

PBS Professional® 12.1

# Installation and Upgrade Guide



 Altair | PBS Works™

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Altair PBS Professional 12.1 Installation & Upgrade Guide, updated 5/16/13, edited by Anne Urban

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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

## **Ordering Software and Publications**

To order additional copies of this manual and other PBS publications, or to purchase additional software licenses, contact your Altair sales representative. Contact information is included on the copyright page of this book.

## **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





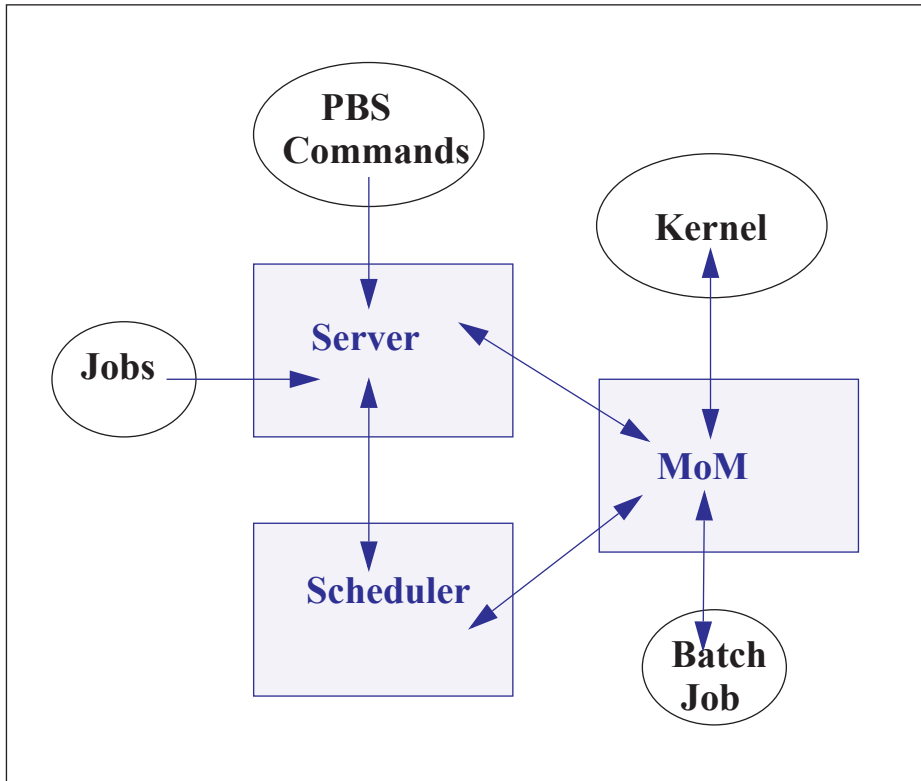
# Chapter 1

## Concepts and Components

PBS is a distributed workload management system which manages and monitors the computational workload on a set of one or more computers.

### 1.1 PBS Components

PBS consist of two major component types: system processes and user-level commands. A brief description of each is given here.



### 1.1.1 Server

The *Server* process is the central focus for PBS. Within this document, it is generally referred to as *the Server* or by the execution name *pbs\_server*. All commands and communication with the Server are via an *Internet Protocol* (IP) network. The Server's main function is to provide the basic batch services such as receiving/creating a batch job, modifying the job, protecting the job against system crashes, and running the job. Typically there is one Server managing a given set of resources.

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

---

### 1.1.2 Job Executor (MoM)

The *Job Executor* is the component that actually places the job into execution. This process, *pbs\_mom*, is informally called *MoM* as it is the mother of all executing jobs. MoM places a job into execution when it receives a copy of the job from a Server. MoM creates a new session that is as identical to a user login session as is possible. For example, if the user's login shell is `cs`, then MoM creates a session in which `.login` is run as well as `.cshrc`. MoM also has the responsibility for returning the job's output to the user when directed to do so by the Server. One MoM runs on each computer which will execute PBS jobs.

### 1.1.3 Scheduler

The *Scheduler*, *pbs\_sched*, implements the site's policy controlling when each job is run and on which resources. The Scheduler communicates with the various MoMs to query the state of system resources and with the Server to learn about the availability of jobs to execute. The interface to the Server is through the same API as used by the client commands. Note that the Scheduler communicates with the Server with the same privilege as the PBS Manager.

### 1.1.4 The *pbs\_rshd* Windows Service

The Windows version of PBS contains a service called *pbs\_rshd* for supporting remote file copy requests for delivering job output and error files to destination hosts.

The *pbs\_rshd* service supports `rcp`, but does not allow normal `rsh` activities. This service is used only by PBS; it is not intended to be used by administrators or users.

*pbs\_rshd* reads either the `%WINDIR%\system32\drivers\etc\hosts.equiv` file or the user's `.rhosts` file to determine the list of accounts that are allowed access to the local host during remote file copying.

PBS uses this same mechanism for determining whether a remote user is allowed to submit jobs to the local server.

*pbs\_rshd* is started automatically during installation; you can also start it manually.

To start *pbs\_rshd* as a service:

```
net start pbs_rshd
```

To start *pbs\_rshd* in debug mode, so that it prints logging output on the command line:

```
pbs_rshd -d
```

---

If `user1` on `hostA` causes a file to be copied to `hostB` (running `pbs_rshd`) so that the source is `file1` and the destination is `hostB:file2`, `pbs_rshd` authenticates `user1` as follows:

- If `user1` is a non-administrator account (e.g. not belonging to the Administrators group), then the copy will succeed in one of 2 ways:
  - `user1@hostA` is authenticated via `hostB`'s `hosts.equiv` file; or
  - `user1@hostA` is authenticated via user's `[PROFILE_PATH]/.rhosts` on `hostB`.

See also [section 2.6.2, "Windows User's HOMEDIR", on page 25](#).

One of the following must be configured:

- The system-wide `hosts.equiv` file on `hostB` includes as one of its entries:
 

```
hostA
```
- or, `[PROFILE_PATH]\.rhosts` on `userA`'s account on `hostB` includes:
 

```
hostA userA
```
- If `userA` is an administrator account, or the source is `file1` and the target is `userB@hostB:file2` then use of the account's `[PROFILE_PATH]\.rhosts` file is the only way to authenticate, and it needs to have the entry:
 

```
hostA userA
```

### 1.1.5 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.

# Chapter 2

## Pre-Installation Steps

This chapter describes the steps to take before installing PBS. Make sure that your setup meets the requirements described here, and that you take the required steps to prepare for installing PBS.

### 2.1 Prerequisites for Running PBS

#### 2.1.1 Run Same Version Within Complex

Do not mix different versions of PBS within a PBS complex or across complexes. This includes both major and minor versions. All daemons and commands must be the same version of PBS Professional.

#### 2.1.2 Resources Required by PBS

The amount of memory required by the PBS server and scheduler depends on the number of hosts and the number of jobs to be queued or running. Each host will need less than 512 bytes. The number of jobs is the important factor, since each job needs about 10 KB at server startup and 5 KB when the server is running. The number of processors in the complex is not a factor.

### **2.1.2.1 Memory Required By Server Running Hooks**

A PBS server executing hook scripts can consume a larger amount of memory than one not executing hook scripts. For example, a system consisting of a server and a MoM on a Linux machine or on a Windows XP machine handling 10,000 short-running jobs being submitted, modified, and moved causing execution of qsub, qalter, and movejob hooks will use around 40 MB of memory in a span of 24 hours.

### **2.1.2.2 Memory Required for Job History**

Enabling job history requires additional memory for the server. When the server is keeping job history, it needs 8k-12k of memory per job, instead of the 5k it needs without job history. Make sure you have enough memory: multiply the number of jobs being tracked by this much memory. For example, if you are starting 100 jobs per day, and tracking history for two weeks, you're tracking 1400 jobs at a time. On average, this will require 14.3M of memory.

If the server is shut down abruptly, there is no loss of job information. However, the server will require longer to start up when keeping job history, because it must read in more information.

### **2.1.2.3 Amount of Memory in Complex**

If the sum of all memory on all vnodes in a PBS complex is greater than 2 terabytes, then the Server (pbs\_server) and Scheduler (pbs\_sched) must be run on a 64-bit architecture host, using a 64-bit binary.

### **2.1.2.4 Adequate Space for Logfiles**

PBS logging can fill up a filesystem. For customers running a large number of array jobs, we recommend that the filesystem where `$PBS_HOME` is located has at least 2 GB of free space for log files. It may also be necessary to rotate and archive log files frequently to ensure that adequate space remains available. (A typical PBS Professional complex will generate about 2 GB of log files for every 1,000,000 subjobs and/or jobs.)

### **2.1.2.5 Installation Disk Space**

Make sure you have adequate disk space to install PBS. It is recommended to have at least 305 MB available, for installation alone.

---

## 2.1.3 Name Resolution and Network Configuration

**Do NOT skip this section.** PBS cannot function if your hostname resolution or network is configured incorrectly.

### 2.1.3.1 Firewalls

PBS needs to be able to use any port for outgoing connections, but only specific ports for incoming connections. If you have firewalls running on the server or execution hosts, be sure to allow incoming connections on the appropriate ports for each host. By default, the PBS server and MoM daemons use ports 15001 through 15004 for incoming connections, and any port below 1024 for outgoing connections. See [section 3.3.4, “Network Addresses and Ports”, on page 37](#) for a list of ports.

Firewall-based issues are often associated with server-MoM communication failures and messages such as 'premature end of message' in the log files.

### 2.1.3.2 Network Tuning

Depending on your network, you may need to tune kernel settings or other configuration parameters. Make sure that your kernel settings support PBS. For example, check your IP tuning parameters, including UDP and TCP, and check your ARP, routing, and name resolution settings.

### 2.1.3.3 Planning for Number of Machines Connected to Complex

Configure your server host with sufficient ARP cache entries in order to allow at least one connection per ethernet address that will connect to the server or to which the server will connect. This includes execution hosts, client hosts, peered servers, storage machines, or machines where the scheduler may execute scripts. Check your ARP table tuning settings.

### 2.1.3.4 Required Name Resolution

Make sure that the following are true:

- Use only one canonical name per host. The canonical name must be unambiguous.
- On the server/scheduler host, the short name must resolve to the correct IP address.
- On the server/scheduler host, the IP address must reverse resolve to the canonical name.
- Make sure that different resolvers cannot disagree when resolving the server host,

whether you are using `/etc/hosts`, DNS, LDAP, NIS, or something else.

- Every MoM must resolve each MoM to the same IP address that the server recognizes for that MoM. So if the server recognizes MoM A at IP address `w.x.y.z`, all other MoMs must resolve MoM A to `w.x.y.z`.
- Make sure that the IP address of each machine in the complex resolves to the fully qualified domain name for that machine, and vice versa. Forward and reverse hostname resolution must work consistently between all machines.
- The server must be able to look up the IP addresses for any execution host, any client host, and itself.
- Make sure that forward and reverse name lookup operate according to the IETF standard. The network on which you will be deploying PBS must be configured according to IETF standards.

### **2.1.3.5 Required Network Configuration**

- PBS can use a static address mapping only.
- Communications between daemons must be robust and must have sufficient capacity. Make sure that your network does not present any limitations to PBS. For example, the ARP table size limit must not interfere when you have a large number of MoMs. Configure your server with sufficient ARP cache entries to allow at least one connection per ethernet address that will connect to the server or to which the server will connect. This includes execution hosts, client hosts, peered servers, storage machines, or machines where the scheduler may execute scripts. See [section 2.1.3.1, “Firewalls”, on page 7](#).

### **2.1.3.6 Recommendations for Name Resolution and Network Configuration**

- Test name resolution using the `ping` command.
- Test the connections between server and MoM daemons on every physical network. You should test TCP and UDP, and make sure that the connection can handle large packets.



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You can use a tool such as `ttcp`, with packets of size 16k, for testing.

