PBS Professional Reference Guide, Altair PBS Professional 11.2, Updated: 12/16/11

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About PBS Documentation

Where to Keep the Documentation

To make cross-references work, put all of the PBS guides in the same directory.

What is PBS Professional?

PBS is a workload management system that provides a unified batch queuing and job management interface to a set of computing resources.

The PBS Professional Documentation

The documentation for PBS Professional includes the following:

- **PBS Professional Administrator’s Guide:**
  Provides the PBS administrator with the information required to configure and manage PBS Professional (PBS).

- **PBS Professional Quick Start Guide:**
  Provides a quick overview of PBS Professional installation and license file generation.

- **PBS Professional Installation & Upgrade Guide:**
  Contains information on installing and upgrading PBS Professional.

- **PBS Professional User’s Guide:**
  Covers user commands and how to submit, monitor, track, delete, and manipulate jobs.

- **PBS Professional Programmer’s Guide:**
  Discusses the PBS application programming interface (API).
PBS Professional Reference Guide:
Contains PBS reference material.

PBS Manual Pages:
Describe PBS commands, resources, attributes, APIs

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Document Conventions
PBS documentation uses the following typographic conventions:

**abbreviation**
The shortest acceptable abbreviation of a command or subcommand is underlined.

**command**
Commands such as `qmgr` and `scp`

**input**
Command-line instructions

**manpage(x)**
File and path names. Manual page references include the section number in parentheses appended to the manual page name.

**formats**
Formats

**Attributes**
Attributes, parameters, objects, variable names, resources, types

**Values**
Keywords, instances, states, values, labels

**Definitions**
Terms being defined
Output

Output or example code
File contents
Chapter 1

Terminology

This chapter describes the terms used in PBS Professional documentation.

Accept an action (Hooks)
A hook accepts an action when the hook allows the action to take place.

Access control list, ACL
An ACL, or Access Control List, is a list of users, groups, or hosts from which users or groups may be attempting to gain access. This list defines who or what is allowed or denied access to parts of PBS such as the Server, queues, or reservations. A Server ACL applies to access to the Server, and therefore all of PBS. A queue’s ACL applies only to that particular queue. A reservation’s ACL applies only to that particular reservation. See section 9.3.4, “ACLs”, on page 549.

Access to a queue
Applies to users, groups, and hosts. Being able to submit jobs to the queue, move jobs into the queue, being able to perform operations on jobs in the queue, and being able to get the status of the queue.

Access to a reservation
Applies to users, groups, and hosts. Being able to place jobs in the reservation, whether by submitting jobs to the reservation or moving jobs into the reservation. It also means being able to delete the reservation, and being able to operate on the jobs in the reservation.

Access to the server
Applies to users, groups, and hosts. Being able to run PBS commands to submit jobs and perform operations on them such as altering, selecting, and querying status. It also means being able to get the status of the Server and queues.
Account
An account is an arbitrary character string, which may have meaning to one or more hosts in the batch system. Frequently, an account is used as a grouping for charging for the use of resources.

Action (Hooks)
A PBS operation or state transition. The actions that hooks can affect are submitting a job, altering a job, running a job, making a reservation, and moving a job to another queue.

Active (Failover)
A server daemon is active when it is managing user requests and communicating with the scheduler and MOMs.

Active Directory (Windows)
Active Directory is an implementation of LDAP directory services by Microsoft to use in Windows environments. It is a directory service used to store information about the network resources (e.g. user accounts and groups) across a domain.

Admin (Windows)
A user logged in from an account that is either:
1. A member of a group having full control over the local computer and the domain controller
2. Allowed to make domain and schema changes to the Active Directory.

Administrator, PBS Administrator
A person who administers PBS, performing functions such as downloading, installing, upgrading, configuring, or managing PBS. A PBS administrator must have an account with Manager privilege and an account with root privilege. Administrator is distinguished from “site administrator”, although often these are the same person.

The term PBS Administrator is used in PBS documentation to mean the above, rather than to indicate a user role recognized by PBS Professional.

Administrators (Windows)
A group that has built-in capabilities that give its members full control over the local system, or the domain controller host itself.

Advance reservation
A reservation for a specific set of resources for a specified start time and duration in the future. Advance reservations are created by users to reserve resources for jobs. The reservation is available only to the creator of the reservation and any users or groups specified by the creator.
**AOE, Application operating environment**
The environment on a vnode. This may be one that results from provisioning that vnode, or one that is already in place.

**API**
PBS provides an *Application Programming Interface*, or *API*, which is used by the commands to communicate with the Server. This API is described in the PBS Professional Programmer’s Guide. A site may make use of the API to implement new commands if so desired.

**Application Checkpoint**
The application performs its own checkpointing when it receives the appropriate signal etc.

**Array job**
See "Job array".

**Attribute**
An *attribute* is a data item belonging to an object. The attribute’s value affects the behavior of or provides information about the object. A job’s owner can set the attributes of a job, and the administrator can set attributes of queues and vnodes.

**Backfilling**
A scheduling policy where
1. High-priority jobs are scheduled for execution
2. Lower-priority jobs are run if the following conditions are true:
   - Resources (that cannot be used by the high-priority jobs) are available
   - The lower-priority jobs will not delay the higher-priority jobs
Lower-priority jobs selected for execution are those next in priority order that will fit in the available resources.

**Batch, Batch processing**
Allowing jobs to be run outside of the interactive login environment.

**Borrowing vnode**
The vnode where a shared vnode resource is available, but not managed.

**Built-in resource**
A resource that is defined in PBS Professional as shipped. Examples of built-in resources are *ncpus*, which tracks the number of CPUs, and *mem*, which tracks memory. See section 5.4.1, "Built-in and Custom Resources” on page 265 in the PBS Professional Administrator’s Guide.
Chapter 1  Terminology

Checkpoint/Restart
Allows jobs to be checkpointed and restarted. Uses OS-provided or third-party checkpoint/restart facility.

Checkpoint and Abort, checkpoint_abort
The checkpoint script or tool writes a restart file, then PBS kills and requeues the job. The job resumes from the start file when it is executed again.

Chunk
A set of resources allocated as a unit to a job. Specified inside a selection directive. All parts of a chunk come from the same host. In a typical MPI (Message-Passing Interface) job, there is one chunk per MPI process.

Cluster
A relatively homogeneous set of systems that are used as if they are a single machine.

Commands
PBS supplies both command line programs that are POSIX 1003.2d conforming and a graphical interface. These are used to submit, monitor, modify, and delete jobs. These client commands can be installed on any system type supported by PBS and do not require the local presence of any of the other components of PBS.

There are three classifications of commands: user commands (which any authorized user can use), Operator commands, and Manager (or administrator) commands. Operator and Manager commands require specific access privileges.

Complex
A PBS complex consists of the machines running one primary Server+Scheduler (plus, optionally, a secondary backup Server+Scheduler) and all the machines on which the MOMs (attached to this Server+Scheduler) are running. A complex can be a heterogeneous mix of system architectures, and can include one or more clusters.

Consumable resource
A consumable resource is a resource that is reduced or taken up by being used. Examples of consumable resources are memory or CPUs. See section 5.4.3, "Consumable and Non-consumable Resources" on page 266 in the PBS Professional Administrator’s Guide.
CPU

Has two meanings, one from a hardware viewpoint, and one from a software viewpoint:

1. A core. The part of a processor that carries out computational tasks. Some systems present virtual cores, for example in hyperthreading.

2. Resource required to execute a program thread. PBS schedules jobs according, in part, to the number of threads, giving each thread a core on which to execute. The resource used by PBS to track CPUs is called “ncpus”. The number of CPUs available for use defaults to the number of cores reported by the OS. When a job requests one CPU, it is requesting one core on which to run.

Custom resource

A resource that is not defined in PBS as shipped. Custom resources are created by the PBS administrator or by PBS for some systems. See section 5.4.1, "Built-in and Custom Resources" on page 265 in the PBS Professional Administrator’s Guide.

Degraded reservation

An advance reservation for which one or more associated vnodes are unavailable.

A standing reservation for which one or more vnodes associated with any occurrence are unavailable.

Delegation (Windows)

A capability provided by Active Directory that allows granular assignment of privileges to a domain account or group. So for instance, instead of adding an account to the “Account Operators” group which might give too much access, delegation allows giving the account read access only to all domain users and groups information. This is done via the Delegation wizard.

Destination, destination queue

A queue where a job is sent. A destination may be at the same PBS server or at another server.

Destination identifier

The string that names a destination queue. It is composed of two parts and has the following format:

queue@server

where
Chapter 1  Terminology

server
The name of a PBS Server

queue
The string identifying a queue on that Server.

Directive
A means by which the user specifies to PBS the value of a job submission variable such as number of CPUs, the name of the job, etc. The default start of a directive is “#PBS”. PBS directives either specify resource requirements or attribute values. See page section 3.11, "Changing the Job’s PBS Directive", on page 58 of the PBS Professional User’s Guide.

Domain Admin Account (Windows)
A domain account on Windows that is a member of the “Domain Admins” group.

Domain Admins (Windows)
A global group whose members are authorized to administer the domain. By default, the Domain Admins group is a member of the Administrators group on all computers that have joined a domain, including the domain controllers.

Domain User Account (Windows)
A domain account on Windows that is a member of the Domain Users group.

Domain Users (Windows)
A global group that, by default, includes all user accounts in a domain. When you create a user account in a domain, it is added to this group automatically.

Enterprise Admins (Windows)
A group that exists only in the root domain of an Active Directory forest of domains. The group is authorized to make forest-wide changes in Active Directory, such as adding child domains.

Entity, PBS entity
A user, group, or host.

Entity share
Setting job execution and/or preemption priority according to how much of the fairshare tree is assigned to each job’s owner.

Execution host
A computer which runs PBS jobs. An execution host is a system with a single operating system (OS) image, a unified virtual memory space, one or
Terminology

more CPUs and one or more IP addresses. Systems like Linux clusters, which contain separate computational units each with their own OS, are collections of hosts. Systems such as the SGI ICE are also collections of hosts. The SGI Altix 4700 is a single execution host.

An execution host can be comprised of one or more vnodes. For example, the SGI Altix 4700, while being a single execution host, can contain multiple vnodes, where each vnode is a blade. On the SGI ICE, each blade is treated as a vnode. See "Vnode".

Execution queue
A queue from which a job can be executed.

Failover
The PBS complex can run a backup server. If the primary server fails, the secondary takes over without an interruption in service.

Fairshare
A scheduling policy that prioritizes jobs according to how much of a specified resource is being used by, and has recently been used by, job submitters. Job submitters can be organized into groups and subgroups, so that jobs can also be prioritized according to those groups’ resource usage. Users and groups can each be allotted a percentage of total resource usage. See section 18.17, "Using Fairshare" on page 991 in the PBS Professional Administrator’s Guide.

File staging
File staging is the transfer of files between a specified storage location and the execution host. See "Stage in" and "Stage out".

Finished jobs
Jobs whose execution is done, for any reason:
• Jobs which finished execution successfully and exited
• Jobs terminated by PBS while running
• Jobs whose execution failed because of system or network failure
• Jobs which were deleted before they could start execution

Floating license
A unit of license dynamically allocated (checked out) when a user begins using an application on some host (when the job starts), and deallocated (checked in) when a user finishes using the application (when the job ends).

Furnishing queue
In peer scheduling, the queue from which jobs are pulled to be run at another complex
Chapter 1

Terminology

**Generic group limit**
A limit that applies separately to groups at the server or a queue. This is the limit for groups which have no individual limit specified. A limit for generic groups is applied to the usage across the entire group. A separate limit can be specified at the server and each queue.

**Generic project limit**
Applies separately to projects at the server or a queue. The limit for projects which have no individual limit specified. A limit for generic projects is applied to the usage across the entire project. A separate limit can be specified at the server and each queue.

**Generic user limit**
A limit that applies separately to users at the server or a queue. This is the limit for users who have no individual limit specified. A separate limit for generic users can be specified at the server and at each queue.

**Global resource**
A global resource is defined in a `resources_available` attribute, at the server, a queue, or a host. Global resources can be operated on via the `qmgr` command and are visible via the `qstat` and `pbsnodes` commands. See section 5.4.5, "Global and Local Resources" on page 267 in the PBS Professional Administrator’s Guide.

**Group**
A collection of system users. A user must be a member of at least one group, and can be a member of more than one group.

**Group access, Access by group**
Refers to access to PBS objects, such as the server, queues, and reservations. A user in the specified group is allowed access at the Server, queues, and reservations.

**Group ID (GID)**
Unique numeric identifier assigned to each group. See "Group".

**Group limit**
Refers to configurable limits on resources and jobs. This is a limit applied to the total used by a group, whether the limit is a generic group limit or an individual group limit.

**History jobs**
Jobs which will no longer execute at this server:
- Moved jobs
- Finished jobs
**Hold**

A restriction which prevents a job from being executed. When a job has a hold applied to it, it is in the *Held* (\(H\)) state. See section 2.43, “qhold”, on page 146.

**Hook**

Hooks are custom executables that can be run at specific points in the execution of PBS. They accept, reject, or modify the upcoming action. This provides job filtering, patches or workarounds, and extends the capabilities of PBS, without the need to modify source code.

**Host**

A machine running an operating system. A host can be made up of one or more vnodes. All vnodes of a host share the same value for `resources_available.host`.

**Host access, Access by host**

Refers to user access at the Server, queues, and reservations from the specified host.

**HPC Basic Profile (HPCBP)**

Proposed standard web services specification for basic job execution capabilities defined by the OGSA High Performance Computing Profile Working Group.

**HPC Basic Profile Job, HPCBP Job**

Generic job that can run either on vnodes managed by PBS or on nodes managed by HPC Basic Profile Server.

**HPC Basic Profile Server**

Service that executes jobs from any HPC Basic Profile compliant client.

**HPCBP MOM**

MOM that sends jobs for execution to an HPC Basic Profile Server. This MOM is a client-side implementation of the HPC Basic Profile Specification, and acts as a proxy for and interface to an HPC Basic Profile compliant server.

**Idle**

A server daemon is idle when it is running, but only accepting handshake messages, not performing workload management.

**Indirect resource**

A shared vnode resource at vnode(s) where the resource is not defined, but which share the resource.
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**Individual group limit**
Applies separately to groups at the server or a queue. This is the limit for a group which has its own individual limit specified. An individual group limit overrides the generic group limit, but only in the same context, for example, at a particular queue. The limit is applied to the usage across the entire group. A separate limit can be specified at the server and each queue.

**Individual project limit**
Applies separately to projects at the server or a queue. Limit for a project which has its own individual limit specified. An individual project limit overrides the generic project limit, but only in the same context, for example, at a particular queue. The limit is applied to the usage across the entire project. A separate limit can be specified at the server and each queue.

**Individual user limit**
Applies separately to users at the server or a queue. This is the limit for users who have their own individual limit specified. A limit for an individual user overrides the generic user limit, but only in the same context, for example, at a particular queue. A separate limit can be specified at the server and each queue.

**Installation account**
The account used by the administrator when installing PBS. Not the *pbsadmin* account used by PBS.

**Interactive job**
A job where standard input and output are connected to the terminal from which the job was submitted.

**Job or Batch job**
A unit of work managed by PBS. *A job* is a related set of tasks, created and submitted by the user. The user specifies the resources required by the job, and the processes that make up the job. When the user submits a job to PBS, the user is handing off these tasks to PBS to manage. PBS then schedules the job to be run, and manages the running of the job, treating the tasks as parts of a whole. A job is usually composed of a set of directives and a shell script.

**Job array**
*A job array* is a container for a collection of similar jobs submitted under a single job ID. It can be submitted, queried, modified and displayed as a unit. The jobs in the collection are called subjobs. For more on job arrays, see section, "Job Arrays", on page 177 of the PBS Professional User’s Guide.
**Terminology**

**Job array identifier**
The identifier returned upon success when submitting a job array. The format is

`sequence_number[]`

or

`sequence_number[].server.domain.com`

Note that some shells require you to enclose a job array identifier in double quotes.

**Job array range**
A specification for a set of subjobs within a job array. When specifying a range, indices used must be valid members of the job array’s indices. Format:

`sequence_number[<first>-<last>:<step>][.server][@new server]`

- `first` is the first index of the subjobs.
- `last` is the last index of the subjobs.
- `step` is the stepping factor.

**Job ID, Job identifier**
When a job is successfully submitted to PBS, PBS returns a unique identifier for the job. Format:

`sequence_number[.server][@new server]`

**Job state**
A job exists in one of the possible states throughout its existence within the PBS system. For example, a job can be queued, running, or exiting. See “States” on page 401.

**Job Submission Description Language (JSDL)**
Language for describing the resource requirements of jobs.

**Job-wide resource, Server resource**
A server resource, also called a server-level or job-wide resource, is a resource that is available at the server. A server resource is available to be consumed or matched at the server if you set the server’s `resources_available.<resource name>` attribute to the available or matching value. For example, you can define a custom resource called `FloatingLicenses` and set the server’s `resources_available.FloatingLicenses` attribute to the number of available floating licenses.

A server resource is a job-wide resource. This means that a job can request this resource for the entire job, but not for individual chunks.
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An example of a job-wide resource is shared scratch space, or any custom resource that is defined at the server and queue level.

**Job-wide resource request**

A job-wide resource request is for resource(s) at the server or queue level. This resource must be a server-level or queue-level resource. A job-wide resource is designed to be used by the entire job, and is available to the complex, not just one execution host. Job-wide resources are requested outside of a selection statement, in this form:

```
-l keyword=value[,keyword=value ...]
```

where *keyword* identifies either a consumable resource or a time-based resource such as `walltime`.

A resource request “outside of a selection statement” means that the resource request comes after “-l”, but not after “-lselect=”.

**Kill a job**

To terminate the execution of a job.

**License Manager Daemon (lmx-serv-altair)**

Daemon that functions as the license server.

**License server**

Manages licenses for PBS jobs.

**License Server List Configuration**

One form of redundant license server configuration. A collection of license server files, or "<port>@<host>" settings, pointing to license servers managing Altair licenses. Each server on the list is tried in turn. There could be *X* licenses on `<server1>`, *Y* licenses on `<server2>`, and *Z* licenses on `<server3>`, and the total licenses available would actually be *X*+*Y*+*Z*, but a request must be satisfied only by one server at a time. The first running server is the only server queried.

**Limit**

A maximum that can be applied in various situations:

- The maximum amount of a resource that can be consumed at any time by running jobs
- The maximum amount of a resource that can be allocated to queued jobs,
- The maximum number of jobs that can be running
- The maximum number of jobs that can be queued
Load balance
Scheduling policy wherein jobs are distributed across multiple hosts to even out the workload on each host.

Local resource
A local resource is defined in a Version 1 MOM configuration file. Local resources cannot be operated on via the qmgr command and are not visible via the qstat and pbsnodes commands. Local resources can be used by the scheduler. See section 5.4.5, "Global and Local Resources" on page 267 in the PBS Professional Administrator’s Guide.

Manager
A person who has been granted Manager privilege by being listed in the Server’s managers attribute. A Manager is authorized to use all restricted capabilities of PBS. A PBS Manager may act upon the Server, queues, or jobs. See section 9.2.2.3, "Manager" on page 546 in the PBS Professional Administrator’s Guide.

Managing vnode
The vnode where a shared vnode resource is defined, and which manages the resource.

Master provisioning script, Master script (Hooks)
The script that makes up the provisioning hook.

Memory-only vnode
Represents a node board that has only memory resources (no CPUs), for example, an Altix memory-only blade.

MOM
The daemon which runs on an execution host, managing the jobs on that host. MOM is the informal name for the process called pbs_mom. One MOM runs on each execution host.

MOM runs each job when it receives a copy of the job from the Server. MOM creates a new session that is as identical to the user’s login session as possible. For example under UNIX, if the user’s login shell is csh, then MOM creates a session in which .login is run as well as .cshrc. MOM returns the job’s output to the user when directed to do so by the Server.

MOM is a reverse-engineered acronym that stands for “Machine Oriented Mini-server”.

Monitoring
The act of tracking and reserving system resources and enforcing usage policy. This covers both user-level and system-level monitoring as well as
monitoring running jobs. Tools are provided to aid human monitoring of the PBS system as well.

**Mother Superior**

*Mother Superior* is the MOM on the head or first host of a multihost job. Mother Superior controls the job, communicates with the Server, and controls and consolidates resource usage information. When a job is to run on more than one execution host, the job is sent to the MOM on the primary execution host, which then starts the job.

**Moved jobs**

Jobs which were moved to another server

**Node**

No longer used. See "Execution host".

**Non-consumable resource**

A non-consumable resource is a resource that is not reduced or taken up by being used. Examples of non-consumable resources are Boolean resources and walltime. See section 5.4.3, "Consumable and Non-consumable Resources" on page 266 in the PBS Professional Administrator’s Guide.

**Object, PBS object**

An element of PBS such as the Server, a queue, or a reservation

**Occurrence of a standing reservation**

An instance of the standing reservation.

An occurrence of a standing reservation behaves like an advance reservation, with the following exceptions:

- While a job can be submitted to a specific advance reservation, it can only be submitted to the standing reservation as a whole, not to a specific occurrence. You can only specify *when* the job is eligible to run. See the `qsub(1B)` man page.

- When an advance reservation ends, it and all of its jobs, running or queued, are deleted, but when an occurrence ends, only its running jobs are deleted.

Each occurrence of a standing reservation has reserved resources which satisfy the resource request, but each occurrence may have its resources drawn from a different source. A query for the resources assigned to a standing reservation will return the resources assigned to the soonest occurrence, shown in the `resv_nodes` attribute reported by `pbs_rstat`. 
Operator
This term means a person who has been granted Operator privilege by being listed in the Server’s operators attribute. An Operator can use some but not all of the restricted capabilities of PBS. See section 9.2.2.2, "Operator" on page 545 in the PBS Professional Administrator’s Guide.

Overall limit
Limit on the total usage. In the context of server limits, this is the limit for usage at the PBS complex. In the context of queue limits, this is the limit for usage at the queue. An overall limit is applied to the total usage at the specified location. Separate overall limits can be specified at the server and each queue.

Owner, Job owner
The user who submitted a specific job to PBS.

Parameter
A parameter specifies an element of the behavior of a component of PBS. For example, MOMs have parameters specifying which events to log, or what the maximum load should be. Parameters are specified by editing the component’s configuration files.

PBS Entity
A user, group, or host

pbs Module
The pbs module is an interface to PBS and the hook environment. The interface is made up of Python objects, which have attributes and methods. You can operate on these objects using Python code.

PBS Object
An element of PBS such as the Server, a queue, or a reservation

pbsadmin (Windows)
The account that is used to execute the PBS daemons pbs_server, pbs_mom, pbs_sched, and pbs_rshd via the Service Control Manager on Windows. This must be “pbsadmin”.

PBS_HOME
The path containing PBS files. The path under which PBS files are installed on the local system.

PBS_EXEC
The path containing PBS executables. The path under which PBS executables are installed on the local system.
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PBS Professional
A workload management system consisting of a Server, a Scheduler, and any number of execution hosts each managed by a MOM. PBS accepts batch jobs from users, and schedules them on execution hosts according to the policy chosen by the site. PBS manages the jobs and their output according to site-specified policy.

Peer scheduling
A feature allowing different PBS complexes to automatically run each others’ jobs. This way jobs can be dynamically load-balanced across the complexes. Each complex involved in peer scheduling is called a peer.

Placement set
A set of vnodes on which jobs can be run, selected so that the job will run as efficiently as possible. Placement sets are used to improve task placement (optimizing to provide a “good fit”) by exposing information on system configuration and topology. See section 4.8.32, "Placement Sets" on page 193 in the PBS Professional Administrator’s Guide.

Placement set series
The set of placement sets defined by a resource, where each set has the same value for the resource. If the resource takes on N values, there are N placement sets in the series. See section 4.8.32, "Placement Sets" on page 193 in the PBS Professional Administrator’s Guide.

Placement pool
All of the placement sets defined at a PBS object. Each queue can have its own placement pool, and the server can have its own placement pool. See section 4.8.32, "Placement Sets" on page 193 in the PBS Professional Administrator’s Guide.

Policy, Scheduling policy
The set of rules by which the scheduler selects jobs for execution.

POSIX
Refers to the various standards developed by the Technical Committee on Operating Systems and Application Environments of the IEEE Computer Society under standard P1003.

Preempt
Stop one or more running jobs in order to start a higher-priority job.

Preemption level
Job characteristic used to determine whether a job may preempt another or may be preempted, such as being in an express queue, starving, having an
owner who is over a soft limit, being a normal job, or having an owner who is over a fairshare allotment.

**Preemption method**
The method by which a job is preempted. This can be checkpointing, suspension, or requeueing.

**Primary Scheduler**
The PBS Professional scheduler daemon which is running during normal operation.

**Primary Server**
The PBS Professional server daemon which is running during normal operation.

**Project**
In PBS, a project is a way to group jobs independently of users and groups. A project is a tag that identifies a set of jobs. Each job’s project attribute specifies the job’s project.

**Project limit**
This is a limit applied to the total used by a project, whether the limit is a generic project limit or an individual project limit.

**Provision**
To install an OS or application, or to run a script which performs installation and/or setup

**Provisioned vnode**
A vnode which, through the process of provisioning, has an OS or application that was installed, or which has had a script run on it.

**Provisioning hook**
The hook which performs the provisioning, either by calling other scripts or by running commands

**Provisioning tool**
A tool that performs the actual provisioning, e.g. SGI Tempo.

**Pulling queue**
In peer scheduling, the queue into which jobs are pulled, and from which they are run.

**Queue**
A queue is a named container for jobs at a Server. There are two types of queues in PBS: routing queues and execution queues. A routing queue is a queue used to move jobs to other queues including those that exist on other
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PBS Servers. A job must reside in an *execution queue* to be eligible to run and remains in an execution queue during the time it is running. In spite of the name, jobs in a queue need not be processed in queue order (first-come first-served or *FIFO*).

**Queuing**

The collecting together of work or tasks to be run on a computer. Users submit tasks or “jobs” to the resource management system where they are queued up until the system is ready to run them.

**Redundant License Server Configuration**

Allows licenses to continue to be available should one or more license servers fail. There are two types: 1) license server list configuration, and 2) three-server configuration.

**Reject an action (Hooks)**

An action is *rejected* when a hook prevents the action from taking place.

**Requeue**

The process of stopping a running job and putting it back into the *queued* ("Q") state.

**Rerunnable**

If a running PBS job can be terminated and then restarted from the beginning without harmful side effects, the job is rerunnable. The job’s *Rerunnable* attribute must be set to *y* in order for PBS to consider a job to be rerunnable.

**Reservation Degradation**

PBS attempts to ensure that reservations run by finding usable vnodes when reservation vnodes become unavailable.

**Resource**

A *resource* can be something used by a job, such as CPUs, memory, high-speed switches, scratch space, licenses, or time, or it can be an arbitrary item defined for another purpose. PBS has built-in resources, and allows custom-defined resources. See section , "PBS Resources" on page 259 in the PBS Professional Administrator’s Guide.

**Restart**

A job that was stopped after being checkpointed while previously executing is executed again, starting from the point where it was checkpointed.
Restart File

The job-specific file that is written by the checkpoint script or tool. This file contains any information needed to restart the job from where it was when it was checkpointed.

Restart Script

The script that MOM runs to restart a job. This script is common to all jobs, and so must use the information in a job’s restart file to restart the job.

Route a job

When PBS moves a job between queues. PBS provides a mechanism whereby a job is automatically moved from a routing queue to another queue. This is performed by PBS. The resource request for each job in a routing queue is examined, and the job is placed in a destination queue which matches the resource request. The destination queue can be an execution queue or another routing queue.

Routing queue

A queue that serves as a temporary holding place for jobs, before they are moved to another queue. Jobs cannot run from routing queues.

Scheduler

The scheduler is the daemon which implements the site’s job scheduling policy controlling when and where each job is run. The scheduler is the process called pbs_sched.

Scheduling

The process of selecting which jobs to run when and where, according to a predetermined policy. Sites balance competing needs and goals on the system(s) to maximize efficient use of resources (both computer time and people time).

Scheduling policy

Scheduling policy determines when each job runs, and how much of each resource it can use. Scheduling policy consists of a system for determining the priority of each job, combined with a set of limits on how many jobs can be run, and/or how much of each resource can be used.

Schema Admins (Windows)

A group that exists only in the root domain of an Active Directory forest of domains. The group is authorized to make schema changes in Active Directory.

Secondary Scheduler

The PBS Professional scheduler daemon which takes over when the primary scheduler is not available.
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**Secondary Server**
The PBS Professional server daemon which takes over when the primary server fails.

**Sequence number**
The numeric part of a job or job array identifier, e.g. 1234.

**Server**
The central PBS daemon, which does the following:
- Handles PBS commands
- Receives and creates batch jobs
- Sends jobs for execution

The server is the process called `pbs_server`.

Each PBS complex has one primary server, and if the complex is configured for failover, a secondary server.

The server contains a licensing client which communicates with the licensing server for licensing PBS jobs.

**Shared resource**
A vnode resource defined and managed at one vnode, but available for use at others.

**Sister**
Any MOM that is not on the head or first host of a multihost job. A sister is directed by the Mother Superior. Also called a *subordinate MOM*.

**Sisterhood**
All of the MOMs involved in running a particular job.

**Snapshot Checkpoint**
The checkpoint script or tool writes a restart file, and the job continues to execute. The job resumes from this start file if the system experiences a problem during the job’s subsequent execution.

**Soonest occurrence of a standing reservation**
The occurrence which is currently active, or if none is active, then it is the next occurrence.

**Stage in**
The process of moving one or more job-related files from a storage location to the execution host before running the job.
Stage out
The process of moving one or more job-related files from the execution host to a storage location after running the job.

Staging and execution directory
The staging and execution directory is a directory on the execution host where the following happens:
• Files are staged into this directory before execution
• The job runs in this directory
• Files are staged out from this directory after execution
A job-specific staging and execution directory can be created for each job, or PBS can use a specified directory, or a default directory. See section 12.14.1, “The Job’s Staging and Execution Directories” on page 721 in the PBS Professional Administrator’s Guide.

Standing reservation
An advance reservation which recurs at specified times. For example, the user can reserve 8 CPUs and 10GB every Wednesday and Thursday from 5pm to 8pm, for the next three months.

State
The PBS server, vnodes, reservations, and jobs can be in various states, depending on what PBS is doing. For example the server can be idle or scheduling, vnodes can be busy or free, and jobs can be queued or running, among other states. For a complete description of states, see “States” on page 401.

Strict ordering
A scheduling policy where jobs are run according to policy order. If the site-specified policy dictates a particular priority ordering for jobs, that is the order in which they are run. Strict ordering can be modified by backfilling in order to increase throughput. See "Backfilling".

Subject
A process belonging to a job run by an authorized, unprivileged user (a job submitter.)

Subjob
One of the jobs in a job array, e.g. 1234[7], where 1234[ ] is the job array itself, and 7 is the index. Queued subjobs are not individually listed in the queue; only their job array is listed. Running subjobs are individually listed.
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**Subjob index**

The unique index which differentiates one subjob from another. This must be a non-negative integer.

**Subordinate MOM**

Any MOM that is not on the head or first host of a multihost job. A subordinate MOM is directed by the Mother Superior. Also called a *sister*.

**Task**

A process belonging to a job. A POSIX session started by MOM on behalf of a job.

**Task placement**

The process of choosing a set of vnodes to allocate to a job that will both satisfy the job's resource request (select and place specifications) and satisfy the configured scheduling policy.

**Three-server Configuration**

One form of redundant license server configuration. Means that if any 2 of the 3 license servers are up and running (referred to as a quorum), the system is functional, with 1 server acting as master who can issue licenses. If the master goes down, then another server must take over as master. This is set up as a license file on each of the 3 redundant servers containing:

```
SERVER <server1> ... <port1>
SERVER <server2> ... <port2>
SERVER <server3> ... <port3>
```

PBS Professional can point to a license server host that has

**Token**

Also called “GridWorks Unit”, a unit of value which is checked out from the license server. The number of PBS tokens will be related to the number of CPUs requested by a job that is being executed.

**User**

Has two meanings:

1. A person who submits jobs to PBS, as differentiated from Operators, Managers and administrators. See section 9.2.2.1, "User" on page 545 in the PBS Professional Administrator's Guide.

2. A system user, identified by a unique character string (the user name) and by a unique number (the user ID). Any person using the system has a username and user ID.
Terminology

User access, Access by user
The specified user is allowed access at the Server, queues, and reservations.

User ID, UID
A unique numeric identifier assigned to each user.

User limit
Refers to configurable limits on resources and jobs. A limit placed on one or more users, whether generic or individual.

vchunk
The part of a chunk that is supplied by one vnode. If a chunk is broken up across multiple vnodes, each vnode supplies a vchunk.

Version 1 configuration file
MOM configuration file containing MOM configuration parameters. See Chapter 3, "MOM Parameters", on page 263.

Version 2 configuration file
Vnode configuration file containing vnode attribute settings. Created using `pbs_mom -s insert` command.

Virtual processor, VP
PBS can treat a vnode as if it has more processors available than the number of physical processors. When `resources_available.ncpus` is set to a number higher than the actual number of physical processors, the vnode can be said to have virtual processors. Also called logical processors.

Vnode
A virtual node, or vnode, is an abstract object representing a set of resources which form a usable part of an execution host. This could be an entire host, or a nodeboard or a blade. A single host can be made up of multiple vnodes. Each vnode can be managed and scheduled independently. Each vnode in a complex must have a unique name. Vnodes can share resources, such as node-locked licenses.
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Chapter 2

PBS Commands

This chapter contains a description of each PBS command. Each description includes any options to the command.

2.1 Windows Requirements

Under Windows, use double quotes when specifying arguments to PBS commands.

2.2 Requirements for Commands

Some PBS commands require root privilege or PBS Operator or Manager privilege in order to run. Some can be executed by anyone, but the output depends upon the privilege of the user. Most PBS commands require that the Server be running; some require that MOMs be running.
The following table lists the commands, and indicates the permissions required to use each, and whether the server or MOM must be running.

<table>
<thead>
<tr>
<th>Command</th>
<th>Permissions Required</th>
<th>Server Must Be Running</th>
<th>MOM Must Be Running</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;mpiexec&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;nqs2pbs&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs-report&quot;</td>
<td>Root</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbsdsh&quot;</td>
<td>Any</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>&quot;pbsfs&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbsnodes&quot;</td>
<td>Result depends on permission</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbsrun&quot;</td>
<td>Can be run by root or PBS administrator only</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbsrun_unwrap&quot;</td>
<td>Can be run by root only</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbsrun_wrap&quot;</td>
<td>Can be run by root only</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>pbs_account</td>
<td>Admin on Windows</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_attach&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>&quot;pbs dataservice&quot;</td>
<td>Root on UNIX; Admin on Windows</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs ds_password&quot;</td>
<td>Root on UNIX; Admin on Windows</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_hostn&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_idled&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_init.d&quot;</td>
<td>Users can only get status</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table 2-1: Permission and Daemon Requirements for Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Permissions Required</th>
<th>Server Must Be Running?</th>
<th>MOM Must Be Running?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;pbs_lamboot&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_migrate_users&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_mkdirs&quot;</td>
<td>Can be run by PBS administrator only</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_mom&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_mom_globus&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_mpihp&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>&quot;pbs_mpilam&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>&quot;pbs_mpirun&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>&quot;pbs_password&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_probe&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_rdel&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_renew&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_rstat&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_rsub&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_sched&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_server&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;pbs_tclsh&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 2-1: Permission and Daemon Requirements for Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Permissions Required</th>
<th>Server Must Be Running?</th>
<th>MOM Must Be Running?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;pbs_tmrsh&quot;</td>
<td>Any</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>&quot;pbs_wish&quot;</td>
<td>Any</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;printjob&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qalter&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qdel&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qdisable&quot;</td>
<td>Requires Manager or Operator privilege to run</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qenable&quot;</td>
<td>Requires Manager or Operator privilege to run</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qhold&quot;</td>
<td>Some holds can be set by root or administrator only</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qmgr&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qmove&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qmsg&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qorder&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qrerun&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qrls&quot;</td>
<td>Some holds can be released by root or administrator only</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qrun&quot;</td>
<td>Can be run only by Operator or Manager</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qselect&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table 2-1: Permission and Daemon Requirements for Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Permissions Required</th>
<th>Server Must Be Running?</th>
<th>MOM Must Be Running?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;qsig&quot;</td>
<td>Any</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qstart&quot;</td>
<td>Can be run only by Operator or Manager</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qstat&quot;</td>
<td>Result depends on permission</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qstop&quot;</td>
<td>Can be run only by Operator or Manager</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qsub&quot;</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;qterm&quot;</td>
<td>Can be run only by Operator or Manager</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;tracejob&quot;</td>
<td>Can be run only by root or PBS administrator</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&quot;xpbs&quot;</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>&quot;xpbsmon&quot;</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

#### 2.3 mpiexec

Runs MPI programs under PBS on Linux

#### 2.3.1 Synopsis

`mpiexec`

`mpiexec --version`
2.3.2 Description

The PBS mpiexec command provides the standard mpiexec interface on the Altix running ProPack 6 or 7 or Performance Suite 1. If executed on a non-Altix system, it will assume it was invoked by mistake. In this case it will use the value of PBS_O_PATH to search for the correct mpiexec. If one is found, the PBS mpiexec will exec it.

The PBS mpiexec calls the SGI mpirun(1). The name of the array to use when invoking mpirun is user-specifiable via the PBS_MPI_SGIARRAY environment variable.

It is transparent to the user; MPI jobs submitted outside of PBS will run as they would normally. MPI jobs can be launched across multiple Altixes. PBS will manage, track, and cleanly terminate multi-host MPI jobs. PBS users can run MPI jobs within specific partitions.

If CSA has been configured and enabled, PBS will collect accounting information on all tasks launched by an MPI job. CSA information will be associated with the PBS job ID that invoked it, on each execution host.

If the PBS_MPI_DEBUG environment variable’s value has a nonzero length, PBS will write debugging information to standard output.

2.3.3 Usage

The PBS mpiexec command presents the mpiexec interface described in section “4.1 Portable MPI Process Startup” of the “MPI-2: Extensions to the Message-Passing Interface” document in http://www.mpiforum.org/docs/mpi-20-html/node42.htm

2.3.4 Options

--version

The mpiexec command returns its PBS version information and exits. This option can only be used alone.

2.3.5 Requirements

Altix running ProPack 6 or 7 or Performance Suite 1.

PBS uses SGI’s mpirun(1) command to launch MPI jobs. SGI’s mpirun must be in the standard location.

The location of pbs_attach() on each node of a multinode MPI job must be the same as it is on the mother superior node.
In order to run multihost jobs, the SGI Array Services must be correctly configured. Altix systems communicating via SGI’s Array Services must all use the same version of the `sgi-arraysvcs` package. Altix systems communicating via SGI’s Array Services must have been configured to interoperate with each other using the default array. See SGI’s `array_services(5)` man page.

2.3.6 Environment Variables

The PBS `mpiexec` script sets the `PBS_CPUSSET_DEDICATED` environment variable to assert exclusive use of the resources in the assigned cpuset.

The PBS `mpiexec` checks the `PBS_MPI_DEBUG` environment variable. If this variable has a nonzero length, debugging information is written.

If the `PBS_MPI_SGIARRAY` environment variable is present, the PBS `mpiexec` will use its value as the name of the array to use when invoking `mpirun`.

The `PBS_ENVIRONMENT` environment variable is used to determine whether `mpiexec` is being called from within a PBS job.

The PBS `mpiexec` uses the value of `PBS_O_PATH` to search for the correct `mpiexec` if it was invoked by mistake.

2.3.7 Path

PBS’ `mpiexec` is located in `PBS_EXEC/bin/mpiexec`.

2.3.8 See Also

The PBS Professional Administrator's Guide

SGI man pages: SGI's `mpirun(1)`, SGI's `mpiexec_mpt(1)`, SGI's `array_services(5)`

PBS man pages: `pbs_attach(8B)`

2.4 nqs2pbs

Converts NQS job scripts to PBS format.
2.4.1 Synopsis

nqs2pbs nqs_script [pbs_script]
nqs2pbs --version

2.4.2 Description

This utility converts an existing NQS job script to work with PBS and NQS. The existing script is copied and PBS directives, #PBS , are inserted prior to each NQS directive #QSUB or #@$, in the original script.

Certain NQS date specification and options are not supported by PBS. A warning message will be displayed indicating the problem and the line of the script on which it occurred.

If any unrecognizable NQS directives are encountered, an error message is displayed. The new PBS script will be deleted if any errors occur.

2.4.3 Options

--version

The nqs2pbs command returns its PBS version information and exits. This option must be used alone.

2.4.4 Operands

nqs_script

Specifies the file name of the NQS script to convert. This file is not changed.

pbs_script

If specified, it is the name of the new PBS script. If not specified, the new file name is nqs_script.new.

NOTES

Converting NQS date specifications to the PBS form may result in a warning message and an incompletely converted date. PBS does not support date specifications of “today”, “tomorrow”, or the name of the days of the week such as “Monday”. If any of these are encountered in a script, the PBS specification will contain only the time portion of the NQS specification, i.e. #PBS -a hhmm[.ss]. It is suggested that you specify the execution time on the qsub command line rather than in the script.
Note that PBS will interpret a time specification without a date in the following way:

- If the time specified has not yet been reached, the job will become eligible to run at that time today.
- If the specified time has already passed when the job is submitted, the job will become eligible to run at that time tomorrow.

This command does not support time zone identifiers. All times are taken as local time.

### 2.4.5 See Also

qsub(1B)

### 2.5 pbs-report

Prints PBS job statistics.

#### 2.5.1 Synopsis

```bash
pbs-report [--age seconds[:offset]] [--account account] [--begin -b yyyymmdd[:hhmm:ss]]
            department] [--end -e yyyymmdd[:hhmm:ss]] [--exit -x integer] [--explainwait] [--
            negate option] [--package solver] [--point yyyymmdd[:hhmm:ss]] [--queue PBS queue]
            seconds] [--wallmin seconds]
```

#### 2.5.2 Description

Allows the PBS Administrator to generate a report of job statistics from the PBS accounting logfiles. Options to the `pbs-report` command control how jobs are selected for reporting and how reports are generated.

The `pbs-report` command is not available on Windows.

Before first using `pbs-report`, the Administrator is advised to tune the configuration to match the local site by editing the file PBS_EXEC/lib/pm/PBS.pm.
2.5.2.1 Permissions

This command can be run only by root.

2.5.2.2 Selecting Jobs For Reporting

2.5.2.2.i Filtering Jobs by Dates or Times

--begin, --end, --range, --age, --point

--begin and --end

Work from hard date limits. Omitting either will cause the report to contain all data to either the beginning or the end of the accounting data.

Unbounded date reports may take several minutes to run, depending on the volume of work logged.

Jobs are listed by start time only, regardless of whether end time is specified via --end or --inclusive.

--range

A short-hand way of selecting a prior date range and will supersede --begin and --end.

--age

Allows the user to select an arbitrary period going back a specified number of seconds from the time the report is run. --age will silently supersede all other date options.

--point

Displays all jobs which were running at the specified point in time, and is incompatible with the other options. --point will produce an error if specified with any other date-related option.

2.5.2.2.ii Filtering Jobs by Attribute

--cpumax, --cpumin, --waitmax, --waitmin, --wallmax, --wallmin

A maximum value will cause any jobs with more than the specified amount to be ignored. A minimum value will cause any jobs with less than the specified amount to be ignored. All six options may be combined, though doing so will often restrict the filter such that no jobs can meet the requested criteria. Combine time filters for different time with caution.

2.5.2.2.iii Filtering Jobs by User or Department

--dept, --group, --user
PBS Commands

--dept
Allows for integration with an LDAP server and will generate reports based on department codes as queried from that server. If no LDAP server is available, department-based filtering and sorting will not function.

--group
Allows for filtering of jobs by primary group ownership of the submitting user, as defined by the operating system on which the PBS server runs.

--user
Allows for explicit naming of users to be included.

It is possible to specify a list of values for these filters, by providing a single colon-concatenated argument or using the option multiple times, each with a single value.

2.5.2.2.iv Filtering Jobs by Job Property
--host, --exit, --package, --queue

--host
Allows for filtering of jobs based on the host on which the job was executed.

--exit
Allows for filtering of jobs based on the job exit code.

--package
Allows for filtering of jobs based on the software package used in the job. This option will only function when a package-specific custom resource is defined for the PBS server and requested by the jobs as they are submitted.

--queue
Allows for filtering of jobs based on the queue in which the job finally executed. With the exception of --exit, it is possible to specify a list of values for these filters, by providing a single colon-concatenated argument or using the option multiple times, each with a single value.

2.5.2.2.v Filtering Jobs by Account String
--account
This option allows the user to filter jobs based on an arbitrary, user-specified job account string. The content and format of these strings is site-defined and unrestricted; it may be used by a custom job front-end which enforces permissible account strings, which are passed to qsub with qsub’s -A option.
2.5.2.2.vi Negating Filters

The **--negate** option allows for logical negation of one or more specified filters. Only the account, dept, exit, group, host, package, queue, and user filters may be negated. If a user is specified with **--user**, and the `--negate user` option is used, only jobs not belonging to that user will be included in the report. Multiple report filters may be negated by providing a single colon-concatenated argument or using **--negate** multiple times, each with a single value.

2.5.2.3 Generating Reports

Several report types can be generated, each indexed and sorted according to the user’s needs.

**--verbose**
Generates a wide tabular output with detail for every job selected. It can be used to generate output for import to a spreadsheet. Verbose reports may be sorted on any field using the **--vsort** option. Default: summary report only.

**--reslist**
Generates a tabular output with detail on resources requested for every job selected. Resource list reports may be sorted on any field using the **--vsort** option. Default: summary report only.

**--inclusive**
Allows a user to require that the job’s start time also falls within the date range.
Jobs are listed by start time only, regardless of whether end time is specified via **--end** or **--inclusive**.

**--index**
Allows specification of the field on which data in the summary should be grouped. Fields listed in the option description are mutually exclusive. The selected field will be the left-most column of the summary report output. One value may be selected as an index while another is selected for sorting. However, since index values are mutually exclusive, the only sort options which may be used (other than the index itself) are account, cpu, jobs, suspend, wait, and wall. If no sort order is selected, the index is used as the sort key for the summary.

**--sort**
Allows the user to specify a field on which to sort the summary report. It operates independently of the sort field for verbose reports (see **--vsort**). See the description for **--index** for how the two options interact.
--vsort

Allows the user to specify a field on which to sort the verbose report. It operates independently of the sort field for summary reports (see --sort).

2.5.3 Options to \texttt{pbs-report}

\texttt{--age -a seconds[:offset]}

Report age in seconds. If an offset is specified, the age range is taken from that offset backward in time, otherwise a zero offset is assumed. The time span is from (now - age - offset) to (now - offset). This option silently supersedes --begin, --end, and --range.

\texttt{--account account}

Limit results to those jobs with the specified account string. Multiple values may be concatenated with colons or specified with multiple instances of --account.

\texttt{--begin -b yyyymmdd[:hhmm[ss]]}

Report begin date and optional time. Default: most recent log data. --begin and --end work from hard date limits. Omitting either will cause the report to contain all data to either the beginning or the end of the accounting data. Unbounded date reports may take several minutes to run, depending on the volume of work logged.

Jobs are listed by start time only, regardless of whether end time is specified via --end or --inclusive.

\texttt{--count -c}

Display a numeric count of matching jobs. Currently only valid with --cpumax for use in monitoring rapidly-exiting jobs.

\texttt{--cpumax seconds}

Filter out any jobs which have more than the specified number of CPU seconds.

\texttt{--cpumin seconds}

Filter out any jobs which have less than the specified number of CPU seconds.

\texttt{--dept -d department}

Limit results to those jobs whose owners are in the indicated department. Default: any. This option only works in conjunction with an LDAP server which supplies department codes. See also the --group option. Multiple values may be concatenated with colons or specified with multiple instances of --dept.
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--end -e yyyymmdd[:hhmm:ss]
    Report end date and optional time. Default: most recent log data. --begin
    and --end work from hard date limits. Omitting either will cause the report
    to contain all data to either the beginning or the end of the accounting data.
    Unbounded date reports may take several minutes to run, depending on the
    volume of work logged.
    Jobs are listed by start time only, regardless of whether end time is specified
    via --end or --inclusive.
--exit -x integer
    Limit results to jobs with the specified exit status. Default: any.
--explainwait
    Print a reason for why jobs had to wait before running.
--group -g group
    Limit results to the specified group name. Group is defined by the operat-
    ing system. Multiple values may be concatenated with colons or specified
    with multiple instances of --group.
--help -h
    Prints a brief help message and exits.
--host -m execution host
    Limit results to the specified execution host. Multiple values may be con-
    catenated with colons or specified with multiple instances of --host.
--inclusive key
    Limit results to jobs which had start times in the range.
    Jobs are listed by start time only, regardless of whether end time is specified
    via --end or --inclusive.
--index -i key
    Field on which to index the summary report. Default: user. Valid values
    include: date, dept, host, package, queue, user.
--man
    Prints the manual page and exits.
--negate -n option
    Logically negate the selected options; print all records except those that
    match the values for the selected criteria. Default: unset. Valid values:
    account, dept, exit, group, host, package, queue, user. Defaults cannot
    be negated, only options explicitly specified are negated. Multiple val-
    ues may be concatenated with colons or specified with multiple instances of
    --negate.
--package -p package
Limit results to the specified software package. Multiple values may be
concatenated with colons or specified with multiple instances of --package. Valid values are can be seen by running a report with the --index
package option. This option keys on custom resources requested at job sub-
mmission time. Sites not using such custom resources will have all jobs
reported under the catchall None package with this option.

--point yyyymmdd[:hhmm:ss]
Print a report of all jobs which were actively running at the point in time
specified. This option cannot be used with any other date or age option.

--queue -q queue
Limit results to the specified queue. Multiple values may be concatenated
with colons or specified with multiple instances of --queue. Note that if
specific queues are defined via the @QUEUES line in PBS.pm, then only
those queues will be displayed. Leaving that parameter blank allows all
queues to be displayed.

--range -r period
Time period used is period before now. For example, if the period given is
“week”, pbs-report looks at all jobs which have finished and which
were running any time from a week ago to now. Default: all. Valid values
for period are today, week, month, quarter, and year. This option
silently supersedes --begin and --end, and is superseded by --age.

--reslist
Include resource requests for all matching jobs. This option is mutually
exclusive with --verbose.

--sched -t
Generate a brief statistical analysis of Scheduler cycle times. No other data
on jobs is reported.

--sort -s field
Field by which to sort reports. Default: user. Valid values are cpu, date,
dept, host, jobs, package, queue, suspend (aka muda), wait, and wall.

--time option
Valid values: “full”, “partial”. Used to indicate how time should be
accounted. The default of “full” means that entire job’s CPU and wall time
is counted in the report if the job ended during the report’s date range. With
the “partial” option, only CPU and wall time during the report’s date range
are counted.

By default, time is credited at the point when the job ended. This can be
changed using the --inclusive option. For a job which ended a few seconds
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after the report range begins, this can cause significant overlap, which may
boost results. During a sufficiently large time frame, this overlap effect is
negligible and may be ignored. This value for --time should be used when
generating monthly usage reports. With “partial”, any CPU or wall time
accumulated prior to the beginning of the report is ignored. “partial” is
intended to allow for more accurate calculation of overall cluster efficiency
during short time spans during which a significant overlap effect can skew
results. See --inclusive.

--user -u username
  Limit results to the specified username. Multiple values may be concate-
nated with colons or specified with multiple instances of --user.

--verbose -v
  Include attributes for reported jobs. Subjobs are shown, but not job arrays.
  Default: no attributes.

--version
  The pbs-report command returns its PBS version information and
  exits. This option can only be used alone.

--vsort field
  Field by which to sort the verbose output section reports. Default: jobid.
  Valid values are cpu, date, exit, host, jobid, jobname, mem, name,
  package, queue, scratch, suspend, user, vmem, wall, wait. If neither
  --verbose nor --reslist is specified, --vsort is silently ignored. The scratch
  sort option is available only for resource reports ( --reslist ).

--waitmax seconds
  Filter out any jobs which have more than the specified wait time in seconds.

--waitmin seconds
  Filter out any jobs which have less than the specified wait time in seconds.

--wallmax seconds
  Filter out any jobs which have more than the specified wall time in seconds.

--wallmin seconds
  Filter out any jobs which have less than the specified wall time in seconds.

--wall -w
  Use the walltime resource attribute rather than wall time calculated by sub-
  tracting the job start time from end time. The walltime resource attribute
does not accumulate when a job is suspended for any reason, and thus may
not accurately reflect the local interpretation of wall time.
2.5.4 Examples

“How much in the way of resources did every job this month waiting more than 10 minutes request?”

```
pbs-report --range month --waitmin 600 --reslist
```

This information might be valuable to determine if some simple resource additions (e.g. more memory or more disk) might increase overall throughput of the cluster.

2.5.4.1 Statistical Analysis

At the bottom of the summary statistics, prior to the job set summary, is a statistical breakdown of the values in each column. Example:

```
# of       Total       Total           Average
Date       jobs    CPU Time   Wall Time  Efcy.  Wait Time
---------  ------  ---------  ---------  -----  ---------
TOTAL      1900    10482613    17636290  0.594       1270
Minimum    4        4715       13276  0.054        221
Maximum    162     1399894     2370006  1.782      49284
Mean       76      419304      705451  0.645       2943
Deviation  41      369271      616196  0.408       9606
Median     80      242685      436724  0.556        465
```

This summary should be read in column format. The values each represent a statistical data point in the column. For instance, while the minimum number of jobs run in one day was 4 and the maximum 162, these values do not correlate to the 4715 and 1399894 CPU seconds listed as minima and maxima.

In the Job Set Summary section, the values should be read in rows, as shown here:

```
Standard
Minimum  Maximum  Mean  Deviation  Median
--------  -------  ----  ---------  -------
CPU time  0   18730  343      812     0
Wall time 0   208190 8496     19711     93
Wait time 0   266822 4129     9018      3
```
These values represent aggregate statistical analysis for the entire set of jobs included in the report. The values in the prior summary represent values over the set of totals based on the summary index (e.g. Maximum and Minimum are the maximum and minimum totals for a given day/user/department, rather than an individual job. The job set summary represents an analysis of all individual jobs.

### 2.5.4.2 Cluster Monitoring

The `--count` and `--cpumax` functions are intended to allow an administrator to periodically run this script to monitor for jobs which are exiting rapidly, representing a potential global error condition causing all jobs to fail. It is most useful in conjunction with `--age`, which allows a report to span an arbitrary number of seconds backward in time from the current moment. A typical set of options would be `"--count --cpumax 30 --age 21600"`, which would show a total number of jobs which consumed less than 30 seconds of CPU time within the last six hours.

### 2.5.5 Standard Error

The `pbs-report` command will write a diagnostic message to standard error for each error occurrence.

### 2.5.6 Exit Status

Zero upon successful processing of all operands.

Greater than zero if the `pbs-report` command fails to process any operand.

### 2.5.7 See Also

The PBS Professional Administrator's Guide, `pbs_server(8B)`, `pbs_sched(8B)`, `pbs_mom(8B)`

### 2.6 `pbs_account`

Manage PBS service account
2.6.1 Synopsis

```bash
```

2.6.2 Description

The `pbs_account` command is used to manage the PBS service account. It is used to create the account, set or validate the account password, add privileges to the account, and register or unregister the account with the SCM.

2.6.3 Permissions

This command can be run by administrators only.

2.6.4 Platforms

This command is available on Windows only.

2.6.5 Options

- `-a <account name>`
  
  Specifies account name.

- `-c [<password>]`
  
  - If specified account does not exist, creates the account with the password.
  
  - If specified account exists, validates password against it.

  If password is not specified, user is prompted for password.

- `-o <output path>`
  
  Prints `stdout` and `stderr` messages in specified output path.

- `-p [<password>]`
  
  Updates the PBS service account password. If no password is specified, the user is prompted for a password.

- `-s`
  
  Adds necessary privileges to the PBS service account. Grants the "Create Token Object", "Replace Process Level Token", "Log On as a Service", and "Act as Part of the Operating System" privileges to PBS service account.
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--reg-server <path to server>      [<password>]
--reg-mom   <path to MOM>       [<password>]
--reg-sched <path to scheduler>  [<password>]
--reg-rshd    <path to rshd>         [<password>]

Registers the PBS service with the SCM, instructing it to run the services under the PBS service account and supplied password. <path> must be in double quotes.

--unreg-server  <path to server>
--unreg-mom    <path to MOM>
--unreg-sched  <path to scheduler>
--unreg-rshd   <path to rshd>

Unregisters the PBS service with the SCM. <path> must be in double quotes.

--ci

Prints actions taken by pbs_account while creating PBS service account when -c option is used

<no options>

Prints name of PBS service account, if it exists. Exit value is 0.

2.6.6  Examples

- To create the PBS service account:
  
  pbs_account -c -s -p password

- To change the PBS service account:
  
  pbs_account [--reg service_path] [- a PBS service account name]

- To register the server, scheduler, MOM, and rshd services:
  
  pbs_account --reg "\Program Files\PBS Pro\exec\sbin\pbs_server.exe" [-p <password>]
  pbs_account --reg "\Program Files\PBS Pro\exec\sbin\pbs_mom.exe" [-p <password>]
  pbs_account --reg "\Program Files\PBS Pro\exec\sbin\pbs_sched.exe" [-p <password>]
  pbs_account --reg "\Program Files\PBS Pro\exec\sbin\pbs_rshd.exe" [-p <password>]
2.7 pbs_attach

Attaches a session ID to a PBS job

2.7.1 Synopsis

```
pbs_attach [-j jobid] [-m port] -p pid
pbs_attach [-j jobid] [-m port] [-P] [-s] cmd [arg ...]
pbs_attach --version
```

2.7.2 Description

The `pbs_attach` command associates the processes in a session with a PBS job by attaching the session ID to the job. This allows PBS MOM to monitor and control those processes. MOM uses process IDs to determine session IDs, which are put into MOM’s task list (attached to the job.) All process IDs in a session are then associated with the job.

When a command `cmd` is given as an operand, the `pbs_attach` process becomes the parent process of `cmd`, and the session ID of `pbs_attach` is attached to the job.

The `-p` option cannot be used with the `-P` or `-s` options or the `cmd` operand.

This command is not supported under Windows.

2.7.3 Options to pbs_attach

- `-j jobid`  
  The job ID to which the session ID is to be attached. If `jobid` is not specified, a best effort will be made to determine the job to which to attach the session.

- `-m port`  
  The port at which to contact MOM. Default: value of `PBS_MANAGER_SERVICE_PORT` from `pbs.conf`

- `-p pid`  
  Process ID whose session ID will be attached to the job. Default: process ID of `pbs_attach`.

- `-P`  
  Attach sessions of both `pbs_attach` and the parent of `pbs_attach` to job. When used with `-s` option, this means the sessions of the new fork() ed
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pbs_attach and its parent, which is pbs_attach, are attached to the job.

- `-s`  
  Starts a new session by `fork()`-ing pbs_attach. The session ID of the new pbs_attach is attached to the job.

--version  
The pbs_attach command returns its PBS version information and exits. This option can only be used alone.

### 2.7.4 Operands

**cmd**

Name of command whose process ID is to be associated with the job.

### 2.7.5 Exit Status

0  
Success

1  
Any error following successful command line processing. A message is printed to standard error.

If `cmd` is specified, pbs_attach waits for `cmd` to exit, then exits with the exit value of `cmd`.

If `cmd` is not specified, pbs_attach exits after attaching the session ID(s) to the job.

### 2.7.6 See Also

The PBS Professional Administrator's Guide, pbs_mom(8B), pbs_tmsh(8B), tm(3)

### 2.8 pbs_dataservice

Start, stop, or check the status of PBS data service

#### 2.8.1 Synopsis

`pbs_dataservice [start|stop|status]`
2.8.2 Description

The `pbs_dataservice` command starts, stops or gets the status of the PBS data service.

2.8.3 Permission

On UNIX, root privilege is required to use this command. On Windows, Admin privilege is required.

2.8.4 Arguments

- **start**
  Starts the PBS data service.
- **stop**
  Stops the PBS data service.
  Can be used only when PBS server is not running.
- **status**
  Displays the status of the PBS data service, as follows:
  - Data service running
    - PBS Data Service running
  - Data service not running
    - PBS Data Service not running

2.8.5 Exit Status

Zero for success
Non-zero for failure

2.9 `pbs_ds_password`

Sets or changes data service user account or its password

2.9.1 Synopsis

`pbs_ds_password [-r] [-C username]`
2.9.2 Description

You can use this command to change the user account or account password for the data service. Blank passwords are not allowed.

2.9.3 Permissions

On UNIX, root privilege is required to use this command. On Windows, Admin privilege is required.

2.9.4 Restrictions

Do not run this command if failover is configured. It is important not to inadvertently start two separate instances of the data service on two machines, thus potentially corrupting the database.

2.9.5 Options to pbs_ds_password

- **C <username>**  
  Changes user account for data service to specified account. Specified user account must already exist.  
  On UNIX-based systems, the specified user account must not be root.  
  On Windows, the specified user account must match the PBS service account (which can be any user account.)  
  This option cannot be used while the data service is running.  
  Can be used with the -r option to automatically generate a password for the new account.

- **r**  
  Generates a random password. The data service is updated with the new password.  
  Can be used with the -C option.

- **<no option>**  
  Asks the user to enter a new password twice. Entries must match. Updates data service with new password.
2.9.6 Exit Status

Zero on success.
Non-zero on failure.

2.10 pbs_hostn

Reports hostname and network address(es)

2.10.1 Synopsis

`pbs_hostn [-v] hostname`
`pbs_hostn --version`

2.10.2 Description

The `pbs_hostn` command takes a hostname, and reports the results of both `gethostbyname(3)` and `gethostbyaddr(3)` system calls. Both forward and reverse lookup of hostname and network addresses need to succeed in order for PBS to authenticate a host.

Running this command can assist in troubleshooting problems related to incorrect or non-standard network configuration, especially within clusters.

2.10.3 Options

- `-v`
  Turns on verbose mode.

- `--version`
  The `pbs_hostn` command returns its PBS version information and exits. This option can only be used alone.

2.10.4 Operands

The `pbs_hostn` command accepts a hostname operand either in short name form, or in fully qualified domain name (FQDN) form.
2.10.5 Standard Error

The `pbs_hostn` command will write a diagnostic message to standard error for each error occurrence.

2.10.6 Exit Status

Zero upon successful processing of all the operands presented to the `pbs_hostn` command.
Greater than zero if the `pbs_hostn` command fails to process any operand.

2.10.7 See Also

The PBS Professional Administrator's Guide and the following manual page: `pbs_server(8B)`

2.11 `pbs_idled`

PBS daemon to watch the X console and inform pbs_mom of idle time

2.11.1 Synopsis

```
pbs_idled [-w wait_time] [-f idle_file] [-D display] [-r reconnect_delay]
pbs_idled --version
```

2.11.2 Description

The `pbs_idled` program sits and watches an X windows display and communicates the idle time of the display back to PBS. If the mouse is moved or a key is touched, PBS is informed that the node is busy.

This program should be run out of the system-wide Xsession file. It should be run in the background before the window manager is run. If this program is run outside of the Xsession, it will need to be able to make a connection to the X display. See the `xhost` or `xauth` man pages for a description of X security.
2.11.3 Options to `pbs_idled`

- `-w <wait_time>`
  Granularity between when the daemon checks for events or pointer move-
  ment.

- `-f <idle_file>`
  Update file times on `<file>`. PBS will not monitor any other than the
default.

- `-D <display>`
  The display to connect to and monitor.

- `-r <reconnect_delay>`
  The amount of time to try and reconnect to the X display if the previous
  attempt was unsuccessful.

- `--version`
  The `pbs_idled` command returns its PBS version information and exits.
  This option can only be used alone.

2.11.4 See Also

The PBS Professional Administrator's Guide and the following manual pages:
`pbs_mom(8B), xhost(1), xauth(1)`

2.12 `pbs_init.d`

Start, stop, restart, or get the PIDs of PBS daemons

2.12.1 Synopsis

```
pbs_init.d [start|stop|restart|status]
```

2.12.2 Description

The `pbs_init.d` command starts, stops or restarts all PBS daemons on the local machine.
Does not affect other hosts. It also reports the PIDs of all daemons when given the status
argument.
2.12.2.1 Caveats

This command operates only on daemons that are marked as active in `pbs.conf`. For example, if `PBS_START_MOM` is set to 0 in the local `pbs.conf`, this command will not operate on `pbs_mom`, and will not start, stop, or restart `pbs_mom`.

2.12.2.2 Privilege

PBS Manager privilege is required to use this command.

2.12.3 Arguments

- **start**
  Each daemon on the local machine is started. PBS reports the number and type of licenses available, as well as the name of the license server. Any running jobs are killed.

- **stop**
  Each daemon on the local machine is stopped, and its PID is reported.

- **restart**
  All daemons on the local machine are stopped, then they are restarted. PBS reports the name of the license server and the number and type of licenses available.

- **status**
  PBS reports the PID of each daemon on the local machine.

2.12.4 See Also

The PBS Professional Administrator's Guide, `pbs_mom(8B)`, `pbs_server(8B)`, `pbs_sched(3)`

2.13 **pbs_lamboot**

PBS front end to LAM's `lamboot` program

2.13.1 Synopsis

```
pbs_lamboot
pbs_lamboot --version
```
2.13.2 Description

The PBS command `pbs_lamboot` replaces the standard `lamboot` command in a PBS LAM MPI job, for starting LAM software on each of the PBS execution hosts running Linux 2.4 or higher.

Usage is the same as for LAM’s `lamboot`. All arguments except for `bhost` are passed directly to `lamboot`. PBS will issue a warning saying that the `bhost` argument is ignored by PBS since input is taken automatically from `$PBS_NODEFILE`. The `pbs_lamboot` program will not redundantly consult the `$PBS_NODEFILE` if it has been instructed to boot the nodes using the `tm` module. This instruction happens when an argument is passed to `pbs_lamboot` containing “`-ssi boot tm`” or when the `LAM_MPI_SSI_boot` environment variable exists with the value `tm`.

2.13.3 Options

  --version
  The `pbs_lamboot` command returns its PBS version information and exits. This option can only be used alone.

2.13.4 Operands

The operands for `pbs_lamboot` are the same as for `lamboot`.

2.13.5 Environment Variables and Path

The `PATH` on remote machines must contain `PBS_EXEC/bin`.

2.13.6 See Also

The PBS Professional Administrator's Guide, `lamboot(1)`, `tm(3)`

2.14 `pbs_migrate_users`

Transfers per-user or per-server passwords between PBS servers during a migration upgrade
2.14.1 Synopsis

`pbs_migrate_users old_server new_server`

`pbs_migrate_users --version`

2.14.2 Description

The `pbs_migrate_users` command is used to transfer the per-user or per-server password of a PBS user from one server to another during a migration upgrade. Users’ passwords on the old server are not deleted.

Available on Windows and supported Linux x86 and x86_64 platforms only.

2.14.3 Options

`--version`

The `pbs_migrate_users` command returns its PBS version information and exits. This option can only be used alone.

2.14.4 Operands

The format of `old_server` and `new_server` is

`hostname[:port_number]`

2.14.5 Exit Status

0  
Success

-1  
Writing out passwords to files failed.

-2  
Communication failure between `old_server` and `new_server`.

-3  
`Single_signon_password_enable` not set in either `old_server` or `new_server`

-4  
User running `pbs_migrate_users` not authorized to migrate users.
2.14.6 See Also

pbs_password(8B)

2.15 pbs_mkdirs

Create, or fix the permissions of, the directories and files used by PBS

2.15.1 Synopsis

pbs_mkdirs

pbs_mkdirs [ mom | sched | server ]

2.15.2 Description

Runs on Windows only. If the directories and files used by PBS exist, the pbs_mkdirs command fixes their permissions. If the directories and/or files do not exist, the pbs_mkdirs command creates them, with the correct permissions. The pbs_mkdirs command always examines the following directories and files:

- pbs.conf
- PBS_EXEC
- PBS_HOME/spool
- PBS_HOME/undelivered
- PBS_HOME/pbs_environment

2.15.3 Options

mom

The pbs_mkdirs command examines the following additional items:

- PBS_HOME/mom_priv
- PBS_HOME/mom_logs

sched

The pbs_mkdirs command examines the following additional items:

- PBS_HOME/sched_priv
- PBS_HOME/sched_logs
server

The `pbs_mkdirs` command examines the following additional items:

- PBS_HOME/server_priv
- PBS_HOME/server_logs

(no options)

The `pbs_mkdirs` command examines all of the files and directories specified for each of the mom, server, and sched options.

2.15.4 See Also

The PBS Professional Administrator’s Guide, `pbs_probe(8B)`

2.16 `pbs_mom`

The PBS job monitoring and execution daemon

2.16.1 Synopsis

```
pbs_mom [-a alarm_timeout] [-C checkpoint_directory] [-c config_file] [-d home_directory]
         script_options]
pbs_mom --version
```

2.16.2 Description

The `pbs_mom` command starts the PBS job monitoring and execution daemon, called `MOM`. A special HPC Basic Profile MOM manages jobs for an HPC Basic Profile Server. This MOM is called the HPCBP MOM; the standard MOM is called the MOM. See HPCBP MOM below.

The standard MOM starts jobs on the execution host, monitors and reports resource usage, enforces resource usage limits, and notifies the server when the job is finished. The MOM also runs any prologue scripts before the job runs, and runs any epilogue scripts after the job runs.

The MOM performs any communication with job tasks and with other MOMs. The MOM on the first vnode on which a job is running manages communication with the MOMs on the remaining vnodes on which the job runs.
The MOM manages one or more vnodes. PBS may treat a host such as an Altix as a set of virtual nodes, in which case one MOM would manage all of the host’s vnodes. See the PBS Professional Administrator’s Guide.

The MOM’s log file is in PBS_HOME/mom_logs. The MOM writes an error message in its log file when it encounters any error. If it cannot write to its log file, it writes to standard error. The MOM will write events to its log file. The MOM writes its PBS version and build information to the logfile whenever it starts up or the logfile is rolled to a new file.

The executable for pbs_mom is in PBS_EXEC/sbin, and can be run only by root.

### 2.16.2.1 HPCBP MOM

The HPCBP MOM acts as an intermediary between the PBS complex and the HPCBP Server. The HPCBP MOM does the following:

- Converts between formats used by PBS and HPCBP for information going both to and from the HPC Basic Profile Server.
- Takes job requests from the PBS complex, converts them to JSDL, and submits these converted jobs to the HPC Basic Profile Server.
- Retrieves job and node status information from the HPCBP Server and hands this status information to the PBS Server.

One HPCBP MOM is required for each HPCBP Server.

The HPCBP MOM is created by setting the HPCBP-specific vnode attributes on the vnode that will host the HPCBP MOM. These are the attributes prefixed by “hpcbp_”. See the pbs_node_attributes(7B) man page.

Many of the configuration variables for pbs_mom behave differently in the HPCBP MOM. See the PBS Professional Administrator’s Guide.

### 2.16.2.2 Cpusets

A cpusetted machine can have a boot cpuset defined by the administrator. A boot cpuset contains one or more CPUs and memory boards and is used to restrict the default placement of system processes, including login. If defined, the boot cpuset will contain CPU 0.

Run parallel jobs exclusively within a cpuset for repeatability of performance. SGI states, “Using cpusets on an Altix system improves cached locality and memory access times and can substantially improve an application’s performance and runtime repeatability.”

The CPUSER_CPU_EXCLUSIVE flag will prevent CPU 0 from being used by the MOM in the creation of job cpusets. This flag is set by default, so this is the default behavior.
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To find out which cpuset is assigned to a running job, use `qstat -f` to see the cpuset field in the job’s altid attribute.

2.16.2.2.i  

Altix Running ProPack 6 or 7 or Performance Suite 1

The cpusets created for jobs are marked cpu-exclusive.

MOM does not use any CPU which was in use at startup.

A PBS job can run across multiple Altixes that run ProPack 6 or 7 or Performance Suite 1.

PBS can run using SGI’s MPI (MPT) over InfiniBand. See the PBS Professional Administrator’s Guide.

2.16.2.3  

Effect on Jobs of Starting MOM

When MOM is started or restarted, her default behavior is to leave any running processes running, but to tell the PBS server to requeue the jobs she manages. MOM tracks the process ID of jobs across restarts.

In order to have all jobs killed and requeued, use the `r` option when starting or restarting MOM.

In order to leave any running processes running, and not to requeue any jobs, use the `p` option when starting or restarting MOM.

