory of the user under whose user id the job executed. The file name will be the default file name given by:
  ```
  job_name.esequence
  ```
  where `job_name` is the name specified for the job, and `sequence` is the sequence number component of the job identifier.
- **o** – The standard output stream is to be retained on the execution host. The stream will be placed in the home directory of the user under whose user id the job executed. The file name will be the default file name given by:
  ```
  job_name.osequence
  ```
  where `job_name` is the name specified for the job, and `sequence` is the sequence number component of the job identifier.
- **eo** – Both the standard output and standard error streams will be retained.
- **oe** – Both the standard output and standard error streams will be retained.

This attribute cannot be altered once the job has begun execution.

### Option: -l

**Name:** resource_list

**Description:**
Modifies the list of resources that are required by the job. The `resource_list` argument is in the following syntax:

```
resource_name=[value],resource_name=[value],...
```

For the complete list of resources that can be modified, see [Requesting Resources](#) on page 59.

If a requested modification to a resource would exceed the resource limits for jobs in the current queue, the server will reject the request.

If the job is running, only certain resources can be altered. Which resources can be altered in the run state is system dependent. A user may only lower the limit for those resources.

### Option: -m

**Name:** mail_options

**Description:**
Replaces the set of conditions under which the execution server will send a mail message about the job. The `mail_options` argument is a string which consists of the single character "n", or one or more of the characters "a", "b", and "e".

If the character "n" is specified, no mail will be sent.

For the letters "a", "b", and "e":

- **a** – Mail is sent when the job is aborted by the batch system.
- **b** – Mail is sent when the job begins execution.
- **e** – Mail is sent when the job ends.
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-M</td>
<td>user_list</td>
<td>Replaces the list of users to whom mail is sent by the execution server when it sends mail about the job. The user_list argument is of the form: user[@host][,user[@host],...].</td>
</tr>
<tr>
<td>-n</td>
<td>node-exclusive</td>
<td>Sets or unsets exclusive node allocation on a job. Use the y and n options to enable or disable the feature. This affects only cpusets and compatible schedulers.</td>
</tr>
<tr>
<td>-N</td>
<td>name</td>
<td>Renames the job. The name specified may be up to and including 15 characters in length. It must consist of printable, nonwhite space characters with the first character alphabetic.</td>
</tr>
</tbody>
</table>
| -o     | path     | Replaces the path to be used for the standard output stream of the batch job. The path argument is of the form: [hostname:]path_name. The argument will be interpreted as follows:  
- `path_name` – Where `path_name` is not an absolute path name, then the `qalter` command will expand the path name relative to the current working directory of the command. The command will supply the name of the host upon which it is executing for the hostname component.  
- `hostname:path_name` – Where `path_name` is not an absolute path name, then the `qalter` command will expand it relative to the home directory of the user on the system specified by hostname.  
This attribute can be altered once the job has begun execution, but it will not take effect unless the job is rerun. |
<p>| -p     | priority | Replaces the priority of the job. The priority argument must be an integer between -1024 and +1023 inclusive. This attribute can be altered once the job has begun execution, but it will not take effect unless the job is rerun. |
| -r     | [y/n]    | Declares whether the job is rerunable (see the qrerun command). The option argument c is a single character. PBS recognizes the following characters: y and n. If the argument is &quot;y&quot;, the job is marked rerunable. If the argument is &quot;n&quot;, the job is marked as not rerunable. |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-S</td>
<td>path</td>
<td>Declares the shell that interprets the job script. The option argument path_list is in the form:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>path[@host],[path[@host],...]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one path may be specified for any host named. Only one path may be specified without the corresponding host name. The path selected will be the one with the host name that matched the name of the execution host. If no matching host is found, then the path specified (without a host) will be selected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the -S option is not specified, the option argument is the null string or no entry from the path_list is selected, the execution will use the login shell of the user on the execution host.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This attribute can be altered once the job has begun execution, but it will not take effect unless the job is rerun.</td>
</tr>
<tr>
<td>-t</td>
<td>array_range</td>
<td>The array_range argument is an integer id or a range of integers. Multiple ids or id ranges can be combined in a comma delimited list. Examples: -t 1-100 or -t 1,10,50-100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If an array range isn’t specified, the command tries to operate on the entire array. The command acts on the array (or specified range of the array) just as it would on an individual job.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An optional &quot;slot limit&quot; can be specified to limit the amount of jobs that can run concurrently in the job array. The default value is unlimited. The slot limit must be the last thing specified in the array_request and is delimited from the array by a percent sign (%).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Example: qalter weatherSimulationArray[] -t %20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Here, the array weatherSimulationArray[] is configured to allow a maximum of 20 concurrently running jobs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slot limits can be applied at job submit time with qsub, or can be set in a global server parameter policy with max_slot_limit.</td>
</tr>
<tr>
<td>-u</td>
<td>user_list</td>
<td>Replaces the user name under which the job is to run on the execution system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The user_list argument is of the form:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>user[@host],[user[@host],...]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one user name may be given for per specified host. Only one of the user specifications may be supplied without the corresponding host specification. That user name will be used for execution on any host not named in the argument list</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This attribute cannot be altered once the job has begun execution.</td>
</tr>
<tr>
<td>-W</td>
<td>additional_attributes</td>
<td>The -W option allows for the modification of additional job attributes. Note if white space occurs anywhere within the option argument string or the equal sign,&quot;=&quot;, occurs within an attribute_value string, then the string must be enclosed with either single or double quote marks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To see the attributes PBS currently supports within the -W option, see -W additional_attributes on page 206.</td>
</tr>
</tbody>
</table>
Table A-1: W additional attributes

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Value</td>
</tr>
<tr>
<td>Type</td>
<td>Category</td>
</tr>
<tr>
<td>Parameters</td>
<td>Inputs</td>
</tr>
<tr>
<td>Outputs</td>
<td>Notes</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| `depend=dependency_list` | Redefines the dependencies between this and other jobs. The `dependency_list` is in the form:  
```
type[ :argument[:argument...]][,type:argument...]
```
The argument is either a numeric count or a PBS job id according to type. If argument is a count, it must be greater than 0. If it is a job id and is not fully specified in the form:  
```
seq_number.server.name
```
the `jobid` must be an integer column to PBS job id, or the argument will be expanded according to the default server rules. If argument is null (the preceding colon need not be specified), the dependency of the corresponding type is cleared (unset).  
- `syncaccount` - This job is the first in a set of jobs to be executed at the same time. Count is the number of additional jobs in the set.  
- `syncwith` - This job is an additional member of a set of jobs to be executed at the same time. In the above and following dependency types, `jobid` is the job identifier of the first job in the set.  
- `after` - This job may be scheduled for execution at any point after jobs `jobid` have started execution.  
- `afterok` - This job may be scheduled for execution only after jobs `jobid` have terminated with no errors. See the csh warning under "Extended Description".  
- `afternotok` - This job may be scheduled for execution only after jobs `jobid` have terminated with errors. See the csh warning under "Extended Description".  
- `afterany` - This job may be scheduled for execution after jobs `jobid` have terminated, with or without errors.  
- `oncount` - This job may be scheduled for execution after count dependencies on other jobs have been satisfied. This dependency is used in conjunction with any of the 'before' dependencies shown below. If job A has `on:2`, it will wait for two jobs with 'before' dependencies on job A to be fulfilled before running.  
- `before` - When this job has begun execution, then jobs `jobid`... may begin.  
- `beforeok` - If this job terminates execution without errors, then jobs `jobid`... may begin. See the csh warning under "Extended Description".  
- `beforenotok` - If this job terminates execution with errors, then jobs `jobid`... may begin. See the csh warning under "Extended Description".  
- `beforeany` - When this job terminates execution, jobs `jobid`... may begin.  
  If any of the before forms are used, the job referenced by `jobid` must have been submitted with a dependency type of on.  
  If any of the before forms are used, the jobs referenced by `jobid` must have the same owner as the job being altered. Otherwise, the dependency will not take effect.  

Error processing of the existence, state, or condition of the job specified to `qalter` is a deferred service, i.e. the check is performed after the job is queued. If an error is detected, the job will be deleted by the server. Mail will be sent to the job submitter stating the error.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>group_list=g_list</td>
<td>Alters the group name under which the job is to run on the execution system. The g_list argument is of the form: group[@host][,group[@host],...]. Only one group name may be given per specified host. Only one of the group specifications may be supplied without the corresponding host specification. That group name will used for execution on any host not named in the argument list.</td>
</tr>
<tr>
<td>stagein=file_list</td>
<td>Alters which files are staged (copied) in before job start or staged out after the job completes execution. The file_list is in the form: local_file@hostname:remote_file[,...]. The name local_file is the name on the system where the job executes. It may be an absolute path or a path relative to the home directory of the user. The name remote_file is the destination name on the host specified by hostname. The name may be absolute or relative to the user's home directory on the destination host.</td>
</tr>
<tr>
<td>stageout=file_list</td>
<td></td>
</tr>
</tbody>
</table>

**Operands**

The `qalter` command accepts one or more job_identifier operands of the form:

```
sequence_number[.server_name][@server]
```

**Standard error**

Any error condition, either in processing the options or the operands, or any error received in reply to the batch requests will result in an error message being written to standard error.

**Exit status**

Upon successful processing of all the operands presented to the `qalter` command, the exit status will be a value of zero.

If the `qalter` command fails to process any operand, the command exits with a value greater than zero.

**Copyright**

Portions of this text are reprinted and reproduced in electronic form from IEEE Std 1003.1, 2003 Edition, Standard for Information Technology -- Portable Operating System Interface (POSIX), The Open Group Base Specifications Issue 6, Copyright © 2001-2003 by the Institute of Electrical and Electronics Engineers, Inc and The Open Group. In the event of any discrepancy between this version and the original IEEE and The Open Group Standard, the original IEEE and The Open Group Standard is the referee document. The original
Standard can be obtained online at http://www.opengroup.org/unix/online.html.

Related Topics

_ qdel
_ qhold
_ qrls
_ qsub

Non-Adaptive Computing topics

- Batch Environment Services
- qmove
- touch

### qchkpt

Checkpoint pbs batch jobs.

**Synopsis**

```bash
qchkpt <JOBID>[ <JOBID>] ...
```

**Description**

The `qchkpt` command requests that the PBS MOM generate a checkpoint file for a running job. This is an extension to POSIX.2d. The `qchkpt` command sends a Chkpt Job batch request to the server as described in the general section.

**Options**

None.

**Operands**

The `qchkpt` command accepts one or more `job_identifier` operands of the form:

```bash
sequence_number[.server_name][@server]
```

**Examples**

```bash
> qchkpt 3233 request a checkpoint for job 3233
```
Standard error

The `qchkpt` command will write a diagnostic message to standard error for each error occurrence.

Exit status

Upon successful processing of all the operands presented to the `qchkpt` command, the exit status will be a value of zero.

If the `qchkpt` command fails to process any operand, the command exits with a value greater than zero.

Related Topics

`qhold`(1B)
`qrls`(1B)
`qalter`(1B)
`qsub`(1B)

Non-Adaptive Computing topics

- `pbs_alterjob`(3B)
- `pbs_holdjob`(3B)
- `pbs_rlsjob`(3B)
- `pbs_job_attributes`(7B)
- `pbs_resources_unicos8`(7B)

qdel

(delete job)

Synopsis

```
qdel [{-a  <asynchronous delete>|-b  <secs>|-m  <message>|-p
<purge>|-t  <array_range>|-W  <delay>}]<JOBID>[ <JOBID>]... | 'all' | 'ALL'
```

Description

The `qdel` command deletes jobs in the order in which their job identifiers are presented to the command. A job is deleted by sending a Delete Job batch request to the batch server that owns the job. A job that has been deleted is no longer subject to management by batch services.

A batch job may be deleted by its owner, the batch operator, or the batch administrator.
A batch job being deleted by a server will be sent a SIGTERM signal following by a SIGKILL signal. The time delay between the two signals is an attribute of the execution queue from which the job was run (set table by the administrator). This delay may be overridden by the -W option.

See the PBS ERS section 3.1.3.3, "Delete Job Request", for more information.

## Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>asynchronous delete</td>
<td>Performs an asynchronous delete. The server responds to the user before contacting the MOM. The option <code>qdel -a all</code> performs <code>qdel all</code> due to restrictions from being single-threaded.</td>
</tr>
<tr>
<td>-b</td>
<td>seconds</td>
<td>Defines the maximum number of seconds <code>qdel</code> will block attempting to contact <code>pbs_server</code>. If <code>pbs_server</code> is down, or for a variety of communication failures, <code>qdel</code> will continually retry connecting to <code>pbs_server</code> for job submission. This value overrides the CLIENTRETRY parameter in <code>torque.cfg</code>. This is a non-portable TORQUE extension. Portability-minded users can use the PBS_CLIENTRETRY environmental variable. A negative value is interpreted as infinity. The default is 0.</td>
</tr>
<tr>
<td>-p</td>
<td>purge</td>
<td>Forcibly purges the job from the server. This should only be used if a running job will not exit because its allocated nodes are unreachable. The admin should make every attempt at resolving the problem on the nodes. If a job's mother superior recovers after purging the job, any epilogue scripts may still run. This option is only available to a batch operator or the batch administrator.</td>
</tr>
<tr>
<td>-t</td>
<td>array_range</td>
<td>The array_range argument is an integer id or a range of integers. Multiple ids or id ranges can be combined in a comma delimited list (examples: <code>-t 1-100</code> or <code>-t 1,10,50-100</code>). If an array range isn’t specified, the command tries to operate on the entire array. The command acts on the array (or specified range of the array) just as it would on an individual job.</td>
</tr>
</tbody>
</table>

> When deleting a range of jobs, you must include the subscript notation after the job ID (for example, "qdel -t 1-3 98432[]").

| -m     | message | Specify a comment to be included in the email. The argument message specifies the comment to send. This option is only available to a batch operator or the batch administrator. |
| -W     | delay   | Specifies the wait delay between the sending of the SIGTERM and SIGKILL signals. The argument is the length of time in seconds of the delay. |

## Operands

**Commands Overview**
The `qdel` command accepts one or more `job_identifier` operands of the form:

```
sequence_number[.server_name][@server]
```

or

```
all
```

## Examples

```
# Delete a job array
$ qdel 1234[]

# Delete one job from an array
$ qdel 1234[1]

# Delete all jobs, including job arrays
$ qdel all

# Delete selected jobs from an array
$ qdel -t 2-4,6,8-10 64[]
```

ℹ️ There is not an option that allows you to delete all job arrays without deleting jobs.

## Standard error

The `qdel` command will write a diagnostic messages to standard error for each error occurrence.

## Exit status

Upon successful processing of all the operands presented to the `qdel` command, the exit status will be a value of zero.

If the `qdel` command fails to process any operand, the command exits with a value greater than zero.

Related Topics

- `qsub`(1B)
- `qsig`(1B)

Non-Adaptive Computing topics

- `pbs_deljob`(3B)

## qgpumode

*(GPU mode)*
Synopsis

qgpumode -H host -g gpuid -m mode

Description

The `qgpumode` command specifies the mode for the GPU. This command triggers an immediate update of the pbs_server.

For additional information about options for configuring GPUs, see NVIDIA GPUs in the Moab Workload Manager Administrator Guide.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-H</td>
<td>Specifies the host where the GPU is located.</td>
</tr>
<tr>
<td>-g</td>
<td>Specifies the ID of the GPU. This varies depending on the version of the Nvidia driver used. For driver 260.x, it is 0, 1, and so on. For driver 270.x, it is the PCI bus address, i.e., 0:5:0.</td>
</tr>
<tr>
<td>-m</td>
<td>Specifies the new mode for the GPU:</td>
</tr>
<tr>
<td></td>
<td>• 0 (Default/Shared): Default/shared compute mode. Multiple threads can use cudaSetDevice() with this device.</td>
</tr>
<tr>
<td></td>
<td>• 1 (Exclusive Thread): Compute-exclusive-thread mode. Only one thread in one process is able to use cudaSetDevice() with this device.</td>
</tr>
<tr>
<td></td>
<td>• 2 (Prohibited): Compute-prohibited mode. No threads can use cudaSetDevice() with this device.</td>
</tr>
<tr>
<td></td>
<td>• 3 (Exclusive Process): Compute-exclusive-process mode. Many threads in one process are able to use cudaSetDevice() with this device.</td>
</tr>
</tbody>
</table>

```
qgpumode -H node01 -g 0 -m 1
This puts the first GPU on node01 into mode 1 (exclusive)
```

```
qgpumode -H node01 -g 0 -m 0
This puts the first GPU on node01 into mode 0 (shared)
```
qgpureset

(reset GPU)

Synopsis
qgpureset  _H  host  _g  gpuid  _p  _v

Description
The qgpureset command resets the GPU.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-H</td>
<td>Specifies the host where the GPU is located.</td>
</tr>
<tr>
<td>-g</td>
<td>Specifies the ID of the GPU. This varies depending on the version of the Nvidia driver used. For driver 260.x, it is 0, 1, and so on. For driver 270.x, it is the PCI bus address, i.e., 0:5:0.</td>
</tr>
<tr>
<td>-p</td>
<td>Specifies to reset the GPU’s permanent ECC error count.</td>
</tr>
<tr>
<td>-v</td>
<td>Specifies to reset the GPU’s volatile ECC error count.</td>
</tr>
</tbody>
</table>

Related Topics
qgpumode on page 212

qhold

(hold job)

Synopsis
qhold [{-h  <HOLD LIST>|-t  <array_range>}]  <JOBID>[  <JOBID>] ...

Description
The qhold command requests that the server place one or more holds on a job. A job that has a hold is not eligible for execution. There are three supported holds: USER, OTHER (also known as operator), and SYSTEM.
A user may place a USER hold upon any job the user owns. An "operator", who is a user with "operator privilege," may place ether an USER or an OTHER hold on any job. The batch administrator may place any hold on any job.

If no -h option is given, the USER hold will be applied to the jobs described by the job_identifier operand.

If the job identified by job_identifier is in the queued, held, or waiting states, then the hold type is added to the job. The job is then placed into held state if it resides in an execution queue.

If the job is in running state, then the following additional action is taken to interrupt the execution of the job. If checkpoint/restart is supported by the host system, requesting a hold on a running job will (1) cause the job to be checkpointed, (2) the resources assigned to the job will be released, and (3) the job is placed in the held state in the execution queue.

If checkpoint/restart is not supported, qhold will only set the requested hold attribute. This will have no effect unless the job is rerun with the qrerun command.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-h</td>
<td>hold_list</td>
<td>The hold_list argument is a string consisting of one or more of the letters &quot;u&quot;, &quot;o&quot;, or &quot;s&quot; in any combination. The hold type associated with each letter is:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• u – USER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• o – OTHER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• s – SYSTEM</td>
</tr>
</tbody>
</table>

- t     | array_range    | The array_range argument is an integer id or a range of integers. Multiple ids or id ranges can be combined in a comma delimited list (examples: -t 1-100 or -t 1,10,50-100). If an array range isn’t specified, the command tries to operate on the entire array. The command acts on the array (or specified range of the array) just as it would on an individual job. |

Operands

The qhold command accepts one or more job_identifier operands of the form:

sequence_number[,server_name][@server]

Example

```>
qhold -h u 3233 place user hold on job 3233
```

Standard error
The `qhold` command will write a diagnostic message to standard error for each error occurrence.

**Exit status**

Upon successful processing of all the operands presented to the `qhold` command, the exit status will be a value of zero.

If the `qhold` command fails to process any operand, the command exits with a value greater than zero.

**Related Topics**

- `qrls`(1B)
- `qalter`(1B)
- `qsub`(1B)

**Non-Adaptive Computing topics**

- `pbs_alterjob`(3B)
- `pbs_holdjob`(3B)
- `pbs_rlsjob`(3B)
- `pbs_job_attributes`(7B)
- `pbs_resources_unixos8`(7B)

---

`qmgr`

*(PBS Queue Manager)* PBS batch system manager.

**Synopsis**

```
qmgr [-a] [-c command] [-e] [-n] [-z] [server...]
```

**Description**

The `qmgr` command provides an administrator interface to query and configure batch system parameters (see *Server Parameters on page 261*).

The command reads directives from standard input. The syntax of each directive is checked and the appropriate request is sent to the batch server or servers.

The list or print subcommands of `qmgr` can be executed by general users. Creating or deleting a queue requires PBS Manager privilege. Setting or unsetting server or queue attributes requires PBS Operator or Manager privilege.
By default, the user root is the only PBS Operator and Manager. To allow other users to be privileged, the server attributes operators and managers will need to be set (i.e., as root, issue `qmgr -c 'set server managers += <USER1>@<HOST>'`). See TORQUE/PBS Integration Guide - RM Access Control in the Moab Workload Manager Administrator Guide.

If `qmgr` is invoked without the `-c` option and standard output is connected to a terminal, `qmgr` will write a prompt to standard output and read a directive from standard input.

Commands can be abbreviated to their minimum unambiguous form. A command is terminated by a new line character or a semicolon, `;`, character. Multiple commands may be entered on a single line. A command may extend across lines by escaping the new line character with a back-slash `\`.

Comments begin with the "#" character and continue to end of the line. Comments and blank lines are ignored by `qmgr`.

### Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-a</code></td>
<td>---</td>
<td>Abort <code>qmgr</code> on any syntax errors or any requests rejected by a server.</td>
</tr>
<tr>
<td><code>-c</code></td>
<td>command</td>
<td>Execute a single command and exit <code>qmgr</code>.</td>
</tr>
<tr>
<td><code>-e</code></td>
<td>---</td>
<td>Echo all commands to standard output.</td>
</tr>
<tr>
<td><code>-n</code></td>
<td>---</td>
<td>No commands are executed, syntax checking only is performed.</td>
</tr>
<tr>
<td><code>-z</code></td>
<td>---</td>
<td>No errors are written to standard error.</td>
</tr>
</tbody>
</table>

### Operands

The server operands identify the name of the batch server to which the administrator requests are sent. Each server conforms to the following syntax:

```
host_name[:port]
```

where `host_name` is the network name of the host on which the server is running and `port` is the port number to which to connect. If `port` is not specified, the default port number is used.

If `server` is not specified, the administrator requests are sent to the local server.

### Standard input
The `qmgr` command reads standard input for directives until end of file is reached, or the exit or quit directive is read.

**Standard output**

If Standard Output is connected to a terminal, a command prompt will be written to standard output when `qmgr` is ready to read a directive.

If the `-e` option is specified, `qmgr` will echo the directives read from standard input to standard output.

**Standard error**

If the `-z` option is not specified, the `qmgr` command will write a diagnostic message to standard error for each error occurrence.

**Directive syntax**

A `qmgr` directive is one of the following forms:

- `command server [names] [attr OP value[,attr OP value,...]]`
- `command queue [names] [attr OP value[,attr OP value,...]]`
- `command node [names] [attr OP value[,attr OP value,...]]`

where `command` is the command to perform on an object.

Commands are:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>active</td>
<td>Sets the active objects. If the active objects are specified, and the name is not given in a <code>qmgr</code> cmd the active object names will be used.</td>
</tr>
<tr>
<td>create</td>
<td>Is to create a new object, applies to queues and nodes.</td>
</tr>
<tr>
<td>delete</td>
<td>Is to destroy an existing object, applies to queues and nodes.</td>
</tr>
<tr>
<td>set</td>
<td>Is to define or alter attribute values of the object.</td>
</tr>
</tbody>
</table>
| unset   | Is to clear the value of attributes of the object.  
  This form does not accept an OP and value, only the attribute name. |
| list    | Is to list the current attributes and associated values of the object. |
## Command Overview

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>print</strong></td>
<td>Is to print all the queue and server attributes in a format that will be usable as input to the <code>qmgr</code> command.</td>
</tr>
</tbody>
</table>
| **names** | Is a list of one or more names of specific objects. The name list is in the form:  

```bash
[name][@server][,queue_name[@server]...]
```

with no intervening white space. The name of an object is declared when the object is first created. If the name is `@server`, then all the objects of specified type at the server will be affected. |
| **attr** | Specifies the name of an attribute of the object which is to be set or modified. If the attribute is one which consist of a set of resources, then the attribute is specified in the form:  

```bash
attribute_name.resource_name
```

| **OP** | Operation to be performed with the attribute and its value:  

- `"="` - set the value of the attribute. If the attribute has an existing value, the current value is replaced with the new value.  
- `"+="` - increase the current value of the attribute by the amount in the new value.  
- `"-="` - decrease the current value of the attribute by the amount in the new value. |
| **value** | The value to assign to an attribute. If the value includes white space, commas or other special characters, such as the "#" character, the value string must be enclosed in quote marks ("'). |

### The following are examples of `qmgr` directives:

```bash
create queue fast priority=10,queue_type=e,enabled = true,max_running=0
set queue fast max_running +=2
create queue little
set queue little resources_max.mem=8mw,resources_max.cput=10
unset queue fast max_running
set node state = "down,offline"
active server s1,s2,s3
list queue @server1
set queue max_running = 10       - uses active queues
```

### Exit status

Upon successful processing of all the operands presented to the `qmgr` command, the exit status will be a value of zero.  

If the `qmgr` command fails to process any operand, the command exits with a value greater than zero.

### Related Topics

- `pbs_server`(8B)
Non-Adaptive Computing topics

- `pbs_queue_attributes (7B)`
- `pbs_server_attributes (7B)`
- `qstart (8B), qstop (8B)`
- `qenable (8B), qdisable (8)`
- PBS External Reference Specification

qmove

Move PBS batch jobs.

Synopsis

qmove destination jobId [jobId ...]

Description

To move a job is to remove the job from the queue in which it resides and instantiate the job in another queue. The `qmove` command issues a Move Job batch request to the batch server that currently owns each job specified by `jobId`. A job in the Running, Transiting, or Exiting state cannot be moved.