- For multihomed MoMs, keep all PBS traffic on the same control network or subnet.
- Keep different types of traffic on separate interfaces to reduce jitter.
- When configuring `/etc/hosts`, do the following:
  - Use the server's FQDN as the first item on the first line on the PBS-to-PBS interface
  - Use different FQDNs as the first item on other lines
  - Use a name on only one line
- If you want redundancy in your network interface, consider using bonding. Aside from presenting a transparent interface, this can allow you to load-balance network traffic across different networks.
- If name resolution is a problem in a network that should be working, tell `nscd` not to cache the host name of the machine with the problem.
- If you are using `nscd` and you change an IP address or hostname, restart `nscd` on all hosts.

#### **2.1.3.6.i Recommendations for Name Resolution and Network Configuration on Windows**

- On Windows, make sure the first nameserver resolves all the needed hostnames, including the server hostname and the domain controller host for active directory queries.
- On Windows, put explicit IP-to-hostname addresses in the `C:\windows\system32\drivers\etc\hosts` file. Otherwise your site will experience extreme slowdowns. If you make these changes to a running PBS complex, you must then restart all the PBS daemons (services).

---

### 2.1.3.7 Order of Operations for Name Resolution and Network Configuration

You can take care of some of the name resolution testing before you install PBS. However, you must do some testing using the `pbs_hostn` command, after you install PBS. The "[Initial Configuration](#)" chapter follows the "[Installation](#)" chapter, and includes steps to test name resolution. We include an overview of the whole process here for clarity:

1. Set up firewall
2. Set up name resolution
3. Test name resolution by using `ping` command; if necessary, fix & re-test
4. Install PBS
5. Test name resolution by using `pbs_hostn` command.
6. If name resolution does not work correctly:
  - a. Uninstall PBS
  - b. Fix name resolution
  - c. Install PBS
  - d. Test using `pbs_hostn`

### 2.1.3.8 Server Hostname

The `PBS_SERVER` entry in `pbs.conf` cannot be longer than 64 characters. If the short name of the server host resolves to the correct IP address, you can use the short name for the value of the `PBS_SERVER` entry in `pbs.conf`. If only the FQDN of the server host resolves to the correct IP address, you must use the FQDN for the value of `PBS_SERVER`.

### 2.1.3.9 Sockets

Some PBS processes cause network sockets to be opened between submission and execution hosts. For more information about these processes, see section 10.3.8, "Advice and Caveats", on page 751 of the PBS Professional Administrator's Guide. Make sure your network and firewalls are set up to handle sockets correctly.

### 2.1.3.10 Planning for File Access

In distributed environments it will be necessary to plan for how the users will access their input files, datasets, etc. Various options exist (such as `NFS`, `rcp`, `scp`, etc.). These need to be considered prior to installing PBS Professional, as such decisions can change which

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parameters are selected for tuning PBS. For details, see the `usecp` MoM configuration parameter in the `pbs_mom(8B)` man page and [section 13.9, "Setting File Transfer Mechanism" on page 897 in the PBS Professional Administrator's Guide](#). The impact of file location and delivery are discussed further in section 4.2 "Input/Output File Staging" on page 49 in the PBS Professional User's Guide.

Asynchronous writes to an NFS server can cause reliability problems. If using an NFS file system, mount the NFS file system synchronously (without caching.)

## 2.1.4 SGI Altix and UV Cpuset Feature Requires ProPack Library or Performance Suite

Customers who intend to run PBS Professional on SGI Altix or UV systems using cpusets should note that there are strict requirements for SGI ProPack or Performance Suite (containing the cpuset API). A supported version of ProPack or Performance Suite is required. The library is required on MoM vnodes where cpuset functionality is desired. To test whether the library is currently installed, execute the following command:

```
ls /usr/lib/libcpuset.so*
```

The PBS Professional MoM binary that supports cpusets is `pbs_mom.cpuset`.

## 2.1.5 Using Comprehensive System Accounting on SGI Altix

PBS support for CSA on SGI systems is no longer available. The CSA functionality for SGI systems has been **removed** from PBS.

## 2.1.6 Requirement on Cray

PBS requires CLE 3.0 and higher on the Cray.

## 2.1.7 Port Requirement

The ports used by the PBS daemons must be available during the installation. See [section 3.3.4, "Network Addresses and Ports", on page 37](#).

## 2.1.8 System Clocks in Sync

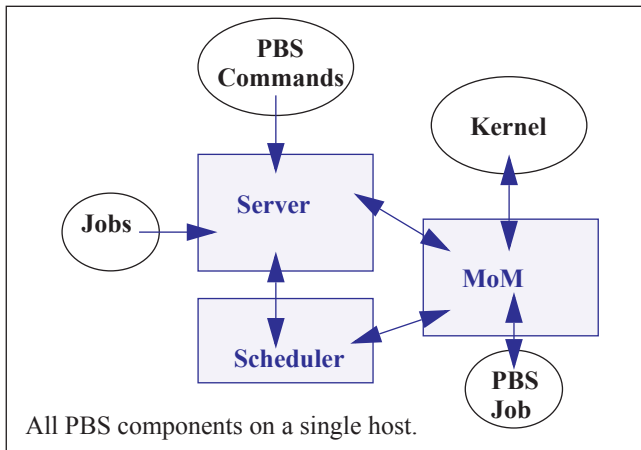
We recommend that clocks on all participating systems be in sync.

### 2.1.9 Windows Caveats

The PBS installer installs `vc++` redistributable binaries into the system root (`C:\Windows`) directory. See section 9.12, "Windows Caveats", on page 700 of the PBS Professional Administrator's Guide.

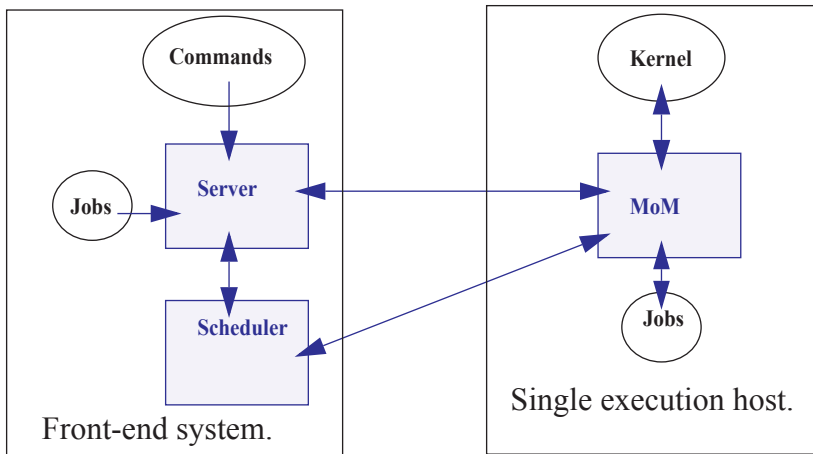
## 2.2 Single Execution System

If PBS is to manage a single system, all three components are installed on that same system. During installation (as discussed in the next chapter) be sure to select option 1 (all components) from the PBS Installation tool.



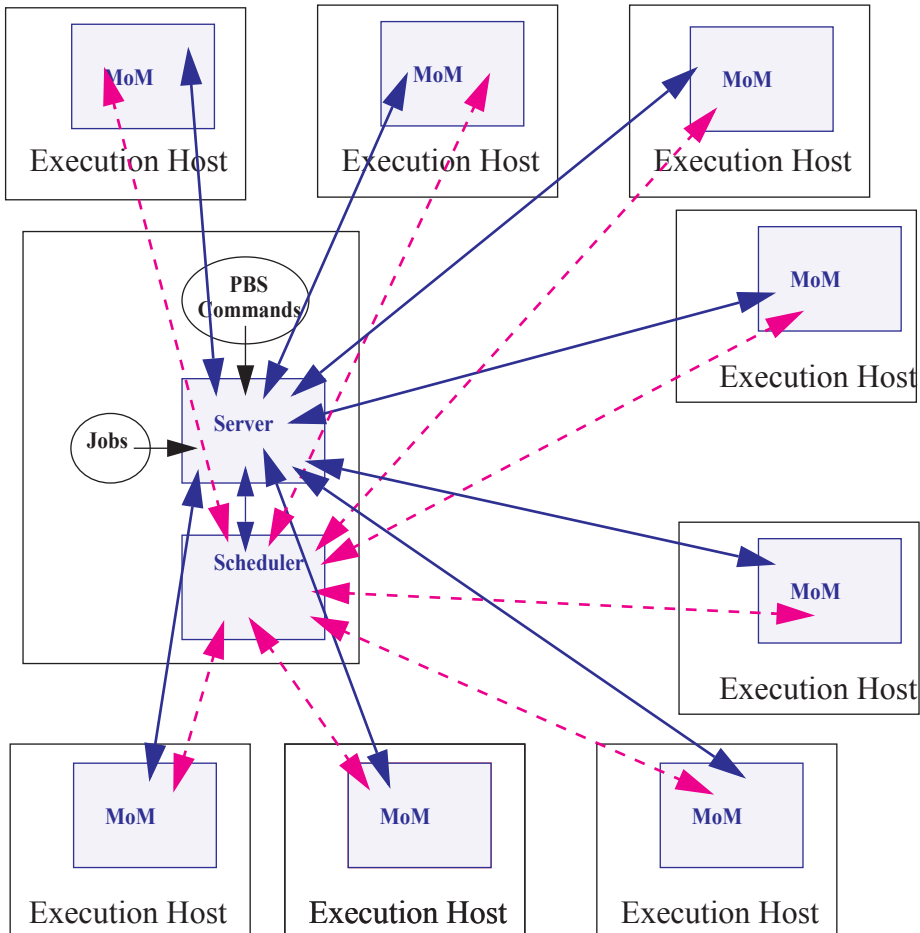
### 2.2.1 Single Execution System with Front-end

If you wish, the PBS Server and Scheduler (`pbs_server` and `pbs_sched`) can run on one system and jobs can execute on another.



## 2.3 Multiple Execution Systems

If PBS is to be installed on a collection (or complex) of systems, normally the Server (`pbs_server`) and the Scheduler (`pbs_sched`) are installed on a “front end” system (option 1 from the PBS Installation tool), and a MoM (`pbs_mom`) is installed (option 2 from the Installation tool) and run on each execution host (i.e. each system where jobs are to be executed). The following diagram illustrates this for an eight host complex.



---

## 2.4 User Requirements on UNIX/Linux

### 2.4.1 User Accounts

Users who will submit jobs must have accounts at the server and at each execution host.

### 2.4.2 UNIX User Authorization

When the user submits a job from a system other than the one on which the PBS Server is running, system-level user authorization is required. This authorization is needed for submitting the job and for PBS to return output files (see also section 4.3 “Managing Output and Error Files” on page 61 in the PBS Professional User’s Guide and section 4.2 “Input/Output File Staging” on page 49 in the PBS Professional User’s Guide).

The username under which the job is to be executed is selected according to the rules listed under the “-u” option to `qsub`. The user submitting the job must be authorized to run the job under the execution user name (whether explicitly specified or not).

Such authorization is provided by any of the following methods:

1. The host on which `qsub` is run (i.e. the submission host) is trusted by the server. This permission may be granted at the system level by having the submission host as one of the entries in the server’s `host.equiv` file naming the submission host. For file delivery and file staging, the host representing the source of the file must be in the receiving host’s `host.equiv` file. Such entries require system administrator access.
2. The host on which `qsub` is run (i.e. the submission host) is explicitly trusted by the server via the user’s `.rhosts` file in his/her home directory. The `.rhosts` must contain an entry for the system from which the job is submitted, with the user name portion set to the name under which the job will run. For file delivery and file staging, the host representing the source of the file must be in the user’s `.rhosts` file on the receiving host. It is recommended to have two lines per host, one with just the “base” host name and one with the full hostname, e.g.: *host.domain.name*.
3. PBS may be configured to use the Secure Copy (`sftp`) for file transfers. The administrator sets up SSH keys as described in [section 13.8, “Enabling Passwordless Authentication” on page 896 in the PBS Professional Administrator’s Guide](#). See also section 13.9, “Setting File Transfer Mechanism”, on page 897 of the PBS Professional Administrator’s Guide.
4. User authentication may also be enabled by setting the server’s `flatuid` attribute to *True*. See the `pbs_server_attributes(7B)` man page and section 9.3.13,

"Flatuid and Access", on page 683 of the PBS Professional Administrator's Guide. Note that flatuid may open a security hole in the case where a vnode has been logged into by someone impersonating a genuine user.