2.16.3  

Options to `pbs_mom`

- `-a alarm_timeout`
  Number of seconds before alarm timeout. Whenever a resource request is processed, an alarm is set for the given amount of time. If the request has not completed before `alarm_timeout`, the OS generates an alarm signal and sends it to MOM.
  Format: Integer
  Default: 10 seconds

- `-C checkpoint_directory`
  Specifies the path to the directory where MOM creates job-specific subdirectories used to hold each job’s restart files. MOM passes this path to checkpoint and restart scripts. Overrides other checkpoint path specification methods. Any directory specified with the `-C` option must be owned, readable, writable, and executable by root only (`rwx`, `---`, `---`, or `0700`), to protect the security of the restart files. See the `-d` option to `pbs_mom` and section 10.3.6.5, “Specifying Checkpoint Path” on page 629 in the PBS Professional Administrator’s Guide.
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Format: *String*
Default: `PBS_HOME/checkpoint`

- **-c config_file**
  
  MOM will read this alternate default configuration file upon starting. If this is a relative file name it will be relative to `PBS_HOME/mom_priv`. If the specified file cannot be opened, `pbs_mom` will abort. See the `-d` option.

  MOM’s normal operation, when the `-c` option is not given, is to attempt to open the default configuration file `PBS_HOME/mom_priv/config`. If this file is not present, `pbs_mom` will log the fact and continue.

- **-d home_directory**
  
  Specifies the path of the directory to be used in place of `PBS_HOME` by `pbs_mom`. The default directory is given by `$PBS_HOME`.

  Format: *String*

- **-L logfile**
  
  Specifies an absolute path and filename for the log file. The default is a file named for the current date in `PBS_HOME/mom_logs/`. See the `-d` option.

  Format: *String*

- **-M TCP_port**
  
  Specifies the number of the TCP port on which MOM will listen for server requests and instructions.

  Format: integer port number.

  Default: `15002`.

- **-n nice_val**
  
  Specifies the priority for the `pbs_mom` daemon.

  Format: integer.

- **-N**
  
  Specifies that when starting, MOM should not detach from the current session.

- **-p**
  
  Specifies that when starting, MOM should allow any running jobs to continue running, and not have them requeued. This option can be used for single-host jobs only; multi-host jobs cannot be preserved. Cannot be used with the `-r` option. MOM is not the parent of these jobs.

---

**Altix running ProPack 6 or 7 or Performance Suite 1**

The Altix ProPack or Performance Suite cpuset `pbs_mom` will, if given the `-p` flag, use the existing CPU and memory allocations for the
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/PBSPro cpusets. The default behavior is to remove these cpusets. Should this fail, MOM will exit, asking to be restarted with the -p flag.

-r

Specifies that when starting, MOM should requeue any rerunnable jobs and kill any non-rerunnable jobs that she was tracking, and mark the jobs as terminated. Cannot be used with the -p option. MOM is not the parent of these jobs.

It is not recommended to use the -r option after a reboot, because process IDs of new, legitimate tasks may match those MOM was previously tracking. If they match and MOM is started with the -r option, MOM will kill the new tasks.

-R UDP_port

Specifies the number of the UDP port on which MOM will listen for pings, resource information requests, communication from other MOMs, etc.

Format: integer port number

Default: 15003

-S server_port

Specifies the number of the TCP port on which pbs_mom initially contact the server.

Format: integer port number

Default: 15001

-s script_options

This option provides an interface that allows the administrator to add, delete, and display MOM’s configuration files. See CONFIGURATION FILES. script_options are used this way:

-s insert <scriptname> <inputfile>

Reads inputfile and inserts its contents in a new site-defined pbs_mom configuration file with the filename scriptname. If a site-defined configuration file with the name scriptname already exists, the operation fails, a diagnostic is presented, and pbs_mom exits with a nonzero status. Scripts whose names begin with the prefix “PBS” are reserved. An attempt to add a script whose name begins with “PBS” will fail. pbs_mom will print a diagnostic message and exit with a nonzero status. Example:

    pbs_mom -s insert <scriptname> <inputfile>

-s remove <scriptname>

The configuration file named scriptname is removed if it exists. If the given name does not exist or if an attempt is made to remove a script
with the reserved “PBS” prefix, the operation fails, a diagnostic is presented, and pbs_mom exits with a nonzero status. Example:

```bash
pbs_mom -s remove <scriptname>
```

-s show <scriptname>
Causes the contents of the named script to be printed to standard output. If scriptname does not exist, the operation fails, a diagnostic is presented, and pbs_mom exits with a nonzero status. Example:

```bash
pbs_mom -s show <scriptname>
```

-s list
Causes pbs_mom to list the set of PBS-prefixed and site-defined configuration files in the order in which they will be executed. Example:

```bash
pbs_mom -s list
```

**WINDOWS:**
Under Windows, the -N option must be used, so that pbs_mom will start up as a standalone program. For example:

```bash
pbs_mom -N -s insert <scriptname> <inputfile>
```

or

```bash
pbs_mom -N -s list
```

--version
The pbs_mom command returns its PBS version information and exits. This option can only be used alone.

## 2.16.4 Files and Directories

- `PBS_HOME/mom_priv`
  Default directory for default configuration files.
- `PBS_HOME/mom_priv/config`
  MOM’s default configuration file.
- `PBS_HOME/mom_logs`
  Default directory for log files written by MOM.
- `PBS_HOME/mom_priv/prologue`
  File containing administrative script to be run before job execution.
- `PBS_HOME/mom_priv/epilogue`
  File containing administrative script to be run after job execution.
2.16.5 Signal Handling

pbs_mom handles the following signals:

- **SIGHUP**
  
  The pbs_mom daemon will reread its configuration files, close and reopen the log file, and reinitialize resource structures.

- **SIGALRM**
  
  MOM writes a log file entry. See the -a alarm_timeout option.

- **SIGINT**
  
  The pbs_mom daemon exits, leaving all running jobs still running. See the -p option.

- **SIGKILL**
  
  This signal is not caught. The pbs_mom daemon exits immediately.

- **SIGTERM, SIGXCPU, SIGXFSZ, SIGCPULIM, SIGSHUTDN**
  
  The pbs_mom daemon terminates all running children and exits.

- **SIGPIPE, SIGUSR1, SIGUSR2, SIGINFO**
  
  These are ignored.

All other signals have their default behavior installed.

2.16.6 Exit Status

- Greater than zero if the pbs_mom daemon fails to start, if the -s insert option is used with an existing scriptname, or if the administrator attempts to add a script whose name begins with “PBS”.
- Greater than zero if the administrator attempts to use the -s remove option on a nonexistent configuration file, or on a configuration file whose name begins with “PBS”.
- Greater than zero if the administrator attempts to use the -s show option on a nonexistent script.

2.16.7 See Also

The PBS Professional Administrator’s Guide, pbs_server(8B), pbs_sched(8B), qstat(1B), SGI’s Altix documentation
2.17  pbs_mom_globus

Starts the PBS job monitoring and execution daemon that supports Globus

2.17.1  Synopsis

```
              [-R RPP_Globus_port] [-r] [-x]
```

2.17.2  Description

The `pbs_mom_globus` command starts the operation of a batch Machine Oriented Mini-
server, MOM supporting Globus, on the local host. Typically, this command will be in a local
boot file such as `/etc/rc.local`. To ensure that the `pbs_mom_globus` command is
not runnable by the general user community, the server will only execute if its real and effec-
tive uid is zero.

When `pbs_mom_globus` picks up a job for execution, the globus resource string `-l
site=globus:<gatekeeper>` of the job is consulted and used to open up a connection to Glo-
bus. `pbs_mom` forks a process for the job, starts up a globus-gass-server on a 1 server per
unique username scheme, transforms #PBS directive lines in the user’s submission script into
an RSL string and submits the job to Globus, and exits out of the forked process. All Globus
job state changes are communicated back to `pbs_mom_globus` through periodic polling.

When a job fails to submit due to globus job initialization failures, or any non GRAM authen-
tication failures, then error message gets dumped into stderr and user is sent email.

When job fails due to no user password, proxy credential from certificate, or credential has
expired, or some sort of “handshaking” error, then user is sent email of the error, and job is
placed on hold.

`pbs_mom_globus` will record a diagnostic message in a log file for any error occurrence.
The log files are maintained in the `mom_globus_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.

2.17.3  Options to `pbs_mom_globus`

- `-a alarm`

  Used to specify 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 10 seconds.

-c config
Specify a alternative configuration file, see description below. If this is a
relative file name it will be relative to \texttt{PBS\_HOME/mom\_globus\_priv},
see the -d option. If the specified file cannot be opened,
\texttt{pbs\_mom\_globus} will abort. If the -c option is not supplied,
\texttt{pbs\_mom\_globus} will attempt to open the default configuration file
“config” in \texttt{PBS\_HOME/mom\_globus\_priv}. If this file is not present,
\texttt{pbs\_mom\_globus} will log the fact and continue.

-d directory
Specifies the path of the directory which is the home of the servers working
files, \texttt{PBS\_HOME}. This option is typically used along with -M when
debugging MOM Globus. The default directory is given by
\texttt{$PBS\_SERVER\_HOME} which is typically \texttt{/usr/spool/PBS}.

-L logfile
Specify an absolute path name for use as the log file. If not specified,
MOM Globus will open a file named for the current date in the
\texttt{PBS\_HOME/mom\_globus\_logs} directory, see the -d option.

-M MOM\_Globus\_port
Specifies the port number on which the mini-server with Globus will listen
for batch requests. Default: 15005.

-R RPP\_Globus\_port
Specifies the port number on which the mini-server with Globus will listen
for resource monitor requests. Both a UDP and a TCP port of this number
will be used.
Default: 15006.

-r
Specifies the impact on jobs which were in execution when the mini-server
shut down. With the -r option, MOM Globus will cancel submitted Globus
jobs, mark the jobs as terminated, and notify the batch server which owns
the job.

Normally the mini-server is started from the system boot file without the -r
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. It will however
attempt to cancel the Globus job.

If the -r option is used following a reboot, process ids (pids) may be reused
and MOM may kill a process that is not a batch session.
2.17.4 Configuration Files

The configuration file may 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_globus: 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).

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.

2.17.4.1 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
```

2.17.4.2 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”:

```
escape !echo 0xx %yyy
```

If a query for “escape” is sent with no qualifiers, the command executed would be “echo 0xx %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.
2.17.4.3 Initialization Value

An initialization value directive has a name which starts with a dollar sign ($) and must be known to MOM via an internal table. The entries in this table now are:

clienthost

which causes a host name to be added to the list of hosts which will be allowed to connect to MOM as long as they are using a privileged port. For example, here are two configuration file lines which will allow the hosts “fred” and “wilma” to connect:

\$clienthost fred
\$clienthost wilma

Two host name are always allowed to connect to pbs_mom_globus, “localhost” and the name returned to pbs_mom_globus by the system call gethostname(). These names need not be specified in the configuration file.

restricted

which causes a host name to be added to the list of hosts which will be allowed to connect to MOM Globus without needing to use a privileged port. These names allow for wildcard matching. For example, here is a configuration file line which will allow queries from any host from the domain “ibm.com”.

\$restricted *.ibm.com

The restriction which applies to these connections is that only internal queries may be made. No resources from a config file will be found. This is to prevent any shell commands from being run by a non-root process.

logevent

which sets the mask that determines which event types are logged by pbs_mom_globus. For example:

\$logevent 0x1fff
\$logevent 255

The first example would set the log event mask to 0x1ff (511) which enables logging of all events including debug events. The second example would set the mask to 0x0ff (255) which enables all events except debug events.

The configuration file must be “secure”. It must be owned by a user id and group id less than 10 and not be world writable.
2.17.5 Files

$PBS_SERVER_HOME/mom_globus_priv
the default directory for configuration files, typical (/usr/spool/pbs)/mom_globus_priv.

$PBS_SERVER_HOME/mom_globus_logs
directory for log files recorded by the server.

$PBS_SERVER_HOME/mom_globus_priv/prologue
the administrative script to be run before job execution.

$PBS_SERVER_HOME/mom_globus_priv/epilogue
the administrative script to be run after job execution.

2.17.6 Signal Handling

pbs_mom_globus handles the following signals:

SIGHUP
causes pbs_mom_globus to re-read its configuration file, close and reopen the log file, and reinitialize resource structures.

SIGALRM
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.

SIGINT and SIGTERM
Result in pbs_mom_globus terminating all running children and exiting. This is the action for the following signals as well: SIGXCPU, SIGXFSZ, SIGCPULIM, and SIGSHUTDN.

SIGPIPE, SIGUSR1, SIGUSR2, SIGINFO
are ignored.

All other signals have their default behavior installed.

2.17.7 Exit Status

If the mini-server command fails to begin operation, the server exits with a value greater than zero.
Chapter 2  PBS Commands

2.17.8  See Also

The PBS Professional Administrator’s Guide and the following manual pages: pbs_server(8B), pbs_sched(8B)

2.18  pbs_mpihp

Runs an MPI application in a PBS job with HP MPI

2.18.1  Synopsis

pbs_mpihp [-np #] [-h host] [other HP mpirun options] program [args]
pbs_mpihp [HP mpirun options] -f appfile [-- [<extra_args>]]
pbs_mpihp --version

2.18.2  Description

The PBS command pbs_mpihp replaces the standard mpirun command in a PBS HP MPI job, for executing programs.

pbs_mpihp is a front end to the HP MPI version of mpirun. It is for PBS jobs running under Linux 2.4 and higher. pbs_mpihp has the same usage as mpirun. When pbs_mpihp is invoked from a PBS job, it will process the command line arguments, then call standard HP mpirun to actually start the MPI ranks. The ranks created will be mapped onto cpus on the nodes allocated to the PBS job. The environment variable MPI_REMSSH will be set to $PBS_EXEC/bin/pbs_tmrsh. This will cause the processes that are created to become part of the PBS job.

The path to standard HP mpirun is found by checking to see if a link exists with the name PBS_EXEC/etc/pbs_mpihp. If this link exists, it will point to standard HP mpirun. If it does not exist, a call to mpirun --version will be made to determine if it is HP mpirun. If so, the call will be made to “mpirun” without an absolute path. If HP mpirun cannot be found, an error will be output, all temp files will be cleaned up and the script will exit with value 127.

If pbs_mpihp is invoked from outside a PBS job, it will pass all of its arguments directly to standard HP mpirun without further processing.
The first form above allows one executable to be specified. The second form above uses an appfile to list multiple executables. The format is described in the HP mpirun man page. If this form is used from inside a PBS job, the file will be read to determine what executables are to be run and how many processes will be started for each.

When HP MPI is wrapped with pbs_mpihp, “rsh” is the default used to start the mpids. If you wish to use “ssh” or something else, be sure to set the following in $PBS_HOME/pbs_environment:

```
PBS_RSHCOMMAND=ssh
```

or put the following in the job script:

```
export PBS_RSHCOMMAND=<rsh_cmd>
```

Executing pbs_mpihp with the -client option is not supported under PBS.

### 2.18.3 Usage

Usage is the same as for HP mpirun.

### 2.18.4 Options to pbs_mpihp

All options except the following are passed directly to HP mpirun with no modification.

- `-client`
  Not supported.

- `-np number`
  Specifies the number of processes to run on the PBS nodes.

- `-h host`
  Ignored by pbs_mpihp.

- `-l user`
  Ignored by pbs_mpihp.

- `-f appfile`
  The specified appfile is read by pbs_mpihp.

- `--version`
  The pbs_mpihp command returns its PBS version information and exits. This option can only be used alone.

### 2.18.5 See Also

The PBS Professional Administrator’s Guide
Chapter 2  PBS Commands

mpirun(1)

2.19  pbs_mpilam

Runs MPI programs under PBS with LAM MPI

2.19.1  Synopsis

pbs_mpilam [options]
pbs_mpilam --version

2.19.2  Description

The PBS command pbs_mpilam replaces the standard mpirun command in a PBS LAM
MPI job, for executing programs under Linux 2.4 or higher.

Usage is the same as for LAM mpirun. All options are passed directly to mpirun. If used
to run a single program, PBS tracks resource usage and controls all user processes spawned
by the program. If used to run multiple programs as specified in an application file (no
<where> argument and no -np/-c option), then PBS does not manage the spawned user pro-
cesses of each program.

If the where argument is not specified, then pbs_mpilam will try to run the user’s program
on all available CPUs using the C keyword.

2.19.3  Options to pbs_mpilam

(options)  The pbs_mpilam command uses the same options as mpirun.
--version  The pbs_mpilam command returns its PBS version information and
          exits. This option can only be used alone.

2.19.4  Path

The PATH on remote machines must contain PBS_EXEC/bin.
2.20 pbs_mpirun

Runs MPI programs under PBS with MPICH

2.20.1 Synopsis

pbs_mpirun [options]

pbs_mpirun --version

2.20.2 Description

The PBS command pbs_mpirun replaces the standard mpirun command in a PBS
MPICH job using P4 running under Linux 2.4 and higher. Usage is the same as for mpirun,
except for the -machinefile option. All other options are passed directly to mpirun.

On Windows, this command cannot be used to start job processes or track a job’s resource
usage.

2.20.3 Options to pbs_mpirun

(options)

The options to pbs_mpirun are the same as for mpirun, except for the
-machinemfile option. This is generated by pbs_mpirun. The user should
not attempt to specify -machinefile.

The value for -machinefile is a temporary file created from
PBS_NODEFILE in the format:

hostname-1[number of processors]
hostname-2[number of processors]
hostname-n[number of processors]

where if the number of processors is not specified, it is 1. An attempt by the
user to specify the -machinefile option will result in a warning saying
“Warning, -machinefile value replaced by PBS”.

2.19.5 See Also

The PBS Professional Administrator’s Guide

mpirun(1)
Chapter 2  

**PBS Commands**

The default value for the `-np` option is the number of entries in `PBS_NODEFILE`.

--version  
The `pbs_mpirun` command returns its PBS version information and exits. This option can only be used alone.

2.20.4  
**Environment Variables**

`pbs_mpirun` modifies `P4_RSHCOMMAND` and `PBS_RSHCOMMAND`. Users should not edit these. `pbs_mpirun` copies the value of `P4_RSHCOMMAND` into `PBS_RSHCOMMAND`.

2.20.5  
**Path**

The `PATH` on remote machines must contain `PBS_EXEC/bin`.

2.20.6  
**See Also**

The PBS Professional Administrator’s Guide  
`mpirun(1)`

2.21  
**pbs_password**

Sets or updates password of a PBS user

2.21.1  
**Synopsis**

`pbs_password [-r] [-s server] [-d] [user]`

`pbs_password --version`

2.21.2  
**Description**

The `pbs_password` command is used to set or update the password of a PBS user. The user does not have to have any jobs on the system.
When no options are given to `pbs_password`, the password credential on the default PBS server for the current user, i.e. the user who executes the command, is updated to the prompted password. Any user jobs previously held due to an invalid password are not released.

Available on Windows and supported Linux x86 and x86_64 platforms only.

The `pbs_password` command has no effect on running jobs. Queued jobs use the new password.

The `pbs_password` command does not change the user's password on the current host, only the password that is cached in PBS.

Note that `pbs_password` encrypts the password obtained from the user before sending it to the PBS Server.

### 2.21.3 Options to `pbs_password`

**(no options)**

The user is prompted for a new password. The password credential on the default PBS server for the current user, i.e. the user who executes the command, is updated to the prompted password. Any user jobs previously held due to an invalid password are not released.

**-r**

Any user jobs previously held due to an invalid password are released.

**-s server**

Allows user to specify server where password will be changed.

**-d**

Deletes the password.

**user**

The password credential of user user is updated to the prompted password. If user is not the current user, this action is only allowed if one of the following is true:

- The current user is root or admin.
- User user has given the current user explicit access via the ruserok() mechanism, i.e. the hostname of the machine from which the current user is logged in appears in the server’s `hosts.equiv` file, or the current user has an entry in user’s `HOMEDIR\.rhosts` file.

**--version**

The `pbs_password` command returns its PBS version information and exits. This option can only be used alone.
2.21.4 Exit Status

Table 2-2: Exit Status

<table>
<thead>
<tr>
<th>Exit Status</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Success</td>
</tr>
<tr>
<td>-1</td>
<td>single_signon_password_enable not set</td>
</tr>
<tr>
<td>-2</td>
<td>Password of user on server failed to be created/updated</td>
</tr>
<tr>
<td>-3</td>
<td>Failed to release jobs held due to bad password owned by user on server</td>
</tr>
<tr>
<td>-4</td>
<td>Failed to delete password of user on server</td>
</tr>
<tr>
<td>-5</td>
<td>Current user not authorized to change password of user</td>
</tr>
</tbody>
</table>

2.21.5 See Also

qhold(1B), qrls(1B), qselect(1B), ruserok()

2.22 pbs_probe

Reports PBS diagnostic information

2.22.1 Synopsis

```
pbs_probe [ -f | -v ]
```

`pbs_probe --version`

2.22.2 Description

The `pbs_probe` command reports post-installation information that is useful for PBS diagnostics. Aside from the direct information that is supplied on the command line, `pbs_probe` uses as the source for basic information the file `/etc/pbs.conf` and the values of any of the following environment variable that may be set in the environment in which `pbs_probe` is run: PBS_CONF_FILE, PBS_HOME, PBS_EXEC, PBS_START_SERVER, PBS_START_MOM, and PBS_START_SCHED.
In order to execute `pbs_probe`, the user must have PBS Operator or Manager privilege.

Used without options, the `pbs_probe` runs in “report” mode. In this mode `pbs_probe` reports on any errors in the PBS infrastructure files that it detects. The problems are categorized, and a list of the problem messages placed in each category are output. Those categories which are empty do not show in the output.

### 2.22.3 Options to `pbs_probe`

- `-f`
  
  Run in “fix” mode. In this mode `pbs_probe` will examine each of the relevant infrastructure files and, where possible, fix any errors that it detects, and print a message of what got changed. If it is unable to fix a problem, it will simply print a message regarding what was detected.

- `-v`
  
  Run in “verbose” mode. If the verbose option is turned on, `pbs_probe` will also output a complete list of the infrastructure files that it checked.

- `--version`
  
  The `pbs_probe` command returns its PBS version information and exits. This option can only be used alone.

### 2.22.4 Standard Error

The `pbs_probe` command will write a diagnostic message to standard error for each error occurrence.

### 2.22.5 Files

`/etc/pbs.conf` `/etc/init.d/pbs`

### 2.22.6 See Also

The PBS Professional Administrator’s Guide and the following manual pages: `pbs_server(8B)`, `pbs_sched(8B)`, `pbs_mom(8B)`.
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2.23  

pbs_rdel

Deletes a PBS advance or standing reservation

2.23.1  

Synopsis

pbs_rdel reservation_identifier[,reservation_identifier...]  
pbs_rdel --version

2.23.2  

Description

The pbs_rdel command deletes reservations in the order in which their reservation identifiers are presented to the command.

A reservation may be deleted by its owner, the PBS Operator, or the PBS Manager.

2.23.3  

Options

--version

The pbs_rdel command returns its PBS version information and exits. This option can only be used alone.

2.23.4  

Operands

The pbs_rdel command accepts one or more reservation_identifier operands.

For an advance reservation this has the form:

[R]sequence_number[.server_name][@remote_server]

For a standing reservation this has the form:

[S]sequence_number[.server_name][@remote_server]

@remote_server is used to specify a reservation at a server other than the default server.

2.23.5  

Exit Status

Zero upon success.

Greater than zero upon failure to process any operand.
2.23.6 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide,
`pbs_rsub(1B)`, `pbs_rstat(1B)`, `pbs_resv_attributes(7B)`

2.24 `pbs_renew`

Renews Kerberos credential

2.24.1 Synopsis

```
pbs_renew [-d] program [arg(s)]
pbs_renew --version
```

2.24.2 Description

The `pbs_renew` command is used internally by PBS when a job has a Kerberos credential. The program is run as a child process with any arguments passed to the command line of program. The `pbs_renew` process runs periodically to renew any Kerberos credential. It will wait for the child process to return, clean up any Kerberos credential and exit when the child process is done.

2.24.3 Options

- `-d` Debug messages are printed to stderr.
- `--version` The `pbs_renew` command returns its PBS version information and exits. This option can only be used alone.

2.24.4 See Also

The PBS Professional Administrator's Guide, `qsub(1B)`
Chapter 2  PBS Commands

2.25  pbs_rstat

Shows status of PBS advance or standing reservations

2.25.1  Synopsis

pbs_rstat [-F] [-B] [-S] [reservation_id...]

pbs_rstat --version

2.25.2  Description

The pbs_rstat command is used to show the status of all reservations on the PBS Server. Denied reservations are not displayed.

This command has three different output formats: brief (B), short (S), and full (F). This command can be used with any level of PBS privilege.

See the pbs_resv_attributes(7B) man page for information about reservation attributes.

2.25.3  Options to pbs_rstat

-B Brief

Displays each reservation identifier only.

-S Short

Displays a table showing the name, queue, owner, state, start time, duration, and end time of each reservation.

-F Full

Displays all reservation attributes that are not set to the default value. Users without manager or operator privilege cannot print custom resources which were created to be invisible to users.

--version

The pbs_rstat command returns its PBS version information and exits. This option can only be used alone.

2.25.4  Output

See section 8.6, “Reservation States”, on page 408.
2.25.5 Operands

The pbs_rstat command accepts one or more reservation_identifier operands.

2.25.5.1 Reservations at the default server

For an advance reservation, the reservation_identifier has the form:

[R]sequence_number[.server_name]

For a standing reservation, the reservation_identifier has the form:

[S]sequence_number[.server_name]

2.25.5.2 Reservations at a server other than the default server:

Specify the remote server’s name using @remote_server.

For an advance reservation:

[R]sequence_number[.server_name][@remote_server]

For a standing reservation:

[S]sequence_number[.server_name][@remote_server]

2.25.6 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide,
pbs_rsub(1B), pbs_rdel(1B), pbs_resv_attributes(7B)

2.26 pbs_rsub

Creates a PBS advance or standing reservation

2.26.1 Synopsis


pbs_rsub --version`
2.26.2 Description

The `pbs_rsub` command is used to create an advance or standing reservation. An advance reservation reserves specific resources for the requested time period, and a standing reservation reserves specific resources for recurring time periods. When a reservation is created, it has an associated queue.

After the reservation is requested, it is either confirmed or denied. Once the reservation has been confirmed, authorized users submit jobs to the reservation’s queue via `qsub` and `qmove`.

A confirmed reservation will accept jobs at any time. The jobs in its queue can run only during the reservation period, whether during a single advance reservation or during the occurrences of a standing reservation.

When an advance reservation ends, all of its jobs are deleted, whether running or queued. When an occurrence of a standing reservation ends, only its running jobs are deleted; those jobs still in the queue are not deleted.

To get information about a reservation, use the `pbs_rstat` command.

To delete a reservation, use the `pbs_rdel` command. Do not use the `qdel` command.

The behavior of the `pbs_rsub` command may be affected by any site hooks. Site hooks can modify the reservation’s attributes.

2.26.3 Requirements

When using `pbs_rsub` to request a reservation, the user must specify two of the following options: `-R`, `-E`, and `-D`. The resource request `-l walltime` can be used instead of the `-D` option.

2.26.4 Options to `pbs_rsub`

- `-D duration`
  Specifies reservation duration. If the start time and end time are the only times specified, this duration time is calculated.
  Format: `Duration`
  Default: none

- `-E end_time`
  Specifies the reservation end time. If start time and duration are the only times specified, the end time value is calculated.
  Format: `Datetime`
Default: none

-g group_list
The group_list is a comma-separated list of group names. The server uses entries on this list, along with an ordered set of rules, to associate a group name with the reservation.

Format: group@hostname[,group@hostname ...]

-G auth_group_list
Comma-separated list of names of groups who can or cannot submit jobs to this reservation. Group names are interpreted in the context of the server’s host, not the context of the host from which the job is submitted.

This list becomes the acl_groups list for the reservation’s queue. More specific entries should be listed before more general, because the list is read left-to-right, and the first match determines access.

If both Authorized_Users and Authorized_Groups are set, a user must belong to both in order to be able to submit jobs to this reservation. If the reservation creator specifies this list, the creator’s group is not automatically added to the list.

Refer to the Authorized_Groups reservation attribute on the pbs_resv_attributes(7B) man page.

Format: [+|-]group_name[,+|-]group_name ...

Default: All groups are authorized to submit jobs.

-H auth_host_list
Comma-separated list of hosts from which jobs can and cannot be submitted to this reservation. This list becomes the acl_hosts list for the reservation’s queue. More specific entries should be listed before more general, because the list is read left-to-right, and the first match determines access.

If the reservation creator specifies this list, the creator’s host is not automatically added to the list.

See the Authorized_Hosts reservation attribute on the pbs_resv_attributes(7B) man page.

Format: [+|-]hostname,[+|-]hostname ...

Default: All hosts are authorized to submit jobs.

-I block_time
Specifies interactive mode. The pbs_rsub command will block, up to block_time seconds, while waiting for the reservation request to be confirmed or denied.
If `block_time` is positive, and the reservation isn’t confirmed or denied in the specified time, the ID string for the reservation is returned with the status “UNCONFIRMED”.

If `block_time` is negative, and the scheduler doesn’t confirm or deny the reservation in the specified time, the reservation is deleted.

Format: `Integer`.
Default: `Not interactive`.

- `l placement`

The placement specifies how a job will be placed on vnodes. The place statement has this form:

```
-l placement={ arrangement }[: sharing ][: grouping]
```

where

- `arrangement` is one of `free` | `pack` | `scatter`
- `sharing` is one of `excl` | `share`
- `grouping` can have only one instance of `group=resource`

and where

- `free`:
  
  Place job on any vnode(s).

- `pack`:
  
  All chunks will be taken from one host.

- `scatter`:
  
  Only one chunk with any MPI processes will be taken from a host. A chunk with no MPI processes may be taken from the same node as another chunk.

- `excl`:
  
  Only this job uses the vnodes chosen.

- `share`:
  
  This job can share the vnodes chosen.

- `group=resource`:
  
  Chunks will be grouped according to a resource. All nodes in the group must have a common value for the resource, which can be either the built-in resource host or a site-defined node-level resource.

Note that nodes can have sharing attributes that override job placement requests.

See the `pbs_node_attributes(7B)` man page.
For more on job placement, see the PBS Professional User’s Guide.

-`l resource_request`

  The resource_request specifies the resources required for the reservation. These resources will be used for the limits on the queue that is dynamically created for the reservation. The aggregate amount of resources for currently running jobs from this queue will not exceed these resource limits. Jobs in the queue that request more of a resource than the queue limit for that resource are not allowed to run. Also, the queue inherits the value of any resource limit set on the server, and these are used for the job if the reservation request itself is silent about that resource. A non-privileged user cannot submit a reservation requesting a custom resource which has been created to be invisible or read-only for users.

  Resources are requested by using the -l option, either in chunks inside of selection statements, or in job-wide requests using resource_name=value pairs. The selection statement is of the form:  
  ```
  -l select=[N:]chunk+[N:]chunk ...
  ```
  where N specifies how many of that chunk, and a chunk is of the form:  
  ```
  resource_name=value[:resource_name=value ...]
  ```
  Job-wide resource_name=value requests are of the form:  
  ```
  -l resource_name=value[,resource_name=value ...]
  ```

-`m mail_points`

  Specifies the set of events that cause mail to be sent to the list of users specified in the -M mail_list option.

  Format: string consisting of 1) any combination of “a”, “b”, “c” or “e”, or 2) the single character “n”.

<table>
<thead>
<tr>
<th>Character</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Notify if the reservation is terminated for whatever reason</td>
</tr>
<tr>
<td>b</td>
<td>Notify when the reservation period begins</td>
</tr>
<tr>
<td>c</td>
<td>Notify when the reservation is confirmed</td>
</tr>
<tr>
<td>e</td>
<td>Notify when the reservation period ends</td>
</tr>
<tr>
<td>n</td>
<td>Send no mail. Cannot be used with any of a, b, c or e.</td>
</tr>
</tbody>
</table>

**Table 2-3: Suboptions to -m Option**
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PBS Commands

Default: “ac”.

-M mail_list

The list of users to whom mail is sent whenever the reservation transitions to one of the states specified in the -m mail_points option. Format: user[@hostname][,user[@hostname]...]

Default: Reservation owner.

-N reservation_name

This specifies a name for the reservation. Format: String up to 15 characters in length. It must consist of printable, non-white space characters with the first character alphabetic. Default: None.

-q destination

Specifies the destination server at which to create the reservation. Default: The default server is used if this option is not selected.

-r recurrence_rule

Specifies rule for recurrence of standing reservations. Rule must conform to iCalendar syntax, and is specified using a subset of parameters from RFC 2445.

Valid syntax for the recurrence_rule takes one of two forms:

FREQ= freq_spec; COUNT= count_spec; interval_spec

or

FREQ= freq_spec; UNTIL= until_spec; interval_spec

where

freq_spec

Frequency with which the standing reservation repeats. Valid values are:

WEEKLY|DAILY|HOURLY

count_spec

The exact number of occurrences. Number up to 4 digits in length. Integer.

interval_spec

Specifies interval. Format is one or both of:

BYDAY = MO|TU|WE|TH|FR|SA|SU
PBS Commands

or

\[ \text{BYHOUR} = 0|1|2|...|23 \]

When using both, separate them with a semicolon.

Elements specified in the recurrence rule override those specified in the arguments to the \(-R\) and \(-E\) options. For example, the \text{BYHOUR} specification overrides the hourly part of the \(-R\) option. For example, \(-R 0730 \-E 0830 \ldots\text{BYHOUR}=9\) results in a reservation that starts at 9:30 and runs for 1 hour.

until spec

Occurrences will start up to but not after date and time specified. Format:

\[ \text{YYYYMMDD/THHMMSS}/ \]

Note that the year-month-day section is separated from the hour-minute-second section by a capital T.

Requirements:

- The recurrence rule must be on one unbroken line and must be enclosed in double quotes.
- A start and end date must be used when specifying a recurrence rule. See the \(R\) and \(E\) options.

- The \text{PBS_TZID} environment variable must be set at the submission host. The format for \text{PBS_TZID} is a timezone location. Examples: America/Los_Angeles, America/Detroit, Europe/Berlin, Asia/Calcutta. See the PBS Professional User’s Guide.

Examples of Standing Reservations

For a reservation that runs every day from 8am to 10am, for a total of 10 occurrences:

\[
\text{pbs}_r\text{sub} \-R 0800 \-E 1000 \-r \text{"FREQ=DAILY;COUNT=10"} \\
\]

Every weekday from 6am to 6pm until December 10, 2008

\[
\text{pbs}_r\text{sub} \-R 0600 \-E 1800 \-r \text{"FREQ=WEEKLY; BYDAY=MO,TU,WE,TH,FR; UNTIL=20081210"} \\
\]

Every week from 3pm to 5pm on Monday, Wednesday, and Friday, for 9 occurrences, i.e., for three weeks:

\[
\text{pbs}_r\text{sub} \-R 1500 \-E 1700 \-r \text{"FREQ=WEEKLY; BYDAY=MO,WE,FR; COUNT=3"} \\
\]
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-R start_time
Specifies reservation starting time. If the reservation’s end time and duration are the only times specified, this start time is calculated.

If the day, DD, is not specified, it defaults to today if the time hhmm is in the future. Otherwise, the day is set to tomorrow. For example, if you submit a reservation with the specification -R 1110 at 11:15 a.m., it is interpreted as being for 11:10am tomorrow. If the month portion, MM, is not specified, it defaults to the current month, provided that the specified day DD, is in the future. Otherwise, the month is set to next month. Similar rules apply to the two other optional, left-side components.

Format: Datetime

-u user_list
Comma-separated list of user names. Not used. Refer to the User_List reservation attribute on the pbs_resv_attributes(7B) man page.

Format: user[@host][,user[@host] ...]

Default: None.

-U auth_user_list
Comma-separated list of users who are and are not allowed to submit jobs to this reservation. This list becomes the acl_users attribute for the reservation’s queue. More specific entries should be listed before more general, because the list is read left-to-right, and the first match determines access.

If both Authorized_Users and Authorized_Groups are set, a user must belong to both in order to be able to submit jobs to this reservation. The reservation creator’s username is automatically added to this list, whether or not the reservation creator specifies this list.

Refer to the Authorized_Users reservation attribute on the pbs_resv_attributes(7B) man page.

Format: [+]user@host,[+|-]user@host...

Default: Job owner only.

-W attribute_value_list
This allows you to define other attributes for the reservation.

Supported attributes:

qmove=jobid
Converts a normal job designated by jobid into a reservation job that will run as soon as possible. Creates the reservation with its queue and moves the job into the reservation’s queue. Uses the resources requested by the job to create the reservation.
When the reservation is created, it inherits its resources from the job, not from the resources requested through the `pbs_rsub` command.

If the `qmove` option is used and the reservation is not confirmed within the timeout period, the reservation is deleted. The default timeout period is 10 seconds. There is no option for this kind of reservation to be unconfirmed.

To specify the timeout, give a negative value for the `-I` option. For example, to specify a timeout of 300 seconds:

```
pbs_rsub -Wqmove=<job ID> -I -300
```

The `-R` and `-E` options to `pbs_rsub` are disabled when using the `qmove=jobid` attribute.

Some shells require that you enclose a job array ID in double quotes. Timeout must be specified with a negative number.

```
--version
```

The `pbs_rsub` command returns its PBS version information and exits. This option can only be used alone.

### 2.26.5 Output

The `pbs_rsub` command returns the reservation name.

For an advance reservation, this has the form

```
RNNNN.server
```

where `N` is a unique integer. The associated queue’s name is the prefix, `RNNNN`.

For a standing reservation, this has the form

```
SNNNN.server
```

where `S` is a unique integer. The associated queue’s name is the prefix, `SNNNN`.

### 2.26.6 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, `pbs_resv_attributes(7B)`, `pbs_rdel(1B)`, `pbs_rstat(1B)`, `qmove(1B)`, `qsub(1B)`
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2.27  pbs_sched

Runs the PBS scheduler

2.27.1  Synopsis

```plaintext
pbs_sched --version
```

2.27.2  Description

`pbs_sched` is the PBS scheduling daemon. It schedules PBS jobs.
`pbs_sched` must be executed with root permission.

2.27.3  Options to `pbs_sched`

- `-a alarm`
  Deprecated. Will overwrite value of `sched_cycle_length` scheduler attribute. Time in seconds to wait for a scheduling cycle to finish.
  Format: Time, in seconds.

- `-c clientsfile`
  Add clients to the scheduler’s list of known clients. The `clientsfile` contains single-line entries of the form
  ```plaintext
  $clienthost <hostname>
  ```
  Each hostname is added to the list of hosts allowed to connect to the scheduler. If `clientsfile` cannot be opened, the scheduler aborts. Path can be absolute or relative. If relative, it is relative to `PBS_HOME/sched_priv`.

- `-d home`
  The directory in which the scheduler will run.
  Default: `PBS_HOME/sched_priv`.

- `-L logfile`
  The absolute path and filename of the log file. The scheduler writes its PBS version and build information to the log file whenever it starts up or the log file is rolled to a new file.
See the `-d` option.

Default: The scheduler will open a file named for the current date in the `PBS_HOME/sched_logs` directory.

- **n**

This will tell the scheduler to not restart itself if it receives a `sigsegv` or a `sigbus`. The scheduler will by default restart itself if it receives either of these two signals. The scheduler will not restart itself if it receives either one within five minutes of starting.

- **N**

Instructs the scheduler not to detach itself from the current session.

- **p file**

Any output which is written to standard out or standard error will be written to this file. The pathname can be absolute or relative, in which case it will be relative to `PBS_HOME/sched_priv`.

See the `-d` option.

Default: `PBS_HOME/sched_priv/sched_out`.

- **R port**

The port for MOM to use. If this option is not given, the port number is taken from `PBS_MANAGER_SERVICE_PORT`, in `pbs.conf`.

Default: `15003`.

- **S port**

The port for the scheduler to use. If this option is not given, the default port for the PBS scheduler is taken from `PBS_SCHEDULER_SERVICE_PORT`, in `pbs.conf`.

Default: `15004`.

- **--version**

The `pbs_sched` command returns its PBS version information and exits. This option can only be used alone.

### 2.27.4 Signal Handling

**SIGHUP**

The scheduler will close and reopen its log file and reread the config file if one exists.

**SIGALRM**

If the scheduler exceeds the time limit, the alarm will cause the scheduler to attempt to core dump and restart itself.
Chapter 2  

**PBS Commands**

---

**SIGINT and SIGTERM**

Will result in an orderly shutdown of the scheduler.

All other signals have the default action installed.

2.27.5  
**Exit Status**

Zero upon normal termination.

2.27.6  
**See Also**

The PBS Professional Administrator’s Guide, pbs_server(8B), pbs_mom(8B)

2.28  
**pbs_server**

Starts a PBS batch server

2.28.1  
**Synopsis**

```
```

`pbs_server --version`

2.28.2  
**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 insure 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. The server writes its PBS version and build information to the logfile whenever it starts up or the logfile is rolled to a new file.

To kill the server:
UNIX/Linux:

```
qterm (see qterm(8B))
```

or

```
"kill <server_pid>", which sends a SIGTERM.
```

Windows:

if you’re running “pbs_server -N” for a standalone mode server, use

```
<cntrl>-<break>.
```

### 2.28.3 Options to pbs_server

- **-a <value>**
  When *True*, the server is in state “*active*” and the scheduler is called to schedule jobs. When *False*, the server is in state “*idle*” and the scheduler is not called to schedule jobs. Sets the server’s scheduling attribute. If the -a T|F option is not specified, the server uses the prior value for the scheduling attribute.
  
  Format: Boolean

- **-A acctfile**
  Specifies an absolute path name for the file to use as the accounting file. If not specified, the file is named for the current date in the PBS_HOME/server_priv/accounting directory.

- **-C**
  The server starts up, creates the database, and exits. Windows only.

- **-d config_path**
  Specifies the path of the directory which is home to the servers 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_HOME which is typically /usr/spool/PBS.

- **-e mask**
  Specifies a log event mask to be used when logging. See “log_events” in the pbs_server_attributes(7B) man page.

- **-F seconds**
  Specifies the number of seconds that the secondary server should wait before taking over when it believes the primary server is down. If the number of seconds is specified as -1, the secondary will make one attempt to contact the primary and then become active.
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Default: 30 seconds

-g mom_globus_port
Specifies the host name and/or port number on which the server should connect the PBS Mom Globus daemon. The option argument, mom_conn, is one of the forms:

host_name, [:]port_number
or
host_name:port_number
If host_name not specified, the local host is assumed. If port_number is not specified, the default port is assumed.

Default: 15005

-G mom_globus_RPPport
Specifies the port number on which the server should query the up/down status of PBS Mom Globus daemon.

Default: 15006

-L logfile
Specifies an absolute path name of the file to use as the log file. If not specified, the file is one named for the current date in the PBS_HOME/server_logs directory
See the -d option.

-M mom_port
Specifies the host name and/or port number on which the server should connect the job executor, MOM. The option argument, mom_conn, is one of the forms:

host_name, [:]port_number
or
host_name:port_number
If host_name not specified, the local host is assumed. If port_number is not specified, the default port is assumed.

See the -M option for pbs_mom(8B).

Default: 15002

-N
The server runs in standalone mode. In Windows, it does not register as a Windows service. On other platforms, MOM will not detach from the current session.
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-p port
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.
Default: 15001

-R mom_RPPport
Specifies the port number on which the server should query the up/down status of Mom. See the -R option for pbs_mom(8B).
Default: 15003

-s replacement_string
Specifies the string to use when replacing spaces in accounting entity names. Only available under Windows.
See the PBS Professional Administrator’s Guide.

-S scheduler_port
Specifies the port number to which the server should connect when contacting the Scheduler. The option argument, scheduler_conn, is of the same syntax as under the -M option.
Default: 15004

-t type
Specifies behavior when the server restarts. The type argument is one of the following:

cold
All jobs are purged. Positive confirmation is required before this direction is accepted.

create
The server will discard any existing configuration files: server, nodes, queues and jobs, and initialize configuration files to the default values. The server is idled (scheduling set False).

hot
All jobs in the Running state are retained in that state. Any job that was requeued into the Queued state from the Running state when the server last shut down will be run immediately, assuming the required resources are available. This returns the server to the same state as when it went down. After those jobs are restarted, then normal scheduling takes place for all remaining queued jobs. All other jobs are retained in their current state.
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If a job cannot be restarted immediately because of a missing resource, such as a node being down, the server will attempt to restart it periodically for up to 5 minutes. After that period, the server will revert to a normal state, as if warm started, and will no longer attempt to restart any remaining jobs which were running prior to the shutdown.

updatedb
Updates format of PBS data from the previous format to the data service format.

warm
All jobs in the Running state are retained in that state. All other jobs are maintained in their current state. The job scheduler will typically make new selections for which jobs are placed into execution. warm is the default if -t is not specified.

--version
The pbs_server command returns its PBS version information and exits. This option can only be used alone.

2.28.4  Files

$PBS_HOME/server_priv
default directory for configuration files.

$PBS_HOME/server_logs
directory for log files recorded by the server.

2.28.5  Signal Handling

On receipt of the following signals, the server performs the defined action:

SIGHUP
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.

SIGTERM
Causes a rapid orderly shutdown of pbs_server, identical to "qterm -t quick".

SIGSHUTDN
On systems (Unicos) where SIGSHUTDN is defined, it also causes an orderly "quick" shutdown of the server.
SIGPIPE, SIGUSR1, SIGUSR2
   These signals are ignored.

All other signals have their default behavior installed.

2.28.6  Exit Status

If the server command fails to begin batch operation, the server exits with a value greater than zero.

2.28.7  See Also

The PBS Professional Administrator’s Guide and the following manual pages: qsub (1B),
pbs_connect(3B), pbs_mom(8B), pbs_sched(8B), pbsnodes(8B),
qdisable(8B), qenable(8B), qmgr(8B), qrun(8B), qstart(8B),
qstop(8B), and qterm(8B)

2.29  pbs_tclsh

TCL shell with TCL-wrapped PBS API

2.29.1  Synopsis

pbs_tclsh
pbs_tclsh -version

2.29.2  Description

The pbs_tclsh is a version of the TCL shell which includes wrapped versions of the PBS external API. The PBS TCL API is documented in the pbs_tclapi (3B) manual page.
Root privilege is required in order to query MOM for dynamic resources. Root privilege is not required in order to query MOM for built-in resources and site-defined static resources.
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The pbs_tclsh command is used to query MOM. For example:

```
> pbs_tclsh
   tclsh> openrm <hostname>
   <file descriptor>
   tclsh> addreq <file descriptor> “loadave”
   tclsh> getreq <file descriptor>
   <load average>
   tclsh> closereq <file descriptor>
```

### 2.29.3 Options

--version

The pbs_tclsh command returns its PBS version information and exits. This option can only be used alone.

### 2.29.4 Standard Error

The pbs_tclsh command will write a diagnostic message to standard error for each error occurrence.

### 2.29.5 See Also

The PBS Professional Administrator’s Guide, the PBS Programmer’s Guide, and the following manual pages: pbs_wish(8B), pbs_server(8B), pbs_mom(8B), pbs_sched(8B)

### 2.30 pbs_tmrsh

TM-enabled replacement for rsh/ssh for use by MPI implementations

#### 2.30.1 Synopsis

```
pbs_tmrsh host [-l username] [-n] command [args ...]
pbs_tmrsh --version
```
2.30.2 Description

The `pbs_tmrsh` command attempts to emulate an “`rsh`” connection to the specified host, via underlying calls to the Task Management (TM) API. The program is intended to be used during MPI integration activities, and not by end-users. The initial version of this program is targeted for use with MPICH and HP-MPI.

Running “`pbs_tmrsh host command`” will cause a PBS task to be started on “host” running “command”. The “host” may be in IP dot address form.

The environment variables used by the two MPI implementations to point to the `rsh` work-alike (MPI_REMSH in the case of HP and P4_RSHCOMMAND for MPICH) must be set in the job environment and point to the full path for `pbs_tmrsh`.

The file `$PBS_HOME/pbs_environment` will be used to set an environment variable `PATH` to be used to search for the program executable. This applies to both Windows and UNIX. It is expected that a full path will be specified for the command and the `PATH` variable will not be needed.

Output and errors are written to the PBS job’s output and error files, not to standard output/error.

2.30.3 Options

- `-l username`  
  Specifies the username under which to execute the task. If used, `username` must match the username running the `pbs_tmrsh` command.

- `-n`  
  Currently a no-op; provided for MPI implementations that expect to call `rsh` with the “`-n`” option.

- `--version`  
  The `pbs_tmrsh` command returns its PBS version information and exits. This option can only be used alone.

2.30.4 Standard Error

The `pbs_tmrsh` command will write a diagnostic message to the PBS job’s error file for each error occurrence.
2.30.5 Exit Status

The `pbs_tmrsh` program will exit with the exit status of the remote command or with 255 if an error occurred. This is because `ssh` works this way.

2.30.6 See Also

The PBS Professional Administrator’s Guide and the following manual pages:
`pbs_attach(8B), tm(3)`

2.31 `pbs_wish`

TK window shell with TCL-wrapped PBS API

2.31.1 Synopsis

`pbs_wish`

`pbs_wish --version`

2.31.2 Description

The `pbs_wish` command is a version of the TK window shell which includes wrapped versions of the PBS external API. The PBS TCL API is documented in the `pbs_tclapi(3B)` manual page.

2.31.3 Options

```
--version
```

The `pbs_wish` command returns its PBS version information and exits. This option can only be used alone.

2.31.4 Standard Error

The `pbs_wish` command will write a diagnostic message to standard error for each error occurrence.
See Also

The PBS Professional Administrator’s Guide and the following manual pages:
pbs_tclsh(8B), pbs_mom(8B), pbs_server(8B), pbs_sched(8B)

2.32   pbsdsh

Distributes task(s) to vnodes under PBS

2.32.1   Synopsis

pbsdsh [-c copies] [-s] [-v] [-o] -- program [program_args]
pbsdsh [-n node_index] [-s] [-v] [-o] -- program [program_args]
pbsdsh --version

2.32.2   Description

The pbsdsh command executes (spawns) a normal application program on one or more
nodes under control of the PBS. pbsdsh uses the Task Manager API to distribute the pro-
gram on the allocated nodes.

When run without the -c or the -n option, pbsdsh will spawn the program on all nodes allo-
cated to the PBS job. The spawns take place concurrently - all execute at (about) the same
time.

Note that the double dash must come after the options and before the program and arguments.
The double dash is only required for Linux.

pbsdsh is not supported on Windows.

2.32.3   Options

-c copies

The program is spawned copies times on the nodes allocated, one per node, unless copies is greater than the number of nodes. If this is True, it will wrap around, running multiple instances on some nodes. This option is mutually exclusive with -n.
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- **-n node_index**
  The program is spawned only on the node_index -th node allocated. This option is mutually exclusive with -c.

- **-s**
  The program is run in turn on each node, one after the other.

- **-v**
  Produces verbose output about error conditions and task exit status.

- **-o**
  No obit request is made for spawned tasks. The program will not wait for the tasks to finish.

--version
  The pbsdsh command returns its PBS version information and exits. This option can only be used alone.

### 2.32.4 Operands

program
  The first operand, program, is the program to execute. The double dash must precede the program under Linux.

program_args
  Additional operands, program_args, are passed as arguments to the program.

### 2.32.5 Standard Error

The pbsdsh command will write a diagnostic message to standard error for each error occurrence.

### 2.32.6 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, qsub(1B), tm(3)

### 2.33 pbsfs

Shows or manipulates PBS fairshare usage data
2.33.1 Synopsis

`pbsfs -f|p]`
`pbsfs -g entity`
`pbsfs -s entity usage_value`
`pbsfs -d`
`pbsfs -e`
`pbsfs -c entity1 entity2`
`pbsfs --version`

2.33.2 Description

The `pbsfs` command is used to print or manipulate the PBS scheduler’s fairshare usage data. Some options should only be used when the scheduler is not running. There are multiple parts to a fairshare node and you can print these data in different formats. The `pbsfs` command must be run by root; otherwise it will print the error message, “Unable to access fairshare data”.

The data:

- **fairshare entity**: The entity in the fairshare tree.
- **group**: The group ID the node is in (i.e. the node’s parent).
- **cgroup**: The group ID of this group.
- **shares**: The number of shares the group has.
- **usage**: The amount of usage.
- **percentage**: The percentage the entity has of the tree. Note that only the leaf nodes sum to 100%. If all of the nodes are summed, the result will be greater than 100%. Only the leaf nodes of the tree are fairshare entities.
- **usage / perc**: The value the scheduler will use to pick which entity has priority over another. The smaller the number the higher the priority.
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Path from root
The path from the root of the tree to the node. This is useful because the scheduler will look down the path to compare two nodes to see which has the higher priority.

resource
The resource for which the scheduler accumulates usage for its fairshare calculations. This defaults to cput (CPU seconds) but can be set in the scheduler’s config file.

2.33.3 Options to pbsfs

Scheduler can be running or down:

- -t
  Print the fairshare tree in a hierarchical format.

- -p
  Print the fairshare tree in a flat format with more data.

- -g entity
  Print one entry with all data and print the path from the root of the tree to the node.

- -c entity1 entity2
  Compare two fairshare entities

--version
The pbsfs command returns its PBS version information and exits. This option can only be used alone.

Scheduler must be down:

- -s entity usage_value
  Set entity’s usage value to usage_value. Please note that editing a non-leaf node is ignored. All non-leaf node usage values are calculated each time the scheduler is run/HUPed.

- -d
  Decay the fairshare tree (divide all values in half)

- -e
  Trim fairshare tree to just the entities in the resource_group file

2.33.4 See Also

The PBS Professional Administrator’s Guide, pbs_sched(8B)

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2.34 **pbsnodes**

Queries PBS host status or mark hosts free or offline

### 2.34.1 Synopsis

```bash
pbsnodes [-o | -r] [-s server] hostname [hostname ...]
pbsnodes [-l] [-s server]
pbsnodes -a [-v] [-s server]
pbsnodes --version
```

### 2.34.2 Description

The `pbsnodes` command is used to query the status of hosts, or to mark hosts *FREE* or *OFFLINE*. The `pbsnodes` command obtains host information by sending a request to the PBS server.

To print the status of the specified host or hosts, run `pbsnodes` with no options (except the `-s` option) and with a list of hosts.

To print the command usage, run `pbsnodes` with no options and without a list of hosts.

PBS Manager or Operator privilege is required to execute `pbsnodes` with the `-o`, or `-r` options.

To remove a node from the scheduling pool, mark it *OFFLINE*. If it is marked *DOWN*, when the server next queries the MOM, and can connect, the node will be marked *FREE*.

For hosts with multiple vnodes, `pbsnodes` operates on a host and all of its vnodes, where the hostname is `resources_available.host`. To offline a single vnode in a multi-vnoded system, use:

```bash
qmgr -c "set node <vnode name> state=offline"
```

Users without operator or manager privilege cannot view custom resources which have been created to be invisible to users.

To act on individual vnodes, use the `qmgr` command.

### 2.34.3 Options to `pbsnodes`

(no options) If neither options nor a host list is given, the `pbsnodes` command prints usage syntax.
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- **a**
Lists all hosts and all their attributes (available and used.)
When listing a host with multiple vnodes:

- The output for the jobs attribute lists all the jobs on all the vnodes on that host. Jobs that run on more than one vnode will appear once for each vnode they run on.
- For consumable resources, the output for each resource is the sum of that resource across all vnodes on that host.
- For all other resources, e.g., string and boolean, if the value of that resource is the same on all vnodes on that host, the value is returned. Otherwise the output is the literal string "<various>".

- **l**
Lists all hosts marked as **DOWN** or **OFFLINE**. Each such host’s state and comment attribute (if set) is listed. If a host also has state **STATE-UNKNOWN**, that will be listed. For hosts with multiple vnodes, only hosts where all vnodes are marked as **DOWN** or **OFFLINE** are listed.

- **o host_list**
Marks listed hosts as **OFFLINE** even if currently in use. This is different from being marked **DOWN**. A host that is marked **OFFLINE** will continue to execute the jobs already on it, but will be removed from the scheduling pool (no more jobs will be scheduled on it.)
For hosts with multiple vnodes, **pbsnodes** operates on a host and all of its vnodes, where the hostname is resources_available.host. To offline a single vnode in a multi-vnoded system, use:

```
Qmgr: qmgr -c "set node <vnode name> state=offline"
```
Requires PBS Manager or Operator privilege.

- **r host_list**
Clears **OFFLINE** from listed hosts.

- **s server**
Specifies the PBS server to which to connect.

- **v**
Can only be used with the **-a** option. Prints one entry for each vnode in the PBS complex. (Information for all hosts is displayed.)
The output for the jobs attribute for each vnode lists the jobs executing on that vnode. The output for resources and attributes lists that for each vnode.
--version

The `pbsnodes` command returns its PBS version information and exits. This option can only be used alone.

### 2.34.4 Operands

- **server**
  Specifies the server to which to connect. Default: default server.

- **host_list**
  Specifies the host(s) whose status will be returned. Format: `hostname [hostname ...]`

### 2.34.5 Exit Status

Zero upon success.

Greater than zero, if:

- incorrect operands are given,
- `pbsnodes` cannot connect to the server,
- there is an error querying the server for the nodes.

### 2.34.6 See Also

The PBS Professional Administrator’s Guide, `pbs_server(8B)` and `qmgr(8B)`

### 2.35 pbsrun

General-purpose wrapper script for `mpirun`

#### 2.35.1 Synopsis

```
pbsrun
pbsrun --version
```
2.35.2 Description

`pbsrun` is a wrapper script for any of several versions of `mpirun`. This provides a user-transparent way for PBS to control jobs which call `mpirun` in their job scripts. The `pbsrun_wrap` script instantiates `pbsrun` so that the wrapper script for the specific version of `mpirun` being used has the same name as that version of `mpirun`.

If the `mpirun` wrapper script is run inside a PBS job, then it will translate any `mpirun` call of the form:

```
mpirun [options] <executable> [args]
```

into

```
mpirun [options] pbs_attach [special_option_to_pbs_attach] <executable> [args]
```

where `[special options]` refer to any option needed by `pbs_attach` to do its job (e.g. `-j $PBS_JOBID`).

If the wrapper script is executed outside of PBS, a warning is issued about “not running under PBS”, but it proceeds as if the actual program had been called in standalone fashion.

The `pbsrun` wrapper script is not meant to be executed directly but instead it is instantiated by `pbsrun_wrap`. It is copied to the target directory and renamed “`pbsrun.<mpirun version/flavor>`” where `<mpirun version/flavor>` is a string that identifies the `mpirun` version being wrapped (e.g. `ch_gm`).

The `pbsrun` script, if executed inside a PBS job, runs an initialization script, named `$PBS_EXEC/lib/MPI/pbsrun.<mpirun version/flavor>.init`, then parses `mpirun`-like arguments from the command line, sorting which options and option values to retain, to ignore, or to transform, before calling the actual `mpirun` script with a “`pbs_attach`” prefixed to the executable. The actual `mpirun` to call is found by tracing the link pointed to by `$PBS_EXEC/lib/MPI/pbsrun.<mpirun version/flavor>.link`.

For all of the wrapped MPIs, the maximum number of ranks that can be launched is the number of entries in `$PBS_NODEFILE`. 


The wrapped MPIs are:

- MPICH-GM’s mpirun (mpirun.ch_gm) with rsh/ssh
- MPICH-MX’s mpirun (mpirun.ch_mx) with rsh/ssh
- MPICH-GM’s mpirun (mpirun.mpd) with MPD
- MPICH-MX’s mpirun (mpirun.mpd) with MPD
- MPICH2’s mpirun
- Intel MPI’s mpirun
- MVAPICH1’s mpirun
- MVAPICH2’s mpiexec
- IBM’s poe

2.35.3 Options

--version  The pbsrun command returns its PBS version information and exits. This option can only be used alone.

2.35.4 Initialization Script

The initialization script, called $PBS_EXEC/lib/MPI/pbsrun.<mpirun version/flavor>.init, where <mpirun version/flavor> reflects the mpirun flavor/version being wrapped, can be modified by an administrator to customize against the local flavor/version of mpirun being wrapped.

Inside this sourced init script, 8 variables are set:

```bash
options_to_retain="-optA -optB <val> -optC <val1> val2> ..."
options_to_ignore="-optD -optE <n> -optF <val1> val2> ..."
options_to_transform="-optG -optH <val> -optI <val1> val2> ..."
options_to_fail="-optX -optZ ..."
options_to_configfile="-optX <val> ...
options_with_another_form="-optW <val> ...
pbs_attach=pbs_attach
options_to_pbs_attach="-J $PBS_JOBID"
```
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2.35.4.1 Initialization Script Options

- **options_to_retain**: Space-separated list of options and values that `pbsrun.<mpirun_version/flavor>` passes on to the actual `mpirun` call. Options must begin with “-” or “--”, and option arguments must be specified by some arbitrary name with left and right arrows, as in “<val1>”.

- **options_to_ignore**: Space-separated list of options and values that `pbsrun.<mpirun_version/flavor>` does not pass on to the actual `mpirun` call. Options must begin with “-” or “--”, and option arguments must be specified by arbitrary names with left and right arrows, as in “<n>”.

- **options_to_transform**: Space-separated list of options and values that `pbsrun` modifies before passing on to the actual `mpirun` call.

- **option_to_fail**: Space-separated list of options that will cause `pbsrun` to exit upon encountering a match.

- **options_to_configfile**: Single option and value that refers to the name of the “configfile” containing command line segments found in certain versions of `mpirun`.

- **options_with_another_form**: Space-separated list of options and values that can be found in `options_to_retain`, `options_to_ignore`, or `options_to_transform`, whose syntax has an alternate, unsupported form.

- **pbs_attach**: Path to `pbs_attach`, which is called before the `<executable>` argument of `mpirun`.

- **options_to_pbs_attach**: Special options to pass to the `pbs_attach` call. You may pass variable references (e.g. `$PBS_JOBID`) and they are substituted by `pbsrun` to actual values.

If `pbsrun` encounters any option not found in `options_to_retain`, `options_to_ignore`, and `options_to_transform`, then it is flagged as an error.
These functions are created inside the init script. These can be modified by the PBS administrator.

```bash
transform_action() {
    # passed actual values of $options_to_transform
    args=$*
}

boot_action() {
    mpirun_location=$1
}

evaluate_options_action() {
    # passed actual values of transformed options
    args=$*
}

configfile_cmdline_action() {
    args=$*
}

drive() {
    mpirun_location=$1
}

transform_action()
```

The `pbsrun.<mpirun version/flavor>` wrapper script invokes the function `transform_action()` (called once on each matched item and value) with actual options and values received matching one of the “options_to_transform”. The function returns a string to pass on to the actual `mpirun` call.
boot_action()
Performs any initialization tasks needed before running the actual mpirun call. For instance, GM’s MPD requires the MPD daemons to be user-started first. This function is called by the pbsrun.<mpirun version/flavor> script with the location of actual mpirun passed as the first argument. Also, the pbsrun.<mpirun version/flavor> checks for the exit value of this function to determine whether or not to progress to the next step.

evaluate_options_action()
Called with the actual options and values that resulted after consulting options_to_retain, options_to_ignore, options_to_transform, and executing transform_action(). This provides one more chance for the script writer to evaluate all the options and values in general, and make any necessary adjustments, before passing them on to the actual mpirun call. For instance, this function can specify what the default value is for a missing -np option.

configfile_cmdline_action()
Returns the actual options and values to be put in before the option_to_configfile parameter.

configfile_firstline_action()
Returns the item that is put in the first line of the configuration file specified in the option_to_configfile parameter.

end_action()
Called by pbsrun.<mpirun version/flavor> at the end of execution. It undoes any action done by transform_action(), like cleanup of temporary files. It is also called when pbsrun.<mpirun version/flavor> is prematurely killed. This function is called with the location of actual mpirun passed as first argument.

The actual mpirun program to call is the path pointed to by $PBS_EXEC/lib/MPI/pbsrun.<mpirun version/flavor>.link.

2.35.4.2 Modifying *.init Scripts
In order for administrators to modify *.init scripts without breaking package verification in RPM, master copies of the initialization scripts are named *.init.in. pbsrun_wrap instantiates the *.init.in files as *.init. For instance, $PBS_EXEC/lib/MPI/pbsrun.mpich2.init.in is the master copy, and pbsrun_wrap instantiates it as $PBS_EXEC/lib/MPI/pbsrun.mpich2.init. pbsrun_unwrap takes care of removing the *.init files.
2.35.5 Versions/Flavors of mpirun

2.35.5.1 MPICH-GM's mpirun (mpirun.ch_gm) with rsh/ssh: pbsrun.ch_gm

2.35.5.1.i Syntax

```
pbsrun.ch_gm <options> <executable> <arg1> <arg2> ... <argn>
```

The PBS wrapper script to MPICH-GM's mpirun (mpirun.ch_gm) with rsh/ssh process startup method is named pbsrun.ch_gm.

If executed inside a PBS job, this allows for PBS to track all MPICH-GM processes started by rsh/ssh so that PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard mpirun.ch_gm was used.

2.35.5.1.ii Options Handling

If executed inside a PBS job script, all mpirun.ch_gm options given are passed on to the actual mpirun call with these exceptions:

- `machinefile <file>`
  The file argument contents are ignored and replaced by the contents of the $PBS_NODEFILE.

- `np`
  If not specified, the number of entries found in the $PBS_NODEFILE is used.

- `pg`
  The use of the -pg option, for having multiple executables on multiple hosts, is allowed but it is up to user to make sure only PBS hosts are specified in the process group file; MPI processes spawned are not guaranteed to be under the control of PBS.

2.35.5.1.iii Wrap/Unwrap

To wrap MPICH-GM's mpirun script:

```
# pbsrun_wrap [MPICH-GM_BIN_PATH]/mpirun.ch_gm pbsrun.ch_gm
```

To unwrap MPICH-GM's mpirun script:

```
# pbsrun_unwrap pbsrun.ch_gm
```
2.35.5.2 MPICH-MX's `mpirun (mpirun.ch_mx)` with `rsh/ssh: pbsrun.ch_mx`

**2.35.5.2.i Syntax**

```
pbsrun.ch_mx <options> <executable> <arg1> <arg2> ... <argn>
```

The PBS wrapper script to MPICH-MX's `mpirun (mpirun.ch_gm)` with `rsh/ssh` process startup method is named `pbsrun.ch_mx`.

If executed inside a PBS job, this allows for PBS to track all MPICH-MX processes started by `rsh/ssh` so that PBS can perform accounting and has complete job control.

If executed outside of a PBS job, it behaves exactly as if standard `mpirun.ch_mx` was used.

**2.35.5.2.ii Options HANDLING**

If executed inside a PBS job script, all `mpirun.ch_gm` options given are passed on to the actual `mpirun` call with some exceptions:

- `-machinefile <file>`
  The file argument contents is ignored and replaced by the contents of the `$PBS_NODEFILE`.

- `-np`
  If not specified, the number of entries found in the `$PBS_NODEFILE` is used.

- `-pg`
  The use of the `-pg` option, for having multiple executables on multiple hosts, is allowed but it is up to user to make sure only PBS hosts are specified in the process group file; MPI processes spawned are not guaranteed to be under the control of PBS.

**2.35.5.2.iii Wrap/Unwrap**

To wrap MPICH-MX's `mpirun` script:

```
# pbsrun_wrap [MPICH-MX BIN PATH]/mpirun.ch_mx pbsrun.ch_mx
```

To unwrap MPICH-MX's `mpirun` script:

```
# pbsrun_unwrap pbsrun.ch_mx
```
2.35.5.3 MPICH-GM’s mpirun (mpirun.mpd) with MPD: pbsrun.gm_mpd

2.35.5.3.i Syntax

pbsrun.gm_mpd <options> <executable> <arg1> <arg2> ... <argn>

The PBS wrapper script to MPICH-GM’s mpirun (mpirun.ch_gm) with MPD process startup method is called pbsrun.gm_mpd.

If executed inside a PBS job, this allows for PBS to track all MPICH-GM processes started by the MPD daemons so that PBS can perform accounting and complete job control.

If executed outside of a PBS job, it behaves exactly as if standard mpirun.ch_gm with MPD was used.

2.35.5.3.ii Options Handling

If executed inside a PBS job script, all mpirun.ch_gm with MPD options given are passed on to the actual mpirun call with these exceptions:

- **-m <file>**

  The file argument contents are ignored and replaced by the contents of the $PBS_NODEFILE.

- **-np**

  If not specified, the number of entries found in the $PBS_NODEFILE is used.

- **-pg**

  The use of the -pg option, for having multiple executables on multiple hosts, is allowed but it is up to user to make sure only PBS hosts are specified in the process group file; MPI processes spawned are not guaranteed to be under the control of PBS.

2.35.5.3.iii Startup/Shutdown

The script starts MPD daemons on each of the unique hosts listed in $PBS_NODEFILE, using either rsh or ssh method based on value of environment variable RSHCOMMAND. The default is rsh.

The script also takes care of shutting down the MPD daemons at the end of a run.

2.35.5.3.iv Wrap/Unwrap

To wrap MPICH-GM’s mpirun script with MPD:

```
# pbsrun_wrap [MPICH-GM_BIN_PATH]/mpirun.mpd pbsrun.gm_mpd
```

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To unwrap MPICH-GM’s `mpirun` script with MPD:

```sh
# pbsrun_unwrap pbsrun.gm_mpd
```

### 2.35.5.4 MPICH-MX’s `mpirun (mpirun.mpd)` with MPD:

#### 2.35.5.4.i Syntax

`pbsrun.mx_mpd <options> <executable> <arg1> <arg2> ... <argn>`

The PBS wrapper script to MPICH-MX’s `mpirun (mpirun.ch_mx)` with MPD process startup method is called `pbsrun.mx_mpd`.

If executed inside a PBS job, this allows for PBS to track all MPICH-MX processes started by the MPD daemons so that PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard `mpirun.ch_mx` with MPD was used.

#### 2.35.5.4.ii Options Handling

If executed inside a PBS job script, all `mpirun.mxd_mpd` with MPD options given are passed on to the actual `mpirun` call with these exceptions:

- `-m <file>`
  
  The file argument contents are ignored and replaced by the contents of the `$PBS_NODEFILE`.

- `-np`

  If not specified, the number of entries found in the `$PBS_NODEFILE` is used.

- `-pg`

  The use of the `-pg` option, for having multiple executables on multiple hosts, is allowed but it is up to user to make sure only PBS hosts are specified in the process group file; MPI processes spawned are not guaranteed to be under the control of PBS.

#### 2.35.5.4.iii Startup/Shutdown

The script starts MPD daemons on each of the unique hosts listed in `$PBS_NODEFILE`, using either `rsh` or `ssh` method, based on value of environment variable `RSHCOMMAND` - `-rsh` is the default.

The script also takes care of shutting down the MPD daemons at the end of a run.
2.35.5.4.iv Wrap/Unwrap

To wrap MPICH-MX’s mpirun script with MPD:

# pbsrun_wrap [MPICH-MX_BIN_PATH]/mpirun.mpd pbsrun.mx_mpd

To unwrap MPICH-MX’s mpirun script with MPD:

# pbsrun_unwrap pbsrun.mx_mpd

2.35.5.5 MPICH2’s mpirun: pbsrun.mpich2

2.35.5.5.i Syntax

pbsrun.mpich2 [global args] [local args] executable [args] [: [local args] executable [args]]

- or -

pbsrun.mpich2 -configfile <configfile>

where <configfile> contains command line segments as lines:

[local args] executable1 [args]
[local args] executable2 [args]
[local args] executable3 [args]

The PBS wrapper script to MPICH2's mpirun is called pbsrun.mpich2.

If executed inside a PBS job, this allows for PBS to track all MPICH2 processes so that PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard MPICH2's mpirun was used.

2.35.5.5.ii Options Handling

If executed inside a PBS job script, all MPICH2’s mpirun options given are passed on to the actual mpirun call with these exceptions:

-host and -ghost
  For specifying the execution host to run on. Not passed on to the actual mpirun call.

-machinefile <file>
  The file argument contents are ignored and replaced by the contents of the $PBS_NODEFILE.

MPICH2’s mpirun -localonly <x>
  For specifying the <x> number of processes to run locally. Not supported. The user is advised instead to use the equivalent arguments: -np <x> -localonly. The reason for this is that the pbsrun wrapper script cannot handle
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A variable number of arguments to an option (e.g. “-localonly” has 1 argument and “-localonly <x>” has 2 arguments).

- **-np**
  
  If user did not specify a -np option, then no default value is provided by the PBS wrapper scripts. It is up to the local mpirun to decide what the reasonable default value should be, which is usually 1.

### 2.35.5.5.iii Startup/Shutdown

The script takes care of ensuring that the MPD daemons on each of the hosts listed in the $PBS_NODEFILE are started. It also takes care of ensuring that the MPD daemons have been shut down at the end of MPI job execution.

### 2.35.5.5.iv Wrap/Unwrap

To wrap MPICH2's mpirun script:

```bash
# pbsrun_wrap [MPICH2_BIN_PATH]/mpirun pbsrun.mpich2
```

To unwrap MPICH2’s mpirun script:

```bash
# pbsrun_unwrap pbsrun.mpich2
```

In the case where MPICH2 uses mpirun.py, run pbsrun_wrap on mpirun.py itself.

### 2.35.5.6 Intel MPI’s mpirun: pbsrun.intelmpi

#### 2.35.5.6.i Syntax

```bash
pbsrun.intelmpi [mpdboot options] [mpiexec options] executable [prog-args] [: [mpiexec options] executable [prog-args]]
```

- or -

```bash
pbsrun.intelmpi [mpdboot options] -f <configfile>
```

where [mpdboot options] are any options to pass to the mpdboot program, which is automatically called by Intel MPI’s mpirun to start MPDs, and <configfile> contains command line segments as lines.

The PBS wrapper script to Intel MPI’s mpirun is called pbsrun.intelmpi.

If executed inside a PBS job, this allows for PBS to track all Intel MPI processes so that PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard Intel MPI’s mpirun was used.
### Options Handling

If executed inside a PBS job script, all of the options to the PBS interface to MPI’s `mpirun` are passed to the actual `mpirun` call with these exceptions:

- **-host and -ghost**
  For specifying the execution host to run on. Not passed on to the actual `mpirun` call.

- **-machinefile <file>**
  The file argument contents are ignored and replaced by the contents of the `$PBS_NODEFILE`.

**mpdboot options --totalnum=* and --file=***
Ignored and replaced by the number of unique entries in `$PBS_NODEFILE` and name of `$PBS_NODEFILE` respectively.

**arguments to mpdboot options --file=* and -f <mpd_hosts_file>**
Replaced by `$PBS_NODEFILE`.

- **-s**
  If `pbsrun.intelmpi` is called inside a PBS job, Intel MPI’s `mpirun -s` argument to `mpdboot` are not supported as this closely matches the `mpirun` option `-s <spec>`. The user can simply run a separate `mpdboot -s` before calling `mpirun`. A warning message is issued by `pbsrun.intelmpi` upon encountering a `-s` option telling users of the supported form.

- **-np**
  If the user does not specify a `-np` option, then no default value is provided by the PBS wrap scripts. It is up to the local `mpirun` to decide what the reasonable default value should be, which is usually 1.

### Startup/Shutdown

Intel MPI’s `mpirun` itself takes care of starting/stopping the MPD daemons. `pbsrun.intelmpi` always passes the arguments `-totalnum=<number of mpds to start>` and `-file=<mpd_hosts_file>` to the actual `mpirun`, taking its input from unique entries in `$PBS_NODEFILE`.

### Wrap/Unwrap

To wrap Intel MPI’s `mpirun` script:

```bash
# pbsrun_wrap [INTEL_MPI_BIN_PATH]/mpirun pbsrun.intelmpi
```

To unwrap Intel MPI’s `mpirun` script:

```bash
# pbsrun_unwrap pbsrun.intelmpi
```
2.35.5.7 MVAPICH1’s mpirun: pbsrun.mvapich1

2.35.5.7.i Syntax

```
pbsrun.mvapich1 <mpirun options> <executable> <options>
```

The PBS wrapper script to MVAPICH1’s mpirun is called pbsrun.mvapich1. Only one executable can be specified. MVAPICH1 allows the use of InfiniBand.

If executed inside a PBS job, this allows for PBS to be aware of all MVAPICH1 ranks and track their resources, so that PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard mpirun was used.

2.35.5.7.ii Options Handling

If executed inside a PBS job script, all mpirun options given are passed on to the actual mpirun call with these exceptions:

- `-map <list>`
  The map option is ignored.

- `-exclude <list>`
  The exclude option is ignored.

- `-machinefile <file>`
  The machinefile option is ignored.

- `-np`
  If not specified, the number of entries found in the $PBS_NODEFILE is used.

2.35.5.7.iii Wrap/Unwrap

To wrap MVAPICH1’s mpirun script:

```
# pbsrun_wrap <path-to-actual-mpirun> pbsrun.mvapich1
```

To unwrap MVAPICH1’s mpirun script:

```
# pbsrun_unwrap pbsrun.mvapich1
```

2.35.5.8 MVAPICH2’s mpiexec: pbsrun.mvapich2

2.35.5.8.i Syntax

```
pbsrun.mvapich2 <mpiexec args> executable <executable's args> [: <mpiexec args> executable <executable's args>]
```

The PBS wrapper script to MVAPICH2's mpiexec is called pbsrun.mvapich2.
Multiple executables can be specified using the colon notation. MVAPICH2 allows the use of InfiniBand.

If executed inside a PBS job, this allows for PBS to be aware of all MVAPICH2 ranks and track their resources, so that PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard mpiexec was used.

2.35.5.8.ii Options Handling

If executed inside a PBS job script, all mpiexec options given are passed on to the actual mpiexec call with these exceptions:

- **-host <host>**
  The host argument contents are ignored.

- **-machinefile <file>**
  The file argument contents are ignored and replaced by the contents of the $PBS_NODEFILE.

2.35.5.8.iii Wrap/Unwrap

To wrap MVAPICH2’s mpiexec script:

```bash
# pbsrun_wrap <path-to-actual-mpiexec> pbsrun.mvapich2
```

To unwrap MVAPICH2’s mpiexec script:

```bash
# pbsrun_unwrap pbsrun.mvapich2
```

2.35.5.9 IBM’s poe: pbsrun.poe

2.35.5.9.i Syntax

```
pbsrun.poe <options> <executable> <arg1> <arg2> ... <argn>
```

The PBS wrapper script to IBM’s poe is called pbsrun.poe.

MPI is supported under IBM’s Parallel Operating Environment (POE) on AIX. Under AIX, the program poe is used to start user processes on remote machines. PBS will manage the IBM HPS in US (User Space) mode.

The PBS wrapper script to IBM’s poe allows LAPI or MPI programs to use InfiniBand or the HPS in US mode.

If executed inside a PBS job, this allows for PBS to track all resources and MPI ranks. PBS can perform accounting and have complete job control.

If executed outside of a PBS job, it behaves exactly as if standard poe was used.
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The script will use the `-euilib {ip | us}` option and the `MP_EUILIB` environment variable to indicate use of US mode, to maintain compatibility with standard `poe`.

2.35.5.9.ii  Options and Environment Variables

Users submitting jobs whose programs use `poe` can set environment variables instead of using options to `poe`. The equivalent environment variable is listed with its `poe` option. If executed inside a PBS job script, all `pbsrun.poe` options and environment variables except the following are passed on to `poe`:

- `devtype, MP_DEVTYPE`
  If InfiniBand is not specified in either the option or the environment variable, the InfiniBand interconnect is not used for the program.

- `euidevice, MP_EUIDEVICE`
  Ignored by PBS.

- `euilib {ip|us}, MP_EUILIB`
  If the command line option `-euilib` is set, it will take precedence over the `MP_EUILIB` environment variable. If set to “us”, the program uses User Space mode. If set to any other value, that value is passed to IBM `poe`.

- `hostfile, -hfile, MP_HOSTFILE`
  Ignored. If this is specified, PBS prints the following:
  
  "pbsrun.poe: Warning, -hostfile value replaced by PBS"

  or

  "pbsrun.poe: Warning -hfile value replaced by PBS"

  If this environment variable is set when a `poe` job is submitted, PBS prints the following error message:

  "pbsrun.poe: Warning MP_HOSTFILE value replaced by PBS"

- `instances, MP_INSTANCES`
  The option and the environment variable are treated differently:

  - `instances`
    If the option is set, PBS prints a warning:

    "pbsrun.poe: Warning, -instances cmd line option removed by PBS"

  - `MP_INSTANCES`
    If the environment variable is set, PBS uses it to calculate the number of network windows for the job. The maximum value allowed can be requested by using the string "max" for the environment variable. If the environment variable is set to a value greater than the maximum allowed value, it is replaced with the maximum allowed value. The default maximum value is 4.
-procs, MP_PROCS

This option or environment variable should be set to the total number of mpiprocs requested by the job when using US mode. If neither this option nor the MP_PROCS environment variable is set, PBS uses the number of entries in $PBS_NODEFILE. If this option is set to $N$, and the job is submitted with a total of $M$ mpiprocs:

If $N \geq M$:

The value $N$ is passed to IBM poe.

If $N < M$ and US mode is not being used:

The value $N$ is passed to poe.

If $N < M$ and US mode is being used:

US mode is turned off and a warning is printed:

"pbsrun.poe: Warning, user mode disabled due to MP_PROCS setting"

2.35.5.9.iii Wrap/Unwrap

To wrap IBM's poe:

```
# pbsrun_wrap <path_to_actual_poe> pbsrun.poe
```

To unwrap the IBM poe:

```
# pbsrun_unwrap pbsrun.poe
```

2.35.6 Requirements

The mpirun being wrapped must be installed and working on all the nodes in the PBS cluster.

2.35.7 Errors

If pbsrun encounters any option not found in options_to_retain, options_to_ignore, and options_to_transform, then it is flagged as an error.

2.35.8 See Also

The PBS Professional Administrator’s Guide

pbs_attach(8B), pbsrun_wrap(8B), pbsrun_unwrap(8B)
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2.36  **pbsrun_unwrap**

Unwraps mpirun, reversing pbsrun_wrap

### 2.36.1 Synopsis

`pbsrun_unwrap pbsrun.<mpirun version/flavor>`

`pbsrun_unwrap --version`

### 2.36.2 Description

The `pbsrun_unwrap` script is used to reverse the actions of the `pbsrun_wrap` script. Use `pbsrun_wrap` to wrap `mpirun`.

### 2.36.3 Usage

#### 2.36.3.1 Syntax:

`pbsrun_unwrap pbsrun.<mpirun version/flavor>`

For example, running the following:

`pbsrun_unwrap pbsrun.ch_gm`

does the following actions:

Checks for a link in `$PBS_EXEC/lib/MPI/pbsrun.ch_gm.link`; If one exists, get the pathname it points to:

```
/opt/mpich-gm/bin/mpirun.ch_gm.actual
```

```
rmdir $PBS_EXEC/lib/MPI/pbsrun.mpirun.ch_gm.link
```

```
rmdir /opt/mpich-gm/bin/mpirun.ch_gm
```

```
rmdir $PBS_EXEC/bin/pbsrun.ch_gm
```

```
mv /opt/mpich-gm/bin/mpirun.ch_gm.actual /opt/mpich-gm/bin/mpirun.ch_gm
```

### 2.36.4 Options

#### --version

The `pbsrun_unwrap` command returns its PBS version information and exits. This option can only be used alone.
See Also

The PBS Professional Administrator’s Guide
pbs_attach(8B), pbsrun(8B), pbsrun_wrap(8B)

## 2.37 pbsrun_wrap

General-purpose script for wrapping mpirun in pbsrun

### 2.37.1 Synopsis

```bash
pbsrun_wrap [-s] <path_to_actual_mpirun> pbsrun.<mpirun version/flavor>
pbsrun_wrap --version
```

### 2.37.2 Description

The `pbsrun_wrap` script is used to wrap any of several versions of `mpirun` in `pbsrun`. The `pbsrun_wrap` script creates a symbolic link with the same path and name as the `mpirun` being wrapped. This calls `pbsrun`, which uses `pbs_attach` to give MOM control of jobs. The result is transparent to the user; when `mpirun` is called from inside a PBS job, PBS can monitor and control the job, but when `mpirun` is called from outside of a PBS job, it behaves as it would normally. See the `pbs_attach(8B)` and `pbsrun(8B)` man pages. Use `pbsrun_unwrap` to reverse the process.

### 2.37.3 Options

- `-s`

  Sets the "strict_pbs" options in the various initialization scripts (e.g. `pbsrun.bgl.init`, `pbsrun.ch_gm.init`, etc...) to 1 from the default 0. This means that the `mpirun` being wrapped by `pbsrun` will only be executed if inside a PBS environment. Otherwise, the user will get the error:

  Not running under PBS exiting since strict_pbs is enabled; execute only in PBS

- `--version`

  The `pbsrun_wrap` command returns its PBS version information and exits. This option can only be used alone.
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2.37.4  USAGE

2.37.4.1  Syntax:

    pbsrun_wrap [ -s ] <path_to_actual_mpirun> pbsrun.<mpirun version/flavor>

Any mpirun version/flavor that can be wrapped has an initialization script ending in
".init", found in $PBS_EXEC/lib/MPI:

    $PBS_EXEC/lib/MPI/pbsrun.<mpirun version/flavor>.init.

The pbsrun_wrap script instantiates the pbsrun wrapper script as pbsrun.<mpirun
version/flavor> in the same directory where pbsrun is located, and sets up the link to
actual mpirun call via the symbolic link

    $PBS_EXEC/lib/MPI/pbsrun.<mpirun version/flavor>.link

For example, running:

    pbsrun_wrap /opt/mpich-gm/bin/mpirun.ch_gm pbsrun.ch_gm

causes the following actions:

Save original mpirun.ch_gm script:

    mv /opt/mpich-gm/bin/mpirun.ch_gm /opt/mpich-gm/bin/mpirun.ch_gm.actual

Instantiate pbsrun wrapper script as pbsrun.ch_gm:

    cp $PBS_EXEC/bin/pbsrun $PBS_EXEC/bin/pbsrun.ch_gm

Link “mpirun.ch_gm” to actually call “pbsrun.ch_gm”:

    ln -s $PBS_EXEC/bin/pbsrun.ch_gm /opt/mpich-gm/bin/mpirun.ch_gm

Create a link so that “pbsrun.ch_gm” calls “mpirun.ch_gm.actual”:

    ln -s /opt/mpich-gm/bin/mpirun.ch_gm.actual $PBS_EXEC/lib/MPI/
pbsrun.ch_gm.link

2.37.5  Requirements

The mpirun being wrapped must be installed and working on all the nodes in the PBS clus-
ter.

2.37.6  See Also

The PBS Professional Administrator’s Guide
pbs_attach(8B), pbsrun(8B), pbsrun_unwrap(8B)
2.38 printjob

Prints job information

2.38.1 Synopsis

printjob [-a | -s ] job ID
printjob [-a ] file [file...]
printjob --version

2.38.2 Description

The printjob command is used to print job information. You can print information either from the server, using a job ID, or from the execution host, using a file path.

Whether or not a MOM is running on the server’s host, you must use the job ID at the server host.

By default all the job data including job attributes are printed. This can be suppressed with the -a option.

You can print out the job script using the -s option at the server host.

This command is useful for troubleshooting, as during normal operation, the qstat(8B) command is the preferred method for displaying job-specific data and attributes.

2.38.3 Permissions

In order to execute printjob, the user must have root or Windows Administrator privilege.

2.38.4 Options to printjob

-a

Suppresses the printing of job attributes. Cannot be used with -s option.

-s

Prints out the job script only. Available only at server host. Cannot be used with -a option.

--version

The printjob command returns its PBS version information and exits. This option can only be used alone.
2.38.5 Operands for printjob

<file path>
The printjob command accepts one or more file operands at the execution host. Files are found in PBS_HOME/mom_priv/jobs/ on the primary execution host. Available only at execution host. Cannot be used with -s option.

<job ID>
The printjob command accepts a job ID at the server host. The format is described in section, “Job Identifier”, on page 396. Available only at server host. Data service must be running.

2.38.6 Standard Error

The printjob command writes a diagnostic message to standard error for each error occurrence.

2.38.7 Exit Status

Zero upon successful processing of all the operands presented to the printjob command. Greater than zero if the printjob command fails to process any operand.

2.38.8 See Also

The PBS Professional Administrator’s Guide,
pbs_server(8B), qstat(8B)

2.39 qalter

Alters a PBS job
2.39.1 Synopsis

qalter --version`

2.39.2 Description

The `qalter` command is used to alter one or more PBS batch jobs. The attributes listed with the options to the `qalter` command can be modified. If any of the modifications to a job fails, none of the job’s attributes is modified.

A job that is in the process of provisioning cannot be altered.

2.39.2.1 Required privilege

- A non-privileged user may only lower the limits for resources
- A Manager or Operator may lower or raise requested resource limits, except for per-process limits such as `pcput` and `pmem`, because these are set when the process starts, and enforced by the kernel.
- The `qalter` command cannot be used by a non-privileged user to alter a custom resource which has been created to be invisible or read-only for users.

2.39.2.2 Modifying resources and job placement:

If a job is running, the only resources that can be modified are `cput` (CPU time) and `walltime`.

If a job is queued, any resource mentioned in the options to the `qalter` command can be modified, but requested modifications must fit within the limits set at the server and queue for the amount of each resource allocated for queued jobs. If a requested modification does not fit within these limits, the modification is rejected.

Note that a job’s resource request must fit within the queue’s and server’s resource run limits. If a modification to a resource exceeds the amount of the resource allowed by the queue or server to be used by running jobs, the job is never run.

Resources are modified by using the `-l` option, either in chunks inside of selection statements, or in job-wide modifications using `resource_name=value` pairs. The selection statement is of the form:

```bash
-l select=[N:]chunk+[N:]chunk ...
```
where \( N \) specifies how many of that chunk, and a chunk is of the form:

\[ resource\_name=value[:resource\_name=value ...] \]

Job-wide \( resource\_name=value \) modifications are of the form:

\[ -l resource\_name=value[,resource\_name=value ...] \]

Placement of jobs on nodes is changed using the place statement:

\[ -l place=modifier[:modifier] \]

where modifier is any combination of \textit{group}, \textit{excl}, and/or one of \textit{free|pack|scatter}.

For more on resource requests, usage limits and job placement, see \texttt{pbs\_resources(7B)}.

### 2.39.2.3 Modifying attributes:

The user alters job attributes by giving options to the \texttt{qalter} command. Each \texttt{qalter} option changes a job attribute.

The behavior of the \texttt{qalter} command may be affected by any site hooks. Site hooks can modify the job’s attributes, change its routing, etc.

#### 2.39.3 Options to \texttt{qalter}

-\texttt{-a date\_time}

Changes the point in time after which the job is eligible for execution.

Given in pairs of digits. Sets job’s \texttt{Execution\_Time} attribute to \texttt{date\_time}.

Format: \textit{Datetime}

Each portion of the date defaults to the current date, as long as the next-
smaller portion is in the future. For example, if today is the 3rd of the
month and the specified day \texttt{DD} is the 5th, the month \texttt{MM} will be set to the
current month.

If a specified portion has already passed, the next-larger portion will be set
to one after the current date. For example, if the day \texttt{DD} is not specified,
but the hour \texttt{hh} is specified to be 10:00 a.m. and the current time is 11:00
a.m., the day \texttt{DD} will be set to tomorrow.

The job’s \texttt{Execution\_Time} attribute can be altered after the job has begun
execution, in which case it will not take effect until the job is rerun.
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-A account_string
Replaces the accounting string associated with the job. Used for labeling accounting data. Sets job's Account_Name attribute to account_string. This attribute cannot be altered once the job has begun execution.
Format: String

-c checkpoint_spec
Changes when the job will be checkpointed. Sets job’s Checkpoint attribute. An $action script is required to checkpoint the job. This attribute can be altered after the job has begun execution, in which case the new value will not take effect until the job is rerun.
See the pbs_mom(8B) man page.
The argument checkpoint_spec can take on one of the following values:

c
Checkpoint at intervals, measured in CPU time, set on job’s execution queue. If no interval set at queue, job is not checkpointed

c=<minutes of CPU time>
Checkpoint at intervals of specified number of minutes of job CPU time. This value must be > 0. If interval specified is less than that set on job’s execution queue, queue's interval is used.
Format: Integer

w
Checkpoint at intervals, measured in walltime, set on job’s execution queue. If no interval set at queue, job is not checkpointed.

w=<minutes of walltime>
Checkpoint at intervals of the specified number of minutes of job walltime. This value must be greater than zero. If the interval specified is less that that set on the execution queue in which the job resides, the queue's interval is used.
Format: Integer

n
No checkpointing.

s
Checkpoint only when the server is shut down.

u
Unset. Defaults to behavior when interval argument is set to s.
Default: u.
Format: String.
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-e path
Replaces the path to be used for the job’s standard error stream. Sets job’s Error_Path attribute to path.

Format: [hostname:]path_name
The path will be interpreted as follows:

path_name
If path_name is a relative path, then it is taken to be relative to the current working directory of the qalter command, where it is executing on the current host.

If path_name is an absolute path, then it is taken to be an absolute path on the current host where the qalter command is executing.

hostname:path_name
If path_name is a relative path, then it is taken to be relative to the user’s home directory on the host named hostname.

If path_name is an absolute path, then it is the absolute path on the host named hostname.

If path_name does not include a filename, the default filename will be jobid.ER
If the -e option is not specified, the default filename for the standard error stream is used.

Format: job_name.esequence_number
This attribute can be altered after the job has begun execution, in which case the new value will not take effect until the job is rerun.

-h hold_list
Updates the job’s hold list. Adds hold_list to the job’s Hold_Types attribute. The hold_list is a string of one or more of the following:

Table 2-4: Hold Types

<table>
<thead>
<tr>
<th>Hold Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>u</td>
<td>Add a USER hold.</td>
</tr>
<tr>
<td>o</td>
<td>Add OTHER hold. Requires operator privilege.</td>
</tr>
<tr>
<td>n</td>
<td>Clear the holds for which the user has privilege.</td>
</tr>
</tbody>
</table>

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This attribute can be altered after the job has begun execution, in which case the new value will not take effect until the job is rerun.

-j join

Changes whether and how to join the job’s standard error and standard output streams. Sets job’s Join_Path attribute to join.

Possible values of join:

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>oe</td>
<td>Standard error and standard output are merged into standard output.</td>
</tr>
<tr>
<td>eo</td>
<td>Standard error and standard output are merged into standard error.</td>
</tr>
<tr>
<td>n</td>
<td>Standard error and standard output are not merged.</td>
</tr>
</tbody>
</table>

This attribute can be altered after the job has begun execution, in which case the new value will not take effect until the job is rerun.

Default: not merged.

-k keep

Changes whether and which of the standard output and standard error streams will be retained on the execution host. Overrides default path names for these streams. Sets the job’s Keep_Files attribute to keep.
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The keep argument can take on the following values:

Table 2-6: Keep Argument Values

<table>
<thead>
<tr>
<th>Option</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| e      | The standard error stream is retained on the execution host, in the job’s staging and execution directory. The filename will be: 

```
job_name.e<sequence number>
```

| o      | The standard output stream is retained on the execution host, in the job’s staging and execution directory. The filename will be: 

```
job_name.o<sequence number>
```

| eo, oe | Both standard output and standard error streams are retained on the execution host, in the job’s staging and execution directory. |

| n      | Neither stream is retained. |

This attribute cannot be altered once the job has begun execution.

In the case where output and/or error is retained on the execution host in a job-specific staging and execution directory created by PBS, these files are deleted when PBS deletes the directory.

Default: neither is retained.

```
-l resource_arg
```

Allows the user to change requested resources and job placement. Sets job’s Resource_list attribute to resource_arg. Uses resource request syntax. Requesting a resource places a limit on its usage. Users without manager or operator privilege cannot alter a custom resource which was created to be invisible or read-only for users.

Requesting resources in chunks:

Format: `-l select=[N:]chunk+[N:]chunk ...`

where N specifies how many of that chunk, and a chunk is:

Format: `resource_name=value[:resource_name=value ...]`

Requesting job-wide resources:

Format: `-l resource_name=value[,resource_name=value ...]`
Specifying placement of jobs:
Format: `-l place=[arrangement][:sharing][:grouping]`
where
`arrangement` is one of `free` | `pack` | `scatter`
`sharing` is one of `excl` | `shared`
`grouping` can have only one instance of `group=resource`
and where
`free`
   Place job on any vnode(s).
`pack`:
   All chunks will be taken from one host.
`scatter`
   Only one chunk with any MPI processes will be taken from a host. A
   chunk with no MPI processes may be taken from the same node as
   another chunk.
`excl`
   Only this job uses the vnodes chosen.
`shared`
   This job can share the vnodes chosen.
`group=resource`
    Chunks will be grouped according to a resource. All nodes in the
    group must have a common value for the resource, which can be either
    the built-in resource host or a site-defined node-level resource.

If a requested modification to a resource would exceed the job’s queue’s
limits, the resource request will be rejected. For a running job, resources
may only be reduced. Which resources can be altered is system-dependent.

If the job was submitted with an explicit “-l select=”, then node level
resources must be altered using the “-l select=” form. In this case a
node level resource RES cannot be altered with the “-l RES” form.

Examples:
1. Submit the job:
   
   ```
   % qsub -l select=ncpus=2:mem=512mb jobscript
   ```
2. qalter the job using “-l RES” form:
   % qalter -l ncpus=4 230
   Error reported by qalter:
   qalter: Resource must only appear in “select” specification when
   select is used: ncpus 230

3. qalter the job using the “-l select=” form:
   % qalter -l select=1:ncpus=4:mem=512mb 230
   No error reported by qalter:
   %

For more on resource requests, usage limits and job placement, see
pbs_resources(7B).

-m mail_events
Changes the set of conditions under which mail about the job is sent. Sets
job’s Mail_Points attribute to mail_events. The mail_events argument
can be either “n” or any combination of “a”, “b”, and “e”.

<table>
<thead>
<tr>
<th>Option</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>No mail will be sent.</td>
</tr>
<tr>
<td>a</td>
<td>Mail is sent when the job is aborted by the batch system.</td>
</tr>
<tr>
<td>b</td>
<td>Mail is sent when the job begins execution.</td>
</tr>
<tr>
<td>e</td>
<td>Mail is sent when the job terminates.</td>
</tr>
</tbody>
</table>

Format: String.
Default value: “a”.

-M user_list
Alters list of users to whom mail about the job is sent. Sets job’s
Mail_Users attribute to user_list.
Format: user[@host][,user[@host],...]
Default: job owner.
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-N name
Renames the job. Sets job’s Job_Name attribute to name.
Format: string, up to 15 characters in length. It must consist of an alpha-

betic character followed by printable, non-white-space characters.
Default: if a script is used to submit the job, the job’s name is the name of
the script. If no script is used, the job’s name is “STDIN”.

-o path
Alters path to be used for the job’s standard output stream. Sets job’s
Output_Path attribute to path.
Format: [hostname:]path_name
The path will be interpreted as follows:
path_name
If path_name is a relative path, then it is taken to be relative to the cur-
rent working directory of the command, where it is executing on the
current host.
If path_name is an absolute path, then it is taken to be an absolute path
on the current host where the command is executing.
hostname:path_name
If path_name is a relative path, then it is taken to be relative to the
user’s home directory on the host named hostname.
If path_name is an absolute path, then it is the absolute path on the host
named hostname.
If path_name does not include a filename, the default filename will be
jobid.OU
If the -o option is not specified, the default filename for the standard output
stream is used. It has this form:
job_name.osequence_number
This attribute can be altered after the job has begun execution, in which
case the new value will not take effect until the job is rerun.

-p priority
Alters priority of the job.
Sets job’s Priority attribute to priority.
This attribute can be altered after the job has begun execution, in which
case the new value will not take effect until the job is rerun.
Format: host-dependent integer.
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Range: \([-1024, +1023]\) inclusive.
Default: zero.

\(-P\) project

Specifies a project for the job. Sets job's project attribute to specified value.

Format: String.

Project name can contain any characters except for the following: Slash (/), left bracket ([], right bracket (]), double quote ("""), semicolon (";"), colon (:), vertical bar (\(|\)), left angle bracket (<), right angle bracket (>)

Default value: ".\_\_pbs\_project\_default".

\(-r\) y|n

Changes whether the job is rerunnable. Sets job’s Rerunnable attribute to the argument. Does not affect how job is treated when the job was unable to begin execution.

See the \(q\_rerun(1B)\) command.

Format: single character, "y" or "n".

\(\ y\)
Job is rerunnable.

\(\ n\)
Job is not rerunnable.

Default: "y".

\(-S\) path_list

Specifies the interpreter or shell path for the job script. Sets job’s Shell Path List attribute to path_list.

The path_list argument is the full path to the interpreter or shell including the executable name.

Only one path may be specified without a host name. Only one path may be specified per named host. The path selected is the one whose host name is that of the server on which the job resides.

This attribute can be altered after the job has begun execution, but in this case the new value will not take effect until the job is rerun.

Format:

\(path[@host][,path[@host ...]]\)

Default: user’s login shell on execution node.
Example of using `bash` via a directive:

```bash
#PBS -S /bin/bash@mars,/usr/bin/bash@jupiter
```

Example of running a Python script from the command line on UNIX/Linux:

```bash
qsub -S $PBS_EXEC/bin/pbs_python <script name>
```

Example of running a Python script from the command line on Windows:

```bash
qsub -S %PBS_EXEC%/bin/pbs_python.exe <script name>
```

- **-u user_list**

  Alters list of usernames. Job will be run under a username from this list. Sets job’s `User_List` attribute to `user_list`.

  Only one username may be specified without a host name. Only one username may be specified per named host. The server on which the job resides will select first the username whose host name is the same as the server name. Failing that, the next selection will be the username with no specified hostname. The usernames on the server and execution hosts must be the same. The job owner must have authorization to run as the specified user.

  This attribute cannot be altered once the job has begun execution.

  Format: `user[@host][,user@host ...]`

  Default: job owner (username on submit host.)

- **-W additional_attributes**

  The `-W` option allows change in specification of additional job attributes.

  Format: `-W attribute_name = value[,attribute_name=value...]`

  If white space occurs within the `additional_attributes` argument, or the equal sign ("=") occurs within an `attribute_value` string, then that must be enclosed with single or double quotes. PBS supports the following attributes within the `-W` option:

  - **depend=dependency_list**

    Defines dependencies between this and other jobs. Sets the job’s `depend` attribute to `dependency_list`. The `dependency_list` has the form:

    ```
    type:arg_list[,type:arg_list ...]
    ```

    where except for the `on` type, the `arg_list` is one or more PBS job IDs in the form:

    ```
    jobid[jobid ...]
    ```

    The type can be:
after: arg_list
This job may be scheduled for execution at any point after all jobs in arg_list have started execution.

afterok: arg_list
This job may be scheduled for execution only after all jobs in arg_list have terminated with no errors. See section 2.39.6.1, “Warning about exit status with csh:”, on page 141.

afternotok: arg_list
This job may be scheduled for execution only after all jobs in arg_list have terminated with errors. See section 2.39.6.1, “Warning about exit status with csh:”, on page 141.

afterany: arg_list
This job may be scheduled for execution after all jobs in arg_list have terminated, with or without errors.

before: arg_list
Jobs in arg_list may begin execution once this job has begun execution.

beforeok: arg_list
Jobs in arg_list may begin execution once this job terminates without errors. See section 2.39.6.1, “Warning about exit status with csh:”, on page 141.

beforenotok: arg_list
If this job terminates execution with errors, then jobs in arg_list may begin. See section 2.39.6.1, “Warning about exit status with csh:”, on page 141.

beforeany: arg_list
Jobs in arg_list may begin execution once this job terminates execution, with or without errors.

on: count
This job may be scheduled for execution after count dependencies on other jobs have been satisfied. This type is used in conjunction with one of the before types listed. count is an integer greater than 0.

Restrictions:
Job IDs in the arg_list of before types must have been submitted with a type of on.
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To use the before types, the user must have the authority to alter the jobs in arg_list. Otherwise, the dependency is rejected and the new job aborted.

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:

```
qalter -W depend = afterok:123.host1.domain.com /tmp/script
qalter -W depend= before:234.host1.com:235.host1.com /tmp/script
```

**group_list=g_list**

Alters list of group names. Job will be run under a group name from this list. Sets job’s group_List attribute to g_list.

Only one group name may be specified without a host name. Only one group name may be specified per named host. The server on which the job resides will select first the group name whose host name is the same as the server name. Failing that, the next selection will be the group name with no specified hostname. The group names on the server and execution hosts must be the same.

Format: `group[@host][.group[@host ...]]`

Default: login group name of job owner.

**sandbox=<value>**

Changes which directory PBS uses for the job’s staging and execution.

Allowed values:

- `PRIVATE`
  - PBS creates a job-specific directory for staging and execution.

- `HOME` or unset
  - PBS uses the user’s home directory for staging and execution.

Format: String

**stagein=path_list**

**stageout=path_list**

Changes files or directories to be staged-in before execution or staged-out after execution is complete. Sets the job’s stagein and stageout attributes to the specified path_lists. On completion of the job, all
staged-in and staged-out files and directories are removed from the execution host(s). The path_list has the form:

```
filespec[,filespec]
```

where filespec is

```
local_path@hostname:remote_path
```

regardless of the direction of the copy. The name local_path is the name of the file or directory on the primary execution host. It can be relative to the staging and execution directory on the execution host, or it can be an absolute path.

The “@” character separates local_path from remote_path.

The name remote_path is the path on hostname. The name can be relative to the staging and execution directory on the primary execution host, or it can be an absolute path.

If path_list has more than one filespec, i.e. it contains commas, it must be enclosed in double-quotes.

```
umask=NNNN
```

Alters the umask with which the job will be started. Controls umask of job’s standard output and standard error. Sets job’s umask attribute to NNNN. Can be used with one to four digits; typically two.

The following example allows group and world read on the job’s output:

```
-W umask=33
```

Default value: 077

```
--version
```

The qalter command returns its PBS version information and exits. This option can only be used alone.

### 2.39.4 Operands

The qalter command accepts a job_identifier_list as its operand. The job_identifier_list is one or more job IDs for normal jobs or array jobs. Individual subjobs of an array job are not alterable.

Note that some shells require that you enclose a job array ID in double quotes.
2.39.5  **Standard Error**

The `qalter` command will write a diagnostic message to standard error for each error occurrence.

2.39.6  **Exit Status**

Zero upon successful processing of input. Exit value will be greater than zero upon failure of `qalter`.

2.39.6.1  **Warning about exit status with csh:**

If a job is run in `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.

2.39.7  **See Also**

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, `pbs_job_attributes(7B)`, `pbs_resources(7B)`, `qdel(1B)`, `qhold(1B)`, `qmove(1B)`, `qmsg(1B)`, `qrerun(1B)`, `qrls(1B)`, `qselect(1B)`, `qstat(1B)`, `qsub(1B)`

2.40  **qdel**

Deletes PBS jobs

2.40.1  **Synopsis**

```
qdel [-W for ce|suppr ess_email=<N>] job_identifier [job_identifier ...]
qdel --version
```

2.40.2  **Description**

The `qdel` command deletes jobs in the order given. This command can be used to delete queued or running jobs whether they are at the local server or at a remote server. This command cannot be used on finished jobs.
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A PBS job may be deleted by its owner, an operator, or the administrator. The server deletes a PBS job by sending a SIGTERM signal, then, if there are remaining processes, a SIGKILL signal.

If someone other than the job's owner deletes the job, mail is sent to the job's owner, or to a list of mail recipients if specified during qsub. See the qsub(1B) man page.

### 2.40.2.1 How Behavior of qdel Command Can Be Affected

The server's default_qdel_arguments attribute may affect the behavior of the qdel command. This attribute is settable by the administrator via the qmgr command. The attribute may be set to "-Wsupress_email=<N>". The server attribute is overridden by command line arguments. See the pbs_server_attributes(1B) man page.

If the job is in the process of provisioning, it can be deleted only by using the -W force option.

### 2.40.2.2 Sequence of Events

1. The job's running processes are killed.
2. The epilogue runs.
3. Files that were staged in are staged out. This includes
4. standard out (.o) and standard error (.e) files.
5. Files that were staged in or out are deleted.
6. The job's temp directory is removed.
7. The job is removed from the MOM(s) and the server.

### 2.40.3 Options to qdel

- **-W force**
  Deletes the job whether or not the job's execution host is reachable. Deletes the job whether or not the job is in the process of provisioning.

- **-Wsupress_email=<N>**
  Sets limit on number of emails sent when deleting multiple jobs. If N >= 1 and N or more job_identifiers are given, N emails are sent. If N >=1 and less than N job identifiers are given, the number of emails is the same as the number of jobs. If N = 0, this option is ignored. If N = -1, no mail is sent.
  Note that there is no space between "W" and "supress_email".
The `<N>` argument is an integer.

`--version`

The `qdel` command returns its PBS version information and exits. This option can only be used alone.

### 2.40.4 Operands

The `qdel` command accepts one or more `job_identifier` operands. These operands can be job identifiers, job array identifiers, job array range identifiers, or subjob identifiers. See Chapter 7, "Formats", on page 393.

Job array identifiers must be enclosed in double quotes for some shells.

### 2.40.5 Standard Error

The `qdel` command will write a diagnostic messages to standard error for each error occurrence.

### 2.40.6 Exit Status

Zero upon successful processing of input.

Greater than zero upon error.

### 2.40.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, `pbs_queue_attributes(7B)`, `pbs_server_attributes(1B)`, `qsub(1B)`, `qsig(1B)`, `pbs_deljob(3B)`

### 2.41 qdisable

Prevents jobs from being enqueued in a queue

#### 2.41.1 Synopsis

```
qdisable destination ...
qdisable --version
```
2.41.2 Description

The `qdisable` command directs that a destination queue should no longer accept batch jobs. If the command is accepted, the queue will no longer accept Queue Job requests which specified the disabled queue. Jobs which already reside in the queue will continue to be processed. This allows a queue to be “drained.”

In order to execute `qdisable`, the user must have PBS Operator or Manager privilege.

2.41.3 Options

   --version

   The `qdisable` command returns its PBS version information and exits. This option can only be used alone.

2.41.4 Operands

The `qdisable` command accepts one or more destination operands. The operands take one of three forms:

   queue
   @server
   queue@server

If `queue` is specified, the request is to disable that queue at the default server. If the `@server` form is given, the request is to disable all the queues at that server. If a full destination identifier, `queue@server`, is given, the request is to disable the named queue at the named server.

2.41.5 Standard Error

The `qdisable` command will write a diagnostic message to standard error for each error occurrence.

2.41.6 Exit Status

Upon successful processing of all the operands presented to the `qdisable` command, the exit status will be a value of zero.

If the `qdisable` command fails to process any operand, the command exits with a value greater than zero.
2.41.7 See Also

The PBS Professional Administrator’s Guide and the following manual pages: pbs_server(8B), qmgr(8B), and qenable(8B)

2.42 qenable

Allow jobs to be enqueued in a queue

2.42.1 Synopsis

qenable destination ...
qenable --version

2.42.2 Description

The qenable command directs that a destination queue should accept batch jobs.

The qenable command sends a Manage request to the batch server specified by queue. If the command is accepted, the destination will accept Queue Job requests which specified the queue.

In order to execute qenable, the user must have PBS Operator or Manager privilege.

2.42.3 Options

--version

The qenable command returns its PBS version information and exits. This option can only be used alone.

2.42.4 Operands

The qenable command accepts one or more destination operands. The operands are one of three forms:
qued
@server
queue@server
If `queue` is specified, the request is to enable that queue at the default server. If the `@server` form is given, the request is to enable all the queues at that server. If a full destination identifier, `queue@server`, is given, the request is to enable the named queue at the named server.

### 2.42.5 Standard Error

The `qenable` command will write a diagnostic message to standard error for each error occurrence.

### 2.42.6 Exit Status

Upon successful processing of all the operands presented to the `qenable` command, the exit status will be a value of zero. If the `qenable` command fails to process any operand, the command exits with a value greater than zero.

### 2.42.7 See Also

The PBS Professional Administrator’s Guide and the following manual pages: `pbs_server(8B)`, `qdisable(8B)`, and `qmgr(8B)`

### 2.43 `qhold`

Holds PBS batch jobs

#### 2.43.1 Synopsis

```
qhold [-h hold_list] job_identifier_list
qhold --version
```

#### 2.43.2 Description

The `qhold` command requests that a server place one or more holds on a job. A job that has a hold is not eligible for execution. Supported holds: `USER`, `OTHER` (also known as `operator`), `SYSTEM`, and `bad password`.
A user may place a *USER* hold upon any job the user owns. An operator, who is a user with operator privilege, may place either an *USER* or an *OTHER* hold on any job. The batch administrator may place any hold on any job.

The *p* option can only be set by root or admin user via `qhold -h p`. The owning user can release with `qrls -h p` or query by `qselect -h p`.

If no `-h` option is given, the *USER* hold will be applied to the jobs described by the `job_identifier_list` operand list.

If the job identified by `job_identifier_list` is in the queued, held, or waiting states, then all that occurs is that the hold type is added to the job. The job is then placed into the held state if it resides in an execution queue.

If the job is running, then the result of the `qhold` command depends upon whether the job can be checkpointed. The job can be checkpointed if the OS supports checkpointing, or if the application being checkpointed supports checkpointing. See the PBS Professional Administrator’s Guide. If the job can be checkpointed, the following happens:

- The job is checkpointed and its execution is interrupted.
- The resources assigned to the job are released.
- The job is placed in the held state in the execution queue.
- The job’s `Hold_Types` attribute is set to *u* for *User Hold*.

If checkpoint / restart is not supported, `qhold` simply sets the job’s `Hold_Types` attribute to *u*. The job continues to execute.

A job’s dependency places a system hold on the job. When the dependency is satisfied, the system hold is removed. This system hold is the same as the one set by an administrator. If the administrator sets a system hold on a job with a dependency, then when the dependency is satisfied, the job becomes eligible for execution.

The `qhold` command can be used on job arrays, but not on subjobs or ranges of subjobs.

If the job is in the process of provisioning, it cannot be held.

### 2.43.3 Options to `qhold`

- `-h hold_list`
  
  Defines the types of holds to be placed on the job.
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The hold_list argument is a string consisting of one or more of the letters “u”, “o”, or “s" in any combination or the character “n" or “p”. The hold type associated with each letter is:

Table 2-8: Hold Types

<table>
<thead>
<tr>
<th>Hold Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>u</td>
<td>USER</td>
</tr>
<tr>
<td>o</td>
<td>OTHER</td>
</tr>
<tr>
<td>s</td>
<td>SYSTEM</td>
</tr>
<tr>
<td>n</td>
<td>None</td>
</tr>
<tr>
<td>p</td>
<td>Bad password</td>
</tr>
</tbody>
</table>

--version

The qhold command returns its PBS version information and exits. This option can only be used alone.

2.43.4  Operands

The qhold command accepts a job_identifier_list which is one or more space-separated job IDs in the form:

`sequence_number[.server_name][@server]`

Note that some shells require that you enclose a job array identifier in double quotes.

2.43.5  Standard Error

The qhold command will write a diagnostic message to standard error for each error occurrence.

2.43.6  Exit Status

Zero upon successful processing of all the operands.
Greater than zero if the qhold command fails to process any operand.
2.43.7  See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, qrls(1B), qalter(1B), qsub(1B), pbs_alterjob(3B), pbs_holdjob(3B), pbs_rlsjob(3B), pbs_job_attributes(7B), pbs_resources(7B)

2.44  qmgr

Administrator's command interface for managing PBS

2.44.1  Synopsis

qmgr [-a] [-c directive] [-e] [-n] [-z] [server [server]...]
qmgr import hook <hook_name> <content-type> <content-encoding> {<input_file>|-}
qmgr export hook <hook_name> <content-type> <content-encoding> [<output_file>]
qmgr --version

2.44.2  Description

The PBS manager command, qmgr, provides a command-line interface to the PBS Server. The qmgr command is used to create or delete queues, vnodes, and hooks, to set or change vnode, queue, hook, server, or scheduler attributes, including resources, and to view information about hooks, queues, vnodes, the server, and the scheduler.

For information about attributes, see Chapter 6, "Attributes", on page 305.

Attributes whose values are unset do not appear in the output of the qmgr command.

If qmgr is invoked without the -c option and standard output is connected to a terminal, qmgr writes a prompt to standard output and reads a directive from standard input. See section 2.44.4.1, "Directive Syntax", on page 151.

For a qmgr prompt, type:

    qmgr <return>

For syntax and command information, type "help" at the qmgr prompt.
2.44.2.1 Required Privilege

The `qmgr` command requires different levels of privilege depending on the operation to be performed. All users can list or print attributes. PBS Operator or Manager privilege is required in order to set or change vnode, queue, hook, server, or scheduler attributes. PBS Manager privilege is required in order to create or delete queues, vnodes, and hooks.

Under UNIX/Linux, root privilege is required in order to operate on hooks or the `job_sort_formula` server attribute. Under Windows, this must be done from the installation account. For domained environments, the installation account must be a local account that is a member of the local Administrators group on the local computer. For standalone environments, the installation account must be a local account that is a member of the local Administrators group on the local computer.

Users without manager or operator privilege cannot view custom resources which were created to be invisible to users.

2.44.2.2 When To Run `qmgr` At Server Host

When operating on hooks or on the `job_sort_formula` server attribute, the `qmgr` command must be run at the server host.

2.44.3 Options to `qmgr`

The following table lists the options to the `qmgr` command:

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-a</code></td>
<td>Abort <code>qmgr</code> on any syntax errors or any requests rejected by a server.</td>
</tr>
<tr>
<td><code>-c directive</code></td>
<td>Execute a single command and exit <code>qmgr</code>. The command must be enclosed in quote marks, e.g. <code>qmgr -c &quot;print server&quot;</code></td>
</tr>
<tr>
<td><code>-e</code></td>
<td>Echo all commands to standard output.</td>
</tr>
<tr>
<td><code>-n</code></td>
<td>No commands are executed; syntax checking only is performed.</td>
</tr>
<tr>
<td><code>server [,server ...]</code></td>
<td>Makes the specified server(s) active. See section 2.44.6.1, “Making Objects Active”, on page 157.</td>
</tr>
</tbody>
</table>
2.44.4 Directives

A `qmgr` directive is a *command* together with the *object* to be operated on, the *attribute* belonging to the object that is to be changed, the *operator*, and the *value* the attribute will take.

A directive is terminated by a newline or a semicolon (“;”). Multiple directives may be entered on a single line. A directive may extend across lines by escaping the newline with a backslash (“\”).

### 2.44.4.1 Directive Syntax

A `qmgr` directive takes one of the following forms:

- `command <object type> [object names] [attribute OP value[,attribute OP value,...]]`
- `import hook <hook_name> <content-type> <content-encoding> {<input_file>|-}`
- `export hook <hook_name> <content-type> <content-encoding> [<output_file>]`

The directive can be used from the command line or from within the `qmgr` command. To use a directive from the command line, enclose the command and its arguments in single or double quotes:

```
qmgr -c "command <object type> [object names] [attribute OP value[,attribute OP value,...]]"
```

For example:

```
qmgr -c 'print queue Q1'
```

To use a directive from within the `qmgr` command, first start `qmgr`:

```
qmgr <return>
```

At the `qmgr` prompt, enter the command and its arguments. For example:

```
Qmgr: print queue Q1
```

Each command is explained in the following subsections.

---

**Table 2-9: qmgr Options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>-z</td>
<td>No errors are written to standard error.</td>
</tr>
<tr>
<td>--version</td>
<td>The <code>qmgr</code> command returns its PBS version information and exits. This option can only be used alone.</td>
</tr>
</tbody>
</table>
2.44.4.2 Comments

Comments begin with the “#” character and continue to the end of the line. Comments and blank lines are ignored by qmgr.

2.44.5 Arguments to Commands

2.44.5.1 Objects

The qmgr command can operate on servers, schedulers, queues, vnodes, and hooks. Each of these can be abbreviated in a directive. The following table lists the objects and their abbreviations:

<table>
<thead>
<tr>
<th>Object Name</th>
<th>Abbr</th>
<th>Object</th>
<th>Can be Created/Deleted By:</th>
<th>Can be Modified By:</th>
</tr>
</thead>
<tbody>
<tr>
<td>server</td>
<td>s</td>
<td>A Server</td>
<td>No one</td>
<td>Operator, Manager</td>
</tr>
<tr>
<td>queue</td>
<td>q</td>
<td>A queue</td>
<td>Operator, Manager</td>
<td>Operator, Manager</td>
</tr>
<tr>
<td>node</td>
<td>n</td>
<td>A vnode</td>
<td>Operator, Manager</td>
<td>Operator, Manager</td>
</tr>
<tr>
<td>hook</td>
<td>h</td>
<td>A hook</td>
<td>UNIX/Linux: root; Windows: installation account</td>
<td>UNIX/Linux: root; Windows: installation account</td>
</tr>
<tr>
<td>sched</td>
<td>sc</td>
<td>A scheduler</td>
<td>No one</td>
<td>Operator, Manager</td>
</tr>
</tbody>
</table>

2.44.5.2 Specifying Server

The qmgr command operates on objects (queues, vnodes, etc.) at the active server. There is always at least one active server; the default server is the active server unless other servers have been made active.

The default server is the server managing the host where the qmgr command runs, meaning it is the server specified in that host’s pbs.conf file.

You can specify the server you want:

@default

Specifies the default server.
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2.44.5.3 Object Names

In a qmgr directive, object names is a list of one or more names of specific objects. All objects in a list must be of the same type. The name list is in the form:

<object name>[[@<server>],<object name>[[@<server>]]] ...

where <server> is replaced in the directive with “default”, “active”, or “<server name>”. There must be no space between the name and the @ sign.

Example 2-1: List queues workq, slowq, and fastq at the active server:

Qmgr: list queue workq,slowq,fastq

Example 2-2: List queues Queue1 at the default server, Queue2 at Server2, and Queue3 at the active server:

Qmgr: list queue Queue1@default,Queue2@Server2,Queue3@active

Name lists must not contain white space between entries.

The administrator specifies the name of an object when creating the object.

Node attributes cannot be used as node names.
2.44.5.4 Specifying Objects

You can specify objects in the following ways:

<object type>

Acts on the active objects of the named type at the active server.

For example, to list all active vnodes, along with their attributes, at the active server:

```
list node
```

<object type> @<server> (note space before @ sign)

Acts on the active objects of the named type at the specified server.

For example, to list all active vnodes at the default server, along with their attributes:

```
list node @default
```

For example, to print out all queues at the default server, along with their attributes:

```
qmgr -c "print queue @default"
```

<object type> <object name>

Acts on the named object.

For example, to list Node1 and its attributes:

```
list node Node1
```

<object type> <object name>@<server>

Acts on the named object at the specified server.

For example, to list Node1 at the default server, along with the attributes of Node1:

```
list node Node1@default
```

2.44.5.5 Attributes

In a qmgr directive, attribute is the name of the attribute belonging to the object on which qmgr is to operate. You can set or modify the value of this attribute.

If the attribute is one which describes a set of resources, then the attribute is specified in the form:

attribute.<resource name>

For example, to set the amount of memory on a vnode:

```
Qmgr: set node Vnode1 resources_available.mem = 2mb
```
Any attribute value set via `qmgr` containing commas, whitespace or the hashmark must be enclosed in double quotes. For example:

```
Qmgr: set node Vnode1 comment="Node will be taken offline Friday at 1:00 for memory upgrade."
```

### 2.44.5.6 Operators

In a `qmgr` directive, `OP` is the operation to be performed with the attribute and its value. Operators are listed here:

#### Table 2-11: Operators

<table>
<thead>
<tr>
<th>Operator</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>=</code></td>
<td>Sets the value of the attribute. If the attribute has an existing value, the current value is replaced with the new value.</td>
</tr>
<tr>
<td><code>+=</code></td>
<td>Increases the current value of the attribute by the amount in the new value. When used for a string array, adds the new value as another string after a comma.</td>
</tr>
<tr>
<td><code>-=</code></td>
<td>Decreases the current value of the attribute by the amount in the new value. When used for a string array, removes the first matching string.</td>
</tr>
</tbody>
</table>

Example 2-3: Set routing destination for queue Queue1 to be Dest1:

```
Qmgr: set queue route_destinations = Dest1
```

Example 2-4: Add new routing destination for queue Queue1:

```
Qmgr: set queue route_destinations += Dest2
```

Example 2-5: Remove new routing destination for queue Queue1:

```
Qmgr: set queue route_destinations -= Dest2
```

### 2.44.5.7 Attribute Values

In a `qmgr` directive, `value` is the value to assign to an attribute. An attribute’s value must be in the correct format for the attribute’s type. Each attribute’s type is listed in Chapter 6, "Attributes", on page 305. Each format is described in Chapter 7, "Formats", on page 393.

If the value includes whitespace, commas or other special characters, such as the # character, the value string must be enclosed in single or double quotes.
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Resource values can be any string made up of alphanumeric, comma (",") underscore ("_"), dash ("-"), colon (":"), slash ("/"), backslash ("\"), space (" "), and equal sign ("=") characters.

2.44.5.8 Windows Requirements

Under Windows, use double quotes when specifying arguments to \texttt{qmgr}. For example:

\texttt{Qmgr: import hook hook1 application/x-python default "\Documents and Settings\pbsuser1\hook1.py"}

or

\texttt{qmgr -c 'import hook hook1 application/x-python default "\Documents and Settings\pbsuser1\hook1.py"'}

2.44.6 Commands

The \texttt{qmgr} commands can be used in two ways. One is to start \texttt{qmgr}, then use directives at the \texttt{qmgr} prompt. For example, type:

\texttt{qmgr <return>}

The \texttt{qmgr} prompt appears:

\texttt{Qmgr:}

Now you can enter commands, using directives, for example:

\texttt{Qmgr: print server}

The other is to call \texttt{qmgr} with the -c option and a directive in quotes. For example, to enter the same "print server" directive:

\texttt{qmgr -c "print server"}

Commands can be abbreviated to their minimum unambiguous form. Commands apply to all objects unless explicitly limited. The following table lists the commands, briefly tells what they do, and gives a link to a full description:

\begin{table}[h]
\centering
\begin{tabular}{|l|l|p{5cm}|p{10cm}|}
\hline
\textbf{Command} & \textbf{Abbrev} & \textbf{Effect} & \textbf{Description} \\
\hline
\texttt{active} & \texttt{a} & Specifies active objects & See section 2.44.6.1, "Making Objects Active", on page 157 \\
\hline
\texttt{create} & \texttt{c} & Creates object & See section 2.44.6.2, "Creating Objects", on page 160 \\
\hline
\end{tabular}
\end{table}
Making objects active is a way to set up a list of objects, all of the same type, on which you can then use a single command. Can be used on any object. For example, if you are going to set the same attribute to the same value on several vnodes, you can make all of the target vnodes active before using a single command to set the attribute value, instead of having to give the command once for each vnode.

When an object is active, it is acted upon when you specify its type but do not specify names. When you specify any object names in a directive, active objects are not operated on unless they are named in the directive.
You can specify a list of active objects for each type of object. You can have active objects of multiple types at the same time. The active objects of one type have no effect on whether objects of another type are active.

Objects are active only until the `qmgr` command is exited, so this feature can be used only at the `qmgr` prompt.

Each time you make any objects active, that list of objects replaces any active objects of the same kind. For example, if you have four queues, and you make Q1 and Q2 active, then later make Q3 and Q4 active, the result is that Q3 and Q4 are the only active queues.

You can make objects be active at different servers simultaneously. For example, you can set vnodes N1 and N2 at the default server, and vnodes N3 and N4 at server Server2 to be active at the same time.

To make all objects inactive, quit `qmgr`. When you quit `qmgr`, any object that was active is no longer active.
2.44.6.1.i Using the active Command

`active <object type> [ <object name> [, <object name> ... ] ]`

Makes the named object(s) of the specified type active.

Example: To make queue Queue1 active:

```
Qmgr: active queue Queue1
```

Example: To make queues Queue1 and Queue2 at the active server be active, then enable them:

```
Qmgr: active queue Queue1,Queue2
Qmgr: set queue enabled=True
```

Example: To make queue Queue1 at the default server and queue Queue2 at Server2 be active:

```
Qmgr: active queue Queue1@default,Queue2@Server2
```

Example: To make vnodes N1, N2, N3, and N4 active, and then give them all the same value for their `max_running` attribute:

```
Qmgr: active node N1,N2,N3,N4
Qmgr: set node max_running = 2
```

`active <object type> @<server>`  (note space before @ sign)

Makes all object(s) of the specified type at the specified server active.

Example: To make all queues at the default server active:

```
Qmgr: active queue @default
```

Example: To make all vnodes at server Server2 active:

```
Qmgr: active node @Server2
```

`active <object type>`

Queries which objects of the specified type are active. The `qmgr` command prints a list of names of active objects of the specified type to stdout.
2.44.6.2 Creating Objects

create <object type> <object name>[,<object name> ...] [[attribute = value] [,attribute = value] ...]

Creates one new object of the specified type for each name, and gives it the specified name. Can be used only with queues, vnodes, and hooks.

For example, to create a queue named Q1 at the active server:

Qmgr: create queue Q1

For example, to create a vnode named N1 and a vnode named N2:

Qmgr: create node N1,N2

For example, to create queue Queue1 at the default server and queue Queue2 at Server2:

Qmgr: create queue Queue1@default,Queue2@Server2

For example, to create vnodes named N1, N2, N3, and N4 at the active server, and to set their Mom attribute to Host1 and their max_running attribute to 1:

Qmgr: create node N1,N2,N3,N4 Mom=Host1, max_running = 1

All objects of the same type at a server must have unique names. For example, each queue at server Server1 must have a unique name. Objects at one server can have the same name as objects at another server.

You can create multiple objects of the same type with a single command. You cannot create multiple types of objects in a single command.
2.44.6.3 Deleting Objects

`delete <object type> <object name>[,<object name> ...]`

Deletes the named object(s). Can be used only with queues, vnodes, and hooks. For example, to delete queue Q1 at the active server:

```
Qmgr: delete queue Q1
```

For example, to delete vnodes N1 and N2 at the active server:

```
Qmgr: delete node N1,N2
```

For example, to delete queue Queue1 at the default server and queue Queue2 at Server2:

```
Qmgr: delete queue Queue1@default,Queue2@Server2
```

`delete <object type>`

Deletes the active objects of the specified type. For example, to delete the active queues:

```
Qmgr: delete queue
```

`delete <object type>@<server>`

Deletes the active objects of the specified type at the specified server. For example, to delete the active queues at server Server2:

```
Qmgr: delete queue @Server2
```

You can delete multiple objects of the same type with a single command. You cannot delete multiple types of objects in a single command.

2.44.6.4 Exporting Hooks

Format for exporting a hook:

`export hook <hook name> <content-type> <content-encoding> [<output_file>]`

This dumps the script contents of hook `<hook_name>` into `<output_file>`, or `<stdout>` if `<output_file>` is not specified.

- The resulting `<output_file>` or `<stdout>` data is of `<content-type>` and `<content-encoding>`.
- The only `<content-type>` currently supported is “application/x-python”.
- The allowed values for `<content-encoding>` are “default” (7bit) and “base64”.
- `<output_file>` must be a path that can be created by `qmgr`.
- Any relative path `<output_file>` is relative to the directory where `qmgr` was executed.
- If `<output_file>` already exists it is overwritten. If PBS is unable to overwrite the file due
to ownership or permission problems, then an error message is displayed in stderr.

- If the <output_file> name contains spaces like the ones used in Windows file names, then <output file> must be enclosed in quotes.

Example 2-6: Dumps hook1's script contents directly into a file "hello.py.out":

```bash
# qmgr -c 'export hook hook1 application/x-python default hello.py'
# cat hello.py
import pbs
pbs.event().job.comment="Hello, world"
```

Example 2-7: To dump the script contents of a hook 'hook1' into a file in "\My Hooks\hook1.py":

```bash
Qmgr: export hook hook1 application/x-python default "\My Hooks\hook1.py"
```

### 2.44.6.5 Importing Hooks

To import a hook, you import the contents of a hook script into the hook. You must specify a filename that is locally accessible to qmgr and the PBS Server.

Format for importing a hook:

```
import hook <hook name> <content-type> <content-encoding> {<input_file>|-}
```

This uses the contents of <input_file> or stdin (-) as the contents of hook <hook_name>.

- The <input_file> or stdin (-) data must have a format <content-type> and must be encoded with <content-encoding>.
- The only <content-type> currently supported is “application/x-python”.
- The allowed values for <content-encoding> are “default” (7bit) and “base64”.
- If the source of input is stdin (-) and <content-encoding> is “default”, then qmgr expects the input data to be terminated by EOF.
- If the source of input is stdin (-) and <content-encoding> is “base64”, then qmgr expects input data to be terminated by a blank line.
- <input_file> must be locally accessible to both qmgr and the requested batch server.
- A relative path <input_file> is relative to the directory where qmgr was executed.
- If a hook already has a content script, that is overwritten by this import call.
- If <input_file> name contains spaces as are used in Windows filenames, then <input file> must be quoted.
- There is no restriction on the size of the hook script.
Example 2-8: Given a Python script in ASCII text file "hello.py", this makes its contents be the script contents of hook1:

```bash
#cat hello.py
import pbs
pbs.event().job.comment="Hello, world"
# qmgr -c 'import hook hook1 application/x-python default hello.py'
```

Example 2-9: Given a base64-encoded file "hello.py.b64", qmgr unencodes the file's contents, and then makes this the script contents of hook1:

```bash
# cat hello.py.b64
chJpbnQqImhlbGxvLCB3b3JsZCIK
# qmgr -c 'import hook hook1 application/x-python base64 hello.py.b64'
```

### 2.44.6.6 Setting Attribute Values

You can use the `qmgr` command to set attributes of any object.

\[
\text{set } <\text{object type}> <\text{object name}>[,<\text{object name}> ...] \text{ attribute } = \text{ value } [,\text{attribute } = \text{ value } ...]
\]

Sets the value of the specified attribute(s) for the named object(s). Each specified attribute is set for each named object, so if you specify three attributes and two objects, both objects get all three attributes set.

\[
\text{set } <\text{object type}> \text{ attribute } = \text{ value}
\]

Sets the attribute value for all active objects when there are active objects of the type specified.

\[
\text{set } <\text{object type}> @<\text{server}> \text{ attribute } = \text{ value}
\]

Sets the attribute value for all active objects at the specified server when there are active objects of the type specified.

You can have spaces between attribute-value pairs.

If a value contains a space or a comma, the value must be enclosed in single or double quotes. For example, to set the value of vnode N1’s comment to “Check later, replacing memory”:

```bash
Qmgr: set node N1 comment = “Check later, replacing memory”
```

You can set attribute values for only one type of object in each command.
2.44.6.7 Unsetting Attribute Values

You can use the `qmgr` command to unset attributes of any object.

```
unset <object type> <object name>[,<object name> ...] attribute[,attribute...]
```

Unsets the value of the specified attributes of the named object(s).

```
unset <object type> attribute[,attribute...]
```

Unsets the value of specified attributes of active objects.

```
unset <object type> <object name> attribute[,attribute...]
```

Unsets the value of specified attributes of the named object.

```
unset <object type> @<server> attribute[,attribute...]
```

Unsets the value of specified attributes of active objects at the specified server.

You can have spaces between attribute names.

You can unset attribute values for only one type of object in each command.

2.44.6.8 Listing Object Attributes

You can use the `qmgr` command to list attributes of any object.

```
list <object type> <object name>[,<object name> ...]
```

Lists the attributes, with associated values, of the named object(s).

```
list <object type> <object name> <attribute name>[, <attribute name>...]
```

Lists values of the specified attributes of the named object.

```
list <object type>
```

Lists attributes, with associated values, of active objects of the specified type at the active server.

```
list <object type> @<server>
```

Lists all objects of the specified type at the specified server, with their attributes and the values associated with the attributes.

```
list server
```

Lists attributes of the active server. If no server other than the default server has been made active, lists attributes of the default server (it is the active server).