Operands

The first operand, the new `destination`, is one of the following:

- `queue`
- `@server`
- `queue@server`

If the `destination` operand describes only a queue, then `qmove` will move jobs into the queue of the specified name at the job's current server. If the `destination` operand describes only a batch server, then `qmove` will move jobs into the default queue at that batch server. If the `destination` operand describes both a queue and a batch server, then `qmove` will move the jobs into the specified queue at the specified server.

All following operands are `jobIds` which specify the jobs to be moved to the new `destination`. The `qmove` command accepts one or more `jobId` operands of the form: `sequenceNumber [.serverName] [@server]`

Standard error
The `qmove` command will write a diagnostic message to standard error for each error occurrence.

Exit status
Upon successful processing of all the operands presented to the `qmove` command, the exit status will be a value of zero.
If the `qmove` command fails to process any operand, the command exits with a value greater than zero.

Related Topics

`qsub` on page 237

Related Topics (non-Adaptive Computing topics)

* `pbs_movejob(3B)`

**qorder**

Exchange order of two PBS batch jobs in any queue.

**Synopsis**

```
qorder job1_identifier job2_identifier
```

**Description**

To order two jobs is to exchange the jobs' positions in the queue(s) in which the jobs reside. The two jobs must be located on the same server. No attribute of the job, such as priority, is changed. The impact of changing the order in the queue(s) is dependent on local job schedule policy. For information about your local job schedule policy, contact your systems administrator.

*A job in the running state cannot be reordered.*

**Operands**

Both operands are `job_identifier`s that specify the jobs to be exchanged. The `qorder` command accepts two `job_identifier` operands of the following form:

```
sequence_number[.server_name][@server]
```

The two jobs must be in the same location, so the server specification for the two jobs must agree.

**Standard error**
The `qorder` command will write diagnostic messages to standard error for each error occurrence.

**Exit status**

Upon successful processing of all the operands presented to the `qorder` command, the exit status will be a value of zero.

If the `qorder` command fails to process any operand, the command exits with a value greater than zero.

**Related Topics**

- [qsub](#) on page 237
- [qmove](#) on page 220

Related Topics (non-Adaptive Computing topics)

- `pbs_orderjob`(3B)
- `pbs_movejob`(3B)

### qrerun

**(Rerun a batch job)**

**Synopsis**

```
qrerun [{-f}] <JOBID>[ <JOBID>] ...
```

**Description**

The `qrerun` command directs that the specified jobs are to be rerun if possible. To rerun a job is to terminate the session leader of the job and return the job to the queued state in the execution queue in which the job currently resides.

If a job is marked as not rerunable then the rerun request will fail for that job. If the mini-server running the job is down, or it rejects the request, the Rerun Job batch request will return a failure unless `-f` is used.

Using `-f` violates IEEE Batch Processing Services Standard and should be handled with great care. It should only be used under exceptional circumstances. The best practice is to fix the problem mini-server host and let `qrerun` run normally. The nodes may need manual cleaning (see the `-r` option on the `qsub` and `qalter` commands).

**Options**
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-f</td>
<td>Force a rerun on a job</td>
</tr>
</tbody>
</table>

The `qrerun all` command is meant to be run if all of the compute nodes go down. If the machines have actually crashed, then we know that all of the jobs need to be restarted. The behavior if you don't run this would depend on how you bring up the pbs_mom daemons, but by default would be to cancel all of the jobs.

Running the command makes it so that all jobs are requeued without attempting to contact the moms on which they should be running.

**Operands**

The `qrerun` command accepts one or more job_identifier operands of the form: `sequence_number[.server_name][@server]`

**Standard error**

The `qrerun` command will write a diagnostic message to standard error for each error occurrence.

**Exit status**

Upon successful processing of all the operands presented to the `qrerun` command, the exit status will be a value of zero.

If the `qrerun` command fails to process any operand, the command exits with a value greater than zero.

**Examples**

```
> qrerun 3233
```

(Job 3233 will be re-run.)

Related Topics

- `qsub(1B)`
- `qalter(1B)`
Non-Adaptive Computing topics

- pbs_alterjob(3B)
- pbs_rerunjob(3B)

qrls

(Release hold on PBS batch jobs)

Synopsis
qrls [{-h <HOLD LIST>|-t <array_range>]} <JOBID>[ <JOBID>] ...

Description
The qrls command removes or releases holds which exist on batch jobs.

A job may have one or more types of holds which make the job ineligible for execution. The types of holds are USER, OTHER, and SYSTEM. The different types of holds may require that the user issuing the qrls command have special privileges. A user may always remove a USER hold on their own jobs, but only privileged users can remove OTHER or SYSTEM holds. An attempt to release a hold for which the user does not have the correct privilege is an error and no holds will be released for that job.

If no -h option is specified, the USER hold will be released.

If the job has no execution_time pending, the job will change to the queued state. If an execution_time is still pending, the job will change to the waiting state.

Options

<table>
<thead>
<tr>
<th>Command</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -h      | hold_list | Defines the types of hold to be released from the jobs. The hold_list option argument is a string consisting of one or more of the letters "u", "o", and "s" in any combination. The hold type associated with each letter is:  
  - u – USER  
  - o – OTHER  
  - s – SYSTEM |
<table>
<thead>
<tr>
<th>Command</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-t</td>
<td>array_range</td>
<td>The array_range argument is an integer id or a range of integers. Multiple ids or id ranges can be combined in a comma delimited list. Examples: -t 1-100 or -t 1,10,50-100 If an array range isn’t specified, the command tries to operate on the entire array. The command acts on the array (or specified range of the array) just as it would on an individual job.</td>
</tr>
</tbody>
</table>

**Operands**

The `qrls` command accepts one or more `job_identifier` operands of the form: `sequence_number[.server_name][@server]`

**Examples**

```
> qrls -h u 3233 release user hold on job 3233
```

**Standard error**

The `qrls` command will write a diagnostic message to standard error for each error occurrence.

**Exit status**

Upon successful processing of all the operands presented to the `qrls` command, the exit status will be a value of zero.

If the `qrls` command fails to process any operand, the command exits with a value greater than zero.

**Related Topics**

- `qsub`(1B)
- `qalter`(1B)
- `qhold`(1B)
- `pbs_alterjob`(3B)
- `pbs_holdjob`(3B)
- `pbs_rlsjob`(3B)

**Non-Adaptive Computing topics**

- `pbs_alterjob`(3B)
- `pbs_holdjob`(3B)
- `pbs_rlsjob`(3B)
qrun

(Run a batch job)

Synopsis
qrun [{\texttt{-H} <HOST>|\texttt{-a}}] <JOBID>[ <JOBID>] ...

Overview
The \texttt{qrun} command runs a job.

Format

\begin{tabular}{|c|l|}
\hline
\textbf{-H} & \hline
\textbf{Format} & <STRING> Host Identifier \\
\textbf{Default} & --- \\
\textbf{Description} & Specifies the host within the cluster on which the job(s) are to be run. The host argument is the name of a host that is a member of the cluster of hosts managed by the server. If the option is not specified, the server will select the "worst possible" host on which to execute the job. \\
\textbf{Example} & \texttt{qrun -H hostname 15406} \\
\hline
\end{tabular}

\begin{tabular}{|c|l|}
\hline
\textbf{-a} & \hline
\textbf{Format} & --- \\
\textbf{Default} & --- \\
\textbf{Description} & Run the job(s) asynchronously. \\
\textbf{Example} & \texttt{qrun -a 15406} \\
\hline
\end{tabular}

Command details
The \texttt{qrun} command is used to force a batch server to initiate the execution of a batch job. The job is run regardless of scheduling position or resource requirements.
In order to execute `qrun`, the user must have PBS Operation or Manager privileges.

**Examples**

```
> qrun 3233
```

(Run job 3233.)

**qsig**

*(Signal a job)*

**Synopsis**

```
qsig [{-s <SIGNAL>}] <JOBID>[ <JOBID>] ...
[-a]
```

**Description**

The `qsig` command requests that a signal be sent to executing batch jobs. The signal is sent to the session leader of the job. If the `-s` option is not specified, SIGTERM is sent. The request to signal a batch job will be rejected if:

- The user is not authorized to signal the job.
- The job is not in the running state.
- The requested signal is not supported by the system upon which the job is executing.

The `qsig` command sends a Signal Job batch request to the server which owns the job.

**Options**
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-s</td>
<td>signal</td>
<td>Declares which signal is sent to the job. The signal argument is either a signal name, e.g. SIGKILL, the signal name without the SIG prefix, e.g. KILL, or an unsigned signal number, e.g. 9. The signal name SIGNULL is allowed; the server will send the signal 0 to the job which will have no effect on the job, but will cause an obituary to be sent if the job is no longer executing. Not all signal names will be recognized by qsig. If it doesn’t recognize the signal name, try issuing the signal number instead. Two special signal names, &quot;suspend&quot; and &quot;resume&quot;, are used to suspend and resume jobs. Cray systems use the Cray-specific suspend() / resume() calls. On non-Cray system, suspend causes a SIGTSTP to be sent to all processes in the job’s top task, wait 5 seconds, and then send a SIGSTOP to all processes in all tasks on all nodes in the job. This differs from TORQUE 2.0.0 which did not have the ability to propagate signals to sister nodes. Resume sends a SIGCONT to all processes in all tasks on all nodes. When suspended, a job continues to occupy system resources but is not executing and is not charged for walltime. The job will be listed in the &quot;S&quot; state. Manager or operator privilege is required to suspend or resume a job. Interactive jobs may not resume properly because the top-level shell will background the suspended child process.</td>
</tr>
<tr>
<td>-a</td>
<td>asynchronously</td>
<td>Makes the command run asynchronously.</td>
</tr>
</tbody>
</table>

**Operands**

The `qsig` command accepts one or more job_identifier operands of the form:

`sequence_number[.server_name][@server]`

**Examples**

```markdown
> qsig -s SIGKILL 3233    send a SIGKILL to job 3233
> qsig -s KILL 3233   send a SIGKILL to job 3233
> qsig -s 9 3233            send a SIGKILL to job 3233
```

**Standard error**

The `qsig` command will write a diagnostic message to standard error for each error occurrence.

**Exit status**

Upon successful processing of all the operands presented to the `qsig` command, the exit status will be a value of zero.
If the `qsig` command fails to process any operand, the command exits with a value greater than zero.

Related Topics
- `qsub`(1B)

**Non-Adaptive Computing topics**
- `pbs_sigjob`(3B)
- `pbs_resources.*`(7B) where * is system type
- PBS ERS

### qstat

Show status of PBS batch jobs.

**Synopsis**

```
qstat [-c] [-C] [-f] [-1] [-W site_specific] [job_identifier...]
```

```
```

```
qstat [-Q] [-f] [-1] [-W site_specific] [destination...]
```

```
qstat [-g] [-c] [-G] [-M] [destination...]
```

```
qstat [-B] [-c] [-f] [-1] [-W site_specific] [server_name...]
```

```
qstat [-t] [-c] [-C]
```

**Description**

The `qstat` command is used to request the status of jobs, queues, or a batch server. The requested status is written to standard out.

When requesting job status, synopsis format 1 or 2, `qstat` will output information about each `job_identifier` or all jobs at each destination. Jobs for which the user does not have status privilege are not displayed.

When requesting queue or server status, synopsis format 3 through 5, `qstat` will output information about each destination.

> You can configure TORQUE with `CFLAGS='DTXT'` to change the alignment of text in `qstat` output. This noticeably improves `qstat -r` output.

**Options**
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-c</td>
<td>Completed jobs are not displayed in the output. If desired, you can set the <code>PBS_QSTAT_NO_COMPLETE</code> environment variable to cause all <code>qstat</code> requests to not show completed jobs by default.</td>
</tr>
<tr>
<td>-C</td>
<td>Specifies that TORQUE will provide only a condensed output (job name, resources used, queue, state, and job owner) for jobs that have not changed recently (as per the <code>job_full_report_time</code> parameter). Jobs that have recently changed will continue to send a full output.</td>
</tr>
<tr>
<td>-f</td>
<td>Specifies that a full status display be written to standard out. The <code>[time]</code> value is the amount of walltime, in seconds, remaining for the job. <code>[time]</code> does not account for wall-time multipliers.</td>
</tr>
<tr>
<td>-a</td>
<td>All jobs are displayed in the alternative format (see <code>Standard output on page 232</code>). If the operand is a destination id, all jobs at that destination are displayed. If the operand is a job id, information about that job is displayed.</td>
</tr>
<tr>
<td>-e</td>
<td>If the operand is a job id or not specified, only jobs in executable queues are displayed. Setting the <code>PBS_QSTAT_EXECONLY</code> environment variable will also enable this option.</td>
</tr>
<tr>
<td>-i</td>
<td>Job status is displayed in the alternative format. For a destination id operand, statuses for jobs at that destination which are not running are displayed. This includes jobs which are queued, held or waiting. If an operand is a job id, status for that job is displayed regardless of its state.</td>
</tr>
<tr>
<td>-r</td>
<td>If an operand is a job id, status for that job is displayed. For a destination id operand, statuses for jobs at that destination which are running are displayed; this includes jobs which are suspended. Note that if there is no walltime given for a job, then elapsed time does not display.</td>
</tr>
<tr>
<td>-n</td>
<td>In addition to the basic information, nodes allocated to a job are listed.</td>
</tr>
<tr>
<td>-1</td>
<td>In combination with -n, the -1 option puts all of the nodes on the same line as the job ID. In combination with -f, attributes are not folded to fit in a terminal window. This is intended to ease the parsing of the <code>qstat</code> output.</td>
</tr>
<tr>
<td>-s</td>
<td>In addition to the basic information, any comment provided by the batch administrator or scheduler is shown.</td>
</tr>
<tr>
<td>-G</td>
<td>Show size information in giga-bytes</td>
</tr>
<tr>
<td>Option</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>-M</td>
<td>Show size information, disk or memory in mega-words. A word is considered to be 8 bytes.</td>
</tr>
<tr>
<td>-R</td>
<td>In addition to other information, disk reservation information is shown. Not applicable to all systems.</td>
</tr>
</tbody>
</table>
| -t     | Normal qstat output displays a summary of the array instead of the entire array, job for job. qstat -t expands the output to display the entire array. Note that arrays are now named with brackets following the array name; for example:  
dbeerp@napali:~/dev/torque/array_changes$ echo sleep 20 | qsub -t 0-299 189[].napali  
Individual jobs in the array are now also noted using square brackets instead of dashes; for example, here is part of the output of qstat -t for the preceding array:  
189[299].napali STDIN[299] dbeer 0 Q batch |
| -u     | Job status is displayed in the alternative format. If an operand is a job id, status for that job is displayed. For a destination id operand, statuses for jobs at that destination which are owned by the user(s) listed in user_list are displayed. The syntax of the user_list is:  
user_name[@host],user_name[@host],...]  
Host names may be wild carded on the left end, e.g. "*.nasa.gov". User_name without a "@host" is equivalent to "user_name@*", that is at any host |
| -Q     | Specifies that the request is for queue status and that the operands are destination identifiers. |
| -q     | Specifies that the request is for queue status which should be shown in the alternative format. |
| -B     | Specifies that the request is for batch server status and that the operands are the names of servers. |

**Operands**

If neither the -Q nor the -B option is given, the operands on the qstat command must be either job identifiers or destinations identifiers.

If the operand is a job identifier, it must be in the following form:

`sequence_number[.server_name][@server]`

where `sequence_number.server_name` is the job identifier assigned at submittal time (see qsub). If the `.server_name` is omitted, the name of the default server will be used. If @server is supplied, the request will be for the job identifier currently at that Server.
If the operand is a destination identifier, it is one of the following three forms:

- queue
- @server
- queue@server

If queue is specified, the request is for status of all jobs in that queue at the default server. If the @server form is given, the request is for status of all jobs at that server. If a full destination identifier, queue@server, is given, the request is for status of all jobs in the named queue at the named server.

If the -Q option is given, the operands are destination identifiers as specified above. If queue is specified, the status of that queue at the default server will be given. If queue@server is specified, the status of the named queue at the named server will be given. If @server is specified, the status of all queues at the named server will be given. If no destination is specified, the status of all queues at the default server will be given.

If the -B option is given, the operand is the name of a server.

**Standard output**

**Displaying job status**

If job status is being displayed in the default format and the -f option is not specified, the following items are displayed on a single line, in the specified order, separated by white space:

- the job identifier assigned by PBS.
- the job name given by the submitter.
- the job owner.
- the CPU time used.
- the job state:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Job is completed after having run.</td>
</tr>
<tr>
<td>E</td>
<td>Job is exiting after having run.</td>
</tr>
<tr>
<td>H</td>
<td>Job is held.</td>
</tr>
<tr>
<td>Q</td>
<td>Job is queued, eligible to run or routed.</td>
</tr>
</tbody>
</table>
the queue in which the job resides.

If job status is being displayed and the -f option is specified, the output will depend on whether qstat was compiled to use a Tcl interpreter. See Configuration on page 236 for details. If Tcl is not being used, full display for each job consists of the header line:

Job Id: job identifier

Followed by one line per job attribute of the form:
attribute_name = value

If any of the options -a, -i, -r, -u, -n, -s, -G, or -M are provided, the alternative display format for jobs is used. The following items are displayed on a single line, in the specified order, separated by white space:

- the job identifier assigned by PBS
- the job owner
- the queue in which the job currently resides
- the job name given by the submitter
- the session id (if the job is running)
- the number of nodes requested by the job
- the number of cpus or tasks requested by the job
- the amount of memory requested by the job
- either the cpu time, if specified, or wall time requested by the job, (hh:mm)
- the jobs current state
- the amount of cpu time or wall time used by the job (hh:mm)

If the -r option is provided, the line contains:

- the job identifier assigned by PBS
- the job owner
- the queue in which the job currently resides
- the number of nodes requested by the job
- the number of cpus or tasks requested by the job
- the amount of memory requested by the job
- either the cpu time or wall time requested by the job
- the jobs current state
- the amount of cpu time or wall time used by the job
- the amount of SRFS space requested on the big file system
- the amount of SRFS space requested on the fast file system
- the amount of space requested on the parallel I/O file system

The last three fields may not contain useful information at all sites or on all systems.

**Displaying queue status**

If queue status is being displayed and the `-f` option was not specified, the following items are displayed on a single line, in the specified order, separated by white space:

- the queue name
- the maximum number of jobs that may be run in the queue concurrently
- the total number of jobs in the queue
- the enable or disabled status of the queue
- the started or stopped status of the queue
- for each job state, the name of the state and the number of jobs in the queue in that state
- the type of queue, execution or routing

If queue status is being displayed and the `-f` option is specified, the output will depend on whether `qstat` was compiled to use a Tcl interpreter. See the configuration section for details. If Tcl is not being used, the full display for each queue consists of the header line:

```
Queue: queue_name
```

Followed by one line per queue attribute of the form:

```
attribute_name = value
```

If the `-Q` option is specified, queue information is displayed in the alternative format: The following information is displayed on a single line:
• the queue name
• the maximum amount of memory a job in the queue may request
• the maximum amount of cpu time a job in the queue may request
• the maximum amount of wall time a job in the queue may request
• the maximum amount of nodes a job in the queue may request
• the number of jobs in the queue in the running state
• the number of jobs in the queue in the queued state
• the maximum number (limit) of jobs that may be run in the queue concurrently
• the state of the queue given by a pair of letters:
  ○ either the letter E if the queue is Enabled or D if Disabled and
  ○ either the letter R if the queue is Running (started) or S if Stopped.

Displaying server status

If batch server status is being displayed and the -f option is not specified, the following items are displayed on a single line, in the specified order, separated by white space:

• the server name
• the maximum number of jobs that the server may run concurrently
• the total number of jobs currently managed by the server
• the status of the server
• for each job state, the name of the state and the number of jobs in the server in that state

If server status is being displayed and the -f option is specified, the output will depend on whether qstat was compiled to use a Tcl interpreter. See the configuration section for details. If Tcl is not being used, the full display for the server consists of the header line:

Server: server name

Followed by one line per server attribute of the form:

 attribute_name = value

Standard error

The qstat command will write a diagnostic message to standard error for each error occurrence.
Configuration

If `qstat` is compiled with an option to include a Tcl interpreter, using the -f flag to get a full display causes a check to be made for a script file to use to output the requested information. The first location checked is `$HOME/.qstatrc`. If this does not exist, the next location checked is administrator configured. If one of these is found, a Tcl interpreter is started and the script file is passed to it along with three global variables. The command line arguments are split into two variable named flags and operands. The status information is passed in a variable named objects. All of these variables are Tcl lists. The flags list contains the name of the command (usually "qstat") as its first element. Any other elements are command line option flags with any options they use, presented in the order given on the command line. They are broken up individually so that if two flags are given together on the command line, they are separated in the list. For example, if the user typed:

```bash
qstat -QfWbigdisplay
```

the flags list would contain:

```bash
qstat -Q -f -W bigdisplay
```

The operands list contains all other command line arguments following the flags. There will always be at least one element in operands because if no operands are typed by the user, the default destination or server name is used. The objects list contains all the information retrieved from the server(s) so the Tcl interpreter can run once to format the entire output. This list has the same number of elements as the operands list. Each element is another list with two elements.

The first element is a string giving the type of objects to be found in the second. The string can take the values "server", "queue", "job" or "error".

The second element will be a list in which each element is a single batch status object of the type given by the string discussed above. In the case of "error", the list will be empty. Each object is again a list. The first element is the name of the object. The second is a list of attributes.

The third element will be the object text.

All three of these object elements correspond with fields in the structure `batch_status` which is described in detail for each type of object by the man pages for `pbs_statjob(3)`, `pbs_statqueue(3)`, and `pbs_statserver(3)`. Each attribute in the second element list whose elements correspond with the `attrl` structure. Each will be a list with two elements. The first will be the attribute name and the second will be the attribute value.

Exit status

Upon successful processing of all the operands presented to the `qstat` command, the exit status will be a value of zero.
If the `qstat` command fails to process any operand, the command exits with a value greater than zero.

Related Topics
- `qalter`(1B)
- `qsub`(1B)

Non-Adaptive Computing topics
- `pbs_alterjob`(3B)
- `pbs_statjob`(3B)
- `pbs_statque`(3B)
- `pbs_statserver`(3B)
- `pbs_submit`(3B)
- `pbs_job_attributes`(7B)
- `pbs_queue_attributes`(7B)
- `pbs_server_attributes`(7B)
- `qmgr query_other_jobs` parameter (allow non-admin users to see other users' jobs
- `pbs_resources_*`(7B) where * is system type
- PBS ERS

### qsub

Submit PBS job.

#### Synopsis

```bash
qsub [\-a date_time] [\-A account_string] [\-b secs] [\-c
```

#### Description

To create a job is to submit an executable script to a batch server. The batch server will be the default server unless the -q option is specified. The command parses a script prior to the actual script execution; it does not execute a script itself. All script-writing rules remain in effect, including the "#!" at the head of
the file (see discussion of PBS_DEFAULT under Environment variables on page 253). Typically, the script is a shell script which will be executed by a command shell such as sh or csh.

Options on the qsub command allow the specification of attributes which affect the behavior of the job.

The qsub command will pass certain environment variables in the Variable_List attribute of the job. These variables will be available to the job. The value for the following variables will be taken from the environment of the qsub command: HOME, LANG, LOGNAME, PATH, MAIL, SHELL, and TZ. These values will be assigned to a new name which is the current name prefixed with the string "PBS_O_". For example, the job will have access to an environment variable named PBS_O_HOME which have the value of the variable HOME in the qsub command environment.