## 2.5 Recommended PBS Configurations for Windows

This section presents the recommended configuration for running PBS Professional under Windows.

### 2.5.1 Definitions

#### Active Directory

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. It was released first with Windows 2000 Server, and extended/improved under Windows Server 2003. Active Directory is fully integrated with DNS and TCP/IP; DNS is required. To be fully functional, the DNS server must support SRV resource records or service records.

#### Admin (Windows)

As referred to in various parts of this document, it is a user logged in from an account who is a member of any group that has full control over the local computer, domain controller, or is allowed to make domain and schema changes to the Active directory.

#### Administrators

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

#### Delegation

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, then delegation allows giving the account read access only to all domain users and groups information. This is done via the Delegation wizard.



---

**Domain Admin Account**

It is a domain account on Windows that is a member of the “Domain Admins” group.

**Domain Admins**

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**

It is a domain account on Windows that is a member of the “Domain Users” group.

**Domain Users**

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**

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.

**Install Account, Installation Account**

The account used by the person who installs PBS.

**Schema Admins**

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.

**PBS service account**

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 account can have any name. The default name is *pbsadmin*.

## 2.5.2 Permission Requirement

On Windows 7 and later with UAC enabled, if you will use the `cmd` prompt to operate on hooks, or for any privileged command such as `qmgr`, you must run the `cmd` prompt with option *Run as Administrator*.

## 2.5.3 Windows Configuration in a Domained Environment

### 2.5.3.1 Machines

- The PBS clients, server, MoMs, scheduler, and rshds must run on a set of Windows machines networked in a single domain.
- The machines must be members of this one domain, and they must be dependent on a centralized database located on the primary/secondary domain controllers.
- All user accounts must be in the same domain as the machines.
- The domain controllers must be running on a Server type of Windows host, using Active Directory configured in "native" mode.
- The choice of DNS must be compatible with Active Directory.
- The PBS server and scheduler must be run on a Server type of Windows machine that is not the domain controller and is running Active Directory.
- PBS must not be installed or run on a Windows machine that is serving as the domain controller (running Active Directory) to the PBS hosts.

### 2.5.3.2 Installation Account

- The installation account is the account from which PBS is installed. The installation account must be the only account that will be used for all steps of PBS installation including modifying configuration files, setting up failover, and so on. If any of the PBS configuration files are modified by an account that is not the installation account, permissions/ownerships of the files could be reset, rendering them inaccessible to PBS. For domained environments, the installation account must be a local account that is a member of the local Administrators group on the local computer.

### 2.5.3.3 The PBS Service Account

- The PBS service account is the account under which the PBS services (`pbs_server`,

- 
- `pbs_mom`, `pbs_sched`, `pbs_rshd`) will run.
- This account can have any name.
  - The name of the account defaults to *pbsadmin*.
  - This account must exist while any PBS services are running.
  - The password for this account should not be changed while PBS is running.
  - Create the PBS service account before installing PBS.
  - For domained environments, the PBS service account must:
    - a. be a domain account
    - b. be a member of the "Domain Users" group, and **only** this group
    - c. have "domain read" privilege to all users and groups.
  - For a domained environment, delegate "read access to all users and groups information" to the PBS service account. See [section 2.5.3.4, "Delegating Read Access"](#), on page 19.
  - If the PBS service account is set up with no explicit domain read privilege, MoM may hang. This happens when XP users submit jobs from a network mapped drive without the `-o/-e` option for redirecting files. When this happens, bring up Task manager, look for a "cmd" process by the user who owned the job, and kill it. After the first cmd process is killed, you may have to look for a second one (the first one copies the output file, the second one does the error file). This should un-hang the MoM.

### 2.5.3.4 Delegating Read Access

- To delegate "read access to users and groups information" to the PBS service account:
  - a. On the domain controller host, bring up Active Directory Users and Computers.
  - b. Select <domain name>, right mouse click, and choose "Delegate Control". This will bring up the "Delegation of Control Wizard".
  - c. When it asks for a user or group to which to delegate control, select the name of the PBS service account.
  - d. When it asks for a task to delegate, specify "Create a custom task to delegate".
  - e. For active directory object type, select the "this folder, existing objects in this folder, and creation of objects in this folder" button.
  - f. For permissions, select "Read" and "Read All Properties".
  - g. Exit out of Active Directory.

### 2.5.3.5 User Accounts

- Each user must explicitly be assigned a HomeDirectory sitting on some network path. PBS does not support a HomeDirectory that is not network-mounted. PBS currently supports network-mounted directories that are using the Windows network share facility.
- If a user was not assigned a HomeDirectory, then PBS uses `PROFILE_PATH\My Documents\PBS Pro`, where `PROFILE_PATH` could be, for example, “`\Documents and Settings\username`”.

### 2.5.3.6 User Jobs

- All users must submit and run PBS jobs using only their domain accounts (no local accounts), and domain groups. If a user has both a domain account and local account, then PBS will ensure that the job runs under the domain account.
- Each user must always supply an initial password in order to submit jobs. This is done by running the `pbs_password` command at least once to supply the password that PBS will use to run the user’s jobs.
- Access by jobs to network resources, such as a network drive, requires a password.
- All job scripts, as well as input, output, error, and intermediate files of a PBS job must reside in an NTFS directory.

### 2.5.3.7 Adding to Local Administrators Group

- Add the PBS service account to the local Administrators group:  

```
net localgroup Administrators <domain name>\<service account name> /add
```

### 2.5.3.8 Installation Path

- The destination/installation path of PBS must be NTFS. All PBS configuration files must reside on an NTFS filesystem.

### 2.5.3.9 Installation

- The same PBS service account must be used in all future invocations of the install program when setting up a complex of PBS hosts.
- The install program requires the installer to supply the password for the PBS service account. This same password must be supplied to future invocations of the install program on other servers/hosts.
- The install program will enable the following rights to the PBS service account: "Create Token Object", "Replace Process Level Token", "Log On As a Service", and "Act As Part

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of the Operating System".

- The install program will enable Full Control permission to local "Administrators" group on the install host for all PBS-related files.
- The install program will give you a specific error if it fails to make the PBS service account be a member of the local Administrators group on the local computer. It will quit at this point, and you must go back and make the PBS service account be a member of the local Administrators group on the local computer. See [section 2.5.3.7, "Adding to Local Administrators Group"](#), on page 20. Then re-run the install program.

## 2.5.4 Windows Configuration in a Standalone Environment

### 2.5.4.1 Machines

- PBS must be run on a set of machines that are not members of any domain (workgroup setup); no domain controllers/ Active Directory are involved.

### 2.5.4.2 Installation Account

- The installation account is the account from which PBS is installed. The installation account must be the only account that will be used in all aspects of PBS installation including modifying configuration files, setting up failover, and so on. If any of the PBS configuration files are modified by an account that is not the installation account, permissions/ownerships of the files could be reset, rendering them inaccessible to PBS.
- For standalone environments, the installation account must be a local account that is a member of the local Administrators group on the local computer.

### 2.5.4.3 The PBS service account for Standalone Environments

- The PBS service account is the account under which PBS services (`pbs_server`, `pbs_mom`, `pbs_sched`, `pbs_rshd`) will run.
- This account can have any name.
- The name of this account defaults to *pbsadmin*.  
This account must exist while any PBS services are running.
- The password for this account should not be changed while PBS is running.
- Create the PBS service account before installing PBS.
- For standalone environments, the PBS service account must be a local account that is a member of the local Administrators group on the local computer. See [section 2.5.4.5,](#)

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[“Adding to Local Administrators Group”, on page 22.](#)

- User Accounts
- Each user should be assigned a local NTFS HomeDirectory.
- If a user was not assigned a HomeDirectory, then PBS uses `PROFILE_PATH\My Documents\PBS Pro`, where `PROFILE_PATH` could be, for example, “\Documents and Settings\*username*”.
- A local account/group having the same name must exist for the user on all the execution hosts.

#### 2.5.4.4 User Jobs

- Users must submit and run PBS jobs using their local accounts and local groups.
- Users should supply a password when submitting jobs. That password must be the same on all the execution hosts. See also section 9.10, "User Passwords", on page 696 of the PBS Professional Administrator’s Guide.
- Job intermediate, input, output, and error files must reside on an NTFS filesystem.
- For a password-ed job, users can access (within the job script) folders in a network share.
- Each user must always supply an initial password to submit jobs. This is done by running the `pbs_password` command at least once to supply the password that PBS will use to run the user’s jobs.
- Access by jobs to network resources (such as a network drive), requires a password.

#### 2.5.4.5 Adding to Local Administrators Group

- Add the PBS service account to the local Administrators group:  
`net localgroup Administrators <name of PBS service account> /add`

#### 2.5.4.6 Installation Path

- The destination/installation path of PBS must be NTFS. All PBS configuration files must reside on an NTFS filesystem.

#### 2.5.4.7 Installation

- The same PBS service account must be used in all future invocations of the install program when setting up a complex of PBS hosts.
- The install program will require the installer to supply the password for the PBS service account. The same password must be supplied to future invocations of the install program

on other Servers/hosts.

- The install program will enable the following rights to the PBS service account: “Create Token Object”, “Replace Process Level Token”, “Log On As a Service”, and “Act As Part of the Operating System”.
- The install program will enable Full Control permission to local "Administrators" group on the install host for all PBS-related files.

### 2.5.5 Caveats

- If you change the name of the PBS service account, you must restart the daemons on that host.

### 2.5.6 PBS Service Account

The PBS service account must be the same on the primary and secondary server hosts.

The PBS service account can be different on each execution host.

### 2.5.7 Unsupported Windows Configurations

The following Windows configurations are currently unsupported:

- PBS running on a set of Windows XP hosts that are involved in several “domains” via any trust mechanism.
- Using NIS/NIS+ for authentication on non-domain accounts.
- Using RSA SecurID module with Windows logons as a means of authenticating non-domain accounts.

### 2.5.8 Sample Windows Deployment Scenario

For planning and illustrative purposes, this section describes deploying PBS Professional on a complex of 20 machines networked in a single domain, with host 1 as the server host, and hosts 2 through 20 as the execution hosts.

For this configuration, the installation program is run 20 times, invoked once per host. “All” mode (server, scheduler, MoM, and `rshd`) installation is selected only on host 1, and “Execution” mode (MoM and `rshd`) installs are selected on the other 19 hosts. The PBS service account must exist in advance. This account is used for running the PBS services.

---

The user who runs the `install` program will supply the password for the PBS service account. The installation program will then propagate the password to the local Services Control Manager database.

A reboot of each machine is necessary at the end of each install.

## 2.6 Windows User Authorization

When the user submits a job from a system other than the one on which the PBS Server is running, system-level user authorization is required. This authorization is needed for submitting the job and for PBS to return output files. See section 4.3 “Managing Output and Error Files” on page 61 in the PBS Professional User’s Guide and section 4.2 “Input/Output File Staging” on page 49 in the PBS Professional User’s Guide.

If running in a domained environment, then a password is also required for user authorization. See the discussion of single-signon in section 9.10, “User Passwords”, on page 696 of the PBS Professional Administrator’s Guide.

The user name under which the job is to be executed is selected according to the rules listed under the “-u” option to `qsub`. See [“qsub” on page 210 of the PBS Professional Reference Guide](#). The user submitting the job must be authorized to run the job under the execution user name (whether explicitly specified or not).