```
list server <server>
```

Lists attributes of the specified server.
list hook

Lists all hooks, along with their attributes.

list hook <hook name>

Lists attributes of the specified hook.

2.44.6.9 Printing Creation and Configuration Commands

print <object type> <object name>[,<object name> ...]

where <object name> follows the name rules in section 2.44.5.3, “Object Names”, on page 153.

Prints out the commands required to do the following:

• Create the named object(s)
• Set object attributes to their current values

print <object type> <object name> [<attribute name>[, <attribute name>]...]

where <object name> follows the name rules in section 2.44.5.3, “Object Names”, on page 153.

Prints out the commands required to do the following:

• Create the named object
• Set specified object attributes to their current values

print <object type>

Prints out the commands to create and configure the active objects of the named type.

print <object type> @<server>

Prints out the commands to create and configure all of the objects of the specified type at the specified server.

print server

Prints information for the active server; if there is no active server, prints information for the default server.

Prints out the commands required to do the following for the server and queues, but not hooks:

• Create each queue
• Set the attributes of each queue to their current values
• Set the attributes of the server to their current values

print hook

Prints out the commands to create and configure all hooks.

print hook <hook name>

Prints out the commands to create and configure the specified hook.

2.44.6.10 Printing Usage Information

The qmgr built-in help function is invoked using the help command. You can request usage information for any of the qmgr commands.

help <command>

Prints out usage information for the specified command.

For example, to print usage information for the set command:

```
qmgr
Qmgr: help set
Syntax: set object [name][,name...] attribute[.resource] OP value
```

2.44.7 Saving and Re-creating Configuration

To save and recreate a configuration, print the configuration information to a file, then read it back in later.

See section 2.44.6.9, “Printing Creation and Configuration Commands”, on page 165.

2.44.7.1 Saving Queue Information

Before re-creating queue and server configuration, use this command to save the configuration/creation commands to a file:

```
Qmgr: print server > savedsettings
```

When re-creating the queue and server configuration, read the commands into qmgr:

```
qmgr < savedsettings
```

2.44.7.2 Saving Hook Information

To save creation and configuration information for all hooks:

```
# qmgr -c "print hook" > hook.qmgr
```
To re-create all hooks:

```bash
# qmgr < hook.qmgr
```

### 2.44.8 Standard Input

The `qmgr` command reads standard input for directives until end-of-file is reached, or the `exit` or `quit` directive is read.

### 2.44.9 Standard Output

If standard output is connected to a terminal, a command prompt is 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.

### 2.44.10 Standard Error

If the `-z` option is not specified, the `qmgr` command writes a diagnostic message to standard error for each error occurrence.

### 2.44.11 Exit Status

Upon successful processing of all the operands presented to the `qmgr` command, the exit status is zero.

If the `qmgr` command fails to process any operand, the command exits with a value greater than zero.

### 2.44.12 Caveats

#### 2.44.12.1 Setting Vnode Attributes

Most of a vnode’s attributes may be set using `qmgr`. However, some must be set on the individual execution host in local vnode definition files, NOT by using `qmgr`. See section 3.5.2, "Choosing Configuration Method" on page 47 in the PBS Professional Administrator’s Guide.

### 2.44.13 Examples

The following are examples of `qmgr` directives:
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List serverA’s scheduler’s attributes

\texttt{list sched @serverA}

List attributes for default server’s scheduler

\texttt{l sched @default}

List PBS version for default server’s scheduler

\texttt{l sched @default pbs_version}

Set software resource on mynode

\texttt{set node mynode resources\_available.software = “myapp=/tmp/foo”}

Create queue

\texttt{create queue fast priority=10,queue\_type=e,enabled = true,max\_running=0}

Increase limit on queue

\texttt{set queue fast max\_running +=2}

Create queue, set resources

\texttt{create queue little}
\texttt{set queue little resources\_max.mem=8mw,resources\_max.cput=10}

Unset limit on queue

\texttt{unset queue fast max\_running}

Set node offline

\texttt{set node state = “offline”}

Define active list

\texttt{active server s1,s2,s3}

List a queue

\texttt{list queue @server1}

Set limit on queue

\texttt{set queue max\_running = 10}

To create a provisioning hook called Provision\_Hook, and import the ASCII hook script called “master\_provision.py” located in /root/data/:

\texttt{Qmgr: create hook Provision\_Hook}
\texttt{Qmgr: import hook Provision\_Hook application/x-python default /root/}
\texttt{data/master\_provision.py}
2.44.14 See Also

The PBS Professional Administrator’s Guide, the PBS Professional Installation and Upgrade Guide, pbs_queue_attributes(7B), pbs_server_attributes(7B), pbs_node_attributes(7B), pbs_hook_attributes(7B), pbs_sched_attributes(7B)

2.45 qmove

Moves PBS batch job

2.45.1 Synopsis

qmove destination job_identifier ...
qmove --version

2.45.2 Description

To move a job is to remove the job from the queue in which it resides and place the job in another queue.

The qmove command can be used on job arrays, but not on subjobs or ranges of subjobs.

Note that job arrays can only be moved from one server to another if they are in the ‘Q’, ‘H’, or ‘W’ states, and only if there are no running subjobs. The state of the job array is preserved, and the job array will run to completion on the new server.

A job in the Running, Transiting, or Exiting state cannot be moved.

A job in the process of provisioning cannot be moved.

The behavior of the qmove command may be affected by any site hooks. Site hooks can modify the job’s attributes, change its routing, etc.

2.45.3 Options

--version

The qmove command returns its PBS version information and exits. This option can only be used alone.
2.45.4 Operands

The first operand is the new destination for the jobs. It will be accepted in the syntax:

```
queue
@server
queue@server
```

See Chapter 7, "Formats", on page 393 for destination identifier information.

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 `job_identifiers` which specify the jobs to be moved to the new destination. The `qmove` command accepts one or more `job_identifier` operands of the form:

```
sequence_number[.server_name][@server]
```

Note that some shells require that you enclose a job array identifier in double quotes.

2.45.5 Standard Error

The `qmove` command will write a diagnostic messages to standard error for each error occurrence.

2.45.6 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.

2.45.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, `qsub(1B)`, `pbs_movejob(3B)`
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2.46 qmsg

Sends message to PBS batch jobs

2.46.1 Synopsis

qmsg [-E] [-O] message_string job_identifier ...
qmsg --version

2.46.2 Description

To send a message to a job is to write a message string into one or more output files of the job. Typically this is done to leave an informative message in the output of the job. The qmsg command writes messages into the files of jobs by sending a Message Job batch request to the batch server that owns the job. The qmsg command does not directly write the message into the files of the job.

The qmsg command cannot be used on job arrays, subjobs or ranges of subjobs.

2.46.3 Options

- E
  Specifies that the message is written to the standard error of each job.
- O
  Specifies that the message is written to the standard output of each job.
--version
  The qmsg command returns its PBS version information and exits. This option can only be used alone.

If no option is specified, the message will be written to the standard error of the job.

2.46.4 Operands

The first operand, message_string, is the message to be written. If the string contains blanks, the string must be quoted. If the final character of the string is not a newline, a newline character will be added when written to the job’s file.
All following operands are job_identifiers which specify the jobs to receive the message string. The qmsg command accepts one or more job_identifier operands of the form:

sequence_number[.server_name]@[server]

2.46.5 Standard Error

The qmsg command will write a diagnostic message to standard error for each error occurrence.

2.46.6 Exit Status

Upon successful processing of all the operands presented to the qmsg command, the exit status will be a value of zero.

If the qmsg command fails to process any operand, the command exits with a value greater than zero.

2.46.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, qsub(1B), pbs_msgjob(3B)

2.47 qorder

Exchanges order of two PBS batch jobs.

2.47.1 Synopsis

qorder job_identifier job_identifier
qorder --version

2.47.2 Description

Allows the exchange of two jobs’ positions in the queue or queues in which the jobs reside. The two jobs must be located at the same server. No attribute of the job, e.g. priority, is changed. The impact of interchanging the order within or between queues is dependent on local job scheduling policy; contact your systems administrator.
A job in the running state cannot be reordered.
The qorder command can be used on job arrays, but not on subjobs or ranges of subjobs.

### 2.47.3 Options

--version

The qorder command returns its PBS version information and exits. This option can only be used alone.

### 2.47.4 Operands

Both operands are job_identifiers which specify the jobs to be exchanged. The qorder command accepts two job_identifier operands of the form:

```
sequence_number[.server_name][@server]
```

The server specification for the two jobs must agree as to the current location of the two job ids.

Note that some shells require that you enclose a job array identifier in double quotes.

### 2.47.5 Standard Error

The qorder command will write diagnostic messages to standard error for each error occurrence.

### 2.47.6 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.

### 2.47.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, qsub(1B), qmove(1B), pbs_orderjob(3B), pbs_movejob(3B)
2.48 qrerun

Reruns a PBS batch job

2.48.1 Synopsis

qrerun [-W force] job_identifier [job_identifier ...]
qrerun --version

2.48.2 Description

The qrerun command reruns the specified jobs if possible. PBS Manager or Operator privilege is required to use this command.

To rerun a job is to kill it and requeue it in the execution queue from which it was run.

If a job is marked as not rerunnable then qrerun will fail. See the -r option on the qsub and qalter commands.

The qrerun command can be used on job arrays, subjobs, and ranges of subjobs. It cannot rerun a subjob which is not running.

2.48.3 Options

-W force

The job is to be requeued even if the node on which the job is executing is unreachable, or if the job's substate is provisioning.

--version

The qrerun command returns its PBS version information and exits. This option can only be used alone.

2.48.4 Operands

The qrerun command accepts one or more job_identifier operands of the form:
sequence_number[.server_name][@server]

Note that some shells require that you enclose a job array identifier in double quotes.
2.48.5 Standard Error

The qrerun command will write a diagnostic message to standard error for each error occurrence.

2.48.6 Exit Status

Zero upon successful processing of all operands.
Greater than zero upon failure to process any operand.

2.48.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, qsub(1B), qalter(1B), pbs_alterjob(3B), pbs_rerunjob(3B)

2.49 qr1s

Releases hold on PBS batch jobs

2.49.1 Synopsis

qr1s [-h hold_list] job_identifier ...  
qr1s --version

2.49.2 Description

The qr1s 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, SYSTEM, and bad password. The different types of holds may require that the user issuing the qr1s command have special privilege. Typically, the owner of the job will be able to remove a USER hold, but not an OTHER or SYSTEM hold. 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.
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Only root or admin can set a bad password hold via `qhold -h p`. The owner of the job can `qrls -h p` to release a hold set with `qhold -h p`.

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.

2.49.3 Options

- `--version`
  The `qrls` command returns its PBS version information and exits. This option can only be used alone.

2.49.4 Operands

The `qrls` command accepts one or more job_identifier operands of the form:

```
sequence_number[.server_name][@server]
```

Note that some shells require that you enclose a job array identifier in double quotes.
2.49.5 Standard Error

The `qrls` command will write a diagnostic message to standard error for each error occurrence.

2.49.6 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.

2.49.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, `qsub(1B), qalter(1B), qhold(1B), pbs_alterjob(3B), pbs_holdjob(3B), and pbs_rlsjob(3B)`

2.50 `qrun`

Runs a PBS batch job now

2.50.1 Synopsis

`qrun [-a] [-H vnode-specification] job_identifier_list`

`qrun --version`

2.50.2 Description

The `qrun` command is used to force a job to run, regardless of scheduling position or resource requirements.

In order to execute `qrun`, the user must have PBS Operator or Manager privilege, and the job must be in the Queued state and reside in an execution queue.

The `qrun` command can be used on a subjob or a range of subjobs, but not on a job array. When it is used on a range of subjobs, the non-running subjobs in that range are run.

The `qrun` command cannot be used on a job that is in the process of provisioning.
NOTE: If you use a -H vnode_specification option to run a job, but specify insufficient vnodes or resources, the job may not run correctly. Avoid using this option unless you are sure.

When preemption is enabled, the scheduler preempts other jobs in order to run this job. Running a job via qrun gives the job higher preemption priority than any other class of job.

2.50.3 Options to qrun

-a

The qrun command exits before the job actually starts execution.

(no -H option)

A request is made of the Scheduler to schedule this job. The job is run immediately regardless of scheduling policy as long as the following are true:

• The queue in which the job resides is an execution queue.

• Either the resources required by the job are available, or preemption is enabled and the required resources can be made available by preemopping jobs that are running.

(with -H option)

With the -H option, all scheduling policies are bypassed and the job is run directly. The job will be run immediately on the named vnodes, regardless of current usage on those vnodes with the exception of vnode state. The job will not be run and the qrun request will be rejected if any named vnode is down, offline, already allocated exclusively or would need to be allocated exclusively and another job is already running on the vnode.

If the qrun -H command is used on a job that requests an AOE, and that AOE is not instantiated on those vnodes, the vnodes are provisioned with the AOE.

If the job requests an AOE, and that AOE is not available on the specified vnodes, the job is held.

-H vnode_specification, without resources

The vnode_specification without resources has this format:

(vchunk)[+(vchunk) ...]

where vchunk has the format

vnode[+vnode ..]

Example:

-H (VnodeA+VnodeB)+(VnodeC)
PBS will apply one requested chunk from the job’s selection directive in round-robin fashion to each vchunk in the list. Each vchunk must be sufficient to run the job’s corresponding chunk, otherwise the job may not execute correctly.

- **H vnode_specification, with resources**
The vnode_specification with resources has this format:

\[ (vchunk)[+(vchunk) ...] \]

where vchunk has the format

\[ vnode:vnode_resources[+vnode:vnode_resources ...] \]

and where vnode_resources has the format

\[ resource=value[;resource=value ...] \]

Example:

\[-H (VnodeA:mem=100kb:ncpus=1) +(VnodeB:mem=100kb:ncpus=2+VnodeC:mem=100kb) \]

PBS creates a new selection directive from the vnode_specification, using it instead of the original specification from the user. Any single resource specification will result in the job’s original selection directive being ignored. Each vchunk must be sufficient to run the job’s corresponding chunk, otherwise the job may not execute correctly.

If the job being run requests \(-l place=exclhost\), take extra care to satisfy the exclhost request. Make sure that if any vnodes are from a multi-vnoded host, all vnodes from that host are allocated. Otherwise those vnodes can be allocated to other jobs.

--version

The qrun command returns its PBS version information and exits. This option can only be used alone.

2.50.4 **Operands**

The qrun command accepts a job_identifier_list containing one or more job_identifiers of the form:

\[ sequence_number[.server_name][@server] \]

Note that some shells require that you enclose a job array identifier in double quotes.
2.50.5  Standard Error

The **qrun** command will write a diagnostic message to standard error for each error occurrence.

2.50.6  Exit Status

Zero, on success.

Greater than zero, if the **qrun** command fails to process any operand.

2.50.7  See Also

The PBS Professional Administrator’s Guide, **qsub(1B)**, **qmgr(8B)**, **pbs_runjob(3B)**

2.51  **qselect**

Selects PBS batch jobs

2.51.1  Synopsis

```
qselect --version
```

2.51.2  Description

The **qselect** command lists those jobs that meet the specified selection criteria. Jobs are selected from a single server.

Each option acts as a filter restricting which jobs are listed. With no options, the **qselect** command will list all jobs at the server which the user is authorized to list (query status of).

When selecting jobs according to their requested resources, this command can be used only on resources in the **Resource_List** job attribute, or on the entire selection directive.

Jobs that are finished or moved are listed only when the **-x** or **-H** options are used. Otherwise, job selection is limited to queued and running jobs.


2.51.3 Relations

When an option is specified with an optional \( \text{op} \) component to the option argument, then \( \text{op} \) specifies a relation between the value of a certain job attribute and the value component of the option argument. If an \( \text{op} \) is allowable on an option, then the description of the option letter will indicate the \( \text{op} \) is allowable. The only acceptable strings for the \( \text{op} \) component, and the relation the string indicates, are shown in the following table of relations:

<table>
<thead>
<tr>
<th>Relation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>.eq.</td>
<td>the value represented by the attribute of the job is equal to the value represented by the option argument.</td>
</tr>
<tr>
<td>.ne.</td>
<td>the value represented by the attribute of the job is not equal to the value represented by the option argument.</td>
</tr>
<tr>
<td>.ge.</td>
<td>the value represented by the attribute of the job is greater than or equal to the value represented by the option argument.</td>
</tr>
<tr>
<td>.gt.</td>
<td>the value represented by the attribute of the job is greater than the value represented by the option argument.</td>
</tr>
<tr>
<td>.le.</td>
<td>the value represented by the attribute of the job is less than or equal to the value represented by the option argument.</td>
</tr>
<tr>
<td>.lt.</td>
<td>the value represented by the attribute of the job is less than the value represented by the option argument.</td>
</tr>
</tbody>
</table>

2.51.4 Options to qselect

- `a [op]date_time`
  
  **Deprecated.** Restrictions selection to a specific execution time, or a range of execution times.

  The \textit{qselect} command selects only jobs for which the value of the \textit{Execution\_Time} attribute is related to the \textit{date\_time} argument by the optional \text{op} operator.

  The \textit{date\_time} argument has the format:

  ```
  [[[CC]YY]MMDDhhmm].SS
  ```
where the 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. CC is the century and YY the year.

If op is not specified, jobs will be selected for which the Execution_Time and date_time values are equal. If op is specified, jobs will be selected according to the definitions given in Relations above.

-A account_string
Restricts selection to jobs whose Account_Name attribute matches the specified account_string.

-c [op]interval
Restricts selection to jobs whose Checkpoint interval attribute matches the specified relationship.
The values of the Checkpoint attribute are defined to have the following ordered relationship:
\[ n > s > c{\text{=}}\text{minutes} > c > u \]
If the optional op is not specified, jobs will be selected whose Checkpoint attribute is equal to the interval argument. If op is specified, jobs will be selected according to the rules in Relations above.

For an interval value of “u”, only “eq.” and “ne.” are valid.

-h hold_list
Restricts the selection of jobs to those with a specific set of hold types. Only those jobs will be selected whose Hold_Types attribute exactly match the value of the hold_list argument.
The hold_list argument is a string consisting of the single letter n, or one or more of the letters u, o, p, or s in any combination. If letters are duplicated, they are treated as if they occurred once. The letters represent the hold types:

<table>
<thead>
<tr>
<th>Hold Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>none</td>
</tr>
<tr>
<td>u</td>
<td>user</td>
</tr>
</tbody>
</table>

Table 2-15: Hold Types
-H
Restricts selection to finished and moved jobs.

-J
Limits the selection to job arrays only.

-I resource_list
Restricts selection of jobs to those with specified resource amounts. Users without operator or manager privilege cannot specify custom resources which were created to be invisible to users.
The resource_list is in the following format:
resource_name op value[,resource_name op val,...]
The relation operator op must be present.
For job-wide resources, all operators are useful. However, resource specifications for chunks using the select statement, or placement using the place statement are stored as strings. Therefore the only useful operators for these are .eq. and .ne.
The definitions given in Relations above are used when comparing the values of resources.

-N name
Restricts selection of jobs to those with a specific name.

-p [op]priority
Restricts selection of jobs to those with a priority that matches the specified relationship. If op is not specified, jobs are selected for which the job Priority attribute is equal to the priority
If the op is specified, the relationship is defined in Relations above.

-P project
Restrict selection of jobs to those matching the specified project.
Format: String.

<table>
<thead>
<tr>
<th>Hold Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>other</td>
</tr>
<tr>
<td>p</td>
<td>bad password</td>
</tr>
<tr>
<td>s</td>
<td>system</td>
</tr>
</tbody>
</table>
PBS Commands

Project name can contain any characters except for the following: Slash (/), left bracket ([), right bracket (]), double quote (""""), semicolon (";"), colon (":"), vertical bar ("|"), left angle bracket (<), right angle bracket (">"), plus ("+"), comma (","), question mark ("?"), and asterisk ("*").

-q destination
Restricts selection to those jobs residing at the specified destination.
The destination may be of one of the following three forms:
queue
@server
queue@server
If the -q option is not specified, jobs will be selected from the default server.
If the destination describes only a queue, only jobs in that queue on the default batch server will be selected.
If the destination describes only a server, then jobs in all queues on that server will be selected.
If the destination describes both a queue and a server, then only jobs in the named queue on the named server will be selected.

-r rerun
Restricts selection of jobs to those with the specified Rerunnable attribute.
The option argument must be a single character. The following two characters are supported by PBS: y and n.

-s states
Restricts job selection to those in the specified states.
The states argument is a character string which consists of any combination of the characters: B, E, F, H, M, Q, R, S, T, U, W, and X. (A repeated character will be accepted, but no additional meaning is assigned to it.)

Table 2-16: Job States

<table>
<thead>
<tr>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Job array has started execution.</td>
</tr>
<tr>
<td>E</td>
<td>The Exiting state.</td>
</tr>
<tr>
<td>F</td>
<td>The Finished state.</td>
</tr>
</tbody>
</table>
Jobs will be selected which are in any of the specified states. Since array jobs are never in states $R$, $S$, $T$, or $U$, if those states are specified, no array job will be selected. Subjobs of the array in those states may be selected if $T$ is specified.

-t suboption [comparison] specified-time
Allows jobs to be selected according to their time attributes. The suboption is one of:

<table>
<thead>
<tr>
<th>Suboption</th>
<th>Time Attribute Selected</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Execution_Time</td>
<td>Time the job began execution</td>
</tr>
<tr>
<td>c</td>
<td>ctime</td>
<td>Job creation time, seconds since epoch</td>
</tr>
<tr>
<td>e</td>
<td>etime</td>
<td>Time the job became eligible to run</td>
</tr>
</tbody>
</table>
The comparison is one of the relations listed above in Relations.

The specified-time is in datetime format. See Chapter 7, "Formats", on page 393.

A time period can be bracketed by using the -t option twice. For example, to select jobs using stime between noon and 3 p.m.:

```
qselect -ts.gt.09251200 -ts.lt.09251500
```

- **T**
  Limits selection to job and subjob identifiers.

- **u user_list**
  Restricts selection to jobs owned by the specified user names.
  This provides a means of limiting the selection to jobs owned by one or more users.

  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. Jobs will be selected which are owned by the listed users at the corresponding hosts.

- **x**
  Allows selection of finished and moved jobs in addition to queued and running jobs.

- **X**
  Allows selection of completed or deleted subjobs (subjobs in X state).

---

**Table 2-17: Suboptions to the -t Option**

<table>
<thead>
<tr>
<th>Suboption</th>
<th>Time Attribute Selected</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>g</strong></td>
<td>eligible_time</td>
<td>Amount of eligible time job accrued waiting to run</td>
</tr>
<tr>
<td><strong>m</strong></td>
<td>mtime</td>
<td>Modification time</td>
</tr>
<tr>
<td><strong>q</strong></td>
<td>qtime</td>
<td>Job queued time</td>
</tr>
<tr>
<td><strong>s</strong></td>
<td>stime</td>
<td>Job start time</td>
</tr>
<tr>
<td><strong>t</strong></td>
<td>estimated.start_time</td>
<td>Job’s estimated start time</td>
</tr>
</tbody>
</table>
--version
The qselect command returns its PBS version information and exits.
This option can only be used alone.

2.51.5 Standard Output
The list of job identifiers of selected jobs is written to standard output. Each job identifier is separated by white space. Each job identifier is of the form:
sequence_number.server_name@server
Where sequence_number.server is the identifier assigned at submission time; see qsub.
@server identifies the server which currently owns the job.

2.51.6 Standard Error
The qselect command will write a diagnostic message to standard error for each error occurrence.

2.51.7 Exit Status
Upon successful processing of all options presented to the qselect command, the exit status will be a value of zero.
If the qselect command fails to process any option, the command exits with a value greater than zero.

2.51.8 See Also
The PBS Professional User's Guide, the PBS Professional Administrator's Guide,
qalter(1B), qdel(1B), qhold(1B), qmove(1B), qrls(1B), qstat(1B), qsub(1B), pbs_job_attributes(7B), pbs_resources(7B)

2.52 qsig
Send signal to PBS batch job
Chapter 2  PBS Commands

2.52.1  Synopsis

```
qsig [-s signal] job_identifier ...
qsig --version
```

2.52.2  Description

The `qsig` command requests that a signal be sent to the specified 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 is 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 job is in the process of provisioning.

The `qsig` command sends a Signal Job batch request to the server which owns the job.

The `qsig` command can be used for job arrays, ranges of subjobs, and subjobs. If it is used on a range of subjobs, the subjobs in the range which are running will be signaled.

2.52.3  Options

```
-s signal
```

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. Not all signal names will be recognized by `qsig` signal name; try issuing the signal number instead.

Two special signal names, “`suspend`” and “`resume`”, [note, all lower case], are used to suspend and resume jobs. When suspended, a job continues to occupy system resources but is not executing and is not charged for wall-time. Manager or operator privilege is required to suspend or resume a job.

If `qsig -s resume` is used on a job that was suspended using `qsig -s suspend`, the job will be resumed when there are sufficient resources.
--version
The qsig command returns its PBS version information and exits. This option can only be used alone.

2.52.4 Operands

The qsig command accepts one or more job_identifier operands. For a job, this has the form:

```
sequence_number[.server_name][@server]
```

and for a job array, it is:

```
sequence_number[][][.server_name][@server]
```

Note that some shells require that you enclose a job array identifier in double quotes.

2.52.5 Standard Error

The qsig command will write a diagnostic messages to standard error for each error occurrence.

2.52.6 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.

2.52.7 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, qsub(1B), pbs_sigjob(3B), pbs_resources(7B)

2.53 qstart

Allows PBS jobs to be run from a queue
2.53.1 Synopsis

qstart destination ...
qstart --version

2.53.2 Description

The qstart command directs that a destination queue should process batch jobs. If the destination is an execution queue, the scheduler will begin to schedule jobs that reside in the queue for execution. If the destination is a routing queue, the server will begin to route jobs from that queue.

In order to execute qstart, the user must have PBS Operator or Manager privilege.

2.53.3 Options

--version

The qstart command returns its PBS version information and exits. This option can only be used alone.

2.53.4 Operands

The qstart command accepts one or more destination operands. The operands are one of three forms:

queue
@server
queue@server

If queue is specified, the request is to start that queue at the default server. If the @server form is given, the request is to start all queues at that server. If a full destination identifier, queue@server, is given, the request is to start the named queue at the named server.

2.53.5 Standard Error

The qstart command will write a diagnostic message to standard error for each error occurrence.
2.53.6 Exit Status

Upon successful processing of all the operands presented to the qstart command, the exit status will be a value of zero.

If the qstart command fails to process any operand, the command exits with a value greater than zero.

2.53.7 See Also

The PBS Professional Administrator’s Guide and the following manual pages:
pbs_server(8B), qstop(8B), and qmgr(8B)

2.54 qstat

Displays status of PBS batch jobs, queues, or servers

2.54.1 Synopsis

2.54.1.1 Displaying Job Status

Default format:
qstat [-p] [-J] [-t] [-x] [ [job_identifier | destination] ...]

Long format:
qstat -f [-p] [-J] [-t] [-x] [ [job_identifier | destination] ...]

Alternate format:
qstat -a [-w] -H | -i | -r ] [-G | -M] [-J] [-n [-1][-w]] [-s [-1][-w]] [-t ] [-u user_list] [ [job_identifier | destination] ...]

2.54.1.2 Displaying Queue Status

Default format:
qstat -Q [destination ...]

Long format:
qstat -Q -f [destination ...]
Chapter 2  PBS Commands

Alternate format:
qstat -q [-G | -M] [destination ...]

2.54.1.3  Displaying Server Status

Default format:
qstat -B [server_name ...]
Long format:
qstat -B -f [server_name ...]

2.54.1.4  Displaying Version Information

qstat --version

2.54.2  Description

The qstat command is used to display the status of jobs, queues, and batch servers. The status information is written to standard output.

Status information can be displayed in a default format, an alternate format, or a long format, depending upon the options given. Default and alternate formats display all status information for a job, queue or server on one line, in columns. Long formats display status information one attribute to a line.

Status information for finished and moved jobs can be displayed using the -x and -H options.

When displaying job status information, the qstat command will display status information about all job_identifiers and destinations specified.

If your job has been moved to another server through peer scheduling, give the job ID as an argument to qstat. If you only give the qstat command, your job will not appear to exist. For example, your job 123.ServerA is moved to ServerB. In this case, use

    qstat 123

or

    qstat 123.ServerA

To list all jobs at ServerB, you can use:

    qstat @ServerB
If your default server is ServerB, and your job started at ServerA but was moved to ServerB, to see the job, you must use:

```
qstat 123@ServerA
```

Users without manager or operator privilege cannot view resources or attributes that are invisible to unprivileged users.

### 2.54.3 Displaying Job Status

#### 2.54.3.1 Job Status in Default Format

The `qstat` command will display job status in default format when the options given are among `-p`, `-J`, `-t` or `-x`, regardless of operands. Jobs are displayed one to a line, with these column headers:

```
Job id   Name       User      Time Use S Queue
-------- ---------- --------- -------- - -----
```

Description of columns:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job id</td>
<td>The job_identifier assigned by PB</td>
</tr>
<tr>
<td>Name</td>
<td>Job name assigned by submitter.</td>
</tr>
<tr>
<td>User</td>
<td>Username of job owner.</td>
</tr>
<tr>
<td>Time Use</td>
<td>The CPU time or walltime used by the job, depending on which is specified or inherited. Before the application has actually started running, for example during stage-in, this field is &quot;0&quot;. At the point where the application starts accumulating cput or walltime, this field changes to &quot;00:00:00&quot;. After that, every time the MOM polls for resource usage, the field is updated. The MOM on the each execution host polls for the usage of all processes belonging to the job on her host. Usage is summed. The polling interval is short when a job first starts running and lengthens to a maximum 2 minutes. See section 3.6.1, &quot;Configuring MOM’s Polling Cycle&quot; on page 52 in the PBS Professional Administrator’s Guide.</td>
</tr>
</tbody>
</table>
### Job Status in Long Format

If the `-f` (full) option is given, full job status information for each job is displayed in this order:

- The job ID
- Each job attribute, one to a line
- The job’s submission arguments
- The job’s executable, in JSDL format
- The executable’s argument list, in JSDL format

The job attributes are listed as `name = value` pairs. This includes the `exec_host` string and the `exec_vnode` string. The full output can be very large.

#### Table 2-18: Description of Default Job Status Columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>The job’s state:</td>
</tr>
<tr>
<td>B</td>
<td>Array job has at least one subjob running.</td>
</tr>
<tr>
<td>E</td>
<td>Job is exiting after having run.</td>
</tr>
<tr>
<td>F</td>
<td>Job is finished.</td>
</tr>
<tr>
<td>H</td>
<td>Job is held.</td>
</tr>
<tr>
<td>M</td>
<td>Job was moved to another server.</td>
</tr>
<tr>
<td>Q</td>
<td>Job is queued.</td>
</tr>
<tr>
<td>R</td>
<td>Job is running.</td>
</tr>
<tr>
<td>S</td>
<td>Job is suspended.</td>
</tr>
<tr>
<td>T</td>
<td>Job is being moved to new location.</td>
</tr>
<tr>
<td>U</td>
<td>Cycle-harvesting job is suspended due to keyboard activity.</td>
</tr>
<tr>
<td>W</td>
<td>Job is waiting for its submitter-assigned start time to be reached.</td>
</tr>
<tr>
<td>X</td>
<td>Subjob has completed execution or has been deleted.</td>
</tr>
</tbody>
</table>

Queue

The queue in which the job resides.
The **exec_host** string has the format:

```
hosta/J1+hostb/J2*P+...
```

where *J1* and *J2* are an index of the job on the named host and *P* is the number of processors allocated from that host to this job. *P* does not appear if it is 1.

The **exec_vnode** string has the format:

```
(vnodeA:ncpus=N1:mem=M1)+(vnodeB:ncpus=N2:mem=M2)+...
```

where *N1* and *N2* are the number of CPUs allocated to that job on that vnode, and *M1* and *M2* are the amount of memory allocated to that job on that vnode.

### 2.54.3.3 Job Status in Alternate Format

The `qstat` command will display job status in the alternate format if any of the -a, -i, -G, -H, -M, -n, -r, -s, or -u user_list options is given. Jobs are displayed one to a line. If jobs are running and the -n option is specified, or if jobs are finished or moved and the -H and -n options are specified, there is a second line for the **exec_host** string.

#### 2.54.3.3.i Output:

The output contains the following columns:

<table>
<thead>
<tr>
<th>Req’d</th>
<th>Req’d</th>
<th>Elap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job ID</td>
<td>Username</td>
<td>Queue</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>------</td>
</tr>
</tbody>
</table>

If -n is specified, the column output is followed by the **exec_host** string.

Description of columns:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job ID</td>
<td>The <em>job_identifier</em> assigned by PBS.</td>
</tr>
<tr>
<td>Username</td>
<td>Username of job owner.</td>
</tr>
<tr>
<td>Queue</td>
<td>Queue in which the job resides.</td>
</tr>
<tr>
<td>Jobname</td>
<td>Job name assigned by submitter.</td>
</tr>
<tr>
<td>SessID</td>
<td>Session ID. Only appears if the job is running.</td>
</tr>
<tr>
<td>NDS</td>
<td>Number of chunks or nodes requested by the job.</td>
</tr>
</tbody>
</table>
### Displaying Queue Status

#### Queue Status in Default Format

The `qstat` command will display queue status in the default format if the only option is `-Q`, regardless of operands. Queue status is displayed one queue to a line, with these column headers:

```
Queue       Max  Tot  Ena  Str  Que  Run  Hld  Wat  Trn  Ext  Type
----------- ---- ---- ---- --- ---- ---- ---- ---- ---- ---- ----
```

Table of column headers:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue</td>
<td>Queue name.</td>
</tr>
<tr>
<td>Max</td>
<td>Maximum number of jobs allowed to run concurrently in the queue.</td>
</tr>
<tr>
<td>Tot</td>
<td>Total number of jobs in the queue.</td>
</tr>
<tr>
<td>Ena</td>
<td>Whether the queue is enabled or disabled.</td>
</tr>
<tr>
<td>Str</td>
<td>Whether the queue is started or stopped.</td>
</tr>
<tr>
<td>Que</td>
<td>Number of queued jobs.</td>
</tr>
</tbody>
</table>

---

Table 2-19: Description of Alternate Format Job Columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSK</td>
<td>Number of CPUs requested by the job.</td>
</tr>
<tr>
<td>Req’d Memory</td>
<td>Amount of memory requested by the job.</td>
</tr>
<tr>
<td>Req’d Time</td>
<td>CPU time or walltime requested by the job, depending upon which was specified by the submitter.</td>
</tr>
<tr>
<td>S</td>
<td>The job’s state. (See listing above.)</td>
</tr>
<tr>
<td>Elap Time</td>
<td>CPU time or walltime used by the job, depending upon which was specified by the submitter.</td>
</tr>
</tbody>
</table>

---

Table 2-20: Description of Default Queue Status Columns
Table 2-20: Description of Default Queue Status Columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run</td>
<td>Number of running jobs.</td>
</tr>
<tr>
<td>Hld</td>
<td>Number of held jobs.</td>
</tr>
<tr>
<td>Wat</td>
<td>Number of waiting jobs.</td>
</tr>
<tr>
<td>Trn</td>
<td>Number of jobs being moved (transiting.)</td>
</tr>
<tr>
<td>Ext</td>
<td>Number of exiting jobs.</td>
</tr>
<tr>
<td>Type</td>
<td>Type of queue: execution or routing.</td>
</tr>
</tbody>
</table>

2.54.4.2 Queue Status in Long Format

If the -f (full) option is given, full queue status information for each queue is displayed starting with the queue name, followed by each attribute, one to a line, as name = value pairs.

2.54.4.2.i Queue Status: Alternate Format

The qstat command will display queue status in the alternate format if any of the -q, -G or -M options is given. Queue status is displayed one queue to a line, with these column headers:

```
Queue   Memory   CPU Time   Walltime   Node Run Que Lm State
------- ------ -------- -------- ---- --- --- -- -----  
```

Description of columns:

Table 2-21: Description of Queue Alternate Status Columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue</td>
<td>Queue name.</td>
</tr>
<tr>
<td>Memory</td>
<td>Maximum amount of memory that can be requested by a job in the queue.</td>
</tr>
<tr>
<td>CPU Time</td>
<td>Maximum amount of CPU time that can be requested by a job in the queue.</td>
</tr>
<tr>
<td>Walltime</td>
<td>Maximum amount of wall time that can be requested by a job in the queue.</td>
</tr>
</tbody>
</table>
2.54.5 Displaying Server Status

2.54.5.1 Server Status in Default Format:

The `qstat` command will display server status if the only option given is `-B`, regardless of operands.

Column headers for default server status:

```
Server Max Tot Que Run Hld Wat Trn Ext Status
-------- ----- ----- ----- ----- ----- ----- ----- ------
```

Description of columns:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>Name of the server.</td>
</tr>
<tr>
<td>Max</td>
<td>Maximum number of jobs allowed concurrently running on the server.</td>
</tr>
<tr>
<td>Tot</td>
<td>Total number of jobs currently managed by the server.</td>
</tr>
<tr>
<td>Que</td>
<td>Number of queued jobs.</td>
</tr>
<tr>
<td>Run</td>
<td>Number of running jobs.</td>
</tr>
</tbody>
</table>
2.54.5.2 Server Status in Long Format

If the -f (full) option is given, full server status information is displayed starting with the server name, followed by each attribute, one to a line, as name = value pairs. PBS version information is listed.

2.54.6 Options to qstat

2.54.6.1 Default Job Status Options

- **J**
  
  Limits status information to job arrays.

- **t**
  
  Displays status information for jobs, job arrays, and subjobs. When used with -J option, limits status information to subjobs.

- **p**
  
  The Time Use column is replaced with the percentage completed for the job. For an array job this is the percentage of subjobs completed. For a normal job, it is the larger of percentage used walltime or percentage used CPU time. Default format used.

- **x**
  
  Displays status information for finished and moved jobs in addition to running and queued jobs.
2.54.6.2 Alternate Job Status Options

The following options will cause the alternate job status format to be used:

- **-a**
  All queued and running jobs are displayed. If a destination is given, information for all jobs at that destination is displayed. If a job identifier is given, information about that job is displayed. Always specify this option before the -n or -s options, otherwise they will not take effect.

- **-H**
  Without a job identifier, displays information for all finished or moved jobs. If a job identifier is given, displays information for that job regardless of its state.

- **-i**
  If a destination is given, information for queued, held or waiting jobs at that destination is displayed. If a job identifier is given, information about that job is displayed regardless of its state.

- **-r**
  If a destination is given, information for running or suspended jobs at that destination is displayed. If a job identifier is given, information about that job is displayed regardless of its state.

- **-T**
  Displays estimated start time for queued jobs, replacing the *Elap Time* field with the *Est Start* field. Jobs with earlier estimated start times are displayed before those with later estimated start times.

  Running jobs are displayed before other jobs. Running jobs are sorted by their *stime* attribute (start time).

  Queued jobs whose estimated start times are unset (*estimated.start_time = unset*) are displayed after those with estimated start times, with estimated start time shown as a double dash (“--”). Queued jobs with estimated start times in the past are treated as if their estimated start times are unset.

  Time displayed is local to the *qstat* command. Current week begins on Sunday.
The following table shows the format used without the -w option:

**Table 2-23: Format for Estimated Start Time Field without -w Option**

<table>
<thead>
<tr>
<th>Format</th>
<th>Job’s Estimated Start Time</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH:MM</td>
<td>Today</td>
<td>15:34</td>
</tr>
<tr>
<td><code>&lt;2-letter weekday&gt;</code> HH</td>
<td>Within 7 days, but after today</td>
<td>We 15</td>
</tr>
<tr>
<td><code>&lt;3-letter month name&gt;</code></td>
<td>This calendar year, but after this week</td>
<td>Feb</td>
</tr>
<tr>
<td>YYYY</td>
<td>Less than or equal to 5 years from today, after this year</td>
<td>2012</td>
</tr>
<tr>
<td>“&gt;`5yrs”</td>
<td>More than 5 years from today</td>
<td>&gt;5yrs</td>
</tr>
</tbody>
</table>

The following table shows the format used with the -w option:

**Table 2-24: Format for Estimated Start Time Field with -w Option**

<table>
<thead>
<tr>
<th>Format</th>
<th>Job’s Estimated Start Time</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today HH:MM</td>
<td>Today</td>
<td>Today 13:34</td>
</tr>
<tr>
<td>Day HH:MM</td>
<td>This week, but after today</td>
<td>Wed 15:34</td>
</tr>
<tr>
<td>Day Mon Daynum HH:MM</td>
<td>This year, but after this week</td>
<td>Wed Feb 10 15:34</td>
</tr>
<tr>
<td>Day Mon Daynum Year HH:MM</td>
<td>After this year</td>
<td>Wed Feb 10 2011 15:34</td>
</tr>
</tbody>
</table>

When used with the -f option, prints the full timezone-qualified start time.
If a job’s estimated start time cannot be calculated, the start time is shown as a question mark (“?”).

Estimated start time information can be made unavailable to unprivileged users; in this case, the estimated start time appears to be unset.

-u user_list
If a destination is given, status for jobs at that destination owned by users in user_list is displayed. If a job_identifier is given, status information for that job is displayed regardless of the job’s ownership.

Hostnames may be wildcarded, but not domain names. When no hostname is specified, username is for any host.

Format: username[@host] in comma-separated list.

-n
The exec_host string is listed on the line below the basic information. If the -1 option is given, the exec_host string is listed on the end of the same line. If using the -a option, always specify the -n option after -a otherwise the -n option will not take effect.

-s
Any comment added by the administrator or scheduler is shown on the line below the basic information. If the -1 option is given, the comment string is listed on the end of the same line. If using the -a option, always specify the -s option after -a otherwise the -s option will not take effect.

-w
Allows display of wider fields. User name, Queue and Job name can be up to 15 characters wide. Session ID can be up to 8 characters wide and NDS can be up to 4 characters wide. Can only be used with -a, -n or -s.

-1
Reformats qstat output to a single line. Can only be used in conjunction with the -n and/or -s options.

2.54.6.3 Queue Status Options

-Q
Display queue status in default format. Operands must be destinations.

-q
Display queue status in alternate format. Operands must be destinations.
2.54.6.4 Server Status Options

-B
Display server status. Operands must be names of servers.

2.54.6.5 Job, Queue, and Server Status Options

-f
Full display. Job, queue or server attributes displayed one to a line.

-G
Show size in gigabytes. Alternate format is used.

-M
Show size in megawords. A word is considered to be 8 bytes. Alternate format is used.

2.54.6.6 Version Information

--version
The qstat command returns its PBS version information and exits. This option can only be used alone.

2.54.7 Operands

2.54.7.1 Job Identifier Operands

job_identifier
Job identifier assigned by PBS at submission. Only used with job status requests. Status information for this job is displayed.

2.54.7.2 Destination Operands

Name of queue, name of queue at a specific server, or specification of server.

Name of queue:
<queue name>

Name of queue at server:
<queue name>@<server>

All queues at a server:
@<server>
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When displaying job status:

- If `<queue name>` is given, status is displayed for all jobs in the named queue at the default server.
- If `<queue name>@<server>` is given, status is displayed for all jobs in queue_name at server.
- If `@<server>` is given, status is displayed for all jobs at all queues at that server.

When displaying queue status:

- If `<queue name>` is given, status is displayed for that queue at the default server.
- If `<queue name>@<server>` is given, status is displayed for the named queue at the named server.
- If `@<server>` is given, status is displayed for all queues at that server.

2.54.7.3  Server Name Operands

`server_name`
Name of server. Used with the `-B` option to display status for that server.

2.54.8  Standard Error

The `qstat` command writes a diagnostic message to standard error for each error occurrence.

2.54.9  Exit Status

- Zero upon successful processing of all the operands.
- Greater than zero if any operands could not be processed.
- Non-zero if `-x` option is not provided when querying finished jobs.

2.54.10  See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide,
`qalter(1B), qsub(1B), pbs_alterjob(3B), pbs_statjob(3B),
pbs_statque(3B), pbs_statservers(3B), pbs_submit(3B),
pbs_job_attributes(7B), pbs_queue_attributes(7B),
pbs_server_attributes(7B), pbs_resources(7B)`
2.55  qstop

Prevents PBS jobs from running from the specified queue

2.55.1  Synopsis

qstop destination ...
qstop --version

2.55.2  Description

The qstop command directs that a destination queue should stop processing batch jobs. If
the destination is an execution queue, the server will cease scheduling jobs that reside in the
queue for execution. If the destination is a routing queue, the server will cease routing jobs
from that queue.

In order to execute qstop, the user must have PBS Operator or Manager privilege.

2.55.3  Options

--version

The qstop command returns its PBS version information and exits. This
option can only be used alone

2.55.4  Operands

The qstop command accepts one or more destination operands. The operands are one of
three forms:
<queue>
@<server>
<queue>@<server>

If <queue> is specified, the request is to stop that queue at the default server. If the
@<server> form is given, the request is to stop all the queues at that server. If a full destina-
tion identifier, <queue>@<server>, is given, the request is to stop the named queue at the
named server.
2.55.5 Standard Error

The `qstop` command will write a diagnostic message to standard error for each error occurrence.

2.55.6 Exit Status

Upon successful processing of all the operands presented to the `qstop` command, the exit status will be a value of zero.

If the `qstop` command fails to process any operand, the command exits with a value greater than zero.

2.55.7 See Also

The PBS Professional Administrator’s Guide and the following manual pages:
`pbs_server(8B)`, `qstart(8B)`, and `qmgr(8B)`

2.56 qsub

Submits PBS job

2.56.1 Synopsis

```
[-j join] [-J range] [-k keep] [-l resource_list] [-m mail_events] [-M user_list] [-N name]
variable_list] [-V] [-W additional_attributes] [-X] [-z] [script | -- executable [arglist for
executable]]

qsub --version
```

2.56.2 Description

The `qsub` command is used to submit a batch job to PBS. Submitting a PBS job specifies a task, requests resources and sets job attributes.
The `qsub` command can read from a job script, from standard input, or from the command line. When the user has submitted the job, PBS returns the job identifier for that job. For a job, this is of the form:

`sequence_number.servername`

For an array job, this is of the form:

`sequence_number[1].servername`

During execution, jobs can be interactive or non-interactive.

### 2.56.2.1 Where PBS Puts Job Files

By default, PBS copies the `stdout` and `stderr` files from the job back to the current working directory where the `qsub` command is executed. See the `-o` and `-e` options.

### 2.56.2.2 Submitting Jobs By Using Scripts

To submit a PBS job script, the user types

```
qsub [options] scriptname
```

Scripts can be written in Python, UNIX shells such as `csh` and `sh`, the Windows command batch language, Perl, etc. The same Python script can be run under UNIX/Linux or under Windows. A PBS job script consists of the following:

- Optional shell specification
- Any PBS directives
- The user’s tasks: programs, commands or applications

Example 2-10: A Python job script named “myjob.py” for a job named “HelloJob” that prints “Hello” under UNIX/Linux or Windows:

```
#PBS -l select=1:ncpus=3:mem=1gb
#PBS -N HelloJob
print "Hello"
```

To run a Python job script under UNIX/Linux:

```
qsub -S $PBS_EXEC/bin/pbs_python <script name>
```

To run a Python job script under Windows:

```
qsub -S %PBS_EXEC%\bin\pbs_python.exe <script name>
```
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Example 2-11: A script named “weatherscript” for a job named “Weather1” which runs the executable “weathersim” on UNIX/Linux:

```
#!/bin/sh
#PBS -N Weather1
#PBS -l walltime=1:00:00
/usr/local/weathersim
```

To submit the job, the user types:

```
qsub weatherscript <return>
```

Example 2-12: A script named “weather.exe” for a job named “Weather1” which runs under Windows:

```
#PBS -N Weather1
#PBS -l walltime=1:00:00
weathersim.exe
```

To submit the job, the user types:

```
qsub weather.exe <return>
```

Scripts can contain comments. Under Windows, comments can contain only ASCII characters. See the PBS Professional User’s Guide.

2.56.2.3  **Submitting Jobs From Standard Input**

To submit a PBS job by typing job specifications at the command line, the user types

```
qsub [options] <return>
```

then types any directives, then any tasks, followed by

- UNIX: CTRL-D on a line by itself
- Windows: CTRL-Z <return>

to terminate the input.

2.56.2.4  **Submitting a Job From the qsub Command Line**

To submit a job from the command line, the user types

```
qsub [options] -- executable [arguments to executable] <return>
```

Example 2-13: To run myprog with the arguments a and b:

```
qsub -- myprog a b <return>
```
Example 2-14: To run myprog with the arguments a and b, naming the job JobA:

```
qsub -N JobA -- myprog a b <return>
```

### 2.56.2.5 Requesting Resources and Placing Jobs

Requesting resources includes setting limits on resource usage and controlling how the job is placed on nodes.

Resources are requested by using the `-l` option, either in chunks inside of selection statements, or in job-wide requests using `resource_name=value` pairs. See the `pbs_resources(7B)` man page. The selection statement is of the form:

```
-l select=[N:]chunk[+[N:]chunk ...]
```

where `N` specifies how many of that chunk, and a chunk is of the form:

```
resource_name=value[,resource_name=value ...]
```

Job-wide `resource_name=value` requests are of the form:

```
-l resource_name=value[,resource_name=value ...]
```

The place statement has this form:

```
-l place=[ arrangement ][: sharing ][: grouping]
```

where

- **arrangement**
  - one of `free` | `pack` | `scatter` | `vscatter`

- **sharing**
  - one of `excl` | `shared` | `exclhost`

- **grouping**
  - can have only one instance of `group=resource`

and where

- **free**
  - Place job on any vnode(s).

- **pack**
  - All chunks will be taken from one host.

- **scatter**
Only one chunk with any MPI processes will be taken from a host. A chunk with no MPI processes may be taken from the same node as another chunk.

**vscatter**

Only one chunk is taken from any vnode. Each chunk must fit on a vnode.

**excl**

Only this job uses the vnodes chosen.

**shared**

This job can share the vnodes chosen.

**exclhost**

The entire host is allocated to the job.

**group=resource**

Chunks will be grouped according to a resource. All nodes in the group must have a common value for the resource, which can be either the built-in resource host or a site-defined node-level resource.

Resource must be a string or a string array.

Note that nodes can have sharing attributes that override job placement requests. See the `pbs_node_attributes(7B)` man page.

For more on resource requests, usage limits and job placement, see `pbs_resources(7B)`.

### 2.56.2.6 Caveats

Do not mix old style resource or node specifications with the new `select` and `place` statements. Do not use one in a job script and the other on the command line. Mixing the two will result in an error.

You cannot submit a job requesting a custom resource which has been created to be invisible or read-only for users, regardless of your privilege. A manager or operator can use the `qalter` command to change a job’s request for this kind of custom resource.

### 2.56.2.7 Setting Attributes

The user sets job attributes by giving options to the `qsub` command or by using PBS directives. Each `qsub` option except `-C`, `-q`, and `-z` sets a job attribute, and has a corresponding PBS directive with the same syntax as the option. Attributes set via command-line options take precedence over those set using PBS directives. See the PBS Professional User’s Guide, or section 6.11, “Job Attributes”, on page 368.
2.56.2.8 Changing qsub Behavior

The behavior of the qsub command may be affected by the server’s default_qsub_arguments attribute. This attribute can set the default for any job attribute. The default_qsub_arguments server attribute is settable by the administrator, and is overridden by command-line arguments and script directives. See section 6.6, “Server Attributes”, on page 310.

The behavior of the qsub command may also be affected by any site hooks. Site hooks can modify the job’s attributes, change its routing, etc.

2.56.3 Options to qsub

-a date_time
Point in time after which the job is eligible for execution. Given in pairs of digits. Sets job’s Execution_Time attribute to date_time.
Format: datetime:


- A account_string
Accounting string associated with the job. Used for labeling accounting data. Sets job’s Account_Name attribute to account_string.
Format: string.

-c checkpoint_spec
Determines when the job will be checkpointed. Sets job’s Checkpoint attribute. An $action script is required to checkpoint the job.
See the pbs_mom(8B) man page.
The argument checkpoint_spec can take on one of the following values:
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\texttt{c}  
Checkpoint at intervals, measured in CPU time, set on job’s execution queue. If no interval set at queue, job is not checkpointed.  
\texttt{c=<minutes of CPU time>}  
Checkpoint at intervals of specified number of minutes of job CPU time. This value must be > 0. If interval specified is less than that set on job’s execution queue, queue’s interval is used.  
Format: Integer

\texttt{w}  
Checkpoint at intervals, measured in walltime, set on job’s execution queue. If no interval set at queue, job is not checkpointed.  
\texttt{w=<minutes of walltime>}  
Checkpoint at intervals of the specified number of minutes of job walltime. This value must be greater than zero. If the interval specified is less than that set on the execution queue in which the job resides, the queue’s interval is used.  
Format: Integer

\texttt{n}  
No checkpointing.

\texttt{s}  
Checkpoint only when the server is shut down.

\texttt{u}  
Unset. Defaults to behavior when interval argument is set to s.  
Default: u.  
Format: String.

\texttt{-C directive\_prefix}  
Defines the prefix identifying a PBS directive. Default prefix is “\#PBS”.  
If the \texttt{directive\_prefix} argument is a null string, \texttt{qsub} does not scan the script file for directives. Overrides the PBS_DPREFIX environment variable and the default. Cannot be used as a PBS directive.

\texttt{-e path}  
Path to be used for the job’s standard error stream. Sets job’s Error\_Path attribute to \texttt{path}. The path argument is of the form:  
\texttt{/hostname:/path\_name}  
The path is interpreted as follows:  
\texttt{path\_name}
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If `path_name` is a relative path, then it is taken to be relative to the current working directory of the `qsub` command, where it is executing on the current host.

If `path_name` is an absolute path, then it is taken to be an absolute path on the current host where the `qsub` command is executing.

`hostname:path_name`

If `path_name` is a relative path, then it is taken to be relative to the user’s home directory on the host named `hostname`.

If `path_name` is an absolute path, then it is the absolute path on the host named `hostname`.

If `path_name` does not include a filename, the default filename is `jobid.ER`

If the `-e` option is not specified, PBS copies the standard error to the current working directory where the `qsub` command was executed. The default filename for the standard error stream is used. It has this form:

`job_name.e<sequence number>`

- `h`
  Applies a user hold to the job. Sets the job’s `Hold_Types` attribute to “u”.

- `I`
  Job is to be run interactively. Sets job’s `interactive` attribute to `True`. The job is queued and scheduled as any PBS batch job, but when executed, the standard input, output, and error streams of the job are connected to the terminal session in which `qsub` is running. If a job script is given, only its directives are processed. When the job begins execution, all input to the job is taken from the terminal session. See the PBS Professional User’s Guide for additional information on interactive jobs.

  Not supported on Windows.

- `j join`
  Whether and how to join the job’s standard error and standard output streams. Sets job’s `Join_Path` attribute to `join`. 

Possible values of join:

Table 2-25: Suboptions to Join Option

<table>
<thead>
<tr>
<th>Suboption</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>o(e)</td>
<td>Standard error and standard output are merged into standard output.</td>
</tr>
<tr>
<td>e(o)</td>
<td>Standard error and standard output are merged into standard error.</td>
</tr>
<tr>
<td>(n)</td>
<td>Standard error and standard output are not merged.</td>
</tr>
</tbody>
</table>

Default: not merged.

-\(J\) range

Declares that this job is an array job. Sets job’s array attribute to True. The argument range identifies the integers greater than or equal to zero that are associated with the subjobs of the array. range is specified in the form \(X-Y[Z]\) where \(X\) is the first index, \(Y\) is the upper bound on the indices and \(Z\) is the stepping factor. For example, 2-7:2 will produce indices of 2, 4, and 6. If \(Z\) is not specified, it is taken to be 1.

-\(k\) keep

Specifies whether and which of the standard output and standard error streams is retained on the execution host. Overrides default path names for these streams. Sets the job’s Keep_Files attribute to keep. Default: neither is retained.

In the case where output and/or error is retained on the execution host in a job-specific staging and execution directory created by PBS, these files are deleted when PBS deletes the directory.
The `keep` argument can take on the following values:

**Table 2-26: Suboptions to keep Option**

<table>
<thead>
<tr>
<th>Suboption</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>e</code></td>
<td>The standard error stream is retained on the execution host, in the job’s staging and execution directory. The filename is <code>job_name.e&lt;sequence number&gt;</code></td>
</tr>
<tr>
<td><code>o</code></td>
<td>The standard output stream is retained on the execution host, in the job’s staging and execution directory. The filename is <code>job_name.o&lt;sequence number&gt;</code></td>
</tr>
<tr>
<td><code>eo, oe</code></td>
<td>Both standard output and standard error streams are retained on the execution host, in the job’s staging and execution directory.</td>
</tr>
<tr>
<td><code>n</code></td>
<td>Neither stream is retained.</td>
</tr>
</tbody>
</table>

- `-l resource_list`
  Allows the user to request resources and specify job placement. Sets job’s `Resource_list` attribute to `resource_list`. Requesting a resource places a limit on its usage.

  Requesting resources in chunks:
  
  `-l select=[N:]chunk+[N:]chunk ...`

  where N specifies how many of that chunk, and a chunk is:

  `resource_name=value[:resource_name=value ...]`

  Requesting job-wide resources:

  `-l resource_name=value[,resource_name=value ...]`

  Specifying placement of jobs:

  `-l place=modifier[:modifier]`

  where modifier is any combination of `group`, `excl`, and/or one of `free|pack|scatter`.

  For more on resource requests, usage limits and job placement, see `pbs_resources(7B)`.
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- **m mail_events**
  
  The set of conditions under which mail about the job is sent. Sets job’s Mail_Points attribute to mail_events. Mail is not sent for job arrays. The mail_events argument can be either “n” or any combination of a, b, and e.

  Cannot be used with array jobs.

  Format: string.

  Default value: “a”.

- **M user_list**

  List of users to whom mail about the job is sent. Sets job’s Mail_Users attribute to user_list.

  The user_list argument is of the form:

  user[@host][,user[@host],...]

  Default: job owner.

- **N name**

  Sets job’s Job_Name attribute and name to name.

  Format: string, up to 15 characters in length. It must consist of an alphabetic or numeric character followed by printable, nonwhite-space characters.

  Default: if a script is used to submit the job, the job’s name is the name of the script. If no script is used, the job’s name is “STDIN”.

- **o path**

  Path to be used for the job’s standard output stream. Sets job’s Output_Path attribute to path. The path argument is of the form:

  [hostname:]path_name

  The path is interpreted as follows:

---

**Table 2-27: Suboptions to m Option**

<table>
<thead>
<tr>
<th>Suboption</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>No mail will be sent.</td>
</tr>
<tr>
<td>a</td>
<td>Mail is sent when the job is aborted by the batch system.</td>
</tr>
<tr>
<td>b</td>
<td>Mail is sent when the job begins execution.</td>
</tr>
<tr>
<td>e</td>
<td>Mail is sent when the job terminates.</td>
</tr>
</tbody>
</table>
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path_name

If path_name is a relative path, then it is taken to be relative to the current working directory of the command, where it is executing on the current host.

If path_name is an absolute path, then it is taken to be an absolute path on the current host where the command is executing.

hostname:path_name

If path_name is a relative path, then it is taken to be relative to the user’s home directory on the host named hostname.

If path_name is an absolute path, then it is the absolute path on the host named hostname.

If path_name does not include a filename, the default filename is jobid.OU

If the -o option is not specified, PBS copies the standard output to the current working directory where the qsub command was executed. The default filename for the standard output stream is used. It has this form:

job_name.o<sequence number>

-p priority

Priority of the job. Sets job’s Priority attribute to priority.
Format: host-dependent integer.
Range: [-1024, +1023] inclusive.
Default: zero.

-P project

Specifies a project for the job. Sets job’s project attribute to specified value.
Format: String.
Project name can contain any characters except for the following: Slash (/), left bracket ([], right bracket (]), double quote (""), semicolon (;), colon (:), vertical bar (|), left angle bracket (<), right angle bracket (>), plus (+), comma (,), question mark (?), and asterisk (*).
Default value: "_pbs_project_default".

-q destination

Where the job is sent upon submission.
Specifies a queue, a server, or a queue at a server. The destination argument can have one of these formats:

<queue>

Job is submitted to the named queue at the default server.
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\[@\text{server}\]\n
Job is submitted to the default queue at the named server.

\textbf{<queue>\@<server>}

Job is submitted to the named queue at the named server.

Default: default queue at default server.

\textbf{-r y|n}

Declares whether the job is rerunnable. See the \texttt{qrerun(1B)} command. Default: “y”. Sets job’s \texttt{Rerunnable} attribute to the argument.

Format: single character, “y” or “n”.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Suboption} & \textbf{Meaning} \\
\hline
\texttt{y} & Job is rerunnable. \\
\hline
\texttt{n} & Job is not rerunnable. \\
\hline
\end{tabular}
\caption{Suboptions to r Option}
\end{table}

\textbf{-S path\_list}

Specifies the interpreter or shell path for the job script. Sets job’s \texttt{Shell\_Path\_List} attribute to \texttt{path\_list}.

The \texttt{path\_list} argument is the full path to the interpreter or shell including the executable name.

Only one path may be specified without a host name. Only one path may be specified per named host. The path selected is the one whose host name is that of the server on which the job resides.

Format:

\texttt{path[@host][,path@host ...]}

Default: user’s login shell on execution node.

Example of using \texttt{bash} via a directive:

\texttt{\#PBS -S /bin/bash@mars,/usr/bin/bash@jupiter}

Example of running a Python script from the command line on UNIX/Linux:

\texttt{qsub -S \$PBS\_EXEC/bin/pbs\_python <script name>}

Example of running a Python script from the command line on Windows:

\texttt{qsub -S %PBS\_EXEC%\bin\pbs\_python.exe <script name>}

-u user_list

List of usernames. Job is run under a username from this list. Sets job’s User_List attribute to user_list.

Only one username may be specified without a host name. Only one username may be specified per named host. The server on which the job resides will select first the username whose host name is the same as the server name. Failing that, the next selection will be the username with no specified hostname. The usernames on the server and execution hosts must be the same. The job owner must have authorization to run as the specified user.

Format of user_list:
user[@host][,user@host ...]
Default: job owner (username on submit host.)

-v variable_list

Lists environment variables to be exported to the job. This is the list of environment variables which is added to those already automatically exported. These variables exist in the user’s login environment from which qsub is run. The job’s Variable_List attribute is appended with the variables in variable_list and their values. See section 2.56.7, “Environment Variables”, on page 224.

Format: comma-separated list of strings in the form:
variable
or
variable=value

If a variable=value pair contains any commas, the value must be enclosed in single or double quotes, and the variable=value pair must be enclosed in the kind of quotes not used to enclose the value. For example:

```
qsub -v "var1='A,B,C,D'" job.sh
qsub -v a=10, "var2='A,B'", c=20, HOME=/home/zzz job.sh
```

Default: no environment variables are added to job’s variable list.

-V

Declares that all environment variables in the user’s login environment where qsub is run are to be exported to the job. The job’s Variable_List attribute is appended with all of these environment variables and their values.
-W additional_attributes
The -W option allows specification of any job attribute. Some job attributes must be specified using this option. Those attributes are listed below. Format:

-W attribute_name=value[.attribute_name=value...]

If white space occurs within the additional_attributes argument, or the equal sign “=” occurs within an attribute_value string, then that must be enclosed with single- or doublequotes.

The following attributes must be set using the -W option:

depend=dependency_list
Defines dependencies between this and other jobs. Sets the job’s depend attribute to dependency_list. The dependency_list has the form:

type:arg_list[,type:arg_list ...]

where except for the on type, the arg_list is one or more PBS job IDs in the form:

jobid[jobid ...]
The type can be:

after: arg_list
This job may be scheduled for execution at any point after all jobs in arg_list have started execution.

afterok: arg_list
This job may be scheduled for execution only after all jobs in arg_list have terminated with no errors. See “Warning about exit status with csh” in Exit Status.

afternotok: arg_list
This job may be scheduled for execution only after all jobs in arg_list have terminated with errors. See section 2.56.8.1, “Warning About Exit Status with csh”, on page 226.

afterany: arg_list
This job may be scheduled for execution after all jobs in arg_list have finished execution, with any exit status (with or without errors.) This job will not run if a job in the arg_list was killed.

before: arg_list
Jobs in arg_list may begin execution once this job has begun execution.
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*beforeok: arg_list*

Jobs in `arg_list` may begin execution once this job terminates without errors. See “Warning about exit status with csh” in Exit Status.

*beforenotok: arg_list*

If this job terminates execution with errors, then jobs in `arg_list` may begin. See section 2.56.8.1, “Warning About Exit Status with csh”, on page 226.

*beforeany: arg_list*

Jobs in `arg_list` may begin execution once this job terminates execution, with or without errors.

*on: count*

This job may be scheduled for execution after `count` dependencies on other jobs have been satisfied. This type is used in conjunction with one of the `before` types listed. `count` is an integer greater than 0.

Jobs IDs in the `arg_list` of `before` types must have been submitted with a type of `on`.

To use the `before` types, the user must have the authority to alter the jobs in `arg_list`. Otherwise, the dependency is rejected and the new job aborted.

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:

```
qsub -W depend=afterok:123.host1.domain.com /tmp/script
```

```
qsub -W depend=before:234.host1.com:235.host1.com /tmp/script
```

*group_list=g_list*

List of group names. Job is run under a group name from this list. Sets job’s `group_List` attribute to `g_list`.

Only one group name may be specified without a host name. Only one group name may be specified per named host. The server on which the job resides will select first the group name whose host name is the same as the server name. Failing that, the next selection will be the
group name with no specified hostname. The group names on the server and execution hosts must be the same.

Under Windows, the primary group is the first group found for the user by PBS when it queries the accounts database.

Format of g_list:

\[\text{group[@host][,group@host ...]}\]

Default: login group name of job owner.

\[\text{pwd} \quad \text{pwd=} \quad \text{pwd=}\]

These forms prompt the user for a password. A space between W and pwd is optional. Spaces between the quotes are optional. Examples:

\[
\begin{align*}
qsub \ldots & \quad -W \text{pwd} <\text{return}> \\
qsub \ldots & \quad -W \text{pwd}='' <\text{return}> \\
qsub \ldots & \quad -W \text{pwd}="" <\text{return}>
\end{align*}
\]

Available on Windows and supported Linux x86 and x86_64 platforms only.

\[\text{block=true}\]

Specifies that qsub waits for the job to terminate, then returns the job’s exit value. Sets job’s block attribute to TRUE. Cannot be used with interactive jobs. See section 2.56.8, “Exit Status”, on page 226.

\[\text{sandbox=<value>}\]

Determines which directory PBS uses for the job’s staging and execution. If value is PRIVATE, PBS creates a job-specific directory for staging and execution. If value is HOME or is unset, PBS uses the user’s home directory for staging and execution.

\[\text{stagein=path_list}\]
\[\text{stageout=path_list}\]

Specifies files or directories to be staged-in before execution or staged-out after execution is complete. Sets the job’s stagein and stageout attributes to the specified path_lists. On completion of the job, all staged-in and staged-out files and directories are removed from the execution host(s). The path_list has the form:

\[\text{filespec[,filespec]}\]

where filespec is
local_path@hostname:remotepath

regardless of the direction of the copy. The name local_path is the name of the file or directory on the primary execution host. It can be relative to the staging and execution directory on the execution host, or it can be an absolute path.

The “@” character separates local_path from remotepath.

The name remotepath is the path on hostname. The name can be relative to the staging and execution directory on the primary execution host, or it can be an absolute path.

If path_list has more than one filespec, i.e. it contains commas, it must be enclosed in double-quotes.

umask=NNNN

The umask with which the job is started. Sets job’s umask attribute to NNNN. Controls umask of job’s standard output and standard error.

The following example allows group and world read on the job’s output:

-W umask=33

Can be used with one to four digits; typically two.

Default value: 077

-X

Allows user to receive X output from interactive job.

DISPLAY variable in submission environment must be set to desired display.

Can be used with interactive jobs only: must be used with -I or -W interactive=true.

Cannot be used with -v DISPLAY.

Can be used with -V option.

Not available under Windows.

-z

Job identifier is not written to standard output.

--version

The qsub command returns its PBS version information and exits. This option can only be used alone.
2.56.4 Operands

The `qsub` command accepts as operands one of the following:

- *(script)*
  Path to script. Can be absolute or relative to current directory where `qsub` is run.

- *(a dash)*
  Any PBS directives and user tasks are read from the command line. Same as for no operands.

- **-- executable [arguments to executable]**
  a single executable (preceded by two dashes) and its arguments
  The executable, and any arguments to the executable, are given on the `qsub` command line. The executable is preceded by two dashes, “--”.

If a script or executable is specified, it must be the last argument to `qsub`. The arguments to an executable must follow the name of the executable.

2.56.5 Standard Output

Unless the -z option is set, the job identifier assigned to the job is written to standard output if the job is successfully created.

2.56.6 Standard Error

The `qsub` command writes a diagnostic message to standard error for each error occurrence.

2.56.7 Environment Variables

The `qsub` command uses the following environment variables:

- **PBS_DEFAULT**
  Name of default server.

- **PBS_DPREFIX**
  Prefix string which identifies PBS directives.

Environment variables beginning with “PBS_O_” are created by `qsub`. PBS automatically exports the following environment variables to the job, and the job’s `Variable_List` attribute is set to this list:
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PBS_ENVIRONMENT
Set to PBS_BATCH for a batch job. Set to PBS_INTERACTIVE for an interactive job. Created upon execution.

PBS_JOBDIR
Pathname of job’s staging and execution directory on the primary execution host.

PBS_JOBID
Job identifier given by PBS when the job is submitted. Created upon execution.

PBS_JOBNAME
Job name given by user. Created upon execution.

PBS_NODEFILE
Name of file containing the list of nodes assigned to the job. Created upon execution.

PBS_O_HOME
User’s home directory. Value of HOME taken from user’s submission environment.

PBS_O_HOST
Name of submit host. Value taken from user’s submission environment.

PBS_O_LANG
Value of LANG taken from user’s submission environment.

PBS_O_LOGNAME
User’s login name. Value of LOGNAME taken from user’s submission environment.

PBS_O_MAIL
Value of MAIL taken from user’s submission environment.

PBS_O_PATH
User’s PATH. Value of PATH taken from user’s submission environment.

PBS_O_QUEUE
Name of the queue to which the job was submitted. Value taken from user’s submission environment.

PBS_O_SHELL
Value taken from user’s submission environment.

PBS_O_SYSTEM
Operating system, from uname -s, on submit host. Value taken from user’s submission environment.
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PBS_O_TZ
Value taken from user’s submission environment.

PBS_O_WORKDIR
Absolute path to directory where qsub is run. Value taken from user’s submission environment.

PBS_QUEUE
Name of the queue from which the job is executed. Created upon execution.

TMPDIR
Pathname of job’s scratch directory.

2.56.8 Exit Status

Zero upon successful processing of input. Exit value is greater than zero upon failure of qsub.

For blocking jobs, qsub exits and returns the exit value of the job. If the job is deleted without being run, qsub returns an exit value of 3.

2.56.8.1 Warning About Exit Status with csh

If a job is run in 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.

2.56.9 See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, pbs_job_attributes(7B), pbs_server_attributes(7B), pbs_resources(7B), qalter(1B), qhold(1B), qmove(1B), qmsg(1B), qrerun(1B), qrls(1B), qselect(1B), qstat(1B)

2.57 qterm

Terminates a PBS server
2.57.1 Synopsis

qterm [ -f | -F | -i ] [ -m ] [ -s ] [ -t type ] [ server[ server ...] ]
qterm --version

2.57.2 Description

The qterm command terminates a PBS batch server.

Once the server is terminating, no new jobs are accepted by the server, and no jobs are allowed to begin execution. The impact on running jobs depends on the way the server is shut down.

The qterm command does not exit until the server has completed its shutdown procedure.

If the complex is configured for failover, and the primary server is shut down, the normal behavior for the secondary server is to become active. The qterm command provides options to manage the behavior of the secondary server; it can be shut down, forced to remain idle, or shut down in place of the primary server.

In order to run the qterm command, the user must have PBS Operator or Manager privilege.

2.57.3 Options

The following table lists the options to the qterm command.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(no option)</td>
<td>The qterm command defaults to -t quick.</td>
</tr>
<tr>
<td>-f</td>
<td>If the complex is configured for failover, both the primary and secondary servers are shut down. Without the -f option, the primary server is shut down and the secondary server becomes active. The -f option cannot be used with the -i or -F options.</td>
</tr>
<tr>
<td>-F</td>
<td>If the complex is configured for failover, only the secondary server is shut down, and the primary server remains active. The -F option cannot be used with the -f or -i options.</td>
</tr>
</tbody>
</table>
Table 2-29: qterm Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-i</td>
<td>If the complex is configured for failover, the secondary server remains idle when the primary server is shut down. The -i option cannot be used with the -f or -F options.</td>
</tr>
<tr>
<td>-m</td>
<td>All MOMs (pbs_mom) are shut down. This option does not cause jobs or subjobs to be killed. Jobs are left running subject to other options to the qterm command.</td>
</tr>
<tr>
<td>-s</td>
<td>The scheduler (pbs_sched) is shut down.</td>
</tr>
</tbody>
</table>
| -t <type> | All running jobs immediately stop execution. Any running jobs that can be checkpointed are checkpointed, terminated, and requeued. Jobs that cannot be checkpointed are terminated and requeued if they are rerunnable, otherwise they are killed.  
If any job cannot be terminated, for example the server cannot contact the MOM of a running job, the server continues to execute and the job is listed as running. The server can be terminated by a second qterm -t immediate command.  
While terminating, the server is in the Terminating state.  
- delay | The server waits to terminate until all non-checkpointable, non-rerunnable jobs are finished executing. Any running jobs that can be checkpointed are checkpointed, terminated, and requeued. Jobs that cannot be checkpointed are terminated and requeued if they are rerunnable, otherwise they are allowed to continue to run.  
While terminating, the server is in the Terminating-Delayed state.  
- quick | Running jobs are left running. Running subjobs are requeued. This is the default behavior when no options are given to the qterm command.  
While terminating, the server is in the Terminating state.  
--version | The qterm command returns its PBS version information and exits. This option can only be used alone. |
2.57.4 Operands

The server list operand specifies which servers are to shut down. It is a space-separated list of server names. If no servers are specified, then the default server is shut down.

2.57.4.1 Standard Error

The qterm command writes a diagnostic message to standard error for each error occurrence.

2.57.4.2 Exit Status

Zero upon successful processing of all the operands presented to the qterm command. Greater than zero if the qterm command fails to process any operand.

2.57.4.3 See Also

The PBS Professional Administrator's Guide, pbs_server(8B), pbs_mom(8B), pbs_sched(8B)

2.58 tracejob

Prints log messages for a PBS job

2.58.1 Synopsis

tracejob --version

2.58.2 Description

The tracejob command extracts log messages for a given jobid and prints them in chronological order.
Log messages contain server, scheduler, accounting and MOM information. Server logs contain information such as when a job was queued or modified. Scheduler logs contain clues as to why a job is not running. Accounting logs contain accounting records for when a job was queued, started, ended or deleted. MOM logs contain information about what happened to a job while it was running.

To get MOM log messages for a job, `tracejob` must be run on the machine on which the job ran.

All users have access to server, scheduler and MOM information. Only Administrator or root can access accounting information.

Some log messages appear many times. In order to make the output of `tracejob` more readable, messages that appear over a certain number of times (see option `-c` below) are restricted to only the most recent message.

If `tracejob` is run on a job array, the information returned will be about the job array itself, and not its subjobs. Job arrays do not have associated MOM log messages. If `tracejob` is run on a subjob, the same types of log messages will be available as for a job. Certain log messages that occur for a regular job will not occur for a subjob.

Note that some shells require that you enclose a job array identifier in double quotes.

### 2.58.3 Options to `tracejob`

- `-a`
  Do not report accounting information.

- `-c <count>`
  Set excessive message limit to `count`. If a message is logged at least `count` times, only the most recent message is printed.
  
  The default for `count` is 15.

- `-f <filter>`
  Do not include log events of type `filter`. The `-f` option can be used more than once on the command line.
  
  Filter values:
Filter values can be any of: `error`, `system`, `admin`, `job`, `job_usage`, `security`, `sched`, `debug`, or `debug2`, or their equivalent in hexadecimal. The following table shows the hex value and category for each filter.

**Table 2-30: Filters**

<table>
<thead>
<tr>
<th>Filter</th>
<th>Hex Value</th>
<th>Message Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>error</td>
<td>0x0001</td>
<td>Internal errors</td>
</tr>
<tr>
<td>system</td>
<td>0x0002</td>
<td>System errors</td>
</tr>
<tr>
<td>admin</td>
<td>0x0004</td>
<td>Administrative events</td>
</tr>
<tr>
<td>job</td>
<td>0x0008</td>
<td>Job-related events</td>
</tr>
<tr>
<td>job_usage</td>
<td>0x0010</td>
<td>Job accounting info</td>
</tr>
<tr>
<td>security</td>
<td>0x0020</td>
<td>Security violations</td>
</tr>
<tr>
<td>sched</td>
<td>0x0040</td>
<td>Scheduler events</td>
</tr>
<tr>
<td>debug</td>
<td>0x0080</td>
<td>Common debug messages</td>
</tr>
<tr>
<td>debug2</td>
<td>0x0100</td>
<td>Uncommon debug messages</td>
</tr>
</tbody>
</table>

- `l`  
  Do not report scheduler information.

- `m`  
  Do not report MOM information.

- `n <days>`  
  Report information from up to days days in the past.
  Default is `1` = today.

- `p <path>`  
  Use path as path to `PBS_HOME` on machine being queried.

- `s`  
  Do not report server information.

- `w <cols>`  
  Width of current terminal. If not specified by the user, `tracejob` queries OS to get terminal width. If OS doesn’t return anything, default is `80`.

- `v`  
  Verbose. Report more of `tracejob`'s errors than default.
Chapter 2  PBS Commands

- `z`  Suppresses printing of duplicate messages.

-- `version`  The *tracejob* command returns its PBS version information and exits. This option can only be used alone.

2.58.4  Exit Status

Zero upon successful processing of all options.
Exit value is greater than zero if *tracejob* is unable to process any options.

2.58.5  See Also

The PBS Professional Administrator’s Guide
pbs_server(8B), pbs_sched(8B), pbs_mom(8B)

2.59  *xpbs*

GUI front end to PBS commands

2.59.1  Synopsis

*xpbs [-admin]*
*xpbs --version*

2.59.2  Description

The *xpbs* command provides a user-friendly point-and-click interface to PBS commands. Please see the sections below for a tour and tutorials. Also, within every dialog box, a Help button can be found for assistance.
2.59.3 Options

-`admin` A mode where additional buttons are made available for terminating PBS servers, starting/stopping/disabling/enabling queues, and running/rerunning jobs.

--`version` The `xpbs` command returns its PBS version information and exits. This option can only be used alone.

2.59.4 Getting Started

Running `xpbs` will initialize the X resource database from various sources in the following order:

1. The RESOURCE_MANAGER property on the root window (updated via xrdb) with settings usually defined in the `.Xdefaults` file
2. Preference settings defined by the system administrator in the global `xpbsrc` file
3. User’s `~/.xpbsrc` file - this file defines various X resources like fonts, colors, list of PBS hosts to query, criteria for listing queues and jobs, and various view states. See section 2.59.13, “Setting Preferences”, on page 242 below for a list of resources that can be set.

2.59.5 Running `xpbs`

To run `xpbs` as a regular, non-privileged user, type:

```bash
setenv DISPLAY <display_host>:0
tpbs
```

To run `xpbs` with the additional purpose of terminating PBS servers, stopping and starting queues, or running/rerunning jobs, then run:

```bash
xpbs -admin
```

NOTE: Be sure to appropriately set `~/.rhosts` file if you’re planning to submit jobs to some remote server, and expecting output files to be returned to the local host (where `xpbs` was run). Usually, adding the PBS hostname running the server to your `.rhosts` file locally, and adding the name of the local machine to the `.rhosts` file at remote host, should be sufficient.

Also, be sure that the PBS client commands are in the default PATH because `xpbs` will call these commands.
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PBS Commands

2.59.6  
The xpbs Display

This section describes the main parts of the xpbs display. The main window is composed of 5 distinct areas (subwindows) arranged vertically (one on top of another) in the following order:

1. Menu
2. Hosts
3. Queues
4. Jobs
5. Info

2.59.6.1  
Menu

The Menu area is composed of a row of command buttons that signal some action with a click of the left mouse button. The buttons are:

- Manual Update: to update the information on hosts, queues, and jobs.
- Auto Update: same as Manual Update except updating is done automatically every <some specified> number of minutes.
- Track Job: for periodically checking for returned output files of jobs.
- Preferences: for setting certain parameters such as the list of server host(s) to query.
- Help: contains some help information.
- About: tells of the author and who to send comments, bugs, suggestions to.
- Close: for exiting xpbs plus saving the current setup information (if anything had changed) in the user’s $HOME/.xpbsrc file. Information saved include the selected host(s), queue(s), job(s), the different jobs listing criteria, the view states (i.e. minimized/maximized) of the Hosts, Queues, Jobs, and INFO regions, and anything in the Preferences section.
2.59.6.2 Hosts

The Hosts area is composed of a leading horizontal HOSTS bar, a listbox, and a set of command buttons. The HOSTS bar contains a minimize/maximize button, identified by a dot or a rectangular image, for displaying or iconifying the Hosts region. The listbox displays information about favorite server host(s), and each entry is meant to be selected via a single left mouse button click, shift key + mouse button 1 click for contiguous selection, or ctrl key + mouse button 1 click for non-contiguous selection. The command buttons represent actions on selected host(s), and commonly found buttons are:

- **detail** for obtaining detailed information about selected server host(s). This functionality can also be achieved by double clicking on an entry in the Hosts listbox.
- **Submit** for submitting a job to any of the queues managed by the selected host(s).
- **terminate** for terminating PBS servers on selected host(s). (-admin only)

The server hosts can be chosen by specifying in the ~/.xpbsrc file (or .Xdefaults) the resource:

```
*serverHosts: hostname1 hostname2 ...
```

Another way of specifying the host is to click on the Preferences button in the Menu region, and manipulate the server Hosts entry widget from the preferences dialog box.

2.59.6.3 Queues

The Queues area is composed of a leading horizontal QUEUES bar, a listbox, and a set of command buttons. The QUEUES bar lists the hosts that are consulted when listing queues; the bar also contains a minimize/maximize button for displaying or iconifying the Queues region. The listbox displays information about queues managed by the server host(s) selected from the Hosts listbox; each listbox entry is meant to be selected (highlighted) via a single left mouse button click, shift key + mouse button 1 click for contiguous selection, or ctrl key + mouse button 1 click for non-contiguous selection. The command buttons represent actions for operating on selected queue(s), and commonly found buttons are:

- **detail** for obtaining detailed information about selected queue(s). This functionality can also be achieved by double clicking on a Queues listbox entry.
- **stop** for stopping the selected queue(s). (-admin only)
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**PBS Commands**

- **start**
  for starting the selected queue(s). (-admin only)

- **disable**
  for disabling the selected queue(s). (-admin only)

- **enable**
  for enabling the selected queue(s). (-admin only)

### 2.59.6.4 Jobs

The Jobs area is composed of a leading horizontal JOBS bar, a listbox, and a set of command buttons. The JOBS bar lists the queues that are consulted when listing jobs; the bar also contains a minimize/maximize button for displaying or iconifying the Jobs region. The listbox displays information about jobs that are found in the queue(s) selected from the Queues listbox; each listbox entry is meant to be selected (highlighted) via a single left mouse button click, shift key + mouse button 1 click for contiguous selection, or control key + mouse button 1 click for non-contiguous selection. The region just above the Jobs listbox shows a collection of command buttons whose labels describe criteria used for filtering the Jobs listbox contents. The list of jobs can be selected according to the owner of jobs (Job_Owner), job state (Job_State), name of the job (Job_Name), type of hold placed on the job (Hold_Types), the account name associated with the job (Account_Name), checkpoint attribute (Checkpoint), time the job is eligible for queueing/execution (Queue_Time), resources requested by the job (Resource_List), priority attached to the job (Priority), and whether or not the job is rerunnable (Rerunnable). The selection criteria can be modified by clicking on any of the appropriate command buttons to bring up a selection box. The criteria command buttons are accompanied by a Select Jobs button, which when clicked, will update the contents of the Jobs listbox based on the new selection criteria. Please see qselect(1B) for more details on how the jobs are filtered.

Finally, to the right of the listbox, the Jobs region is accompanied by the following command buttons, for operating on selected job(s):

- **detail**
  for obtaining detailed information about selected job(s). This functionality can also be achieved by double clicking on a Jobs listbox entry.

- **modify**
  for modifying attributes of the selected job(s).

- **delete**
  for deleting the selected job(s).

- **hold**
  for placing some type of hold on selected job(s).  

---

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release for releasing held job(s).

signal for sending signals to selected job(s) that are running.

msg for writing a message string into the output streams of the selected job(s).

move for moving selected job(s) into some specified destination queue.

order for exchanging order of two selected jobs in a queue.

run for running selected job(s). (-admin only)

rerun for requeuing selected job(s) that are running. (-admin only)

2.59.6.5 Info

The Info Area shows the progress of the commands’ executed by xpbs. Look into this box for errors. The INFO bar also contains a minimize/maximize button for displaying or iconifying the Info region.

2.59.7 Widgets Used in xpbs

Some of the widgets used in xpbs and how they are manipulated are described in the following:
2.59.7.1 listbox

can be multi-selectable (a number of entries can be selected/highlighted using a mouse click) or single-selectable (one entry can be highlighted at a time). For a multi-selectable listbox, the following operations are allowed:

1. single click with mouse button 1 to select/highlight an entry.
2. shift key + mouse button 1 to contiguously select more than one entry.
3. cntrl key + mouse button 1 to non-contiguously select more than one entry. NOTE: For systems running Tk < 4.0, the newly selected item is reshuffled to appear next to already selected items.
4. click the Select All/Deselect All button to select all entries or deselect all entries at once.
5. double clicking an entry usually activates some action that uses the selected entry as a parameter.

2.59.7.2 scrollbar

usually appears either vertically or horizontally and contains 5 distinct areas that are mouse clicked to achieve different effects:

- **top arrow**
  Causes the view in the associated widget to shift up by one unit (i.e. the object appears to move down one unit in its window). If the button is held down the action will auto-repeat.

- **top gap**
  Causes the view in the associated window to shift up by one less than the number of units in the window (i.e. the portion of the object that used to appear at the very top of the window will now appear at the very bottom). If the button is held down the action will auto-repeat.

- **slider**
  Pressing button 1 in this area has no immediate effect except to cause the slider to appear sunken rather than raised. However, if the mouse is moved with the button down then the slider will be dragged, adjusting the view as the mouse is moved.

- **bottom gap**
  Causes the view in the associated window to shift down by one less than the number of units in the window (i.e. the portion of the object that used to appear at the very bottom of the window will now appear at the very top). If the button is held down the action will auto-repeat.
bottom arrow
Causes the view in the associated window to shift down by one unit (i.e. the object appears to move up one unit in its window). If the button is held down the action will auto-repeat.

2.59.7.3 entry
brought into focus with a click of the left mouse button. To manipulate this widget, simply type in the text value. Use of arrow keys, mouse selection of text for deletion or overwrite, copying and pasting with sole use of mouse buttons are permitted. This widget is usually accompanied by a scrollbar for horizontally scanning a long text entry string.

2.59.7.4 matrix of entry boxes
usually shown as several rows of entry widgets where a number of entries (called fields) can be found per row. The matrix is accompanied by up/down arrow buttons for paging through the rows of data, and each group of fields gets one scrollbar for horizontally scanning long entry strings. Moving from field to field can be done using the <Tab>, <Cntrl-f>, or <Cntrl-b> (move backwards) keys.

2.59.7.5 spinbox
a combination of an entry widget and a horizontal scrollbar. The entry widget will only accept values that fall within a defined list of valid values, and incrementing through the valid values is done by clicking on the up/down arrows.

2.59.7.6 button
a rectangular region appearing either raised or pressed that invokes an action when clicked with the left mouse button. When the button appears pressed, then hitting the <RETURN> key will automatically select the button.

2.59.7.7 text
an editor like widget. This widget is brought into focus with a click of the left mouse button. To manipulate this widget, simply type in the text. Use of arrow keys, backspace/delete key, mouse selection of text for deletion or overwrite, copying and pasting with sole use of mouse buttons are permitted. This widget is usually accompanied by a scrollbar for vertically scanning a long entry.
2.59.8 Submitting Jobs

Submitting a PBS job requires only to manipulate the widgets found in the Submit window. The submit dialog box is composed of 4 distinct regions:

1. Job Script
2. Options
3. OTHER Options
4. Command Buttons

The Job Script file region is at the upper left, the Options region containing various widgets for setting job attributes is scattered all over the dialog box, the OTHER Options is located just below the Job Script file region, and Command Buttons region is at the bottom.

The job script region is composed of a header box, the text box, FILE entry box, and a couple of buttons labeled load and save. If you have a script file containing PBS options and executable lines, then type the name of the file on the FILE entry box, and then click on the load button. The various widgets in the Submit window will get loaded with values found in the script file. The script file text box will only be loaded with executable lines (non-PBS) found in the script. The job script header box has a Prefix entry box that can be modified to specify the PBS directive to look for when parsing a script file for PBS options. If you don’t have a script file, you can start typing the executable lines of the job in the file text box.

To submit a job, perform the following steps:

1. Select a host from the HOSTS listbox in the main xpbs display.
2. Click on the Submit button located in the Menu bar.
3. Specify the script file containing the job execution lines and job resource and attribute values, or simply type in the execution lines in the FILE textbox.
4. Start manipulating the various widgets in the Submit window. Particularly, pay close attention to the Destination listbox. This box lists all the queues found in the host that you selected. A special entry called “@host” refers to the default queue at host. Select appropriately the destination queue of the job. More options can be found by clicking the OTHER Options buttons.
5. At the bottom of the Submit window, click confirm submit. You can also click on interactive to run the job interactively. Running a job interactively will open an xterm window to your display host containing the session.

NOTE: The script FILE entry box is accompanied by a save button that you click to save the current widget values to the specified file in a form that can later be read by xpbs or by the qsub command.
2.59.9 Modifying Attributes of Jobs

Modifying a PBS job requires only to manipulate the widgets found in the Modify window. To modify a job or jobs, do the following steps:

1. Select one or more jobs from the JOBS listbox in the main `xbss` display.
2. Click on the modify button located to the right of the listbox.
3. The Modify window is structured similarly to the Submit window. Simply manipulate the widgets to specify replacement or additional values of job attributes.
4. Click on the confirm modify button located at the bottom of the dialog box.

2.59.10 Deleting Jobs

Deleting a PBS job requires only to manipulate the widgets found in the Delete window. To delete a job or jobs, do the following steps:

1. Select one or more jobs from the JOBS listbox in the main `xbss` display.
2. Click on the delete button located to the right of the listbox.
3. Manipulate the spinbox widget to set the kill delay signal interval.
4. Click on the delete button located at the bottom of the dialog box.

2.59.11 Tracking Returned Output Files

If you want to be informed of returned output files of current jobs, and be able to quickly see the contents of those files, then enable the “track job” feature as follows:

1. Submit all the jobs that you want monitored.
2. Click on the Track Job button located in the Menu bar to bring up the Track Job dialog box.
3. Specify the list of user names, whose jobs are to be monitored for returned output files, in the matrix located at the upper left of the dialog box.
4. Manipulate the minutes spinbox, located just below the user names matrix, to specify the interval value when output files will be periodically checked.
5. Specify the location of job output files (whether locally or remotely) by clicking on one of the radio buttons located at the upper right of the dialog box. Returned locally means the output files will be returned back to the host where `xbss` was run. If the output files are returned to some remote host, then `xbss` will execute an RSH `<remote_host> test -f`
Chapter 2  PBS Commands

<output_files> to test the existence of the files. RSH is whatever you set the remote shell command to in the corresponding entry box.

NOTE: Be sure the files are accessible from the host where xpbs was run (i.e. .rho-sts appropriately set).

6. Click start/reset tracking button located at the bottom of the dialog box to:
   - cancel any previous tracking
   - build a new list of jobs to be monitored for returned output files based on currently queued jobs.
   - start periodic tracking.

7. Click on close window button.

When an output file for a job being monitored is found, then the Track Job button (the one that originally invoked the Track Job dialog box) will turn into a different color, and the Jobs Found Completed listbox, located in the Track Job dialog box, is then loaded with the corresponding job id(s). Then double click on a job id to see the contents of the output file and the error file. Click stop tracking if you want to cancel tracking.

2.59.12 Leaving xpbs

Click on the Close button located in the Menu bar to leave xpbs. If anything had changed, it will bring up a dialog box asking for a confirmation in regards to saving state information like the view states (minimize/maximize) of the HOSTS, QUEUES, JOBS, and INFO subwindows, and various criteria for listing queues and jobs. The information is saved in ~/.xpbsrc file.

2.59.13 Setting Preferences

The resources that can be set in the X resources file, ~/.xpbsrc, are:

*serverHosts
   list of server hosts (space separated) to query by xpbs keyword
   PBS_DEFAULT_SERVER can be used which will be used as a place holder for the value obtained from *defServerFile.

*defServerFile
   the file containing the name of the default server host. The content of this will be substituted for the PBS_DEFAULT_SERVER keyword in *serverHosts value.
PBS Commands

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*timeoutSecs
specify the number of seconds before timing out waiting for a connection to a PBS host.

*xtermCmd
the xterm command to run driving an interactive PBS session.

*labelFont
font applied to text appearing in labels.

*fixlabelFont
font applied to text that label fixed-width widgets such as listbox labels. This must be a fixed-width font.

*textFont
font applied to a text widget. Keep this as fixed-width font.

*backgroundColor
the color applied to background of frames, buttons, entries, scrollbar handles.

*foregroundColor
the color applied to text in any context (under selection, insertion, etc...).

*activeColor
the color applied to the background of a selection, a selected command button, or a selected scroll bar handle.

*disabledColor
color applied to a disabled widget.

*signalColor
color applied to buttons that signal something to the user about a change of state. For example, the color of the Track Job button when returned output files are detected.

*shadingColor
a color shading applied to some of the frames to emphasize focus as well as decoration.

*selectorColor
the color applied to the selector box of a radio button or check-button.

*selectHosts
list of hosts (space separated) to automatically select/highlight in the HOSTS listbox.
*selectQueues
list of queues (space separated) to automatically select/highlight in the QUEUES listbox.

*selectJobs
list of jobs (space separated) to automatically select/highlight in the JOBS listbox.

*selectOwners
list of owners checked when limiting the jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Owners: <list_of_owners>”. See -u option in qselect(1B) for format of <list_of_owners>.

*selectStates
list of job states to look for (do not space separate) when limiting the jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Job_States: <states_string>”. See -s option in qselect(1B) for format of <states_string>.

*selectRes
list of resource amounts (space separated) to consult when limiting the jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Resources: <res_string>”. See -l option in qselect(1B) for format of <res_string>.

*selectExecTime
the Execution Time attribute to consult when limiting the list of jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Queue_Time: <exec_time>”. See -a option in qselect(1B) for format of <exec_time>.

*selectAcctName
the name of the account that will be checked when limiting the jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Account_Name: <account_name>”. See -A option in qselect(1B) for format of <account_name>.

*selectCheckpoint
the checkpoint attribute relationship (including the logical operator) to consult when limiting the list of jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Checkpoint: <checkpoint_arg>”. See -c option in qselect(1B) for format of <checkpoint_arg>.

*selectHold
the hold types string to look for in a job when limiting the jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Hold_Types:
<hold_string>”. See -h option in qselect(1B) for format of <hold_string>.

*selectPriority
the priority relationship (including the logical operator) to consult when limiting the list of jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Priority: <priority_value>”. See -p option in qselect(1B) for format of <priority_value>.

*selectRerun
the rerunnable attribute to consult when limiting the list of jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Rerunnable: <rerun_val>”. See -r option in qselect(1B) for format of <rerun_val>.

*selectJobName
name of the job that will be checked when limiting the jobs appearing on the Jobs listbox in the main xpbs window. Specify value as “Job_Name: <jobname>”. See -N option in qselect(1B) for format of <jobname>.

*iconizeHostsView
a boolean value (True or False) indicating whether or not to iconize the HOSTS region.

*iconizeQueuesView
a boolean value (True or False) indicating whether or not to iconize the QUEUES region.

*iconizeJobsView
a boolean value (True or False) indicating whether or not to iconize the JOBS region.

*iconizeInfoView
a boolean value (True or False) indicating whether or not to iconize the INFO region.

*jobResourceList
a curly-braced list of resource names as according to architecture known to xpbs. The format is as follows:

{ <arch-type1> resname1 resname2 ... resnameN }
{ <arch-type2> resname1 resname2 ... resnameN }
... 
{ <arch-typeN> resname1 resname2 ... resnameN }
## 2.59.14 xpbs and PBS Commands

xpbs calls PBS commands as follows:

<table>
<thead>
<tr>
<th>Command Button</th>
<th>PBS Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>detail (Hosts)</td>
<td><code>qstat -B -f &lt;selected server_host(s)&gt;</code></td>
</tr>
<tr>
<td>terminate</td>
<td><code>qterm &lt;selected server_host(s)&gt;</code></td>
</tr>
<tr>
<td>detail (Queues)</td>
<td><code>qstat -Q -f &lt;selected queue(s)&gt;</code></td>
</tr>
<tr>
<td>stop</td>
<td><code>qstop &lt;selected queue(s)&gt;</code></td>
</tr>
<tr>
<td>start</td>
<td><code>qstart &lt;selected queue(s)&gt;</code></td>
</tr>
<tr>
<td>enable</td>
<td><code>qenable &lt;selected queue(s)&gt;</code></td>
</tr>
<tr>
<td>disable</td>
<td><code>qdisable &lt;selected queue(s)&gt;</code></td>
</tr>
<tr>
<td>detail (Jobs)</td>
<td><code>qstat -f &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>modify</td>
<td><code>qalter &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>delete</td>
<td><code>qdel &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>hold</td>
<td><code>qhold &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>release</td>
<td><code>qrls &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>run</td>
<td><code>qrun &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>rerun</td>
<td><code>qrerun &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>signal</td>
<td><code>qsig &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>msg</td>
<td><code>qmsg &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>move</td>
<td><code>qmove &lt;selected job(s)&gt;</code></td>
</tr>
<tr>
<td>order</td>
<td><code>qorder &lt;selected job(s)&gt;</code></td>
</tr>
</tbody>
</table>

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PBS Commands

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2.59.15  Exit Status

Upon successful processing, the `xpbs` exit status will be a value of zero.
If the `xpbs` command fails, the command exits with a value greater than zero.

2.59.16  See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide,
`qalter(1B)`, `qdel(1B)`, `qhold(1B)`, `qmove(1B)`, `qmsg(1B)`, `qrun(1B)`, `qrls(1B)`, `qselect(1B)`, `qsig(1B)`, `qstat(1B)`,
`qorder(1B)`, `qsub(1B)`, `qdisable(8B)`, `qenable(8B)`, `qrun(8B)`, `qstart(8B)`, `qstop(8B)`, `qterm(8B)`

2.60  `xpbsmon`

GUI for displaying, monitoring execution hosts under PBS

2.60.1  Synopsis

`xpbsmon`

`xpbsmon --version`

2.60.2  Description

The `xpbsmon` command provides a way to graphically display the various nodes that run jobs. A node or execution host can be running a `pbs_mom` daemon, or not running the daemon. For the latter case, it could just be a nodename that appears in a nodes file that is managed by a main `pbs_server` running on another host. This utility also provides the ability to monitor values of certain system resources by posting queries to the `pbs_mom` of a node. With this utility, you can see what job is running on what node, who owns the job, how many nodes assigned to a job, status of each node (color-coded and the colors are user-modifiable), how many nodes are available, free, down, reserved, offline, of unknown status, in use running multiple jobs or executing only 1 job. Please see the sections below for a tour and tutorials of `xpbsmon`. Also, within every dialog box, a Help button can be found for assistance.
2.60.3 Getting Started

Running `xpbsmon` will initialize the X resource database from various sources in the following order:

1. The RESOURCE_MANAGER property on the root window (updated via `xrdb`) with settings usually defined in the .Xdefaults file
2. Preference settings defined by the system administrator in the global `xpbsmonrc` file
3. User’s ~/.xpbsmonrc file - this file defines various X resources like fonts, colors, list of colors to use to represent the various status of the nodes, list of PBS sites to query, list of server hosts on each site, list of nodes/execution hosts on each server host, list of system resource queries to send to the nodes’ pbs_mom, and various view states. See section 2.60.10, “Setting Preferences”, on page 254 below for a list of resources that can be set.

2.60.4 Running `xpbsmon`

`xpbsmon` can be run either as a regular user or superuser. If you run it with less privilege, you may not be able to see all the information for a node. If it is executed as a regular user, you should still be able to see what jobs are running on what nodes, possibly state, as this information are obtained by `xpbsmon` talking directly to the specified server. If you want other system resource values, it may require special privilege since `xpbsmon` will have to talk directly to the pbs_mom of a node. In addition, the host where `xpbsmon` was running must also have been given explicit access permission by the MOM (unless the GUI is running on the same host where MOM is running). This is done done by updating the `$clienthost` and/or the `$restricted` parameter on the MOM’s configuration file.

To run `xpbsmon`, type:

```
setenv DISPLAY <display_host>:0
xpbsmon
```

If you are running the GUI and only interested in jobs data, then be sure to set all the nodes’ type to NOMOM in the Pref dialog box.

2.60.5 Options

```
--version
```

The `xpbsmon` command returns its PBS version information and exits. This option can only be used alone.
2.60.6 The *xpbsmon* Display

This section describes the main parts of the *xpbsmon* display. The main window is composed of 3 distinct areas (subwindows) arranged vertically (one on top of another) in the following order:

1. Menu
2. Site Information
3. Info

2.60.6.1 Menu

The Menu area is composed of a row of command buttons that signal some action with a click of the left mouse button. The buttons are:

- **Site..**
  - displays a popup menu containing the list of PBS sites that have been added using the Sites Preferences window. Simply drag your mouse and release to the site name whose servers/nodes information you would like to see.

- **Pref..**
  - brings up various dialog boxes for specifying the list of sites, servers on each site, nodes that are known to a server, and the system resource queries to be sent to a node’s *pbs_mom* daemon.

- **Auto Update..**
  - brings up another window for specifying whether or not to do auto updates of nodes information, and also for specifying the interval number of minutes between updates.

- **Help**
  - contains some help information.

- **About**
  - tells who the author is and who to send comments, bugs, suggestions to.

- **Close**
  - for exiting *xpbsmon* plus saving the current setup information (if anything had changed) in the user’s $HOME/.xpbsmonrc file. Information saved include the specified list of sites, servers on each site, nodes known to each server, and system resource queries to send to node’s *pbs_mom*.

- **Minimize Button**
  - shows the iconized view of Site Information where nodes are represented as tiny boxes, where each box is colored according to status. In order to get
more information about a node, you need to double click on the colored box.

Maximize button
shows the full view of Site Information where nodes are represented in bigger boxes, still colored depending on the status, and some information on it is displayed.

2.60.6.2 Site Information

Only one site at a time can be displayed. This area (shown as one huge box referred to as the site box) can be further subdivided into 3 areas: the site name label at the top, server boxes in the middle, and the color status bar at the bottom. The site name label shows the name of the site as specified in the Pref. window. At the middle of the site box shows a row of big boxes housing smaller boxes.

The big box is an abstraction of a server host (called a server box), showing its server display label at the top of the box, a grid of smaller boxes representing the nodes that the server knows about (where jobs are run), and summary status for the nodes under the server. Status information will show counters for the number of nodes used, available, reserved, offline, or of unknown status and even # of cpus assigned. For a cleaner display, some counters with a value of zero are not displayed. The server boxes are placed in a grid, with a new row being started when either *siteBoxMaxNumServerBoxesPerRow or *siteBoxMaxWidth limit has been reached.

The smaller boxes represent the nodes/execution hosts where jobs are run (referred to as node boxes). Each node box shows the name at the top, and a sub-box (a smaller square) that is colored according to the status of the node that it represents, and if the view type is FULL, it will display some node information according to the system resource queries specified on the Pref. window. Clicking on the sub-box will show a much bigger box (called the MIRROR view) with bigger fonts containing nodes information. Another view is called ICON and this shows a tiny box with a colored area. The node boxes are arranged in a grid, where a new row is created if either the *serverBoxMaxNumNodeBoxesPerRow or *serverBoxMaxWidth limit has been reached. ICON view of the node boxes will be constrained by the *nodeBoxIconMaxHeight and *nodeBoxIconMaxWidth pixel values; FULL view of the node boxes will be bounded by *nodeBoxFullMaxWidth and *nodeBoxFullMaxHeight; the mirror view of the node boxes has its size be *nodeBoxMirrorMaxWidth, and *nodeBoxMirrorMaxHeight.

Horizontal and vertical scrollbars for the site box, server box, and node box will be displayed as needed.
Finally, the color bar information shows a color chart displaying what the various colors mean in terms of node status. The color-to-status mapping can be modified by setting the X resources: *nodeColorNOINFO, *nodeColorFREE, *nodeColorINUSEshared, *nodeColorINUSEexclusive, *nodeColorDOWN, *nodeColorRSVD, *nodeColorOFFL, *nodeColorBUSY.

### 2.60.6.3  Info

The Info Area shows the progress of some of the background actions performed by `xpbsmon`. Look into this box for errors.

### 2.60.7  Widgets Used in `xpbsmon`

Some of the widgets used in `xpbsmon` and how they are manipulated are described in the following:

#### 2.60.7.1  listbox

the ones found in this GUI are only single-selectable (one entry can be highlighted/selected at a time via a mouse click).

#### 2.60.7.2  scrollbar

usually appears either vertically or horizontally and contains 5 distinct areas that are mouse clicked to achieve different effects:

- **top arrow**
  Causes the view in the associated widget to shift up by one unit (i.e. the object appears to move down one unit in its window). If the button is held down the action will auto-repeat.

- **top gap**
  Causes the view in the associated window to shift up by one less than the number of units in the window (i.e. the portion of the object that used to appear at the very top of the window will now appear at the very bottom). If the button is held down the action will auto-repeat.

- **slider**
  Pressing button 1 in this area has no immediate effect except to cause the slider to appear sunken rather than raised. However, if the mouse is moved with the button down then the slider will be dragged, adjusting the view as the mouse is moved.
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**bottom gap**  
Causes the view in the associated window to shift down by one less than the number of units in the window (i.e. the portion of the object that used to appear at the very bottom of the window will now appear at the very top). If the button is held down the action will auto-repeat.

**bottom arrow**  
Causes the view in the associated window to shift down by one unit (i.e. the object appears to move up one unit in its window). If the button is held down the action will auto-repeat.

2.60.7.3  **entry**

brought into focus with a click of the left mouse button. To manipulate this widget, simply type in the text value. Use of arrow keys, mouse selection of text for deletion or overwrite, copying and pasting with sole use of mouse buttons are permitted. This widget is usually accompanied by a scrollbar for horizontally scanning a long text entry string.

2.60.7.4  **box**

made up of 1 or more listboxes displayed adjacent to each other giving the effect of a “matrix”. Each row from the listboxes makes up an element of the box. In order to add items to the box, you need to manipulate the accompanying entry widgets, one for each listbox, and then clicking the add button. Removing items from the box is done by selecting an element, and then clicking delete.

2.60.7.5  **spinbox**

a combination of an entry widget and a horizontal scrollbar. The entry widget will only accept values that fall within a defined list of valid values, and incrementing through the valid values is done by clicking on the up/down arrows.

2.60.7.6  **button**

a rectangular region appearing either raised or pressed that invokes an action when clicked with the left mouse button. When the button appears pressed, then hitting the `<RETURN>` key will automatically select the button.
### 2.60.8 Updating Preferences

#### 2.60.8.1 Time Sharing

Suppose you have a time-sharing environment where the front-end is called bower and you have 4 nodes: bower1, bower2, bower3, bower4. bower is the host that runs the server; jobs are submitted to host bower where it enqueues it for future execution. Also, a `pbs_mom` daemon is running on each of the execution hosts. If the server bower also maintains a nodes list containing information like state for the 4 nodes, then this will also be reported. Then to setup `xpbsmon`, do the following:

1. Click the Pref.. button on the Menu section.
2. On the Sites Preference dialog, enter any arbitrary site name, for example “Local”. Then click the add button.
3. On the Server_Host entry box, enter “bower”, and on the DisplayLabel entry box, put an arbitrary label (as it would appear on the header of the server box) like “Bower”, and then click add.
4. Click the nodes.. button that is accompanying the Servers box. This would bring up the Server Preference dialog.
5. Now add the entries “bower1”, “bower2”, “bower3”, “bower4” specifying type MOM for each on the Nodes box.
6. If you need to monitor certain system resource parameters for each of the nodes, you need to specify query expressions containing resource queries to be sent to the individual PBS moms. For example, if you want to obtain memory usage, then select a node from the Nodes list, click on the query.. button that accompanies the Nodes list, and this would bring up the Query Table dialog. Specify the following input:

   **Query_Expr**: `(availmem/totmem) * 100`

   **Display_Info**: Memory Usage:

   **Display_Type**: SCALE

   The above says to display the result of the “Query_Expr” in a scale widget calibrated over 100. The queries “availmem” and “totmem” will be sent to the PBS mom, and the
expression is evaluated upon receiving all results from the mom. If you want to display the result of another query, say “loadave”, directly, then specify the following:

Query_EXPR: loadave
Display_Info: Load Average:
Display_Type: TEXT

NOTE: For a list of queries that can be sent to a pbs_mom, please click on the Help button on the Query table window.

2.60.8.2 Jobs Exclusive Environment

Supposing you have a “space non-sharing” environment where the server maintains a list of nodes that it runs jobs on exclusively (one job at a time outstanding per node). Let’s call this server b1. Simply update Preferences information as follows:

1. Click the Pref. button on the Menu section.
2. On the Sites Preference dialog, enter a site name, for example “B System”. Then click the add button.
3. On the Server_Host entry box, enter “b1”, DisplayLabel entry box type “B1” (or whatever label that you would like to appear on the header of the server box), and then click add.

2.60.8.3 Hybrid Time Sharing/Space Sharing Environment

A cluster of heterogeneous machines, time-sharing or jobs exclusive, could easily be represented in xpbsmon by combining steps in CASE 1 and CASE 2.

2.60.9 Leaving xpbsmon

Click on the Close button located in the Menu bar to leave xpbsmon. If anything had changed, it will bring up a dialog box asking for a confirmation in regards to saving preferences information about list of sites, their view types, list of servers on each site, the list of nodes known to each server, and the list of queries to be sent to the pbs_mom of each node. The information is saved in ~/.xpbsmonrc file.

2.60.10 Setting Preferences

The resources that can be set in the X resources file, ~/.xpbsmonrc, are described in the following:
2.60.10.1 Node Box Properties

Resource names beginning with "*small" or "*node" apply to the properties of the node boxes. A node box is made of an outer frame where the node label sits on top, the canvas (smaller box) is on the middle, and possibly some horizontal/vertical scrollbars.

nodeColorNOINFO
color of node box when information for the node it represents could not be obtained.

*nodeColorFREE
color of canvas when node it represents is up.

*nodeColorINUSEshared
color when node it represents has more than 1 job running on it, or when node has been marked by the server that manages it as “job-sharing”.

*nodeColorINUSEexclusive
list of colors to assign to a node box when host it represents is running only 1 job, or when node has been marked by the server that manages it as “time-sharing”. xpbsmon will use this list to assign 1 distinct color per job unless all the colors have been exhausted, in which case, colors will start getting assigned more than once in a round-robin fashion.

*nodeColorDOWN
color when node it represents is down.

*nodeColorRSVD
color when node it represents is reserved.

*nodeColorOFFL
color when node it represents is offline.

*nodeColorBUSY
color when node it represents is busy (high load average).

*smallForeground
applies to the color of text inside the canvas.

*smallBackground
applies to the color of the frame.

*smallBorderWidth
distance (in pixels) from other node boxes.

*smallRelief
how node box will visually appear (style).
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*smallScrollBorderWidth
  significant only in FULL mode, this is the distance of the horizontal/vertical
  scrollbars from the canvas and lower edge of the frame.

*smallScrollBackground
  background color of the scrollbars

*smallScrollRelief
  how scrollbars would visually appear (style).

*smallCanvasBackground
  color of the canvas (later overridden depending on status of the node it rep-
  resents)

*smallCanvasBorderWidth
  distance of the canvas from the frame and possibly the scrollbars.

*smallCanvasRelief
  how the canvas is visually represented (style).

*smallLabelBorderWidth
  the distance of the node label from the canvas and the topmost edge of the
  frame.

*smallLabelBackground
  the background of the area of the node label that is not filled.

*smallLabelRelief
  how the label would appear visually (style).

*smallLabelForeground
  the color of node label text.

*smallLabelFont
  the font to use for the node label text.

*smallLabelFontWidth
  font width (in pixels) of *smallLabelFont

*smallLabelFontHeight
  font height (in pixels) of *smallLabelFont

*smallTextFont
  font to use for the text that appear inside a canvas.

*smallTextFontWidth
  font width (in pixels) of *smallTextFont.

*smallTextFontHeight
  font height (in pixels) of *smallTextFont.
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*nodeColorTrough  
color of trough part (the /100 portion) of a canvas scale item.

*nodeColorSlider  
color of slider part (value portion) of a canvas scale item.

*nodeColorExtendedTrough  
color of extended trough (over 100 portion when value exceeds max) of a canvas scale item.

*nodeScaleFactor  
tells how much bigger you want the scale item on the canvas to appear. (1 means to keep size as is)

*nodeBoxFullMaxWidth  
*nodeBoxFullMaxHeight  
maximum width and height (in pixels) of a node box in FULL mode.

*nodeBoxIconMaxWidth  
*nodeBoxIconMaxHeight  
maximum width and height (in pixels) of a node box in ICON mode.

*nodeBoxMirrorMaxWidth  
*nodeBoxMirrorMaxHeight  
maximum width and height (in pixels) of a node box displayed on a separate window (after it has been clicked with the mouse to obtain a bigger view)

*nodeBoxMirrorScaleFactor  
tells how much bigger you want the scale item on the canvas to appear while the node box is displayed on a separate window (1 means to keep size as is)

2.60.10.2 Server Box Properties

Resource names beginning with "*medium" apply to the properties of the server boxes. A server box is made of an outer frame where the server display label sits on top, a canvas filled with node boxes is on the middle, possibly some horizontal/vertical scrollbars, and a status label at the bottom.

*mediumLabelForeground  
color of text applied to the server display label and status label.

*mediumLabelBackground  
background color of the unfilled portions of the server display label and status label.
*mediumLabelBorderWidth
distance of the server display label and status label from other parts of the server box.

*mediumLabelRelief
how the server display label and status label appear visually (style).

*mediumLabelFont
font used for the text of the server display label and status label.

*mediumLabelFontWidth
font width (in pixels) of *mediumLabelFont.

*mediumLabelFontHeight
font height (in pixels) of *mediumLabelFont.

*mediumCanvasBorderWidth
the distance of the server box’s canvas from the label widgets.

*mediumCanvasBackground
the background color of the canvas.

*mediumCanvasRelief
how the canvas appear visually (style).

*mediumScrollBorderWidth
distance of the scrollbars from the other parts of the server box.

*mediumScrollBackground
the background color of the scrollbars.

*mediumScrollRelief
how the scrollbars appear visually.

*mediumBackgroundColor
the color of the server box frame.

*mediumBorderWidth
the distance of the server box from other boxes.

*mediumRelief
how the server box appears visually (style).

*serverBoxMaxWidth
*serverBoxMaxHeight
maximum width and height (in pixels) of a server box.

*serverBoxMaxNumNodeBoxesPerRow
maximum # of node boxes to appear in a row within a canvas.
2.60.10.3 Miscellaneous Properties

Resource names beginning with “*big” apply to the properties of a site box, as well as to widgets found outside of the server box and node box. This includes the dialog boxes that appear when the menu buttons of the main window are manipulated. The site box is the one that appears on the main region of xpbsmon.

*bigBackgroundColor
background color of the outer layer of the main window.

*bigForeground
color applied to regular text that appear outside of the node box and server box.

*bigBorderWidth
distance of the site box from the menu area and the color information area.

*bigRelief
how the site box is visually represented (style)

*bigActiveColor
the color applied to the background of a selection, a selected command button, or a selected scroll bar handle.

*bigShadingColor
a color shading applied to some of the frames to emphasize focus as well as decoration.

*bigSelectorColor
the color applied to the selector box of a radiobutton or checkbutton.

*bigDisabledColor
color applied to a disabled widget.

*bigLabelBackground
color applied to the unfilled portions of label widgets.

*bigLabelBorderWidth
distance from other widgets of a label widget.

*bigLabelRelief
how label widgets appear visually (style)

*bigLabelFont
font to use for labels.

*bigLabelFontWidth
font width (in pixels) of *bigLabelFont.

*bigLabelFontHeight
font height (in pixels) of *bigLabelFont.
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- **bigLabelForeground**: color applied to text that function as labels.
- **bigCanvasBackground**: the color of the main region.
- **bigCanvasRelief**: how the main region looks like visually (style)
- **bigCanvasBorderWidth**: distance of the main region from the menu and info regions.
- **bigScrollBorderWidth**: if the main region has a scrollbar, this is its distance from other widgets appearing on the region.
- **bigScrollBackground**: background color of the scrollbar appearing outside a server box and node box.
- **bigScrollRelief**: how the scrollbar that appears outside a server box and node box looks like visually (style)
- **bigTextFontWidth**: the font width (in pixels) of bigTextFont
- **bigTextFontHeight**: the font height (in pixels) of bigTextFont
- **siteBoxMaxWidth**: maximum width (in pixels) of the site box.
- **siteBoxMaxHeight**: maximum height (in pixels) of the site box.
- **siteBoxMaxNumServerBoxesPerRow**: maximum number of server boxes to appear in a row inside the site box.
- **autoUpdate**: if set to *True*, then information about nodes is periodically gathered.
- **autoUpdateMins**: the # of minutes between polling for data regarding nodes when *autoUpdate* is set.
- **siteInView**: the name of the site that should be in view
- **rcSiteInfoDelimiterChar**: the separator character for each input within a curly-bracketed line of input of *siteInfo*. 
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2.60.11 Exit Status

Upon successful processing, the \texttt{xpbsmon} exit status will be a value of zero.

If the \texttt{xpbsmon} command fails, the command exits with a value greater than zero.

If \texttt{xpbsmon} is querying a host running a server with an incompatible version, you may see the following messages:

\begin{verbatim}
Internal error: pbsstatnode: End of File (15031)
\end{verbatim}
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The above message can be safely ignored.

2.60.12  See Also

The PBS Professional User's Guide, the PBS Professional Administrator's Guide, pbs_sched(8B), pbs_mom(8B), pbs_tclapi(3B)
Chapter 3

MOM Parameters

This chapter describes the configuration files used by MOM and lists the MOM configuration parameters that are found in the Version 1 MOM configuration file, PBS_HOME/mom_priv/config.

3.1 Syntax of MOM Configuration File

The Version 1 MOM configuration file contains parameter settings for the MOM on the local host.

Version 1 configuration files list local resources and initialization values for MOM. Local resources are either static, listed by name and value, or externally-provided, listed by name and command path. Local static resources are for use only by the scheduler. They do not appear in a pbsnodes -a query. See the -c option to the pbs_mom command. Do not change the syntax of the Version 1 configuration file.

Each configuration item is listed on a single line, with its parts separated by white space. Comments begin with a hashmark ("#").

3.1.1 Externally-provided Resources

Externally-provided resources, for example dynamic resources such as scratch space, use a shell escape to run a command. These resources are described with a name and value, where the first character of the value is an exclamation mark ("!"). The remainder of the value is the path and command to execute.
Parameters in the command beginning with a percent sign ("\%") can be replaced when the command is executed. For example, this line in a configuration file describes a resource named "escape":

```
   escape   !echo \%xxx \%yyy
```

If a query for the "escape" resource is sent with no parameter replacements, the command executed is "echo \%xxx \%yyy". If one parameter replacement is sent, "escape[xxx=hi there]", the command executed is "echo hi there \%yyy". If two parameter replacements are sent, "escape[xxx=hi][yyy=there]", the command executed is "echo hi there". If a parameter replacement is sent with no matching token in the command line, "escape[zzz=snafu]", an error is reported.

### 3.1.2 Windows Notes

If the argument to a MOM option is a pathname containing a space, enclose it in double quotes as in the following:

```
   hostn !"\Program Files\PBS Pro\exec\bin\hostn" host
```

When you edit any PBS configuration file, make sure that you put a newline at the end of the file. The Notepad application does not automatically add a newline at the end of a file; you must explicitly add the newline.

### 3.2 Contents of MOM Configuration File

Initialization value directives have names beginning with a dollar sign ("\$"). They are listed here:

```
   Saction <default_action> <timeout> <new_action>
```

Replaces the `default_action` for an event with the site-specified `new_action`. `timeout` is the time allowed for `new_action` to run. `new_action` is the site-
supplied script that replaces \texttt{default_action}. This is the complete list of values for \texttt{default_action}:

\textbf{Table 3-1: How \textit{action} is Used}

<table>
<thead>
<tr>
<th>$\texttt{action}$</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\texttt{checkpoint}$</td>
<td>Run \texttt{new_action} in place of the periodic job checkpoint, after which the job continues to run.</td>
</tr>
<tr>
<td>$\texttt{checkpoint_abort}$</td>
<td>Run \texttt{new_action} to checkpoint the job, after which the job must be terminated by the script.</td>
</tr>
<tr>
<td>$\texttt{multinode_busy &lt;timeout&gt; requeue}$</td>
<td>Used with cycle harvesting and multi-vnode jobs. Changes default behavior when a vnode becomes busy. Instead of allowing the job to run, the job is requeued. Timeout is ignored. The only \texttt{new_action} is \texttt{requeue}.</td>
</tr>
<tr>
<td>$\texttt{restart}$</td>
<td>Runs \texttt{new_action} in place of restart.</td>
</tr>
<tr>
<td>$\texttt{terminate}$</td>
<td>Runs \texttt{new_action} in place of SIGTERM or SIGKILL when MOM terminates a job.</td>
</tr>
</tbody>
</table>

$\texttt{aix\_largepagemode <value>}$
Controls whether large page mode is available for PBS jobs on AIX. Settable by root only.
Format: Boolean.
Default: \texttt{False}.

$\texttt{checkpoint\_path <path>}$
MOM passes this parameter to the checkpoint and restart scripts. This path can be absolute or relative to \texttt{PBS\_HOME/mom\_priv}. Overrides default.
Overridden by path specified in the \texttt{pbs\_mom \_C} option and by \texttt{PBS\_CHECKPOINT\_PATH} environment variable. Not supported in the HPCBP MOM. See section 10.3.6.5, "Specifying Checkpoint Path" on page 629 in the PBS Professional Administrator’s Guide.
Chapter 3  MOM Parameters

$clienthost <hostname>

hostname is added to the list of hosts which will be allowed to connect to MOM as long as they are using a privileged port. For example, this will allow the hosts “fred” and “wilma” to connect to MOM:

$clienthost fred
$clienthost wilma

The following hostnames are added to $clienthost automatically: the server, the localhost, and if configured, the secondary server. The server sends each MOM a list of the hosts in the nodes file, and these are added internally to $clienthost. None of these hostnames need to be listed in the configuration file.

Two hostnames are always allowed to connect to pbs_mom, “localhost” and the name returned to MOM by the system call gethostbyname(). These hostnames do not need to be listed in the configuration file.

The hosts listed as “clienthosts” make up a “sisterhood” of machines. Any one of the sisterhood will accept connections from within the sisterhood. The sisterhood must all use the same port number.

$cpuset_error_action

When using a cpuset-enabled MOM, specifies the action taken when a cpuset creation error occurs. Can take one of the following values:

continue
   The error is logged and the job is killed and requeued.
offline
   The vnodes on this host for this job are marked offline, and the job is requeued.

Format: String
Allowable values: continue, offline
Default: offline

$cputmult <factor>

This sets a factor used to adjust CPU time used by each job. This allows adjustment of time charged and limits enforced where jobs run on a system with different CPU performance. If MOM’s system is faster than the reference system, set factor to a decimal value greater than 1.0. For example:

$cputmult 1.5
If MOM’s system is slower, set factor to a value between 1.0 and 0.0. For example:

$cputmult 0.75

$dce_refresh_delta <delta>
Defines the number of seconds between successive refreshings of a job’s DCE login context. For example:

$dce_refresh_delta 18000
Not supported in the HPCBP MOM.

$enforce <limit>
MOM will enforce the given limit. Some limits have associated values, and appear in the configuration file like this:

$enforce variable_name value
See The PBS Professional Administrator’s Guide. Not supported in the HPCBP MOM.

$enforce mem
MOM will enforce each job’s memory limit.

$enforce cpuaverage
MOM will enforce ncpus when the average CPU usage over a job’s lifetime usage is greater than the job’s limit.

$enforce average_trialperiod <seconds>
Modifies cpuaverage. Minimum number of seconds of job wall-time before enforcement begins.
Format: Integer
Default: 120

$enforce average_percent_over <percentage>
Modifies cpuaverage. Gives percentage by which a job may exceed its ncpus limit.
Format: Integer
Default: 50

$enforce average_cpufactor <factor>
Modifies cpuaverage. The ncpus limit is multiplied by factor to produce actual limit.
Format: Float
Default: 1.025
$enforce cpuburst
MOM will enforce the ncpus limit when CPU burst usage exceeds the job’s limit.

$enforce delta_percent_over <percentage>
Modifies cpuburst. Gives percentage over limit to be allowed.
Format: Integer
Default: 50

$enforce delta_cpusfactor <factor>
Modifies cpuburst. The ncpus limit is multiplied by factor to produce actual limit.
Format: Float
Default: 1.5

$enforce delta_weightup <factor>
Modifies cpuburst. Weighting factor for smoothing burst usage when average is increasing.
Format: Float
Default: 0.4

$enforce delta_weightdown <factor>
Modifies cpuburst. Weighting factor for smoothing burst usage when average is decreasing.
Format: Float
Default: 0.4

$ideal_load <load>
Defines the load below which the vnode is not considered to be busy. Used with the $max_load directive. Not supported in the HPCBP MOM.
Example:
$ideal_load 1.8
Format: Float
No default

$jobdir_root <stage_directory_root>
Directory under which PBS creates job-specific staging and execution directories. PBS creates a job’s staging and execution directory when the job’s sandbox attribute is set to PRIVATE. If $jobdir_root is unset, it defaults to the job owner’s home directory. In this case the user’s home directory must exist. If $stage_directory_root does not exist when MOM starts up, MOM will abort. If $stage_directory_root does not exist when
MOM Parameters

MOM tries to run a job. MOM will kill the job. Path must be owned by root, and permissions must be 1777. On Windows, this directory should have Full Control Permission for the local Administrators group.

Example:

$jobdir_root /scratch/foo

$kbd_idle <idle_wait> <min_use> <poll_interval>
Declares that the vnode will be used for batch jobs during periods when the keyboard and mouse are not in use. Not supported in the HPCBP MOM.

idle_wait
Time, in seconds, that the workstation keyboard and mouse must be idle before being considered available for batch jobs.

Must be set to non-zero value for cycle harvesting to be enabled.

Format: Integer
No default

min_use
Time, in seconds, during which the workstation keyboard or mouse must continue to be in use before the workstation is determined to be unavailable for batch jobs.

Format: Integer
Default: 10

poll_interval
Interval, in seconds, at which MOM checks for keyboard and mouse activity.

Format: Integer
Default: 1

Example:

$kbd_idle 1800 10 5

$logevent <mask>
Sets the mask that determines which event types are logged by pbs_mom.
To include all debug events, use 0xffffffff.
Log events:

### Table 3-2: Event Classes

<table>
<thead>
<tr>
<th>Name</th>
<th>Hex Value</th>
<th>Message Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERROR</td>
<td>0001</td>
<td>Internal errors</td>
</tr>
<tr>
<td>SYSTEM</td>
<td>0002</td>
<td>System errors</td>
</tr>
<tr>
<td>ADMIN</td>
<td>0004</td>
<td>Administrative events</td>
</tr>
<tr>
<td>JOB</td>
<td>0008</td>
<td>Job-related events</td>
</tr>
<tr>
<td>JOB_USAGE</td>
<td>0010</td>
<td>Job accounting info</td>
</tr>
<tr>
<td>SECURITY</td>
<td>0020</td>
<td>Security violations</td>
</tr>
<tr>
<td>SCHED</td>
<td>0040</td>
<td>Scheduler events</td>
</tr>
<tr>
<td>DEBUG</td>
<td>0080</td>
<td>Common debug messages</td>
</tr>
<tr>
<td>DEBUG2</td>
<td>0100</td>
<td>Uncommon debug messages</td>
</tr>
<tr>
<td>RESV</td>
<td>0200</td>
<td>Reservation-related info</td>
</tr>
<tr>
<td>DEBUG3</td>
<td>0400</td>
<td>Rare debug messages</td>
</tr>
<tr>
<td>DEBUG4</td>
<td>0800</td>
<td>Limit-related messages</td>
</tr>
</tbody>
</table>

### $\texttt{max\_check\_poll\ <seconds>}$

Maximum time between polling cycles, in seconds. See section 3.6.1, "Configuring MOM's Polling Cycle" on page 52 in the PBS Professional Administrator’s Guide. Minimum recommended value: 30 seconds.

Minimum value: 1 second

Default: 120 seconds

Format: Integer

### $\texttt{max\_load\ <load> [suspend]}$

Defines the load above which the vnode is considered to be busy. Used with the $\texttt{ideal\_load}$ directive. No new jobs are started on a busy vnode.

The optional suspend directive tells PBS to suspend jobs running on the node if the load average exceeds the max_load number, regardless of the
source of the load (PBS and/or logged-in users). Without this directive, PBS will not suspend jobs due to load.

We recommend setting this to a slightly higher value than the number of CPUs, for example .25 + ncpus.

Not supported in the HPCBP MOM.

Example:

$\texttt{max\_load\ 3.5}$

Format: Float

Default: number of CPUs on machine

$\texttt{min\_check\_poll <seconds>}$

Minimum time between polling cycles, in seconds. Must be greater than zero and less than $\texttt{max\_check\_poll}$. See section 3.6.1, "Configuring MOM's Polling Cycle" on page 52 in the PBS Professional Administrator's Guide. Minimum recommended value: 10 seconds.

Minimum value: 1 second

Default: 10 seconds

Format: Integer

$\texttt{prologalarm <timeout>}$

Defines the maximum number of seconds the prologue and epilogue may run before timing out.

Example:

$\texttt{prologalarm 30}$

Format: Integer

Default: 30

$\texttt{restart\_background <value>}$

Controls how MOM runs a restart script after checkpointing a job. When this option is set to True, MOM forks a child which runs the restart script. The child returns when all restarts for all the local tasks of the job are done. MOM does not block on the restart. When this option is set to False, MOM runs the restart script and waits for the result. Not supported in the HPCBP MOM.

Format: Boolean

Default: False

$\texttt{restart\_transmogrify <value>}$

Controls how MOM runs a restart script after checkpointing a job.
Chapter 3  MOM Parameters

When this option is set to True, MOM runs the restart script, replacing the session ID of the original task’s top process with the session ID of the script.

When this option is set to False, MOM runs the restart script and waits for the result. The restart script must restore the original session ID for all the processes of each task so that MOM can continue to track the job.

When this option is set to False and the restart uses an external command, the configuration parameter restart_background is ignored and treated as if it were set to True, preventing MOM from blocking on the restart.

Not supported in the HPCBP MOM.

Format: Boolean

Default: False

$restrict_user <value>
Controls whether users not submitting jobs have access to this machine. If value is True, restrictions are applied.

See $restrict_user_exceptions and $restrict_user_maxsysid.

Not supported on Windows.

Format: Boolean

Default: False

$restrict_user_exceptions <user_list>
Comma-separated list of users who are exempt from access restrictions applied by $restrict_user. Leading spaces within each entry are allowed. Maximum of 10 names.

$restrict_user_maxsysid <value>
Any user with a numeric user ID less than or equal to value is exempt from restrictions applied by $restrict_user.

If $restrict_user is on and no value exists for $restrict_user_maxsysid, PBS looks in /etc/login.defs, if it exists, for the value. Otherwise the default is used.

Format: Integer

Default: 999

$restricted <hostname>
The hostname is added to the list of hosts which will be allowed to connect to MOM without being required to use a privileged port. Queries from the hosts in the restricted list are only allowed access to information internal to
this host, such as load average, memory available, etc. They may not run shell commands.

Hostnames can be wildcarded. For example, to allow queries from any host from the domain “xyz.com”:

$restricted *.xyz.com

$suspendsig <suspend_signal> [resume_signal]
Alternate signal suspend_signal is used to suspend jobs instead of SIG-STOP. Optional resume_signal is used to resume jobs instead of SIG-CONT. Not supported in the HPCBP MOM.

$tmpdir <directory>
Location where each job’s scratch directory will be created.
PBS creates a temporary directory for use by the job, not by PBS. PBS creates the directory before the job is run and removes the directory and its contents when the job is finished. It is scratch space for use by the job. Permission must be 1777 on UNIX/Linux, writable by Everyone on Windows.
Not supported in the HPCBP MOM.
Example:

$tmpdir /memfs
Default on UNIX: /tmp.
Default on Windows: value of the TMP environment variable.

$usecp <hostname:source_prefix> <destination_prefix>
MOM will use /bin/cp to deliver output files when the destination is a network mounted file system, or when the source and destination are both on the local host, or when the source_prefix can be replaced with the destination_prefix on hostname. Both source_prefix and destination_prefix are absolute pathnames of directories, not files.
Not supported in the HPCBP MOM.
Use trailing slashes on both the source and destination. For example:

$usecp HostA:/users/work/myproj/ /sharedwork/proj_results/

$vnodedef_additive
Specifies whether MOM considers a vnode that appeared previously either in the inventory or in a vnode definition file, but that does not appear now, to be in her list of vnodes.

When $vnodedef_additive is True, MOM treats missing vnodes as if they are still present, and continues to report them as if they are present. This means that the server does not mark missing vnodes as stale.
Chapter 3  \hspace{1.0cm} MOM Parameters

When $\text{vnodedef_additive}$ is \textit{False}, MOM does not list missing vnodes, the server's information is brought up to date with the inventory and vnode definition files, and the server marks missing vnodes as \textit{stale}.

Visible in configuration file on Cray only.

Format: \textit{Boolean}

Default for MOM on Cray login node: \textit{False}

\texttt{$\text{wallmult}$ <factor>}

Each job's \textit{walltime} usage is multiplied by this factor. For example:

\texttt{$\text{wallmult}$ 1.5}

3.2.0.0.i  \hspace{1.0cm} SGI-only Initialization Values

\texttt{pbs\_accounting\_workload\_mgmt <value>}

Controls whether CSA accounting is enabled. Name does not start with dollar sign. If set to "1", "on", or "true", CSA accounting is enabled. If set to "0", "off", or "false", accounting is disabled.

Default: "true"; enabled.

\texttt{cpuset\_create\_flags <flags>}

Lists the flags for when MOM does a \texttt{cpusetCreate(3)} for each job. flags is an or-ed list of flags. The flags are:

Altix, ProPack 6, 7, Performance Suite 1

\texttt{CPUSET\_CPU\_EXCLUSIVE}\texttt{0}

Default: \texttt{CPUSET\_CPU\_EXCLUSIVE}

ICE, ProPack 6, 7, Performance Suite 1

\texttt{CPUSET\_CPU\_EXCLUSIVE}\texttt{0}

Default: \texttt{0}

\texttt{cpuset\_destroy\_delay <delay>}

MOM will wait \texttt{delay} seconds before issuing a \texttt{cpusetDestroy(3)} on the cpuset of a just-completed job. This allows processes time to finish.

Example:

\texttt{cpuset\_destroy\_delay 10}

Format: Integer

Default for Altix: \texttt{0}

\texttt{memreserved <megabytes>}

**Deprecated.** The amount of per-vnode memory reserved for system overhead.
For example,

```
memreserved 16
```

Default: 0MB

### 3.2.1 Static MOM Resources

Static resources local to the vnode are described one resource to a line, with a name and value separated by white space. For example, tape drives of different types could be specified by:

```
tape3480 4
tape3420 2
tapedat 1
tape8mm 1
```

```
memreserved <megabytes>
```

**Deprecated.** The amount of per-vnode memory reserved for system overhead. This much memory is deducted from the value of `resources_available.mem` for each vnode managed by this MOM. Default is 0MB. For example,

```
memreserved 16
```
Chapter 4

Scheduler Parameters

This chapter lists the scheduler’s configuration parameters. These parameters are found in the scheduler’s configuration file, PBS_HOME/sched_priv/sched_config.

4.1 Format of Scheduler’s Configuration File

4.1.1 Parameters with Separate Primetime and Non-primetime Specification

If a scheduler parameter can be specified separately for primetime and non-primetime, the format for the parameter is the following:

name: value [prime | non_prime | all | none]

- The name field cannot contain any whitespace.
- The value field may contain whitespace if the string is double-quoted. value can be: True | False | <number> | <string>. “True” and “False” are not case-sensitive.
- The third field allows you to specify that the setting is to apply during primetime, non-primetime, all the time, or none of the time. A blank third field is equivalent to “all” which means that it applies to both prime- and non-primetime.

Chapter 4  Scheduler Parameters

4.1.2 Parameters without Separate Primetime and Non-primetime Specification

If a scheduler parameter cannot be specified separately for primetime and non-primetime, the format for the parameter is the same as the above, except that there is no third field.

4.1.3 Format Details

- Each entry must be a single, unbroken line.
- Entries must be quoted if they contain whitespace.
- Any line starting with a “#” is a comment, and is ignored.

4.1.4 Editing Configuration Files Under Windows

When you edit any PBS configuration file, make sure that you put a newline at the end of the file. The Notepad application does not automatically add a newline at the end of a file; you must explicitly add the newline.

4.2 Configuration Parameters

backfill

Toggle that controls whether PBS uses backfilling. If this is set to True, the scheduler attempts to schedule smaller jobs around higher-priority jobs when using strict_ordering, as long as running the smaller jobs won’t change the start time of the jobs they were scheduled around. The scheduler chooses jobs in the standard order, so other high-priority jobs will be considered first in the set to fit around the highest-priority job.

When this parameter is True, the scheduler backfills around starving jobs when help_starving_jobs is True.

Can be used with strict_ordering and help_starving_jobs

Format: Boolean
Default: True all

backfill_prime

The Scheduler will not run jobs which would overlap the boundary between primetime and non-primetime. This assures that jobs restricted to running in either primetime or non-primetime can start as soon as the time boundary happens.
Scheduler Parameters

See also prime_spill, prime_exempt_anytime_queues.
Format: Boolean
Default: False

by_queue
If set to True, all jobs that can be run from the highest-priority queue are run, then any jobs that can be run from the next queue are run, and so on. If sort queues is set to True, queues are ordered highest-priority first. If by queue is set to False, all jobs are treated as if they are in one large queue. The by_queue parameter is overridden by the round_robin parameter when round_robin is set to True.

See section 4.8.4, "Examining Jobs Queue by Queue" on page 122 in the PBS Professional Administrator’s Guide.
Format: Boolean
Default: True

cpus_per_ssinode
Deprecated. Such configuration now occurs automatically.

dedicated_prefix
Queue names with this prefix are treated as dedicated queues, meaning jobs in that queue will only be considered for execution if the system is in dedicated time as specified in the configuration file PBS_HOME/sched_priv/dedicated_time.

See section 18.12, "Defining Dedicated Time" on page 974 in the PBS Professional Administrator’s Guide.
Format: String
Default: ded

fair_share
Enables the fairshare algorithm, and turns on usage collecting. Jobs will be selected based on a function of their recent usage and priority (shares).

Format: Boolean
Default: False

fairshare_entity
Specifies the entity for which fairshare usage data will be collected. Can be one of “euser”, “egroup”, “Account_Name”, “queue”, or “egroup:euser”.

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Chapter 4  Scheduler Parameters

**fairshare_enforce_no_shares**

If this option is enabled, jobs whose entity has zero shares will never run.
Requires `fair_share` to be enabled.

Format: Boolean
Default: *False*

**fairshare_usage_res**

Specifies the resource to collect and use in fairshare calculations and can be any valid PBS resource, including user-defined resources.

A special case resource is the exact string "ncpus*walltime". The number of CPUs used is multiplied by the walltime in seconds used by the job to determine the usage.

See section 18.17.5, "Tracking Resource Usage" on page 996 in the PBS Professional Administrator’s Guide.

Format: String
Default: *cput*

**half_life**

The half-life for fairshare usage; after the amount of time specified, the fairshare usage is halved. Requires that `fair_share` be enabled.


Format: Duration
Default: *24:00:00*

**help_starving_jobs**

Setting this option enables starving job support. Once jobs have waited for the amount of time given by `max_starve` they are considered starving. If a job is considered starving, then no lower-priority jobs will run until the starving job can be run, unless backfilling is also specified. To use this option, the `max_starve` configuration parameter needs to be set as well.

See also `backfill`, `max_starve`, and the server’s `eligible_time_enable` attribute.

At each scheduler iteration, PBS calculates `estimated.start_time` and `estimated.exec_vnode` for starving jobs being backfilled around.

Format: Boolean
Default: *True all*
Scheduler Parameters

job_sort_key

Selects how jobs should be sorted. job_sort_key can be used to sort using either (a) resources or (b) special case sorting routines. Multiple job_sort_key entries can be used, one to a line, in which case the first entry will be the primary sort key, the second will be used to sort equivalent items from the first sort, etc. This attribute is overridden by the job_sort_formula attribute. If both are set, job_sort_key is ignored and an error message is printed.

Syntax:

job_sort_key: “PBS_resource HIGH|LOW”
job_sort_key: “fair_share_perc HIGH|LOW”
job_sort_key: “job_priority HIGH|LOW”
job_sort_key: “preempt_priority HIGH|LOW”

Options: One of the following is required.

HIGH

Specifies descending sort.

LOW

Specifies ascending sort.
There are three special case sorting routines, which can be used instead of a specific PBS resource:

**Table 4-1: Special Sorting in job_sort_key**

<table>
<thead>
<tr>
<th>Special Sort</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fair_share_perc HIGH</td>
<td>Sort based on the values in the resource_group file. If user A has more priority than user B, all of user A's jobs will always be run first. Past history is not used. This should only be used if entity share (strict priority) sorting is needed. <strong>Do not enable fair_share_perc sorting if using the fair_share scheduling option.</strong> (This option was previously named “fair_share” in the deprecated sort_by parameter). See section 18.18, &quot;Enabling Strict Priority&quot; on page 1001 in the PBS Professional Administrator’s Guide</td>
</tr>
<tr>
<td>job_priority HIGH</td>
<td>Sort jobs by the job priority attribute regardless of job owner.</td>
</tr>
<tr>
<td>preempt_priority HIGH</td>
<td>Sort jobs by preemption priority. Recommended that this be used when soft user limits are used. Also recommended that this be the primary sort key.</td>
</tr>
<tr>
<td>sort_priority HIGH</td>
<td>Deprecated. See job_priority above.</td>
</tr>
</tbody>
</table>

The following example shows how to sort jobs so that those with high CPU count come first:

    job_sort_key: “ncpus HIGH” all

The following example shows how to sort jobs so that those with lower memory come first:

    job_sort_key: “mem LOW” prime

Format: Quoted string

Default: Not in force
key

**Deprecated.** Use `job_sort_key`.

load_balancing

When set to `True`, the scheduler takes into account the load average on vnodes as well as the resources listed in the `resources` line in `sched_config`. Load balancing can result in overloaded CPUs.

See section 18.15, "Enabling Load Balancing" on page 979 in the PBS Professional Administrator’s Guide.

Format: Boolean
Default: `False`

load_balancing_rr

**Deprecated.** To duplicate this setting, enable `load_balancing` and set `smp_cluster_dist` to `round_robin`.

See section 18.15, "Enabling Load Balancing" on page 979 in the PBS Professional Administrator’s Guide.

log_filter

Defines which event types to keep out of the scheduler’s logfile. The value should be set to the bitwise OR of the event classes which should be filtered. A value of 0 specifies maximum logging.

See section 13.4.4.1.iii, "Specifying Scheduler Log Events" on page 746 in the PBS Professional Administrator’s Guide.

Format: Integer
Default: 3328

max_starve

The amount of time before a job is considered starving. This variable is used only if `help_starving_jobs` is set.

Upper limit: None
Format: Duration
Default: `24:00:00`

mem_per_ssinode

**Deprecated.** Such configuration now occurs automatically.

mom_resources

This option is used to query the MOMs to set the value of `resources_available.RES` where RES is a site-defined resource. Each MOM is queried with the resource name and the return value is used to replace `resources_available.RES` on that vnode. On a multi-vnoded
machine with a natural vnode, all vnodes will share anything set in mom_resources.
Format: String
Default: Unset

node_sort_key
Defines sorting on resource or priority values on vnodes. Resource must be numerical, for example, long or float. Up to 20 node_sort_key entries can be used, in which case the first entry will be the primary sort key, the second will be used to sort equivalent items from the first sort, etc.

Syntax:

\[
\text{node_sort_key: } <\text{resource}>|\text{sort_priority }\text{HIGH}|\text{LOW} \\
\text{node_sort_key: } <\text{resource}> \text{ HIGH}|\text{LOW} \\
\text{total|assigned|unused} \\
\text{total} \\
\text{assigned} \\
\text{unused} \\
\text{sort_priority} \\
\text{Sort vnodes by the value of the vnode priority attribute.} \\
\text{See section 18.8.8.1, "Sorting Vnodes with node_sort_key" on page 941 in the PBS Professional Administrator’s Guide.} \\
Format: String \\
Default: node_sort_key: sort_priority HIGH all

nonprimetime_prefix
Queue names which start with this prefix will be treated as non-primetime queues. Jobs within these queues will only run during non-primetime.
Primetime and non-primetime are defined in the holidays file.

See section 18.13, "Defining Primetime and Holidays" on page 974 in the PBS Professional Administrator’s Guide.

Format: String
Default: np_
peer_queue
Defines the mapping of a remote queue to a local queue for Peer Scheduling. Maximum number is 50 peer queues per scheduler.
See section 18.19, "Enabling Peer Scheduling" on page 1002 in the PBS Professional Administrator’s Guide.
Format: String
Default: unset

preemptive_sched
Enables job preemption.
Format: String
Default: True all

preempt_checkpoint
 Deprecated. Add “C” to preempt_order parameter.
preempt_fairshare
 Deprecated. Add “fairshare” to preempt_prio parameter.

preempt_order
Defines the order of preemption methods which the Scheduler will use on jobs. This order can change depending on the percentage of time remaining on the job. The ordering can be any combination of S C and R:

Table 4-2: Preemption Order Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>suspend</td>
</tr>
<tr>
<td>C</td>
<td>checkpoint</td>
</tr>
<tr>
<td>R</td>
<td>Requeue</td>
</tr>
</tbody>
</table>

Usage: an ordering (SCR) optionally followed by a percentage of time remaining and another ordering.
Must be a quoted list("’").
Example:

preempt_order: “SR”
This example specifies that PBS should first attempt to use suspension to preempt a job, and if that is unsuccessful, then requeue the job.

Example:

```
preempt_order: "SCR 80 SC 50 S"
```

This example says if the job has between 100-81% of requested time remaining, first try to suspend the job, then try checkpoint then requeue. If the job has between 80-51% of requested time remaining, then attempt suspend then checkpoint; and between 50% and 0% time remaining just attempt to suspend the job.

Format: Quoted list

Default: `SCR`

**preempt_prio**

Specifies the ordering of priority for different preemption levels. Two or more job types may be combined at the same priority level with a plus sign ("+") between them, using no whitespace. Comma-separated preemption levels are evaluated left to right, with higher priority to the left. The table below lists the six preemption levels. Note that any level not specified in the `preempt_prio` list is ignored.

**Table 4-3: Preemption Levels**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>express_queue</code></td>
<td>Jobs in the express queues preempt other jobs. See <code>preempt_queue_prio</code>. Does not require <code>by_queue</code> or <code>sort_queues</code> to be <code>True</code>.</td>
</tr>
<tr>
<td><code>starving_jobs</code></td>
<td>When a job becomes starving it can preempt other jobs.</td>
</tr>
<tr>
<td><code>fairshare</code></td>
<td>When the entity owning a job exceeds its fairshare limit.</td>
</tr>
<tr>
<td><code>queue_softlimits</code></td>
<td>Jobs which are over their queue soft limits</td>
</tr>
<tr>
<td><code>server_softlimits</code></td>
<td>Jobs which are over their server soft limits</td>
</tr>
<tr>
<td><code>normal_jobs</code></td>
<td>The preemption level into which a job falls if it does not fit into any other specified level.</td>
</tr>
</tbody>
</table>
Example:

\texttt{preempt\_prio: "starving\_jobs,\ normal\_jobs, fairshare"}

In this example, the first line states that starving jobs have the highest priority, then normal jobs, and jobs whose entities are over their fair-share limit are third highest.

Example:

\texttt{preempt\_prio: "normal\_jobs, starving\_jobs+fairshare"}

This example shows that starving jobs whose entities are also over their fairshare limit are lower priority than normal jobs.

Format: Quoted list
Default: \texttt{express\_queue, normal\_jobs}

\textbf{preempt\_queue\_prio}

Specifies the minimum queue priority required for a queue to be classified as an express queue. Express queues do not require \texttt{by\_queue} or \texttt{sort\_queues} to be \texttt{True}.

Format: Integer
Default: \texttt{150}

\textbf{preempt\_requeue}

\textbf{Deprecated}. Add an \texttt{R} to \texttt{preempt\_order} parameter.

\textbf{preempt\_sort}

Whether jobs most eligible for preemption will be sorted according to their start times.

If set to \texttt{"min\_time\_since\_start"}, first job preempted will be that with most recent start time.

If not set, preempted job will be that with longest running time.

Must be commented out in order to be unset; default scheduler configuration file has this parameter set to \texttt{min\_time\_since\_start}.

Allowable values: \texttt{"min\_time\_since\_start"}, or no \texttt{preempt\_sort} setting.

See section 18.16.4.1, "Preemption Ordering by Start Time" on page 987 in the PBS Professional Administrator's Guide.

Format: String
Default: \texttt{min\_time\_since\_start}

\textbf{preempt\_starving}

\textbf{Deprecated}. Add “starving\_jobs” to \texttt{preempt\_prio} parameter.
preempt_suspend

Deprecated. Add an “S” to preempt_order parameter.

primetime_prefix

Queue names starting with this prefix are treated as primetime queues. Jobs will only run in these queues during primetime. Primetime and non-primetime are defined in the holidays file.
See section 18.13, "Defining Primetime and Holidays" on page 974 in the PBS Professional Administrator’s Guide.
Format: String
Default: p_

prime_exempt_anytime_queues

Determines whether anytime queues are controlled by backfill_prime.
If set to True, jobs in an anytime queue will not be prevented from running across a primetime/non-primetime or non-primetime/primetime boundary.
If set to False, the jobs in an anytime queue may not cross this boundary, except for the amount specified by their prime_spill setting.
See also backfill_prime, prime_spill.
Format: Boolean.
Default: False

prime_spill

Specifies the amount of time a job can spill over from non-primetime into primetime or from primetime into non-primetime. This option can be separately specified for prime- and non-primetime. This option is only meaningful if backfill_prime is True.
See also backfill_prime, prime_exempt_anytime_queues.
For example, the first setting below means that non-primetime jobs can spill into primetime by 1 hour. However the second setting means that jobs in either prime/non-prime can spill into the other by 1 hour.

prime_spill: 1:00:00 prime
prime_spill: 1:00:00 all
Format: Duration
Default: 00:00:00

provision_policy

Specifies how vnodes are selected for provisioning. Can be set by Manager only; readable by all. Can be set to one of the following:
Scheduler Parameters

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avoid_provision
PBS first tries to satisfy the job's request from free vnodes that already have the requested AOE instantiated. PBS uses node_sort_key to sort these vnodes.

If it cannot satisfy the job's request using vnodes that already have the requested AOE instantiated, it does the following:

PBS uses the server's node_sort_key to select the free vnodes that must be provisioned in order to run the job, choosing from any free vnodes, regardless of which AOE is instantiated on them.

Of the selected vnodes, PBS provisions any that do not have the requested AOE instantiated on them.

aggressive_provision
PBS selects vnodes to be provisioned without considering which AOE is currently instantiated.

PBS uses the server's node_sort_key to select the vnodes on which to run the job, choosing from any free vnodes, regardless of which AOE is instantiated on them. Of the selected vnodes, PBS provisions any that do not have the requested AOE instantiated on them.

Format: String
Default: aggressive_provision

resources
Specifies those resources which are not to be over-allocated when scheduling jobs. Vnode-level boolean resources are automatically honored and do not need to be listed here. Limits are set by setting resources_available.resourceName on vnodes, queues, and the server. The Scheduler will consider numeric (integer or float) items as consumable resources and ensure that no more are assigned than are available (e.g. ncpus or mem). Any string resources will be compared using string comparisons. If “host” is not added to the resources line, then when the user submits a job requesting a specific vnode in the following syntax:

qsub -l select=host=vnodeName

the job will run on any host.

Format: String.
Default: ncpus, mem, arch, host, vnode, aoe, netwins

resource_unset_infinite
Resources in this list are treated as infinite if they are unset. Cannot be set differently for primetime and non-primetime.
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Example:

  resource_unset_infinite: “vmem, foo_licenses”

Format: Comma-delimited list of resources
Default: Empty list

round_robin
If set to True, the scheduler will consider one job from the first queue, then
one job from the second queue, and so on in a circular fashion. If
sort_queues is set to True, the queues are ordered with the highest priority
queue first. Each scheduling cycle starts with the same highest-priority
queue, which will therefore get preferential treatment.

If round_robin is set to False, the scheduler will consider jobs according
to the setting of the by_queue parameter.

When True, overrides the by_queue parameter.

Format: Boolean
Default: False all

server_dyn_res
Directs the Scheduler to replace the Server’s resources_available values
with new values returned by a site-specific external program.

See section 5.14.4.1, "Dynamic Server-level Resources" on page 304 in the
PBS Professional Administrator’s Guide for details of usage.

Format: String
Default: Unset.

smp_cluster_dist
Specifies how single-host jobs should be distributed to all hosts of the com-
plex.

Options:

  pack
  Keep putting jobs onto one host until it is full and then move on to
  the next.

  round_robin
  Put one job on each vnode in turn before cycling back to the first
  one.

  lowest_load
  Put the job on the lowest-loaded host.

See section 18.14, "Configuring SMP Cluster Scheduling" on page 977 in
the PBS Professional Administrator’s Guide and section 18.15, "Enabling
Scheduler Parameters

Load Balancing” on page 979 in the PBS Professional Administrator’s Guide.

Format: String
Default: pack all

sort_by

Deprecated. Use job_sort_key.

sort_queues

If set to True queues are sorted so that the highest priority queues are considered first. Queues are sorted by each queue’s priority attribute. The queues are sorted in a descending fashion, that is, a queue with priority 6 comes before a queue with priority 3.

When set to False, queues are not sorted.

This is a prime option, which means it can be selectively applied to prime-time or non-primetime.

Note that the sorted order of queues is not taken into consideration unless by_queue is set to True.

See section 18.11, "How Queues are Ordered" on page 973 in the PBS Professional Administrator’s Guide.

Format: Boolean
Default: True ALL

strict_fifo

Deprecated. Use strict_ordering.

strict_ordering

Specifies that jobs must be run in the order determined by whatever sorting parameters are being used. This means that a job cannot be skipped due to resources required not being available. If a job due to run next cannot run, no job will run, unless backfilling is used, in which case jobs can be backfilled around the job that is due to run next.

See section 18.20.1, "Enabling FIFO Scheduling with strict_ordering" on page 1008 in the PBS Professional Administrator’s Guide.

Example line in PBS_HOME/sched_priv/sched_config:

    strict_ordering: True ALL

Format: Boolean.
Default: False all
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Scheduler Parameters

sync_time

*Deprecated.* The amount of time between writing the fairshare usage data to disk. Requires `fair_share` to be enabled.

Format: Duration

Default: 1:00:00

unknown_shares

The number of shares for the `unknown` group. These shares determine the portion of a resource to be allotted to that group via fairshare. Requires `fair_share` to be enabled.


Format: Integer

Default: The unknown group gets 0 shares unless set.
Chapter 5

Resources

This chapter describes the resources provided by PBS Professional.

5.1 Resource Data Types

Data types for built-in and custom resource are described in section 7.1, “List of Formats”, on page 393.

5.2 Advice on Using Resources

Resource names are case-insensitive.

The following advice will help you use resources.

5.2.1 Using boolean Resources

See “Boolean” on page 394.

Non-consumable.

5.2.2 Using duration Resources

See “Duration” on page 395.

Specifies a maximum time period the resource can be used.

Non-consumable.
Chapter 5 Resources

5.2.3 Using float Resources

See “Float” on page 395.
Consumable.

5.2.4 Using long Resources

See “long” on page 397.
Consumable.

5.2.5 Using size Resources

See “Size” on page 398.
Consumable.

5.2.6 Using string Resources

See “String (resource value)” on page 398.
Non-consumable.

We do not recommend using non-printing characters.

When using `qsub -l <string resource>=<string value>`, you must escape string values for both `qsub` and the shell. Example:

```
qsub -l teststring='"abc def"
```

The final quote should be single, not double.

Values are case-sensitive.

5.2.7 Using string_array Resources

See “string_array” on page 398.

Non-consumable. Resource request will succeed if request matches one of the values.

Resource request can contain only one string.

A string array resource with one value works exactly like a string resource.

The value of `resources_default.<string array resource>` can only be one string.
5.3 Custom Resource Formats

The names of custom numeric resources must be alphanumeric with a leading alphabetic: [a-zA-Z][a-zA-Z0-9_]*. Allowable values for float and long resources are the same as for built-in resources. Custom boolean, time, size, string or string array resources must have the same format as built-in resources.

5.4 Built-in Resources

Different resources are available on different systems, often depending on the architecture of the computer itself. The table below lists the available resources that can be requested by PBS jobs on any system.

**Table 5-1: Built-in Resources**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>accelerator</td>
<td>Indicates whether this vnode is associated with an accelerator. Host-level. Can be requested only inside of a select statement. On Cray, this resource exists only when there is at least one associated accelerator. On Cray, this is set to True when there is at least one associated accelerator whose state is UP. On Cray, set to False when all associated accelerators are in state DOWN. Used for requesting accelerators. Format: Boolean. Python type: bool</td>
</tr>
<tr>
<td>accelerator_memory</td>
<td>Indicates amount of memory for accelerator(s) associated with this vnode. Host-level. Can be requested only inside of a select statement. On Cray, PBS sets this resource only on vnodes with at least one accelerator with state = UP. For Cray, PBS sets this resource on the 0th NUMA node (the vnode with PBS crayseg=0), and the resource is shared by other vnodes on the compute node. For example, on vnodeA_2_0: resources_available.accelerator_memory=4196mb On vnodeA_2_1: resources_available.accelerator_memory=@vnodeA_2_0 Consumable. Format: size. Python type: pbs.size</td>
</tr>
</tbody>
</table>
## Chapter 5

### Resources

#### Table 5-1: Built-in Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>accelerator_model</td>
<td>Indicates model of the accelerator(s) associated with this vnode. Host-level. On Cray, PBS sets this resource only on vnodes with at least one accelerator with state = UP. Can be requested only inside of a select statement. Non-consumable. Format: String. Python type: str</td>
</tr>
<tr>
<td>aoe</td>
<td>List of AOE(s) (Application Operating Environments) that can be instantiated on a vnode. Case-sensitive. An AOE is the environment that results from provisioning a vnode. Each job can request at most one AOE. Cannot be set on Server's host. Allowable values are site-dependent. Settable by Manager and Operator; visible to all. Non-consumable. Type: string array. Python type: str</td>
</tr>
<tr>
<td>arch</td>
<td>System architecture. One architecture can be defined for a vnode. One architecture can be requested per vnode. Allowable values and effect on job placement are site-dependent. Can be requested only inside of a select statement. Non-consumable. Type: string. Python type: str</td>
</tr>
<tr>
<td>cput</td>
<td>Amount of CPU time used by the job for all processes on all vnodes. Establishes a job resource limit. Can be requested only outside of a select statement. Non-consumable. Type: duration. Python type: pbs.duration</td>
</tr>
<tr>
<td>exec_vnode</td>
<td>Read-only. The vnodes that PBS estimates this job will use. Cannot be requested for a job; used for reporting only. Type: string. Python type: str</td>
</tr>
<tr>
<td>file</td>
<td>Size of any single file that may be created by the job. Can be requested only outside of a select statement. Type: size. Python type: pbs.size</td>
</tr>
<tr>
<td>host</td>
<td>Name of execution host. Can be requested only inside of a select statement. Automatically set to the short form of the hostname in the Mom attribute. On Cray compute node, set to &lt;mpp_host&gt;_&lt;nid&gt;. On CLE 2.2, value is set to “default”. Cannot be changed. Site-dependent. Type: string. Python type: str</td>
</tr>
<tr>
<td>mem</td>
<td>Amount of physical memory i.e. workingset allocated to the job, either job-wide or vnode-level. Can be requested only inside of a select statement. Consumable. Type: size. Python type: pbs.size</td>
</tr>
</tbody>
</table>
## Resources

### Table 5-1: Built-in Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
</table>
| `mpiprocs` | Number of MPI processes for this chunk. Defaults to 1 if ncpus > 0, 0 otherwise. Can be requested only inside of a select statement. Type: integer. Python type: int.  
The number of lines in `PBS_NODEFILE` is the sum of the values of `mpiprocs` for all chunks requested by the job. For each chunk with `mpiprocs=P`, the host name for that chunk is written to the `PBS_NODEFILE` P times. |
| `mpparch`  | **Deprecated.** MPP compute node system type. Can be requested only outside of a select statement. Allowable values: XT or X2. Cray-only resource. Ignored at other systems. Type: string. Python type: str. |
| `mppdepth` | **Deprecated.** Depth (number of threads) of each processor. Specifies the number of processors that each processing element will use. Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Default: 1. Type: integer. Python type: int. |
| `mpphost`  | **Deprecated.** MPP host. Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Type: string. Python type: str. |
| `mpplabels` | **Deprecated.** List of node labels. Runs the application only on those nodes with the specified labels. Format: comma-separated list of labels and/or a range of labels. Any lists containing commas should be enclosed in quotes escaped by backslashes. For example:  
```bash  
#PBS -l mpplabels="red,blue"  
```

or

```bash  
qsub -l mpplabels="red,blue"  
```

Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Type: string. Python type: str, one of “soft” or “hard”. |
| `mppmem`   | **Deprecated.** The maximum memory for all applications. The per-processing-element maximum resident set size memory limit. Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Type: size. Python type: pbs.size. |
## Resources

### Table 5-1: Built-in Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
</table>
| mppnodes | Deprecated. Manual placement list consisting of a comma-separated list of nodes (node1,node2), a range of nodes (node1-node2), or a combination of both formats. Node values are expressed as decimal numbers. The first number in a range must be less than the second number (i.e., 8-6 is invalid). A complete node list is required. Any lists containing commas should be enclosed in quotes escaped by backslashes. For example:  

```  
#PBS -l mppnodes="40-48,52-60,84,86,88,90"  
```

or

```
qsub -l mppnodes="40-48,52-60,84,86,88,90"
```

Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Type: string. Python type: str |
| mppnppn | Deprecated. Number of processing elements (PEs) per node. Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Type: integer. Python type: int |
| mppwidth | Deprecated. Number of processing elements (PEs) for the job. Can be requested only outside of a select statement. Cray-only resource. Ignored at other systems. Type: integer. Python type: int |
| naccelerators | Indicates number of accelerators on the host. Host-level. On Cray, should not be requested for jobs; PBS does not pass the request to ALPS. On Cray, PBS sets this resource only on vnodes whose hosts have at least one accelerator with state = UP. PBS sets this resource to the number of accelerators with state = UP. For Cray, PBS sets this resource on the 0th NUMA node (the vnode with PBScrayseg=0), and the resource is shared by other vnodes on the compute node.  

For example, on vnodeA_2_0:  

```  
resources_available.naccelerators=1  
```

On vnodeA_2_1:  

```  
resources_available.naccelerators=@vnodeA_2_0  
```

Can be requested only inside of a select statement. Consumable. Format: long. Python type: int |
### Resources

#### Table 5-1: Built-in Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>nchunk</td>
<td>This is the number of chunks requested between plus symbols in a select statement. For example, if the select statement is <code>-lselect 4:ncpus=2+12:ncpus=8</code>, the value of <code>nchunk</code> for the first part is <code>4</code>, and for the second part it is <code>12</code>. The <code>nchunk</code> resource cannot be named in a select statement; it can only be specified by placing a number before the colon, as in the above example. When the number is omitted, <code>nchunk</code> is <code>1</code>. Non-consumable. This resource can be used to specify the default number of chunks at the server or queue (replacing <code>mppwidth</code>). Example: <code>set queue myqueue default_chunk.nchunk=2</code> Settable by Manager and Operator; readable by all. This resource cannot be used in server and queue <code>resources_min</code> and <code>resources_max</code>. Format: Integer. Python type: <code>int</code>. Default value: <code>1</code>.</td>
</tr>
<tr>
<td>netwins</td>
<td>Number of network windows on a high performance switch. Can be requested only inside of a select statement. Read-only. Type: integer. Python type: <code>int</code>.</td>
</tr>
<tr>
<td>nice</td>
<td>Nice value under which the job is to be run. Host-dependent. Can be requested only outside of a select statement. Type: integer. Python type: <code>int</code>.</td>
</tr>
<tr>
<td>nodect</td>
<td><strong>Deprecated.</strong> Number of chunks in resource request from selection directive, or number of hosts requested from node specification. Otherwise defaults to value of <code>1</code>. Can be requested only outside of a select statement. Read-only. Type: integer. Python type: <code>int</code>.</td>
</tr>
<tr>
<td>nodes</td>
<td><strong>Deprecated.</strong> Number of hosts requested. Integer.</td>
</tr>
<tr>
<td>ompthreads</td>
<td>Number of OpenMP threads for this chunk. Defaults to <code>ncpus</code> if not specified. Can be requested only inside of a select statement. Type: integer. Python type: <code>int</code>. For the MPI process with rank <code>0</code>, the environment variables <code>NCPUS</code> and <code>OMP_NUM_THREADS</code> are set to the value of <code>ompthreads</code>. For other MPI processes, behavior is dependent on MPI implementation.</td>
</tr>
</tbody>
</table>
## Resources

### Table 5-1: Built-in Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>pcput</code></td>
<td>Amount of CPU time allocated to any single process in the job. Establishes a job resource limit. Non-consumable. Can be requested only outside of a select statement. Type: duration. Python type: <code>pbs.duration</code></td>
</tr>
<tr>
<td><code>pmem</code></td>
<td>Amount of physical memory (workingset) for use by any single process of the job. Establishes a job resource limit. Can be requested only outside of a select statement. Non-consumable. Type: size. Python type: <code>pbs.size</code></td>
</tr>
<tr>
<td><code>pvmem</code></td>
<td>Amount of virtual memory for use by the job. Establishes a job resource limit. Can be requested only outside of a select statement. Not consumable. Type: size. Python type: <code>pbs.size</code></td>
</tr>
<tr>
<td><code>software</code></td>
<td>Site-specific software specification. Can be requested only outside of a select statement. Allowable values and effect on job placement are site-dependent. Type: string. Python type: <code>pbs.software</code></td>
</tr>
<tr>
<td><code>start_time</code></td>
<td>Read-only. The estimated start time for this job. Cannot be requested for a job; used for reporting only. Type: long. Python type: <code>int</code></td>
</tr>
<tr>
<td><code>vmem</code></td>
<td>Amount of virtual memory for use by all concurrent processes in the job. Establishes a per-chunk limit. Can be requested only inside of a select statement. Consumable. Type: size. Python type: <code>pbs.size</code></td>
</tr>
</tbody>
</table>
| `vnode`  | Name of virtual node (vnode) on which to execute. For use inside chunks only. Site-dependent. Can be requested only inside of a select statement. Type: string. Python type: `str`  
See the `pbs_node_attributes(7B)` man page. |
| `vntype` | This resource represents the type of the vnode. Automatically set by PBS to one of two specific values for cray vnodes. Has no meaning for non-Cray vnodes. Can be requested only inside of a select statement. Non-consumable. Format: String array.  
Automatically assigned values for Cray vnodes:  
`cray_compute`: This vnode represents part of a compute node.  
`cray_login`: This vnode represents a login node.  
Default value: None. Python type: `str` |
5.5 Custom Cray Resources

PBS provides custom resources specifically created for the Cray. They are listed in the following table:

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBScrayhost</td>
<td>On CLE 2.2, this is set to “default”.</td>
</tr>
<tr>
<td></td>
<td>On CLE 3.0 and higher, used to delineate a Cray system, containing ALPS, login nodes running PBS MOMs, and compute nodes, from a separate Cray system with a separate ALPS. Non-consumable. The value of PBScrayhost is set to the value of mpp_host for this system. Format: String. Default: CLE 2.2: “default”; CLE 3.0 and higher: None</td>
</tr>
<tr>
<td>PBScraylabel_&lt;label name&gt;</td>
<td>Tracks labels applied to compute nodes. For each label on a compute node, PBS creates a custom resource whose name is a concatenation of PBScraylabel_ and the name of the label. PBS sets the value of the resource to True on all vnodes representing the compute node. Name format: PBScraylabel_&lt;label name&gt; For example, if the label name is Blue, the name of this resource is PBScraylabel_Blue. Format: Boolean. Default: None</td>
</tr>
</tbody>
</table>
Chapter 5 Resources

Table 5-2: Custom Cray Resources

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS\textit{craynid}</td>
<td>Used to track the node ID of the associated compute node. All vnodes representing a particular compute node share a value for \textit{PBS\textit{craynid}}. Non-consumable. The value of \textit{PBS\textit{craynid}} is set to the value of node_id for this compute node. Non-consumable. Format: String. Default: None</td>
</tr>
<tr>
<td>PBS\textit{crayorder}</td>
<td>Used to track the order in which compute nodes are listed in the Cray inventory. All vnodes associated with a particular compute node share a value for \textit{PBS\textit{crayorder}}. Non-consumable. Vnodes for the first compute node listed are assigned a value of 1 for \textit{PBS\textit{crayorder}}. The vnodes for each subsequent compute node listed are assigned a value one greater than the previous value. Do not use this resource in a resource request. Format: Integer. Default: None</td>
</tr>
<tr>
<td>PBS\textit{crayseg}</td>
<td>Tracks the segment ordinal of the associated NUMA node. For the first NUMA node of a compute host, the segment ordinal is 0, and the value of \textit{PBS\textit{crayseg}} for the associated vnode is 0. For the second NUMA node, the segment ordinal is 1, \textit{PBS\textit{crayseg}} is 1, and so on. Non-consumable. Format: String. Default: None</td>
</tr>
</tbody>
</table>

5.6 Specifying Architectures

The \texttt{resources\_available.arch} resource is the value reported by MOM unless explicitly set by the Administrator. The values for \texttt{arch} are:

Table 5-3: Values for \texttt{resources\_available.arch}

<table>
<thead>
<tr>
<th>OS</th>
<th>Resource Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIX 5</td>
<td>aix4</td>
</tr>
<tr>
<td>CLE</td>
<td>XT</td>
</tr>
</tbody>
</table>

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### Resources

**Chapter 5**

<table>
<thead>
<tr>
<th>OS</th>
<th>Resource Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP-UX 11</td>
<td>hpux11</td>
</tr>
<tr>
<td>Linux</td>
<td>linux</td>
</tr>
<tr>
<td>Linux with cpusets</td>
<td>linux_cpuset</td>
</tr>
<tr>
<td>Solaris</td>
<td>solaris7</td>
</tr>
<tr>
<td>Unicos</td>
<td>unicos</td>
</tr>
<tr>
<td>Unicos MK2</td>
<td>unicosmk2</td>
</tr>
<tr>
<td>Unicos SMP</td>
<td>unicossmp</td>
</tr>
</tbody>
</table>

Table 5-3: Values for `resources_available.arch`
Chapter 5  Resources
Chapter 6

Attributes

This chapter lists all of the PBS attributes. Attributes are listed by the PBS object they modify. For example, all attributes of jobs are listed in section 6.11, “Job Attributes”, on page 368. Attributes are case-sensitive.

6.1 When Attribute Changes Take Effect

When you set the value of most attributes, the change takes place immediately. You do not need to restart any daemons in order to make the change.

6.2 How To Set Attributes

Most attributes are set using the qmgr command. However, some vnode attributes must be set using the pbs_mom -s insert command, to create a Version 2 configuration file. For information about these requirements, see section 3.5.2, "Choosing Configuration Method" on page 47 in the PBS Professional Administrator’s Guide. The following are the instructions for setting all other attributes.
Chapter 6   Attributes

To set the value of an attribute, use the `$qmgr` command, either from the command line or within `$qmgr`:

```
qmgr -c 'set <object> <attribute> = <value>'
Qmgr: set <object> <attribute> = <value>
```

To unset the value of an attribute:

```
qmgr -c 'unset <object> <attribute>'
Qmgr: unset <object> <attribute>
```

where `<object>` is one of `server`, `queue`, `hook`, `node`, or `sched`.

For example, to set `resources_max.walltime` at the server to be 24 hours:

```
Qmgr: set server resources_max.walltime = 24:00:00
```

See “`qmgr`” on page 149.
6.3 Viewing Attribute Values

If you want to view attribute values, the following commands are helpful:

- `qstat`; see “qstat” on page 191 of the PBS Professional Reference Guide
- `qmgr`; see “qmgr” on page 149 of the PBS Professional Reference Guide
- `pbs_rstat`; see “pbs_rstat” on page 78 of the PBS Professional Reference Guide

- To see server attributes, use one of the following:
  - `qstat -B -f`
  - `Qmgr: list server`

- To see queue attributes, use one of the following:
  - `qstat -Q -f <queue name>`
  - `Qmgr: list queue <queue name>`

- To see job attributes:
  - `qstat -f <job ID>`

- To see hook attributes:
  - `Qmgr: list hook <hook name>`

- To see scheduler attributes:
  - `Qmgr: list sched`

- To see vnode attributes:
  - `Qmgr: list node <node name>`

- To see reservation attributes:
  - `Qmgr: pbs_rstat -F`
6.4 Attribute Table Format

In the following tables, the columns contain the following information:

- **Name**: The name of the attribute
- **Description**: A description of the attribute’s function
- **Format**: The attribute’s format
- **Val/Opt**: If the attribute can take only specific values or options, each is listed here
- **Value/Option Description**: If the attribute can take only specific values or options, the behavior of each value or option is described here
- **Default Value, Def Val**: The attribute’s default value, if any
- **Python Type**: The attribute’s Python attribute value type
- **User, Oper, Mgr**: Indicates the actions allowed for unprivileged users, Operators, and Managers
Attributes

The following table shows the operations allowed and their symbols:

Table 6-1: User, Operator, Manager Actions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>Entity can read attribute</td>
</tr>
<tr>
<td>w</td>
<td>Entity can directly set or alter attribute</td>
</tr>
<tr>
<td>s</td>
<td>Entity can set but not alter attribute</td>
</tr>
<tr>
<td>a</td>
<td>Entity can alter but not set attribute</td>
</tr>
<tr>
<td>i</td>
<td>Entity can indirectly set attribute</td>
</tr>
<tr>
<td>-</td>
<td>Entity cannot set or alter attribute, whether directly or indirectly</td>
</tr>
</tbody>
</table>

6.5 Caveats

- The Python types listed as Python dictionaries support a restricted set of operations. They can reference values by index. Other features, such as has_key(), are not available.
- Do not use qmgr to set attributes for reservation queues.
6.6 Server Attributes

Server attributes are divided into these groups:

- Those that can be set by an operator or manager
- Those that are read-only

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Op</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_host_enable</td>
<td>Specifies whether the server obeys the host access control list in the acl_hosts server attribute.</td>
<td><em>Boolean.</em></td>
<td>When this attribute is <em>True</em>, the server limits host access according to the access control list.</td>
<td><em>False</em>; all hosts allowed access</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>acl_hosts</td>
<td>List of hosts from which services can be requested of this server. Requests from the Server’s host always honored whether or not that host is in the list. This list contains the fully qualified domain names of the hosts. List is evaluated left-to-right; first match in list is used.</td>
<td><em>String.</em></td>
<td>Form: `[+</td>
<td>-]hostname.domain[,...]`</td>
<td>None; all hosts allowed access</td>
<td>pbs.acl</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>acl_resv_group_enable</td>
<td>Specifies whether the server obeys the group reservation access control list in the acl_resv_groups server attribute.</td>
<td><em>Boolean</em></td>
<td>When this attribute is <em>True</em>, the server limits group access according to the access control list.</td>
<td><em>False</em>; all groups allowed access</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
</tbody>
</table>
### Attributes

#### Chapter 6

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Attr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_resv_groups</td>
<td>List of groups allowed or denied permission to create reservations in this PBS complex. The groups in the list are groups on the server host, not submission hosts. List is evaluated left-to-right; first match in list is used.</td>
<td>String</td>
<td>[+]</td>
<td>Form: <code>[+]group_name[,...]</code></td>
<td></td>
<td>pbs.acl</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>acl_resv_host_enable</td>
<td>Specifies whether the server obeys the host reservation access control list in the <code>acl_resv_hosts</code> server attribute.</td>
<td>Boolean</td>
<td></td>
<td></td>
<td><code>False</code>; access allowed from all hosts</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>acl_resv_hosts</td>
<td>List of hosts from which reservations can be created in this PBS complex. This list is made up of the fully-qualified domain names of the hosts. List is evaluated left-to-right; first match in list is used.</td>
<td>String</td>
<td>[+]</td>
<td>Form: <code>[+]hostname.domai[n][,...]</code></td>
<td></td>
<td>pbs.acl</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>acl_resv_user_enable</td>
<td>Specifies whether the server limits which users are allowed to create reservations, according to the access control list in the <code>acl_resv_users</code> server attribute.</td>
<td>Boolean</td>
<td></td>
<td></td>
<td><code>False</code>; all users are allowed to create reservations</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>acl_resv_users</td>
<td>List of users allowed or denied permission to create reservations in this PBS complex. List is evaluated left-to-right; first match in list is used.</td>
<td>String</td>
<td>[+]</td>
<td>Form: <code>[+]user[@host][,...]</code></td>
<td></td>
<td>pbs.acl</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
</tbody>
</table>
### Server Attributes

<table>
<thead>
<tr>
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<th>Format</th>
<th>Val/Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Or</th>
<th>Mod</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_user_enable</td>
<td>Specifies whether the server limits which users are allowed to run commands at the server, according to the control list in the acl_users server attribute.</td>
<td>Boolean</td>
<td></td>
<td>When this attribute is True, the server limits user access according to the access control list.</td>
<td>False: all users have access</td>
<td>bool</td>
<td>r</td>
<td>f</td>
<td></td>
</tr>
<tr>
<td>acl_users</td>
<td>List of users allowed or denied permission to run commands at this server. List is evaluated left-to-right; first match in list is used.</td>
<td>String</td>
<td></td>
<td>None; all users allowed access</td>
<td>pbs.acl</td>
<td>r</td>
<td>r</td>
<td>f</td>
<td></td>
</tr>
<tr>
<td>backfill_depth</td>
<td>Modifies backfilling behavior. Sets the number of jobs that are to be backfilled around. Recommendation: set this to less than 100.</td>
<td>Integer</td>
<td></td>
<td>PBS backfills around the specified number of jobs.</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>comment</td>
<td>Informational text.</td>
<td>String</td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>default_chunk</td>
<td>The list of resources which will be inserted into each chunk of a job’s select specification if the corresponding resource is not specified by the user. Provides a means for a site to be sure a given resource is properly accounted for even if not specified by the user.</td>
<td>String</td>
<td></td>
<td>None</td>
<td>Dictionary: \default_chunk&lt;resource name&gt;=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>default_node</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>default_qdel_arguments</td>
<td>Argument to \qdel\ command. Automatically added to all \qdel\ commands. See \qdel\ (1B). Overrides standard defaults. Overridden by arguments given on the command line.</td>
<td>String</td>
<td></td>
<td>None</td>
<td>pbs.args</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
</tbody>
</table>
### Attributes

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<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Maint</th>
</tr>
</thead>
<tbody>
<tr>
<td>default_qsub_arguments</td>
<td>Arguments that are automatically added to the <code>qsub</code> command. Any valid arguments to <code>qsub</code> command, such as job attributes. Setting a job attribute via <code>default_qsub_arguments</code> sets that attribute for each job which does not explicitly override it. See <code>qsub(1B)</code>. Settable by the administrator via the <code>qmgr</code> command. Overrides standard defaults. Overridden by arguments given on the command line and in script directives.</td>
<td><strong>String.</strong> Form: <code>&lt;option&gt; &lt;value&gt; &lt;option&gt; &lt;value&gt;</code>, e.g. <code>-r y -N MyJob</code> To add to existing: <code>Qmgr: s s default_qsub_arguments +=&quot;&lt;option&gt; &lt;value&gt;&quot;</code></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>default_queue</td>
<td>The name of the default target queue. Used for requests that do not specify a queue name. Must be set to an existing queue.</td>
<td><strong>Queue name</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eligible_time_enable</td>
<td>Controls starving behavior. Viewable via <code>qstat</code> by job owner, Operator and Manager.</td>
<td><strong>Boolean</strong></td>
<td></td>
<td><strong>True</strong></td>
<td>The value of the job’s <code>eligible_time</code> attribute is used for its starving time.</td>
<td><strong>False</strong></td>
<td><strong>bool</strong></td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>False</strong></td>
<td>The value of <code>now() - etime</code> is used for the job’s starving time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<th>User</th>
<th>Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td>est_start_time_freq</td>
<td>Interval at which PBS calculates estimated start times and vnodes for all jobs. Best value is workload dependent. Recommendation: set this to two hours.</td>
<td>Duration: Expressed as an integer number of seconds or a Duration. See section &quot;Duration&quot;, on page 395</td>
<td>( &gt;0 ) PBS calculates estimated start times and vnodes for all jobs at the specified interval.</td>
<td>Unset</td>
<td>pbs.duration</td>
<td>R, W</td>
<td>F, R, W</td>
</tr>
<tr>
<td></td>
<td>( 0 ) PBS calculates estimated start times and vnodes for all jobs at every scheduling cycle.</td>
<td>( 0 )</td>
<td>( Unset ) PBS does not calculate estimated start times or vnodes for all jobs; PBS calculates these only for the top N jobs specified in backfill_depth.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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**Attributes**

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<th>Mode</th>
</tr>
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<tr>
<td>flatuid</td>
<td>Used for authorization allowing users to submit and alter jobs. Specifies whether user names are treated as being the same across the PBS server and all submission hosts in the PBS complex. Can be used to allow users without accounts at the Server host to submit jobs. If UserA has an account at the Server host, PBS requires that UserA@&lt;server&gt; is the same as UserA@&lt;execution host&gt;.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Boolean</strong> True: PBS assumes that UserA@&lt;submissionhost&gt; is the same user as UserA@&lt;server&gt;. Jobs that run under the name of the job owner do not need authorization. A job submitted under a different username, by using the u option to the qsub command, requires authorization. Entries in .rhosts or hosts.equiv are not checked, so even if UserA@host1 has an entry for UserB@host2, UserB@host2 cannot operate on UserA@host1's jobs. User without account on Server can submit jobs. False: PBS does not assume that UserA@&lt;submission host&gt; is the same user as UserA@&lt;server host&gt;. Jobs that run under the name of the job owner need authorization. Users must have accounts on the Server host to submit jobs.</td>
<td></td>
<td></td>
<td></td>
<td>bool</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>job_history_duration</td>
<td>Specifies the length of time PBS will keep each job's history.</td>
<td>Duration</td>
<td>Two weeks</td>
<td>int</td>
<td></td>
<td>r</td>
<td>r, w</td>
</tr>
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<th>Python Type</th>
<th>User</th>
<th>Operator</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>job_history_enable</td>
<td>Enables job history management. Setting this attribute to True enables job history management.</td>
<td>Boolean</td>
<td></td>
<td></td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r, w</td>
<td></td>
</tr>
<tr>
<td>job_requeue_timeout</td>
<td>Specifies the length of time that can be taken while requeuing a job. Minimum allowed value: 1 second. Maximum allowed value: 3 hours.</td>
<td>Duration</td>
<td></td>
<td></td>
<td>45 seconds</td>
<td>pbs.duration</td>
<td>r</td>
<td>r, w</td>
<td>w, w</td>
</tr>
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<th>Python Type</th>
<th>User</th>
<th>Operator</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>job_sort_formula</td>
<td>Formula for computing job priorities. Described in the <strong>PBS Professional Administrator’s Guide</strong>. If the attribute job_sort_formula is set, the scheduler will use the formula in it to compute job priorities. If it is unset, the scheduler computes job priorities according to fairshare, if fairshare is enabled. If neither is defined, the scheduler uses job_sort_key. When the scheduler sorts jobs according to the formula, it computes a priority for each job, where that priority is the value produced by the formula. Jobs with a higher value get higher priority. Can be set by Manager or Operator. Viewable by users, Manager or Operator. The formula can be made up of expressions, where expressions contain terms which are added, subtracted, multiplied, or divided, and which can contain parentheses, exponents, and unary plus and minus.</td>
<td><em>String</em> containing mathematical formula</td>
<td></td>
<td></td>
<td>Unset</td>
<td>pbs.job_sort_formula</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>log_events</td>
<td>Specifies the types of events which are logged.</td>
<td><em>Integer</em> representation of bit string</td>
<td></td>
<td></td>
<td>511</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
</tbody>
</table>
## Attributes

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<th>Default Value</th>
<th>Python Type</th>
<th>User Op Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>mail_from</td>
<td>The username from which server-generated mail is sent to users. Mail is sent to this address upon failover. On Windows, requires fully qualified mail address.</td>
<td>String</td>
<td></td>
<td></td>
<td>adm</td>
<td>str</td>
<td>r r r w</td>
</tr>
<tr>
<td>managers</td>
<td>List of PBS managers. If this attribute is explicitly set, root@&lt;server_host&gt; is no longer automatically included, and must be set explicitly.</td>
<td>String, Form: &quot;<a href="mailto:user@host.sub.domain">user@host.sub.domain</a>[, <a href="mailto:user@host.sub.domain">user@host.sub.domain</a>...]&quot;. The host, sub-domain, or domain name may be wildcarded with an asterisk (*).</td>
<td></td>
<td></td>
<td>Root on the server host</td>
<td>pbs.adm</td>
<td>r r r w</td>
</tr>
<tr>
<td>max_array_size</td>
<td>The maximum number of sub-jobs allowed in any array job.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>10000</td>
<td>int</td>
<td>r r r w</td>
</tr>
<tr>
<td>max_concurrent_provision</td>
<td>The maximum number of vnodes allowed to be in the process of being provisioned. Cannot be set to zero.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>&gt;0</td>
<td>int</td>
<td>r r r w</td>
</tr>
<tr>
<td>max_group_res</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum amount of the specified resource that any single group may consume in this PBS complex.</td>
<td>String, Form: max_group_res.&lt;resource&gt;=&lt;value&gt;</td>
<td></td>
<td></td>
<td>None</td>
<td>Dictionary: max_group_res[&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r r r w</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>Format</td>
<td>Val/Opt</td>
<td>Value/Option Description</td>
<td>Default Value</td>
<td>Python Type</td>
<td>User</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>max_group_res_soft</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The soft limit for the specified resource that any single group may consume in this complex. If a group is consuming more than this amount of the specified resource, their jobs are eligible to be preempted by jobs from groups who are not over their soft limit.</td>
<td><code>String; Form: “max_group_res_soft.resource_name=value”</code></td>
<td>Any PBS resource, e.g. “ncpus”, “mem”, “pmem”, etc.</td>
<td>None</td>
<td>Dictionary: max_group_res_soft[&lt;resource name&gt;] =&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r, w, w</td>
<td></td>
</tr>
<tr>
<td><code>max_group_run</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs owned by the users in one group allowed to be running within this complex at one time.</td>
<td><code>Integer</code></td>
<td></td>
<td></td>
<td>No limit</td>
<td>int</td>
<td>r, r, w, w</td>
</tr>
<tr>
<td><code>max_group_run_soft</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs owned by the users in one group allowed to be running in this complex at one time. If a group has more than this number of jobs running, their jobs are eligible to be preempted by jobs from groups who are not over their soft limit.</td>
<td><code>Integer</code></td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r, r, w, w</td>
</tr>
</tbody>
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## Attributes

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<th>User</th>
<th>Dr.</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>maxqueued</td>
<td>Limit attribute. The maximum number of jobs allowed to be queued or running in the complex. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393.</td>
<td></td>
<td>None</td>
<td>None</td>
<td>r, r, r, w</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maxqueued_res.&lt;resource&gt;</td>
<td>Limit attribute. The maximum amount of the specified resource allowed to be allocated to jobs queued or running in the complex. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393.</td>
<td></td>
<td>None</td>
<td>None</td>
<td>r, r, r, w</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maxrun</td>
<td>Limit attribute. The maximum number of jobs allowed to be running in the complex. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393.</td>
<td></td>
<td>None</td>
<td>None</td>
<td>r, r, r, w</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maxrun_res.&lt;resource&gt;</td>
<td>Limit attribute. The maximum amount of the specified resource allowed to be allocated to jobs running in the complex. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393.</td>
<td></td>
<td>None</td>
<td>None</td>
<td>r, r, r, w</td>
<td></td>
<td></td>
<td></td>
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<th>Python Type</th>
<th>User</th>
<th>Admin</th>
<th>Oper</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_run_res_soft.&lt;resource&gt;</td>
<td>Limit attribute. Soft limit on the amount of the specified resource allowed to be allocated to jobs running in the complex. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td></td>
<td></td>
<td>None</td>
<td>None</td>
<td>r</td>
<td>r, w</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>max_run_soft</td>
<td>Limit attribute. Soft limit on the number of jobs allowed to be running in the complex. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td></td>
<td></td>
<td>None</td>
<td>None</td>
<td>r</td>
<td>r, w</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>max_running</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs allowed to be selected for execution at any given time, from all possible jobs.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>max_user_res</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum amount of the specified resource that any single user may consume within this complex.</td>
<td>String. Form: max_user_res.&lt;resource&gt;=&lt;value&gt;</td>
<td>Any PBS resource, e.g. “ncpus”, “mem”, “pmem”, etc.</td>
<td>None</td>
<td>Dictionary: max_user_res[&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r, w</td>
<td>r</td>
<td>w</td>
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<tbody>
<tr>
<td><code>max_user_res_soft</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The soft limit on the amount of the specified resource that any single user may consume within a complex. If a user is consuming more than this amount of the specified resource, their jobs are eligible to be preempted by jobs from users who are not over their soft limit.</td>
<td><em>String:</em> Form: <code>max_user_res_soft.resource_name=value</code></td>
<td>Any valid PBS resource, e.g. &quot;ncpus&quot;, &quot;mem&quot;, &quot;pmem&quot;, etc</td>
<td>None</td>
<td>Dictionary: <code>max_user_res_soft[&lt;resource name&gt;]=&lt;value&gt;</code> where <code>&lt;resource name&gt;</code> is any built-in or custom resource</td>
<td>r w w</td>
</tr>
<tr>
<td><code>max_user_run</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs owned by a single user allowed to be running within the complex at one time.</td>
<td><em>Integer</em></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r w w</td>
</tr>
<tr>
<td><code>max_user_run_soft</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The soft limit on the number of jobs owned by a single user that are allowed to be running within this complex at one time. If a user has more than this number of jobs running, their jobs are eligible to be preempted by jobs from users who are not over their soft limit.</td>
<td><em>Integer</em></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r w w</td>
</tr>
</tbody>
</table>
## Attributes

### Server Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val/Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User Access</th>
<th>Operational Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>node_fail_request</td>
<td>Controls whether running jobs are automatically requeued or are deleted when the primary execution vnode fails. Number of seconds to wait after losing contact with Mother Superior before requeuing or deleting jobs.</td>
<td><em>integer</em></td>
<td></td>
<td>Jobs are not requeued; they are left in the <em>Running</em> state until the execution vnode is recovered.</td>
<td>310</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Greater than zero</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Jobs are requeued if they are marked as rerunnable, or are deleted when the node has been down for the specified number of seconds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>node_group_enable</td>
<td>Specifies whether placement sets (which includes node grouping) are enabled. See <em>node_group_key</em> server attribute.</td>
<td><em>boolean</em></td>
<td></td>
<td>When set to <em>True</em>, placement sets are enabled.</td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>node_group_key</td>
<td>Specifies the resources to use for placement sets (node grouping). Overridden by queue’s <em>node_group_key</em> attribute. See <em>node_group_enable</em> server attribute.</td>
<td><em>string_array</em></td>
<td></td>
<td>When specifying multiple resources, enclose the value in double quotes.</td>
<td>Unset</td>
<td>pbs.node_group_key</td>
<td>r</td>
<td>r, w</td>
</tr>
</tbody>
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## Attributes

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<th>User</th>
<th>Oper</th>
<th>Perm</th>
</tr>
</thead>
<tbody>
<tr>
<td>operators</td>
<td>List of PBS operators.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.acl</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>pbs_license_file_location</td>
<td>Deprecated. Do not use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Form: user@host.sub.domain[,user@host.sub.domain...]. The host, sub-domain, or domain name may be wildcarded with an asterisk (*).*
### Attributes

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<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Operator</th>
<th>Main</th>
</tr>
</thead>
<tbody>
<tr>
<td>pbs_license_info</td>
<td>Location of license information. Can be port and hostname of license server, or local pathname to the actual license file(s) associated with a license server.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>pbs_license_linger_time</td>
<td>The number of seconds to keep an unused CPU license, when the number of licenses is above the value given by pbs_license_min.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>3600 seconds</td>
<td>pbs.duration</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
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<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>pbs_license_max</td>
<td>Maximum number of licenses to be checked out at any time, i.e. maximum number of CPU licenses to keep in the PBS local license pool. Sets a cap on the number of CPUs that can be licensed at one time.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>Maximum number for an integer</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>pbs_license_min</td>
<td>Minimum number of CPUs to permanently keep licensed, i.e. the minimum number of CPU licenses to keep in the PBS local license pool. This is the minimum number of licenses to keep checked out.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>Zero</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>query_other_jobs</td>
<td>Controls whether unprivileged users are allowed to select or query the status of jobs owned by other users.</td>
<td>Boolean</td>
<td></td>
<td></td>
<td>True</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>require_cred</td>
<td>Specifies the Kerberos credential authentication method required. All jobs submitted without the specified credential will be rejected. See require_cred_enable. Depends on optional Kerberos and DCE support. Not supported under Windows.</td>
<td>String</td>
<td>krb5 dce</td>
<td>Unset</td>
<td>Unset</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
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<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>require_cred_enable</td>
<td>Specifies whether the server is to use the Kerberos credential authentication method given in the <code>require_cred</code> server attribute. Depends on optional Kerberos and DCE support. Not supported under Windows.</td>
<td>Boolean</td>
<td></td>
<td><code>True</code> means use the Kerberos authentication method specified. <code>False</code>: no Kerberos credential authentication used</td>
<td>bool</td>
<td>f</td>
<td>f, w</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserve_retry_cutoff</td>
<td>The time period before the reservation start time during which PBS does not attempt to reconfirm a degraded reservation. When this value is changed, all degraded reservations use the new value. Must be greater than zero.</td>
<td>Integer</td>
<td>Seconds</td>
<td>7200 (2 hours)</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>r, w</td>
<td></td>
</tr>
<tr>
<td>reserve_retry_init</td>
<td>The amount of time after a reservation becomes degraded that PBS waits before attempting to reconfirm the reservation. When this value is changed, only reservations that become degraded after the change use the new value. Must be greater than zero.</td>
<td>Integer</td>
<td>Seconds</td>
<td>7200 (2 hours)</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>r, w</td>
<td></td>
</tr>
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<th>User</th>
<th>Oper</th>
<th>Maint</th>
</tr>
</thead>
<tbody>
<tr>
<td>resources_available</td>
<td>The list of available resources and their values defined on the server. Each resource is listed on a separate line.</td>
<td>String. Form: <code>resources_available.&lt;resource&gt;=&lt;value&gt;</code></td>
<td></td>
<td></td>
<td>None</td>
<td>Dictionary: <code>resources_available[&lt;resource_name&gt;=&lt;value&gt;]</code> where <code>&lt;resource_name&gt;</code> is any built-in or custom resource</td>
<td>f</td>
<td>t</td>
<td>w w</td>
</tr>
<tr>
<td>resources_cost</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>resources_default</td>
<td>The list of default job-wide resource values that are set as limits for jobs in this complex when a) the job does not specify a limit, and b) there is no queue default. The value for a string array, e.g. <code>resources_default.&lt;string array resource&gt;</code>, can contain only one string. For host-level resources, see the <code>default_chunk.&lt;resource&gt;</code> server attribute.</td>
<td>String. Form: <code>resources_default.&lt;resource_name&gt;=value[,...]</code></td>
<td></td>
<td></td>
<td>No limit</td>
<td>Dictionary: <code>resources_default[&lt;resource_name&gt;=&lt;value&gt;]</code> where <code>&lt;resource_name&gt;</code> is any built-in or custom resource</td>
<td>t</td>
<td>f</td>
<td>f, w</td>
</tr>
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<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Maint</th>
</tr>
</thead>
<tbody>
<tr>
<td>resources_max</td>
<td>The maximum amount of each resource that can be requested by any single job in this complex, if there is not a resources_max value defined for the queue at which the job is targeted. This attribute functions as a gating value for jobs entering the PBS complex.</td>
<td>String</td>
<td>Val/Opt</td>
<td>Dictionary: resources_max[&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>No limit</td>
<td>str</td>
<td>r</td>
<td>w</td>
<td>w</td>
</tr>
<tr>
<td>resv_enable</td>
<td>Specifies whether or not advance and standing reservations can be created in this complex.</td>
<td>Boolean</td>
<td></td>
<td>When set to True, new reservations can be created. When changed from True to False, new reservations cannot be created, but existing reservations are honored.</td>
<td>True</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>resv_post_processing_time</td>
<td>The amount of time allowed for reservations to clean up after running jobs. Reservation duration and end time are extended by this amount of time. Jobs are not allowed to run during the cleanup period.</td>
<td>Duration</td>
<td></td>
<td>Unset; behaves as if zero</td>
<td></td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>rpp_highwater</td>
<td>The maximum number of RPP packets that can be in transit at any time.</td>
<td>Integer</td>
<td></td>
<td>Greater than or equal to 64</td>
<td>64</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>Format</td>
<td>Val / Opt</td>
<td>Value/Option Description</td>
<td>Default Value</td>
<td>Python Type</td>
<td>User Op Mut</td>
<td></td>
<td></td>
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<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------</td>
<td>-----------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>---------------</td>
<td>-------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rpp_retry</td>
<td>The maximum number of times the RPP network library will try to send a UDP packet again before giving up. The number of retries is added to the original try, so if rpp_retry is set to 2, the total number of tries will be 3.</td>
<td>Integer</td>
<td></td>
<td>Greater than or equal to zero</td>
<td>10</td>
<td>int</td>
<td>r r r w</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scheduler_iteration</td>
<td>The time between scheduling iterations.</td>
<td>Integer</td>
<td>Seconds</td>
<td></td>
<td>10 minutes (600 seconds)</td>
<td>pbs.duration</td>
<td>r r r w</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scheduling</td>
<td>Enables scheduling of jobs. Specified by value of -a option to pbs_server command. If -a is not specified, value is taken from previous invocation of pbs_server.</td>
<td>Boolean</td>
<td></td>
<td>When this attribute is set to True, scheduling is enabled.</td>
<td>False if never set via pbs_server command.</td>
<td>bool</td>
<td>r r r w</td>
<td></td>
<td></td>
</tr>
<tr>
<td>single_signon_password_enable</td>
<td>Only used on systems requiring passwords, such as Windows or HPCBP. Incompatible with other systems. Specifies whether or not users must give a password for each job. Can be enabled only when no jobs exist, or when all jobs have a bad password hold (&quot;p&quot; hold). Can be disabled only when no jobs exist.</td>
<td>Boolean</td>
<td>True</td>
<td>Users submitting jobs must specify a password only once; PBS remembers it for future job execution.</td>
<td>UNIX: False Windows: True</td>
<td>bool</td>
<td>r r r w</td>
<td></td>
<td></td>
</tr>
<tr>
<td>system_cost</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<th>Default Value</th>
<th>Python Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_roots</td>
<td>List of users with root privilege who can submit and run jobs in this PBS complex. For any job whose owner is root or Administrator, the job owner must be listed in this access control list, or the job is rejected. List is evaluated left-to-right; first match in list is used. Can be set or altered by root only, and only at the server host.</td>
<td>String</td>
<td></td>
<td></td>
<td>None; no root jobs allowed</td>
<td>pbs.acl</td>
</tr>
<tr>
<td>licenses</td>
<td>The number of floating licenses currently available for allocation to unlicensed CPUs. One license is required for each virtual CPU.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
</tr>
<tr>
<td>license_count</td>
<td>The license_count attribute is made up of four numbers: Avail_Global, Avail_Local, Used, High_Use.</td>
<td>String</td>
<td>Avail_Global:</td>
<td>The number of PBS CPU licenses still kept by the Altair license server (checked in.)</td>
<td>Avail_Global:0</td>
<td>pbs.license_count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avail_Local:</td>
<td>Used:</td>
<td>The number of PBS CPU licenses still kept by PBS (checked out.)</td>
<td>Avail_Local:0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Used:</td>
<td>High_Use:&lt;val&gt;</td>
<td>The number of PBS CPU licenses currently in use.</td>
<td>Used:0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High_Use:&lt;val&gt;</td>
<td></td>
<td>The highest number of PBS CPU licenses ever checked out and used by the current instance of the PBS server.</td>
<td>High_Use:0</td>
<td></td>
</tr>
<tr>
<td>pbs_version</td>
<td>The version of PBS for this server.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.version</td>
</tr>
</tbody>
</table>

The following server attributes can be set by root only:

- **acl_roots**
  - **Description**: List of users with root privilege who can submit and run jobs in this PBS complex. For any job whose owner is root or Administrator, the job owner must be listed in this access control list, or the job is rejected. List is evaluated left-to-right; first match in list is used. Can be set or altered by root only, and only at the server host.
  - **Format**: String
  - **Value/Option Description**: Form: [+]user[@host][,...]
  - **Default Value**: None; no root jobs allowed
  - **Python Type**: pbs.acl

The following server attributes are read-only:

- **licenses**
  - **Description**: The number of floating licenses currently available for allocation to unlicensed CPUs. One license is required for each virtual CPU.
  - **Format**: Integer
  - **Default Value**: None
  - **Python Type**: int

- **license_count**
  - **Description**: The license_count attribute is made up of four numbers: Avail_Global, Avail_Local, Used, High_Use.
  - **Format**: String
  - **Value/Option Description**: Form: Avail_Global::<val> Avail_Local::<val> Used::<val> High_Use::<val>
  - **Default Value**: Avail_Global:0 Avail_Local:0 Used:0 High_Use:0
  - **Python Type**: pbs.license_count

- **pbs_version**
  - **Description**: The version of PBS for this server.
  - **Format**: String
  - **Default Value**: None
  - **Python Type**: pbs.version
## Attributes

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<th>Oper</th>
<th>Mem</th>
</tr>
</thead>
<tbody>
<tr>
<td>resources_assigned</td>
<td>The total of each type of resource allocated to jobs running in this complex.</td>
<td><em>String</em>: Form: <code>resources_assigned.&lt;resource&gt;=&lt;val&gt;, resources_assigned.&lt;resource&gt;=&lt;val&gt;,...</code></td>
<td></td>
<td>None</td>
<td>Dictionary: <code>resources_assigned[&lt;resource name&gt;]=&lt;value&gt;</code> where <code>&lt;resource name&gt;</code> is any built-in or custom resource</td>
<td>T</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>server_host</td>
<td>The name of the server. The server name is the same as the host name.</td>
<td><em>Hostname</em>: If the server is listening to a non-standard port, the port number is appended, with a colon, to the host name. Example: <code>host.domain:9999</code></td>
<td></td>
<td>None</td>
<td>str</td>
<td>T</td>
<td>T</td>
<td>F</td>
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<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>server_state</td>
<td>The current state of the server:</td>
<td>String</td>
<td><strong>Hot_Start</strong>&lt;br&gt;The server will run first any jobs that were running when it was shut down.</td>
<td>None</td>
<td>Server state constant pbs.SV_STATE_HOT</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Idle</strong>&lt;br&gt;The server is running. Scheduling has been turned off.</td>
<td></td>
<td>Server state constant pbs.SV_STATE_IDLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Active</strong>&lt;br&gt;The server is running. The scheduler is not in a scheduling cycle.</td>
<td></td>
<td>Server state constant pbs.SV_STATE_ACTIVE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Scheduling</strong>&lt;br&gt;The server is running. The scheduler is in a scheduling cycle.</td>
<td></td>
<td>Server state constant pbs.SV_STATE_ACTIVE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Terminating</strong>&lt;br&gt;The server is terminating. No additional jobs will be run.</td>
<td></td>
<td>Server state constant pbs.SV_STATE_SHUTDEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>state_count</td>
<td>List of the number of jobs in each state in the complex. Suspended jobs are counted as running.</td>
<td>String, Form: transitioning=&lt;X&gt;, queued=&lt;Y&gt;, ...</td>
<td>Server is terminating in delayed mode. No new jobs will be run. Server will shut down after all running jobs are finished.</td>
<td>None</td>
<td>pbs.state_count</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

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## Attributes

### Server Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val/Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Perm</th>
</tr>
</thead>
<tbody>
<tr>
<td>total_jobs</td>
<td>The total number of jobs in the complex. If the job_history_enable attribute is set to True, this includes jobs that are finished, deleted, and moved.</td>
<td>integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>
### 6.7 Scheduler Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val/ Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>Use</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>do_not_span_psets</td>
<td>Specifies whether or not the scheduler requires the job to fit within one existing placement set.</td>
<td>Boolean</td>
<td>True</td>
<td>The job must fit in one existing placement set. All existing placement sets are checked. If the job fits in an occupied placement set, the job waits for the placement set to be available. If the job can’t fit within a single placement set, it won’t run.</td>
<td>False</td>
<td>r, r, w</td>
<td>r, r, w</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sched_cycle_length</td>
<td>The scheduler’s maximum cycle length. Overwritten by the -a alarm option to pbs_sched command.</td>
<td>Duration</td>
<td>20:00 (20 minutes)</td>
<td>None</td>
<td>r, r, w</td>
<td>r, w, w</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following attributes are read-only.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val/ Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>Use</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>pbs_version</td>
<td>The version of PBS for this scheduler.</td>
<td>String</td>
<td>None</td>
<td>None</td>
<td>-</td>
<td>r</td>
<td>r</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sched_host</td>
<td>The hostname of the machine on which the scheduler runs.</td>
<td>String</td>
<td>Server</td>
<td>None</td>
<td>-</td>
<td>r</td>
<td>r</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 6.8 Reservation Attributes

Reservation attributes are divided into these groups:

- Those that can be set by users, operators, or managers
- Those that are read-only

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account_Name</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Authorized_Groups</td>
<td>List of groups who can or cannot submit jobs to this reservation.</td>
<td>String</td>
<td></td>
<td></td>
<td></td>
<td>pbs.acl</td>
<td>r w f t</td>
<td>w w f</td>
<td>t</td>
</tr>
</tbody>
</table>

The following attributes can be set by user, operator, or manager:

- **Account_Name**: No longer used.
- **Authorized_Groups**: List of groups who can or cannot submit jobs to this reservation. Group names are interpreted relative to the server, not the submission host. List is evaluated left-to-right; first match in list is used. This list is used to set the reservation queue’s acl_groups attribute. See the G option to the pbs_rsub command.
### Attributes

**Authorized Hosts**

The list of hosts from which jobs can and cannot be submitted to this reservation. List is evaluated left-to-right; first match in list is used. This list is used to set the reservation queue's `acl_hosts` attribute. See the `H` option to the `pbs_rsub` command.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorized _Hosts</td>
<td>The list of hosts from which jobs can and cannot be submitted to this reservation. List is evaluated left-to-right; first match in list is used. This list is used to set the reservation queue's acl_hosts attribute. See the H option to the pbs_rsub command.</td>
<td>String: Form: `[+</td>
<td>-]hostname, ...<code>, </code>[+</td>
<td>-]hostname</td>
<td></td>
<td>Jobs can be submitted from all hosts</td>
<td>pbs.acl</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Mem</th>
<th>User</th>
<th>Oper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorized _Users</td>
<td>The list of users who can or cannot submit jobs to this reservation. This list is used to set the reservation queue’s acl_users attribute. List is evaluated left-to-right; first match in list is used. See the U option to the pbs_rsub command.</td>
<td>String: “/+user[hostname,domain],...,[+,-]...” where, ‘-’ means “deny” and ‘+’ means “allow”. In addition, a single ‘*’ may be used to wildcard various list entries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>w</td>
<td>r.</td>
<td>r.</td>
</tr>
<tr>
<td>group_list</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
## Attributes

### Reservation Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interactive</strong></td>
<td>Number of seconds that the pbs_rsub command will block while waiting for confirmation or denial of the reservation. See the -1 block_time option to the pbs_rsub command.</td>
<td>Integer</td>
<td>Less than zero</td>
<td>The reservation is automatically deleted if it cannot be confirmed in the time specified.</td>
<td>Zero</td>
<td>int</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Zero or greater than zero</td>
<td>The reservation is not automatically deleted if it cannot be confirmed in the time specified.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mail_Points</strong></td>
<td>Sets the list of events for which mail is sent by the server. Mail is sent to the list of users specified in the Mail_Users attribute. See the m mail_points option to the pbs_rsub command.</td>
<td>String</td>
<td>a</td>
<td>Notify when reservation is terminated</td>
<td>“ac”</td>
<td>pbs.mail_points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b</td>
<td>Notify when reservation period begins</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td>Notify when reservation is confirmed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e</td>
<td>Notify when reservation period ends</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n</td>
<td>Do not send mail. Cannot be used with other letters.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mail_Users</td>
<td>The set of users to whom mail is sent for the reservation events specified in the Mail_Points attribute. See the M mail_list option to the pbs_rsub command.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserve_count</td>
<td>The count of occurrences in the standing reservation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserve_duration</td>
<td>Reservation duration in seconds. For a standing reservation, this is the duration for one occurrence.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserve_end</td>
<td>The date and time when an advance reservation or the soonest occurrence of a standing reservation ends.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Attributes**

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail_Users</td>
<td>String</td>
<td></td>
<td>Form: user@host[,...]</td>
<td></td>
<td>pbs.user_list</td>
</tr>
<tr>
<td>Priority</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserve_count</td>
<td>Integer</td>
<td></td>
<td></td>
<td></td>
<td>int</td>
</tr>
<tr>
<td>reserve_duration</td>
<td>Integer</td>
<td></td>
<td></td>
<td></td>
<td>pbs.duration</td>
</tr>
<tr>
<td>reserve_end</td>
<td>Date</td>
<td></td>
<td></td>
<td></td>
<td>long</td>
</tr>
</tbody>
</table>

**Reservation Attributes**

- **User**: r, w
- **Oper**: r, w
- **Mgr**: r, w
## Attributes

### Chapter 6

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserve_Name</td>
<td>The name assigned to the reservation during creation, if specified. See the N option to the pbs_rsub command.</td>
<td>String up to 15 characters. First character is alphabetic</td>
<td>None</td>
<td>str</td>
<td></td>
<td>t, r, w</td>
</tr>
</tbody>
</table>
## Attributes

### Chapter 6

### Reservation Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
</tr>
</thead>
</table>
| **reserve_rule** | The rule that describes the recurrence pattern of a standing reservation. See the `pbs_rsub` command. | Either of two forms: 
  - "FREQ=freq_spec; COUNT=count_spec; interval_spec"
  - "FREQ=freq_spec; UNTIL=until_spec; interval_spec"
| freq_spec    | Frequency with which the standing reservation repeats. Valid values are: 
  - WEEKLY
  - DAILY
  - HOURLY
| None          | str                                                                         | t, r, s, w                                                              |
| count_spec   | The exact number of occurrences. Number up to 4 digits in length. Format: integer. | None                                                                  |                 |
| interval_spec| Specifies interval. Format is one or both of: 
  - BYDAY = MO|TU|WE|TH|FR|SA|SU
  - BYHOUR = 0|1|2|...|23
| None          |                                                             | r, t, r, s, w                                                           |
| until_spec   | Occurrences will start up to but not after date and time specified. Format: YYYY-MM-DD[THHMMSS]
  - Year-month-day part and hour-minute-second part separated by a capital T. | None                                                                  |                 |

### reserve_start

The date and time when the reservation period for the reservation or soonest occurrence begins.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>reserve_start</td>
<td>The date and time when the reservation period for the reservation or soonest occurrence begins.</td>
<td>Date</td>
<td>None</td>
<td>long</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Attributes

#### Chapter 6

#### Reservation Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Mr</th>
<th>Pr</th>
<th>Dr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource List</td>
<td>The list of resources allocated to the reservation. Jobs running in the reservation cannot use aggregate more than the specified amount of a resource.</td>
<td>String: Form: Resource_List.&lt;res&gt;=&lt;val&gt;, Resource_List.&lt;res&gt;=&lt;val&gt;, ...</td>
<td></td>
<td></td>
<td>None</td>
<td>Dictionary: Resource_List[&lt;resource name&gt;]=&lt;resource value&gt; where &lt;resource&gt; name is any built-in or custom resource</td>
<td>r</td>
<td>w</td>
<td>w</td>
</tr>
<tr>
<td>User_List</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following reservation attributes are read-only:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Mr</th>
<th>Pr</th>
<th>Dr</th>
</tr>
</thead>
<tbody>
<tr>
<td>ctime</td>
<td>The time that the reservation was created.</td>
<td>Date. Seconds since epoch.</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>hashname</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mtime</td>
<td>The time that the reservation was last modified.</td>
<td>Date</td>
<td></td>
<td></td>
<td>int</td>
<td></td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>
## Attributes

### Reservation Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Val</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue</td>
<td>Name of the reservation queue. Jobs that are to use resources belonging to this reservation are submitted to this queue.</td>
<td>Format for an advance reservation: R&lt;unique integer&gt; Format for a standing reservation: S&lt;unique integer&gt;</td>
<td></td>
<td></td>
<td>pbs.queue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Attributes

#### Reservation Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
</tr>
</thead>
<tbody>
<tr>
<td>reserve_ID</td>
<td>The reservation identifier. For an advance reservation: string of the form R&lt;unique integer&gt;.server_name For a standing reservation: string of the form S[unique integer].server_name</td>
<td>str</td>
<td></td>
<td></td>
<td>str</td>
<td>str</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>reserve_index</td>
<td>The index of the soonest occurrence of a standing reservation.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>int</td>
<td>int</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>Reserve_Owner</td>
<td>The login name on the submission host of the user who created the reservation.</td>
<td>String. Username@host</td>
<td></td>
<td></td>
<td>Login name of creator</td>
<td>str</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>
## Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Maint</th>
</tr>
</thead>
<tbody>
<tr>
<td>reserve_retry</td>
<td>Time at which reservation will be reconfirmed.</td>
<td>Integer, Seconds since epoch.</td>
<td>None</td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>reserve_state</td>
<td>The state of the reservation.</td>
<td></td>
<td>NO_RESV_NONE</td>
<td>No reservation yet.</td>
<td>None</td>
<td>reservation state constant: pbs.RESV_STATE_NONE</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>UN_RESV_UNCONFIRMED</td>
<td></td>
<td>Reservation request is awaiting confirmation.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_UNCONFIRMED</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>CO_RESV_CONFIRMED</td>
<td></td>
<td>Resv. confirmed. All occurrences of standing resv. confirmed.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_CONFIRMED</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>WT_RESV_WAIT</td>
<td></td>
<td>Unused.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_WAIT</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>TR_RESV_TIME_TO_RUN</td>
<td></td>
<td>Start of the reservation period.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_TIME_TO_RUN</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>RN_RESV_RUNNING</td>
<td></td>
<td>Resv. period has started; reservation is running.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_RUNNING</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>FN_RESV_FINISHED</td>
<td></td>
<td>End of the reservation period.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_FINISHED</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>BD_RESV_BEING_DELETED</td>
<td></td>
<td>Reservation is being deleted.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_BEING_DELETED</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>DE_RESV_DELETED</td>
<td></td>
<td>Reservation has been deleted.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_DELETED</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>DJ_RESV_DELETING_JOBS</td>
<td></td>
<td>Jobs belonging to the reservation are being deleted.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_DELETING_JOBS</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>DG_DEGRADED</td>
<td></td>
<td>Reservation is degraded.</td>
<td></td>
<td></td>
<td>reservation state constant: pbs.RESV_STATE_DEGRADED</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>
### Attributes

#### Reservation Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>reserve_substate</td>
<td>The substate of the reservation or occurrence. The substate is used internally by PBS.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>reserve_type</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>resv_nodes</td>
<td>The list of each vnode and the resources allocated from it to satisfy the chunks requested for this reservation or occurrence.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.exec_vnode</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>server</td>
<td>Name of server.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.server</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>Variable_List</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 6.9 Queue Attributes

Queue attributes are divided into the following groups:

- Those that apply to both execution and routing queues
- Those that apply only to execution queues
- Those that apply only to routing queues

In the following table, Q Type indicates the type of queue to which the attribute applies: R (routing), E (execution):

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User Opt</th>
<th>Oper Opt</th>
<th>Err Opt</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_group_enable</td>
<td>Controls whether the queue obeys the access control list defined in the acl_groups queue attribute.</td>
<td>Boolean</td>
<td>R, E</td>
<td></td>
<td>When set to True, the queue limits group access according to the access control list.</td>
<td>False; all groups allowed access</td>
<td>bool</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>acl_groups</td>
<td>List of groups which are allowed or denied access to this queue. The groups in the list are groups on the server host, not submitting hosts. List is evaluated left-to-right; first match in list is used.</td>
<td>String. Form: [+</td>
<td>-] group-name[...]</td>
<td>R, E</td>
<td></td>
<td>None</td>
<td>pbs.acl</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>acl_host_enable</td>
<td>Controls whether the queue obeys the access control list defined in the acl_hosts queue attribute.</td>
<td>Boolean</td>
<td>R, E</td>
<td></td>
<td>When set to True, the queue limits host access according to the access control list.</td>
<td>False; all hosts allowed access.</td>
<td>bool</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>acl_hosts</td>
<td>List of hosts from which jobs may be submitted to this queue. List is evaluated left-to-right; first match in list is used.</td>
<td>String. Form: [+</td>
<td>-]hostname[...]</td>
<td>R, E</td>
<td></td>
<td>None</td>
<td>pbs.acl</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
</tbody>
</table>
## Attributes

### Chapter 6

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>U</th>
<th>O</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>acl_user_enable</td>
<td>Controls whether the queue obeys the access control list defined in the acl_users queue attribute.</td>
<td>Boolean</td>
<td>R, E</td>
<td></td>
<td>When set to <strong>True</strong>, the queue limits user access according to the access control list.</td>
<td><strong>False</strong>; all users allowed access</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>acl_users</td>
<td>List of users allowed or denied access to this queue. List is evaluated left-to-right; first match in list is used.</td>
<td>String</td>
<td>R, E</td>
<td></td>
<td>None</td>
<td>pbs.acl</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>enabled</td>
<td>Specifies whether this queue accepts new jobs.</td>
<td>Boolean</td>
<td>R, E</td>
<td><strong>T</strong>rue</td>
<td>The queue is <strong>enabled</strong>. The queue accepts new jobs; new jobs can be enqueued.</td>
<td><strong>False</strong></td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>from_route_only</td>
<td>Specifies whether this queue accepts jobs only from routing queues, or from both execution and routing queues.</td>
<td>Boolean</td>
<td>R, E</td>
<td><strong>T</strong>rue</td>
<td>This queue accepts jobs only from routing queues.</td>
<td><strong>False</strong></td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>max_array_size</td>
<td>The maximum number of sub-jobs that are allowed in an array job.</td>
<td>Integer</td>
<td>R, E</td>
<td></td>
<td>No limit</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>max_queueable</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs allowed to reside in the queue at any given time.</td>
<td>Integer</td>
<td>R, E</td>
<td></td>
<td>No limit</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
</tbody>
</table>
## Attributes

### Queue Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>Us</th>
<th>Mod</th>
<th>Obj</th>
<th>Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_queue_d</td>
<td>Limit attribute. The maximum number of jobs allowed to be queued in or running from this queue. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td>R, E</td>
<td></td>
<td></td>
<td>None</td>
<td>r, r, w, r</td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_queue_d_&lt;resource&gt;</td>
<td>Limit attribute. The maximum amount of the specified resource allowed to be allocated to jobs queued in or running from this queue. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td>R, E</td>
<td></td>
<td></td>
<td>None</td>
<td>r, r, w, r</td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_running</td>
<td>Old limit attribute. Incompatible with new limit attributes. For an execution queue, this is the largest number of jobs allowed to be running at any given time. For a routing queue, this is the largest number of jobs allowed to be transiting from this queue at any given time.</td>
<td><strong>Integer</strong></td>
<td>R, E</td>
<td></td>
<td></td>
<td>None</td>
<td>r, r, w, r</td>
<td>r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>Format</td>
<td>Q Type</td>
<td>Val / Opt</td>
<td>Value/Option Description</td>
<td>Default Value</td>
<td>Python Type</td>
<td>Sr Op Mgr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>--------</td>
<td>-----------</td>
<td>----------------------------</td>
<td>---------------</td>
<td>--------------</td>
<td>-----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>node_group_key</td>
<td>Specifies the resources to use for placement sets (node grouping). Overrides server’s node_group_key attribute. Resources used must be of type string_array.</td>
<td>string_array</td>
<td>R, E</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.node_group_key</td>
<td>r, w, r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>The priority of this queue compared to other queues of the same type in this PBS complex. The value of priority has no meaning for routing queues.</td>
<td>Integer. -1024 to 1023</td>
<td>R, E</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r, r, w</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>queue_type</td>
<td>The type of this queue. This attribute must be explicitly set at queue creation.</td>
<td>String</td>
<td>R, E</td>
<td>e, r</td>
<td>execution</td>
<td>Execution queue</td>
<td>PBS queue type constants: pbs.QUEUETY PE_EXECUTION or pbs.QUEUETY PE_ROUTE</td>
<td>r, r, w</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>require_credential</td>
<td>Specifies the credential type required. All jobs submitted to the named queue without the specified credential will be rejected. Not supported under Windows.</td>
<td>String</td>
<td>R, E</td>
<td>krb5, dce</td>
<td></td>
<td>unset</td>
<td>str</td>
<td>r, r, w</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User Op</th>
<th>Mgr Op</th>
</tr>
</thead>
<tbody>
<tr>
<td>require_credential_enable</td>
<td>Specifies whether the credential authentication method specified in the require_credential queue attribute is required for this queue. Not supported under Windows.</td>
<td>Boolean</td>
<td>R, E</td>
<td></td>
<td>When set to <code>true</code>, the credential authentication method is required</td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>resources_default</td>
<td>The list of default resource values which are set as limits for a job residing in this queue and for which the job did not specify a limit. If not set, the default limit for a job is determined by the first of the following attributes which is set: server’s resources_default, queue’s resources_max, server’s resources_max. If none of these is set, the job gets unlimited resource usage.</td>
<td>String. Form: <code>resources_default.&lt;resource_name&gt;=&lt;value&gt;</code>, <code>resources_default.&lt;resource_name&gt;=&lt;value&gt;</code>, ...</td>
<td>R, E</td>
<td></td>
<td>None</td>
<td>Dictionary: <code>resources_default[&lt;resource_name&gt;]=&lt;value&gt;</code>, where <code>&lt;resource_name&gt;</code> is any built-in or custom resource</td>
<td></td>
<td></td>
<td>r</td>
</tr>
<tr>
<td>resources_max</td>
<td>The maximum amount of each resource which can be requested by a single job in this queue. The queue value supersedes any server wide maximum limit.</td>
<td>String. Form: <code>resources_max.&lt;resource_name&gt;=&lt;value&gt;</code>, <code>resources_max.&lt;resource_name&gt;=&lt;value&gt;</code>, ...</td>
<td>R, E</td>
<td></td>
<td>None; infinite usage</td>
<td>Dictionary: <code>resources_max[&lt;resource_name&gt;]=&lt;value&gt;</code>, where <code>&lt;resource_name&gt;</code> is any built-in or custom resource</td>
<td></td>
<td></td>
<td>r</td>
</tr>
</tbody>
</table>
## Attributes

### Queue Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q</th>
<th>Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>resources_min</strong></td>
<td>The minimum amount of each resource that can be requested by a single job in this queue.</td>
<td>String: Form: <code>resources_max.&lt;resource_name&gt;=&lt;value&gt;, resources_min.&lt;resource_name&gt;=&lt;value&gt;, ...</code></td>
<td>R, E</td>
<td></td>
<td></td>
<td></td>
<td>Zero usage</td>
<td>Dictionary: resources_min[&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>started</td>
<td>Specifies whether jobs in this queue can be scheduled for execution.</td>
<td>Boolean</td>
<td>R, E</td>
<td></td>
<td></td>
<td>Set to True: jobs in this queue can run</td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r, w, w</td>
</tr>
<tr>
<td>state_count</td>
<td>The number of jobs in each state currently residing in this queue.</td>
<td>String: Form: <code>transiting=&lt;val&gt;, exiting=&lt;val&gt;, ...</code></td>
<td>R, E</td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.state_count</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>total_jobs</td>
<td>The number of jobs currently residing in this queue.</td>
<td>Integer</td>
<td>R, E</td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

**The following attributes apply only to execution queues:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q</th>
<th>Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>checkpoint_min</td>
<td>Specifies the minimum number of minutes of CPU time or wall-time allowed between checkpoints of a job. If a user specifies a time less than this value, this value is used instead. The value given in checkpoint_min is used for both CPU minutes and walltime minutes.</td>
<td>Integer</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.duration</td>
<td>r</td>
<td>r</td>
<td>r, w, w</td>
</tr>
</tbody>
</table>
### Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>Use</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>default_chunk</td>
<td>The list of resources which will be inserted into each chunk of a job's select specification if the corresponding resource is not specified by the user. This provides a means for a site to be sure a given resource is properly accounted for even if not specified by the user.</td>
<td>String. Form: default_chunk.&lt;resource&gt;=&lt;value&gt;, default_chunk.&lt;resource&gt;=&lt;value&gt;, ...</td>
<td>E</td>
<td>E</td>
<td>This attribute is set to True if there are vnodes associated with this queue.</td>
<td>None</td>
<td>Dictionary: default_chunk[ &lt;resource name&gt; ]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r</td>
<td>t,i</td>
</tr>
<tr>
<td>hasnodes</td>
<td>Describes whether this queue has associated vnodes.</td>
<td>Boolean</td>
<td>E</td>
<td>E</td>
<td></td>
<td>False; no vnodes are associated with this queue</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>t,i</td>
</tr>
<tr>
<td>kill_delay</td>
<td>The time delay between sending SIGTERM and SIGKILL when a qdel command is issued against a running job.</td>
<td>Integer. Seconds. Must be greater than or equal to zero.</td>
<td>E</td>
<td>E</td>
<td>10 seconds</td>
<td>pbs.duration</td>
<td>r</td>
<td>r</td>
<td>t,w</td>
<td></td>
</tr>
<tr>
<td>max_group_res</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum amount of the specified resource that any single group may consume in a complex.</td>
<td>String. Form: max_group_res.resource_name=value Example: set server max_group_res.ncpus=6</td>
<td>E</td>
<td>E</td>
<td>Any PBS resource, e.g. &quot;ncpus&quot;, &quot;mem&quot;, &quot;pmem&quot;, etc.</td>
<td>None</td>
<td>Dictionary: max_group_res[ &lt;resource name&gt; ]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r</td>
<td>t,w</td>
</tr>
</tbody>
</table>
### Attributes

**Chapter 6**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val/Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Operator</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_group_res_soft</td>
<td>Old limit attribute. Incompatible with new limit attributes. The soft limit on the amount of the specified resource that any single group may consume in a complex. If a group is consuming more than this amount of the specified resource, their jobs are eligible to be preempted by jobs from groups who are not over their soft limit.</td>
<td>String: Form: max_group_res_soft.resource_name=value Example: set server max_group_res_soft.ncpus=3</td>
<td>E</td>
<td>Any</td>
<td>valid PBS resource, e.g. &quot;ncpus&quot;, &quot;mem&quot;, &quot;pmem&quot;, etc.</td>
<td>None</td>
<td>Dictionary: max_group_res_soft[&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>max_group_run</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs owned by a group that are allowed to be running from this queue at one time.</td>
<td>Integer</td>
<td>E</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>max_group_run_soft</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs owned by users in a single group that are allowed to be running from this queue at one time. If a group has more than this number of jobs running, their jobs are eligible to be preempted by jobs from groups who are not over their soft limit.</td>
<td>Integer</td>
<td>E</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
</tr>
</tbody>
</table>
### Attributes

#### Queue Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>Set</th>
<th>Oper</th>
<th>Mod</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_run</td>
<td>Limit attribute. The maximum number of jobs allowed to be running from this queue. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Format: Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td>E</td>
<td>None</td>
<td>None</td>
<td>r, w, r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_run_res.&lt;resource&gt;</td>
<td>Limit attribute. The maximum amount of the specified resource allowed to be allocated to jobs running from this queue. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Format: Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td>E</td>
<td>None</td>
<td>None</td>
<td>r, w, r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rux_run_res_soft.&lt;resource&gt;</td>
<td>Limit attribute. Soft limit on the amount of the specified resource allowed to be allocated to jobs running from this queue. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Format: Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td>E</td>
<td>None</td>
<td>None</td>
<td>r, w, r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_run_soft</td>
<td>Limit attribute. Soft limit on the number of jobs allowed to be running from this queue. Can be specified for projects, users, groups, or all. Cannot be used with old limit attributes.</td>
<td>Format: Limit specification. See Chapter 7, &quot;Formats&quot;, on page 393</td>
<td>E</td>
<td>None</td>
<td>None</td>
<td>r, w, r</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

### Chapter 6

#### Queue Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_user_res</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum amount of the specified resource that any single user may consume.</td>
<td><em>String:</em> Form: max_user_res.resource_name=value</td>
<td>E</td>
<td>any PBS resource, e.g. “ncpus”, “mem”, “pmem”, etc</td>
<td>None</td>
<td>Dictionary: max_user_res[&lt;resource name&gt;] =&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r, r, w, w</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_user_res_soft</td>
<td>Old limit attribute. Incompatible with new limit attributes. The soft limit on the amount of the specified resource that any single user may consume. If a user is consuming more than this amount of the specified resource, their jobs are eligible to be preempted by jobs from users who are not over their soft limit.</td>
<td><em>String:</em> Form: max_user_res_soft.resource_name=value</td>
<td>E</td>
<td>any valid PBS resource, e.g. “ncpus”, “mem”, “pmem”, etc</td>
<td>None</td>
<td>Dictionary: max_user_res_soft[&lt;resource name&gt;] =&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r, r, r, w</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_user_run</td>
<td>Old limit attribute. Incompatible with new limit attributes. The maximum number of jobs owned by a single user that are allowed to be running from this queue at one time.</td>
<td><em>Integer</em></td>
<td>E</td>
<td>int</td>
<td>None</td>
<td>int</td>
<td>r, r, r, w</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

### Queue Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q</th>
<th>Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>max_user_run_soft</code></td>
<td>Old limit attribute. Incompatible with new limit attributes. The soft limit on the number of jobs owned by a single user that are allowed to be running from this queue at one time. If a user has more than this number of jobs running, their jobs are eligible to be preempted by jobs from users who are not over their soft limit.</td>
<td><code>integer</code></td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>resources_assigned</code></td>
<td>The total for each kind of resource allocated to jobs running from this queue.</td>
<td><code>string</code></td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dictionary: <code>resources_assigned[ &lt;resource_name&gt; ]=&lt;value&gt;</code> where <code>&lt;resource_name&gt;</code> is any built-in or custom resource</td>
<td></td>
<td></td>
<td>r</td>
</tr>
<tr>
<td><code>resources_available</code></td>
<td>The list of resources and amounts available to jobs running in this queue. The sum of the resource of each type used by all jobs running from this queue cannot exceed the total amount listed here. See <code>qmgr(1B)</code>.</td>
<td><code>string</code></td>
<td>E</td>
<td></td>
<td></td>
<td></td>
<td>Dictionary: <code>resources_available[ &lt;resource_name&gt; ]=&lt;value&gt;</code> where <code>&lt;resource_name&gt;</code> is any built-in or custom resource</td>
<td></td>
<td></td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

The following attributes apply only to routing queues:

| Name     | Description                                      | | | | | | | | | |
|-----------|--------------------------------------------------|---|------|---|------|---------------------------|---------------|-------------|------|------|-----|
| `alt_router` | No longer used.                                | | | | | | | | | |
### Attributes

#### Queue Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Q</th>
<th>Type</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>User</th>
<th>Oper</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>route_destinations</td>
<td>The list of destinations to which jobs may be routed.</td>
<td>String</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td>None. Must be set to at least one valid destination</td>
<td>pbs.route_destinations</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>route_held_jobs</td>
<td>Specifies whether jobs in the held state can be routed from this queue.</td>
<td>Boolean</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>route_lifetime</td>
<td>The maximum time a job is allowed to reside in a routing queue. If a job cannot be routed in this amount of time, the job is aborted.</td>
<td>Integer. Seconds</td>
<td>R</td>
<td>&gt;0</td>
<td></td>
<td>Number of seconds specified</td>
<td>Unset; infinite</td>
<td>pbs.duration</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>route_retry_time</td>
<td>Time delay between routing retries. Typically used when the network between servers is down.</td>
<td>Integer. Seconds</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td>30 seconds</td>
<td>pbs.duration</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>route_waiting_jobs</td>
<td>Specifies whether jobs whose execution_time attribute value is in the future can be routed from this queue.</td>
<td>Boolean</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

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Attributes

6.10 Vnode Attributes

Vnode attributes are divided into the following groups:

- Those that can be set by an operator or manager
- Those that are read-only

<table>
<thead>
<tr>
<th>Vnode Attributes</th>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Str</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>comment</td>
<td>Information about this vnode. This attribute may be set by the manager to any string to inform users of any information relating to the node. If this attribute is not explicitly set, the PBS Server will use the attribute to pass information about the node status, specifically why the node is down. If the attribute is explicitly set by the manager, it will not be modified by the Server.</td>
<td>String</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>current_aoe</td>
<td>This attribute identifies the AOE currently instantiated on this vnode. Case-sensitive. Cannot be set on Server’s host.</td>
<td>String</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hpcbp_enable</td>
<td>Enables HPCBP features in Linux MOM.</td>
<td>Boolean</td>
<td></td>
<td>When set to True, HPCBP features are enabled.</td>
<td>False</td>
<td>bool</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following attributes can be set by a manager or operator:
## Attributes

Chapter 6

### Vnode Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User Op</th>
<th>Mgr Op</th>
</tr>
</thead>
<tbody>
<tr>
<td>hpcbp_stage_protocol</td>
<td>Protocol and port number for staging files to and from HPC Basic Profile Server.</td>
<td>String</td>
<td></td>
<td></td>
<td>scp</td>
<td>str</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td>hpcbp_user_name</td>
<td>User account with limited privilege, used for request-</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td>ing job/node status from HPC Basic Profile Server.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hpcbp_webserver_address</td>
<td>URL for HPC Basic Profile Server.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td>The address must start with https://.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lictype</td>
<td>No longer used. (Was deprecated.)</td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Gone from .c file.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_group_run</td>
<td>The maximum number of jobs owned by any users in a single group</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td>allowed to run on this vnode at one time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_running</td>
<td>The maximum number of jobs allowed to be run on this vnode at any given</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td>time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max_user_run</td>
<td>The maximum number of jobs owned by a single user</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td>allowed to run on this vnode at one time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Op</th>
<th>Managed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mom</strong></td>
<td>Hostname of host on which MOM daemon runs. Can be explicitly set by Manager only via <code>qmgr</code>, and only at vnode creation. The server can set this to the FQDN of the host on which MOM runs, if the vnode name is the same as the hostname.</td>
<td><code>String</code></td>
<td></td>
<td>Value of vnode resource (vnode name.)</td>
<td>str</td>
<td>True</td>
<td>r</td>
<td>r</td>
<td>True</td>
</tr>
<tr>
<td><strong>no_multi_node_jobs</strong></td>
<td>Controls whether jobs which request more than one chunk are allowed to execute on this vnode. Used for cycle harvesting.</td>
<td><code>Boolean</code></td>
<td></td>
<td>When set to <code>true</code>, jobs requesting more than one chunk are not allowed to execute on this vnode.</td>
<td>False</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td><strong>ntype</strong></td>
<td>The type of the vnode.</td>
<td><code>String</code></td>
<td>PBS</td>
<td>Normal vnode, not Globus. The vnode is a gateway into a Globus cloud. Jobs assigned to this vnode will be run in the Globus cloud. There can be only one Globus MOM per PBS complex.</td>
<td>PBS</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td><strong>pnames</strong></td>
<td>The list of resources being used for placement sets. Not used for scheduling; advisory only.</td>
<td><code>String</code></td>
<td></td>
<td>Comma-separated list of resource names.</td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td><strong>Port</strong></td>
<td>Port number on which MOM daemon listens. Can be explicitly set only via <code>qmgr</code>, and only at vnode creation.</td>
<td><code>Integer</code></td>
<td></td>
<td>15002</td>
<td>15002</td>
<td>int</td>
<td>-</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

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### Vnode Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Inv</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>The priority of this vnode compared with other vnodes.</td>
<td>Integer</td>
<td>[-1024, +1023] inclusive</td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>w</td>
<td></td>
</tr>
<tr>
<td>provision_enable</td>
<td>Controls whether this vnode can be provisioned. If set to <code>True</code>, this vnode may be provisioned. Cannot be set on Server's host.</td>
<td>Boolean</td>
<td></td>
<td></td>
<td>Unset</td>
<td>bool</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td>queue</td>
<td>The queue with which this vnode is associated. Each vnode can be associated with at most 1 queue. Queues can be associated with multiple vnodes. Any jobs in a queue that has associated vnodes can run only on those vnodes. If a vnode has an associated queue, only jobs in that queue can run on that vnode.</td>
<td>String</td>
<td></td>
<td>Only jobs in specified queue may run on this vnode.</td>
<td>None</td>
<td>pbs.queue</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unset</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>List Opt</th>
<th>Read Opt</th>
<th>Write Opt</th>
</tr>
</thead>
<tbody>
<tr>
<td>resources_available</td>
<td>The list of resources and the amounts available on this vnode. If not explicitly set, the amount shown is that reported by the pbs_mom running on the vnode. If a resource value is explicitly set, that value is retained across restarts.</td>
<td>String. Form: resources_available.&lt;resource name&gt;=&lt;value&gt;, resources_available.&lt;resource name&gt;=&lt;value&gt;, ...</td>
<td>Dictionary: resources_available['&lt;resource&gt;'] = '&lt;val&gt;' where '&lt;resource&gt;' is any custom or built-in resource</td>
<td>None</td>
<td>Dictionary</td>
<td>r, r, r</td>
<td>r, r, r</td>
<td>r, r, w</td>
</tr>
<tr>
<td>resv_enable</td>
<td>Controls whether the vnode can be used for advance and standing reservations. Reservations are incompatible with cycle harvesting.</td>
<td>Boolean</td>
<td>When set to True, this vnode can be used for reservations. Existing reservations are honored when this attribute is changed from True to False.</td>
<td>True</td>
<td>bool</td>
<td>r, r, r</td>
<td>r, r, r</td>
<td>r, r, w</td>
</tr>
</tbody>
</table>
## Attributes

### Vnode Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default</th>
<th>Python Type</th>
<th>USD Opt</th>
<th>Mgr Opt</th>
</tr>
</thead>
<tbody>
<tr>
<td>sharing</td>
<td>Specifies whether more than one job at a time can use the resources of the vnode or the vnode’s host. Either (1) the vnode or host is allocated exclusively to one job, or (2) the vnode’s or host’s unused resources are available to other jobs. Can be set using pbs_mom -s insert only. Behavior is determined by a combination of the sharing attribute and a job’s placement directive, defined as follows:</td>
<td>String: <code>vnode-name: sharing=force_excl</code></td>
<td><em>default_shared</em></td>
<td>Defaults to shared</td>
<td>int</td>
<td>r, r, r, w, w</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>default_excl</em></td>
<td>Defaults to exclusive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>default_exclhost</em></td>
<td>Entire host is assigned to the job unless the job’s sharing request specifies otherwise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>ignore_excl</em></td>
<td>Overrides any job <code>place=excl</code> setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>force_excl</em></td>
<td>Overrides any job <code>place=shared</code> setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>force_exclhost</em></td>
<td>The entire host is assigned to the job, regardless of the job’s sharing request</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Unset</em></td>
<td>Defaults to shared</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Behavior of vnode:

<table>
<thead>
<tr>
<th>Value of sharing</th>
<th>Placement Request (-lplace=)</th>
<th>Vnode</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>not specified</td>
<td>place=shared</td>
</tr>
<tr>
<td>not set</td>
<td>shared</td>
<td>shared</td>
<td>exclusive</td>
</tr>
<tr>
<td><em>default_shared</em></td>
<td>shared</td>
<td>shared</td>
<td>exclusive</td>
</tr>
<tr>
<td><em>default_excl</em></td>
<td>exclusive</td>
<td>shared</td>
<td>exclusive</td>
</tr>
<tr>
<td><em>default_exclhost</em></td>
<td>exclusive</td>
<td>shared</td>
<td>exclusive</td>
</tr>
<tr>
<td><em>ignore_excl</em></td>
<td>shared</td>
<td>shared</td>
<td>shared</td>
</tr>
<tr>
<td><em>force_excl</em></td>
<td>exclusive</td>
<td>exclusive</td>
<td>exclusive</td>
</tr>
<tr>
<td><em>force_exclhost</em></td>
<td>exclusive</td>
<td>exclusive</td>
<td>exclusive</td>
</tr>
</tbody>
</table>
### Attributes

**Vnode Attributes**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr Opr</th>
<th>Mgr Opr</th>
</tr>
</thead>
<tbody>
<tr>
<td>state</td>
<td>Shows or sets the state of the vnode. Must be a comma-separated list of one or more states: state[ , state ...]</td>
<td>String</td>
<td>free</td>
<td>Node is up and capable of accepting new job(s). Cannot be combined with other states.</td>
<td>int</td>
<td>r r r</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>offline</td>
<td></td>
<td>offline</td>
<td>Jobs are not to be assigned to this vnode. Can combine: busy, job-busy, job-exclusive, resv_exclusive.</td>
<td>r r r</td>
<td>r, r, w, w</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>down</td>
<td></td>
<td>down</td>
<td>Node is not responding to queries from the Server. Cannot be combined with free.</td>
<td>r r r</td>
<td>r r r</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>job-busy</td>
<td></td>
<td>job-busy</td>
<td>All CPUs on the vnode are allocated to jobs. Can combine with offline, resv_exclusive.</td>
<td>r r r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>job-exclusive</td>
<td></td>
<td>job-exclusive</td>
<td>Entire vnode is exclusively allocated to one job at the job's request. Can combine with offline and resv_exclusive.</td>
<td>r r r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>resv-exclusive</td>
<td></td>
<td>resv-exclusive</td>
<td>Running reservation has requested exclusive use of vnode. Can combine with job-exclusive and offline.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>busy</td>
<td></td>
<td>busy</td>
<td>Vnode is reporting load average greater than allowed max. Can combine with offline.</td>
<td>r r r</td>
<td>r r r</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>provisioning</td>
<td></td>
<td>provisioning</td>
<td>Vnode is being provisioned. Cannot be combined with any other states.</td>
<td>r r r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>wait-provisioning</td>
<td></td>
<td>wait-provisioning</td>
<td>Vnode needs to be provisioned, but can't: limit reached for concurrent provisioning vnodes. Cannot be combined with other states. See max_concurrent_provision.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>stale</td>
<td></td>
<td>stale</td>
<td>Vnode was previously reported to server, but is no longer reported to server. Cannot combine with free.</td>
<td>r r r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>state-unknown</td>
<td></td>
<td>state-unknown</td>
<td>The Server has never been able to contact the vnode. Either MOM is not running on the vnode, the vnode hardware is down, or there is a network problem.</td>
<td>r r r</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following attributes are read-only:

<table>
<thead>
<tr>
<th>in_multi_vnode_host</th>
<th>Specifies whether a vnode is part of a multi-vnode host. Used internally. Do not set.</th>
<th>Integer</th>
<th>unset</th>
<th>Not part of a multi-vnode host</th>
<th>int</th>
<th>r, w</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>t</td>
<td></td>
<td>Part of a multi-vnode host</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>Format</td>
<td>Val / Opt</td>
<td>Value/Option Description</td>
<td>Def Val</td>
<td>Python Type</td>
<td>List Opr</td>
<td>Mnt</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>---------</td>
<td>-------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>jobs</td>
<td>List of jobs running on the vnode.</td>
<td>String</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>#jobsid,... where # is the number of the processor.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>license</td>
<td>No longer used. Was deprecated. Gone from .c file.</td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>pbs_version</td>
<td>The version of PBS for this MOM</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>pcpus</td>
<td>The number of physical CPUs on the vnode. This is set to the number of CPUs available when MOM starts. For a multiple-vnode MOM, only the natural vnode has pcpus.</td>
<td>Integer</td>
<td></td>
<td></td>
<td></td>
<td>int</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>resv</td>
<td>List of advance and standing reservations pending on the vnode.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>Comma-separated list of reservation IDs. Form: RNNNN.&lt;server&gt;,RNNNN.&lt;server&gt;, ...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 6

Attributes

Job attributes are divided into the following groups:

- Those that can be set by users, operators, or managers
- Those that are read-only

The following job attributes can be set by users, operators, or managers:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account_Name</td>
<td>Account to which the job is charged.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>w</td>
<td>r</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>resources_assigned</td>
<td>The total amount of each resource allocated to jobs running on this vnode.</td>
<td>String: resources_assigned.&lt;resource&gt;=&lt;value&gt;, resources_assigned.&lt;resource&gt;=&lt;value&gt;</td>
<td></td>
<td></td>
<td>None</td>
<td>Dictionary: resources_available[&lt;resource&gt;]=&lt;val&gt; where &lt;resource&gt; is any custom or built-in resource</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>
## Attributes

### Job Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>argument_list</td>
<td>JSDL-encoded listing of arguments to job’s executable.</td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r,</td>
<td>w</td>
<td></td>
</tr>
<tr>
<td>array</td>
<td>Indicates whether this is a job array.</td>
<td>Boolean</td>
<td></td>
<td>Set to <em>True</em> if this is an array job.</td>
<td><em>False</em></td>
<td>bool</td>
<td></td>
<td></td>
<td>r</td>
</tr>
<tr>
<td>array_indices_submitted</td>
<td>Applies only to job arrays. Complete list of indices of subjobs given at submission time.</td>
<td>String</td>
<td></td>
<td>Given as range, e.g. 1-100</td>
<td>None</td>
<td>pbs.range</td>
<td></td>
<td></td>
<td>r</td>
</tr>
<tr>
<td>block</td>
<td>Specifies whether qsub will wait for the job to complete, and return the exit value of the job.</td>
<td>Boolean</td>
<td></td>
<td><em>False</em></td>
<td>int</td>
<td></td>
<td></td>
<td>r,</td>
<td>r,</td>
</tr>
</tbody>
</table>
### Chapter 6

#### Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checkpoint</td>
<td>Determines when the job will be checkpointed. An action script is required to checkpoint the job.</td>
<td>String</td>
<td>c</td>
<td>Checkpoint at intervals, measured in CPU time, set on job’s execution queue. If no interval set at queue, job is not checkpointed.</td>
<td>u</td>
<td>pbs.checkpoint</td>
<td>r</td>
<td>w</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>c = minutes of CPU time</td>
<td></td>
<td></td>
<td>Checkpoint at intervals of specified number of minutes of job CPU time. This value must be &gt; 0. If interval specified is less than that set on job’s execution queue, queue’s interval is used. Format: integer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>w</td>
<td></td>
<td></td>
<td>Checkpoint at intervals, measured in walltime, set on job’s execution queue. If no interval set at queue, job is not checkpointed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>w = minutes of walltime</td>
<td></td>
<td></td>
<td>Checkpoint at intervals of the specified number of minutes of job walltime. This value must be greater than zero. If the interval specified is less than that set on the execution queue in which the job resides, the queue’s interval is used. Format: integer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>No checkpointing.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s</td>
<td>Checkpoint only when the server is shut down.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>u</td>
<td>Unset. Defaults to behavior when interval argument is set to $s.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>comment</td>
<td>Comment about job. Informational only.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>w</td>
</tr>
</tbody>
</table>
**Attributes**

### Job Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Ust</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
</table>
| depend | Specifies inter-job dependencies. | **String.** Form: `type:arg_list [,type:arg_list ...]`  
*arg_list* is one or more PBS job IDs in the form: `jobid[jobid ...]`  
Must be enclosed in double quotes if it contains commas. Example: `"type:jobid [,jobid ...]` | after:  
*arg_list* | This job may run at any point after all jobs in *arg_list* have started execution. | None; no dependencies | pbs.depend | r | w | r | w |
|        |             |        |           | afterok:  
*arg_list* | This job may run only after all jobs in *arg_list* have terminated with no errors. | | | |
|        |             |        |           | afternotok:  
*arg_list* | This job may run only after all jobs in *arg_list* have terminated with errors. | | | |
|        |             |        |           | afterany:  
*arg_list* | This job can run after all jobs in *arg_list* have finished execution, with or without errors. This job will not run if a job in the *arg_list* was killed. | | | |
|        |             |        |           | before:  
*arg_list* | Jobs in *arg_list* may start once this job has started. | | | |
|        |             |        |           | beforeok:  
*arg_list* | Jobs in *arg_list* may start once this job terminates without errors. | | | |
|        |             |        |           | beforenotok:  
*arg_list* | If this job terminates execution with errors, then jobs in *arg_list* may begin. | | | |
|        |             |        |           | beforeany:  
*arg_list* | Jobs in *arg_list* may begin execution once this job terminates execution, with or without errors. | | | |
| on: count | This job may run after *count* dependencies on other jobs have been satisfied. This type is used with one of the *before* types listed. Count is an integer greater than 0. | | | | | | | | |
### Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>eligible_time</strong></td>
<td>The amount of wall clock wait time a job has accrued while the job is blocked waiting for resources. For a job currently accruing eligible_time, if we were to add enough of the right type of resources, the job would start immediately. Viewable via qstat -f.</td>
<td><strong>Duration</strong></td>
<td></td>
<td></td>
<td>Nine</td>
<td>pbs.duration</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td><strong>Error_Path</strong></td>
<td>The final path name for the file containing the job’s standard error stream. If the output path is specified, but does not include a filename, the default filename is jobid.ER. If the path name is not specified, the default filename is &lt;job name&gt;.e&lt;sequence number&gt;. See the qsub and qalter commands.</td>
<td><strong>String</strong>; Form: [host-name:path-name]</td>
<td></td>
<td>Path is relative to the current working directory of command executing on current host.</td>
<td>Path is current working directory where qsub is run. File name is &lt;job name&gt;.e&lt;job number&gt;.</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Path is absolute path on current host where command is executing.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Path is relative to user’s home directory on specified host.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Path is absolute path on named host.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Path is current working directory where qsub is executed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

### Chapter 6

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>executable</td>
<td>JSDL-encoded listing of job’s executable.</td>
<td>Example: if the executable is ping: <code>&lt;jsdl-hpcpa:Executable&gt;ping&lt;/jsdl-hpcpa:Executable&gt;</code></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>Execution_Time</td>
<td>The point in time after which the job may execute. While this time has not yet been reached, the job remains queued and is in the wait state.</td>
<td>Datetime. See Chapter 7, &quot;Formats&quot;, on page 393.</td>
<td></td>
<td>Unset</td>
<td>int</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>exec_host</td>
<td>If the job is running, this is set to the name of the host or hosts on which the job is executing.</td>
<td>String. Form: <code>host/N[*C][+...]</code>, where &quot;host&quot; is the name of the host, “N” is task slot number starting with 0, on that node, and “C” is the number of CPUs allocated to the job. “*C” does not appear if C has a value of one.</td>
<td></td>
<td>None</td>
<td>pbs.exec_host</td>
<td>r, i</td>
<td>r, i</td>
<td></td>
</tr>
</tbody>
</table>
### exec_vnode

List of chunks for the job. Each chunk shows the name of the vnode(s) from which it is taken, along with the host-level, consumable resources allocated from that vnode, and any AOE provisioned on this vnode for this job.

If a vnode is allocated to the job but no resources from the vnode are used by the job, the vnode name appears alone.

If a chunk is split across vnodes, the name of each vnode and its resources appear inside one pair of parentheses, joined with a plus (“+”) sign.