In addition to the above, the following environment variables will be available to the batch job:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_O_HOST</td>
<td>The name of the host upon which the qsub command is running.</td>
</tr>
<tr>
<td>PBS_SERVER</td>
<td>The hostname of the pbs_server which qsub submits the job to.</td>
</tr>
<tr>
<td>PBS_O_QUEUE</td>
<td>The name of the original queue to which the job was submitted.</td>
</tr>
<tr>
<td>PBS_O_WORKDIR</td>
<td>The absolute path of the current working directory of the qsub command.</td>
</tr>
<tr>
<td>PBS_ARRAYID</td>
<td>Each member of a job array is assigned a unique identifier (see -t option).</td>
</tr>
<tr>
<td>PBS_ENVIRONMENT</td>
<td>Set to PBS_BATCH to indicate the job is a batch job, or to PBS_INTERACTIVE to indicate the job is a PBS interactive job (see -I option).</td>
</tr>
<tr>
<td>PBS_GPUFILE</td>
<td>The name of the file containing the list of assigned GPUs. For more information about how to set up TORQUE with GPUs, see Accelerators in the Moab Workload Manager Administrator Guide.</td>
</tr>
<tr>
<td>PBS_JOBID</td>
<td>The job identifier assigned to the job by the batch system. It can be used in the stdout and stderr paths. TORQUE replaces $PBS_JOBID with the job’s jobid (for example, #PBS -o /tmp/$PBS_JOBID.output).</td>
</tr>
<tr>
<td>PBS_JOBNAME</td>
<td>The job name supplied by the user.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PBS_NODEFILE</td>
<td>The name of the file contains the list of nodes assigned to the job (for parallel and cluster systems).</td>
</tr>
<tr>
<td>PBS_QUEUE</td>
<td>The name of the queue from which the job is executed.</td>
</tr>
</tbody>
</table>

**Options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>date_time</td>
<td>Declares the time after which the job is eligible for execution. The date_time argument is in the form: [[[CC]YY]MM]DD]hhmm [.SS] where CC is the first two digits of the year (the century), YY is the second two digits of the year, MM is the two digits for the month, DD is the day of the month, hh is the hour, mm is the minute, and the optional SS is the seconds. If the month (MM) is not specified, it will default to the current month if the specified day (DD) is in the future. Otherwise, the month will be set to next month. Likewise, if the day (DD) is not specified, it will default to today if the time (hhmm) is in the future. Otherwise, the day will be set to tomorrow. For example, if you submit a job at 11:15 am with a time of -a 1110, the job will be eligible to run at 11:10 am tomorrow.</td>
</tr>
<tr>
<td>-A</td>
<td>account_string</td>
<td>Defines the account string associated with the job. The account_string is an undefined string of characters and is interpreted by the server which executes the job. See section 2.7.1 of the PBS ERS.</td>
</tr>
<tr>
<td>-b</td>
<td>seconds</td>
<td>Defines the maximum number of seconds qsub will block attempting to contact pbs_server. If pbs_server is down, or for a variety of communication failures, qsub will continually retry connecting to pbs_server for job submission. This value overrides the CLIENTRETRY parameter in torque.cfg. This is a non-portable TORQUE extension. Portability-minded users can use the PBS_CLIENTRETRY environmental variable. A negative value is interpreted as infinity. The default is 0.</td>
</tr>
<tr>
<td>Option</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>-c</td>
<td>checkpoint_options</td>
<td>Defines the options that will apply to the job. If the job executes upon a host which does not support checkpoint, these options will be ignored.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Valid checkpoint options are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• none – No checkpointing is to be performed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• enabled – Specify that checkpointing is allowed but must be explicitly invoked by either the qhold or qchkpt commands.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• shutdown – Specify that checkpointing is to be done on a job at pbs_mom shutdown.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• periodic – Specify that periodic checkpointing is enabled. The default interval is 10 minutes and can be changed by the $checkpoint_interval option in the MOM config file or by specifying an interval when the job is submitted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• interval=minutes – Checkpointing is to be performed at an interval of minutes, which is the integer number of minutes of wall time used by the job. This value must be greater than zero.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• depth=number – Specify a number (depth) of checkpoint images to be kept in the checkpoint directory.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• dir=path – Specify a checkpoint directory (default is /var/spool/torque/checkpoint).</td>
</tr>
<tr>
<td>-C</td>
<td>directive_prefix</td>
<td>Defines the prefix that declares a directive to the qsub command within the script file. (See the paragraph on script directives under Extended description on page 254.) If the –C option is presented with a directive_prefix argument that is the null string, qsub will not scan the script file for directives.</td>
</tr>
<tr>
<td>-d</td>
<td>path</td>
<td>Defines the working directory path to be used for the job. If the –d option is not specified, the default working directory is the home directory. This option sets the environment variable PBS_O_INITDIR.</td>
</tr>
<tr>
<td>-D</td>
<td>path</td>
<td>Defines the root directory to be used for the job. This option sets the environment variable PBS_O_ROOTDIR.</td>
</tr>
<tr>
<td>Option</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| -e     | path  | Defines the path to be used for the standard error stream of the batch job. The path argument is of the form:  
[hostname:]path_name  
where hostname is the name of a host to which the file will be returned, and path_name is the path name on that host in the syntax recognized by POSIX.  

When specifying a directory for the location you need to include a trailing slash.  
The argument will be interpreted as follows:  
- path_name – where path_name is not an absolute path name, then the qsub command will expand the path name relative to the current working directory of the command. The command will supply the name of the host upon which it is executing for the hostname component.  
- hostname:path_name – where path_name is not an absolute path name, then the qsub command will not expand the path name relative to the current working directory of the command. On delivery of the standard error, the path name will be expanded relative to the user’s home directory on the hostname system.  
- path_name – where path_name specifies an absolute path name, then the qsub will supply the name of the host on which it is executing for the hostname.  
- hostname:path_name – where path_name specifies an absolute path name, the path will be used as specified.  
If the -e option is not specified, the default file name for the standard error stream will be used. The default name has the following form:  
- job_name:sequence_number – where job_name is the name of the job (see the -n name option) and sequence_number is the job number assigned when the job is submitted. |
| -f     | ---   | Job is made fault tolerant. Jobs running on multiple nodes are periodically polled by mother superior. If one of the nodes fails to report, the job is canceled by mother superior and a failure is reported. If a job is fault tolerant, it will not be canceled based on failed polling (no matter how many nodes fail to report). This may be desirable if transient network failures are causing large jobs not to complete, where ignoring one failed polling attempt can be corrected at the next polling attempt.  
If TORQUE is compiled with PBS_NO_POSIX_VIOLATION (there is no config option for this), you have to use -W fault_tolerant=true to mark the job as fault tolerant. |
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -F     | ---  | Specifies the arguments that will be passed to the job script when the script is launched. The accepted syntax is:  
```plaintext
qsub -F "myarg1 myarg2 myarg3=myarg3value" myscript2.sh
```
|       |      | **Quotation marks are required.** If the argument following `-F` is not a quoted value, the pbsmom server will pass the quoted value as arguments to the job script when it launches the script. |
| -h     | ---  | Specifies that a user hold be applied to the job at submission time. |
| -I     | ---  | Declares that the job is to be run "interactively". The job will be queued and scheduled as any PBS batch job, but when executed, the standard input, output, and error streams of the job are connected through `qsub` to the terminal session in which `qsub` is running. Interactive jobs are forced to not rerunnable. See [Extended description on page 254](#) for additional information of interactive jobs. |
| -j     | join | Declares if the standard error stream of the job will be merged with the standard output stream of the job.  
An option argument value of `oe` directs that the two streams will be merged, intermixed, as standard output. An option argument value of `eo` directs that the two streams will be merged, intermixed, as standard error.  
If the `join` argument is `n` or the option is not specified, the two streams will be two separate files. |
<p>|       |      | <strong>If using either the <code>-e</code> or the <code>-o</code> option and the <code>-j eo oe</code> option, the <code>-j</code> option takes precedence and all standard error and output messages go to the chosen output file.</strong> |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -k     | keep         | Defines which (if either) of standard output or standard error will be retained on the execution host. If set for a stream, this option overrides the path name for that stream. If not set, neither stream is retained on the execution host. The argument is either the single letter "e" or "o", or the letters "e" and "o" combined in either order. Or the argument is the letter "n".  
   - e – The standard error stream is to be retained on the execution host. The stream will be placed in the home directory of the user under whose user id the job executed. The file name will be the default file name given by:  
     
     ```bash
     job_name.esequence
     ```
     
     where `job_name` is the name specified for the job, and `sequence` is the sequence number component of the job identifier.  
   - o – The standard output stream is to be retained on the execution host. The stream will be placed in the home directory of the user under whose user id the job executed. The file name will be the default file name given by:  
     
     ```bash
     job_name.osequence
     ```
     
     where `job_name` is the name specified for the job, and `sequence` is the sequence number component of the job identifier.  
   - eo – Both the standard output and standard error streams will be retained.  
   - oe – Both the standard output and standard error streams will be retained.  
   - n – Neither stream is retained.  

| -l     | resource_list | Defines the resources that are required by the job and establishes a limit to the amount of resource that can be consumed. If not set for a generally available resource, such as CPU time, the limit is infinite. The `resource_list` argument is of the form:  
  
  ```bash
  resource_name=[[value]]|,resource_name=[[value]],...
  ```
  
  In this situation, you should request the more inclusive resource first. For example, a request for procs should come before a gres request.  

  In TORQUE 3.0.2 or later, `qsub` supports the mapping of `-l gpus=X` to `-l gres=gpus:X`. This allows users who are using NUMA systems to make requests such as `-l ncpus=20:gpus=5` indicating they are not concerned with the GPUs in relation to the NUMA nodes they request, they only want a total of 20 cores and 5 GPUs.  

  For more information, see [Requesting Resources on page 59](#).  

  For information on specifying multiple types of resources for allocation, see Multi-Req Support in the [Moab Workload Manager Administrator Guide](#).
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -m     | mail_options | Defines the set of conditions under which the execution server will send a mail message about the job. The mail_options argument is a string which consists of either the single character "n", or one or more of the characters "a", "b", and "e". If the character "n" is specified, no normal mail is sent. Mail for job cancels and other events outside of normal job processing are still sent. For the letters "a", "b", and "e":  
- a – Mail is sent when the job is aborted by the batch system.  
- b – Mail is sent when the job begins execution.  
- e – Mail is sent when the job terminates. If the -m option is not specified, mail will be sent if the job is aborted. |
<p>| -M     | user_list  | Declares the list of users to whom mail is sent by the execution server when it sends mail about the job. The user_list argument is of the form: user[@host],user[@host],... If unset, the list defaults to the submitting user at the qsub host, i.e. the job owner.                                                                                                                                                                                                                                    |
| -n     | node-exclusive | Allows a user to specify an exclusive-node access/allocation request for the job. This affects only cpusets and compatible schedulers (see Linux Cpuset Support on page 98).                                                                                                                                                                                                                                                                                     |
| -N     | name       | Declares a name for the job. The name specified may be an unlimited number of characters in length. It must consist of printable, nonwhite space characters with the first character alphabetic. If the -N option is not specified, the job name will be the base name of the job script file specified on the command line. If no script file name was specified and the script was read from the standard input, then the job name will be set to STDIN.                                                                                           |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -o     | path  | Defines the path to be used for the standard output stream of the batch job. The path argument is of the form:  
  [hostname:]path_name  
  where hostname is the name of a host to which the file will be returned, and path_name is the path name on that host in the syntax recognized by POSIX.  
  
  When specifying a directory for the location you need to include a trailing slash.  
  
  The argument will be interpreted as follows:  
  
  - path_name – where path_name is not an absolute path name, then the qsub command will expand the path name relative to the current working directory of the command. The command will supply the name of the host upon which it is executing for the hostname component.  
  - hostname:path_name – where path_name is not an absolute path name, then the qsub command will not expand the path name relative to the current working directory of the command. On delivery of the standard output, the path name will be expanded relative to the user’s home directory on the hostname system.  
  - path_name – where path_name specifies an absolute path name, then the qsub will supply the name of the host on which it is executing for the hostname.  
  - hostname:path_name where path_name specifies an absolute path name, the path will be used as specified.  
  
  If the -o option is not specified, the default file name for the standard output stream will be used. The default name has the following form:  
  
  - job_name:sequence_number – where job_name is the name of the job (see the -n name option) and sequence_number is the job number assigned when the job is submitted. |
<p>| -p     | priority | Defines the priority of the job. The priority argument must be a integer between -1024 and +1023 inclusive. The default is no priority which is equivalent to a priority of zero. |
| -P     | user[:group] | Allows a root user or manager to submit a job as another user. TORQUE treats proxy jobs as though the jobs were submitted by the supplied username. This feature is available in TORQUE 2.4.7 and later; however, TORQUE 2.4.7 does not have the ability to supply the [:group] option; it is available in TORQUE 2.4.8 and later. |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -q     | destination | Defines the destination of the job. The destination names a queue, a server, or a queue at a server. The qsub command will submit the script to the server defined by the destination argument. If the destination is a routing queue, the job may be routed by the server to a new destination. If the -q option is not specified, the qsub command will submit the script to the default server. (See Environment variables on page 253 and the PBS ERS section 2.7.4, "Default Server"). If the -q option is specified, it is in one of the following three forms:  
  - queue  
  - @server  
  - queue@server  
  If the destination argument names a queue and does not name a server, the job will be submitted to the named queue at the default server.  
  If the destination argument names a server and does not name a queue, the job will be submitted to the default queue at the named server.  
  If the destination argument names both a queue and a server, the job will be submitted to the named queue at the named server. |
| -r     | y/n      | Declares whether the job is rerunable (see the qrerun command). The option argument is a single character, either y or n. If the argument is "y", the job is rerunable. If the argument is "n", the job is not rerunable. The default value is y, rerunable. |
| -S     | path_list | Declares the path to the desires shell for this job. qsub script.sh -S /bin/tcsh  
  If the shell path is different on different compute nodes, use the following syntax:  
  path[@host],[path[@host]],...  
  qsub script.sh -S /bin/tcsh@node1,/usr/bin/tcsh@node2  
  Only one path may be specified for any host named. Only one path may be specified without the corresponding host name. The path selected will be the one with the host name that matched the name of the execution host. If no matching host is found, then the path specified without a host will be selected, if present.  
  If the -S option is not specified, the option argument is the null string, or no entry from the path_list is selected, the execution will use the user's login shell on the execution host. |
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| -t     | array_request | Specifies the task ids of a job array. Single task arrays are allowed. The array_request argument is an integer id or a range of integers. Multiple ids or id ranges can be combined in a comma delimited list. Examples: `-t 1-100` or `-t 1,10,50-100`  
An optional *slot limit* can be specified to limit the amount of jobs that can run concurrently in the job array. The default value is unlimited. The slot limit must be the last thing specified in the array_request and is delimited from the array by a percent sign (%).  
```
{qsub script.sh -t 0-299%5
```
This sets the slot limit to 5. Only 5 jobs from this array can run at the same time. You can use qalter to modify slot limits on an array. The server parameter `max_slot_limit` can be used to set a global slot limit policy. |
| -u     | user_list  | Defines the user name under which the job is to run on the execution system. The user_list argument is of the form: `user[@host],[user[@host],...]`  
Only one user name may be given per specified host. Only one of the user specifications may be supplied without the corresponding host specification. That user name will be used for execution on any host not named in the argument list. If unset, the user_list defaults to the user who is running qsub. |
<p>| -v     | variable_list | Expands the list of environment variables that are exported to the job. In addition to the variables described in the &quot;Description&quot; section above, variable_list names environment variables from the qsub command environment which are made available to the job when it executes. The variable_list is a comma separated list of strings of the form <code>variable or variable=value</code>. These variables and their values are passed to the job. Note that <code>-v</code> has a higher precedence than <code>-V</code>, so identically named variables specified via <code>-v</code> will provide the final value for an environment variable in the job. |
| -V     | ---       | Declares that all environment variables in the qsub commands environment are to be exported to the batch job. |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-W</td>
<td>additional_attributes</td>
<td>The -W option allows for the specification of additional job attributes. The general syntax of -W is in the form:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-W attr_name=attr_value.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>You can use multiple -W options with this syntax:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-W attr_name1=attr_value1 -W attr_name2=attr_value2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>i</strong> If white space occurs anywhere within the option argument string or the equal sign, &quot;=&quot; occurs within an attribute_value string, then the string must be enclosed with either single or double quote marks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PBS currently supports the following attributes within the -W option:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- depend=dependency_list – Defines the dependency between this and other jobs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The dependency_list is in the form:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>type[:argument[:argument...]][,type:argument...]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The argument is either a numeric count or a PBS job id according to type. If argument is a count, it must be greater than 0. If it is a job id and not fully specified in the form seq_number.server.name, it will be expanded according to the default server rules which apply to job IDs on most commands. If argument is null (the preceding colon need not be specified), the dependency of the corresponding type is cleared (unset). For more information, see depend=dependency_list valid dependencies on page 249.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- group_list=g_list – Defines the group name under which the job is to run on the execution system. The g_list argument is of the form:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>group[@host][,group[@host],...]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only one group name may be given per specified host. Only one of the group specifications may be supplied without the corresponding host specification.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>That group name will be used for execution on any host not named in the argument list. If not set, the group_list defaults to the primary group of the user under which the job will be run.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- interactive=true – If the interactive attribute is specified, the job is an interactive job. The -I option is an alternative method of specifying this attribute.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- job_radix=&lt;int&gt; – To be used with parallel jobs. It directs the Mother Superior of the job to create a distribution radix of size &lt;int&gt; between sisters. See Managing Multi-Node Jobs on page 58.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- stagein=file_list</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- stageout=file_list – Specifies which files are staged (copied) in before job start or staged out after the job completes execution. On completion of the job, all staged-in and staged-out files are removed from the execution system. The file_list is in the form:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>local_file=hostname:remote_file[,...]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>regardless of the direction of the copy. The name local_file is the name of the file on the system where the job executed. It may be an absolute path or relative to the home directory of the user. The name remote_file is the destination name on the host specified by hostname. The name may be</td>
</tr>
<tr>
<td>Option</td>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
|        |      | absolute or relative to the user’s home directory on the destination host. The use of wildcards in the file name is not recommended. The file names map to a remote copy program (rcp) call on the execution system in the following manner:  
  - For stagein: rcp hostname:remote_file local_file  
  - For stageout: rcp local_file hostname:remote_file  
  
  Data staging examples:
  -W stagein=/tmp/input.txt@headnode:/home/user/input.txt  
  -W stageout=/tmp/output.txt@headnode:/home/user/output.txt  
  
  If TORQUE has been compiled with wordexp support, then variables can be used in the specified paths. Currently only $PBS_JOBID, $HOME, and $TMPDIR are supported for stagein.  
  - umask=XXX – Sets umask used to create stdout and stderr spool files in pbs_mom spool directory. Values starting with 0 are treated as octal values, otherwise the value is treated as a decimal umask value.  
  
-x | --- | By default, if you submit an interactive job with a script, the script will be parsed for PBS directives but the rest of the script will be ignored since it’s an interactive job. The -x option allows the script to be executed in the interactive job and then the job completes. For example:  
  script.sh  
  #!/bin/bash  
  ls  
  --- end script ---  
  qsub -I script.sh  
  qsub: waiting for job 5.napali to start  
  dbeer@napali:#  
  <displays the contents of the directory, because of the ls command>  
  qsub: job 5.napali completed  

-X | --- | Enables X11 forwarding. The DISPLAY environment variable must be set.  

-z | --- | Directs that the qsub command is not to write the job identifier assigned to the job to the commands standard output.  

For job dependencies to work correctly, you must set the keep_completed on page 269 server parameter.
<table>
<thead>
<tr>
<th>Dependency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>synccount:count</td>
<td>This job is the first in a set of jobs to be executed at the same time. Count is the number of additional jobs in the set.</td>
</tr>
<tr>
<td>syncwith:jobid</td>
<td>This job is an additional member of a set of jobs to be executed at the same time. In the above and following dependency types, jobid is the job identifier of the first job in the set.</td>
</tr>
<tr>
<td>after:jobid[:jobid...]</td>
<td>This job may be scheduled for execution at any point after jobs jobid have started execution.</td>
</tr>
<tr>
<td>afterok:jobid[:jobid...]</td>
<td>This job may be scheduled for execution only after jobs jobid have terminated with no errors. See the csh warning under Extended description on page 254.</td>
</tr>
<tr>
<td>afternotok:jobid[:jobid...]</td>
<td>This job may be scheduled for execution only after jobs jobid have terminated with errors. See the csh warning under Extended description on page 254.</td>
</tr>
<tr>
<td>afterany:jobid[:jobid...]</td>
<td>This job may be scheduled for execution after jobs jobid have terminated, with or without errors.</td>
</tr>
<tr>
<td>on:count</td>
<td>This job may be scheduled for execution after count dependencies on other jobs have been satisfied. This form is used in conjunction with one of the &quot;before&quot; forms (see below).</td>
</tr>
<tr>
<td>before:jobid[:jobid...]</td>
<td>When this job has begun execution, then jobs jobid... may begin.</td>
</tr>
<tr>
<td>beforeok:jobid[:jobid...]</td>
<td>If this job terminates execution without errors, then jobs jobid... may begin. See the csh warning under Extended description on page 254.</td>
</tr>
<tr>
<td>beforenotok:jobid[:jobid...]</td>
<td>If this job terminates execution with errors, then jobs jobid... may begin. See the csh warning under Extended description on page 254.</td>
</tr>
<tr>
<td>Dependency</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>beforeany:jobid[:jobid...]</td>
<td>When this job terminates execution, jobs jobid... may begin. If any of the before forms are used, the jobs referenced by jobid must have been submitted with a dependency type of on. If any of the before forms are used, the jobs referenced by jobid must have the same owner as the job being submitted. Otherwise, the dependency is ignored.</td>
</tr>
</tbody>
</table>

**Array dependencies make a job depend on an array or part of an array. If no count is given, then the entire array is assumed. For examples, see Dependency examples on page 252.**

<table>
<thead>
<tr>
<th>Dependency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>afterstartarray:arrayid[count]</td>
<td>After this many jobs have started from arrayid, this job may start.</td>
</tr>
<tr>
<td>afterokarray:arrayid[count]</td>
<td>This job may be scheduled for execution only after jobs in arrayid have terminated with no errors.</td>
</tr>
<tr>
<td>afternotokarray:arrayid[count]</td>
<td>This job may be scheduled for execution only after jobs in arrayid have terminated with errors.</td>
</tr>
<tr>
<td>afteranyarray:arrayid[count]</td>
<td>This job may be scheduled for execution after jobs in arrayid have terminated, with or without errors.</td>
</tr>
<tr>
<td>beforestartarray:arrayid[count]</td>
<td>Before this many jobs have started from arrayid, this job may start.</td>
</tr>
<tr>
<td>beforeokarray:arrayid[count]</td>
<td>If this job terminates execution without errors, then jobs in arrayid may begin.</td>
</tr>
<tr>
<td>beforenotokarray:arrayid[count]</td>
<td>If this job terminates execution with errors, then jobs in arrayid may begin.</td>
</tr>
<tr>
<td>beforeanyarray:arrayid[count]</td>
<td>When this job terminates execution, jobs in arrayid may begin. If any of the before forms are used, the jobs referenced by arrayid must have been submitted with a dependency type of on. If any of the before forms are used, the jobs referenced by arrayid must have the same owner as the job being submitted. Otherwise, the dependency is ignored.</td>
</tr>
</tbody>
</table>
Error processing of the existence, state, or condition of the job on which the newly submitted job is a deferred service, i.e. the check is performed after the job is queued. If an error is detected, the new job will be deleted by the server. Mail will be sent to the job submitter stating the error.

Dependency examples

<table>
<thead>
<tr>
<th>Dependency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>qsub -W depend=afterok:123.big.iron.com /tmp/script</td>
<td></td>
</tr>
<tr>
<td>qsub -W depend=before:234.hunk1.com:235.hunk1.com</td>
<td></td>
</tr>
<tr>
<td>/tmp/script</td>
<td></td>
</tr>
<tr>
<td>qsub script.sh -W depend=afterokarray:427[]</td>
<td></td>
</tr>
</tbody>
</table>

(This assumes every job in array 427 has to finish successfully for the dependency to be satisfied.)

| qsub script.sh -W depend=afterokarray:427[][5] |

(This means that 5 of the jobs in array 427 have to successfully finish in order for the dependency to be satisfied.)

Operands

The `qsub` command accepts a script operand that is the path to the script of the job. If the path is relative, it will be expanded relative to the working directory of the `qsub` command.

If the script operand is not provided or the operand is the single character "-", the `qsub` command reads the script from standard input. When the script is being read from Standard Input, `qsub` will copy the file to a temporary file. This temporary file is passed to the library interface routine `pbs_submit`. The temporary file is removed by `qsub` after `pbs_submit` returns or upon the receipt of a signal which would cause `qsub` to terminate.

Standard input

The `qsub` command reads the script for the job from standard input if the script operand is missing or is the single character "-".

Input files

The script file is read by the `qsub` command. `qsub` acts upon any directives found in the script.

When the job is created, a copy of the script file is made and that copy cannot be modified.
Standard output
Unless the \texttt{-z} option is set, the job identifier assigned to the job will be written to standard output if the job is successfully created.

Standard error
The \texttt{qsub} command will write a diagnostic message to standard error for each error occurrence.

Environment variables
The values of some or all of the variables in the \texttt{qsub} commands environment are exported with the job (see the \texttt{-v} and \texttt{-v} options).

The environment variable PBS\_DEFAULT defines the name of the default server. Typically, it corresponds to the system name of the host on which the server is running. If PBS\_DEFAULT is not set, the default is defined by an administrator established file.

The environment variable PBS\_DPREFIX determines the prefix string which identifies directives in the script.

The environment variable PBS\_CLIENTRETRY defines the maximum number of seconds \texttt{qsub} will block (see the \texttt{-b} option). Despite the name, currently \texttt{qsub} is the only client that supports this option.

torque.cfg
The \texttt{torque.cfg} file, located in PBS\_SERVER\_HOME (/var/spool/torque by default) controls the behavior of the \texttt{qsub} command. This file contains a list of parameters and values separated by whitespace.

- \texttt{QSUBSLEEP} – takes an integer operand which specifies time to sleep when running \texttt{qsub} command. Used to prevent users from overwhelming the scheduler.
- \texttt{SUBMITFILTER} – specifies the path to the submit filter used to pre-process job submission. The default path is libexecdir/qsub\_filter, which falls back to /usr/local/sbin/torque\_submitfilter for backwards compatibility. This \texttt{torque.cfg} parameter overrides this default.
- \texttt{SERVERHOST}
- \texttt{QSUBHOST}
- \texttt{QSUBSENDUID}
- \texttt{XAUTHPATH}
- \texttt{CLIENTRETRY}
- \texttt{VALIDATEGROUP}
- DEFAULTCKPT
- VALIDATEPATH
- RERUNNABLEBYDEFAULT

For example:

```
QSUBSLEEP 2
RERUNNABLEBYDEFAULT false
```

**Extended description**

**Script Processing:**

A job script may consist of PBS directives, comments and executable statements. A PBS directive provides a way of specifying job attributes in addition to the command line options. For example:

```
#:PBS -N Job_name
#:PBS -l walltime=10:30,mem=320kb
#:PBS -m be
#:step1 arg1 arg2
#:step2 arg3 arg4
```

The `qsub` command scans the lines of the script file for directives. An initial line in the script that begins with the characters "#!" or the character ":" will be ignored and scanning will start with the next line. Scanning will continue until the first executable line, that is a line that is not blank, not a directive line, nor a line whose first nonwhite space character is ":". If directives occur on subsequent lines, they will be ignored.

A line in the script file will be processed as a directive to `qsub` if and only if the string of characters starting with the first nonwhite space character on the line and of the same length as the directive prefix matches the directive prefix.

The remainder of the directive line consists of the options to `qsub` in the same syntax as they appear on the command line. The option character is to be preceded with the "-" character.

If an option is present in both a directive and on the command line, that option and its argument, if any, will be ignored in the directive. The command line takes precedence.