Such authorization is provided by either of the following methods:

1. The host on which `qsub` is run (i.e. the submission host) is trusted by the execution host. This permission may be granted at the system level by having the submission host as one of the entries in the execution host’s `host.equiv` file naming the submission host. For file delivery and file staging, the host representing the source of the file must be in the receiving host’s `host.equiv` file. Such entries require system administrator access.
2. The host on which `qsub` is run (i.e. the submission host) is explicitly trusted by each execution host via the user’s `.rhosts` file in his/her home directory. The `.rhosts` must contain an entry for the system on which the job will execute, with the user name portion set to the name under which the job will run. For file delivery and file staging, the host representing the source of the file must be in the user’s `.rhosts` file on the receiving host. It is recommended to have two lines per host, one with just the “base” host name and one with the full hostname, e.g.:  
*host.domain.name*.



---

## 2.6.1 Windows `hosts.equiv` File

The Windows `hosts.equiv` file determines the list of non-Administrator accounts that are allowed access to the local host, that is, the host containing this file. This file also determines whether a remote user is allowed to submit jobs to the local PBS Server, with the user on the local host being a non-Administrator account.

This file is usually: `%WINDIR%\system32\drivers\etc\hosts.equiv`.

The format of the `hosts.equiv` file is as follows:

```
[+|-] hostname username
```

'+' means enable access, whereas '-' means to disable access. If '+' or '-' is not specified, then this implies enabling of access. If only *hostname* is given, then users logged into that host are allowed access to like-named accounts on the local host. If only *username* is given, then that user has access to all accounts (except Administrator-type users) on the local host. Finally, if both *hostname* and *username* are given, then user at that host has access to like-named account on local host.

### 2.6.1.1 Ownership Requirements

The `hosts.equiv` file must be owned by an admin-type user or group, with write access granted to an admin-type user or group.

## 2.6.2 Windows User's `HOMEDIR`

Each Windows user is assumed to have a home directory (`HOMEDIR`) where his/her PBS job will initially be started. For jobs that do not have their staging and execution directories created by PBS, the home directory is also the starting location of file transfers when users specify relative path arguments to `qsub/qalter -W stagein/stageout` options.

### 2.6.2.1 Configuring User's `HOMEDIR`

The home directory can be configured by an Administrator by setting the user's `HomeDirectory` field in the user database, via the User Management Tool. It is important to include the drive letter when specifying the home directory path. The directory specified for the home folder must be accessible to the user. If the directory has incorrect permissions, PBS will be unable to run jobs for the user.

### 2.6.2.2 Directory Must Exist Already

You must specify an already existing directory for home folder. If you don't, the system will create it for you, but set the permissions to that which will make it inaccessible to the user.

### 2.6.2.3 Default Directory

If a user has not been explicitly assigned a home directory, then PBS will use this Windows-assigned default, local home directory as base location for its default home directory. More specifically, the actual home path will be:

```
[PROFILE_PATH]\My Documents\PBS Pro
```

For instance, if a *userA* has not been assigned a home directory, it will default to a local home directory of:

```
\Documents and Settings\userA\My Documents\PBS Pro
```

User's job will use the above path as working directory, and for jobs that do not have their staging and execution directories created by PBS, any relative pathnames in stagein, stageout, output, error file delivery will resolve to the above path.

Note that Windows can return as `PROFILE_PATH` one of the following forms:

```
\Documents and Settings\username
\Documents and Settings\username.local-hostname
\Documents and Settings\username.local-hostname.00N where N is a
  number
\Documents and Settings\username.domain-name
```

### 2.6.2.4 Network Mounted Home Directory

A user can be assigned a HomeDirectory that is network mounted. For instance, a user's directory can be: "\\fileserver\_host\sharename". This would cause PBS to map this network path to a local drive, say `G:`, and allow the working directory of user's job to be on this drive. It is important that the network location (file server) for the home directory be on a Server-type of Windows machine. Workstation-type machines like Windows XP Professional have an inherent limit on the maximum number of outgoing network connections (10) which can cause PBS to fail to map or even access the user's network HomeDirectory. The net effect is the job's working directory ends up in the user's default directory:

```
PROFILE_PATH\My Documents\PBS Pro
```

If a user has been set up with a home directory network mounted, such as referencing a mapped network drive in a `HOMEDIR` path, then the user must submit jobs with a password either via `qsub -wpwd=""`, or via the single-signon feature. See [“qsub” on page 210 of the](#)

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[PBS Professional Reference Guide](#) and section 9.10, "User Passwords", on page 696 of the PBS Professional Administrator's Guide. When PBS runs the job, it will change directory to the user's home directory using his/her credential which must be unique (and passworded) when network resources are involved.

To avoid having to require passworded jobs, users must be set up to have a local home directory. Do this by accessing *Start Menu->Control Panel->Performance and Maintenance->Administrative Tools->Computer Management* (Windows XP), and selecting *System Tools->Local Users and Groups*, double clicking *Users* on the right pane, double clicking on the *username* which brings up the user properties dialog from which you can select *Profile*, and specify an input for *Local path* (Home path). Be sure to include the drive information.

## 2.7 Caveats and Advice

- **Do not** start or stop the data service using anything except the `pbs_dataservice` command. Start or stop the data service using only the `pbs_dataservice` command.
- Do not change the IP address or hostname of a machine in the complex while PBS is running.
- Do not change a hostname without updating the corresponding Version 2 configuration file.
- Do not change a PBS host's IP address while PBS is running. Stop PBS (server, scheduler, and MoMs), change the IP address, and restart PBS.

## 2.8 Windows Caveats

### 2.8.1 Installation of Microsoft Redistributable Pack

The PBS installer installs the Microsoft 2005 redistributable pack. Please refer to the Microsoft documentation for further details on this package.

---

## 2.8.2 Make Sure ComSpec Environment Variable Is Set

Check that in the `pbs_environment` file, the environment variable `ComSpec` is set to `C:\WINDOWS\system32\cmd.exe`. If it is not, set it to that value:

1. Change directory:

```
cmd.admin> cd \Program Files\PBS Pro\home
```

2. Edit the `pbs_environment` file:

```
cmd.admin> edit pbs_environment
```

3. Add the following entry to the `pbs_environment` file:

```
ComSpec=C:\WINDOWS\system32\cmd.exe
```

4. Restart the MoM and the server:

```
net stop pbs_mom
```

```
net start pbs_mom
```

```
net stop pbs_server
```

```
net start pbs_server
```

Simply setting this variable inside a job script doesn't work. The `ComSpec` variable must be set before PBS executes `cmd`. `cmd` invokes the user's submission script.

# Chapter 3

## Installation

### 3.1 Overview of Installation

PBS uses two kinds of licenses: socket licenses, which are tied to hosts, and floating licenses, which are per-job. Socket licenses are managed via a file you obtain from Altair or a manufacturer. Floating licenses are managed through the Altair license server. In order for a job to run, it must either be running on a socket-licensed host, or be using floating licenses. Floating licenses fill in where socket licenses are unavailable.

Hosts are socket licensed as a unit; you can license sockets on a host only when you can license all sockets on that host. If all hosts have socket licenses, you do not need the license server. If you do need the license server, PBS starts working sooner if the Altair license server is installed and configured before installing PBS.

This chapter shows how to install PBS Professional. You should read the Release Notes and [Chapter 2, "Pre-Installation Steps", on page 5](#) before installing the software. If you are installing on a system where PBS is already running, you probably want to preserve your configuration and your jobs during the upgrade. See [Chapter 6, "Upgrading PBS Professional", on page 113](#).

### 3.2 Major Steps for Installing PBS Professional

The major steps for installing PBS depend on whether you are using socket licenses for some or all of your hosts:

- If you are not using socket licenses, follow the steps in [section 3.2.1, "No Hosts Use](#)

[Socket Licenses](#)”, on page 30.

- If you are using socket licenses for all hosts, follow the steps in [section 3.2.2, “All Hosts Use Socket Licenses](#)”, on page 31.
- If you are using socket licenses for some but not all hosts, follow the steps in [section 3.2.3, “Some Hosts Use Socket Licenses](#)”, on page 32.

### 3.2.1 No Hosts Use Socket Licenses

1. Download, install, and configure the Altair license server package. If you use the Altair license server, PBS starts working sooner if the license server package is installed on the license server host(s) and configured before installing the PBS Professional package. See the Altair License Management System Installation and Operations Guide, available at [www.altair.com](http://www.altair.com).
2. If you want to use redundant Altair license servers, follow the instructions in [section 5.4, “Redundant License Servers](#)”, on page 102.
3. Create accounts used by PBS. See [section 3.4.1, “Create Required Accounts](#)”, on page 42 and [section 3.5.5, “Pre-installation Configuration](#)”, on page 78.
4. Download the correct PBS Professional package for each host. The PBS Professional package is available on the PBS download page at <https://secure.altair.com/UserArea/>.
5. Please read [section 3.3, “All Installations](#)”, on page 34. Then install PBS Professional on the server host and all execution hosts, without starting any daemons. For

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instructions, see [Section 3.4, "Installation on UNIX/Linux Systems"](#) or [Section 3.5, "Installation on Windows Systems"](#).

6. Install PBS commands on any client hosts.
7. Start PBS on each execution host using the PBS start/stop script. See [section 7.1, "Starting and Stopping PBS: UNIX and Linux"](#), on page 179.
8. Start PBS on the server host using the PBS start/stop script. See [section 7.1, "Starting and Stopping PBS: UNIX and Linux"](#), on page 179.
9. Set the server's `pbs_license_info` attribute to point to the socket license file and the Altair license server(s). See [section 5.3, "Configuring PBS for Licensing"](#), on page 95.
10. Using the `qmgr` command, define the vnodes that the server will manage. See [section 3.1.5, "Creating Vnodes" on page 37 in the PBS Professional Administrator's Guide](#).
11. Perform post-installation tasks such as validation. See [Chapter 4, "Initial Configuration"](#), on page 87.

### 3.2.2 All Hosts Use Socket Licenses

1. Obtain enough socket licenses for all sockets managed by PBS; see the Altair License Management System Installation and Operations Guide.
2. Create accounts used by PBS. See [section 3.4.1, "Create Required Accounts"](#), on page 42 and [section 3.5.5, "Pre-installation Configuration"](#), on page 78.
3. Download the correct PBS Professional package for each host. The PBS Professional package is available on the PBS download page at <https://secure.altair.com/UserArea/>.
4. Please read [section 3.3, "All Installations"](#), on page 34. Then install PBS Professional on the server host and all execution hosts, without starting any daemons. For

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instructions, see [Section 3.4, "Installation on UNIX/Linux Systems"](#) or [Section 3.5, "Installation on Windows Systems"](#).

5. Install the socket license file where the PBS server can reach it. If you are using failover, install the socket license file, so that it is available to both primary and secondary server. You can use `PBS_HOME`.
6. Install PBS commands on any client hosts.
7. Start PBS on each execution host using the PBS start/stop script. See [section 7.1, "Starting and Stopping PBS: UNIX and Linux"](#), on page 179.
8. Start PBS on the server host using the PBS start/stop script. See [section 7.1, "Starting and Stopping PBS: UNIX and Linux"](#), on page 179.
9. Set the server's `pbs_license_info` attribute to point to the socket license file and the Altair license server(s). See [section 5.3, "Configuring PBS for Licensing"](#), on page 95.
10. Using the `qmgr` command, define the vnodes that the server will manage. See [section 3.1.5, "Creating Vnodes" on page 37 in the PBS Professional Administrator's Guide](#).
11. Perform post-installation tasks such as validation. See [Chapter 4, "Initial Configuration"](#), on page 87.