```
Each chunk is enclosed in parentheses. Chunks are connected by plus signs. For a job which requested two chunks satisfied by resources from three vnodes, exec_vnode is:

```

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Gr</th>
</tr>
</thead>
<tbody>
<tr>
<td>exec_vnode</td>
<td>List of chunks for the job. Each chunk shows the name of the vnode(s) from which it is taken, along with the host-level, consumable resources allocated from that vnode, and any AOE provisioned on this vnode for this job. If a vnode is allocated to the job but no resources from the vnode are used by the job, the vnode name appears alone. If a chunk is split across vnodes, the name of each vnode and its resources appear inside one pair of parentheses, joined with a plus (“+”) sign.</td>
<td>Each chunk is enclosed in parentheses. Chunks are connected by plus signs. For a job which requested two chunks satisfied by resources from three vnodes, exec_vnode is: (vnodeA:ncpus=N:mem=X) + (nodeB:ncpus=P:mem=Y + nodeC:mem=Z).</td>
<td>None</td>
<td>pbs.exec_vnode</td>
<td>r</td>
<td>r, w</td>
<td>r, w</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Attributes

#### Chapter 6

**Job Attributes**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Ufr</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>group_list</td>
<td>A list of group names used to determine the group under which the job runs. When a job runs, the server selects a group name from the list according to the following ordered set of rules: 1. Select the group name for which the associated host name matches the name of the server host. 2. Select the group name which has no associated host name. 3. Use the login group for the user name under which the job will be run.</td>
<td><strong>String</strong>. Form: `group_name[@host]`[<code>,\</code>group_name[@host]`...`] Must be enclosed in double quotes if it contains commas.</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>pbs.group_list</td>
<td>r</td>
<td>w</td>
<td>r</td>
</tr>
<tr>
<td>Hold_Types</td>
<td>The set of holds currently applied to the job. If the set is not null, the job will not be scheduled for execution and is said to be in the hold state. The hold state takes precedence over the wait state.</td>
<td><strong>String</strong>, made up of the letters 'n', 'o', 'p', 's', 'u'</td>
<td>n</td>
<td>No hold</td>
<td>n</td>
<td>pbs.hold_types</td>
<td>r</td>
<td>w</td>
<td>r</td>
</tr>
<tr>
<td>interactive</td>
<td>Specifies whether the job is interactive. Can be set, but not altered, by unprivileged user.</td>
<td><strong>Boolean</strong></td>
<td>False</td>
<td>Set to True if this is an interactive job.</td>
<td>False</td>
<td>int</td>
<td>r</td>
<td>w</td>
<td>r</td>
</tr>
</tbody>
</table>
## Attributes

### Job Attributes

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<tr>
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<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job_Name</strong></td>
<td>The job name. See the qalter and qsub commands.</td>
<td><strong>String</strong></td>
<td>up to 15</td>
<td>characters, first character must be alphabetic or numeric</td>
<td></td>
<td>Base name of job script, or STDIN</td>
<td>r, w, r, w</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Join_Path</strong></td>
<td>Specifies whether the job’s standard error and standard output streams are to be merged and placed in the file specified in the Output_Path job attribute.</td>
<td><strong>Boolean</strong></td>
<td></td>
<td></td>
<td><strong>True</strong></td>
<td>False</td>
<td>pbs.join_path</td>
<td>r, w, r, w</td>
<td></td>
</tr>
<tr>
<td><strong>Keep_Files</strong></td>
<td>Specifies whether the standard output and/or standard error streams are retained on the execution host in the job’s staging and execution directory after the job has executed. Otherwise these files are returned to the submission host. Keep_Files overrides the Output_Path and Error_Path attributes.</td>
<td><strong>String</strong></td>
<td>o, e, oe, n</td>
<td>The standard output and standard error streams are retained. The filename can be: <code>job_name.o&lt;sequence number&gt;</code>, <code>job_name.e&lt;sequence number&gt;</code>, or <code>job_name.oe&lt;sequence number&gt;</code></td>
<td>n</td>
<td>pbs.keep_files</td>
<td>r, w, r, w</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mail_Points</strong></td>
<td>Specifies state changes for which the server sends mail about the job.</td>
<td><strong>String</strong></td>
<td>a, b, e, n</td>
<td>Mail is sent: a - on abort, b - at beginning, e - at end of job, n - no mail sent</td>
<td>a</td>
<td>pbs.mail_points</td>
<td>r, w, r, w</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Attributes

### Chapter 6

### Job Attributes

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<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail_Use$\text{s}$</td>
<td>The set of users to whom mail is sent when the job makes state changes specified in the Mail_Points job attribute.</td>
<td>String, Form: &quot;user@host[,user@host]&quot; Must be enclosed in double quotes if it contains commas.</td>
<td>Job owner only</td>
<td>jobid.oU. If the path name is not specified, the default filename is jobid.oU. If the path name is not specified, the default filename is jobid.oU. See the qsub and qalter commands.</td>
<td></td>
<td>pbs.email_list</td>
<td>r</td>
<td>w</td>
<td>r</td>
</tr>
<tr>
<td>no_stdio_socket$\text{s}$</td>
<td>Not used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output_Path</td>
<td>The final path name for the file containing the job's standard output stream. If the output path is specified, but does not include a filename, the default filename is jobid.oU. If the path name is not specified, the default filename is jobid.oU. See the qsub and qalter commands.</td>
<td>String, Form: [host-name]:path-name</td>
<td>Path is relative to the current working directory of command executing on current host.</td>
<td>Path is absolute path on current host where command is executing.</td>
<td>Path is relative to user's home directory on specified host.</td>
<td>Path is absolute path on named host.</td>
<td>Path is current working directory where qsub is executed.</td>
<td>str</td>
<td>r</td>
</tr>
<tr>
<td>Priority</td>
<td>The scheduling priority for the job. Higher values indicate greater priority.</td>
<td>Integer, Form: [-1024, +1023] inclusive</td>
<td>Unset</td>
<td>int</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>project</td>
<td>The job’s project. A project is a way to tag jobs. Each job can belong to at most one project.</td>
<td><strong>String</strong></td>
<td>Val / Opt</td>
<td>String: Can contain any characters except for the following: Slash (/), left bracket ([), right bracket (]), double quote (&quot;&quot;&quot;&quot;), semicolon (&quot;;&quot;), colon (&quot;:&quot;), vertical bar (&quot;</td>
<td>&quot;), left angle bracket (&quot;&lt;&quot;), right angle bracket (&quot;&gt;&quot;), plus (&quot;+&quot;), comma (&quot;,&quot;), question mark (&quot;?&quot;), and asterisk (*).</td>
<td>pbs_project_default</td>
<td>str</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>pset</td>
<td>Shows name of placement set used by the job. On BlueGene, specifies which partition should be used.</td>
<td><strong>String</strong></td>
<td></td>
<td></td>
<td>str</td>
<td></td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
</tbody>
</table>
## Attributes

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### Job Attributes

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<th>Ust</th>
<th>Opr</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rerunnable</td>
<td>Specifies whether the job can be rerun. Does not affect how a job is treated if the job could not begin execution. See section 3.13.8, &quot;Marking a Job as &quot;Rerunnable&quot; or Not&quot;, on page 68 of the PBS Professional User's Guide. Job arrays are required to be rerunnable and are rerunnable by default.</td>
<td>Character: “y” or “n”</td>
<td>y</td>
<td>The job can be rerun.</td>
<td>y</td>
<td>bool</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>Resource_List</td>
<td>The list of resources required by the job. List is a set of name=value strings. The meaning of name and value is dependent upon defined resources. Each value establishes the limit of usage of that resource. If not set, the value for a resource may be determined by a queue or server default established by the administrator. See Chapter 5, &quot;Resources&quot;, on page 293.</td>
<td>String. Form: Resource_List. &lt;res&gt;=&lt;value&gt;, Resource_List. &lt;res&gt;=&lt;value&gt;, ...</td>
<td>None</td>
<td>Dictionary: Resource_List [&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>None</td>
<td>Dictionary: Resource_List [&lt;resource name&gt;]=&lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
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<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>sandbox</td>
<td>Specifies type of location PBS uses for job staging and execution. User-settable via <code>qsub -Wsandbox=&lt;value&gt;</code> or via a PBS directive. See the <code>$jobdir_root</code> MOM configuration option in <code>pbs_mom.8B</code>.</td>
<td>String</td>
<td>PRIVATE</td>
<td>PBS creates job-specific staging and execution directories under the directory specified in the <code>$jobdir_root</code> MOM configuration option.</td>
<td>Unset</td>
<td>str</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HOME or unset</td>
<td>PBS will use the job owner’s home directory for staging and execution.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sched_hint</td>
<td>No longer used.</td>
<td>String</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shell_Path_List</td>
<td>One or more absolute paths to the program(s) to process the job’s script file.</td>
<td>String</td>
<td>Form: “path[@host],path[@host]...” Must be enclosed in double quotes if it contains commas.</td>
<td></td>
<td>User’s login shell on execution host</td>
<td>pbs.path_list</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>stagein</td>
<td>The list of files to be staged in prior to job execution.</td>
<td>String</td>
<td>Form: “execution_path@storage_host:storage_path” Must be enclosed in double quotes if it contains commas.</td>
<td></td>
<td>None</td>
<td>pbs.staging_list</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
</tbody>
</table>
## Attributes

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<th>Value/Option Description</th>
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<th>Ust</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>stageout</td>
<td>The list of files to be staged out after job execution.</td>
<td><code>String. Form: “execution_path@storage_host:storage_path”</code> Must be enclosed in double quotes if it contains commas.</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.staging_list</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>Submit_arguments</td>
<td>Job submission arguments given on the qsub command line.</td>
<td><code>String</code></td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>umask</td>
<td>The initial umask of the job is set to the value of this attribute when the job is created. This may be changed by umask commands in the shell initialization files such as .profile or .cshrc.</td>
<td><code>Decimal integer</code></td>
<td></td>
<td></td>
<td>077</td>
<td>int</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
</tbody>
</table>
### User_List

The list of users which determines the user name under which the job is run on a given host. When a job is to be executed, the server selects a user name from the list according to the following ordered set of rules:

1. Select the user name from the list for which the associated host name matches the name of the server.
2. Select the user name which has no associated host name; the wild card name.
3. Use the Job_Owner as the user name.

*String* Form:
- \( \text{user@host}, \text{user@host} \ldots \) 
- Must be enclosed in double quotes if it contains commas. May be up to 15 characters in length.

<table>
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<tr>
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<th>Val / Opt</th>
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<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>User_List</td>
<td>The list of users which determines the user name under which the job is run on a given host. When a job is to be executed, the server selects a user name from the list according to the following ordered set of rules: 1. Select the user name from the list for which the associated host name matches the name of the server. 2. Select the user name which has no associated host name; the wild card name. 3. Use the Job_Owner as the user name.</td>
<td><em>String</em> Form: ( \text{user@host}, \text{user@host} \ldots ) Must be enclosed in double quotes if it contains commas. May be up to 15 characters in length.</td>
<td></td>
<td></td>
<td></td>
<td>pbs user list</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
<tr>
<td>Variable_List</td>
<td>List of environment variables set in the job’s execution environment. See the qsub (1B) command.</td>
<td><em>String</em> Form: ( \text{name=value}, \text{name=value} \ldots ) Must be enclosed in double quotes if it contains commas.</td>
<td></td>
<td></td>
<td></td>
<td>Dictionary: Variable_List[ &lt;variable name&gt; ] = &lt;value&gt; where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r, w</td>
<td>r, w</td>
<td>r, w</td>
</tr>
</tbody>
</table>
## Attributes

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<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>User</th>
<th>Option</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>accounting_id</td>
<td>Accounting ID for tracking accounting data not produced by PBS.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>accrue_type</td>
<td>Indicates what kind of time the job is accruing.</td>
<td>Integer</td>
<td>0 (initial time)</td>
<td>Job is accruing initial time.</td>
<td>2 (eligible_time)</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 (ineligible_time)</td>
<td>Job is accruing ineligible time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 (eligible_time)</td>
<td>Job is accruing eligible time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 (run_time)</td>
<td>Job is accruing run time.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>alt_id</td>
<td>For a few systems, the session id is insufficient to track which processes belong to the job. Where a different identifier is required, it is recorded in this attribute. If set, it will also be recorded in the end-of-job accounting record. For jobs running in CPU sets, the alt_id holds the set name in a form usable by the <code>cpuset(1)</code> command. For HPCBP, holds HPCBP server job ID. On Windows, holds PBS home directory.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

The following attributes are read-only:

- **accounting_id**: Accounting ID for tracking accounting data not produced by PBS.
- **accrue_type**: Indicates what kind of time the job is accruing.
- **alt_id**: For a few systems, the session id is insufficient to track which processes belong to the job. Where a different identifier is required, it is recorded in this attribute. If set, it will also be recorded in the end-of-job accounting record. For jobs running in CPU sets, the alt_id holds the set name in a form usable by the `cpuset(1)` command. For HPCBP, holds HPCBP server job ID. On Windows, holds PBS home directory.
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<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>array_id</td>
<td>Applies only to subjobs. Array identifier of subjob.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>array_index</td>
<td>Applies only to subjobs. Index number of subjob.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>array_indices_remaining</td>
<td>Applies only to job arrays. List of indices of subjobs still queued.</td>
<td>String. Range</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>or list of ranges, e.g. 500, 552, 596-1000.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>array_state_count</td>
<td>Applies only to job arrays. Lists number of subjobs in each state.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.state_count</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>ctime</td>
<td>The time that the job was created.</td>
<td>Integer. Seconds</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>egroup</td>
<td>If the job is queued, this attribute is set to the group name under which the job is to be run.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>estimated</td>
<td>List of values associated with job’s estimated start time. Used to report job’s exec_vnode and start_time. Can be set in a hook or via qalter, but PBS will overwrite the values.</td>
<td>String. Form: estimated.&lt;res&gt;=&lt;value&gt;, estimated.&lt;res&gt;=&lt;value&gt;</td>
<td></td>
<td></td>
<td>Unset</td>
<td>Dictionary: estimated. &lt;resource name&gt;=&lt;value&gt; where &lt;resource name&gt; is any resource.</td>
<td>r</td>
<td>r</td>
<td>r, w</td>
</tr>
<tr>
<td></td>
<td>exec_vnode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>start_time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etime</td>
<td>The time that the job became eligible to run when queued in an execution queue.</td>
<td>Integer. Seconds</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>

---

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PBS Professional 11.2 Reference Guide
### Attributes

**Chapter 6**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>USr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>euser</td>
<td>If the job is queued, this attribute is set to the user name under which the job is to be run.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>-</td>
<td>-</td>
<td>r</td>
</tr>
<tr>
<td>Exit_status</td>
<td>Exit status of job. Set to zero for successful execution. If any subjob of an array job has non-zero exit status, the array job has non-zero exit status.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>forward_x11(cookie)</td>
<td>Contains the X authorization cookie.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>forward_x11(port)</td>
<td>Contains the number of the port being listened to by the port forwarder on the submission host.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>hashname</td>
<td>No longer used.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>jobdir</td>
<td>Path of the job’s staging and execution directory on the primary execution host. Either user’s home, or private sandbox. Depends on value of sandbox attribute. Viewable via qstat -f</td>
<td>String</td>
<td></td>
<td></td>
<td></td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>Job_Owner</td>
<td>The login name on the submitting host of the user who submitted the batch job.</td>
<td>String</td>
<td></td>
<td>&lt;User-name&gt;@&lt;submission host&gt;</td>
<td></td>
<td>str</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>
### Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>job_state</td>
<td>The state of the job.</td>
<td>Character</td>
<td>E</td>
<td>(Exiting) The job has finished, with or without errors, and PBS is cleaning up post-execution.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>(Held) The job is held.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Q</td>
<td>(Queued) The job resides in an execution or routing queue pending execution or routing. It is not in held or waiting state.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R</td>
<td>(Running) The job is in an execution queue and is running.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S</td>
<td>(Suspend) The job was executing and has been suspended. The job retains its assigned resources but does not use CPU cycles or walltime.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T</td>
<td>(Transiting) The job is being routed or moved to a new destination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>U</td>
<td>(User suspend) The job was running on a workstation configured for cycle harvesting and the keyboard/mouse is currently busy. The job is suspended until the workstation has been idle for a configured amount of time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>W</td>
<td>(Waiting) The job is not held but the Execution_Time attribute contains a time which has not yet been reached.</td>
</tr>
<tr>
<td>mtime</td>
<td>The time that the job was last modified, changed state, or changed locations.</td>
<td>Integer</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>qttime</td>
<td>The time that the job entered the current queue.</td>
<td>Integer</td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
## Attributes

### Chapter 6

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Queue</strong></td>
<td>The name of the queue in which the job currently resides.</td>
<td>String</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.queue</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td><strong>queue_rank</strong></td>
<td>A number indicating the job’s position within its queue. Only used internally by PBS.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>r</td>
</tr>
<tr>
<td><strong>queue_type</strong></td>
<td>The type of queue in which the job is currently residing.</td>
<td>Character</td>
<td>E</td>
<td>Execution queue</td>
<td>None</td>
<td>PBS queue type constant</td>
<td>-</td>
<td>-</td>
<td>r</td>
</tr>
<tr>
<td><strong>resources_used</strong></td>
<td>The amount of each resource used by the job.</td>
<td>String</td>
<td></td>
<td>resources_used.&lt;res&gt;=&lt;val&gt;, resources_used.&lt;res&gt;=&lt;val&gt;</td>
<td>None</td>
<td>Dictionary: resources_used where &lt;resource name&gt; is any built-in or custom resource</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td><strong>run_count</strong></td>
<td>The number of times the job has been executed.</td>
<td>Integer</td>
<td></td>
<td></td>
<td>Zero</td>
<td>int</td>
<td>-</td>
<td>-</td>
<td>r</td>
</tr>
<tr>
<td><strong>schedselect</strong></td>
<td>The union of the select specification of the job, and the queue and server defaults for resources in a chunk.</td>
<td>None</td>
<td></td>
<td></td>
<td>None</td>
<td>pbs.select</td>
<td>-</td>
<td>-</td>
<td>r</td>
</tr>
</tbody>
</table>
## Attributes

### Job Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>server</td>
<td>The name of the server which is currently managing the job. When the secondary server is running during failover, shows the name of the primary server. After a job is moved to another server, either via qmove or peer scheduling, shows the name of the new server.</td>
<td>String</td>
<td></td>
<td>None</td>
<td>pbs.server</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>session_id</td>
<td>If the job is running, this is set to the session id of the first executing task.</td>
<td></td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>Stageout_status</td>
<td>Status of stageout. If stageout succeeded, this is set to 1. If stageout failed, this is set to 0. Available only for finished jobs. Displayed only if set. If stageout fails for any subjob of an array job, the value of Stageout_status is zero for the array job.</td>
<td>Integer</td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>stime</td>
<td>The time when the job started execution. Changes when job is restarted.</td>
<td>Integer</td>
<td></td>
<td>Seconds since epoch</td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
</tbody>
</table>
### Attributes

**Chapter 6**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Def Val</th>
<th>Python Type</th>
<th>Usr</th>
<th>Opt</th>
<th>Mgr</th>
</tr>
</thead>
<tbody>
<tr>
<td>substate</td>
<td>The substate of the job. The substate is used internally by PBS.</td>
<td>Integer</td>
<td></td>
<td>None</td>
<td>int</td>
<td>r</td>
<td>r</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>sw_index</td>
<td>No longer used. Gone from .c file.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 6.12 Hook Attributes

An unset hook attribute takes the default value for that attribute.

Hook attributes can be set by root only.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>enabled</td>
<td>Determines whether or not a hook is run when its triggering event occurs.</td>
<td>Boolean</td>
<td>True / Opt</td>
<td>Hook is run when triggering event occurs</td>
<td>True</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>False</td>
<td>Hook is not run when triggering event occurs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>user</td>
<td>Specifies who executes the hook.</td>
<td>String</td>
<td>pbsadmin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>event</td>
<td>List of events that trigger the hook. Can be operated on with the &quot;=&quot;&quot;, &quot;+=&quot;, and &quot;-=&quot; operators. The provision event cannot be combined with any other events.</td>
<td>String_array</td>
<td>queuejob, modifyjob, movejob, resvsub, runjob, &quot;provision&quot;</td>
<td>Hook is triggered when job is enqueued</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hook is triggered when job is modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hook is triggered when job is moved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hook is triggered when reservation is created</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hook is triggered when job is run</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;provision&quot; meaning hook is not triggered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>order</td>
<td>Indicates relative order of hook execution, for hooks sharing a trigger.</td>
<td>Integer</td>
<td></td>
<td>Hook is master provisioning hook</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hooks with lower order values execute before those with higher values.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following attributes are settable and readable by root or the Admin at the local server only.
### Attributes

**Chapter 6**

#### Hook Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Format</th>
<th>Val / Opt</th>
<th>Value/Option Description</th>
<th>Default Value</th>
<th>Python Type</th>
<th>S</th>
<th>O</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarm</td>
<td>Specifies the number of seconds to allow a hook to run before the hook times out.</td>
<td>Integer</td>
<td></td>
<td>Integer. Must be greater than zero.</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Attributes

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PBS Professional 11.2 Reference Guide
Chapter 7

Formats

This chapter describes the formats used in PBS Professional.

7.1 List of Formats

PBS NAME
This is a generic term, used to describe various PBS entities. For example, attribute names are PBS NAMES.
Must start with an alpha-numeric character, and may contain the following: alpha-numeric . _ - # : / @
Specifically excluded: ` ~ ! $ % ^ & * ( ) + = < > ? ; " |

Accounting Log Entry
logfile-date-time;record-type;id-string;message-text
where
logfile-date-time
Date and time stamp in the format:
mm/dd/yyyy hh:mm:ss
record-type
A single character indicating the type of record
id-string
The job or reservation identifier
message-text
Format: blank-separated keyword=value fields.
Chapter 7  Formats

Message text is ASCII text.
Content depends on the record type.

Attribute Name
PBS NAME

Boolean
Name of resource is a string.
Values:
TRUE, True, true, T, t, Y, y, 1
FALSE, False, false, F, f, N, n, 0

Date
<Date of week> <Name of month> <Day of month> <HH:MM:SS>
<YYYY>

Datetime
[[[CC]YY][MM][DD][hhmm].[SS]]
where

Table 7-1: Datetime Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>Century</td>
</tr>
<tr>
<td>YY</td>
<td>Year</td>
</tr>
<tr>
<td>MM</td>
<td>Month</td>
</tr>
<tr>
<td>DD</td>
<td>Day of month</td>
</tr>
<tr>
<td>hh</td>
<td>Hour</td>
</tr>
<tr>
<td>mm</td>
<td>Minute</td>
</tr>
<tr>
<td>SS</td>
<td>Second</td>
</tr>
</tbody>
</table>

When setting the value, each portion of the date defaults to the current date, as long as the next-smaller portion is in the future. For example, if today is the 3rd of the month and the specified day DD is the 5th, the month MM will be set to the current month.
If a specified portion has already passed, the next-larger portion will be set to one after the current date. For example, if the day DD is not specified, but the hour hh is specified to be 10:00 a.m. and the current time is 11:00 a.m., the day DD will be set to tomorrow.

Unspecified portions default to now.

**Destination Identifier**

String used to specify a particular destination. The identifier may be specified in one of three forms:

- `<queue name>@<server name>`
- `<queue name>`
- `@<server name>`

where `<queue name>` is an ASCII character string of up to 15 characters. Valid characters are alphanumerics, the hyphen and the underscore. The string must begin with a letter.

**Duration**

A period of time, expressed either as

- integer seconds

or

- `[[hours:]minutes:]seconds[.milliseconds]`
  in the form:
  - `[[HH:]MM:]SS[.milliseconds]`
  Note that milliseconds are rounded to nearest second.

**Float**

Floating point. Allowable values: `[-+0-9][0-9]...[.][0-9]...`

**Host Name**

String of the form

- `name.domain`

where `domain` is a hierarchical, dot-separated list of subdomains. Therefore, a host name cannot contain a dot, "." as a legal character other than as a subdomain separator.

The name must not contain the commercial at sign, "@", as this is often used to separate a file from the host in a remote file name.

A host name cannot contain a colon, ":".

The maximum length of a host name supported by PBS is defined by `PBS_MAXHOSTNAME`, currently set to 64.
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Formats

**Job Identifier**

`sequence_number[.server_name][@server]`

Format:

`[0-9]+[(0-9]+)[.]IP_HOSTNAME[.IP_DOMAINNAME]`

**Job Array Identifier**

Job array identifiers are a sequence number followed by square brackets:

`sequence_number[][.server_name][@server]`

Example:

`1234[]`

Note that some shells require that you enclose a job array ID in double quotes.

**Job Array Range**

`sequence_number[<first>-<last>][.server_name][@server]`

`first` and `last` are the first and last indices of the subjobs.

**Job Name, Job Array Name**

A job name or job array name can be at most 15 characters. It must consist of printable, non-whitespace characters. The first character must be alphabetic, numeric, plus sign (“+”), dash or minus (“-”), or underscore (“_”). The name must not contain special characters.

**Limit Specification**

`limit-spec=limit[, limit-spec=limit, ...]`

where `limit-spec` is:

<table>
<thead>
<tr>
<th><code>limit-spec</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>o:PBS_ALL</td>
</tr>
<tr>
<td>p:PBS_GENERIC</td>
</tr>
<tr>
<td>p:&lt;project name&gt;</td>
</tr>
<tr>
<td>u:PBS_GENERIC</td>
</tr>
</tbody>
</table>

Table 7-2: Limit Specification Syntax
See the PBS Professional Administrator’s Guide for an explanation of what each limit-spec means.

**logfile-date-time**
Date and time stamp in the format:

```
mm/dd/yyyy hh:mm:ss
```

**long**
Long integer. Allowable values: 0-9 [[0-9] ...]

**Queue Identifier**
To specify a queue at the default server:

```
<queue name>
```

To specify all queues at a server:

```
@<server name>
```

To specify a queue at a specific server:

```
<queue name>@<server name>
```

**Queue Name**
PBS NAME

**Resource Name**
PBS NAME

Resource names are case-insensitive.

**Resource Value**

- PBS NAME, or
- Anything inside double quotes

The format of each data type is defined for that data type. For example, float resources are defined above, in “Float” on page 395.
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**Formats**

**Size**

Number of bytes or words. The size of a word is the word size on the execution host.

Default: bytes

Format:

\[ \text{integer[suffix]} \]

where suffix can be one of the following:

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Meaning</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>b or w</td>
<td>Bytes or words</td>
<td>1</td>
</tr>
<tr>
<td>kb or kw</td>
<td>Kilobytes or kilowords</td>
<td>2 to the 10th, or 1024</td>
</tr>
<tr>
<td>mb or mw</td>
<td>Megabytes or mega-words</td>
<td>2 to the 20th, or 1,048,576</td>
</tr>
<tr>
<td>gb or gw</td>
<td>Gigabytes or gigawords</td>
<td>2 to the 30th, or 1,073,741,824</td>
</tr>
<tr>
<td>tb or tw</td>
<td>Terabytes or terawords</td>
<td>2 to the 40th, or 1024 gigabytes</td>
</tr>
<tr>
<td>pb or pw</td>
<td>Petabytes or petawords</td>
<td>2 to the 50th, or 1,048,576 gigabytes</td>
</tr>
</tbody>
</table>

**String (resource value)**

Any character, including the space character.

Only one of the two types of quote characters, " or ", may appear in any given value.

Values: [-a-zA-Z0-9][\_\-a-zA-Z0-9 ! # $ % \^ * + , . / : ; < > ? @ [ \ ] ^ _ \{ \} ~ ...]

String resource values are case-sensitive.

**string_array**

Comma-separated list of strings. Strings in string_array may not contain commas.
Subjob Identifier

Subjob identifiers are a sequence number followed by square brackets enclosing the subjob’s index:

\[ sequence\_number[index]/.server\_name[@server] \]

Example:

1234[99]

User Name

String up to 16 characters in length. PBS supports names containing any printable, non-whitespace character except the at sign (“@”). Your platform may place additional limitations on user names.

User Name, Windows

Must conform to the POSIX-1 standard for portability:

• The username must contain only alphanumeric characters, dot (.), underscore (_), and/or hyphen "-".

• The hyphen must not be the first letter of the username.

• If "@" appears in the username, then it will assumed to be in the context of a Windows domain account: username@domainname.

• An exception to the above rule is the space character, which is allowed. If a space character appears in a username string, then it will be displayed quoted and must be specified in a quoted manner.

Vnode Name

• For the natural vnode, the vnode name must conform to legal name for a host

• For other vnodes, the vnode name is a PBS NAME
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Formats
Chapter 8

States

This chapter lists and describes the states in PBS Professional.

8.1 Job States

Job states are abbreviated to one character.

Table 8-1: Job States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Job arrays only: job array has started</td>
</tr>
<tr>
<td>E</td>
<td>Job is exiting after having run</td>
</tr>
<tr>
<td>F</td>
<td>Job is finished. Job has completed execution, job failed during execution, or job was deleted.</td>
</tr>
<tr>
<td>H</td>
<td>Job is held. A job is put into a held state by the server or by a user or administrator. A job stays in a held state until it is released by a user or administrator.</td>
</tr>
<tr>
<td>M</td>
<td>Job was moved to another server</td>
</tr>
<tr>
<td>Q</td>
<td>Job is queued, eligible to run or be routed</td>
</tr>
<tr>
<td>R</td>
<td>Job is running</td>
</tr>
<tr>
<td>S</td>
<td>Job is suspended by server. A job is put into the suspended state when a higher priority job needs the resources.</td>
</tr>
</tbody>
</table>
## States

### 8.1.1 Job Substates

Job substates are numeric:

<table>
<thead>
<tr>
<th>Substate Number</th>
<th>Substate Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Transit in, prior to waiting for commit</td>
</tr>
<tr>
<td>01</td>
<td>Transit in, waiting for commit</td>
</tr>
<tr>
<td>02</td>
<td>transiting job outbound, not ready to commit</td>
</tr>
<tr>
<td>03</td>
<td>transiting outbound, ready to commit</td>
</tr>
<tr>
<td>10</td>
<td>job queued and ready for selection</td>
</tr>
<tr>
<td>11</td>
<td>job queued, has files to stage in</td>
</tr>
<tr>
<td>14</td>
<td>job staging in files before waiting</td>
</tr>
<tr>
<td>15</td>
<td>job staging in files before running</td>
</tr>
<tr>
<td>16</td>
<td>job stage in complete</td>
</tr>
<tr>
<td>20</td>
<td>job held - user or operator</td>
</tr>
<tr>
<td>22</td>
<td>job held - waiting on dependency</td>
</tr>
<tr>
<td>30</td>
<td>job waiting until user-specified execution time</td>
</tr>
</tbody>
</table>
### States

Chapter 8

#### Table 8-2: Job Substates

<table>
<thead>
<tr>
<th>Substate Number</th>
<th>Substate Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>job held - file stage in failed</td>
</tr>
<tr>
<td>41</td>
<td>job sent to MOM to run</td>
</tr>
<tr>
<td>42</td>
<td>Running</td>
</tr>
<tr>
<td>43</td>
<td>Suspended by Operator or Manager</td>
</tr>
<tr>
<td>44</td>
<td>job sent to run under Globus</td>
</tr>
<tr>
<td>45</td>
<td>Suspended by Scheduler</td>
</tr>
<tr>
<td>50</td>
<td>Server received job obit</td>
</tr>
<tr>
<td>51</td>
<td>Staging out stdout/err and other files</td>
</tr>
<tr>
<td>52</td>
<td>Deleting stdout/err files and staged-in files</td>
</tr>
<tr>
<td>53</td>
<td>Mom releasing resources</td>
</tr>
<tr>
<td>54</td>
<td>job is being aborted by server</td>
</tr>
<tr>
<td>56</td>
<td>(Set by MOM) Mother Superior telling sisters to kill everything</td>
</tr>
<tr>
<td>57</td>
<td>(Set by MOM) job epilogue running</td>
</tr>
<tr>
<td>58</td>
<td>(Set by MOM) job obit notice sent</td>
</tr>
<tr>
<td>59</td>
<td>Waiting for site &quot;job termination&quot; action script</td>
</tr>
<tr>
<td>60</td>
<td>Job to be rerun, MOM sending stdout/stderr back to Server</td>
</tr>
<tr>
<td>61</td>
<td>Job to be rerun, staging out files</td>
</tr>
<tr>
<td>62</td>
<td>Job to be rerun, deleting files</td>
</tr>
<tr>
<td>63</td>
<td>Job to be rerun, freeing resources</td>
</tr>
<tr>
<td>70</td>
<td>Array job has begun</td>
</tr>
<tr>
<td>71</td>
<td>Job is waiting for vnode(s) to be provisioned with its requested AOE.</td>
</tr>
<tr>
<td>153</td>
<td>(Set by MOM) Mother Superior waiting for delete ACK from sisters</td>
</tr>
</tbody>
</table>
8.2 Job Array States

Job array states map closely to job states except for the ‘B’ state. The ‘B’ state applies to job arrays and indicates that at least one subjob has left the queued state and is running or has run, but not all subjobs have run. Job arrays will never be in the ‘R’, ‘S’ or ‘U’ states.

<table>
<thead>
<tr>
<th>State</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>The job array has started</td>
</tr>
<tr>
<td>E</td>
<td>All subjobs are finished and the server is cleaning up the job array</td>
</tr>
<tr>
<td>F</td>
<td>The job array is finished</td>
</tr>
<tr>
<td>H</td>
<td>The job array is held</td>
</tr>
<tr>
<td>Q</td>
<td>The job array is queued, or has been qrerun</td>
</tr>
<tr>
<td>T</td>
<td>The job array is in transit between servers</td>
</tr>
<tr>
<td>W</td>
<td>The job array has a wait time in the future</td>
</tr>
</tbody>
</table>

8.3 Subjob States

Subjobs can be in one of six states, listed here.

<table>
<thead>
<tr>
<th>State</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Ending</td>
</tr>
<tr>
<td>F</td>
<td>Finished</td>
</tr>
<tr>
<td>Q</td>
<td>Queued</td>
</tr>
<tr>
<td>R</td>
<td>Running</td>
</tr>
<tr>
<td>S</td>
<td>Suspended</td>
</tr>
<tr>
<td>U</td>
<td>Suspended by keyboard activity</td>
</tr>
</tbody>
</table>
8.4 Server States

The state of the server is shown in the server_state server attribute. Possible values are:

**Table 8-5: Server States**

<table>
<thead>
<tr>
<th>State</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot_Start</td>
<td>The Server has been started so that it will run first any jobs that were running when the Server was shut down. Python type: pbs.SV_STATE_HOT</td>
</tr>
<tr>
<td>Idle</td>
<td>The Server is running. The Scheduler is between scheduling cycles. Python type: pbs.SV_STATE_IDLE</td>
</tr>
<tr>
<td>Scheduling</td>
<td>The Server is running. The Scheduler is in a scheduling cycle. Python type: pbs.SV_STATE_ACTIVE</td>
</tr>
<tr>
<td>Terminating</td>
<td>The Server is terminating. Python type: pbs.SV_STATE_SHUTIMM or pbs.SV_STATE_SHUTSIG</td>
</tr>
<tr>
<td>Terminating_Delayed</td>
<td>The Server is terminating in delayed mode. No new jobs will be run, and the Server will shut down when the last running job finishes. Python type: pbs.SV_STATE_SHUTDEL</td>
</tr>
</tbody>
</table>

**Table 8-4: Subjob States**

<table>
<thead>
<tr>
<th>State</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Expired or deleted; subjob has completed execution or been deleted</td>
</tr>
</tbody>
</table>
8.5 Vnode States

If a vnode’s state attribute is unset, that is equivalent to the state being free. A vnode’s state is shown in its state attribute, which can take on zero or more of the values listed here. Some vnode state values can be set simultaneously. Values are:

<table>
<thead>
<tr>
<th>State</th>
<th>Set By</th>
<th>Description</th>
<th>Can Combine With these States</th>
</tr>
</thead>
<tbody>
<tr>
<td>busy</td>
<td>Server</td>
<td>Node is up and has load average greater than max_load, or is showing keyboard or mouse activity. When the loadave is above max_load, that node is marked busy. The scheduler won’t place jobs on a node marked busy. When the loadave drops below ideal_load, or when the mouse and keyboard have not shown any activity for a specified amount of time, the busy mark is removed. Consult your OS documentation to determine values that make sense.</td>
<td>offline</td>
</tr>
<tr>
<td>down</td>
<td>Server</td>
<td>Node is not usable. Existing communication lost between Server and MOM.</td>
<td>Cannot be set with free</td>
</tr>
<tr>
<td>free</td>
<td>Server</td>
<td>Node is up and has available CPU(s). Server will mark a vnode “free” on first successful ping after vnode was “down”.</td>
<td>None</td>
</tr>
<tr>
<td>job-busy</td>
<td>Server</td>
<td>Node is up and all CPUs are allocated to jobs.</td>
<td>offline resv-exclusive</td>
</tr>
</tbody>
</table>
### Table 8-6: Vnode States

<table>
<thead>
<tr>
<th>State</th>
<th>Set By</th>
<th>Description</th>
<th>Can Combine With these States</th>
</tr>
</thead>
</table>
| *job-exclusive*  | Server     | Node is up and has been allocated exclusively to a single job.              | *offline*
|                  |            |                                                                             | *resv-exclusive*                                |
| *offline*        | Manager/Operator | Node is not usable. Jobs running on this vnode will continue to run. Used by Manager/Operator to mark a vnode not to be used for jobs. | *busy*
|                  |            |                                                                             | *job-busy*
|                  |            |                                                                             | *job-exclusive*
|                  |            |                                                                             | *resv-exclusive*                                |
| *provisioning*   | Server     | A vnode is in the provisioning state while it is in the process of being provisioned. No jobs are run on vnodes in the provisioning state. | Cannot be set with any other states |
| *resv-exclusive* | Server     | Reservation has requested exclusive use of vnode, and reservation is running. | *job-exclusive*, *offline*                     |
| *stale*          | Server     | MOM managing vnode is not reporting any information about this vnode, but was reporting it previously. Server can still communicate with MOM. A vnode becomes *stale* when: 1. A vnode is defined in the Server 2. MOM starts or restarts and reports a set of vnodes according to her configuration 3. A vnode which existed in the server earlier is not in the set being reported now by MOM 4. That vnode is marked "*stale" | Cannot be set with *free*                      |
Chapter 8  

**States**

### Table 8-6: Vnode States

<table>
<thead>
<tr>
<th>State</th>
<th>Set By</th>
<th>Description</th>
<th>Can Combine With these States</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>state-unknown, down</code></td>
<td>Server</td>
<td>Node is not usable. Since Server’s latest start, no communication with this vnode. May be network or hardware problem, or no MOM on vnode.</td>
<td></td>
</tr>
<tr>
<td><code>wait-provisioning</code></td>
<td>Server</td>
<td>There is a limit on the maximum number of vnodes that can be in the provisioning state. This limit is specified in the Server’s <code>max_concurrent_provision</code> attribute. If a vnode is to be provisioned, but cannot because the number of concurrently provisioning vnodes has reached the specified maximum, the vnode goes into the <code>wait-provisioning state</code>. No jobs are run on vnodes in the <code>wait-provisioning state</code>.</td>
<td>Cannot be set with any other states</td>
</tr>
</tbody>
</table>

### 8.6 Reservation States

The following table shows the list of possible states for a reservation. The states that you will usually see are `CO`, `UN`, `BD`, and `RN`, although a reservation usually remains unconfirmed for too short a time to see that state.

**Table 8-7: Reservation States**

<table>
<thead>
<tr>
<th>Code</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>RESV_NONE</td>
<td>No reservation yet</td>
</tr>
<tr>
<td>UN</td>
<td>RESV_UNCONFIRMED</td>
<td>Reservation not confirmed</td>
</tr>
</tbody>
</table>
Table 8-7: Reservation States

<table>
<thead>
<tr>
<th>Code</th>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>RESV_CONFIRMED</td>
<td>Reservation confirmed</td>
</tr>
<tr>
<td>DG</td>
<td>RESV_DEGRADED</td>
<td>Vnode(s) allocated to reservation unavailable</td>
</tr>
<tr>
<td>WT</td>
<td>RESV_WAIT</td>
<td>Unused</td>
</tr>
<tr>
<td>TR</td>
<td>RESV_TIME_TO_RUN</td>
<td>Transitory state; reservation’s start time has arrived</td>
</tr>
<tr>
<td>RN</td>
<td>RESV_RUNNING</td>
<td>Time period from reservation’s start time to end time is being traversed</td>
</tr>
<tr>
<td>FN</td>
<td>RESV_FINISHED</td>
<td>Transitory state; reservation’s end time has arrived and reservation will be deleted</td>
</tr>
<tr>
<td>BD</td>
<td>RESV_BEING_DELETED</td>
<td>Transitory state; reservation is being deleted</td>
</tr>
<tr>
<td>DE</td>
<td>RESV_DELETED</td>
<td>Transitory state; reservation has been deleted</td>
</tr>
<tr>
<td>DJ</td>
<td>RESV_DELETING_JOBS</td>
<td>Jobs remaining after reservation’s end time being deleted</td>
</tr>
</tbody>
</table>

Table 8-8: Degraded Reservation States and Substates

<table>
<thead>
<tr>
<th></th>
<th>Reservation Time in Future</th>
<th>Reservation Time Is Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Reserva-</td>
<td>RESV_DEGRADED</td>
<td>RESV_RUNNING</td>
</tr>
<tr>
<td>tion State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance Reserva-</td>
<td>RESV_DEGRADED</td>
<td>RESV_DEGRADED</td>
</tr>
<tr>
<td>tion Substate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.6.1 Degraded Reservation Substates

The following table shows states and substates for degraded reservations:
8.6.2 Numeric Reservation States

The following table lists the numeric representations of reservation states and substates:

Table 8-9: Numeric Reservation States and Substates

<table>
<thead>
<tr>
<th>Decimal</th>
<th>State/Substate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>RESV_NONE</td>
</tr>
<tr>
<td>1</td>
<td>RESV_UNCONFIRMED</td>
</tr>
<tr>
<td>2</td>
<td>RESV_CONFIRMED</td>
</tr>
<tr>
<td>3</td>
<td>RESV_WAIT</td>
</tr>
<tr>
<td>4</td>
<td>RESV_TIME_TO_RUN</td>
</tr>
<tr>
<td>5</td>
<td>RESV_RUNNING</td>
</tr>
<tr>
<td>6</td>
<td>RESV_FINISHED</td>
</tr>
<tr>
<td>7</td>
<td>RESV_RESV_BEING_DELETED</td>
</tr>
<tr>
<td>8</td>
<td>RESV_DELETED</td>
</tr>
<tr>
<td>9</td>
<td>RESV_DELETING_JOBS</td>
</tr>
<tr>
<td>10</td>
<td>RESV_DEGRADED</td>
</tr>
</tbody>
</table>
Accounting Log

This chapter describes the accounting log. The PBS accounting log is a text file with each entry terminated by a newline. There is no limit to the size of an entry.

9.1 Log Entry Format

The format of an entry is:

logfile-date-time;record-type;id-string;message-text

where

logfile-date-time

Date and time stamp in the format:

mm/dd/yyyy hh:mm:ss

record-type

A single character indicating the type of record

id-string

The job or reservation identifier

message-text

Message text format is blank-separated keyword=value fields.
Message text is ASCII text.
Content depends on the record type.
There is no dependable ordering of the content of each message.
Chapter 9  

**Accounting Log**

### 9.1.1 Resources

Values for requested resources are written in the same units as those in the resource requests. Values for `resources_used` and `resources_assigned` are written in kb. A suffix is always written unless the quantity is measured in bytes.

For `Resource_List` and `resources_used`, there is one entry per resource, corresponding to the resources requested and used, respectively.

If a job ends between MOM poll cycles, `resources_used` numbers will be slightly lower than they are in reality. For long-running jobs, the error percentage will be minor.

### 9.2 Record Types

The record types are:

A  
Job was aborted by the server.

B  
Beginning of reservation period. If the log entry is for a reservation, the `message-text` field contains information describing the specified reservation. Possible information includes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>owner=ownername</code></td>
<td>Name of party who submitted the reservation request.</td>
</tr>
<tr>
<td><code>name=reservation_name</code></td>
<td>If submitter supplied a name string for the reservation.</td>
</tr>
<tr>
<td><code>queue=queue_name</code></td>
<td>The name of the reservation queue.</td>
</tr>
<tr>
<td><code>ctime=creation_time</code></td>
<td>Time at which the reservation was created; seconds since the epoch.</td>
</tr>
<tr>
<td><code>start=period_start</code></td>
<td>Time at which the reservation period is to start, in seconds since the epoch.</td>
</tr>
<tr>
<td><code>end=period_end</code></td>
<td>Time at which the reservation period is to end, in seconds since the epoch.</td>
</tr>
</tbody>
</table>
Job was checkpointed and held.

Job was deleted by request. The message-text will contain requestor=user@host to identify who deleted the job.

Job ended (terminated execution). In this case, the message-text field contains information about the job. The end of job accounting record will not be written until all of the resources have been freed. The “end” entry in the

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>duration = reservation_duration</td>
<td>The duration specified or computed for the reservation, in seconds.</td>
</tr>
<tr>
<td>exec_host= vnode_list</td>
<td>List of each vnode with vnode-level, consumable resources allocated from that vnode. exec_host=vnodeA/P*C [+vnodeB/P * C] where P is a unique index and C is the number of CPUs assigned to the reservation, 1 if omitted.</td>
</tr>
<tr>
<td>Authorized_Users = user_list</td>
<td>The list of users who are and are not authorized to submit jobs to the reservation.</td>
</tr>
<tr>
<td>Authorized_Groups= group_list</td>
<td>The list of groups who are and are not authorized to submit jobs to the reservation.</td>
</tr>
<tr>
<td>Authorized_Hosts= host_list</td>
<td>The list of hosts from which jobs may and may not be submitted to the reservation.</td>
</tr>
<tr>
<td>Resource_List= resources_list</td>
<td>List of resources requested by the reservation. Resources are listed individually as, for example: Resource_List.ncpus = 16 Resource_List.mem = 1048676.</td>
</tr>
</tbody>
</table>
job end record will include the time to stage out files, delete files, and free the resources. This will not change the recorded walltime for the job. Possible information includes:

**Table 9-2: Job End Record Contents**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exit_status= &lt;value&gt;</td>
<td>The exit status of the job. See section 12.9, &quot;Job Exit Codes&quot; on page 715 in the PBS Professional Administrator’s Guide.</td>
</tr>
<tr>
<td>account= &lt;account_string&gt;</td>
<td>If job has an “account name” string.</td>
</tr>
<tr>
<td>accounting_id=&lt;jidvalue&gt;</td>
<td>CSA JID, job container ID</td>
</tr>
<tr>
<td>alt_id=&lt;ID&gt;</td>
<td>Optional alternate job identifier. Included only for certain systems: On Altix machines with ProPack 6/7 or Performance Suite 1, the alternate ID will show the path to the job’s cpuset, starting with /PBSPro/.</td>
</tr>
<tr>
<td>ctime=&lt;time&gt;</td>
<td>Time in seconds when job was created (first submitted), seconds since epoch.</td>
</tr>
<tr>
<td>eligible_time=&lt;time&gt;</td>
<td>Amount of time job has waited while blocked on resources.</td>
</tr>
<tr>
<td>end=&lt;time&gt;</td>
<td>Time in seconds since epoch when this accounting record was written.</td>
</tr>
<tr>
<td>etime=&lt;time&gt;</td>
<td>Time in seconds when job became eligible to run, i.e. was enqueued in an execution queue and was in the “Q” state. Reset when a job moves queues. Not affected by qaltering.</td>
</tr>
</tbody>
</table>
### Table 9-2: Job End Record Contents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>exec_host= &lt;vnode_list&gt;</td>
<td>List of each vnode with vnode-level, consumable resources allocated from that vnode. exec_host=vnodeA/P*C [+vnodeB/P * C] where P is a unique index and C is the number of CPUs assigned to the job, 1 if omitted.</td>
</tr>
<tr>
<td>exec_vnode= &lt;vnode_list&gt;</td>
<td>List of each vnode with vnode-level, consumable resources from that vnode. (vnodeA+resource_name=P+..)+(vnodeB+resource_name=P+..) P is the amount of that resource allocated from that vnode.</td>
</tr>
<tr>
<td>group=&lt;groupname&gt;</td>
<td>The group name under which the job executed.</td>
</tr>
<tr>
<td>jobname=&lt;job_name&gt;</td>
<td>The name of the job.</td>
</tr>
<tr>
<td>project=&lt;project name&gt;</td>
<td>The job’s project name at the end of the job.</td>
</tr>
<tr>
<td>qtime=&lt;time&gt;</td>
<td>Time in seconds when job was queued into current queue.</td>
</tr>
<tr>
<td>queue=&lt;queue_name&gt;</td>
<td>The name of the queue in which the job executed.</td>
</tr>
<tr>
<td>resources_used.&lt;resource&gt;=&lt;amount&gt;</td>
<td>Resources used by the job as reported by MOM. Typically includes ncpus, mem, vmem, cput, walltime, cpupercent. Walltime does not include suspended time.</td>
</tr>
</tbody>
</table>
Table 9-2: Job End Record Contents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>resource_assigned.&lt;resource&gt; = &lt;value&gt;</td>
<td>Not a job attribute; simply a label for reporting job resource assignment. The value of resources_assigned reported in the Accounting records is the actual amount assigned to the job by PBS. All allocated consumable resources will be included in the &quot;resource_assigned&quot; entries, one resource per entry. Consumable resources include ncpus, mem and vmem by default, and any custom resource defined with the -n or -f flags. A resource will not be listed if the job does not request it directly or inherit it by default from queue or server settings. For example, if a job requests one CPU on an Altix that has four CPUs per blade/vnode and that vnode is allocated exclusively to the job, even though the job requested one CPU, it is assigned all 4 CPUs.</td>
</tr>
<tr>
<td>Resource_List.&lt;resource&gt;=&lt;amount&gt;</td>
<td>List of resources requested by the job. Resources are listed individually as, for example: Resource_List.ncpus =16 Resource_List.mem =1048676.</td>
</tr>
<tr>
<td>run_count=&lt;value&gt;</td>
<td>The number of times the job has been executed.</td>
</tr>
</tbody>
</table>
F

Resource reservation period finished.

K

Scheduler or server requested removal of the reservation. The message-text field contains: requestor=Server@host or requestor=Scheduler@host to identify who deleted the resource reservation.

K

Resource reservation terminated by ordinary client - e.g. an owner issuing a pbs_rdel command. The message-text field contains: requestor=user@host to identify who deleted the resource reservation.

L

License information. This line in the log will have the following fields:

Log date; record type; keyword; specification for floating license; hour; day; month; max

The following table explains each field:

<table>
<thead>
<tr>
<th>Field</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log date</td>
<td>Date of event</td>
</tr>
<tr>
<td>record type</td>
<td>Indicates license info</td>
</tr>
<tr>
<td>keyword</td>
<td>license</td>
</tr>
<tr>
<td>specification for floating license</td>
<td>Indicates that this is floating license info</td>
</tr>
<tr>
<td>hour</td>
<td>Number of licenses used in the last hour</td>
</tr>
</tbody>
</table>
Chapter 9  

**Accounting Log**

### Table 9-3: Licensing Information in Accounting Log

<table>
<thead>
<tr>
<th>Field</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>day</td>
<td>Number of licenses used in the last day</td>
</tr>
<tr>
<td>month</td>
<td>Number of licenses used in the last month</td>
</tr>
<tr>
<td>max</td>
<td>Maximum number of licenses ever used.</td>
</tr>
<tr>
<td></td>
<td>Not dependent on server restarts.</td>
</tr>
</tbody>
</table>

**M**

Information about moved jobs. Contains date, time, record type, job ID, destination.

**Q**

Job entered a queue. For this kind of record type, the `message-text` contains `queue=name` identifying the queue into which the job was placed. There will be a new `Q` record each time the job is routed or moved to a new (or the same) queue.

**R**

Job was rerun.

In this case, the `message-text` field contains information about the job. Possible information includes:

### Table 9-4: Job Rerun Record Contents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Exit_status=&lt;value&gt;</code></td>
<td>The exit status of the previous start of the job. See section 12.9, &quot;Job Exit Codes&quot; on page 715 in the PBS Professional Administrator’s Guide.</td>
</tr>
<tr>
<td><code>account= &lt;account_string&gt;</code></td>
<td>If job has an “account name” string.</td>
</tr>
<tr>
<td><code>accounting_id=&lt;jidvalue&gt;</code></td>
<td>CSA JID, job container ID</td>
</tr>
</tbody>
</table>
### Table 9-4: Job Rerun Record Contents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>alt_id=&lt;ID&gt;</td>
<td>Optional alternate job identifier. Included only for certain systems: On Altix machines with ProPack 6/7 or Performance Suite 1, the alternate ID will show the path to the job’s cpuset, starting with /PBSPro/.</td>
</tr>
<tr>
<td>ctime=&lt;time&gt;</td>
<td>Time in seconds when job was created (first submitted), seconds since epoch.</td>
</tr>
<tr>
<td>eligible_time=&lt;time&gt;</td>
<td>Amount of time job has waited while blocked on resources, starting at creation time.</td>
</tr>
<tr>
<td>end=&lt;time&gt;</td>
<td>Time in seconds since epoch when this accounting record was written.</td>
</tr>
<tr>
<td>etime=&lt;time&gt;</td>
<td>Time in seconds when job most recently became eligible to run, i.e. was enqueued in an execution queue and was in the “Q” state. Reset when a job moves queues. Not affected by qaltering.</td>
</tr>
<tr>
<td>exec_host= &lt;vnode_list&gt;</td>
<td>List of each vnode with vnode-level, consumable resources allocated from that vnode. exec_host=vnodeA/P<em>C [+vnodeB/P</em>C] where P is a unique index and C is the number of CPUs assigned to the job, 1 if omitted.</td>
</tr>
</tbody>
</table>
### Table 9-4: Job Rerun Record Contents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>exec_vnode= &lt;vnode_list&gt;</td>
<td>List of each vnode with vnode-level, consumable resources from that vnode. (vnodeA+resource_name=P+.)+(vnodeB+resource_name=P+.). P is the amount of that resource allocated from that vnode.</td>
</tr>
<tr>
<td>group=&lt;groupname&gt;</td>
<td>The group name under which the job executed.</td>
</tr>
<tr>
<td>jobname=&lt;job_name&gt;</td>
<td>The name of the job.</td>
</tr>
<tr>
<td>project=&lt;project name&gt;</td>
<td>The job’s project name.</td>
</tr>
<tr>
<td>qtime=&lt;time&gt;</td>
<td>Time in seconds when job was queued into current queue.</td>
</tr>
<tr>
<td>queue=&lt;queue_name&gt;</td>
<td>The name of the queue in which the job is enqueued.</td>
</tr>
<tr>
<td>Resource_List.&lt;resource&gt;=&lt;amount&gt;</td>
<td>List of resources requested by the job. Resources are listed individually as, for example: Resource_List.ncpus =16 Resource_List.mem =1048676.</td>
</tr>
<tr>
<td>run_count=&lt;value&gt;</td>
<td>The number of times the job has been executed.</td>
</tr>
<tr>
<td>session=&lt;sessionID&gt;</td>
<td>Session number of job.</td>
</tr>
<tr>
<td>start=&lt;time&gt;</td>
<td>Time when job execution started most recently.</td>
</tr>
<tr>
<td>user=&lt;username&gt;</td>
<td>The user name under which the job executed.</td>
</tr>
</tbody>
</table>
Job execution started. The *message-text* field contains:

**Table 9-5: Job Start Record Contents**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>accounting_id=</td>
<td>An identifier that is associated with system-generated accounting data. In the case where accounting is CSA on Altix, <em>identifier_string</em> is a job container identifier or JID created for the PBS job.</td>
</tr>
<tr>
<td>identifier_string</td>
<td></td>
</tr>
<tr>
<td>ctime=time</td>
<td>Time in seconds when job was created (first submitted).</td>
</tr>
<tr>
<td>etime=time</td>
<td>Time in seconds when job became eligible to run; no holds, etc.</td>
</tr>
<tr>
<td>exec_host=vnode_list</td>
<td>List of each vnode with vnode-level, consumable resources allocated from that vnode. exec_host=vnodeA/P*C [+vnodeB/P * C] where P is the job number and C is the number of CPUs assigned to the job, 1 if omitted.</td>
</tr>
<tr>
<td>group=groupname</td>
<td>The group name under which the job will execute.</td>
</tr>
<tr>
<td>jobname=job_name</td>
<td>The name of the job.</td>
</tr>
<tr>
<td>project=&lt;project name&gt;</td>
<td>The job’s project name at the start of the job.</td>
</tr>
<tr>
<td>qtime=time</td>
<td>Time in seconds when job was queued into current queue.</td>
</tr>
<tr>
<td>queue=queue_name</td>
<td>The name of the queue in which the job resides.</td>
</tr>
<tr>
<td>resource_assigned</td>
<td><strong>Not</strong> a job attribute; instead simply a label for reporting resources assigned to a job. Consumable resources that were allocated to that job.</td>
</tr>
</tbody>
</table>

PBS Professional 11.2 Reference Guide
Accounting Log

Table 9-5: Job Start Record Contents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource_List.resource=amount</td>
<td>List of resources requested by the job. Resources are listed individually as, for example: Resource_List.ncpus=16 Resource_List.mem=1048676.</td>
</tr>
<tr>
<td>session=sessionID</td>
<td>Session number of job.</td>
</tr>
<tr>
<td>start=time</td>
<td>Time in seconds when job execution started.</td>
</tr>
<tr>
<td>user=username</td>
<td>The user name under which the job will execute.</td>
</tr>
</tbody>
</table>

T

Job was restarted from a checkpoint file.

U

Created unconfirmed reservation on Server. The message-text field contains requestor=user@host to identify who requested the reservation.

Y

Reservation confirmed by the Scheduler. The message-text field contains requestor=user@host to identify who requested the reservation.
Chapter 10

Example Configurations

This chapter shows some configuration-specific scenarios which will hopefully clarify any configuration questions. Several configuration models are discussed, followed by several complex examples of specific features.

- Single Vnode System
- Single Vnode System with Separate PBS Server
- Multi-vnode complex
- Complex Multi-level Route Queues (including group ACLs)
- Multiple User ACLs

For each of these possible configuration models, the following information is provided:

- General description for the configuration model
- Type of system for which the model is well suited
- Contents of Server nodes file
- Any required Server configuration
- Any required MOM configuration
- Any required Scheduler configuration
10.1 Single Vnode System

Running PBS on a single vnode/host as a standalone system is the least complex configuration. This model is most applicable to sites who have a single large Server system, a single SMP system (e.g. an SGI Origin server), or even a vector supercomputer. In this model, all three PBS components run on the same host, which is the same host on which jobs will be executed, as shown in the figure below.

For this example, let’s assume we have a 32-CPU server machine named “mars”. We want users to log into mars and jobs will be run via PBS on mars.

In this configuration, the server’s default nodes file (which should contain the name of the host on which the Server was installed) is sufficient. Our example nodes file would contain only one entry: mars

The default MOM and Scheduler config files, as well as the default queue/Server limits are also sufficient in order to run jobs. No changes are required from the default configuration, however, you may wish to customize PBS to your site.
10.2 Separate Server and Execution Host

A variation on the model presented above would be to provide a “front-end” system that ran the PBS Server and Scheduler, and from which users submitted their jobs. Only the MOM would run on our execution server, mars. This model is recommended when the user load would otherwise interfere with the computational load on the Server.

In this case, the PBS server_priv/nodes file would contain the name of our execution server mars, but this may not be what was written to the file during installation, depending on which options were selected. It is possible the hostname of the machine on which the Server was installed was added to the file, in which case you would need to use qmgr(1B) to manipulate the contents to contain one vnode: mars. If the default scheduling policy, based on available CPUs and memory, meets your requirements, then no changes are required in either the MOM or Scheduler configuration files.

However, if you wish the execution host (mars) to be scheduled based on load average, the following changes are needed. Edit MOM’s mom_priv/config file so that it contains the target and maximum load averages:

```
$ideal_load 30
$max_load 32
```

In the Scheduler sched_priv/sched_config file, the following options would need to be set:

```
load_balancing: True all
```
The multi-vnode complex model is a very common configuration for PBS. In this model, there is typically a front-end system as we saw in the previous example, with a number of back-end execution hosts. The PBS Server and Scheduler are typically run on the front-end system, and a MOM is run on each of the execution hosts, as shown in the diagram to the right.

In this model, the server’s `nodes` file will need to contain the list of all the vnodes in the complex.

The MOM `config` file on each vnode will need two static resources added, to specify the target load for each vnode. If we assume each of the vnodes in our “planets” cluster is a 32-processor system, then the following example shows what might be desirable ideal and maximum load values to add to the MOM `config` files:

```
$ideal_load 30
$max_load 32
```

Furthermore, suppose we want the Scheduler to load balance the workload across the available vnodes, making sure not to run two jobs in a row on the same vnode (round robin vnode scheduling). We accomplish this by editing the Scheduler configuration file and enabling load balancing:

```
load_balancing: True all
smp_cluster_dist: round_robin
```
This diagram illustrates a multi-vnode complex configuration wherein the Scheduler and Server communicate with the MOMs on the execution hosts. Jobs are submitted to the Server, scheduled for execution by the Scheduler, and then transferred to a MOM when it’s time to be run. MOM periodically sends status information back to the Server, and answers resource requests from the Scheduler.
10.4 Complex Multi-level Route Queues

There are times when a site may wish to create a series of route queues in order to filter jobs, based on specific resources, or possibly to different destinations. For this example, consider a site that has two large Server systems, and a Linux cluster. The Administrator wants to configure route queues such that everyone submits jobs to a single queue, but the jobs get routed based on (1) requested architecture and (2) individual group IDs. In other words, users request the architecture they want, and PBS finds the right queue for them. Only groups “math”, “chemistry”, and “physics” are permitted to use either server systems; while anyone can use the cluster. Lastly, the jobs coming into the cluster should be divided into three separate queues for long, short, and normal jobs. But the “long” queue was created for the astronomy department, so only members of that group should be permitted into that queue. Given these requirements, let’s look at how we would set up such a collection of route queues. (Note that this is only one way to accomplish this task. There are various other ways too.)

First we create a queue to which everyone will submit their jobs. Let’s call it “submit”. It will need to be a route queue with three destinations, as shown:

```
Qmgr: create queue submit
Qmgr: set queue submit queue_type = Route
Qmgr: set queue submit route_destinations = server_1
Qmgr: set queue submit route_destinations += server_2
Qmgr: set queue submit route_destinations += cluster
Qmgr: set queue submit enabled = True
Qmgr: set queue submit started = True
```

Now we need to create the destination queues. (Notice in the above example, we have already decided what to call the three destinations: `server_1`, `server_2`, `cluster`.) First we create the `server_1` queue, complete with a group ACL, and a specific architecture limit.

```
Qmgr: create queue server_1
Qmgr: set queue server_1 queue_type = Execution
Qmgr: set queue server_1 from_route_only = True
Qmgr: set queue server_1 resources_max.arch = linux
Qmgr: set queue server_1 resources_min.arch = linux
Qmgr: set queue server_1 acl_group_enable = True
Qmgr: set queue server_1 acl_groups = math
Qmgr: set queue server_1 acl_groups += chemistry
Qmgr: set queue server_1 acl_groups += physics
Qmgr: set queue server_1 enabled = True
Qmgr: set queue server_1 started = True
```
Next we create the queues for server_2 and cluster. Note that the server_2 queue is very similar to the server_1 queue, only the architecture differs. Also notice that the cluster queue is another route queue, with multiple destinations.

```plaintext
Qmgr: create queue server_2
Qmgr: set queue server_2 queue_type = Execution
Qmgr: set queue server_2 from_route_only = True
Qmgr: set queue server_2 resources_max.arch = sv2
Qmgr: set queue server_2 resources_min.arch = sv2
Qmgr: set queue server_2 acl_group_enable = True
Qmgr: set queue server_2 acl_groups = math
Qmgr: set queue server_2 acl_groups += chemistry
Qmgr: set queue server_2 acl_groups += physics
Qmgr: set queue server_2 enabled = True
Qmgr: set queue server_2 started = True
Qmgr: create queue cluster
Qmgr: set queue cluster queue_type = Route
Qmgr: set queue cluster from_route_only = True
Qmgr: set queue cluster resources_max.arch = linux
Qmgr: set queue cluster resources_min.arch = linux
Qmgr: set queue cluster route_destinations = long
Qmgr: set queue cluster route_destinations += short
Qmgr: set queue cluster route_destinations += medium
Qmgr: set queue cluster enabled = True
Qmgr: set queue cluster started = True
```

In the cluster queue above, you will notice the particular order of the three destination queues (long, short, medium). PBS will attempt to route a job into the destination queues in the order specified. Thus, we want PBS to first try the long queue (which will have an ACL on
Chapter 10  Example Configurations

it), then the short queue (with its short time limits). Thus any jobs that had not been routed into any other queues (server or cluster) will end up in the medium cluster queue. Now to create the remaining queues.

Qmgr: create queue long
Qmgr: set queue long queue_type = Execution
Qmgr: set queue long from_route_only = True
Qmgr: set queue long resources_max.cput = 20:00:00
Qmgr: set queue long resources_max.walltime = 20:00:00
Qmgr: set queue long resources_min.cput = 02:00:00
Qmgr: set queue long resources_min.walltime = 03:00:00
Qmgr: set queue long acl_group_enable = True
Qmgr: set queue long acl_groups = astrology
Qmgr: set queue long enabled = True
Qmgr: set queue long started = True

Qmgr: create queue short
Qmgr: set queue short queue_type = Execution
Qmgr: set queue short from_route_only = True
Qmgr: set queue short resources_max.cput = 01:00:00
Qmgr: set queue short resources_max.walltime = 01:00:00
Qmgr: set queue short enabled = True
Qmgr: set queue short started = True
Qmgr: create queue medium
Qmgr: set queue medium queue_type = Execution
Qmgr: set queue medium from_route_only = True
Qmgr: set queue medium enabled = True
Qmgr: set queue medium started = True
Qmgr: set server default_queue = submit

Notice that the long and short queues have time limits specified. This will ensure that jobs of certain sizes will enter (or be prevented from entering) these queues. The last queue, medium, has no limits, thus it will be able to accept any job that is not routed into any other queue.
Lastly, note the last line in the example above, which specified that the default queue is the new submit queue. This way users will simply submit their jobs with the resource and architecture requests, without specifying a queue, and PBS will route the job into the correct location. For example, if a user submitted a job with the following syntax, the job would be routed into the server_2 queue:

```
qsub -l select=arch=sv2:ncpus=4 testjob
```

### 10.5 External Software License Management

PBS Professional can be configured to schedule jobs based on externally-controlled licensed software. A detailed example is provided in section 5.14.7.3.ii, "Example of Floating, Externally-managed License with Features" on page 320 in the PBS Professional Administrator’s Guide.
10.6 Multiple User ACL Example

A site may have a need to restrict individual users to particular queues. In the previous example we set up queues with group-based ACLs, in this example we show user-based ACLs. Say a site has two different groups of users, and wants to limit them to two separate queues (perhaps with different resource limits). The following example illustrates this.

```bash
Qmgr: create queue structure
Qmgr: set queue structure queue_type = Execution
Qmgr: set queue structure acl_user_enable = True
Qmgr: set queue structure acl_users = curly
Qmgr: set queue structure acl_users += jerry
Qmgr: set queue structure acl_users += larry
Qmgr: set queue structure acl_users += moe
Qmgr: set queue structure acl_users += moe
Qmgr: set queue structure acl_users += tom
Qmgr: set queue structure resources_max.nodes = 48
Qmgr: set queue structure enabled = True
Qmgr: set queue structure started = True

Qmgr: create queue engine
Qmgr: set queue engine queue_type = Execution
Qmgr: set queue engine acl_user_enable = True
Qmgr: set queue engine acl_users = bill
Qmgr: set queue engine acl_users += bobby
Qmgr: set queue engine acl_users += chris
Qmgr: set queue engine acl_users += jim
Qmgr: set queue engine acl_users += mike
Qmgr: set queue engine acl_users += rob
Qmgr: set queue engine acl_users += scott
Qmgr: set queue engine resources_max.nodes = 12
Qmgr: set queue engine resources_max.walltime=04:00:00
Qmgr: set queue engine enabled = True
Qmgr: set queue engine started = True
```
Run Limit Error Messages

This chapter lists the error messages generated when limits are exceeded. See section 5.15.1, "Managing Resource Usage By Users, Groups, and Projects, at Server & Queues" on page 337 in the PBS Professional Administrator’s Guide.

11.1 Run Limit Error Messages

When a job would exceed a limit by running, the job’s comment field is set to one of the following messages. The following table shows the limit attribute, where the limit is applied, to whom the limit is applied, and the message.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Where Applied</th>
<th>To Whom Applied</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_run</td>
<td>queue</td>
<td>o: PBS_ALL</td>
<td>Not Running: Queue &lt;Q&gt; job limit has been reached.</td>
</tr>
<tr>
<td>max_run</td>
<td>server</td>
<td>o: PBS_ALL</td>
<td>Not Running: Server job limit has been reached.</td>
</tr>
<tr>
<td>max_run</td>
<td>server</td>
<td>p:PBS_GENERIC</td>
<td>Not Running: Project has reached server running limit.</td>
</tr>
<tr>
<td>max_run</td>
<td>queue</td>
<td>p:PBS_GENERIC</td>
<td>Not Running: Project has reached queue&lt;queue-name&gt;’s running limit.</td>
</tr>
</tbody>
</table>
## Chapter 11  
Run Limit Error Messages

Table 11-1: Job Run Limit Error Messages

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Where Applied</th>
<th>To Whom Applied</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_run server</td>
<td>p:&lt;project name&gt;</td>
<td>Not Running: Server job limit reached for project &lt;project name&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run queue</td>
<td>p:&lt;project name&gt;</td>
<td>Not Running: Queue &lt;queue-name&gt; job limit reached for project &lt;project name&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run queue</td>
<td>g: PBS GENERIC</td>
<td>Not Running: Group has reached queue &lt;Q&gt; running limit.</td>
<td></td>
</tr>
<tr>
<td>max_run server</td>
<td>g: PBS GENERIC</td>
<td>Not Running: Group has reached server running limit.</td>
<td></td>
</tr>
<tr>
<td>max_run queue</td>
<td>u: PBS GENERIC</td>
<td>Not Running: User has reached queue &lt;Q&gt; running job limit.</td>
<td></td>
</tr>
<tr>
<td>max_run server</td>
<td>u: PBS GENERIC</td>
<td>Not Running: User has reached server running job limit.</td>
<td></td>
</tr>
<tr>
<td>max_run queue</td>
<td>g:&lt;group name&gt;</td>
<td>Queue &lt;Q&gt; job limit reached for group &lt;G&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run server</td>
<td>g:&lt;group name&gt;</td>
<td>Server job limit reached for group &lt;G&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run queue</td>
<td>u:&lt;user name&gt;</td>
<td>Queue &lt;Q&gt; job limit reached for user &lt;U&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run server</td>
<td>u:&lt;user name&gt;</td>
<td>Server job limit reached for user &lt;U&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run_res queue</td>
<td>o: PBS_ALL</td>
<td>Queue &lt;Q&gt; job limit reached on resource &lt;res&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run_res server</td>
<td>o: PBS_ALL</td>
<td>Server job limit reached on resource &lt;res&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run_res queue</td>
<td>p:PBS GENERIC</td>
<td>Not Running: Queue &lt;queue-name&gt; per-project limit reached on resource &lt;res&gt;</td>
<td></td>
</tr>
<tr>
<td>max_run_res server</td>
<td>p:PBS GENERIC</td>
<td>Not Running: Server per-project limit reached on resource &lt;res&gt;</td>
<td></td>
</tr>
</tbody>
</table>
## Run Limit Error Messages

### Table 11-1: Job Run Limit Error Messages

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Where Applied</th>
<th>To Whom Applied</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>max_run_res</td>
<td>server</td>
<td>p:&lt;project name&gt;</td>
<td>Not Running: would exceed project &lt;project_name&gt;'s limit on resource &lt;res&gt; in complex</td>
</tr>
<tr>
<td>max_run_res</td>
<td>queue</td>
<td>p:&lt;project name&gt;</td>
<td>Not Running: would exceed project &lt;project_name&gt;'s limit on resource &lt;res&gt; in queue &lt;queue-name&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>queue</td>
<td>g: PBS_GENERIC</td>
<td>Queue &lt;Q&gt; per-group limit reached on resource &lt;res&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>server</td>
<td>g: PBS_GENERIC</td>
<td>Server per-group limit reached on resource &lt;res&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>queue</td>
<td>u: PBS_GENERIC</td>
<td>Queue &lt;Q&gt; per-user limit reached on resource &lt;res&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>server</td>
<td>u: PBS_GENERIC</td>
<td>Server per-user limit reached on resource &lt;res&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>queue</td>
<td>g:&lt;group name&gt;</td>
<td>would exceed group &lt;G&gt;'s limit on resource &lt;res&gt; in queue &lt;Q&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>server</td>
<td>g:&lt;group name&gt;</td>
<td>would exceed group &lt;G&gt;'s limit on resource &lt;res&gt; in complex</td>
</tr>
<tr>
<td>max_run_res</td>
<td>queue</td>
<td>u:&lt;user name&gt;</td>
<td>would exceed user &lt;U&gt;'s limit on resource &lt;res&gt; in queue &lt;Q&gt;</td>
</tr>
<tr>
<td>max_run_res</td>
<td>server</td>
<td>u:&lt;user name&gt;</td>
<td>would exceed user &lt;U&gt;'s limit on resource &lt;res&gt; in complex</td>
</tr>
</tbody>
</table>
Chapter 11  Run Limit Error Messages
Error Codes

The following table lists all the PBS error codes, their textual names, and a description of each.

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_NONE</td>
<td>0</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_ATTRRRO</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>PBSE_BADHOST</td>
<td>15008</td>
<td>Access from host not allowed</td>
</tr>
<tr>
<td>PBSE_JOBEXIST</td>
<td>15009</td>
<td>Job already exists</td>
</tr>
</tbody>
</table>
# Error Codes

## Table 12-1: Error Codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_SYSTEM</td>
<td>15010</td>
<td>System error occurred</td>
</tr>
<tr>
<td>PBSE_INTERNAL</td>
<td>15011</td>
<td>Internal Server error occurred</td>
</tr>
<tr>
<td>PBSE_REGROUTE</td>
<td>15012</td>
<td>Parent job of dependent in route queue</td>
</tr>
<tr>
<td>PBSE_UNKSIG</td>
<td>15013</td>
<td>Unknown signal name</td>
</tr>
<tr>
<td>PBSE_BADATVAL</td>
<td>15014</td>
<td>Bad attribute value</td>
</tr>
<tr>
<td>PBSE_MODATRRUN</td>
<td>15015</td>
<td>Cannot modify attribute in run state</td>
</tr>
<tr>
<td>PBSE_BADSTATE</td>
<td>15016</td>
<td>Request invalid for job state</td>
</tr>
<tr>
<td>PBSE_UNKQUE</td>
<td>15018</td>
<td>Unknown queue name</td>
</tr>
<tr>
<td>PBSE_BADCRED</td>
<td>15019</td>
<td>Invalid Credential in request</td>
</tr>
<tr>
<td>PBSE_EXPIRED</td>
<td>15020</td>
<td>Expired Credential in request</td>
</tr>
<tr>
<td>PBSE_QUNOENB</td>
<td>15021</td>
<td>Queue not enabled</td>
</tr>
<tr>
<td>PBSE_QACCESS</td>
<td>15022</td>
<td>No access permission for queue</td>
</tr>
<tr>
<td>PBSE_BADUSER</td>
<td>15023</td>
<td>Missing userID, username, or GID. Returned under following conditions:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. User does not have a password entry (getpwnam() returns null).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. User’s UID is zero and root isn’t allowed to run jobs (acl_roots).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. PBS_O_HOST is not set in the job.</td>
</tr>
<tr>
<td>PBSE_HOPCOUNT</td>
<td>15024</td>
<td>Max hop count exceeded</td>
</tr>
<tr>
<td>PBSE_QUEEXIST</td>
<td>15025</td>
<td>Queue already exists</td>
</tr>
<tr>
<td>PBSE_ATTRTYPE</td>
<td>15026</td>
<td>Incompatible queue attribute type</td>
</tr>
</tbody>
</table>
## Table 12-1: Error Codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_OBJBUSY</td>
<td>15027</td>
<td>Object Busy</td>
</tr>
<tr>
<td>PBSE_QUENBIG</td>
<td>15028</td>
<td>Queue name too long</td>
</tr>
<tr>
<td>PBSE_NOSUP</td>
<td>15029</td>
<td>Feature/function not supported</td>
</tr>
<tr>
<td>PBSE_QUENOEN</td>
<td>15030</td>
<td>Can’t enable queue, lacking definition</td>
</tr>
<tr>
<td>PBSE_PROTOCOL</td>
<td>15031</td>
<td>Protocol (ASN.1) error. Message is distorted or truncated.</td>
</tr>
<tr>
<td>PBSE_BADATLST</td>
<td>15032</td>
<td>Bad attribute list structure</td>
</tr>
<tr>
<td>PBSE_NOCONNECTS</td>
<td>15033</td>
<td>No free connections</td>
</tr>
<tr>
<td>PBSE_NOSERVER</td>
<td>15034</td>
<td>No Server to connect to</td>
</tr>
<tr>
<td>PBSE_UNKRESC</td>
<td>15035</td>
<td>Unknown resource</td>
</tr>
<tr>
<td>PBSE_EXCQRESC</td>
<td>15036</td>
<td>Job exceeds Queue resource limits</td>
</tr>
<tr>
<td>PBSE_QUENODFLT</td>
<td>15037</td>
<td>No Default Queue Defined</td>
</tr>
<tr>
<td>PBSE_NORERUN</td>
<td>15038</td>
<td>Job Not Rerunnable</td>
</tr>
<tr>
<td>PBSE_ROUTEREJ</td>
<td>15039</td>
<td>Route rejected by all destinations</td>
</tr>
<tr>
<td>PBSE_ROUTEEXPD</td>
<td>15040</td>
<td>Time in Route Queue Expired</td>
</tr>
<tr>
<td>PBSE_MOMREJECT</td>
<td>15041</td>
<td>Request to MOM failed</td>
</tr>
<tr>
<td>PBSE_BADSCRIPT</td>
<td>15042</td>
<td>(qsub) Cannot access script file</td>
</tr>
<tr>
<td>PBSE_STAGEIN</td>
<td>15043</td>
<td>Stage In of files failed</td>
</tr>
<tr>
<td>PBSE_RESCUNAV</td>
<td>15044</td>
<td>Resources temporarily unavailable</td>
</tr>
<tr>
<td>PBSE_BADGRP</td>
<td>15045</td>
<td>Bad Group specified</td>
</tr>
<tr>
<td>PBSE_MAXQUED</td>
<td>15046</td>
<td>Max number of jobs in queue</td>
</tr>
<tr>
<td>PBSE_CKPBSY</td>
<td>15047</td>
<td>Checkpoint Busy, may be retries</td>
</tr>
</tbody>
</table>
# Chapter 12

## Error Codes

### Table 12-1: Error Codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_EXLIMIT</td>
<td>15048</td>
<td>Limit exceeds allowable</td>
</tr>
<tr>
<td>PBSE_BADACCT</td>
<td>15049</td>
<td>Bad Account attribute value</td>
</tr>
<tr>
<td>PBSE_ALRDYEXIT</td>
<td>15050</td>
<td>Job already in exit state</td>
</tr>
<tr>
<td>PBSE_NOCOPYFILE</td>
<td>15051</td>
<td>Job files not copied</td>
</tr>
<tr>
<td>PBSE_CLEANEDOUT</td>
<td>15052</td>
<td>Unknown job id after clean init</td>
</tr>
<tr>
<td>PBSE_NOSYNCMSTR</td>
<td>15053</td>
<td>No Master in Sync Set</td>
</tr>
<tr>
<td>PBSE_BADDEPEND</td>
<td>15054</td>
<td>Invalid dependency</td>
</tr>
<tr>
<td>PBSE_DUPLIST</td>
<td>15055</td>
<td>Duplicate entry in List</td>
</tr>
<tr>
<td>PBSE_DISPROTO</td>
<td>15056</td>
<td>Bad DIS based Request Protocol</td>
</tr>
<tr>
<td>PBSE_EXECTHERE (Obsolete)</td>
<td>15057</td>
<td>Cannot execute there (Obsolete; no longer used.)</td>
</tr>
<tr>
<td>PBSE_SISREJECT</td>
<td>15058</td>
<td>Sister rejected</td>
</tr>
<tr>
<td>PBSE_SISCOMM</td>
<td>15059</td>
<td>Sister could not communicate</td>
</tr>
<tr>
<td>PBSE_SVRDOWN</td>
<td>15060</td>
<td>Request rejected -server shutting down</td>
</tr>
<tr>
<td>PBSE_CKPSHORT</td>
<td>15061</td>
<td>Not all tasks could checkpoint</td>
</tr>
<tr>
<td>PBSE_UNKNODE</td>
<td>15062</td>
<td>Named vnode is not in the list</td>
</tr>
<tr>
<td>PBSE_UNKNODEATR</td>
<td>15063</td>
<td>Vnode attribute not recognized</td>
</tr>
<tr>
<td>PBSE_NONODES</td>
<td>15064</td>
<td>Server has no vnode list</td>
</tr>
<tr>
<td>PBSE_NODENBIG</td>
<td>15065</td>
<td>Node name is too big</td>
</tr>
<tr>
<td>PBSE_NODEEXIST</td>
<td>15066</td>
<td>Node name already exists</td>
</tr>
<tr>
<td>PBSE_BADNDATVAL</td>
<td>15067</td>
<td>Bad vnode attribute value</td>
</tr>
</tbody>
</table>
Table 12-1: Error Codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_MUTUALEX</td>
<td>15068</td>
<td>State values are mutually exclusive</td>
</tr>
<tr>
<td>PBSE_GMODERR</td>
<td>15069</td>
<td>Error(s) during global mod of vnodes</td>
</tr>
<tr>
<td>PBSE_NORELYMOM</td>
<td>15070</td>
<td>Could not contact MOM</td>
</tr>
<tr>
<td>Reserved</td>
<td>15076</td>
<td>Not used.</td>
</tr>
<tr>
<td>PBSE_TOOLEATE</td>
<td>15077</td>
<td>Reservation submitted with a start time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>that has already passed</td>
</tr>
<tr>
<td>PBSE_genBatchReq</td>
<td>15082</td>
<td>Batch request generation failed</td>
</tr>
<tr>
<td>PBSE_mgrBatchReq</td>
<td>15083</td>
<td>qmgr batch request failed</td>
</tr>
<tr>
<td>PBSE_UNKRESVID</td>
<td>15084</td>
<td>Unknown reservation ID</td>
</tr>
<tr>
<td>PBSE_delProgress</td>
<td>15085</td>
<td>Delete already in progress</td>
</tr>
<tr>
<td>PBSE_BADTSPEC</td>
<td>15086</td>
<td>Bad time specification(s)</td>
</tr>
<tr>
<td>PBSE_RESVMSG</td>
<td>15087</td>
<td>So reply_text can return a msg</td>
</tr>
<tr>
<td>PBSE_BADNODESPEC</td>
<td>15089</td>
<td>Node(s) specification error</td>
</tr>
<tr>
<td>PBSE_LICENSECPU</td>
<td>15090</td>
<td>Licensed CPUs exceeded</td>
</tr>
<tr>
<td>PBSE_LICENSEINV</td>
<td>15091</td>
<td>License is invalid</td>
</tr>
<tr>
<td>PBSE_RESVAUTH_H</td>
<td>15092</td>
<td>Host not authorized to make AR</td>
</tr>
<tr>
<td>PBSE_RESVAUTH_G</td>
<td>15093</td>
<td>Group not authorized to make AR</td>
</tr>
<tr>
<td>PBSE_RESVAUTH_U</td>
<td>15094</td>
<td>User not authorized to make AR</td>
</tr>
<tr>
<td>PBSE_R_UID</td>
<td>15095</td>
<td>Bad effective UID for reservation</td>
</tr>
<tr>
<td>PBSE_R_GID</td>
<td>15096</td>
<td>Bad effective GID for reservation</td>
</tr>
<tr>
<td>PBSE_IBMSPSWITCH</td>
<td>15097</td>
<td>IBM SP Switch error</td>
</tr>
<tr>
<td>PBSE_LICENSEUNAV</td>
<td>15098</td>
<td>Floating License unavailable</td>
</tr>
</tbody>
</table>
## Chapter 12

### Error Codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_RESCNOTSTR</td>
<td>15099</td>
<td>UNUSED</td>
</tr>
<tr>
<td>PBSE_SSIGNON_UNSET_REJECT</td>
<td>15100</td>
<td>Resource is not of type string</td>
</tr>
<tr>
<td>PBSE_SSIGNON_UNSET_REJECT</td>
<td>15101</td>
<td>rejected if SVR_ssignon_enable not set</td>
</tr>
<tr>
<td>PBSE_SSIGNON_SET_REJECT</td>
<td>15102</td>
<td>rejected if SVR_ssignon_enable set</td>
</tr>
<tr>
<td>PBSE_SSIGNON_BAD_TRANSITION</td>
<td>15103</td>
<td>bad attempt: true to false</td>
</tr>
<tr>
<td>PBSE_SSIGNON_NOCONNECT_DEST</td>
<td>15105</td>
<td>couldn't connect to destination host</td>
</tr>
<tr>
<td></td>
<td></td>
<td>during a user migration request</td>
</tr>
<tr>
<td>PBSE_SSIGNON_NO_PASSWORD</td>
<td>15106</td>
<td>no per-user/per-server password</td>
</tr>
<tr>
<td>PBSE_MaxArraySize</td>
<td>15107</td>
<td>max array size exceeded</td>
</tr>
<tr>
<td>PBSE_INVALSELECTRESC</td>
<td>15108</td>
<td>resource invalid in select spec</td>
</tr>
<tr>
<td>PBSE_INVALJOBRESC</td>
<td>15109</td>
<td>invalid job resource</td>
</tr>
<tr>
<td>PBSE_INVALNODEPLACE</td>
<td>15110</td>
<td>node invalid w/place</td>
</tr>
<tr>
<td>PBSE_PLACENOSELECT</td>
<td>15111</td>
<td>cannot have place w/o select</td>
</tr>
<tr>
<td>PBSE_INDIRECTHOP</td>
<td>15112</td>
<td>too many indirect resource levels</td>
</tr>
<tr>
<td>PBSE_INDIRECTBT</td>
<td>15113</td>
<td>target resource undefined</td>
</tr>
<tr>
<td>PBSE_NGBLUEGENE</td>
<td>15114</td>
<td>No node_group_enable on Blue-Gene</td>
</tr>
<tr>
<td>PBSE_NODESTALE</td>
<td>15115</td>
<td>Cannot change state of stale vnode</td>
</tr>
<tr>
<td>PBSE_DUPRESC</td>
<td>15116</td>
<td>cannot dup resource within a chunk</td>
</tr>
<tr>
<td>PBSE_CONNFULL</td>
<td>15117</td>
<td>server connection table full</td>
</tr>
<tr>
<td>PBSE_LICENSE_MIN_BADVAL</td>
<td>15118</td>
<td>bad value for pbs_license_min</td>
</tr>
<tr>
<td>PBSE_LICENSE_MAX_BADVAL</td>
<td>15119</td>
<td>bad value for pbs_license_max</td>
</tr>
</tbody>
</table>

Table 12-1: Error Codes
## Error Codes

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<tr>
<th>Error Name</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_LICENSE_LINGER_BADVAL</td>
<td>15120</td>
<td>bad value for pbs_license_linger_time</td>
</tr>
<tr>
<td>PBSE_LICENSE_SERVER_DOWN</td>
<td>15121</td>
<td>License server is down</td>
</tr>
<tr>
<td>PBSE_LICENSE_BAD_ACTION</td>
<td>15122</td>
<td>Not allowed action with licensing</td>
</tr>
<tr>
<td>PBSE_BAD_FORMULA</td>
<td>15123</td>
<td>invalid sort formula</td>
</tr>
<tr>
<td>PBSE_BAD_FORMULA_KW</td>
<td>15124</td>
<td>invalid keyword in formula</td>
</tr>
<tr>
<td>PBSE_BAD_FORMULA_TYPE</td>
<td>15125</td>
<td>invalid resource type in formula</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_YEARLY</td>
<td>15126</td>
<td>reservation duration exceeds 1 year</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_MONTHLY</td>
<td>15127</td>
<td>reservation duration exceeds 1 month</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_WEEKLY</td>
<td>15128</td>
<td>reservation duration exceeds 1 week</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_DAILY</td>
<td>15129</td>
<td>reservation duration exceeds 1 day</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_HOURLY</td>
<td>15130</td>
<td>reservation duration exceeds 1 hour</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_MINUTELY</td>
<td>15131</td>
<td>reservation duration exceeds 1 minute</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_SECONDLY</td>
<td>15132</td>
<td>reservation duration exceeds 1 second</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_SYNTAX</td>
<td>15133</td>
<td>invalid recurrence rule syntax</td>
</tr>
<tr>
<td>PBSE_BAD_RRULE_SYNTAX2</td>
<td>15134</td>
<td>invalid recurrence rule syntax</td>
</tr>
<tr>
<td>PBSE_BAD_ICAL_TZ</td>
<td>15135</td>
<td>Undefined timezone info directory</td>
</tr>
<tr>
<td>PBSE_HOOKERROR</td>
<td>15136</td>
<td>error encountered related to hooks</td>
</tr>
<tr>
<td>PBSE_NEEDQUET</td>
<td>15137</td>
<td>need queue type set</td>
</tr>
</tbody>
</table>
## Error Codes

### Table 12-1: Error Codes

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<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_ETERROR</td>
<td>15138</td>
<td>not allowed to alter attribute when <code>eligible_time_enable</code> is off</td>
</tr>
<tr>
<td>PBSE_HISTJOBID</td>
<td>15139</td>
<td>History job ID</td>
</tr>
<tr>
<td>PBSE_JOBHISTNOTSET</td>
<td>15140</td>
<td><code>job_history_enable</code> not SET</td>
</tr>
<tr>
<td>PBSE_MIXENTLIMS</td>
<td>15141</td>
<td>mixing old and new limit enforcement</td>
</tr>
<tr>
<td></td>
<td>15145</td>
<td>Server host not allowed to be provisioned</td>
</tr>
<tr>
<td></td>
<td>15146</td>
<td>While provisioning, provisioning attributes can't be modified</td>
</tr>
<tr>
<td></td>
<td>15147</td>
<td>State of provisioning vnode can't be changed</td>
</tr>
<tr>
<td></td>
<td>15148</td>
<td>Vnode can't be deleted while provisioning</td>
</tr>
<tr>
<td></td>
<td>15149</td>
<td>Attempt to set an AOE that is not in <code>resources_available.aoe</code></td>
</tr>
<tr>
<td></td>
<td>15150</td>
<td>Illegal job/reservation submission/alteration</td>
</tr>
</tbody>
</table>

Resource monitor specific error codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_RMUNKNOWN</td>
<td>15201</td>
<td>Resource unknown</td>
</tr>
<tr>
<td>PBSE_RMBADPARAM</td>
<td>15202</td>
<td>Parameter could not be used</td>
</tr>
<tr>
<td>PBSE_RMNOPARAM</td>
<td>15203</td>
<td>A needed parameter did not exist</td>
</tr>
<tr>
<td>PBSE_RMEXIST</td>
<td>15204</td>
<td>Something specified didn't exist</td>
</tr>
<tr>
<td>PBSE_RMSYSTEM</td>
<td>15205</td>
<td>A system error occurred</td>
</tr>
<tr>
<td>PBSE_RM PART</td>
<td>15206</td>
<td>Only part of reservation made</td>
</tr>
</tbody>
</table>
## Error Codes

### Table 12-1: Error Codes

<table>
<thead>
<tr>
<th>Error Name</th>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBSE_SSIGNON_BAD_TRANSITION2</td>
<td>15207</td>
<td>bad attempt: false to true</td>
</tr>
</tbody>
</table>
Chapter 12  Error Codes
Chapter 13

Request Codes

When reading the PBS event logfiles, you may see messages of the form “Type 19 request received from PBS_Server...”. These “type codes” correspond to different PBS batch requests. The following table lists all the PBS type codes and the corresponding request of each.

Table 13-1: Request Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PBS_BATCH_Connect</td>
</tr>
<tr>
<td>1</td>
<td>PBS_BATCH_QueueJob</td>
</tr>
<tr>
<td>2</td>
<td>UNUSED</td>
</tr>
<tr>
<td>3</td>
<td>PBS_BATCH_jobscript</td>
</tr>
<tr>
<td>4</td>
<td>PBS_BATCH_RdytoCommit</td>
</tr>
<tr>
<td>5</td>
<td>PBS_BATCH_Commit</td>
</tr>
<tr>
<td>6</td>
<td>PBS_BATCH_DeleteJob</td>
</tr>
<tr>
<td>7</td>
<td>PBS_BATCH_HoldJob</td>
</tr>
<tr>
<td>8</td>
<td>PBS_BATCH_LocateJob</td>
</tr>
<tr>
<td>9</td>
<td>PBS_BATCH_Manager</td>
</tr>
<tr>
<td>10</td>
<td>PBS_BATCH_MessJob</td>
</tr>
<tr>
<td>11</td>
<td>PBS_BATCH_ModifyJob</td>
</tr>
</tbody>
</table>
### Table 13-1: Request Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Request Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>PBS_BATCH_MoveJob</td>
</tr>
<tr>
<td>13</td>
<td>PBS_BATCH_ReleaseJob</td>
</tr>
<tr>
<td>14</td>
<td>PBS_BATCH_Rerun</td>
</tr>
<tr>
<td>15</td>
<td>PBS_BATCH_RunJob</td>
</tr>
<tr>
<td>16</td>
<td>PBS_BATCH_SelectJobs</td>
</tr>
<tr>
<td>17</td>
<td>PBS_BATCH_Shutdown</td>
</tr>
<tr>
<td>18</td>
<td>PBS_BATCH_SignalJob</td>
</tr>
<tr>
<td>19</td>
<td>PBS_BATCH_StatusJob</td>
</tr>
<tr>
<td>20</td>
<td>PBS_BATCH_StatusQue</td>
</tr>
<tr>
<td>21</td>
<td>PBS_BATCH_StatusSvr</td>
</tr>
<tr>
<td>22</td>
<td>PBS_BATCH_TrackJob</td>
</tr>
<tr>
<td>23</td>
<td>PBS_BATCH_AsyrunJob</td>
</tr>
<tr>
<td>24</td>
<td>PBS_BATCH_Rescq</td>
</tr>
<tr>
<td>25</td>
<td>PBS_BATCH_ReserveResc</td>
</tr>
<tr>
<td>26</td>
<td>PBS_BATCH_ReleaseResc</td>
</tr>
<tr>
<td>27</td>
<td>PBS_BATCH_FailOver</td>
</tr>
<tr>
<td>48</td>
<td>PBS_BATCH_StageIn</td>
</tr>
<tr>
<td>49</td>
<td>PBS_BATCH_AuthenUser</td>
</tr>
<tr>
<td>50</td>
<td>PBS_BATCH_OrderJob</td>
</tr>
<tr>
<td>51</td>
<td>PBS_BATCH_SelStat</td>
</tr>
<tr>
<td>52</td>
<td>PBS_BATCH_RegistDep</td>
</tr>
<tr>
<td>54</td>
<td>PBS_BATCH_CopyFiles</td>
</tr>
<tr>
<td>55</td>
<td>PBS_BATCH_DelFiles</td>
</tr>
<tr>
<td>56</td>
<td>PBS_BATCH_JobObit</td>
</tr>
</tbody>
</table>
### Table 13-1: Request Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Request Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>PBS_BATCH_MvJobFile</td>
</tr>
<tr>
<td>58</td>
<td>PBS_BATCH_StatusNode</td>
</tr>
<tr>
<td>59</td>
<td>PBS_BATCH_Disconnect</td>
</tr>
<tr>
<td>60</td>
<td>UNUSED</td>
</tr>
<tr>
<td>61</td>
<td>UNUSED</td>
</tr>
<tr>
<td>62</td>
<td>PBS_BATCH_JobCred</td>
</tr>
<tr>
<td>63</td>
<td>PBS_BATCH_CopyFiles_Cred</td>
</tr>
<tr>
<td>64</td>
<td>PBS_BATCH_DelFiles_Cred</td>
</tr>
<tr>
<td>65</td>
<td>PBS_BATCH_GSS_Context</td>
</tr>
<tr>
<td>66</td>
<td>UNUSED</td>
</tr>
<tr>
<td>67</td>
<td>UNUSED</td>
</tr>
<tr>
<td>68</td>
<td>UNUSED</td>
</tr>
<tr>
<td>69</td>
<td>UNUSED</td>
</tr>
<tr>
<td>70</td>
<td>PBS_BATCH_SubmitResv</td>
</tr>
<tr>
<td>71</td>
<td>PBS_BATCH_StatusResv</td>
</tr>
<tr>
<td>72</td>
<td>PBS_BATCH_DeleteResv</td>
</tr>
<tr>
<td>73</td>
<td>PBS_BATCH_UserCred</td>
</tr>
<tr>
<td>74</td>
<td>PBS_BATCH_UserMigrate</td>
</tr>
<tr>
<td>75</td>
<td>PBS_BATCH_ConfirmResv</td>
</tr>
<tr>
<td>80</td>
<td>PBS_BATCH_DefSchReply</td>
</tr>
<tr>
<td>81</td>
<td>PBS_BATCH_StatusSched</td>
</tr>
<tr>
<td>82</td>
<td>PBS_BATCH_StatusRsc</td>
</tr>
</tbody>
</table>

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Chapter 13

Request Codes
PBS Environment Variables

14.1 PBS Environment Variables

The following table lists the PBS environment variables:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCPUS</td>
<td>Number of threads, defaulting to number of CPUs, on the vnode</td>
</tr>
<tr>
<td>OMP_NUM_THREADS</td>
<td>Same as NCPUS.</td>
</tr>
<tr>
<td>PBS_ARRAY_ID</td>
<td>Identifier for job arrays. Consists of sequence number.</td>
</tr>
<tr>
<td>PBS_ARRAY_INDEX</td>
<td>Index number of subjob in job array.</td>
</tr>
<tr>
<td>PBS_CONF_FILE</td>
<td>Path to pbs.conf</td>
</tr>
<tr>
<td>PBS_CPUSET_DEDICATED</td>
<td>Set by mpiexec to assert exclusive use of resources in assigned cpuset.</td>
</tr>
<tr>
<td>PBS_ENVIRONMENT</td>
<td>Indicates job type: PBS_BATCH or PBS_INTERACTIVE</td>
</tr>
<tr>
<td>PBS_JOBCOOKIE</td>
<td>Unique identifier for inter-MOM job-based communication.</td>
</tr>
</tbody>
</table>
### Table 14-1: PBS Environment Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_JOBDIR</td>
<td>Pathname of job-specific staging and execution directory</td>
</tr>
<tr>
<td>PBS_JOBID</td>
<td>The job identifier assigned to the job or job array by the batch system.</td>
</tr>
<tr>
<td>PBS_JOBNAME</td>
<td>The job name supplied by the user.</td>
</tr>
<tr>
<td>PBS_MOMPORT</td>
<td>Port number on which this job’s MOMs will communicate.</td>
</tr>
<tr>
<td>PBS_NODEFILE</td>
<td>The filename containing a list of vnodes assigned to the job.</td>
</tr>
<tr>
<td>PBS_NODENUM</td>
<td>Logical vnode number of this vnode allocated to the job.</td>
</tr>
<tr>
<td>PBS_O_HOME</td>
<td>Value of HOME from submission environment</td>
</tr>
<tr>
<td>PBS_O_HOST</td>
<td>The host name on which the qsub command was executed.</td>
</tr>
<tr>
<td>PBS_O_LANG</td>
<td>Value of LANG from submission environment</td>
</tr>
<tr>
<td>PBS_O_LOGNAME</td>
<td>Value of LOGNAME from submission environment</td>
</tr>
<tr>
<td>PBS_O_MAIL</td>
<td>Value of MAIL from submission environment</td>
</tr>
<tr>
<td>PBS_O_PATH</td>
<td>Value of PATH from submission environment</td>
</tr>
<tr>
<td>PBS_O_QUEUE</td>
<td>The original queue name to which the job was submitted.</td>
</tr>
<tr>
<td>PBS_O_SHELL</td>
<td>Value of SHELL from submission environment</td>
</tr>
<tr>
<td>PBS_O_SYSTEM</td>
<td>The operating system name where qsub was executed.</td>
</tr>
<tr>
<td>PBS_O_TZ</td>
<td>Value of TZ from submission environment</td>
</tr>
<tr>
<td>PBS_O_WORKDIR</td>
<td>The absolute path of directory where qsub was executed.</td>
</tr>
</tbody>
</table>
# PBS Environment Variables

## Table 14-1: PBS Environment Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_QUEUE</td>
<td>The name of the queue from which the job is executed.</td>
</tr>
<tr>
<td>PBS_TASKNUM</td>
<td>The task (process) number for the job on this vnode.</td>
</tr>
<tr>
<td>TMPDIR</td>
<td>The job-specific temporary directory for this job.</td>
</tr>
</tbody>
</table>
Chapter 15

File Listing

The following table lists all the PBS files and directories; owner and permissions are specific to UNIX systems.

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_EXEC/</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/bin</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/bin/nqs2pbs</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>16062</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbsdsh</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>111837</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbsnodes</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>153004</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbs_dataservice</td>
<td>root</td>
<td>-rwx------</td>
<td></td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbs_hostn</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>35493</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbs_rdel</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>151973</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbs_rstat</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>156884</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbs_rsub</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>167446</td>
</tr>
<tr>
<td>PBS_EXEC/bin/pbs_tclsh</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>857552</td>
</tr>
</tbody>
</table>
Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_EXEC/bin/pbs_wish</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>1592236</td>
</tr>
<tr>
<td>PBS_EXEC/bin/printjob</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>42667</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qalter</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>210723</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qdel</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>164949</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qdisable</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>139559</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qenable</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>139558</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qhold</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>165368</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qmgr</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>202526</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qmove</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>160932</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qmsg</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>160408</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qorder</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>146393</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qrerun</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>157228</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qrls</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>165361</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qrun</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>160978</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qselect</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>163266</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qsig</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>160083</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qstart</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>139589</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qstat</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>207532</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qstop</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>139584</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qsub</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>275460</td>
</tr>
<tr>
<td>PBS_EXEC/bin/qterm</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>132188</td>
</tr>
<tr>
<td>PBS_EXEC/bin/tracejob</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>64730</td>
</tr>
</tbody>
</table>
Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_EXE/bin/xpbs</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>817</td>
</tr>
<tr>
<td>PBS_EXE/bin/xpbsmon</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>817</td>
</tr>
<tr>
<td>PBS_EXE/etc</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXE/etc/au-nodeupdate.pl</td>
<td>root</td>
<td>-rw-r-r--</td>
<td></td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_dedicated</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>557</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_habitat</td>
<td>root</td>
<td>-rw-wx------</td>
<td>10059</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_holidays</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>1173</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_init.d</td>
<td>root</td>
<td>-rw-wx------</td>
<td>5382</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_postinstall</td>
<td>root</td>
<td>-rw-wx------</td>
<td>10059</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_resource_group</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>657</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_sched_config</td>
<td>root</td>
<td>-r-r-r-r--</td>
<td>9791</td>
</tr>
<tr>
<td>PBS_EXE/etc/pbs_setlicense</td>
<td>root</td>
<td>-rw-wx------</td>
<td>2118</td>
</tr>
<tr>
<td>PBS_EXE/include</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXE/include/pbs_error.h</td>
<td>root</td>
<td>-r-r-r-r--</td>
<td>7543</td>
</tr>
<tr>
<td>PBS_EXE/include/pbs_ifl.h</td>
<td>root</td>
<td>-r-r-r-r--</td>
<td>17424</td>
</tr>
<tr>
<td>PBS_EXE/include/rm.h</td>
<td>root</td>
<td>-r-r-r-r--</td>
<td>740</td>
</tr>
<tr>
<td>PBS_EXE/include/tm.h</td>
<td>root</td>
<td>-r-r-r-r--</td>
<td>2518</td>
</tr>
<tr>
<td>PBS_EXE/include/tm_.h</td>
<td>root</td>
<td>-r-r-r-r--</td>
<td>2236</td>
</tr>
<tr>
<td>PBS_EXE/lib</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXE/lib/libattr.a</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>390274</td>
</tr>
<tr>
<td>PBS_EXE/lib/liblog.a</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>101230</td>
</tr>
</tbody>
</table>
# Chapter 15

## File Listing

**Table 15-1: File Listing**

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_EXEC/lib/libnet.a</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>145968</td>
</tr>
<tr>
<td>PBS_EXEC/lib/libpbs.a</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>1815486</td>
</tr>
<tr>
<td>PBS_EXEC/lib/libsite.a</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>132906</td>
</tr>
<tr>
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### Table 15-1: File Listing

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<th>Owner</th>
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### Table 15-1: File Listing

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### Table 15-1: File Listing

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## File Listing

### Table 15-1: File Listing

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<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
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<td>Permission</td>
<td>Average Size</td>
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<td>root</td>
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Chapter 15

File Listing

Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
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## File Listing

### Table 15-1: File Listing

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<thead>
<tr>
<th>Directory / File</th>
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<th>Permission</th>
<th>Average Size</th>
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<tr>
<th>Directory / File</th>
<th>Owner</th>
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<th>Average Size</th>
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<th>Average Size</th>
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# File Listing

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<tr>
<td>PBS_EXEC/man/man8/pbs_sched_cc.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>6731</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/pbs_server.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>7914</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/pbs_tclsh.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2475</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/pbs_tmrsh.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>3556</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/pbs_wish.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2123</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/printjob.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2823</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/qdisable.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>3104</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/qenable.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2937</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/qmgr.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>7282</td>
</tr>
</tbody>
</table>
## Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_EXEC/man/man8/qrun.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2850</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/qstart.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2966</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/qstop.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>2963</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/qterm.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>4839</td>
</tr>
<tr>
<td>PBS_EXEC/man/man8/tracejob.8B</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>4664</td>
</tr>
<tr>
<td>PBS_EXEC/pgsql</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td></td>
</tr>
<tr>
<td>PBS_EXEC/sbin</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td></td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs-report</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>68296</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbsfs</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>663707</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_demux</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>38688</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_idled</td>
<td>root</td>
<td>-rwxr-xr-x</td>
<td>99373</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_iff</td>
<td>root</td>
<td>-rwsr-xr-x</td>
<td>133142</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_mom</td>
<td>root</td>
<td>-rwx------</td>
<td>839326</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_mom.cpuset</td>
<td>root</td>
<td>-rwx------</td>
<td>0</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_mom.standard</td>
<td>root</td>
<td>-rwx------</td>
<td>0</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_probe</td>
<td>root</td>
<td>-rwsr-xr-x</td>
<td>83108</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_rcp</td>
<td>root</td>
<td>-rwsr-xr-x</td>
<td>75274</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_sched</td>
<td>root</td>
<td>-rwx------</td>
<td>705478</td>
</tr>
<tr>
<td>PBS_EXEC/sbin/pbs_server</td>
<td>root</td>
<td>-rwx------</td>
<td>1133650</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/bin</td>
<td>root</td>
<td>drwxr-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/bin/tclsh8.3</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>552763</td>
</tr>
</tbody>
</table>
### File Listing

#### Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_EXEC/tcltk/bin/wish8.3</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>1262257</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/include</td>
<td>root</td>
<td>drwx-r-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/include/tcl.h</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>57222</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/include/tclDe-cl.s.h</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>123947</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/include/tk.h</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>47420</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/include/tkDe-cl.s.h</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>80181</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib</td>
<td>root</td>
<td>drwx-r-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/libtcl8.3.a</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>777558</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/libtclstub8.3.a</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>1832</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/libtk8.3.a</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>1021024</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/libtkstub8.3.a</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>3302</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/tcl8.3</td>
<td>root</td>
<td>drwx-r-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/tclConfig.sh</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>7076</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/tk8.3</td>
<td>root</td>
<td>drwx-r-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/lib/tkConfig.sh</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>3822</td>
</tr>
<tr>
<td>PBS_EXEC/tcltk/license.terms</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>2233</td>
</tr>
<tr>
<td>PBS_HOME</td>
<td>root</td>
<td>drwx-r-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/aux</td>
<td>root</td>
<td>drwx-r-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/checkpoint</td>
<td>root</td>
<td>drwx------</td>
<td>4096</td>
</tr>
</tbody>
</table>
### Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_HOME/datastore</td>
<td>data service account</td>
<td>-rwx-------</td>
<td></td>
</tr>
<tr>
<td>PBS_HOME/mom_logs</td>
<td>root</td>
<td>drwx-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/mom_priv</td>
<td>root</td>
<td>drwx-x-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/mom_priv/config</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>18</td>
</tr>
<tr>
<td>PBS_HOME/mom_priv/jobs</td>
<td>root</td>
<td>drwx-x-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/mom_priv/mom.lock</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>4</td>
</tr>
<tr>
<td>PBS_HOME/pbs_environment</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>0</td>
</tr>
<tr>
<td>PBS_HOME/sched_logs</td>
<td>root</td>
<td>drwx-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv</td>
<td>root</td>
<td>drwx-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv/dedicated_time</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>557</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv/holidays</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>1228</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv/resource_group</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>0</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv/sched.lock</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>4</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv/sched_config</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>6370</td>
</tr>
<tr>
<td>PBS_HOME/sched_priv/sched_out</td>
<td>root</td>
<td>-rw-r-r--</td>
<td>0</td>
</tr>
<tr>
<td>PBS_HOME/server_logs</td>
<td>root</td>
<td>drwx-xr-x</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv</td>
<td>root</td>
<td>drwx-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/accounting</td>
<td>root</td>
<td>drwx-xr-x</td>
<td>4096</td>
</tr>
</tbody>
</table>
## Table 15-1: File Listing

<table>
<thead>
<tr>
<th>Directory / File</th>
<th>Owner</th>
<th>Permission</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBS_HOME/server_priv/acl_groups</td>
<td>root</td>
<td>drwxr-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/acl_hosts</td>
<td>root</td>
<td>drwxr-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/acl_svr</td>
<td>root</td>
<td>drwxr-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/acl_svr/managers</td>
<td>root</td>
<td>-rw-------</td>
<td>13</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/acl_users</td>
<td>root</td>
<td>drwxr-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/jobs</td>
<td>root</td>
<td>drwxr-x---</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/license_file</td>
<td>root</td>
<td>-rw-r--r--</td>
<td>34</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/queues/newqueue</td>
<td>root</td>
<td>-rw-------</td>
<td>303</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/queues/workq</td>
<td>root</td>
<td>-rw-------</td>
<td>303</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/resource-def</td>
<td>root</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBS_HOME/server_priv/server.lock</td>
<td>root</td>
<td>-rw-------</td>
<td>4</td>
</tr>
<tr>
<td>PBS_HOME/server_priv/svrlive</td>
<td>root</td>
<td>-rw-------</td>
<td></td>
</tr>
<tr>
<td>PBS_HOME/server_priv/tracking</td>
<td>root</td>
<td>-rw-------</td>
<td>0</td>
</tr>
<tr>
<td>PBS_HOME/spool</td>
<td>root</td>
<td>drwxrwxrwt</td>
<td>4096</td>
</tr>
<tr>
<td>PBS_HOME/undelivered</td>
<td>root</td>
<td>drwxrwxrwt</td>
<td>4096</td>
</tr>
</tbody>
</table>
Log Messages

The server, scheduler and MOM all write messages to their log files. Which messages are written depends upon each daemon’s event mask. See section 13.4, "Event Logging" on page 742 in the PBS Professional Administrator’s Guide.

A few log messages are listed here.

**RPP Retries**

<table>
<thead>
<tr>
<th>Logs</th>
<th>Server, scheduler, MOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0002</td>
</tr>
<tr>
<td>Form</td>
<td>date; time;event type; reporting daemon; event class; rpp_stats; total (pkts=&lt;packets&gt;, retries=&lt;retries&gt;, fails=&lt;fails&gt;) last &lt;number of seconds&gt; secs (pkts=&lt;packets&gt;, retries=&lt;retries&gt;, fails=&lt;fails&gt;)</td>
</tr>
<tr>
<td>Example</td>
<td>03/22/2006 15:20:44;0002; pbs_mom; Svr;rpp_stats; total (pkts=4321, retries=25, fails=3) last 3621 secs (pkts=43, retries=2, fails=0)</td>
</tr>
</tbody>
</table>
Chapter 16  Log Messages

| Explanation | RPP packet retries, reported both for total number since daemon start ("total") and since last log message ("last <seconds> secs"). Logged at most once per hour unless this hour’s retry count is 0. The number of seconds since the previous log message is shown in “last <seconds> secs”.
|             | pkts: number of RPP packets sent. In “total” group, this is since daemon start (in example, 4321). In “last” group, this is since previous log message (in example, 43).
|             | retries: number of RPP data packet retries. In “total” group, this is since daemon start (in example, 25). In “last” group, this is since previous log message (in example, 2).
|             | fails: number of failures reported to the caller of the RPP function. In “total” group, this is since daemon start (in example, 3). In “last” group, this is since previous log message (in example, 0).
|             | No log message if the number of fails and retries are zero. |

**cput and mem logarithmized by Mother Superior**

<table>
<thead>
<tr>
<th>Logs</th>
<th>Mother Superior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0100</td>
</tr>
<tr>
<td>Form</td>
<td>Date; Time; event class; reporting daemon; Job; Job ID; Hostname; cput; mem</td>
</tr>
<tr>
<td>Example</td>
<td>07/02/2007 19:47:14;0100;pbs_mom;Job;40.pepsi;pepsi cput= 0:00:00 mem=4756kb</td>
</tr>
<tr>
<td>Explanation</td>
<td>On job exit, Mother superior logs the amount of cput and mem used by this job on each node.</td>
</tr>
</tbody>
</table>

**MOM adds $clienthost Address**

<table>
<thead>
<tr>
<th>Logs</th>
<th>MOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Event level 0x0002, event class Server</td>
</tr>
<tr>
<td>Form</td>
<td>Adding IP address XXX.XXX.XXX.XXX as authorized</td>
</tr>
<tr>
<td>Example</td>
<td>Adding IP address 127.0.0.1 as authorized</td>
</tr>
</tbody>
</table>
Log Messages

Chapter 16

| Explanation | When MOM starts up, she logs the addresses associated with a host listed in Mom's config file in `Sclienhost` statements. When MOM receives the list from the Server, addresses associated with other MOMs in the PBS complex will be listed. This occurs as soon as MOM and the Server establish communication and again whenever a node goes down and comes back up, or there is a change to the list of execution hosts (node added to or deleted from the complex). That event and the associated logging may occur at any time. |

Scheduler: Job is Invalid

| Logs | Scheduler |
| Level | 0x0080 |
| Form | Job is invalid - ignoring for this cycle |
| Example | Job is invalid - ignoring for this cycle |
| Explanation | Job failed a validity check such as 1) no egroup, euser, select, place, 2) in peer scheduling, pulling server is not a manager for furnishing server, 3) internal scheduler memory failure |

Scheduler: Message Indicating Whether It Is Prime Time

| Logs | Scheduler |
| Level | 0x0100 (256) |
| Form | “It is *P*. It will end in XX seconds at MM/DD/YY HH:MM:SS” |
| Example | “It is prime time. It will end in 29 seconds at 03/10/2007 09:29:31” |
| Explanation | The scheduler is declaring whether the current time is prime time or non-prime time. The scheduler is stating when this period of prime time or non-prime time will end. |

Jobs that Can Never Run

| Logs | Scheduler |
| Level | 0x0080 |
### Chapter 16  
**Log Messages**

<table>
<thead>
<tr>
<th>Form</th>
<th>“resource request is impossible to solve: job will never run”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>“resource request is impossible to solve: job will never run”</td>
</tr>
<tr>
<td>Explanation</td>
<td>The “most deserving” job can never run. Only printed when backfilling is on.</td>
</tr>
</tbody>
</table>

**Resource Permission Flag Error**

<table>
<thead>
<tr>
<th>Logs</th>
<th>Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0080, 0x0100</td>
</tr>
<tr>
<td>Form</td>
<td>“It is invalid to set both flags 'r' and 'i'. Flag 'r' will be ignored.”</td>
</tr>
<tr>
<td>Example</td>
<td>“It is invalid to set both flags 'r' and 'i'. Flag 'r' will be ignored.”</td>
</tr>
<tr>
<td>Explanation</td>
<td>The “i” and “r” flags are incompatible. The “i” flag takes precedence.</td>
</tr>
</tbody>
</table>

**Error During Evaluation of Tunable Formula**

<table>
<thead>
<tr>
<th>Logs</th>
<th>Scheduler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0100</td>
</tr>
<tr>
<td>Form</td>
<td>1234.mars;Formula evaluation for job had an error. Zero value will be used</td>
</tr>
<tr>
<td>Example</td>
<td>1234.mars;Formula evaluation for job had an error. Zero value will be used</td>
</tr>
<tr>
<td>Explanation</td>
<td>Tunable formula produced error when evaluated.</td>
</tr>
</tbody>
</table>

**Creation of Job-specific Directory**

<table>
<thead>
<tr>
<th>Logs</th>
<th>MOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0008</td>
</tr>
<tr>
<td>Form</td>
<td>“created the job directory &lt;jobdir_root&gt;&lt;unique_job_dir_name&gt;”</td>
</tr>
<tr>
<td>Example</td>
<td>“created the job directory /Users/user1/pbsjobs/345.myhost”</td>
</tr>
<tr>
<td>Explanation</td>
<td>PBS created a job-specific execution and staging directory</td>
</tr>
</tbody>
</table>
## Log Messages

### Failure to Create Job-specific Directory

<table>
<thead>
<tr>
<th>Logs</th>
<th>MOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0001</td>
</tr>
<tr>
<td>Form</td>
<td>“unable to create the job directory <code>&lt;unique_job_dir_name&gt;</code>”</td>
</tr>
<tr>
<td>Example</td>
<td>“unable to create the job directory <code>/Users/user1/pbsjobs/345.myhost</code>”</td>
</tr>
<tr>
<td>Explanation</td>
<td>The MOM was unable to create the job-specific staging and execution directory</td>
</tr>
</tbody>
</table>

### Failure to Validate MOM's `$jobdir_root`

<table>
<thead>
<tr>
<th>Logs</th>
<th>MOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0001</td>
</tr>
</tbody>
</table>
| Form    | "<file>[<linenum>]command "\$jobdir_root <full path>" failed, aborting"
| Example | "config[3] command "\$jobdir_root /foodir" failed, aborting" |
| Explanation | `$jobdir_root` exists in the MOM’s configuration file, and the MOM was unable to validate `$jobdir_root`; MOM has aborted |

### Job Eligible Time

<table>
<thead>
<tr>
<th>Logs</th>
<th>Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0400</td>
</tr>
<tr>
<td>Form</td>
<td>MM/DD/YYYY hh:mm:ss;log event;Server@hostname;Job;jobID;job accrued 23 secs of <code>&lt;previous sample type&gt;</code>, new accrue_type=&lt;next_sample_type&gt;, eligible_time=&lt;current amount of eligible_time&gt;</td>
</tr>
<tr>
<td>Example</td>
<td>08/07/2007 13:xx:yy;0040;Server@myhost;Job;163.myhost;job accrued 23 secs of eligible_time, new accrue_type=run_time, eligible_time=00:00:23</td>
</tr>
<tr>
<td>Explanation</td>
<td>Previous sample was of eligible time; next sample will be of run_time, job has accrued 23 seconds of eligible_time.</td>
</tr>
</tbody>
</table>
## Invalid Syntax for Standing Reservation

<table>
<thead>
<tr>
<th>Logs</th>
<th>Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0x0080</td>
</tr>
<tr>
<td>Form</td>
<td>pbs_rsub error: Undefined iCalendar syntax</td>
</tr>
<tr>
<td>Example</td>
<td>pbs_rsub error: Undefined iCalendar syntax</td>
</tr>
<tr>
<td>Explanation</td>
<td>Invalid syntax given to pbs_rsub for recurrence rule for standing reservation</td>
</tr>
</tbody>
</table>
Appendix A: License Agreement

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Attn: Tom M. PerringAttn: ______________________

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