If an option is present in a directive and not on the command line, that option and its argument, if any, will be processed as if it had occurred on the command line.

The directive prefix string will be determined in order of preference from:
• The value of the -c option argument if the option is specified on the command line.
• The value of the environment variable PBS_DPREFIX if it is defined.
• The four character string #PBS.

If the -c option is found in a directive in the script file, it will be ignored.

User Authorization:

When the user submits a job from a system other than the one on which the PBS Server is running, the name under which the job is to be executed is selected according to the rules listed under the -u option. The user submitting the job must be authorized to run the job under the execution user name. This authorization is provided if:

• The host on which qsub is run is trusted by the execution host (see /etc/hosts.equiv).
• The execution user has an .rhosts file naming the submitting user on the submitting host.

C-Shell .logout File:

The following warning applies for users of the c-shell, csh. If the job is executed under the csh and a .logout file exists in the home directory in which the job executes, the exit status of the job is that of the .logout script, not the job script. This may impact any inter-job dependencies. To preserve the job exit status, either remove the .logout file or place the following line as the first line in the .logout file:

```
set EXITVAL = $status
```

and the following line as the last executable line in .logout:

```
exit $EXITVAL
```

Interactive Jobs:

If the -I option is specified on the command line or in a script directive, or if the "interactive" job attribute declared true via the -W option, -W interactive=true, either on the command line or in a script directive, the job is an interactive job. The script will be processed for directives, but will not be included with the job. When the job begins execution, all input to the job is from the terminal session in which qsub is running.

When an interactive job is submitted, the qsub command will not terminate when the job is submitted. qsub will remain running until the job terminates, is aborted, or the user interrupts qsub with an SIGINT (the control-C key). If qsub is interrupted prior to job start, it will query if the user wishes to exit. If the user response "yes", qsub exits and the job is aborted.
One the interactive job has started execution, input to and output from the job pass through qsub. Keyboard generated interrupts are passed to the job. Lines entered that begin with the tilde (~) character and contain special sequences are escaped by qsub. The recognized escape sequences are:

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>~.</td>
<td>qsub terminates execution. The batch job is also terminated.</td>
</tr>
<tr>
<td>~susp</td>
<td>Suspend the qsub program if running under the C shell. &quot;susp&quot; is the suspend character (usually CNTL-Z).</td>
</tr>
<tr>
<td>~asusp</td>
<td>Suspend the input half of qsub (terminal to job), but allow output to continue to be displayed. Only works under the C shell. &quot;asusp&quot; is the auxiliary suspend character, usually CNTL-Y.</td>
</tr>
</tbody>
</table>

**Exit status**

Upon successful processing, the qsub exit status will be a value of zero.

If the qsub command fails, the command exits with a value greater than zero.

**Related Topics**

- qalter(1B)
- qdel(1B)
- qhold(1B)
- qrls(1B)
- qsig(1B)
- qstat(1B)
- pbs_server(8B)

**Non-Adaptive Computing topics**

- pbs_connect(3B)
- pbs_job_attributes(7B)
- pbs_queue_attributes(7B)
- pbs_resources_irix5(7B)
- pbs_resources_sp2(7B)
- pbs_resources_sunos4(7B)
- pbs_resources_unixos8(7B)
- pbs_server_attributes(7B)
- qselect(1B)
- qmove(1B)
- qmsg(1B)
- qrerun(1B)
qterm

Terminate processing by a PBS batch server.

Synopsis

qterm [-t type] [server...]

Description

The qterm command terminates a batch server. When a server receives a terminate command, the server will go into the "Terminating" state. No new jobs will be allowed to be started into execution or enqueued into the server. The impact on jobs currently being run by the server depends

In order to execute qterm, the user must have PBS Operation or Manager privileges.

Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-t</td>
<td>type</td>
<td>Specifies the type of shut down. The types are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• quick - This is the default action if the -t option is not specified. This option is used when you wish that running jobs be left running when the server shuts down. The server will cleanly shutdown and can be restarted when desired. Upon restart of the server, jobs that continue to run are shown as running; jobs that terminated during the server's absence will be placed into the exiting state.</td>
</tr>
</tbody>
</table>

The immediate and delay types are deprecated.

Operands

The server operand specifies which servers are to shut down. If no servers are given, then the default server will be terminated.

Standard error

The qterm command will write a diagnostic message to standard error for each error occurrence.

Exit status

Upon successful processing of all the operands presented to the qterm command, the exit status will be a value of zero.
If the `qterm` command fails to process any operand, the command exits with a value greater than zero.

Related Topics (non-Adaptive Computing topics)
- `pbs_server(8B)`
- `qmgr(8B)`
- `pbs_resources_aix4(7B)`
- `pbs_resources_irix5(7B)`
- `pbs_resources_sp2(7B)`
- `pbs_resources_sunos4(7B)`
- `pbs_resources_unicos8(7B)`

### trqauthd

*(TORQUE authorization daemon)*

#### Synopsis

```
trqauthd -D
trqauthd -d
```

#### Description

The `trqauthd` daemon, introduced in TORQUE 4.0.0, replaced the `pbs_iff` authentication process. When users connect to `pbs_server` by calling one of the TORQUE utilities or by using the TORQUE APIs, the new user connection must be authorized by a trusted entity which runs as root. The advantage of `trqauthd`'s doing this rather than `pbs_iff` is that `trqauthd` is resident, meaning you do not need to be loaded every time a connection is made; multi-threaded; scalable; and more easily adapted to new functionality than `pbs_iff`.

Beginning in TORQUE 4.2.6, `trqauthd` can remember the currently active `pbs_server` host, enhancing high availability functionality. Previously, `trqauthd` tried to connect to each host in the `$TORQUE_HOME/<server_name>` file until it could successfully connect. Because it now remembers the active server, it tries to connect to that server first. If it fails to connect, it will go through the `<server_name>` file and try to connect to a host where an active `pbs_server` is running.

#### Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-D</code></td>
<td>Debug</td>
</tr>
</tbody>
</table>

Commands Overview
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>-D — Debug</td>
<td>Run trqauthd in debug mode.</td>
<td><code>trqauthd -D</code></td>
</tr>
<tr>
<td>-d — Terminate</td>
<td>Terminate trqauthd.</td>
<td><code>trqauthd -d</code></td>
</tr>
</tbody>
</table>
Server Parameters

TORQUE server parameters are specified using the qmqr command. The set subcommand is used to modify the server object. For example:

```bash
$ qmqr -c 'set server default_queue=batch'
```

Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Page Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_hosts</td>
<td>262</td>
</tr>
<tr>
<td>acl_host_enable</td>
<td>262</td>
</tr>
<tr>
<td>acl_logic_or</td>
<td>262</td>
</tr>
<tr>
<td>allow_node_submit</td>
<td>263</td>
</tr>
<tr>
<td>allow_proxy_user</td>
<td>263</td>
</tr>
<tr>
<td>auto_node_np</td>
<td>263</td>
</tr>
<tr>
<td>automatic_requeue_exit_code</td>
<td>263</td>
</tr>
<tr>
<td>checkpoint_defaults</td>
<td>264</td>
</tr>
<tr>
<td>clone_batch_delay</td>
<td>264</td>
</tr>
<tr>
<td>clone_batch_size</td>
<td>264</td>
</tr>
<tr>
<td>copy_on_rerun</td>
<td>264</td>
</tr>
<tr>
<td>cray_enabled</td>
<td>265</td>
</tr>
<tr>
<td>default_queue</td>
<td>265</td>
</tr>
<tr>
<td>disable_automatic_requeue</td>
<td>265</td>
</tr>
<tr>
<td>disable_server_id_check</td>
<td>265</td>
</tr>
<tr>
<td>display_job_server_suffix</td>
<td>266</td>
</tr>
<tr>
<td>interactive_jobs_can_roam</td>
<td>266</td>
</tr>
<tr>
<td>job_exclusive_on_use</td>
<td>266</td>
</tr>
<tr>
<td>job_force_cancel_time</td>
<td>266</td>
</tr>
<tr>
<td>job_full_report_time</td>
<td>266</td>
</tr>
<tr>
<td>job_log_file_max_size</td>
<td>267</td>
</tr>
<tr>
<td>job_log_file_roll_depth</td>
<td>267</td>
</tr>
<tr>
<td>job_log_keep_days</td>
<td>268</td>
</tr>
<tr>
<td>job_nanny</td>
<td>268</td>
</tr>
<tr>
<td>job_stat_rate</td>
<td>268</td>
</tr>
<tr>
<td>job_start_timeout</td>
<td>268</td>
</tr>
<tr>
<td>job_sync_timeout</td>
<td>269</td>
</tr>
<tr>
<td>keep_completed</td>
<td>269</td>
</tr>
<tr>
<td>kill_delay</td>
<td>269</td>
</tr>
<tr>
<td>lock_file</td>
<td>270</td>
</tr>
<tr>
<td>lock_file_update_time</td>
<td>270</td>
</tr>
<tr>
<td>lock_file_check_time</td>
<td>270</td>
</tr>
<tr>
<td>log_events</td>
<td>270</td>
</tr>
<tr>
<td>log_file_max_size</td>
<td>271</td>
</tr>
<tr>
<td>log_file_roll_depth</td>
<td>271</td>
</tr>
<tr>
<td>log_file_roll_depth</td>
<td>271</td>
</tr>
<tr>
<td>log_keep_days</td>
<td>271</td>
</tr>
<tr>
<td>log_level</td>
<td>272</td>
</tr>
<tr>
<td>mail_body_fmt</td>
<td>272</td>
</tr>
<tr>
<td>mail_domain</td>
<td>272</td>
</tr>
<tr>
<td>mail_from</td>
<td>273</td>
</tr>
<tr>
<td>mail_subject_fmt</td>
<td>273</td>
</tr>
<tr>
<td>managers</td>
<td>273</td>
</tr>
<tr>
<td>max_job_array_size</td>
<td>274</td>
</tr>
<tr>
<td>max_job_size</td>
<td>274</td>
</tr>
<tr>
<td>max_threads</td>
<td>274</td>
</tr>
<tr>
<td>max_user_queueable</td>
<td>274</td>
</tr>
<tr>
<td>min_threads</td>
<td>275</td>
</tr>
<tr>
<td>moab_array_compatible</td>
<td>275</td>
</tr>
<tr>
<td>mom_job_sync</td>
<td>275</td>
</tr>
<tr>
<td>next_job_number</td>
<td>276</td>
</tr>
<tr>
<td>node_check_rate</td>
<td>276</td>
</tr>
<tr>
<td>node_pack</td>
<td>276</td>
</tr>
<tr>
<td>node_ping_rate</td>
<td>276</td>
</tr>
<tr>
<td>no_mail_force</td>
<td>276</td>
</tr>
<tr>
<td>np_default</td>
<td>277</td>
</tr>
<tr>
<td>operators</td>
<td>277</td>
</tr>
<tr>
<td>pass_cpu_clock</td>
<td>277</td>
</tr>
<tr>
<td>poll_jobs</td>
<td>278</td>
</tr>
<tr>
<td>query_other_jobs</td>
<td>278</td>
</tr>
<tr>
<td>record_job_info</td>
<td>278</td>
</tr>
<tr>
<td>record_job_script</td>
<td>279</td>
</tr>
<tr>
<td>resources_available</td>
<td>279</td>
</tr>
<tr>
<td>scheduling</td>
<td>279</td>
</tr>
<tr>
<td>submit_hosts</td>
<td>279</td>
</tr>
<tr>
<td>tcp_timeout</td>
<td>280</td>
</tr>
<tr>
<td>thread_idle_seconds</td>
<td>280</td>
</tr>
<tr>
<td>use_jobs_subdirs</td>
<td>280</td>
</tr>
</tbody>
</table>
### acl_host

<table>
<thead>
<tr>
<th><strong>Format</strong></th>
<th><code>&lt;HOST&gt;[&lt;HOST&gt;].. or &lt;HOST&gt;[range] or &lt;HOST*&gt;</code> where the asterisk (*) can appear anywhere in the host name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td>Not set.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specifies a list of hosts which can have access to <code>pbs_server</code> when <code>acl_host_enable</code> is set to <strong>TRUE</strong>. This does not enable a node to submit jobs. To enable a node to submit jobs use <code>submit_hosts</code>.</td>
</tr>
</tbody>
</table>

**Hosts which are in the $TORQUE_HOME/server_priv/nodesfile do not need to be added to this list.**

```
Qmgr: set queue batch acl_hosts="hostA,hostB"
Qmgr: set queue batch acl_hosts+=hostC
Qmgr: set server acl_hosts="hostA,hostB"
Qmgr: set server acl_hosts+=hostC
```

**In version 2.5 and later, the wildcard (*) character can appear anywhere in the host name, and ranges are supported; these specifications also work for managers and operators.**

```
Qmgr: set server acl_hosts = "galaxy*.tom.org"
Qmgr: set server acl_hosts += "galaxy[0-50].tom.org"
```

### acl_host_enable

<table>
<thead>
<tr>
<th><strong>Format</strong></th>
<th><code>&lt;BOOLEAN&gt;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td><strong>FALSE</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>When set to <strong>TRUE</strong>, hosts not in the <code>pbs_server</code> nodes file must be added to the <code>acl_hosts</code> list in order to get access to <code>pbs_server</code>.</td>
</tr>
</tbody>
</table>

### acl_logic_or

<table>
<thead>
<tr>
<th><strong>Format</strong></th>
<th><code>&lt;BOOLEAN&gt;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td><strong>FALSE</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>When set to <strong>TRUE</strong>, the user and group queue ACLs are logically OR’d. When set to <strong>FALSE</strong>, they are AND’d.</td>
</tr>
</tbody>
</table>
### allow_node_submit

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, allows all hosts that are in the $TORQUE_HOME/server_priv/nodes file (MOM nodes) to submit jobs to pbs_server.</td>
</tr>
</tbody>
</table>

### allow_proxy_user

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, specifies that users can proxy from one user to another. Proxy requests will be either validated by ruserok() or by the scheduler (see Job Submission on page 55).</td>
</tr>
</tbody>
</table>

### auto_node_np

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, automatically configures a node's np (number of processors) value based on the ncpus value from the status update. Requires full manager privilege to set or alter.</td>
</tr>
</tbody>
</table>

### automatic_requeue_exit_code

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;LONG&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>This is an exit code, defined by the admin, that tells pbs_server to requeue the job instead of considering it as completed. This allows the user to add some additional checks that the job can run meaningfully, and if not, then the job script exits with the specified code to be requeued.</td>
</tr>
</tbody>
</table>
### checkpoint_defaults

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies for a queue the default checkpoint values for a job that does not have checkpointing specified. The checkpoint_defaults parameter only takes effect on execution queues.</td>
</tr>
</tbody>
</table>

```plaintext
set queue batch checkpoint_defaults="enabled, periodic, interval=5"
```

### clone_batch_delay

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>1</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the delay (in seconds) between clone batches (see clone_batch_size).</td>
</tr>
</tbody>
</table>

### clone_batch_size

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>256</td>
</tr>
<tr>
<td>Description</td>
<td>Job arrays are created in batches of size X. X jobs are created, and after the clone_batch_delay, X more are created. This repeats until all are created.</td>
</tr>
</tbody>
</table>

### copy_on_rerun

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, Moab HPC Suite will copy the output and error files over to the user-specified directory when the <code>g rerun</code> command is executed (i.e. a job preemption). Output and error files are only created when a job is in running state before the preemption occurs.</td>
</tr>
</tbody>
</table>

- `pbs_server` and `pbs_mom` need to be on the same version.

- When you change the value, you must perform a `pbs_server` restart for the change to effect.
### cray_enabled

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, specifies that this instance of pbs_server has Cray hardware that reports to it. See Installation Notes for Moab and TORQUE for Cray in the <em>Moab Workload Manager Administrator Guide</em>.</td>
</tr>
</tbody>
</table>

### default_queue

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Indicates the queue to assign to a job if no queue is explicitly specified by the submitter.</td>
</tr>
</tbody>
</table>

### disable_automatic_requeue

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>Normally, if a job cannot start due to a transient error, the MOM returns a special exit code to the server so that the job is requeued instead of completed. When this parameter is set, the special exit code is ignored and the job is completed.</td>
</tr>
</tbody>
</table>

### disable_server_id_check

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, makes it so the user for the job doesn't have to exist on the server. The user must still exist on all the compute nodes or the job will fail when it tries to execute.</td>
</tr>
</tbody>
</table>

⚠️ If you have `disable_server_id_check` set to TRUE, a user could request a group to which they do not belong. Setting `VALIDATEGROUP` to TRUE in the `torque.cfg` file prevents such a scenario (see "torque.cfg" Configuration File on page 337).
<table>
<thead>
<tr>
<th><strong>display_job_server_suffix</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
<td><code>&lt;BOOLEAN&gt;</code></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>TRUE</td>
</tr>
</tbody>
</table>
| **Description** | When set to TRUE, TORQUE will display both the job ID and the host name. When set to FALSE, only the job ID will be displayed.  
If set to FALSE, the environment variable `NO_SERVER_SUFFIX` must be set to TRUE for `pbs_track` to work as expected. |

<table>
<thead>
<tr>
<th><strong>interactive_jobs_can_roam</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
<td><code>&lt;BOOLEAN&gt;</code></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>FALSE</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>By default, interactive jobs run from the login node that they submitted from. When TRUE, interactive jobs may run on login nodes other than the one where the jobs were submitted to. See Installation Notes for Moab and TORQUE for Cray in the Moab Workload Manager Administrator Guide.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>job-exclusive-on-use</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
<td><code>&lt;BOOLEAN&gt;</code></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>FALSE</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>When <code>job-exclusive-on-use</code> is set to TRUE, <code>pbsnodes</code> will show job-exclusive on a node when there’s at least one of its processors running a job. This differs with the default behavior which is to show job-exclusive on a node when all of its processors are running a job.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><code>set server job-exclusive-on-use=TRUE</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>job_force_cancel_time</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
<td><code>&lt;INTEGER&gt;</code></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>Disabled</td>
</tr>
</tbody>
</table>
### job_force_cancel_time

**Description**
If a job has been deleted and is still in the system after x seconds, the job will be purged from the system. This is mostly useful when a job is running on a large number of nodes and one node goes down. The job cannot be deleted because the MOM cannot be contacted. The `qdel` fails and none of the other nodes can be reused. This parameter can be used to remedy such situations.

### job_full_report_time

**Format**
`<INTEGER>`

**Default**
300 seconds

**Description**
Sets the time in seconds that a job should be fully reported after any kind of change to the job, even if condensed output was requested.

### job_log_file_max_size

**Format**
`<INTEGER>`

**Default**
---

**Description**
This specifies a soft limit (in kilobytes) for the job log's maximum size. The file size is checked every five minutes and if the current day file size is greater than or equal to this value, it is rolled from `<filename>` to `<filename.1>` and a new empty log is opened. If the current day file size exceeds the maximum size a second time, the `<filename.1>` log file is rolled to `<filename.2>`, the current log is rolled to `<filename.1>`, and a new empty log is opened. Each new log causes all other logs to roll to an extension that is one greater than its current number. Any value less than 0 is ignored by `pbs_server` (meaning the log will not be rolled).

### job_log_file_roll_depth

**Format**
`<INTEGER>`

**Default**
---

**Description**
This sets the maximum number of new log files that are kept in a day if the `job_log_file_max_size` parameter is set. For example, if the roll depth is set to 3, no file can roll higher than `<filename.3>`. If a file is already at the specified depth, such as `<filename.3>`, the file is deleted so it can be replaced by the incoming file roll, `<filename.2>`.
### job_log_keep_days

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>This maintains logs for the number of days designated. If set to 4, any log file older than 4 days old is deleted.</td>
</tr>
</tbody>
</table>

### job_nanny

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, enables the experimental &quot;job deletion nanny&quot; feature. All job cancels will create a repeating task that will resend KILL signals if the initial job cancel failed. Further job cancels will be rejected with the message &quot;job cancel in progress.&quot; This is useful for temporary failures with a job’s execution node during a job delete request.</td>
</tr>
</tbody>
</table>

### job_stat_rate

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>300 (30 in TORQUE 1.2.0p5 and earlier)</td>
</tr>
<tr>
<td>Description</td>
<td>If the mother superior has not sent an update by the specified time, at the specified time pbs_server requests an update on job status from the mother superior.</td>
</tr>
</tbody>
</table>

### job_start_timeout

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the pbs_server to pbs_mom TCP socket timeout in seconds that is used when the pbs_server sends a job start to the pbs_mom. It is useful when the MOM has extra overhead involved in starting jobs. If not specified, then the tcp_timeout parameter is used.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Format</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------</td>
</tr>
<tr>
<td>job_sync_timeout</td>
<td>&lt;INTEGER&gt;</td>
</tr>
<tr>
<td>keep_completed</td>
<td>&lt;INTEGER&gt;</td>
</tr>
<tr>
<td>kill_delay</td>
<td>&lt;INTEGER&gt;</td>
</tr>
</tbody>
</table>

Example:
```
gmgr -c "set server kill_delay=30"
```
### lock_file

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>torque/server_priv/server.lock</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the name and location of the lock file used to determine which high availability server should be active. If a full path is specified, it is used verbatim by TORQUE. If a relative path is specified, TORQUE will prefix it with torque/server_priv.</td>
</tr>
</tbody>
</table>

### lock_file_update_time

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>3</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies how often (in seconds) the thread will update the lock file.</td>
</tr>
</tbody>
</table>

### lock_file_check_time

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>9</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies how often (in seconds) a high availability server will check to see if it should become active.</td>
</tr>
</tbody>
</table>

### log_events

<table>
<thead>
<tr>
<th>Format</th>
<th>Bitmap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
</tbody>
</table>
log_events

By default, all events are logged. However, you can customize things so that only certain events show up in the log file. These are the bitmaps for the different kinds of logs:

```c
#define PBSEVENT_ERROR 0x0001 /* internal errors */
#define PBSEVENT_SYSTEM 0x0002 /* system (server) events */
#define PBSEVENT_ADMIN 0x0004 /* admin events */
#define PBSEVENT_JOB 0x0008 /* job related events */
#define PBSEVENT_JOB_USAGE 0x0010 /* End of Job accounting */
#define PBSEVENT_SECURITY 0x0020 /* security violation events */
#define PBSEVENT_SCHED 0x0040 /* scheduler events */
#define PBSEVENT_DEBUG 0x0080 /* common debug messages */
#define PBSEVENT_DEBUG2 0x0100 /* less needed debug messages */
#define PBSEVENT_FORCE 0x8000 /* set to force a message */
```

If you want to log only error, system, and job information, use `qmgr` to set `log_events` to 11:

```
set server log_events = 11
```

log_file_max_size

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0</td>
</tr>
</tbody>
</table>

Specifies a soft limit, in kilobytes, for the server’s log file. The file size is checked every 5 minutes, and if the current day file size is greater than or equal to this value then it will be rolled from X to X.1 and a new empty log will be opened. Any value less than or equal to 0 will be ignored by `pbs_server` (the log will not be rolled).

log_file_roll_depth

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>1</td>
</tr>
</tbody>
</table>

Controls how deep the current day log files will be rolled, if `log_file_max_size` is set, before they are deleted.

log_keep_days

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
</table>
### log_keep_days

<table>
<thead>
<tr>
<th>Default</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies how long (in days) a server or MOM log should be kept.</td>
</tr>
</tbody>
</table>

### log_level

<table>
<thead>
<tr>
<th><strong>Format</strong></th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specifies the <code>pbs_server</code> logging verbosity. Maximum value is 7.</td>
</tr>
</tbody>
</table>

### mail_body_fmt

<table>
<thead>
<tr>
<th><strong>Format</strong></th>
<th>A printf-like format string</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td>PBS Job Id: %i Job Name: %j Exec host: %h %m %d</td>
</tr>
</tbody>
</table>
| **Description** | Override the default format for the body of outgoing mail messages. A number of printf-like format specifiers and escape sequences can be used:  
\n new line  
\t tab  
\\ backslash  
\' single quote  
" double quote  
%d details concerning the message  
%h PBS host name  
%i PBS job identifier  
%j PBS job name  
%m long reason for message  
%f short reason for message  
%\ a single % |

### mail_domain

<table>
<thead>
<tr>
<th><strong>Format</strong></th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td>---</td>
</tr>
</tbody>
</table>
### mail_domain

| **Description** | Override the default domain for outgoing mail messages. If set, emails will be addressed to `<user->@<hostdomain>`. If unset, the job’s `Job_Owner` attribute will be used. If set to `never`, TORQUE will never send emails. |

### mail_from

| **Format** | `<STRING>` |
| **Default** | `adm` |
| **Description** | Specify the name of the sender when TORQUE sends emails. |

### mail_subject_fmt

| **Format** | A printf-like format string |
| **Default** | `PBS JOB %i` |
| **Description** | Override the default format for the subject of outgoing mail messages. A number of printf-like format specifiers and escape sequences can be used:  
\n new line  
\t tab  
\ \ backslash  
 single quote  
 double quote  
%d details concerning the message  
%h PBS host name  
%i PBS job identifier  
%j PBS job name  
%m long reason for message  
%r short reason for message  
%% a single % |

### managers

<p>| <strong>Format</strong> | <code>&lt;user&gt;@&lt;host.sub.domain&gt; [,&lt;user&gt;@&lt;host.sub.domain&gt;...]</code> |
| <strong>Default</strong> | <code>root@localhost</code> |</p>
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>managers</strong></td>
<td>List of users granted batch administrator privileges. The host, sub-domain, or domain name may be wildcarded by the use of an asterisk character (*). Requires full manager privilege to set or alter.</td>
</tr>
</tbody>
</table>
| **max_job_array_size** | Format: <INTEGER>  
Default: Unlimited  
Description: Sets the maximum number of jobs that can be in a single job array. |
| **max_slot_limit** | Format: <INTEGER>  
Default: Unlimited  
Description: This is the maximum number of jobs that can run concurrently in any job array. Slot limits can be applied at submission time with qsub, or it can be modified with qalter.  
```
qmgr -c 'set server max_slot_limit=10'
```

No array can request a slot limit greater than 10. Any array that does not request a slot limit receives a slot limit of 10. Using the example above, slot requests greater than 10 are rejected with the message: "Requested slot limit is too large, limit is 10." |
| **max_threads** | Format: <INTEGER>  
Default: The value of min_threads ((2 * the number of procs listed in /proc/cpuinfo) + 1) * 20  
Description: This is the maximum number of threads that should exist in the thread pool at any time. See Setting min_threads and max_threads on page 131 for more information. |
| **max_user_queuable** | Format: <INTEGER> |
### max_user_queuable

<table>
<thead>
<tr>
<th>Default</th>
<th>Unlimited</th>
</tr>
</thead>
</table>

**Description**

When set, `max_user_queuable` places a system-wide limit on the amount of jobs that an individual user can queue.

```bash
qmgr -c 'set server max_user_queuable=500'
```

### min_threads

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
</table>

**Default**

\[(2 * \text{the number of procs listed in} \ /	ext{proc/cpuinfo}) + 1. \text{If TORQUE is unable to read} \ /	ext{proc/cpuinfo, the default is} 10.\]

**Description**

This is the minimum number of threads that should exist in the thread pool at any time. See Setting min_threads and max_threads on page 131 for more information.