### 3.2.3 Some Hosts Use Socket Licenses

1. If you will have non-socket-licensed hosts, download, install, and configure the Altair license server package. If you use the Altair license server, PBS starts working sooner if the license server package is installed on the license server host(s) and configured before installing the PBS Professional package. See the Altair License



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Management System Installation and Operations Guide, available at [www.altair.com](http://www.altair.com).

2. If you want to use redundant Altair license servers, follow the instructions in [section 5.4, “Redundant License Servers”](#), on page 102.
  3. Obtain socket licenses; see the Altair License Management System Installation and Operations Guide.
  4. Create accounts used by PBS. See [section 3.4.1, “Create Required Accounts”](#), on page 42 and [section 3.5.5, “Pre-installation Configuration”](#), on page 78.
  5. Download the correct PBS Professional package for each host. The PBS Professional package is available on the PBS download page at <https://secure.altair.com/UserArea/>.
  6. Please read [section 3.3, “All Installations”](#), on page 34. Then install PBS Professional on the server host and all execution hosts, without starting any daemons. For instructions, see [Section 3.4, “Installation on UNIX/Linux Systems”](#) or [Section 3.5, “Installation on Windows Systems”](#).
  7. Install the socket license file where the PBS server can reach it. If you are using failover, install the socket license file, so that it is available to both primary and secondary server. You can use `PBS_HOME`.
  8. Start the PBS server only, according to the following rules:
    - If you will not run a MoM on the server host, use the PBS start/stop script.
    - If you will run a MoM on the server host, use the `pbs_server` command.
- See [section 7.1, “Starting and Stopping PBS: UNIX and Linux”](#), on page 179.
9. Using the `qmgr` command, define the vnodes that the server will manage. See [section 3.1.5, “Creating Vnodes”](#) on page 37 in the [PBS Professional Administrator’s Guide](#).
  10. Start PBS MoMs in the order in which they should be socket licensed. Socket licenses are assigned to each host in the order in which the MoMs are started, until there are not enough licenses for any remaining unlicensed host. See [section 5.1.1.1,](#)

[“Choosing Hosts for Socket Licenses”](#), on page 92. Start each MoM according to the following rules:

- If you will not run this MoM on the server host, use the PBS start/stop script.
- If you will run this MoM on the server host, use the `pbs_mom` command.

See [section 7.1, “Starting and Stopping PBS: UNIX and Linux”](#), on page 179.

11. If you are running a MoM on the server host, restart PBS on the server host using the PBS start/stop script. See [section 7.1, “Starting and Stopping PBS: UNIX and Linux”](#), on page 179.
12. Install PBS commands on any client hosts.
13. Set the server’s `pbs_license_info` attribute to point to the socket license file and the Altair license server(s). See [section 5.3, “Configuring PBS for Licensing”](#), on page 95.
14. Perform post-installation tasks such as validation. See [Chapter 4, “Initial Configuration”](#), on page 87.

## 3.3 All Installations

### 3.3.1 Supported Platforms for PBS Server

The PBS server contains a licensing client. This licensing client, and therefore the PBS server, is supported on the platforms listed in the release notes.

When you run the PBS install program on platforms that don't support the licensing client, you will not be prompted for a "server type" installation option; only for "commands-only" or "execution type". The server/scheduler component in the PBS Professional package will not be included in platforms that don't support the licensing client. A list of these platforms is provided in the Release Notes.

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### 3.3.2 Setting PBS License Server Location

During installation of the server, you will be prompted for the location of the Altair license server. You must use an Altair server; you cannot use a FLEX server. See [section 5.3.2, “Server Licensing Attributes”](#), on page 96. The installer will display the following:

```
PBS Professional version 9.0 and later is licensed via the Altair License
  Manager.
```

```
The Altair License Manager can be downloaded from:
```

```
http://www.pbspro.com/UserArea/Software/
```

```
For more information, please refer to the PBS Professional Administrator's
  Guide, or contact pbssupport@altair.com.
```

```
Continue with the installation? (y or n)
```

The PBS install program will prompt you for the location of the license server:

```
Please enter the list of Altair License file location(s), in a space-
  separated list of entries of the form:
```

```
<port>@<host>
```

```
@<host>
```

```
<license-file-path>
```

The install program then lists some examples:

```
Examples:
```

```
@fest
```

```
27100@aspasia
```

```
@perikles 27000@aspasia
```

```
@127.3.4.5
```

```
/usr/local/altair/security/altair_lic.dat
```

```
Enter License File Location(s): <>
```

NOTE: The “Enter License File Location(s):” is the actual prompt; the lines above it are informational.

The install program will take care of setting the `pbs_license_info` attribute to the location entered.

### 3.3.2.1 Caveats

If you do not input any entry for the "Enter License File Location(s)" prompt, then the install program will not initialize the `pbs_license_info` attribute. This means the `pbs_license_info` attribute value is left as is, which could be set to some previous value or unset. It is usually set to some previous value when doing an overlay or migration upgrade.

If the license server location is incorrectly initialized (e.g. the host name or port number is incorrect), PBS may not be able to pinpoint the misconfiguration as the cause of the failure to reach a license server. The PBS server's first attempt to contact the license server will result in the following message on the server's log file:

```
"unable to connect to license server at host <H>, port <P>"
```

If the license server location is set to a FLEX server, PBS may encounter a problem requiring you to reboot the server's host. See section 14.2, "Server Host Bogs Down After Startup", on page 907 of the PBS Professional Administrator's Guide.

## 3.3.3 Choosing Installation Type

You can choose the tasks for each machine in a PBS complex. These tasks are:

- Host on which server and scheduler run. This uses the server/scheduler package described below.
- Host which runs MoM, i.e. run users' tasks. This uses the execution package described in [section 3.3.3.2, "Execution Package", on page 37](#).
- Host from which users submit jobs. This uses the client commands package described in [section 3.3.3.3, "Client Commands", on page 37](#).

You can choose to run all PBS components, and submit jobs, and run jobs, on a single machine, or you can divide up the tasks.

A typical cluster of computers has a front-end system which usually manages the whole cluster. Most sites install the PBS Server and Scheduler on this front-end system, but not the MoM, as most sites tend *not* to want to run batch jobs on the front-end host. The MoM is then installed on each execution host within the cluster.

You need to decide what kind of PBS installation you want for each machine in your complex. During installation, there are three options:

1. Server/scheduler package, execution package, and client commands
2. Execution package and client commands
3. Client commands

---

### 3.3.3.1 Server/Scheduler Package

Install this package on the machine(s) which will run the PBS server. If you are going to use failover, install this package (option 1) on both server hosts. This package includes the server, the scheduler, a MoM, and the commands.

If you are going to run all the PBS components on a single host, install the Server package (option 1).

### 3.3.3.2 Execution Package

If you are going to have a complex of machines, you need to install the execution package (option 2) on all the execution hosts in the complex. This package includes the MoM and the client commands.

### 3.3.3.3 Client Commands

The client package (option 3) is for hosts which will not be used for execution but need to have access to PBS. It contains the commands, the GUIs, and the man pages. This allows users to submit jobs, and to check the status of jobs, queues, and any PBS Servers.

## 3.3.4 Network Addresses and Ports

PBS daemons listen for inbound connections at specific network ports. These ports have defaults, but can be configured if necessary. PBS daemons use any ports numbered less than 1024 for outbound communication. For PBS daemon-to-daemon communication over TCP, the originating daemon will request a privileged port for its end of the communication.

PBS makes use of fully qualified host names for identifying the jobs and their location. A PBS installation is known by the host name on which the Server is running. The canonical host name is used to authenticate messages, and is taken from the primary name field, `h_name`, in the structure returned by the library call `gethostbyaddr()`. According to the IETF RFCs, this name must be fully qualified and consistent for any IP address assigned to that host.

Port numbers can be set via `/etc/services`, the command line, or in `pbs.conf`. If not set by any of these means, they will be set to the default values. The PBS components and the commands will attempt to use the system `services` file to identify the standard port numbers to use for communication. If the port number for a PBS service can't be found in the system file, a default value for that service will be used. Each daemon has startup options for setting port numbers. In the PBS Professional Reference Guide, see "[pbs\\_mom](#)" on page 58, "[pbs\\_sched](#)" on page 88, and "[pbs\\_server](#)" on page 90.

The table below lists the default port numbers for PBS services:

**Table 3-1: Ports Used by PBS Services**

Daemon Listening at Port	Port Number	Protocol	Type of Communication
<code>pbs_server</code>	<i>15001</i>	TCP	All TCP communication to server
<code>pbs_server</code>	<i>15001</i>	UDP	Server to MoM via RPP
<code>pbs_mom</code>	<i>15002</i>	TCP	MoM to/from Server
<code>pbs_resmon</code>	<i>15003</i>	TCP	MoM resource requests
<code>pbs_resmon</code>	<i>15003</i>	UDP	MoM resource requests
<code>pbs_sched</code>	<i>15004</i>	TCP	PBS Scheduler
<code>pbs_mom_globus</code>	<i>15005</i>	TCP	Globus can still send jobs to PBS, but PBS no longer supports sending jobs to Globus. MoM Globus
<code>pbs_mom_globus</code>	<i>15006</i>	TCP	Globus can still send jobs to PBS, but PBS no longer supports sending jobs to Globus. MoM Globus resource requests
<code>pbs_mom_globus</code>	<i>15006</i>	UDP	Globus can still send jobs to PBS, but PBS no longer supports sending jobs to Globus. MoM Globus resource requests
<code>pbs_datastore</code>	<i>15007</i>	proprietary	PBS information storage and retrieval
License server	<i>6200</i>		

The scheduler uses any privileged port (less than 1024) as the outgoing port to talk to the Server.

Under UNIX, the `services` file is named `/etc/services`.

Under Windows, it is named `%WINDIR%\system32\drivers\etc\services`.

---

The port numbers listed are the default numbers used by PBS. If you change them, be careful to use the same numbers on all systems. The port number for `pbs_resmon` must be one higher than for `pbs_mom`.

Communication between the scheduler and server is via TCP.

### 3.3.5 Versioned Installation

Except on Windows, the PBS binaries are installed in a versioned directory, which is created by the installation program. The PBS information files are not installed in a versioned directory.

#### 3.3.5.1 Version Number

M.N.P.S refers to the PBS Professional version number. The version number has this form:

`<major>.<minor>.<patch>.<sequence>`

Example:

M: Major release number: 11

N: Minor release number: 3

P: Patch number: 0

S: Sequence number: 08765

In this example, the version number is 11.3.0.08765.

### 3.3.6 Pathname Conventions

The term `PBS_HOME` refers to the location where the daemon/service configuration files, accounting logs, etc. are installed.

The term `PBS_EXEC` refers to the location where the executable programs are installed. `PBS_EXEC` includes the directory named with the M.N.P.S version number.

`<PBS_EXEC_BASE>` is used to reference the base path of the directory into which `PBS_EXEC` is being installed. It excludes the “version” subdirectory. For example, if `PBS_EXEC` is being installed into `/opt/pbs/11.3.0.12345`, then `<PBS_EXEC_BASE>` refers to `/opt/pbs`.

### 3.3.7 Default Installation Locations

The installation program installs the various PBS components into specific locations on the system. The installation program allows you to override these default locations if you wish. The locations are written to the `pbs.conf` file created by the installation process. For details see section 13.1, "The PBS Configuration File", on page 875 of the PBS Professional Administrator's Guide. The PBS package will install into the default directory unless you specify otherwise.

#### 3.3.7.1 Location of PBS\_HOME

The default installation directories for PBS\_HOME are determined by the operating system being used. During installation, if `pbs.conf` or the administrator specifies the location of PBS\_HOME, PBS\_HOME will be put there.

#### 3.3.7.2 Location of PBS\_EXEC

The default installation directories for PBS\_EXEC are versioned. If the administrator overrides the default installation directory, the new directory must also be correctly versioned. If it is not, the version will be appended to the new directory. For example, if the administrator chooses `/usr/local/pbs`, the package is installed into `/usr/local/pbs/M.N.P.S`.

#### 3.3.7.3 Default Installation Locations

Default installation directories are shown in the following table.

**Table 3-2: Default Installation Locations**

OS	Location of PBS_HOME	Location of PBS_EXEC
AIX	<code>/usr/local/spool/PBS</code>	<code>/opt/pbs/M.N.P.S</code>
HP-UX	<code>/usr/spool/PBS</code>	<code>/opt/pbs/M.N.P.S</code>
Linux	<code>/var/spool/PBS</code>	<code>/opt/pbs/M.N.P.S</code>
Solaris	<code>/usr/spool/PBS</code>	<code>/opt/pbs/M.N.P.S</code>
Windows (32-bit)	<code>C:\Program Files\PBS Pro\home</code>	<code>C:\Program Files\PBS Pro\exec</code>
Windows (64-bit)	<code>C:\Program Files (x86)\PBS Pro\home</code>	<code>C:\Program Files (x86)\PBS Pro\exec</code>



### 3.3.8 Unset PBS\_EXEC Environment Variable

On Cray, perform this step on the server host or node.

Make sure that the PBS\_EXEC environment variable is unset.

### 3.3.9 Instructions by Platform

The procedure for installing PBS is the same on most platforms. Some platforms have a few minor differences, and some require special instructions. To install PBS on a platform with minor differences, for example Solaris, follow the generic instructions for UNIX/Linux, and read the platform-specific section. The following table lists instructions for generic platforms, specific platforms, and platforms with only minor differences:

**Table 3-3: Installation Steps by Platform**

Platform	Instructions
Most UNIX/Linux	<a href="#">section 3.4.6, “Installation Procedure (Most Systems)”, on page 47</a>
Cray	<a href="#">section 3.4.10, “Installing PBS on the Cray”, on page 66</a>
SGI Altix and UV	<a href="#">section 3.4.8, “Installing on an Altix or UV”, on page 57</a>
SGI ICE/XE	<a href="#">section 3.4.9, “Installing PBS on the SGI ICE/XE”, on page 59</a>
AIX (Minor difference)	<a href="#">section 3.4.7.1, “Notes About AIX”, on page 53</a>
Solaris (Minor difference)	<a href="#">section 3.4.7.2, “Notes About Solaris”, on page 55</a>
Windows	<a href="#">section 3.5, “Installation on Windows Systems”, on page 77</a>

## 3.4 Installation on UNIX/Linux Systems

### 3.4.1 Create Required Accounts

Before you install PBS, you must create the accounts that PBS requires. Create the data service user account, with the following characteristics:

- Non-root account
- Account is enabled
- If you are using failover, the UID of this account must be the same on both primary and secondary server hosts
- We recommend that the account is called *pbsdata*. The installer looks for an account called *pbsdata*. If this account exists, the installer does not need to prompt for a username, and can install silently.
- Root must be able to `su` to the data service account and run commands as that user. Do not add lines such as `'exec bash'` to the `.profile` of the data service account. If you want to use `bash` or similar, set this in the `/etc/passwd` file, via the OS tools for user management.
- The data service account must have a home directory.

### 3.4.2 Permissions

The location for the installation of the PBS Professional software binaries (`PBS_EXEC`) and private directories (`PBS_HOME`) must be owned and writable by root, and must not be writable by other users.

### 3.4.3 Installation Programs

The PBS install script uses the native package installer provided with each system.

Some systems' installation programs (e.g. Solaris `pkgadd`) will ask you to confirm that it is acceptable to install `setuid/setgid` programs as well as to run installation sub-programs as root. You should answer `yes` or `y` to either of these questions, if asked.

---

### 3.4.4 If You Have Multiple Execution Hosts

Instead of running the installer by hand on each machine, you can use a command such as `pdsh` with NFS-mounted common directories on all hosts to distribute the installation to each host. The general form to distribute commands to a large number of hosts is

```
# for hosts node001-005
pdsh -w node[001-005] command
```

When using the PBS `INSTALL` command you can make a simple text file called “answers” with the answers to the installation prompts, and redirect them into the `INSTALL` script:

```
./INSTALL < answers
```

where `answers` contains the answers for a MoM-only installation:

```
<newline>
<newline>
2
y
<server name>
y
```

To feed your file of answers to the install script:

```
pdsh -w node[001-005] ./INSTALL < answers
```

### 3.4.5 Systems With Prior Versions of PBS

It is important to preserve your configuration information, and to handle existing jobs correctly. Please read [Chapter 6, "Upgrading PBS Professional", on page 113](#).

If a prior version of PBS Professional already exists, the installation procedure will not remove it, except for Solaris. See [section 3.4.7.2.i, "Automatic Uninstallation of Prior Packages on Solaris", on page 55](#). The installation program allows you to choose to switch to the new version of PBS.

Future versions installed into a versioned `PBS_EXEC` directory may co-reside with the other versions also installed into a versioned directory. The Administrator may uninstall the older package at any future time.

On Cray XT systems only, if the directory `/opt/modulefiles` exists, a module description file is installed in `/opt/modulefiles/pbs/M.N.P.S`. See [section 3.4.10, "Installing PBS on the Cray", on page 66](#).

### 3.4.5.1 Which Version To Run

If a prior version of PBS is found while installing the new version of PBS, the installation program asks whether to switch to the new version of PBS. If no prior version of PBS Professional was found, the install script does not ask whether to switch to the new version.

#### 3.4.5.1.i Switching To New Version Now

If you choose to switch to the new version, the installation program updates configuration files including `/etc/pbs.conf`. It also moves the pre-existing `/etc/pbs.conf` to `/etc/pbs.conf.pre.M.N.P.S`.

When PBS is switched to the newly installed version, a symbolic link named `<PBS_EXEC_BASE>/default` is created to point to the location of the new version. For example, `/opt/pbs/default -> /opt/pbs/11.3.0.4567`.

#### 3.4.5.1.ii Switching To New Version Later

If you choose not to switch to the new version of PBS at the time of installation, you can switch later. To switch to the new version of PBS, run the new `pbs_postinstall` script in the newly-created directory for the version to which you are switching:

```
<PBS_EXEC_BASE>/<new M.N.P.S>/etc/pbs_postinstall
```

For example, if you are switching to version 11.3.0:

```
/opt/pbs/11.3.0.08470/etc/pbs_postinstall
```

Running `pbs_postinstall` updates `/etc/pbs.conf` with the new information and establishes `PBS_EXEC/default` as a symbolic link to the new `PBS_EXEC`, which is `/opt/pbs/11.3.0.08470` here.

### 3.4.5.2 Automatic Archiving and User Path Preservation

If your prior version of PBS was installed in the default location, the installation will automatically create links so that the old default paths will continue to work. Note that the new default paths are different, and users should update their paths anyway. However, if the prior version of PBS was not installed in the default location, the installation will not create links to the old paths. You may choose to do so by hand. Please read the following subsections.

### 3.4.5.2.i Archiving Prior Version

Older PBS Professional packages may be archived to prevent users from accidentally running the old version of commands. The installation program archives the old version of PBS if the following conditions are true:

- The prior PBS\_EXEC directory was any of:
  - /usr/pbs
  - /opt/pbs
  - /usr/local/pbs
- The directory exists when the administrator switches to the new version of PBS

This is what happens when the installation program archives the old version of PBS:

1. A new directory called PBS\_EXEC/pre.M.N.P.S is created, for example “/usr/pbs/pre.11.3.0.4567”.
2. The bin, etc, include, lib, man, sbin, tcltk and unsupported directories are moved into the newly created directory.

### 3.4.5.2.ii Automatic Preservation of User Paths

If the PBS installation program was able to archive the older version of PBS, it also creates symbolic links where possible so that user paths are unchanged. The following symbolic links are created:

```
OLD_PBS_EXEC/bin -> /<PBS_EXEC_BASE>/default/bin
OLD_PBS_EXEC/sbin -> /<PBS_EXEC_BASE>/default/sbin
OLD_PBS_EXEC/etc -> /<PBS_EXEC_BASE>/default/etc
```

### 3.4.5.2.iii Re-creating User Paths By Hand

If uninstalling the prior package removes or relocates the prior PBS\_EXEC directory which was pointed to by users' PATH variable, you may wish to recreate that directory and create under it the following symbolic links to enable users to access the new commands via their current PATH:

```
OLD_PBS_EXEC/bin -> <PBS_EXEC_BASE>/default/bin
OLD_PBS_EXEC/sbin -> <PBS_EXEC_BASE>/default/sbin
```

For example if the old location was /usr/pbs\_bin, create the link /usr/pbs\_bin/bin -> /opt/pbs/default/bin.

### 3.4.5.2.iv Updating User Paths

Users should set their path to include `<PBS_EXEC_BASE>/default/bin`. For example, if `<PBS_EXEC_BASE>` is `/opt/pbs`, by including `/opt/pbs/default/bin`, users will have the current version of PBS in their path.

### 3.4.5.3 Uninstalling Old Versions

Future versions installed into a versioned `PBS_EXEC` directory may co-reside with the other versions also installed into a versioned directory. You may uninstall the older package at any future time.

When you wish to remove a prior version which was relocated by the new install, some package managers (such as `rpm`) may be unable to remove the relocated directory. In this case, you should remove the old directory by hand. The prior version of the `/etc/pbs.conf` file was saved as `/etc/pbs.conf.pre.M.N.P.S`; remove this as well.

#### 3.4.5.3.i Caveats

If POE, Intel MPI, HP MPI, MPICH, etc., were wrapped, you must make sure that those are unwrapped before uninstalling PBS.

On UNIX, when PBS is uninstalled, files in `PBS_HOME/datastore` may remain.

### 3.4.5.4 Reverting To An Older Version of PBS

To revert to a prior, still installed, version of PBS, follow these steps:

1. Shut down PBS as described in [section 7.1, “Starting and Stopping PBS: UNIX and Linux”, on page 179](#).
2. Change the `<PBS_EXEC_BASE>/default` link to point to the desired version on the Server node and on each execution node.
3. Restart PBS as described in [section 7.1, “Starting and Stopping PBS: UNIX and Linux”, on page 179](#).

#### 3.4.5.4.i Dangers in Reverting

Note that reverting may remove added capabilities and may cause the loss of certain job, queue, or Server attributes that were introduced in the newer version. If the newer version introduces incompatibilities which would prevent reverting back to a prior version, this will be documented in the release notes for the newer version. Please review the release notes prior to reverting.

---

#### 3.4.5.4.ii Reverting on Solaris

On Solaris systems, the older package had to be removed prior to installation of the new package; therefore the new package must be uninstalled and the older version must be reinstalled in order to revert back to that version. See [section 3.4.7.2, “Notes About Solaris”, on page 55](#).

### 3.4.6 Installation Procedure (Most Systems)

#### 3.4.6.1 Before Installing

Please do not jump straight to this section in your reading. Before downloading and installing PBS, please make sure that you have read the following and taken any required steps:

- Prerequisites: All of [Section 2.1, "Prerequisites for Running PBS"](#), [Section 2.2, "Single Execution System"](#), [Section 2.3, "Multiple Execution Systems"](#), and [Section 2.4, "User Requirements on UNIX/Linux"](#) and their subsections.
- Please read [Section 3.1, "Overview of Installation"](#).
- Please start your installation by following the steps in [Section 3.2, "Major Steps for Installing PBS Professional"](#).
- Please check all of [Section 3.3, "All Installations"](#) and its subsections to make sure you have prepared properly.
- Installation steps: [Section 3.4.1, "Create Required Accounts"](#), [Section 3.4.2, "Permissions"](#), [Section 3.4.3, "Installation Programs"](#), [Section 3.4.4, "If You Have Multiple Execution Hosts"](#), and [Section 3.4.5, "Systems With Prior Versions of PBS"](#), and their subsections.