### moab_array_compatible

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
</table>

**Default**

TRUE

**Description**

This parameter places a hold on jobs that exceed the slot limit in a job array. When one of the active jobs is completed or deleted, one of the held jobs goes to a queued state.

### mom_job_sync

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
</table>

**Default**

TRUE

**Description**

When set to TRUE, specifies that the pbs_server will synchronize its view of the job queue and resource allocation with compute nodes as they come online. If a job exists on a compute node, it will be automatically cleaned up and purged. (Enabled by default in TORQUE 2.2.0 and higher.) Jobs that are no longer reported by the mother superior are automatically purged by pbs_server. Jobs that pbs_server instructs the MOM to cancel have their processes killed in addition to being deleted (instead of leaving them running as in versions of TORQUE prior to 4.1.1).
### next_job_number

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>...</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the ID number of the next job. If you set your job number too low and TORQUE repeats a job number that it has already used, the job will fail. Before setting next_job_number to a number lower than any number that TORQUE has already used, you must clear out your .e and .o files.</td>
</tr>
</tbody>
</table>

*If you use Moab Workload Manager and have configured it to synchronize job IDs with TORQUE), then Moab will generate the job ID and next_job_number will have no effect on the job ID. See Resource Manager Configuration in the Moab Workload Manager Administrator Guide for more information.*

### node_check_rate

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>600</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the minimum duration (in seconds) that a node can fail to send a status update before being marked down by the pbs_server daemon.</td>
</tr>
</tbody>
</table>

### node_pack

| Description | This is deprecated. |

### node_ping_rate

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>300</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the maximum interval (in seconds) between successive &quot;pings&quot; sent from the pbs_server daemon to the pbs_mom daemon to determine node/daemon health.</td>
</tr>
</tbody>
</table>

### no_mail_force

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
</table>
### no_mail_force

<table>
<thead>
<tr>
<th>Default</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>When set to TRUE, eliminates all e-mails when mail_options (see qsub on page 237) is set to &quot;n&quot;. The job owner won't receive e-mails when a job is deleted by a different user or a job failure occurs. If no_mail_force is unset or is FALSE, then the job owner receives e-mails when a job is deleted by a different user or a job failure occurs.</td>
</tr>
</tbody>
</table>

### np_default

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Allows the administrator to unify the number of processors (np) on all nodes. The value can be dynamically changed. A value of 0 tells pbs_server to use the value of np found in the nodes file. The maximum value is 32767.</td>
</tr>
</tbody>
</table>

> np_default sets a minimum number of np per node. Nodes with less than the np_default get additional execution slots.

### operators

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;user&gt;@&lt;host.sub.domain&gt;[,&lt;user&gt;@&lt;host.sub.domain&gt;...]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>root@localhost</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>List of users granted batch operator privileges. Requires full manager privilege to set or alter.</td>
</tr>
</tbody>
</table>

### pass_cpuclock

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

---

Server Parameters
pass_cpuclock

**Description**

If set to **TRUE**, the `pbs_server` daemon passes the option and its value to the `pbs_mom` daemons for direct implementation by the daemons, making the CPU frequency adjustable as part of a resource request by a job submission.

If set to **FALSE**, the `pbs_server` daemon creates and passes a `PBS_CPUCLOCK` job environment variable to the `pbs_mom` daemons that contains the value of the `cpuclock` attribute used as part of a resource request by a job submission. The CPU frequencies on the MOMs are not adjusted. The environment variable is for use by prologue and epilogue scripts, enabling administrators to log and research when users are making `cpuclock` requests, as well as researchers and developers to perform CPU clock frequency changes using a method outside of that employed by the TORQUE `pbs_mom` daemons.

**poll_jobs**

**Format**

<BOOLEAN>

**Default**

**TRUE** (FALSE in TORQUE 1.2.0p5 and earlier)

**Description**

If set to **TRUE**, `pbs_server` will poll job info from MOMs over time and will not block on handling requests which require this job information.

If set to **FALSE**, no polling will occur and if requested job information is stale, `pbs_server` may block while it attempts to update this information. For large systems, this value should be set to **TRUE**.

**query_other_jobs**

**Format**

<BOOLEAN>

**Default**

**FALSE**

**Description**

When set to **TRUE**, specifies whether or not non-admin users may view jobs they do not own.

**record_job_info**

**Format**

<BOOLEAN>

**Default**

**FALSE**

**Description**

This must be set to **TRUE** in order for job logging to be enabled.
### record_job_script

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>If set to TRUE, this adds the contents of the script executed by a job to the log.</td>
</tr>
</tbody>
</table>

**Important Note:** For `record_job_script` to take effect, `record_job_info` on page 278 must be set to TRUE.

### resources_available

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Allows overriding of detected resource quantities (see Assigning Queue Resource Limits on page 113). <code>pbs_server</code> must be restarted for changes to take effect. Also, <code>resources_available</code> is constrained by the smallest of <code>queue.resources_available</code> and the <code>server.resources_available</code>.</td>
</tr>
</tbody>
</table>

### scheduling

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Allows <code>pbs_server</code> to be scheduled. When FALSE, <code>pbs_server</code> is a resource manager that works on its own. When TRUE, TORQUE allows a scheduler, such as Moab or Maui, to dictate what <code>pbs_server</code> should do.</td>
</tr>
</tbody>
</table>

### submit_hosts

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;HOSTNAME&gt;,&lt;HOSTNAME&gt;...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>Not set.</td>
</tr>
</tbody>
</table>
### submit_hosts

| Description | Hosts in this list are able to submit jobs. This applies to any node whether within the cluster or outside of the cluster. If acl_host_enable is set to TRUE and the host is not in the $TORQUE/server_priv/nodes file, then the host must also be in the acl_hosts list. |

### tcp_timeout

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>300</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the timeout for idle TCP connections. If no communication is received by the server on the connection after the timeout, the server closes the connection. There is an exception for connections made to the server on port 15001 (default); timeout events are ignored on the server for such connections established by a client utility or scheduler. Responsibility rests with the client to close the connection first. See Large Cluster Considerations on page 315 for additional information.</td>
</tr>
</tbody>
</table>

> If you use Moab Workload Manager, prevent communication errors by giving tcp_timeout at least twice the value of the Moab RMPOLLINTERVAL (see the Moab Workload Manager Administrator Guide).

### thread_idle_seconds

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>300</td>
</tr>
<tr>
<td>Description</td>
<td>This is the number of seconds a thread can be idle in the thread pool before it is deleted. If threads should not be deleted, set to -1. TORQUE will always maintain at least min_threads number of threads, even if all are idle.</td>
</tr>
</tbody>
</table>

### use_jobs_subdirs

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>Not set (FALSE).</td>
</tr>
<tr>
<td>use_jobs_subdirs</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td></td>
</tr>
<tr>
<td>Lets an administrator direct the way pbs_server will store its job-related files.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>- When <code>use_jobs_subdirs</code> is unset (or set to <code>FALSE</code>), job and job array files will be stored directly under <code>$PBS_HOME/server_priv/jobs</code> and <code>$PBS_HOME/server_priv/arrays</code>.</td>
<td></td>
</tr>
<tr>
<td>- When <code>use_jobs_subdirs</code> is set to <code>TRUE</code>, job and job array files will be distributed over 10 subdirectories under their respective parent directories. This method helps to keep a smaller number of files in a given directory.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>- This setting does not automatically move existing job and job array files into the respective subdirectories. If you choose to use this setting (<code>TRUE</code>), you must first</td>
<td></td>
</tr>
<tr>
<td>- shutdown the TORQUE server daemon,</td>
<td></td>
</tr>
<tr>
<td>- in the contrib directory, run the &quot;use_jobs_subdirs_setup&quot; python script with <code>-m</code> option,</td>
<td></td>
</tr>
<tr>
<td>- start the TORQUE server daemon, and then</td>
<td></td>
</tr>
<tr>
<td>- set <code>use_jobs_subdirs</code> to <code>TRUE</code>.</td>
<td></td>
</tr>
</tbody>
</table>
Node Manager (MOM) Configuration

Under TORQUE, MOM configuration is accomplished using the `mom_priv/config` file located in the PBS directory on each execution server. You must create this file and insert any desired lines in a text editor (blank lines are allowed). When you modify the `mom_priv/config` file, you must restart `pbs_mom`.

The following examples demonstrate two methods of modifying the `mom_priv/config` file:

```
> echo "\$loglevel 3" > /var/spool/torque/mom_priv/config

> vim /var/spool/torque/mom_priv/config
...
$loglevel 3
```

For details, see these topics:

- [MOM Parameters on page 283](#)
- [Node Features and Generic Consumable Resource Specification on page 302](#)
- [Command-line Arguments on page 303](#)

Related Topics

- [Commands Overview on page 177](#)
- [Prologue and Epilogue Scripts on page 323](#)

MOM Parameters

These parameters go in the `mom_priv/config` file. They control various behaviors for the MOMs.
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>arch</td>
<td>Specifies the architecture of the local machine. This information is used by the scheduler only.</td>
</tr>
<tr>
<td>$attempt_to_make_dir</td>
<td></td>
</tr>
<tr>
<td>$clienthost</td>
<td></td>
</tr>
<tr>
<td>$check_poll_time</td>
<td></td>
</tr>
<tr>
<td>$configversion</td>
<td></td>
</tr>
<tr>
<td>$cputmult</td>
<td></td>
</tr>
<tr>
<td>$cuda_visible_devices</td>
<td></td>
</tr>
<tr>
<td>$down_on_error</td>
<td></td>
</tr>
<tr>
<td>$enablemomrestart</td>
<td></td>
</tr>
<tr>
<td>$exec_with_exec</td>
<td></td>
</tr>
<tr>
<td>$ext_pwd_retry</td>
<td></td>
</tr>
<tr>
<td>$ideal_load</td>
<td></td>
</tr>
<tr>
<td>$igncput</td>
<td></td>
</tr>
<tr>
<td>$ignmem</td>
<td></td>
</tr>
<tr>
<td>$ignvmem</td>
<td></td>
</tr>
<tr>
<td>$ignwalltime</td>
<td></td>
</tr>
<tr>
<td>$jobdirectory_sticky</td>
<td></td>
</tr>
<tr>
<td>$job_exit_wait_time</td>
<td></td>
</tr>
<tr>
<td>$job_output_file_unmask</td>
<td></td>
</tr>
<tr>
<td>$job_starters</td>
<td></td>
</tr>
<tr>
<td>$log_directory</td>
<td></td>
</tr>
<tr>
<td>$log_file_suffix</td>
<td></td>
</tr>
<tr>
<td>$logfile</td>
<td></td>
</tr>
<tr>
<td>$log_file_max_size</td>
<td></td>
</tr>
<tr>
<td>$log_file_roll_depth</td>
<td></td>
</tr>
<tr>
<td>$log_keep_days</td>
<td></td>
</tr>
<tr>
<td>$max_conn_timeout_usec</td>
<td></td>
</tr>
<tr>
<td>$max_load</td>
<td></td>
</tr>
<tr>
<td>$memory_pressure_duration</td>
<td></td>
</tr>
<tr>
<td>$memory_pressure_threshold</td>
<td></td>
</tr>
<tr>
<td>$mom_hierarchy_retry_time</td>
<td></td>
</tr>
<tr>
<td>$mom_host</td>
<td></td>
</tr>
<tr>
<td>$node_check_script</td>
<td></td>
</tr>
<tr>
<td>$node_check_interval</td>
<td></td>
</tr>
<tr>
<td>$nodefile_suffix</td>
<td></td>
</tr>
<tr>
<td>$nospool_dir_list</td>
<td></td>
</tr>
<tr>
<td>$opsys</td>
<td></td>
</tr>
<tr>
<td>$pbsclient</td>
<td></td>
</tr>
<tr>
<td>$pbsserver</td>
<td></td>
</tr>
<tr>
<td>$prologalarm</td>
<td></td>
</tr>
<tr>
<td>$remote_reconfig</td>
<td></td>
</tr>
<tr>
<td>$remote_checkpoint_dirs</td>
<td></td>
</tr>
<tr>
<td>$reduce_prolog_checks</td>
<td></td>
</tr>
<tr>
<td>$reject_job_submission</td>
<td></td>
</tr>
<tr>
<td>$resend_join_job_wait_time</td>
<td></td>
</tr>
<tr>
<td>$restricted</td>
<td></td>
</tr>
<tr>
<td>$rpp_throttle</td>
<td></td>
</tr>
<tr>
<td>$rcpcmd</td>
<td></td>
</tr>
<tr>
<td>$remote_checkpoint_dirs</td>
<td></td>
</tr>
<tr>
<td>$reduce_prolog_checks</td>
<td></td>
</tr>
<tr>
<td>$remote_reconfig</td>
<td></td>
</tr>
<tr>
<td>$remote_checkpoint_dirs</td>
<td></td>
</tr>
<tr>
<td>$reduce_prolog_checks</td>
<td></td>
</tr>
<tr>
<td>$reject_job_submission</td>
<td></td>
</tr>
<tr>
<td>$resend_join_job_wait_time</td>
<td></td>
</tr>
<tr>
<td>$restricted</td>
<td></td>
</tr>
<tr>
<td>$rpp_throttle</td>
<td></td>
</tr>
<tr>
<td>$rcpcmd</td>
<td></td>
</tr>
<tr>
<td>$remote_reconfig</td>
<td></td>
</tr>
<tr>
<td>$remote_checkpoint_dirs</td>
<td></td>
</tr>
<tr>
<td>$reduce_prolog_checks</td>
<td></td>
</tr>
<tr>
<td>$reject_job_submission</td>
<td></td>
</tr>
<tr>
<td>$resend_join_job_wait_time</td>
<td></td>
</tr>
<tr>
<td>$restricted</td>
<td></td>
</tr>
<tr>
<td>$rpp_throttle</td>
<td></td>
</tr>
<tr>
<td>$rcpcmd</td>
<td></td>
</tr>
<tr>
<td>$remote_reconfig</td>
<td></td>
</tr>
<tr>
<td>$remote_checkpoint_dirs</td>
<td></td>
</tr>
<tr>
<td>$reduce_prolog_checks</td>
<td></td>
</tr>
<tr>
<td>$reject_job_submission</td>
<td></td>
</tr>
<tr>
<td>$resend_join_job_wait_time</td>
<td></td>
</tr>
</tbody>
</table>

### arch

**Format**<STRING>

**Description**

Specifies the architecture of the local machine. This information is used by the scheduler only.

**Example**

arch ia64

### $attempt_to_make_dir

**Format**<BOOLEAN>
$attempt_to_make_dir

Description
When set to \textit{TRUE}, specifies that you want TORQUE to attempt to create the output directories for jobs if they do not already exist. Default is \textit{FALSE}.

TORQUE uses this parameter to make the directory as the \textit{user} and not as \textit{root}. TORQUE will create the directory (or directories) \textbf{ONLY} if the user has permissions to do so.

Example
$attempt_to_make_dir true

$clienthost

Format
<STRING>

Description
Specifies the machine running pbs\_server.

\textbf{This parameter is deprecated. Use $pbsserver.}

Example
$clienthost node01.teracluster.org

$check_poll_time

Format
<STRING>

Description
Amount of time between checking running jobs, polling jobs, and trying to resend obituaries for jobs that haven't sent successfully. Default is 45 seconds.

Example
$check_poll_time 90

$configversion

Format
<STRING>

Description
Specifies the version of the config file data.

Example
$configversion 113
### $cputmult

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;FLOAT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>CPU time multiplier.</td>
</tr>
<tr>
<td></td>
<td>If set to 0.0, MOM level cputime enforcement is disabled.</td>
</tr>
<tr>
<td>Example</td>
<td>$cputmult 2.2</td>
</tr>
</tbody>
</table>

### $cuda_visible_devices

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>TRUE</td>
</tr>
<tr>
<td>Description</td>
<td>When set to TRUE, the MOM will set the CUDA_VISIBLE_DEVICES environment variable for jobs using NVIDIA GPUs. If set to FALSE, the MOM will not set CUDA_VISIBLE_DEVICES for any jobs.</td>
</tr>
<tr>
<td>Example</td>
<td>$cuda_visible_devices true</td>
</tr>
</tbody>
</table>

### $down_on_error

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Causes the MOM to report itself as state &quot;down&quot; to pbs_server in the event of a failed health check. This feature is experimental. For more information, see MOM Parameters on page 283.</td>
</tr>
<tr>
<td>Example</td>
<td>$down_on_error true</td>
</tr>
</tbody>
</table>

### $enablemomrestart

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
</table>
### $enablemomrestart

<table>
<thead>
<tr>
<th>Description</th>
<th>Enables automatic restarts of the MOM. If enabled, the MOM will check if its binary has been updated and restart itself at a safe point when no jobs are running; thus making upgrades easier. The check is made by comparing the mtime of the pbs_mom executable. Command-line args, the process name, and the PATH env variable are preserved across restarts. It is recommended that this not be enabled in the config file, but enabled when desired with momctl (see MOM Parameters on page 283 for more information.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>$enablemomrestart true</td>
</tr>
</tbody>
</table>

### $exec_with_exec

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>pbs_mom uses the exec command to start the job script rather than the TORQUE default method, which is to pass the script’s contents as the input to the shell. This means that if you trap signals in the job script, they will be trapped for the job. Using the default method, you would need to configure the shell to also trap the signals. Default is FALSE.</td>
</tr>
<tr>
<td>Example</td>
<td>$exec_with_exec true</td>
</tr>
</tbody>
</table>

### $ext_pwd_retry

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>(Available in TORQUE 2.5.10, 3.0.4, and later.) Specifies the number of times to retry checking the password. Useful in cases where external password validation is used, such as with LDAP. The default value is 3 retries.</td>
</tr>
<tr>
<td>Example</td>
<td>$ext_pwd_retry = 5</td>
</tr>
</tbody>
</table>

### $ideal_load

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;FLOAT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Ideal processor load.</td>
</tr>
<tr>
<td>Example</td>
<td>$ideal_load 4.0</td>
</tr>
</tbody>
</table>
### $igncput

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Ignores limit violation pertaining to CPU time. Default is FALSE.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$igncput true</td>
</tr>
</tbody>
</table>

### $ignmem

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Ignores limit violations pertaining to physical memory. Default is FALSE.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$ignmem true</td>
</tr>
</tbody>
</table>

### $ignvmem

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Ignores limit violations pertaining to virtual memory. Default is FALSE.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$ignvmem true</td>
</tr>
</tbody>
</table>

### $ignwalltime

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Ignore walltime (do not enable MOM based walltime limit enforcement).</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$ignwalltime true</td>
</tr>
</tbody>
</table>

### $jobdirectory_sticky

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>When this option is set (true), the job directory on the MOM can have a sticky bit set. The default is false.</td>
</tr>
</tbody>
</table>

---

**Node Manager (MOM) Configuration**
### $jobdirectory_sticky

| Example | $jobdirectory_sticky true |

### $job_exit_wait_time

| Format | <INTEGER> |
| Description | This is the timeout to clean up parallel jobs after one of the sister nodes for the parallel job goes down or is otherwise unresponsive. The MOM sends out all of its kill job requests to sisters and marks the time. Additionally, the job is placed in the substate JOB_SUBSTATE_EXIT_WAIT. The MOM then periodically checks jobs in this state and if they are in this state for more than the specified time, death is assumed and the job gets cleaned up. Default is 10 minutes. |
| Example | $job_exit_wait_time 300 |

### $job_output_file_unmask

| Format | <STRING> |
| Description | Uses the specified umask when creating job output and error files. Values can be specified in base 8, 10, or 16; leading 0 implies octal and leading 0x or 0X hexadecimal. A value of "userdefault" will use the user’s default umask. This parameter is in version 2.3.0 and later. |
| Example | $job_output_file_unmask 027 |

### $job_starter

| Format | <STRING> |
| Description | Specifies the fully qualified pathname of the job starter. If this parameter is specified, instead of executing the job command and job arguments directly, the MOM will execute the job starter, passing the job command and job arguments to it as its arguments. The job starter can be used to launch jobs within a desired environment. |
| Example | $job_starter /var/torque/mom_priv/job_starter.sh
> cat /var/torque/mom_priv/job_starter.sh
#!/bin/bash
export FOOHOME=/home/foo
ulimit -n 314
$* |
### $log_directory

**Format**

<STRING>

**Description**

Changes the log directory. Default is `TORQUE_HOME/mom_logs`. `TORQUE_HOME` default is `/var/spool/torque/` but can be changed in the `./configure` script. The value is a string and should be the full path to the desired MOM log directory.

**Example**

$log_directory /opt/torque/mom_logs/

### $log_file_suffix

**Format**

<STRING>

**Description**

Optional suffix to append to log file names. If `%h` is the suffix, `pbs_mom` appends the hostname for where the log files are stored if it knows it, otherwise it will append the hostname where the MOM is running.

**Example**

$log_file_suffix %h = 20100223.mybox
$log_file_suffix foo = 20100223.foo

### $logevent

**Format**

<STRING>

**Description**

Specifies a bitmap for event types to log.

**Example**

$logevent 255

### $loglevel

**Format**

<INTEGER>

**Description**

Specifies the verbosity of logging with higher numbers specifying more verbose logging. Values may range between 0 and 7.

**Example**

$loglevel 4
### $log_{\text{file\_max\_size}}$

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Soft limit for log file size in kilobytes. Checked every 5 minutes. If the log file is found to be greater than or equal to $log_{\text{file_max_size}}$ the current log file will be moved from X to X.1 and a new empty file will be opened.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$log_{\text{file_max_size}} = 100$</td>
</tr>
</tbody>
</table>

### $log_{\text{file\_roll\_depth}}$

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies how many times a log fill will be rolled before it is deleted.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$log_{\text{file_roll_depth}} = 7$</td>
</tr>
</tbody>
</table>

### $log_{\text{keep\_days}}$

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies how many days to keep log files. pbs_mom deletes log files older than the specified number of days. If not specified, pbs_mom won't delete log files based on their age.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$log_{\text{keep_days}} = 10$</td>
</tr>
</tbody>
</table>

### $max_{\text{conn\_timeout\_micro\_sec}}$

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies how long pbs_mom should wait for a connection to be made. Default value is 10000 (1 sec).</td>
</tr>
</tbody>
</table>
| **Example** | $max_{\text{conn\_timeout\_micro\_sec}} = 30000$
This sets the connection timeout on the MOM to .3 seconds. |
### $max_join_job_wait_time

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The interval to wait for jobs stuck in a prerun state before deleting them from the MOMs and requeueing them on the server. Default is 10 minutes.</td>
</tr>
<tr>
<td>Example</td>
<td>$max_join_job_wait_time 300</td>
</tr>
</tbody>
</table>

### $max_load

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;FLOAT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Maximum processor load.</td>
</tr>
<tr>
<td>Example</td>
<td>$max_load 4.0</td>
</tr>
</tbody>
</table>

### $memory_pressure_duration

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>(Applicable in version 3.0 and later) Memory pressure duration sets a limit to the number of times the value of $memory_pressure_threshold can be exceeded before a process is terminated. This can only be used with $memory_pressure_threshold.</td>
</tr>
<tr>
<td>Example</td>
<td>$memory_pressure_duration 5</td>
</tr>
</tbody>
</table>

### $memory_pressure_threshold

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>$memory_pressure_threshold</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>(Applicable in version 3.0 and later.) The memory pressure of a cpuset provides a simple per-cpu set running average of the rate that the processes in a cpuset are attempting to free up in-use memory on the nodes of the cpuset to satisfy additional memory requests. The memory_pressure_threshold is an integer number used to compare against the reclaim rate provided by the memory_pressure file. If the threshold is exceeded and memory_pressure_duration is set, then the process terminates after exceeding the threshold by the number of times set in memory_pressure_duration. If memory_pressure duration is not set, then a warning is logged and the process continues. Memory_pressure_threshold is only valid with memory_pressure enabled in the root cpuset. To enable, log in as the super user and execute the command <code>echo 1 &gt;&gt; /dev/cpuset/memory_pressure_enabled</code>. See the cpuset man page for more information concerning memory pressure.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$memory_pressure_threshold 1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$mom_hierarchy_retry_time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$mom_host</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$node_check_script</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>
### $node_check_interval

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
</table>
| **Description** | Specifies the number of MOM intervals between subsequent executions of the specified health check. This value defaults to 1 indicating the check is run every MOM interval (see [Compute Node Health Check](#) on page 166 for more information). $node_check_interval has two special strings that can be set:  
  - **jobstart** – makes the node health script run when a job is started (before the prologue script).  
  - **jobend** – makes the node health script run after each job has completed on a node (after the epilogue script). |
| **Example** | $node_check_interval 5 |

---

### $nodefile_suffix

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies the suffix to append to a host names to denote the data channel network adapter in a multi-homed compute node.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>$nodefile_suffix i with the suffix of &quot;i&quot; and the control channel adapter with the name node01, the data channel would have a hostname of node01i.</td>
</tr>
</tbody>
</table>

---

### $nospool_dir_list

<p>| Format   | &lt;STRING&gt; |</p>
<table>
<thead>
<tr>
<th><strong>$nospool_dir_list</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>opsys</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>$pbsclient</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>$pbsserver</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Format</strong></td>
</tr>
</tbody>
</table>
### $pbsserver

**Description**
Specifies the machine running pbs_server.

- This parameter replaces the deprecated parameter $clienthost.