#### 3.4.6.2 Where to Find Information

Follow the instructions below for downloading or reading the CD-ROM. If you are installing PBS on a standalone system, follow the instructions in [section 3.4.6.5, “Installing on a Standalone Machine”, on page 50](#). If you are installing on a cluster, follow the instructions in [section 3.4.6.6, “Installing on a UNIX/Linux Cluster”, on page 52](#). An example of running the installer via ./INSTALL is shown in [section 3.4.6.4, “Example of Running the Installer”, on page 49](#).

### 3.4.6.3 Download/CDROM Instructions

#### 3.4.6.3.i CD-ROM

If installing from the PBS CD-ROM:

1. Insert the PBS CD into the system CD-ROM drive
2. Mount the CD-ROM device (if needed)

```
mount /cdrom
```

3. Change directory to the distribution directory.

```
cd /cdrom/PBSPro_<M.N.P.S>
```

#### 3.4.6.3.ii Download

1. Download the PBS tar.gz package to /tmp
2. Change directory to /tmp:

```
cd /tmp
```

3. Extract the tar file:

```
tar zxvf PBSPro_<M.N.P.S>-linux26_i686.tar.gz
```



---

### 3.4.6.4 Example of Running the Installer

The installation process is launched by executing the `INSTALL` command, as shown below. `<M.N.P.S>` is a placeholder for the actual version number.

```
./INSTALL
Installation of PBS
The following directory will be the root of the installation. Several
subdirectories will be created if they don't already exist: bin, sbin,
lib, man and include.
Execution directory? [/opt/pbs/<M.N.P.S>]
PBS needs to have a private directory (referred to as "PBS_HOME" in the
documentation) where it can permanently store information.
Home directory? [/usr/spool/PBS]
/usr/spool/PBS does not exist, I'll make it...done
[ Description of the different configuration options ]
PBS Installation:
  1. Server, execution and commands
  2. Execution only
  3. Commands
```

Next, the installation program will proceed to extract and install the PBS package(s) that you selected above. The process should look similar to the example below.

```
## Installing part 1 of 1.
/etc/init.d/pbs
```

(listing of files not shown for brevity )

```
## Executing postinstall script.
*** PBS Installation Summary
***
*** PBS Server has been installed in /opt/pbs/<M.N.P.S>/sbin
*** PBS commands have been installed in /opt/pbs/<M.N.P.S>/bin
***
*** This host has the PBS Server installed, so
*** the PBS commands will use the local server.
*** The PBS command server host is mars
***
*** PBS MoM has been installed in /opt/pbs/<M.N.P.S>/sbin.
*** PBS Scheduler has been installed in /opt/pbs/<M.N.P.S>/sbin.
***
Installation of <pbs64> was successful.
```

### 3.4.6.5 Installing on a Standalone Machine

**If you are installing PBS for the first time:** If you have not already done so, follow the instructions in [section 3.4.6.1, “Before Installing”, on page 47](#). When you have finished this section, continue to [Chapter 4, “Initial Configuration”, on page 87](#).

**If you are performing an overlay upgrade of PBS:** Make sure that you start at [section 6.7, “Overlay Upgrade Under UNIX/Linux”, on page 121](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.7.4, “Prepare the New Scheduler’s Configuration File”, on page 123](#) and the remaining subsections of [“Overlay Upgrade Under UNIX/Linux”](#).

**If you are performing a migration upgrade of PBS:** Make sure that you start at [section 6.9, “Migration Upgrade Under UNIX and Linux”, on page 135](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.9.11, “Transfer MoM Configuration Information”, on page 142](#) and the remaining subsections of [“Migration Upgrade Under UNIX and Linux”](#).

---

The following example shows an installation on a single host on which all PBS components will run, and from which users will also submit jobs. The process may vary depending on the native package installer on each system.

1. Change to the directory where PBS was put when extracted:

```
cd PBSPro_<M.N.P.S>
```

2. Execute INSTALL.

```
./INSTALL
```

See [section 3.4.6.4, “Example of Running the Installer”, on page 49](#).

Choose option 1.

Set the server's `pbs_license_info` attribute by giving the location of the license server.

See [section 5.3.3.1, “Setting the Licensing Information in `pbs license info`”, on page 98](#).

3. Start PBS:

```
/etc/init.d/pbs start
```

4. Check to see that the server, scheduler and MoM daemons are running:

```
ps -ef | grep pbs
```

You should see that there are three daemons running: `pbs_mom`, `pbs_server`, `pbs_sched`

5. Optionally re-create user paths. See [section 3.4.5.2.iii, “Re-creating User Paths By Hand”, on page 45](#).

6. Test that a normal user can submit a job:

```
echo "sleep 60" | /opt/pbs/default/bin/qsub
```

This will submit a job in the 'workq' queue because it is the default queue defined within `qmgr`

7. Verify that user paths have been preserved. See [section 3.4.5.2, “Automatic Archiving and User Path Preservation”, on page 44](#).

```
echo "sleep 60" | <old user path>/bin/qsub
```

8. Verify that new user path has been created:

```
echo "sleep 60" | /opt/pbs/default/bin/qsub
```

9. Verify that the jobs are running:

```
/opt/pbs/default/bin/qstat -a
```

10. Verify that you are running the correct version:

---

```
/opt/pbs/default/bin/qstat --version
```

### 3.4.6.6 Installing on a UNIX/Linux Cluster

**If you are installing PBS for the first time:** If you have not already done so, follow the instructions in [section 3.4.6.1, “Before Installing”, on page 47](#). When you have finished this section, continue to [Chapter 4, “Initial Configuration”, on page 87](#).

**If you are performing an overlay upgrade of PBS:** Make sure that you start at [section 6.7, “Overlay Upgrade Under UNIX/Linux”, on page 121](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.7.4, “Prepare the New Scheduler’s Configuration File”, on page 123](#) and the remaining subsections of [“Overlay Upgrade Under UNIX/Linux”](#).

**If you are performing a migration upgrade of PBS:** Make sure that you start at [section 6.9, “Migration Upgrade Under UNIX and Linux”, on page 135](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.9.11, “Transfer MoM Configuration Information”, on page 142](#) and the remaining subsections of [“Migration Upgrade Under UNIX and Linux”](#).

You may or may not want to run batch jobs on the server/scheduler host. First, install and start PBS on the Server host. Then install PBS on each execution host. Follow these steps:

1. Install PBS on the cluster’s front-end machine. See [section 3.4.6.4, “Example of Running the Installer”, on page 49](#).
2. When asked if you want to start PBS, enter “no”.
3. If you do *not* want to run batch jobs on the front-end host:

Edit the newly installed `/etc/pbs.conf` file. Set `PBS_START_MOM=0`.

4. Start PBS on the Server machine by running the PBS startup script. The location of the script varies depending on system type. See [section 7.1, “Starting and Stopping PBS: UNIX and Linux”, on page 179](#).
5. Install PBS on each execution host. Do this by running the `INSTALL` program on each host, selecting the execution package only (option 2).

When prompted if you wish to start PBS on that host, enter **yes**.

If all execution hosts are identical, you could install one of the execution hosts, and then distribute the installation to other hosts via a program such as `rdist`, or via `tar` plus `scp/rcp`. See [section 3.4.4, “If You Have Multiple Execution Hosts”, on page 43](#).

6. Using the `qmgr` command, define the vnodes that the server will manage. See [section 3.1.5, “Creating Vnodes” on page 37 in the PBS Professional Administrator’s Guide](#).

---

## 3.4.7 Minor Differences

### 3.4.7.1 Notes About AIX

**If you are installing PBS for the first time:** If you have not already done so, follow the instructions in [section 3.4.6.1, “Before Installing”, on page 47](#). When you have finished this section, continue to [Chapter 4, “Initial Configuration”, on page 87](#).

**If you are performing an overlay upgrade of PBS:** Make sure that you start at [section 6.7, “Overlay Upgrade Under UNIX/Linux”, on page 121](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.7.4, “Prepare the New Scheduler’s Configuration File”, on page 123](#) and the remaining subsections of [“Overlay Upgrade Under UNIX/Linux”](#).

**If you are performing a migration upgrade of PBS:** Make sure that you start at [section 6.9, “Migration Upgrade Under UNIX and Linux”, on page 135](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.9.11, “Transfer MoM Configuration Information”, on page 142](#) and the remaining subsections of [“Migration Upgrade Under UNIX and Linux”](#).

When you download the AIX package, you will get two versions of `pbs_mom`. One is for using with the HPS switch, and the other is the standard `pbs_mom`. The installer automatically looks for the HPS switch, and if it finds it, installs the version of `pbs_mom` that manages the switch. If the installer doesn’t find the switch, it installs the standard `pbs_mom`.

#### 3.4.7.1.i Detecting High Performance Switches

During installation, the PBS install script looks for the presence of either an InfiniBand switch or an HPS. The script prints messages to stdout.

While checking for InfiniBand and HPS:

```
*** Checking for High Performance Network
```

If the install script detects neither an InfiniBand switch nor an HPS:

```
*** INFO: No High Performance Network adaptors detected
*** It appears no High Performance Network is available
*** If this is incorrect, please see the PBS
*** Administrator's Guide to configure PBS for
*** jobs to be able use the High Performance Network
```

If the install script finds an HPS:

```
*** HPS found!
```

If the install script finds InfiniBand:

```
*** InfiniBand found!
```

The script sets the default transfer method to User Space (US) mode.

- If the script has found an HPS switch:  
\*\*\* setting MP\_EUILIB=us
- If the script has found an InfiniBand switch:  
\*\*\* setting MP\_EUILIB=us  
\*\*\* setting MP\_DEVTYPE=ib

At startup the PBS MoM logs the InfiniBand adapters it has detected:

```
02/13/2009 10:34:13;0002;pbs_mom;Svr;pbs_mom;detected 4 InfiniBand
adapters connected to 2 networks using 512 windows
```

The value for windows shown in the log message above appears in the output of the `pbsnodes` command as the following:

```
resources_available.netwins=512
```

This value should not be changed, via either `qmgr` or MoM configuration files.

### 3.4.7.1.ii Failure to Detect InfiniBand Switch

If the install script fails to detect an InfiniBand switch, you can install the InfiniBand-configured MoM by hand:

```
cp PBS_EXEC/sbin/pbs_mom PBS_EXEC/sbin/pbs_mom.standard
cp PBS_EXEC/sbin/pbs_mom.ib PBS_EXEC/sbin/pbs_mom
```

### 3.4.7.2 Notes About Solaris

**If you are installing PBS for the first time:** If you have not already done so, follow the instructions in [section 3.4.6.1, “Before Installing”, on page 47](#). When you have finished this section, continue to [Chapter 4, “Initial Configuration”, on page 87](#).

**If you are performing an overlay upgrade of PBS:** Make sure that you start at [section 6.7, “Overlay Upgrade Under UNIX/Linux”, on page 121](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.7.4, “Prepare the New Scheduler’s Configuration File”, on page 123](#) and the remaining subsections of [“Overlay Upgrade Under UNIX/Linux”](#).

---

**If you are performing a migration upgrade of PBS:** Make sure that you start at [section 6.9, “Migration Upgrade Under UNIX and Linux”, on page 135](#), and follow all of the steps in the subsections, before you proceed with this section. After you have completed this section, continue with [section 6.9.11, “Transfer MoM Configuration Information”, on page 142](#) and the remaining subsections of [“Migration Upgrade Under UNIX and Linux”](#).

During installation on Solaris:

- You must specify the location of `PBS_EXEC` to the package manager
- The package manager uninstalls any existing versions of PBS during installation

#### **3.4.7.2.i Automatic Uninstallation of Prior Packages on Solaris**

If a prior version of PBS which was installed via the Solaris package manager (`pkgadd`) exists, it is removed by the install procedure. The install procedure requests permission to remove the prior version. If you do not give permission, the installation is abandoned.