**Example**
$pbservenode01.teracluster.org

### $prologalarm

**Format**
<INTEGER>

**Description**
Specifies maximum duration (in seconds) which the MOM will wait for the job prologue or job epi-
logue to complete. The default value is 300 seconds (5 minutes). When running parallel jobs, this
is also the maximum time a sister node will wait for a job to start.

**Example**
$prologalarm 60

### $rcpcmd

**Format**
<STRING>

**Description**
Specifies the full path and optional additional command line args to use to perform remote copies.

**Example**
mom_priv/config:
$rcpcmd /usr/local/bin/scp -i /etc/sshauth.dat

### $remote_reconfig

**Format**
<STRING>

**Description**
Enables the ability to remotely reconfigure pbs_mom with a new config file. Default is disabled.
This parameter accepts various forms of true, yes, and 1. For more information on how to recon-
figure MOMs, see momctl -r.

**Example**
$remote_reconfig true
### $remote_checkpoint_dirs

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Specifies which server checkpoint directories are remotely mounted. It tells the MOM which directories are shared with the server. Using remote checkpoint directories eliminates the need to copy the checkpoint files back and forth between the MOM and the server. All entries must be on the same line, separated by a space.</td>
</tr>
<tr>
<td>Example</td>
<td>$remote_checkpoint_dirs /checkpointFiles /bigStorage /fast&lt;br&gt;This informs the MOM that the /checkpointFiles, /bigStorage, and /fast directories are remotely mounted checkpoint directories.</td>
</tr>
</tbody>
</table>

### $reduce_prolog_checks

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>If enabled, TORQUE will only check if the file is a regular file and is executable, instead of the normal checks listed on the prologue and epilogue page. Default is FALSE.</td>
</tr>
<tr>
<td>Example</td>
<td>$reduce_prolog_checks true</td>
</tr>
</tbody>
</table>

### $reject_job_submission

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>If set to TRUE, jobs will be rejected and the user will receive the message, &quot;Jobs cannot be run on mom %s.&quot; Default is FALSE.</td>
</tr>
<tr>
<td>Example</td>
<td>$reject_job_submission job01</td>
</tr>
</tbody>
</table>

### $resend_join_job_wait_time

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This is the timeout for the Mother Superior to re-send the join job request if it didn’t get a reply from all the sister MOMs. The resend happens only once. Default is 5 minutes.</td>
</tr>
<tr>
<td>Example</td>
<td>$resend_join_job_wait_time 120</td>
</tr>
</tbody>
</table>
### $restricted

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Specifies hosts which can be trusted to access MOM services as non-root. By default, no hosts are trusted to access MOM services as non-root.</td>
</tr>
<tr>
<td>Example</td>
<td>$restricted *.teracluster.org</td>
</tr>
</tbody>
</table>

### $rpp_throttle

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>This integer is in microseconds and causes a sleep after every RPP packet is sent. It is for systems that experience job failures because of incomplete data.</td>
</tr>
</tbody>
</table>
| Example   | $rpp_throttle 100  
(will cause a 100 microsecond sleep) |

### size[fs=<FS>]

<table>
<thead>
<tr>
<th>Format</th>
<th>N/A</th>
</tr>
</thead>
</table>
| Description | Specifies that the available and configured disk space in the <FS> filesystem is to be reported to the pbs_server and scheduler.  

```
To request disk space on a per job basis, specify the file resource as in qsub -l nodes=1,file=1000kb
```


```
Unlike most MOM config options, the size parameter is not preceded by a "$" character.
```

| Example   | size[fs=/localscratch]  
The available and configured disk space in the /localscratch filesystem will be reported. |

### $source_login_batch

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
</table>
### $source_login_batch

| **Description** | Specifies whether or not MOM will source the /etc/profile, etc. type files for batch jobs. Parameter accepts various forms of true, false, yes, no, 1 and 0. Default is TRUE. This parameter is in version 2.3.1 and later. |
| **Example** | $source_login_batch False  
MOM will bypass the sourcing of /etc/profile, etc. type files. |

### $source_login_interactive

| **Format** | <STRING> |
| **Description** | Specifies whether or not MOM will source the /etc/profile, etc. type files for interactive jobs. Parameter accepts various forms of true, false, yes, no, 1 and 0. Default is TRUE. This parameter is in version 2.3.1 and later. |
| **Example** | $source_login_interactive False  
MOM will bypass the sourcing of /etc/profile, etc. type files. |

### $spool_as_final_name

| **Format** | <BOOLEAN> |
| **Description** | This makes the job write directly to its output destination instead of a spool directory. This allows users easier access to the file if they want to watch the jobs output as it runs. |
| **Example** | $spool_as_final_name true |

### $status_update_time

| **Format** | <INTEGER> |
| **Description** | Specifies the number of seconds between subsequent MOM-to-server update reports. Default is 45 seconds. |
| **Example** | status_update_time:  
$status_update_time 120  
MOM will send server update reports every 120 seconds. |
### $thread_unlink_calls

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Threads calls to unlink when deleting a job. Default is false. If it is set to TRUE, pbs_mom will use a thread to delete the job’s files.</td>
</tr>
<tr>
<td>Example</td>
<td>thread_unlink_calls: $thread_unlink_calls true</td>
</tr>
</tbody>
</table>

### $timeout

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Specifies the number of seconds before a TCP connection on the MOM will timeout. Default is 300 seconds. In version 3.x and earlier, this specifies the number of seconds before MOM-to-MOM messages will timeout if RPP is disabled. Default is 60 seconds.</td>
</tr>
</tbody>
</table>
| Example    | $timeout 120  
A TCP connection will wait up to 120 seconds before timing out. For 3.x and earlier, MOM-to-MOM communication will allow up to 120 seconds before timing out. |

### $tmpdir

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Specifies a directory to create job-specific scratch space (see Creating Per-Job Temporary Directories).</td>
</tr>
<tr>
<td>Example</td>
<td>$tmpdir /localscratch</td>
</tr>
</tbody>
</table>

### $usecp

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;HOST&gt;:&lt;SRCDIR&gt; &lt;DSTDIR&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Specifies which directories should be staged (see NFS and Other Networked Filesystems on page 138)</td>
</tr>
<tr>
<td>Example</td>
<td>$usecp *.fte.com:/data /usr/local/data</td>
</tr>
</tbody>
</table>
### "$use_smt"

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Indicates that the user would like to use SMT. If set, each logical core inside of a physical core will be used as a normal core for cpusets. This parameter is on by default.</td>
</tr>
<tr>
<td>Example</td>
<td>$use_smt false</td>
</tr>
</tbody>
</table>

#### $varattr

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INTEGER&gt; &lt;STRING&gt;</th>
</tr>
</thead>
</table>
| Description | Provides a way to keep track of dynamic attributes on nodes.  

- `<INTEGER>` is how many seconds should go by between calls to the script to update the dynamic values. If set to -1, the script is read only one time.  
- `<STRING>` is the script path. This script should check for whatever dynamic attributes are desired, and then output lines in this format:  

```
name=value
```

Include any arguments after the script's full path. These features are visible in the output of `pbsnodes -a varattr=Matlab=7.1;Octave=1.0`.  

For information about using $varattr to request dynamic features in Moab, see Resource Manager Extensions in the *Moab Workload Manager Administrator Guide*. |
| Example  | $varattr 25 /usr/local/scripts/nodeProperties.pl arg1 arg2 arg3 |

### "$wallmult"

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;FLOAT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Sets a factor to adjust walltime usage by multiplying a default job time to a common reference system. It modifies real walltime on a per-MOM basis (MOM configuration parameters). The factor is used for walltime calculations and limits in the same way that cputmult is used for cpu time.</td>
</tr>
<tr>
<td>Example</td>
<td>$wallmult 2.2</td>
</tr>
</tbody>
</table>
### $xauthpath

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Specifies the path to the xauth binary to enable X11 forwarding.</td>
</tr>
<tr>
<td>Example</td>
<td>$xauthpath /opt/bin/xauth/</td>
</tr>
</tbody>
</table>

**Related Topics**

[Node Manager (MOM) Configuration on page 283](#)

---

### Node Features and Generic Consumable Resource Specification

Node features (a.k.a. "node properties") are opaque labels which can be applied to a node. They are not consumable and cannot be associated with a value. (Use generic resources described below for these purposes). Node features are configured within the nodes file on the pbs_server head node. This file can be used to specify an arbitrary number of node features.

Additionally, per node consumable generic resources may be specified using the format "<ATTR> <VAL>" with no leading dollar ("$") character. When specified, this information is routed to the scheduler and can be used in scheduling decisions. For example, to indicate that a given host has two tape drives and one node-locked matlab license available for batch jobs, the following could be specified:

```
mom_priv/config:
$clienthost 241.13.153.7
tape 2
matlab 1
```

Dynamic consumable resource information can be routed in by specifying a path preceded by an exclamation point (!) as in the example below. If the resource value is configured in this manner, the specified file will be periodically executed to load the effective resource value.

```
mom_priv/config:
$clienthost 241.13.153.7
tape !/opt/rm/gettapecount.pl
matlab !/opt/tools/getlicensecount.pl
```

**Related Topics**

[Node Manager (MOM) Configuration on page 283](#)
# Command-line Arguments

Below is a table of `pbs_mom` command-line startup flags.

<table>
<thead>
<tr>
<th>Flag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a &lt;integer&gt;</td>
<td>Alarm time in seconds.</td>
</tr>
<tr>
<td>c &lt;file&gt;</td>
<td>Config file path.</td>
</tr>
<tr>
<td>C &lt;directory&gt;</td>
<td>Checkpoint path.</td>
</tr>
<tr>
<td>d &lt;directory&gt;</td>
<td>Home directory.</td>
</tr>
<tr>
<td>L &lt;file&gt;</td>
<td>Log file.</td>
</tr>
<tr>
<td>M &lt;integer&gt;</td>
<td>MOM port to listen on.</td>
</tr>
<tr>
<td>p</td>
<td>Perform ‘poll’ based job recovery on restart (jobs persist until associated processes terminate).</td>
</tr>
<tr>
<td>P</td>
<td>On restart, deletes all jobs that were running on MOM (Available in 2.4.X and later).</td>
</tr>
<tr>
<td>q</td>
<td>On restart, requeues all jobs that were running on MOM (Available in 2.4.X and later).</td>
</tr>
<tr>
<td>r</td>
<td>On restart, kills all processes associated with jobs that were running on MOM, and then requeues the jobs.</td>
</tr>
<tr>
<td>R &lt;integer&gt;</td>
<td>MOM ‘RM’ port to listen on.</td>
</tr>
<tr>
<td>S &lt;integer&gt;</td>
<td>pbs_server port to connect to.</td>
</tr>
<tr>
<td>v</td>
<td>Display version information and exit.</td>
</tr>
<tr>
<td>x</td>
<td>Disable use of privileged port.</td>
</tr>
<tr>
<td>?</td>
<td>Show usage information and exit.</td>
</tr>
</tbody>
</table>

For more details on these command-line options, see `pbs_mom on page 183`.

Related Topics

Node Manager (MOM) Configuration on page 283
Diagnostics and Error Codes

TORQUE has a diagnostic script to assist you in giving TORQUE Support the files they need to support issues. It should be run by a user that has access to run all TORQUE commands and access to all TORQUE directories (this is usually root).

The script (contrib/diag/tdiag.sh) is available in TORQUE 2.3.8, TORQUE 2.4.3, and later. The script grabs the node file, server and MOM log files, and captures the output of qmgr -c 'ps'. These are put in a tar file.

The script also has the following options (this can be shown in the command line by entering ./tdiag.sh -h):

**USAGE:** ./torque_diag [-d DATE] [-h] [-o OUTPUT_FILE] [-t TORQUE_HOME]

- **DATE** should be in the format YYYYmmdd. For example, "20091130" would be the date for November 30th, 2009. If no date is specified, today's date is used.

- **OUTPUT_FILE** is the optional name of the output file. The default output file is torque_diag<today's_date>.tar.gz. TORQUE_HOME should be the path to your TORQUE directory. If no directory is specified, /var/spool/torque is the default.

<table>
<thead>
<tr>
<th>Error code name</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_FLOOR</td>
<td>15000</td>
<td>No error</td>
</tr>
<tr>
<td>PBSE_UNKJOBID</td>
<td>15001</td>
<td>Unknown job ID error</td>
</tr>
<tr>
<td>PBSE_NOATTR</td>
<td>15002</td>
<td>Undefined attribute</td>
</tr>
<tr>
<td>PBSE_ATTRIBRO</td>
<td>15003</td>
<td>Cannot set attribute, read only or insufficient permission</td>
</tr>
<tr>
<td>PBSEIVALREQ</td>
<td>15004</td>
<td>Invalid request</td>
</tr>
<tr>
<td>PBSE_UNKREQ</td>
<td>15005</td>
<td>Unknown request</td>
</tr>
<tr>
<td>PBSE_TOOMANY</td>
<td>15006</td>
<td>Too many submit retries</td>
</tr>
<tr>
<td>PBSE_PERM</td>
<td>15007</td>
<td>Unauthorized Request</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_IFF_NOT_FOUND</td>
<td>15008</td>
<td>trqauthd unable to authenticate</td>
</tr>
<tr>
<td>PBSE_MUNGE_NOT_FOUND</td>
<td>15009</td>
<td>Munge executable not found, unable to authenticate</td>
</tr>
<tr>
<td>PBSE_BADHOST</td>
<td>15010</td>
<td>Access from host not allowed, or unknown host</td>
</tr>
<tr>
<td>PBSE_JOBEXIST</td>
<td>15011</td>
<td>Job with requested ID already exists</td>
</tr>
<tr>
<td>PBSE_SYSTEM</td>
<td>15012</td>
<td>System error</td>
</tr>
<tr>
<td>PBSE_INTERNAL</td>
<td>15013</td>
<td>PBS server internal error</td>
</tr>
<tr>
<td>PBSE_REGROUTE</td>
<td>15014</td>
<td>Dependent parent job currently in routing queue</td>
</tr>
<tr>
<td>PBSE_UNKSIG</td>
<td>15015</td>
<td>Unknown/illegal signal name</td>
</tr>
<tr>
<td>PBSE_BADATVAL</td>
<td>15016</td>
<td>Illegal attribute or resource value for</td>
</tr>
<tr>
<td>PBSE_MODATRRUN</td>
<td>15017</td>
<td>Cannot modify attribute while job running</td>
</tr>
<tr>
<td>PBSE_BADSTATE</td>
<td>15018</td>
<td>Request invalid for state of job</td>
</tr>
<tr>
<td>PBSE_UNKQUE</td>
<td>15020</td>
<td>Unknown queue</td>
</tr>
<tr>
<td>PBSE_BADCRED</td>
<td>15021</td>
<td>Invalid credential</td>
</tr>
<tr>
<td>PBSE_EXPIRED</td>
<td>15022</td>
<td>Expired credential</td>
</tr>
<tr>
<td>PBSE_QUNOENB</td>
<td>15023</td>
<td>Queue is not enabled</td>
</tr>
<tr>
<td>PBSE_QACCESS</td>
<td>15024</td>
<td>Access to queue is denied</td>
</tr>
<tr>
<td>PBSE_BADUSER</td>
<td>15025</td>
<td>Bad UID for job execution</td>
</tr>
<tr>
<td>PBSE_HOPCOUNT</td>
<td>15026</td>
<td>Job routing over too many hops</td>
</tr>
<tr>
<td>PBSE_QUEUEXIST</td>
<td>15027</td>
<td>Queue already exists</td>
</tr>
<tr>
<td>PBSE_ATTRTYPE</td>
<td>15028</td>
<td>Incompatible type</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_QUEUEBUSY</td>
<td>15029</td>
<td>Cannot delete busy queue</td>
</tr>
<tr>
<td>PBSE_QUENBIG</td>
<td>15030</td>
<td>Queue name too long</td>
</tr>
<tr>
<td>PBSE_NOSUP</td>
<td>15031</td>
<td>No support for requested service</td>
</tr>
<tr>
<td>PBSE_QUENOEN</td>
<td>15032</td>
<td>Cannot enable queue, incomplete definition</td>
</tr>
<tr>
<td>PBSE_PROTOCOL</td>
<td>15033</td>
<td>Batch protocol error</td>
</tr>
<tr>
<td>PBSE_BADATLST</td>
<td>15034</td>
<td>Bad attribute list structure</td>
</tr>
<tr>
<td>PBSE_NOCONNECTS</td>
<td>15035</td>
<td>No free connections</td>
</tr>
<tr>
<td>PBSE_NOSERVER</td>
<td>15036</td>
<td>No server specified</td>
</tr>
<tr>
<td>PBSE_UNKRESQ</td>
<td>15037</td>
<td>Unknown resource type</td>
</tr>
<tr>
<td>PBSE_EXCQRESQ</td>
<td>15038</td>
<td>Job exceeds queue resource limits</td>
</tr>
<tr>
<td>PBSE_QUENOENFLT</td>
<td>15039</td>
<td>No default queue specified</td>
</tr>
<tr>
<td>PBSE_NORERUN</td>
<td>15040</td>
<td>Job is not rerunnable</td>
</tr>
<tr>
<td>PBSE_ROUTEREJ</td>
<td>15041</td>
<td>Job rejected by all possible destinations (check syntax, queue resources, ...)</td>
</tr>
<tr>
<td>PBSE_ROUTEEXPD</td>
<td>15042</td>
<td>Time in Route Queue Expired</td>
</tr>
<tr>
<td>PBSE_MOMREJECT</td>
<td>15043</td>
<td>Execution server rejected request</td>
</tr>
<tr>
<td>PBSE_BADSCRIPT</td>
<td>15044</td>
<td>(qsub) cannot access script file</td>
</tr>
<tr>
<td>PBSE_STAGEIN</td>
<td>15045</td>
<td>Stage-in of files failed</td>
</tr>
<tr>
<td>PBSE_RESCUNAV</td>
<td>15046</td>
<td>Resource temporarily unavailable</td>
</tr>
<tr>
<td>PBSE_BADGRP</td>
<td>15047</td>
<td>Bad GID for job execution</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_MAXQUED</td>
<td>15048</td>
<td>Maximum number of jobs already in queue</td>
</tr>
<tr>
<td>PBSE_CKPBSY</td>
<td>15049</td>
<td>Checkpoint busy, may retry</td>
</tr>
<tr>
<td>PBSE_EXLIMIT</td>
<td>15050</td>
<td>Resource limit exceeds allowable</td>
</tr>
<tr>
<td>PBSE_BADACCT</td>
<td>15051</td>
<td>Invalid Account</td>
</tr>
<tr>
<td>PBSE_ALRDYEXIT</td>
<td>15052</td>
<td>Job already in exit state</td>
</tr>
<tr>
<td>PBSE_NOCOPYFILE</td>
<td>15053</td>
<td>Job files not copied</td>
</tr>
<tr>
<td>PBSE_CLEANEDOUT</td>
<td>15054</td>
<td>Unknown job id after clean init</td>
</tr>
<tr>
<td>PBSE_NOSYNCMSTR</td>
<td>15055</td>
<td>No master found for sync job set</td>
</tr>
<tr>
<td>PBSE_BADDEPEND</td>
<td>15056</td>
<td>Invalid Job Dependency</td>
</tr>
<tr>
<td>PBSE_DUPLIST</td>
<td>15057</td>
<td>Duplicate entry in list</td>
</tr>
<tr>
<td>PBSE_DISPROTO</td>
<td>15058</td>
<td>Bad DIS based Request Protocol</td>
</tr>
<tr>
<td>PBSE_EXECHERE</td>
<td>15059</td>
<td>Cannot execute at specified host because of checkpoint or stagein files</td>
</tr>
<tr>
<td>PBSE_SISREJECT</td>
<td>15060</td>
<td>Sister rejected</td>
</tr>
<tr>
<td>PBSE_SISCOMM</td>
<td>15061</td>
<td>Sister could not communicate</td>
</tr>
<tr>
<td>PBSE_SVRDOWN</td>
<td>15062</td>
<td>Request not allowed: Server shutting down</td>
</tr>
<tr>
<td>PBSE_CKPSHORT</td>
<td>15063</td>
<td>Not all tasks could checkpoint</td>
</tr>
<tr>
<td>PBSE_UNKNODE</td>
<td>15064</td>
<td>Unknown node</td>
</tr>
<tr>
<td>PBSE_UNKNODEATR</td>
<td>15065</td>
<td>Unknown node-attribute</td>
</tr>
<tr>
<td>PBSE_NONODES</td>
<td>15066</td>
<td>Server has no node list</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>PBSE_NODENBIG</td>
<td>15067</td>
<td>Node name is too big</td>
</tr>
<tr>
<td>PBSE_NODEEXIST</td>
<td>15068</td>
<td>Node name already exists</td>
</tr>
<tr>
<td>PBSE_BADNDATVAL</td>
<td>15069</td>
<td>Illegal value</td>
</tr>
<tr>
<td>PBSE_MUTUALEX</td>
<td>15070</td>
<td>Mutually exclusive values for</td>
</tr>
<tr>
<td>PBSE_GMODERR</td>
<td>15071</td>
<td>Modification failed for</td>
</tr>
<tr>
<td>PBSE_NORELYMOM</td>
<td>15072</td>
<td>Server could not connect to MOM</td>
</tr>
<tr>
<td>PBSE_NOTSNODE</td>
<td>15073</td>
<td>No time-share node available</td>
</tr>
<tr>
<td>PBSE_JOBTYPE</td>
<td>15074</td>
<td>Wrong job type</td>
</tr>
<tr>
<td>PBSE_BADACLHOST</td>
<td>15075</td>
<td>Bad ACL entry in host list</td>
</tr>
<tr>
<td>PBSE_MAXUSERQUED</td>
<td>15076</td>
<td>Maximum number of jobs already in queue for user</td>
</tr>
<tr>
<td>PBSE_BADDISALLOWTYPE</td>
<td>15077</td>
<td>Bad type in disallowed_types list</td>
</tr>
<tr>
<td>PBSE_NOINTERACTIVE</td>
<td>15078</td>
<td>Queue does not allow interactive jobs</td>
</tr>
<tr>
<td>PBSE_NOBATCH</td>
<td>15079</td>
<td>Queue does not allow batch jobs</td>
</tr>
<tr>
<td>PBSE_NORERUNABLE</td>
<td>15080</td>
<td>Queue does not allow rerunable jobs</td>
</tr>
<tr>
<td>PBSE_NONONRERUNABLE</td>
<td>15081</td>
<td>Queue does not allow nonrerunable jobs</td>
</tr>
<tr>
<td>PBSE_UNKARRAYID</td>
<td>15082</td>
<td>Unknown Array ID</td>
</tr>
<tr>
<td>PBSE_BAD_ARRAY_REQ</td>
<td>15083</td>
<td>Bad Job Array Request</td>
</tr>
<tr>
<td>PBSE_BAD_ARRAY_DATA</td>
<td>15084</td>
<td>Bad data reading job array from file</td>
</tr>
<tr>
<td>PBSE_TIMEOUT</td>
<td>15085</td>
<td>Time out</td>
</tr>
<tr>
<td>PBSE_JOBNOTFOUND</td>
<td>15086</td>
<td>Job not found</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_NOFAULTTOLERANT</td>
<td>15087</td>
<td>Queue does not allow fault tolerant jobs</td>
</tr>
<tr>
<td>PBSE_NOFAULTINTOLERANT</td>
<td>15088</td>
<td>Queue does not allow fault intolerant jobs</td>
</tr>
<tr>
<td>PBSE_NOJOBARRAYS</td>
<td>15089</td>
<td>Queue does not allow job arrays</td>
</tr>
<tr>
<td>PBSE_RELAYED_TO_MOM</td>
<td>15090</td>
<td>Request was relayed to a MOM</td>
</tr>
<tr>
<td>PBSE_MEM_MALLOC</td>
<td>15091</td>
<td>Error allocating memory - out of memory</td>
</tr>
<tr>
<td>PBSE_MUTEX</td>
<td>15092</td>
<td>Error allocating controlling mutex (lock/unlock)</td>
</tr>
<tr>
<td>PBSE_THREADATTR</td>
<td>15093</td>
<td>Error setting thread attributes</td>
</tr>
<tr>
<td>PBSE_THREAD</td>
<td>15094</td>
<td>Error creating thread</td>
</tr>
<tr>
<td>PBSE_SELECT</td>
<td>15095</td>
<td>Error in socket select</td>
</tr>
<tr>
<td>PBSE_SOCKET_FAULT</td>
<td>15096</td>
<td>Unable to get connection to socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_WRITE</td>
<td>15097</td>
<td>Error writing data to socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_READ</td>
<td>15098</td>
<td>Error reading data from socket</td>
</tr>
<tr>
<td>PBSE_SOCKET_CLOSE</td>
<td>15099</td>
<td>Socket close detected</td>
</tr>
<tr>
<td>PBSE_SOCKET_LISTEN</td>
<td>15100</td>
<td>Error listening on socket</td>
</tr>
<tr>
<td>PBSE_AUTH_INVALID</td>
<td>15101</td>
<td>Invalid auth type in request</td>
</tr>
<tr>
<td>PBSE_NOT_IMPLEMENTED</td>
<td>15102</td>
<td>This functionality is not yet implemented</td>
</tr>
<tr>
<td>PBSE_QUENOTAVAILABLE</td>
<td>15103</td>
<td>Queue is currently not available</td>
</tr>
<tr>
<td>PBSE_TMPDIFFOWNER</td>
<td>15104</td>
<td>tmpdir owned by another user</td>
</tr>
<tr>
<td>PBSE_TMPNOTDIR</td>
<td>15105</td>
<td>tmpdir exists but is not a directory</td>
</tr>
<tr>
<td>PBSE_TMPNONAME</td>
<td>15106</td>
<td>tmpdir cannot be named for job</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>PBSE_CANTOPENSOCKET</td>
<td>15107</td>
<td>Cannot open demux sockets</td>
</tr>
<tr>
<td>PBSE_CANTCONTACTSISTERS</td>
<td>15108</td>
<td>Cannot send join job to all sisters</td>
</tr>
<tr>
<td>PBSE_CANTCREATETMPDIR</td>
<td>15109</td>
<td>Cannot create tmpdir for job</td>
</tr>
<tr>
<td>PBSE_BADMOMSTATE</td>
<td>15110</td>
<td>Mom is down, cannot run job</td>
</tr>
<tr>
<td>PBSE_SOCKET_INFORMATION</td>
<td>15111</td>
<td>Socket information is not accessible</td>
</tr>
<tr>
<td>PBSE_SOCKET_DATA</td>
<td>15112</td>
<td>Data on socket does not process correctly</td>
</tr>
<tr>
<td>PBSE_CLIENT_INVALID</td>
<td>15113</td>
<td>Client is not allowed/trusted</td>
</tr>
<tr>
<td>PBSE_PREMATURE_EOF</td>
<td>15114</td>
<td>Premature End of File</td>
</tr>
<tr>
<td>PBSE_CAN_NOT_SAVE_FILE</td>
<td>15115</td>
<td>Error saving file</td>
</tr>
<tr>
<td>PBSE_CAN_NOT_OPEN_FILE</td>
<td>15116</td>
<td>Error opening file</td>
</tr>
<tr>
<td>PBSE_CAN_NOT_WRITE_FILE</td>
<td>15117</td>
<td>Error writing file</td>
</tr>
<tr>
<td>PBSE_JOB_FILE_CORRUPT</td>
<td>15118</td>
<td>Job file corrupt</td>
</tr>
<tr>
<td>PBSE_JOB_RERUN</td>
<td>15119</td>
<td>Job can not be rerun</td>
</tr>
<tr>
<td>PBSE_CONNECT</td>
<td>15120</td>
<td>Can not establish connection</td>
</tr>
<tr>
<td>PBSE_JOBWORKDELAY</td>
<td>15121</td>
<td>Job function must be temporarily delayed</td>
</tr>
<tr>
<td>PBSE_BAD_PARAMETER</td>
<td>15122</td>
<td>Parameter of function was invalid</td>
</tr>
<tr>
<td>PBSE_CONTINUE</td>
<td>15123</td>
<td>Continue processing on job. (Not an error)</td>
</tr>
<tr>
<td>PBSE_JOBSUBSTATE</td>
<td>15124</td>
<td>Current sub state does not allow trasaction.</td>
</tr>
<tr>
<td>PBSE_CAN_NOT_MOVE_FILE</td>
<td>15125</td>
<td>Error moving file</td>
</tr>
<tr>
<td>PBSE_JOB_RECYCLED</td>
<td>15126</td>
<td>Job is being recycled</td>
</tr>
<tr>
<td>Error code name</td>
<td>Number</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>PBSE_JOB_ALREADY_IN_QUEUE</td>
<td>15127</td>
<td>Job is already in destination queue.</td>
</tr>
<tr>
<td>PBSE_INVALID_MUTEX</td>
<td>15128</td>
<td>Mutex is NULL or otherwise invalid</td>
</tr>
<tr>
<td>PBSE_MUTEX_ALREADY_LOCKED</td>
<td>15129</td>
<td>The mutex is already locked by this object</td>
</tr>
<tr>
<td>PBSE_MUTEX_ALREADY_UNLOCKED</td>
<td>15130</td>
<td>The mutex has already been unlocked by this object</td>
</tr>
<tr>
<td>PBSE_INVALID_SYNTAX</td>
<td>15131</td>
<td>Command syntax invalid</td>
</tr>
<tr>
<td>PBSE_NODE_DOWN</td>
<td>15132</td>
<td>A node is down. Check the MOM and host</td>
</tr>
<tr>
<td>PBSE_SERVER_NOT_FOUND</td>
<td>15133</td>
<td>Could not connect to batch server</td>
</tr>
<tr>
<td>PBSE_SERVER_BUSY</td>
<td>15134</td>
<td>Server busy. Currently no available threads</td>
</tr>
</tbody>
</table>
Considerations Before Upgrading

TORQUE is flexible in regards to how it can be upgraded. In most cases, a TORQUE "shutdown" followed by a configure, make, make install procedure as documented in this guide is all that is required (see Installing TORQUE on page 10). This process will preserve existing configuration and in most cases, existing workload.

A few considerations are included below:

- If upgrading from OpenPBS, PBSPro, or TORQUE 1.0.3 or earlier, queued jobs whether active or idle will be lost. In such situations, job queues should be completely drained of all jobs.

- If not using the pbs_mom -r or -p flag (see Command-line Arguments on page 303), running jobs may be lost. In such cases, running jobs should be allowed to be completed or should be requeued before upgrading TORQUE.

- pbs_mom and pbs_server daemons of differing versions may be run together. However, not all combinations have been tested and unexpected failures may occur.

- When upgrading from early versions of TORQUE (pre-4.0) and Moab, you may encounter a problem where Moab core files are regularly created in /opt/moab. This can be caused by old TORQUE library files used by Moab that try to authorize with the old TORQUE pbs_iff authorization daemon. You can resolve the problem by removing the old version library files from /usr/local/lib.

To upgrade

1. Build new release (do not install).
2. Stop all TORQUE daemons (see qterm and momctl -s).
3. Install new TORQUE (use make install).
4. Start all TORQUE daemons.

Rolling Upgrade

If you are upgrading to a new point release of your current version (for example, from 4.2.2 to 4.2.3) and not to a new major release from your current version (for example, from 4.1 to 4.2), you can use the following procedure to upgrade TORQUE without taking your nodes offline.
Because TORQUE version 4.1.4 changed the way that pbs_server communicates with the MOMs, it is not recommended that you perform a rolling upgrade of TORQUE from version 4.1.3 to 4.1.4.

To perform a rolling upgrade in TORQUE

1. Enable the pbs_mom on page 183 flag on the MOMs you want to upgrade. The enablemomrestart option causes a MOM to check if its binary has been updated and restart itself at a safe point when no jobs are running. You can enable this in the MOM configuration file, but it is recommended that you use momctl instead.

   ```bash
   > momctl -q enablemomrestart=1 -h :ALL
   The enablemomrestart flag is enabled on all nodes.
   ```

2. Replace the pbs_mom binary, located in /usr/local/bin by default. pbs_mom will continue to run uninterrupted because the pbs_mom binary has already been loaded in RAM.

   ```bash
   > torque-package-mom-linux-x86_64.sh --install
   ```

   The next time pbs_mom is in an idle state, it will check for changes in the binary. If pbs_mom detects that the binary on disk has changed, it will restart automatically, causing the new pbs_mom version to load.

   After the pbs_mom restarts on each node, the enablemomrestart parameter will be set back to false (0) for that node.

If you have cluster with high utilization, you may find that the nodes never enter an idle state so pbs_mom never restarts. When this occurs, you must manually take the nodes offline and wait for the running jobs to complete before restarting pbs_mom. To set the node to an offline state, which will allow running jobs to complete but will not allow any new jobs to be scheduled on that node, use pbsnodes -o <nodeName>. After the new MOM has started, you must make the node active again by running pbsnodes -c <nodeName>. 

Considerations Before Upgrading
Large Cluster Considerations

TORQUE has enhanced much of the communication found in the original OpenPBS project. This has resulted in a number of key advantages including support for:

- larger clusters.
- more jobs.
- larger jobs.
- larger messages.

In most cases, enhancements made apply to all systems and no tuning is required. However, some changes have been made configurable to allow site specific modification. The configurable communication parameters are: node_check_rate, node_ping_rate, and tcp_timeout.

For details, see these topics:

- Scalability Guidelines on page 315
- End-User Command Caching on page 316
- Moab and TORQUE Configuration for Large Clusters on page 318
- Starting TORQUE in Large Environments on page 319
- Other Considerations on page 320

Scalability Guidelines

In very large clusters (in excess of 1,000 nodes), it may be advisable to tune a number of communication layer timeouts. By default, PBS MOM daemons timeout on inter-MOM messages after 60 seconds. In TORQUE 1.1.0p5 and higher, this can be adjusted by setting the timeout parameter in the mom_priv/config file (see, Node Manager (MOM) Configuration on page 283). If 15059 errors (cannot receive message from sisters) are seen in the MOM logs, it may be necessary to increase this value.

Client-to-server communication timeouts are specified via the tcp_timeout server option using the qmgr command.
On some systems, *ulimit* values may prevent large jobs from running. In particular, the open file descriptor limit (i.e., `ulimit -n`) should be set to at least the maximum job size in procs + 20. Further, there may be value in setting the `fs.file-max` in `sysctl.conf` to a high value, such as:

```
/etc/sysctl.conf:
fs.file-max = 65536
```

**Related Topics**

[Large Cluster Considerations on page 315](#)

**End-User Command Caching**

**qstat**

In a large system, users may tend to place excessive load on the system by manual or automated use of resource manager end user client commands. A simple way of reducing this load is through the use of client command wrappers which cache data. The example script below will cache the output of the command 'qstat -f' for 60 seconds and report this info to end users.
#!/bin/sh

# USAGE: qstat @

CMDPATH=/usr/local/bin/qstat
CACHETIME=60
TMPFILE=/tmp/qstat.f.tmp

if [ "$1" != "-f" ]; then
    echo "direct check (arg1=$1)"
    CMDPATH $1 $2 $3 $4
    exit $?
fi

if [ -n "$2" ]; then
    echo "direct check (arg2=$2)"
    CMDPATH $1 $2 $3 $4
    exit $?
fi

if [ -f $TMPFILE ]; then
    TMPFILEMTIME=`stat -c %Z $TMPFILE`
else
    TMPFILEMTIME=0
fi

NOW=`date +%s`
AGE=$((NOW - $TMPFILEMTIME))

#echo AGE=$AGE

for i in 1 2 3;do
    if [ "$AGE" -gt $CACHETIME ]; then
        echo "cache is stale"
        if [ -f $TMPFILE.1 ]; then
            echo someone else is updating cache
            sleep 5
            NOW=`date +%s`
            TMPFILEMTIME=`stat -c %Z $TMPFILE`
        else
            break;
        fi
    fi
done

if [ -f $TMPFILE.1 ]; then
    echo someone else is hung
    rm $TMPFILE.1
fi

if [ "$AGE" -gt $CACHETIME ]; then
    echo updating cache
    $CMDPATH -f > $TMPFILE.1
    mv $TMPFILE.1 $TMPFILE
fi

#echo "using cache"
The above script can easily be modified to cache any command and any combination of arguments by changing one or more of the following attributes:

- script name
- value of $CMDPATH
- value of $CACHETIME
- value of $TMPFILE

For example, to cache the command pbsnodes -a, make the following changes:

- Move original pbsnodes command to pbsnodes.orig.
- Save the script as 'pbsnodes'.
- Change $CMDPATH to pbsnodes.orig.
- Change $TMPFILE to /tmp/pbsnodes.a.tmp.

Related Topics

Large Cluster Considerations on page 315

Moab and TORQUE Configuration for Large Clusters

There are a few basic configurations for Moab and TORQUE that can potentially improve performance on large clusters.

Moab configuration

In the moab.cfg file, add:

1. RMPOLLINTERVAL 30,30 - This sets the minimum and maximum poll interval to 30 seconds.
2. RMCFG[<name>] FLAGS=ASYNCSTART - This tells Moab not to block until it receives a confirmation that the job starts.
3. RMCFG[<name>] FLAGS=ASYNCDELETE - This tells Moab not to block until it receives a confirmation that the job was deleted.

TORQUE configuration

1. Follow the Starting TORQUE in large environments recommendations.
2. Increase job_start_timeout on pbs_server. The default is 300 (5 minutes), but for large clusters the value should be changed to something like 600 (10
minutes). Sites running very large parallel jobs might want to set this value even higher.

3. Use a node health check script on all MOM nodes. This helps prevent jobs from being scheduled on bad nodes and is especially helpful for large parallel jobs.

4. Make sure that `ulimit -n` (maximum file descriptors) is set to `unlimited`, or a very large number, and not the default.

5. For clusters with a high job throughput it is recommended that the server parameter `max_threads` be increased from the default. The default is `(2 * number of cores + 1) * 10`.

Related Topics

[Large Cluster Considerations on page 315](#)

## Starting TORQUE in Large Environments

If running TORQUE in a large environment, use these tips to help TORQUE start up faster.

### Fastest possible start up

1. Create a `MOM hierarchy`, even if your environment has a one-level MOM hierarchy (meaning all MOMs report directly to `pbs_server`), and copy the file to the `mom_priv` directory on the MOMs.

2. Start `pbs_server` with the `-n option`. This specifies that `pbs_server` won't send the hierarchy to the MOMs unless a MOM requests it.

3. Start the MOMs normally.

### If no daemons are running

1. Start `pbs_server` with the `-c option`.

2. Start the MOMs without the `-w option`.

### If MOMs are running and just restarting `pbs_server`

1. Start `pbs_server` without the `-c option`.

### If restarting a MOM or all MOMs

1. Start `pbs_server` without the `-w option`. Starting it with `-w` causes the MOMs to appear to be down.

Related Topics

[Large Cluster Considerations on page 315](#)
Other Considerations

**job_stat_rate**

In a large system, there may be many users, many jobs, and many requests for information. To speed up response time for users and for programs using the API the job_stat_rate can be used to tweak when the pbs_server daemon will query MOMs for job information. By increasing this number, a system will not be constantly querying job information and causing other commands to block.

**poll_jobs**

The poll_jobs parameter allows a site to configure how the pbs_server daemon will poll for job information. When set to TRUE, the pbs_server will poll job information in the background and not block on user requests. When set to FALSE, the pbs_server may block on user requests when it has stale job information data. Large clusters should set this parameter to TRUE.

**Internal Settings**

On large, slow, and/or heavily loaded systems, it may be desirable to increase the pbs_tcp_timeout setting used by the pbs_mom daemon in MOM-to-MOM communication. This setting defaults to 20 seconds and requires rebuilding code to adjust. For client-server based communication, this attribute can be set using the qmgr command. For MOM-to-MOM communication, a source code modification is required. To make this change, edit the $TORQUEBUILD/src/lib/Libifl/tcp_dis.c file and set pbs_tcp_timeout to the desired maximum number of seconds allowed for a MOM-to-MOM request to be serviced.

A system may be heavily loaded if it reports multiple 'End of File from addr' or 'Premature end of message' failures in the pbs_mom or pbs_server logs.

**Scheduler Settings**

If using Moab, there are a number of parameters which can be set on the scheduler which may improve TORQUE performance. In an environment containing a large number of short-running jobs, the JOBAGGREGATIONTIME parameter (in the Moab Workload Manager Administrator Guide) can be set to reduce the number of workload and resource queries performed by the scheduler when an event based interface is enabled. If the pbs_server daemon is heavily loaded and PBS API timeout errors (i.e. "Premature end of message") are reported within the scheduler, the "TIMEOUT" attribute of the RMCFG parameter may be set with a value of between 30 and 90 seconds.
File System

TORQUE can be configured to disable file system blocking until data is physically written to the disk by using the \texttt{--disable-filesync} argument with \texttt{configure}. While having filesync enabled is more reliable, it may lead to server delays for sites with either a larger number of nodes, or a large number of jobs. Filesync is enabled by default.

Network ARP Cache

For networks with more than 512 nodes it is mandatory to increase the kernel's internal ARP cache size. For a network of ~1000 nodes, we use these values in \texttt{/etc/sysctl.conf} on all nodes and servers:

```
/etc/sysctl.conf
# Don't allow the arp table to become bigger than this
net.ipv4.neigh.default.gc_thresh3 = 4096
# Tell the gc when to become aggressive with arp table cleaning.
net.ipv4.neigh.default.gc_thresh2 = 2048
# Adjust this based on size of the LAN.
net.ipv4.neigh.default.gc_thresh1 = 1024
# Adjust where the gc will leave arp table alone
net.ipv4.neigh.default.gc_interval = 3600
# ARP cache entry timeout
net.ipv4.neigh.default.gc_stale_time = 3600
```

Use \texttt{sysctl -p} to reload this file.

The ARP cache size on other Unixes can presumably be modified in a similar way.

An alternative approach is to have a static \texttt{/etc/ethers} file with all hostnames and MAC addresses and load this by \texttt{arp -f /etc/ethers}. However, maintaining this approach is quite cumbersome when nodes get new MAC addresses (due to repairs, for example).

Related Topics

Large Cluster Considerations on page 315
TORQUE provides administrators the ability to run scripts before and/or after each job executes. With such a script, a site can prepare systems, perform node health checks, prepend and append text to output and error log files, cleanup systems, and so forth.

The following table shows which MOM runs which script. All scripts must be in the TORQUE_HOME/mom_priv/ directory and be available on every compute node. The "Mother Superior" is the pbs_mom on the first node allocated for a job. While it is technically a sister node, it is not a "Sister" for the purposes of the following table.

<table>
<thead>
<tr>
<th>Script</th>
<th>Execution location</th>
<th>Execute as</th>
<th>File permissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>prologue</td>
<td>Mother Superior</td>
<td>root</td>
<td>Readable and executable by root and NOT writable by anyone but root (e.g., -r-x----)</td>
</tr>
<tr>
<td>epilogue</td>
<td>root</td>
<td>root</td>
<td></td>
</tr>
<tr>
<td>prologue.user</td>
<td>user</td>
<td>user</td>
<td>Readable and executable by root and other (e.g., -r-x-- -r-x)</td>
</tr>
<tr>
<td>epilogue.user</td>
<td>user</td>
<td>user</td>
<td></td>
</tr>
<tr>
<td>prologue.parallel</td>
<td>Sister</td>
<td>root</td>
<td>Readable and executable by root and NOT writable by anyone but root (e.g., -r-x----)</td>
</tr>
<tr>
<td>epilogue.parallel</td>
<td>root</td>
<td>root</td>
<td></td>
</tr>
<tr>
<td>prologue.user.parallel</td>
<td></td>
<td>user</td>
<td>Readable and executable by root and other (e.g., -r-x-- -r-x)</td>
</tr>
<tr>
<td>epilogue.user.parallel</td>
<td></td>
<td>user</td>
<td></td>
</tr>
<tr>
<td>epilogue.precancel</td>
<td>Mother Superior</td>
<td>user</td>
<td>Readable and executable by root and other (e.g., -r-x-- -r-x)</td>
</tr>
</tbody>
</table>

epilogue.parallel is available in version 2.1 and later.
This section contains these topics:

- [Script Order of Execution on page 324](#)
- [Script Environment on page 324](#)
- [Per Job Prologue and Epilogue Scripts on page 326](#)
- [Prologue and Epilogue Scripts Time Out on page 327](#)
- [Prologue Error Processing on page 327](#)

### Script Order of Execution

When jobs start, the order of script execution is **prologue** followed by **prologue.user**. On job exit, the order of execution is **epilogue.user** followed by **epilogue** unless a job is canceled. In that case, **epilogue.precancel** is executed first. **epilogue.parallel** is executed only on the Sister nodes when the job is completed.

- **The epilogue and prologue scripts are controlled by the system administrator.** However, beginning in TORQUE version 2.4 a user **epilogue** and **prologue** script can be used on a per job basis. (See [Per Job Prologue and Epilogue Scripts on page 326](#) for more information.)

- **The node health check may be configured to run before or after the job with the "jobstart" and/or "jobend" options.** However, the job environment variables do not get passed to node health check script, so it has no access to those variables at any time.

- **Root squashing is now supported for epilogue and prologue scripts.**

#### Related Topics

- [Prologue and Epilogue Scripts on page 323](#)

### Script Environment

The **prologue** and **epilogue** scripts can be very simple. On most systems, the script must declare the execution shell using the `#!/<SHELL>` syntax (for example, `#!/bin/sh`). In addition, the script may want to process context sensitive arguments passed by TORQUE to the script.

### Prologue Environment

The following arguments are passed to the **prologue**, **prologue.user**, and **prologue.parallel** scripts:
<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>argv[1]</td>
<td>job id</td>
</tr>
<tr>
<td>argv[2]</td>
<td>job execution user name</td>
</tr>
<tr>
<td>argv[3]</td>
<td>job execution group name</td>
</tr>
<tr>
<td>argv[4]</td>
<td>job name (TORQUE 1.2.0p4 and higher only)</td>
</tr>
<tr>
<td>argv[5]</td>
<td>list of requested resource limits (TORQUE 1.2.0p4 and higher only)</td>
</tr>
<tr>
<td>argv[6]</td>
<td>job execution queue (TORQUE 1.2.0p4 and higher only)</td>
</tr>
<tr>
<td>argv[7]</td>
<td>job account (TORQUE 1.2.0p4 and higher only)</td>
</tr>
</tbody>
</table>

### Epilogue Environment

TORQUE supplies the following arguments to the `epilogue`, `epilogue.user`, `epilogue.precancel`, and `epilogue.parallel` scripts:

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>argv[1]</td>
<td>job id</td>
</tr>
<tr>
<td>argv[2]</td>
<td>job execution user name</td>
</tr>
<tr>
<td>argv[3]</td>
<td>job execution group name</td>
</tr>
<tr>
<td>argv[4]</td>
<td>job name</td>
</tr>
<tr>
<td>argv[5]</td>
<td>session id</td>
</tr>
<tr>
<td>argv[6]</td>
<td>list of requested resource limits</td>
</tr>
<tr>
<td>argv[7]</td>
<td>list of resources used by job</td>
</tr>
<tr>
<td>argv[8]</td>
<td>job execution queue</td>
</tr>
<tr>
<td>argv[9]</td>
<td>job account</td>
</tr>
<tr>
<td>Argument</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>argv[10]</td>
<td>job exit code</td>
</tr>
</tbody>
</table>

The `epilogue.precancel` script is run after a job cancel request is received by the MOM and before any signals are sent to job processes. If this script exists, it is run whether the canceled job was active or idle.

The cancel job command (qdel) will take as long to return as the `epilogue.precancel` script takes to run. For example, if the script runs for 5 minutes, it takes 5 minutes for qdel to return.

For all scripts, the environment passed to the script is empty. However, if you submit the job using `msub` rather than `qsub`, some Moab environment variables are available in the TORQUE prologue and epilogue script environment: `MOAB_CLASS`, `MOAB_GROUP`, `MOAB_JOBARRAYINDEX`, `MOAB_JOBARRAYRANGE`, `MOABJOBID`, `MOAB_JOBNAME`, `MOAB_MACHINE`, `MOAB_NODECOUNT`, `MOAB_NODELIST`, `MOAB_PARTITION`, `MOAB_PROCCOUNT`, `MOAB_QOS`, `MOAB_TASKMAP`, and `MOAB_USER`. See the msub command in the *Moab Workload Manager Administrator Guide* for more information.

Also, standard input for both scripts is connected to a system dependent file. Currently, for all systems this is `/dev/null`. Except for `epilogue.precancel` scripts of an interactive job, prologue.parallel, `epilogue.parallel`, and `epilogue.precancel`, the standard output and error are connected to output and error files associated with the job. For an interactive job, since the pseudo terminal connection is released after the job completes, the standard input and error point to `/dev/null`. For prologue.parallel and `epilogue.parallel`, the user will need to redirect `stdout` and `stderr` manually.

Related Topics

Prologue and Epilogue Scripts on page 323

Per Job Prologue and Epilogue Scripts

TORQUE supports per job prologue and epilogue scripts when using the `qsub -l` option. The syntax is:

```
qsub -l prologue=<prologue_script_path> epilogue=<epilogue_script_path> <script>.
```

The path can be either relative (from the directory where the job is submitted) or absolute. The files must be owned by the user with at least execute and read privileges, and the permissions must not be writeable by group or other.

```
/home/usertom/dev/
```
Example G-1:

```bash
$ qsub -l prologue=/home/usertom/dev/prologue_script.sh,epilogue=/home/usertom/dev/epilogue_script.sh job14.pl
```

This job submission executes the prologue script first. When the prologue script is complete, job14.pl runs. When job14.pl completes, the epilogue script is executed.

Related Topics

Prologue and Epilogue Scripts on page 323

Prologue and Epilogue Scripts Time Out

TORQUE takes preventative measures against prologue and epilogue scripts by placing an alarm around the scripts execution. By default, TORQUE sets the alarm to go off after 5 minutes of execution. If the script exceeds this time, it will be terminated and the node will be marked down. This timeout can be adjusted by setting the $prologalarm parameter in the mom_priv/config file.

While TORQUE is executing the epilogue, epilogue.user, or epilogue.precancel scripts, the job will be in the E (exiting) state.

If an epilogue.parallel script cannot open the .OU or .ER files, an error is logged but the script is continued.

Related Topics

Prologue and Epilogue Scripts on page 323

Prologue Error Processing

If the prologue script executes successfully, it should exit with a zero status. Otherwise, the script should return the appropriate error code as defined in the table below. The pbs_mom will report the script's exit status to pbs_server which will in turn take the associated action. The following table describes each exit code for the prologue scripts and the action taken.

<table>
<thead>
<tr>
<th>Error</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>The script timed out</td>
<td>Job will be requeued</td>
</tr>
<tr>
<td>Error</td>
<td>Description</td>
<td>Action</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>-3</td>
<td>The wait(2) call returned an error</td>
<td>Job will be requeued</td>
</tr>
<tr>
<td>-2</td>
<td>Input file could not be opened</td>
<td>Job will be requeued</td>
</tr>
<tr>
<td>-1</td>
<td>Permission error (script is not owned by root, or is writable by others)</td>
<td>Job will be requeued</td>
</tr>
<tr>
<td>0</td>
<td>Successful completion</td>
<td>Job will run</td>
</tr>
<tr>
<td>1</td>
<td>Abort exit code</td>
<td>Job will be aborted</td>
</tr>
<tr>
<td>&gt;1</td>
<td>other</td>
<td>Job will be requeued</td>
</tr>
</tbody>
</table>

Example G.2:

Following are example prologue and epilogue scripts that write the arguments passed to them in the job’s standard out file:

```
prologue

Script
#!/bin/sh
echo "Prologue Args:"
echo "Job ID: $1"
echo "User ID: $2"
echo "Group ID: $3"
echo ""
exit 0

stdout
Prologue Args:
Job ID: 13724.node01
User ID: user1
Group ID: user1
```
The Ohio Supercomputer Center contributed the following scripts:

"prologue creates a unique temporary directory on each node assigned to a job before the job begins to run, and epilogue deletes that directory after the job completes.

Having a separate temporary directory on each node is probably not as good as having a good, high performance parallel filesystem.
#!/bin/sh
#
Create TMPDIR on all the nodes
#
Copyright 1999, 2000, 2001 Ohio Supercomputer Center
#
prologue gets 3 arguments:
# 1 -- jobid
# 2 -- userid
# 3 -- grpid
#
jobid=$1
user=$2
group=$3
nodefile=/var/spool/pbs/aux/$jobid
if [ ! -r $nodefile ]; then
  nodes=$(sort $nodefile | uniq)
else
  nodes=localhost
fi
tmp=/tmp/pbstmp.$jobid
for i in $nodes; do
  ssh $i mkdir -m 700 $tmp && chown $user.$group $tmp
done
exit 0

epilogue
#!/bin/sh
#
Clear out TMPDIR
#
Copyright 1999, 2000, 2001 Ohio Supercomputer Center
#
epilogue gets 9 arguments:
# 1 -- jobid
# 2 -- userid
# 3 -- grpid
# 4 -- job name
# 5 -- sessionid
# 6 -- resource limits
# 7 -- resources used
# 8 -- queue
# 9 -- account
#
jobid=$1
nodefile=/var/spool/pbs/aux/$jobid
if [ ! -r $nodefile ]; then
  nodes=$(sort $nodefile | uniq)
else
  nodes=localhost
fi
tmp=/tmp/pbstmp.$jobid
for i in $nodes; do
  ssh $i rm -rf $tmp
done
exit 0

---

**Related Topics**

Prologue and Epilogue Scripts on page 323
Running Multiple TORQUE Servers and MOMs on the Same Node

TORQUE can be configured to allow multiple servers and MOMs to run on the same node. This example will show how to configure, compile and install two different TORQUE servers and MOMs on the same node. For details, see these topics:

- Configuring the First TORQUE on page 331
- Configuring the Second TORQUE on page 331
- Bringing the First TORQUE Server online on page 331
- Bringing the Second TORQUE Server Online on page 332

Configuring the First TORQUE

```
./configure --with-server-home=/usr/spool/PBS1 --bindir=/usr/spool/PBS1/bin --
  sbindir=/usr/spool/PBS1/sbin
```

Then make and make install will place the first TORQUE into /usr/spool/PBS1 with the executables in their corresponding directories.

Configuring the Second TORQUE

```
./configure --with-server-home=/usr/spool/PBS2 --bindir=/usr/spool/PBS2/bin --
  sbindir=/usr/spool/PBS2/sbin
```

Then make and make install will place the second TORQUE into /usr/spool/PBS2 with the executables in their corresponding directories.

Bringing the First TORQUE Server online

Each command, including pbs_server and pbs_mom, takes parameters indicating which servers and ports to connect to or listen on (when appropriate). Each of these is documented in their corresponding man pages (configure with --enable-docs).

In this example the first TORQUE server will accept batch requests on port 35000, communicate with the MOMs on port 35001, and communicate via RPP on port 35002. The first TORQUE MOM will try to connect to the server on port 35000, it will listen for requests from the server on port 35001 and will communicate via RPP on port 35002. (Each of these command arguments is discussed in further details on the corresponding man page. In particular, -t create is only used the first time a server is run.)
Afterwards, when using a client command to make a batch request it is necessary to specify the server name and server port (35000):

```bash
> pbsnodes -a -s node01:35000
```

Submitting jobs can be accomplished using the `-q` option (`[queue]@[host [:port]]`):

```bash
> qsub -q @node01:35000 /tmp/script.pbs
```

**Bringing the Second TORQUE Server Online**

In this example the second TORQUE server will accept batch requests on port 36000, communicate with the MOMS on port 36002, and communicate via RPP on port 36002. The second TORQUE MOM will try to connect to the server on port 36000, it will listen for requests from the server on port 36001 and will communicate via RPP on port 36002.

```bash
> pbs_server -p 36000 -M 36001 -R 36002 -t create
> pbs_mom -S 36000 -M 36001 -R 36002
```

Afterward, when using a client command to make a batch request it is necessary to specify the server name and server port (36002):

```bash
> pbsnodes -a -s node01:36000
> qsub -q @node01:36000 /tmp/script.pbs
```
Security Overview

The authorization model for TORQUE changed in version 4.0.0 from `pbs_iff` to a daemon called `trqauthd`. The job of the `trqauthd` daemon is the same as `pbs_iff`. The difference is that `trqauthd` is a resident daemon whereas `pbs_iff` is invoked by each client command. `pbs_iff` is not scalable and is prone to failure under even small loads. `trqauthd` is very scalable and creates the possibility for better security measures in the future.

**trqauthd and pbs_iff Authorization Theory**

The key to security of both `trqauthd` and `pbs_iff` is the assumption that any host which has been added to the TORQUE cluster has been secured by the administrator. Neither `trqauthd` nor `pbs_iff` do authentication. They only do authorization of users. Given that the host system is secure the following is the procedure by which `trqauthd` and `pbs_iff` authorize users to `pbs_server`.

1. Client utility makes a connection to `pbs_server` on a dynamic port.
2. Client utility sends a request to `trqauthd` with the user name and port.
3. `trqauthd` verifies the user ID and then sends a request to `pbs_server` on a privileged port with the user ID and dynamic port to authorize the connection.
4. `trqauthd` reports results of the server to client utility.

Both `trqauthd` and `pbs_iff` use Unix domain sockets for communication from the client utility. Unix domain sockets have the ability to verify that a user is who they say they are by using security features that are part of the file system.
When a "submit filter" exists, TORQUE will send the command file (or contents of STDIN if piped to qsub) to that script/executable and allow it to evaluate the submitted request based on specific site policies. The resulting file is then handed back to qsub and processing continues. Submit filters can check user jobs for correctness based on site policies. They can also modify user jobs as they are submitted. Some examples of what a submit filter might evaluate and check for are:

- **Memory Request** - Verify that the job requests memory and rejects if it does not.
- **Job event notifications** - Check if the job does one of the following and rejects it if it:
  - explicitly requests no notification.
  - requests notifications but does not provide an email address.
- **Walltime specified** - Verify that the walltime is specified.
- **Global Walltime Limit** - Verify that the walltime is below the global max walltime.
- **Test Walltime Limit** - If the job is a test job, this check rejects the job if it requests a walltime longer than the testing maximum.

The script below reads the original submission request from STDIN and shows how you could insert parameters into a job submit request:

```bash
#!/bin/sh
# add default memory constraints to all requests
# that did not specify it in user's script or on command line
echo "#PBS -l mem=16MB"
while read i
do
echo $i
done
```

The same command line arguments passed to qsub will be passed to the submit filter and in the same order. Exit status of -1 will cause qsub to reject the submission with a message stating that it failed due to administrative policies.

The "submit filter" must be executable, must be available on each of the nodes where users may submit jobs, and by default must be located at ${libexecdir}/qsub_filter (for version 2.1 and older: /usr/local/sbin/torque_submitfilter). At run time, if the file does not exist at this new preferred path then qsub will fall back to the old hard-coded path. The submit filter location can be customized by setting the SUBMITFILTER parameter inside the file (see "torque.cfg" Configuration File on page 337), as in the following example:
torque.cfg:

```bash
SUBMITFILTER /opt/torque/submit.pl
...
```

ℹ️ Initial development courtesy of Oak Ridge National Laboratories.
### CLIENTRETRY

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0</td>
</tr>
<tr>
<td>Description</td>
<td>Seconds between retry attempts to talk to pbs_server.</td>
</tr>
</tbody>
</table>

**Example**

```plaintext
CLIENTRETRY 10
TORQUE waits 10 seconds after a failed attempt before it attempts to talk to pbs_server again.
```

### DEFAULTCKPT

<table>
<thead>
<tr>
<th>Format</th>
<th>One of None, Enabled, Shutdown, Periodic, Interval=minutes, depth=number, or dir=path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>None</td>
</tr>
<tr>
<td>Description</td>
<td>Default value for job’s checkpoint attribute. For a description of all possible values, see qsub on page 237</td>
</tr>
</tbody>
</table>

This default setting can be overridden at job submission with the qsub -c option.

**Example**

```plaintext
DEFAULTCKPT Shutdown
By default, TORQUE checkpoints at pbs_mom shutdown.
```

### FAULT_TOLERANT_BY_DEFAULT

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>Sets all jobs to fault tolerant by default. (See qsub -f for more information on fault tolerance.)</td>
</tr>
</tbody>
</table>
### FAULT_TOLERANT_BY_DEFAULT

**Example**

```
FAULT_TOLERANT_BY_DEFAULT TRUE
```

Jobs are fault tolerant by default. They will not be canceled based on failed polling, no matter how many nodes fail to report.

### HOST_NAME_SUFFIX

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies a hostname suffix. When <code>qsub</code> submits a job, it also submits the username of the submitter and the name of the host from which the user submitted the job. TORQUE appends the value of HOST_NAME_SUFFIX to the hostname. This is useful for multi-homed systems that may have more than one name for a host.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td></td>
</tr>
</tbody>
</table>

```
HOST_NAME_SUFFIX -ib
```

When a job is submitted, the `-ib` suffix is appended to the host name.

### QSUBHOST

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;HOSTNAME&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>---</td>
</tr>
<tr>
<td>Description</td>
<td>The hostname given as the argument of this option will be used as the PBS_O_HOST variable for job submissions. By default, PBS_O_HOST is the hostname of the submission host. This option allows administrators to override the default hostname and substitute a new name.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td></td>
</tr>
</tbody>
</table>

```
QSUBHOST host1
```

The default hostname associated with a job is `host1`.

### QSUBSENDUID

<table>
<thead>
<tr>
<th>Format</th>
<th>N/A</th>
</tr>
</thead>
</table>
### QSUBSENDUID

<table>
<thead>
<tr>
<th>Default</th>
<th>---</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Integer for job’s PBS_OUID variable. Specifying the parameter name anywhere in the config file enables the feature. Removing the parameter name disables the feature.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```plaintext
QSUBSENDUID
TORQUE assigns a unique ID to a job when it is submitted by qsub.
```

### QSUBSLEEP

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;INT&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies time, in seconds, to sleep between a user’s submitting and TORQUE’s starting a qsub command. Used to prevent users from overwhelming the scheduler.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```plaintext
QSUBSLEEP 2
When a job is submitted with qsub, it will sleep for 2 seconds.
```

### RERUNNABLEBYDEFAULT

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>TRUE</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies if a job is re-runnable by default. Setting this to false causes the re-runnable attribute value to be false unless the users specifies otherwise with the qsub -r option. (New in TORQUE 2.4.)</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```plaintext
RERUNNABLEBYDEFAULT FALSE
By default, qsub jobs cannot be rerun.
```
### SERVERHOST

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>localhost</td>
</tr>
<tr>
<td>Description</td>
<td>If set, the <code>qsub</code> command will open a connection to the host specified by the SERVERHOST string.</td>
</tr>
</tbody>
</table>
| Example  | SERVERHOST orion15  

The server will open socket connections and communicate using serverhost orion15.

### SUBMITFILTER

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>${libexecdir}/qsub_filter (for version 2.1 and older: /usr/local/sbin/torque_submitfilter)</td>
</tr>
<tr>
<td>Description</td>
<td>Specifies the location of the submit filter (see Job Submission Filter (&quot;qsub Wrapper&quot;) on page 335 used to pre-process job submission.</td>
</tr>
</tbody>
</table>
| Example  | SUBMITFILTER /usr/local/sbin/qsub_filter  

The location of the submit filter is specified as /usr/local/sbin/qsub_filter.

### TRQ_IFNAME

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;STRING&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>null</td>
</tr>
<tr>
<td>Description</td>
<td>Allows you to specify a specific network interface to use for outbound TORQUE requests. The string is the name of a network interface, such as <code>eth0</code> or <code>eth1</code>, depending on which interface you want to use.</td>
</tr>
</tbody>
</table>
| Example  | TRQ_IFNAME eth1  

Outbound TORQUE requests are handled by eth1.
### VALIDATEGROUP

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>FALSE</td>
</tr>
<tr>
<td>Description</td>
<td>Validate submit user’s group on qsub commands. For TORQUE builds released after 2/8/2011, VALIDATEGROUP also checks any groups requested in group_list at the submit host. Set VALIDATEGROUP to &quot;TRUE&quot; if you set disable_server_id_check to TRUE.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```plaintext
VALIDATEGROUP TRUE

qsub verifies the submitter’s group ID.
```

### VALIDATEPATH

<table>
<thead>
<tr>
<th>Format</th>
<th>&lt;BOOLEAN&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>TRUE</td>
</tr>
<tr>
<td>Description</td>
<td>Validate local existence of '−d' working directory.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```plaintext
VALIDATEPATH FALSE

qsub does not validate the path.
```
Appendix L: TORQUE Quick Start Guide

Initial Installation

TORQUE is now hosted at https://github.com under the adaptivecomputing organization. To download source, you will need to use the git utility. For example:

```
[root]# git clone https://github.com/adaptivecomputing.com/torque.git -b 5.1.1 5.1.1
```

To download a different version, replace each 5.1.1 with the desired version. After downloading a copy of the repository, you can list the current branches by typing `git branch -a` from within the directory of the branch you cloned.

ℹ️ If you're checking source out from git, read the `README.building-40` file in the repository.

Extract and build the distribution on the machine that will act as the "TORQUE server" - the machine that will monitor and control all compute nodes by running the pbs_server daemon. See the example below:

```
> tar -xzvf torque.tar.gz
> cd torque
> ./configure
> make
> make install
```

ℹ️ OSX 10.4 users need to change the `#define __TDARWIN` in `src/include/pbs_config.h` to `#define __TDARWIN_8`.

ℹ️ After installation, verify you have PATH environment variables configured for `/usr/local/bin/` and `/usr/local/sbin/`. Client commands are installed to `/usr/local/bin` and server binaries are installed to `/usr/local/sbin`.

ℹ️ In this document, TORQUE_HOME corresponds to where TORQUE stores its configuration files. The default is `/var/spool/torque`.

Initialize/Configure TORQUE on the Server (pbs_server)

- Once installation on the TORQUE server is complete, configure the pbs_server daemon by executing the command `torque.setup <USER>` found packaged with the distribution source code, where `<USER>` is a username...
that will act as the TORQUE admin. This script will set up a basic batch queue to get you started. If you experience problems, make sure that the most recent TORQUE executables are being executed, or that the executables are in your current PATH.

**If you are upgrading from TORQUE 2.5.9, run pbs_server -u before running torque.setup.**

```
[root]# pbs_server -u
```

- If doing this step manually, be certain to run the command `pbs_server -t create` to create the new batch database. If this step is not taken, the pbs_server daemon will be unable to start.
- Proper server configuration can be verified by following the steps listed in Testing server configuration.

### Install TORQUE on the Compute Nodes

To configure a compute node do the following on each machine (see page 19, Section 3.2.1 of *PBS Administrator's Manual* for full details):

- Create the self-extracting, distributable packages with `make packages` (See the INSTALL file for additional options and features of the distributable packages) and use the parallel shell command from your cluster management suite to copy and execute the package on all nodes (i.e. xCAT users might do `prcp torque-package-linux-i686.sh main:/tmp/; psh main /tmp/torque-package-linux-i686.sh --install`). Optionally, distribute and install the clients package.

### Configure TORQUE on the Compute Nodes

- For each compute host, the MOM daemon must be configured to trust the pbs_server daemon. In TORQUE 2.0.0p4 and earlier, this is done by creating the `TORQUE_HOME/mom priv/config` file and setting the `$pbsserver` parameter. In TORQUE 2.0.0p5 and later, this can also be done by creating the `TORQUE_HOME/server_name` file and placing the server hostname inside.
- Additional config parameters may be added to `TORQUE_HOME/mom priv/config` (see [Node Manager (MOM) Configuration on page 283](#) for details).

### Configure Data Management on the Compute Nodes

Data management allows jobs' data to be staged in/out or to and from the server and compute nodes.
• For shared filesystems (i.e., NFS, DFS, AFS, etc.) use the $usecp parameter in the mom_priv/config files to specify how to map a user's home directory.
  (Example: $usecp gridmaster.tmx.com:/home /home)
• For local, non-shared filesystems, rcp or scp must be configured to allow direct copy without prompting for passwords (key authentication, etc.)

Update TORQUE Server Configuration
On the TORQUE server, append the list of newly configured compute nodes to the TORQUE_HOME/server_priv/nodes file:

server_priv/nodes
computenode001.cluster.org
computenode002.cluster.org
computenode003.cluster.org

Start the pbs_mom Daemons on Compute Nodes
• Next start the pbs_mom daemon on each compute node by running the pbs_mom executable.

Run the trqauthd daemon to run client commands (see Configuring trqauthd for Client Commands on page 25). This enables running client commands.

Verify Correct TORQUE Installation
The pbs_server daemon was started on the TORQUE server when the torque.setup file was executed or when it was manually configured. It must now be restarted so it can reload the updated configuration changes.

```bash
# shutdown server
> qterm # shutdown server
# start server
> pbs_server
# verify all queues are properly configured
> qstat -q
# view additional server configuration
> qmgr -c 'p s'
# verify all nodes are correctly reporting
> pbsnodes -a
# submit a basic job
>echo "sleep 30" | qsub
# verify jobs display
> qstat
```

At this point, the job will not start because there is no scheduler running. The scheduler is enabled in the next step below.
Enable the Scheduler

Selecting the cluster scheduler is an important decision and significantly affects cluster utilization, responsiveness, availability, and intelligence. The default TORQUE scheduler, pbs_sched, is very basic and will provide poor utilization of your cluster's resources. Other options, such as Maui Scheduler or Moab Workload Manager are highly recommended. If using Maui/Moab, see Moab-TORQUE Integration Guide in the Moab Workload Manager Administrator Guide. If using pbs_sched, start this daemon now.

If you are installing ClusterSuite, TORQUE and Moab were configured at installation for interoperability and no further action is required.

Startup/Shutdown Service Script for TORQUE/Moab (OPTIONAL)

Optional startup/shutdown service scripts are provided as an example of how to run TORQUE as an OS service that starts at bootup. The scripts are located in the contrib/init.d/ directory of the TORQUE tarball you downloaded. In order to use the script you must:

- Determine which init.d script suits your platform the best.
- Modify the script to point to TORQUE's install location. This should only be necessary if you used a non-default install location for TORQUE (by using the --prefix option of ./configure).
- Place the script in the /etc/init.d/ directory.
- Use a tool like chkconfig to activate the start-up scripts or make symbolic links (S99moab and K15moab, for example) in desired runtimes (/etc/rc.d/rc3.d/ on Redhat, etc.).

Related Topics

Advanced Configuration on page 26
BLCR Acceptance Tests

This section contains a description of the testing done to verify the functionality of the BLCR implementation. For details, see these topics:

- **Test Environment on page 347**
- **Test 1 - Basic Operation on page 347**
- **Test 2 - Persistence of Checkpoint Images on page 350**
- **Test 3 - Restart After Checkpoint on page 351**
- **Test 4 - Multiple Checkpoint/Restart on page 352**
- **Test 5 - Periodic Checkpoint on page 352**
- **Test 6 - Restart from Previous Image on page 353**

**Test Environment**

All these tests assume the following test program and shell script, `test.sh`.

```c
#include
int main( int argc, char *argv[] )
{
  int i;
  for (i=0; i<100; i++)
  {
    printf("i = %d\n", i);
    fflush(stdout);
    sleep(1);
  }
}
```

```
#!/bin/bash
/home/test/test
```

**Test 1 - Basic Operation**

**Introduction**

This test determines if the proper environment has been established.

**Test Steps**
Submit a test job and the issue a hold on the job.

```
> qsub -c enabled test.sh
999.xxx.yyy
> qhold 999
```

**Possible Failures**

Normally the result of `qhold` is nothing. If an error message is produced saying that `qhold` is not a supported feature then one of the following configuration errors might be present.

- The TORQUE images may have not be configured with `--enable-blc`.
- BLCR support may not be installed into the kernel with `insmod`.
- The config script in `mom_priv` may not exist with `$checkpoint_script` defined.
- The config script in `mom_priv` may not exist with `$restart_script` defined.
- The config script in `mom_priv` may not exist with `$checkpoint_run_exe` defined.
- The scripts referenced in the config file may not exist.
- The scripts referenced in the config file may not have the correct permissions.

**Successful Results**

If no configuration was done to specify a specific directory location for the checkpoint file, the default location is off of the TORQUE directory, which in my case is `/var/spool/torque/checkpoint`.

Otherwise, go to the specified directory for the checkpoint image files. This was done by either specifying an option on job submission, i.e. `-c
dir=/home/test` or by setting an attribute on the execution queue. This is done with the command `qmgr -c 'set queue batch checkpoint_dir=/home/test'`.

Doing a directory listing shows the following.
Doing a `qstat -f` command should show the job in a held state, `job_state = H`. Note that the attribute `checkpoint_name` is set to the name of the file seen above.

If a checkpoint directory has been specified, there will also be an attribute `checkpoint_dir` in the output of `qstat -f.`
The value of Resource_List.* is the amount of resources requested.

Related Topics

  BLCR Acceptance Tests on page 347

Test 2 - Persistence of Checkpoint Images

Introduction

This test determines if the checkpoint files remain in the default directory after the job is removed from the TORQUE queue.
Note that this behavior was requested by a customer but in fact may not be the right thing to do as it leaves the checkpoint files on the execution node. These will gradually build up over time on the node being limited only by disk space. The right thing would seem to be that the checkpoint files are copied to the user's home directory after the job is purged from the execution node.

Test Steps
Assuming the steps of Test 1 (see Test 1 - Basic Operation on page 347), delete the job and then wait until the job leaves the queue after the completed job hold time. Then look at the contents of the default checkpoint directory to see if the files are still there.

```
> qsub -c enabled test.sh
999.xxx.yyy
> qhold 999
> qdel 999
> sleep 100
> qstat
>
> find /var/spool/torque/checkpoint
... files ...
```

Possible Failures
The files are not there, did Test 1 actually pass?

Successful Results
The files are there.

Related Topics
BLCR Acceptance Tests on page 347

Test 3 - Restart After Checkpoint

Introduction
This test determines if the job can be restarted after a checkpoint hold.

Test Steps
Assuming the steps of Test 1 (see Test 1 - Basic Operation on page 347), issue a qrls command. Have another window open into the /var/spool/torque/spool directory and tail the job.

Successful Results
After the qrls, the job's output should resume.
Test 4 - Multiple Checkpoint/R Restart

Introduction

This test determines if the checkpoint/restart cycle can be repeated multiple times.

Test Steps

Start a job and then while tailing the job output, do multiple qhold/qrls operations.

```bash
> qsub -c enabled test.sh
999.xxx.yyy
> qhold 999
> qrls 999
> qhold 999
> qrls 999
> qhold 999
> qrls 999
```

Successful results

After each qrls, the job’s output should resume. Also tried "while true; do qrls 999; qhold 999; done" and this seemed to work as well.

Test 5 - Periodic Checkpoint

Introduction

This test determines if automatic periodic checkpoint will work.

Test Steps

Start the job with the option `-c enabled,periodic,interval=1` and look in the checkpoint directory for checkpoint images to be generated about every minute.

```bash
> qsub -c enabled,periodic,interval=1 test.sh
999.xxx.yyy
```

Successful Results
After each `qrls`, the job's output should resume. Also tried "while true; do qrls 999; qhold 999; done" and this seemed to work as well.

Related Topics

_BLCR Acceptance Tests on page 347_

Test 6 - Restart from Previous Image

Introduction

This test determines if the job can be restarted from a previous checkpoint image.

Test Steps

Start the job with the option `-c enabled,periodic,interval=1` and look in the checkpoint directory for checkpoint images to be generated about every minute. Do a `qhold` on the job to stop it. Change the attribute checkpoint_name with the `qalter` command. Then do a `qrls` to restart the job.

```
> qsub -c enabled,periodic,interval=1 test.sh 999.xxx.yyy
> qhold 999
> qalter -W checkpoint_name=ckpt.999.xxx.yyy.1234567
> qrls 999
```

Successful Results

The job output file should be truncated back and the count should resume at an earlier number.

Related Topics

_BLCR Acceptance Tests on page 347_