The following messages are displayed:

```
There is an existing PBS installed, pbs64.  
The Solaris package manager only allows one version to be installed.  
Do you wish to remove the existing package and continue with the install  
(y/n)?:
```

If you answer “y”, this is the response:

```
Removing package pbs64
```

If you answer “n”, this is the response:

```
Abandoning the install.
```

#### **3.4.7.2.ii Requirements for Installation on Solaris**

Installing PBS on Solaris requires you to specify the location of `PBS_EXEC`. The Solaris package manager does not automatically install PBS into `/opt/pbs/M.N.P.S.` The package manager will ask for the location of the directory into which to install the binaries, twice, and you must make sure that the answers match perfectly.

The package manager ensures that M.N.P.S is at the end of the path that you specify. If you enter just `<PBS_EXEC_BASE>`, whether this is the default or not, it will append the M.N.P.S. If you enter an incorrect M.N.P.S, the correct one will be appended, after the incorrect one. So if the version is 11.3.0.12345, and you accidentally enter `/usr/local/111.3.0.12345`, you'll get `/usr/local/111.3.0.12345/11.3.0.12345`.

1. In the first request, the installation script offers a default directory. In this example, the version is 11.3.0.82971.

```
Execution directory? [/opt/pbs/11.3.0.82971]
```

You can do one of the following:

- a. You can accept the default
    - The default always includes the M.N.P.S.
  - b. You can enter the desired `<PBS_EXEC_BASE>`
    - If you enter `<PBS_EXEC_BASE>`, the package manager appends M.N.P.S to your answer.
  - c. You can enter the desired `<PBS_EXEC_BASE>/M.N.P.S`.
    - If you enter `<PBS_EXEC_BASE>/M.N.P.S`, the package manager accepts your answer.
2. In the second request, the package manager shows you `<PBS_EXEC_BASE>/M.N.P.S` and asks:

```
You had entered: <PBS_EXEC_BASE>/M.N.P.S
```

```
Enter path to package base directory [?,q]
```

You **must** enter what it shows, which is `<PBS_EXEC_BASE>/M.N.P.S`, exactly.

### 3.4.7.2.iii Reverting to a Prior Version on Solaris

In order to revert to a prior version of PBS, you must uninstall the new package and reinstall the prior package.

## 3.4.8 Installing on an Altix or UV

### 3.4.8.1 Before Installing

Please do not jump straight to this section in your reading. Before downloading and installing PBS, please make sure that you have read the following and taken any required steps:

- Prerequisites: All of [Section 2.1, "Prerequisites for Running PBS"](#), [Section 2.2, "Single Execution System"](#), [Section 2.3, "Multiple Execution Systems"](#), and [Section 2.4, "User](#)



[Requirements on UNIX/Linux](#) and their subsections.

- Please read [Section 3.1, "Overview of Installation"](#).
- Please start your installation by following the steps in [Section 3.2, "Major Steps for Installing PBS Professional"](#).
- Please check all of [Section 3.3, "All Installations"](#) and its subsections to make sure you have prepared properly.
- Installation steps: [Section 3.4.1, "Create Required Accounts"](#), [Section 3.4.2, "Permissions"](#), [Section 3.4.3, "Installation Programs"](#), [Section 3.4.4, "If You Have Multiple Execution Hosts"](#), [Section 3.4.6, "Installation Procedure \(Most Systems\)"](#), and [Section 3.4.5, "Systems With Prior Versions of PBS"](#), and their subsections.

---

### 3.4.8.2 Download and Install the New PBS

1. Download the PBS `tar.gz` package to `/tmp`.
2. Change directory to `/tmp`:  
`cd /tmp`
3. Extract from the package:  
`tar zxvf PBSPro_<M.N.P.S>-SGIAltix_pp<ProPack version>_ia64.tar.gz`
4. Change directories:  
`cd PBSPro_<M.N.P.S>`
5. Execute installation script:  
`./INSTALL`
6. Answer the questions; supply the license string; do not start the daemons yet.
7. Change directories:  
`cd /opt/pbs/M.N.P.S/sbin`
8. Rename the standard PBS MoM:  
`mv pbs_mom pbs_mom.bak`
9. Copy the cpuset PBS MoM to `pbs_mom`:  
`cp -rp pbs_mom.cpuset pbs_mom`
10. Check to see that new paths work:  
`/opt/pbs/default/sbin/pbs_mom -s list`
11. Check to see that symbolic links to old paths have been created:  
`<old path>/sbin/pbs_mom -s list`

### 3.4.8.3 Start and Test the New PBS

12. Start PBS. If the PBS startup script is not used on the Altix or UV, `pbs_mom` will not start:

```
/etc/init.d/pbs start
```

13. Check to see that vnode definitions for `pbs_mom` have been generated:

```
/opt/pbs/M.N.P.S/sbin/pbs_mom -s list
```

14. Check to see that the PBS daemons are running. You should see that there are three daemons running: `pbs_mom`, `pbs_server`, `pbs_sched`:

```
ps -ef | grep pbs
```

15. Submit jobs as a normal user.

Submit a job to the default queue:

```
echo "sleep 60" | /opt/pbs/default/bin/qsub
```

16. Verify that the jobs are running:

```
/opt/pbs/default/bin/qstat -an
```

## 3.4.9 Installing PBS on the SGI ICE/XE

### 3.4.9.1 Before Installing

Please do not jump straight to this section in your reading. Before downloading and installing PBS, please make sure that you have read the following and taken any required steps:

- Prerequisites: All of [Section 2.1, "Prerequisites for Running PBS"](#), [Section 2.2, "Single Execution System"](#), [Section 2.3, "Multiple Execution Systems"](#), and [Section 2.4, "User Requirements on UNIX/Linux"](#) and their subsections.
- Please read [Section 3.1, "Overview of Installation"](#).
- Please start your installation by following the steps in [Section 3.2, "Major Steps for Installing PBS Professional"](#).
- Please check all of [Section 3.3, "All Installations"](#) and its subsections to make sure you have prepared properly.
- Installation steps: [Section 3.4.1, "Create Required Accounts"](#), [Section 3.4.2, "Permissions"](#), [Section 3.4.3, "Installation Programs"](#), [Section 3.4.4, "If You Have Multiple Execution Hosts"](#), [Section 3.4.6, "Installation Procedure \(Most Systems\)"](#), and [Section 3.4.5, "Systems With Prior Versions of PBS"](#), and their subsections.

### 3.4.9.2 Considerations

Most sites that are running PBS Professional on an SGI ICE/XE will not want PBS to manage the cpusets on the machine. These sites should install the standard PBS MoM.

Placement sets improve job placement on execution nodes. See [section 4.8.32, "Placement Sets" on page 210 in the PBS Professional Administrator's Guide](#). If you run the cpuset MoM, placement sets are generated automatically for the machines listed in [section 11.4.8.1, "Generation of Placement Set Information", on page 830](#). If you run the standard MoM, placement sets are not automatically generated, and you may wish to configure placement sets. See [section 3.4.9.9, "Configuring Placement Sets on the SGI ICE/XE", on page 65](#) for the steps involved.

### 3.4.9.3 SGI ICE Components

An ICE system consists of one Admin node, one or more Service (login) nodes, and a set of one or more compute racks. Each compute rack consists of one or more IRU nodes and one or more compute nodes per IRU. The racks are diskless. The root file system of the IRU and compute nodes are mounted read-only from a NAS managed by the Admin node. There is a single image of the root file system for all of the compute nodes and a separate image for all of the IRU nodes. Tempo node management commands are used to publish the image to the various nodes in a process that involves powering down the nodes, pushing a new image, and re-powering the nodes.

In a typical configuration, user home file systems are mounted from NAS, and each node has a separately mounted file system for `/var/spool`.

SGI follows a naming convention when preparing a system for shipment. Service nodes are named "service0", "service1", ... Compute nodes are named `rRiLnN` where 'R' is the rack number starting with 1; 'L' is the IRU node number within a rack starting with 0 in each rack; N is the node number, starting with 0, under the specific Rack Leader. For example, two racks with 2 IRUs per rack and 4 nodes per IRU are named:

**Table 3-4: Node Names**

	Rack 1	Rack 2
IRU 0	<i>r1i0n0</i>	<i>r2i0n0</i>
	<i>r1i0n1</i>	<i>r2i0n1</i>
	<i>r1i0n2</i>	<i>r2i0n2</i>
	<i>r1i0n3</i>	<i>r2i0n3</i>

**Table 3-4: Node Names**

	Rack 1	Rack 2
IRU 1	<i>r1i1n0</i>	<i>r2i1n0</i>
	<i>r1i1n1</i>	<i>r2i1n1</i>
	<i>r1i1n2</i>	<i>r2i1n2</i>
	<i>r1i1n3</i>	<i>r2i1n3</i>

### 3.4.9.4 Requirements for the SGI ICE with ProPack or Performance Suite

- In order to run PBS on the SGI ICE with ProPack or Performance Suite, SGI's Tempo node management tools must already be installed. You will be using the following Tempo commands:

**Table 3-5: Tempo Commands**

Tempo command	Description
<code>cnodes --compute</code>	List the compute node names; useful in scripting operations
<code>cpower --down NODE</code>	Powers down
<code>cpower --up NODE</code>	Powers up the named nodes
<code>cimage --...</code>	Manages the file system image for the various nodes

- You must use the correct names for the Admin and Service nodes in any commands.
- If you will use PBS to manage the cpusets on the ICE/XE, the file `/etc/sgi-compute-node-release` must be present in order for the PBS `init.d` script to create `vnode` definitions and for the `pbs_habitat` script to set up the CPuset flags.

### 3.4.9.5 Choosing Whether PBS Will Manage Cpusets with SGI ICE Running ProPack or Performance Suite

You can choose whether or not to use PBS to manage the cpusets on the SGI ICE. Most sites will not want PBS to manage the cpusets. To have PBS manage the cpusets, install `pbs_mom.cpuset`; otherwise, install `pbs_mom.standard`.

---

### 3.4.9.5.i Using PBS to Manage cpusets on the SGI ICE

If you are running the cpuset MoM, the `init.d/pbs` script will configure one vnode per MoM. This enables cpusets and sets sharing to `default_shared`.

To provide the maximum number of available CPUs on a small node, make sure that the file `/etc/sgi-compute-node-release` is present. This way, on installation the `pbs_habitat` script will add a “`cpuset_create_flags 0`” to Mom's config file.

In order to exclude CPU 0, change the MoM configuration file line to

```
cpuset_create_flags CPUSET_CPU_EXCLUSIVE
```

This flag controls only whether CPU 0 is included in the PBS cpuset.

There is only one logical memory pool available per node on the SGI ICE. If, at startup, MoM finds:

- any CPU in an existing, non-root, non-PBS cpuset
- CPU 0 has been excluded as above

MoM will

- Exclude that CPU from the top set `/dev/cpuset/PBSPro`
- Create the top set with `mem_exclusive` set to `false`

Otherwise, the top set is created using all CPUs and with `mem_exclusive` set to `True`.

### 3.4.9.6 Installation of the PBS Server and Scheduler

The PBS Server, Scheduler and commands are installed on a single service node; here we assume this node is “`service0`”. To install the complete PBS package:

1. Log on to `service0` as root.
2. Unzip and untar the install package.
3. Change to the directory created when the package was untarred.
4. Run the `INSTALL` script: accept the default locations, and select the number `1` (Server, execution and commands) option.
5. When asked if you wish to start PBS, answer “`no`”.
6. Modify `/etc/pbs.conf` by changing the line “`PBS_START_MOM=1`” to “`PBS_START_MOM=0`”.

### 3.4.9.7 Installation of the PBS MoM

You install and configure MoM on each of the compute nodes. The installation and configuration is only done once on the root file system; this is then pushed to all of the compute nodes.

1. Log on to the Admin node as root.
2. Determine which image file is being used on the compute nodes. To list the nodes on the rack 1:

```
cimage --list-nodes r1
```

It will show output in the form “*node: image\_name kernel*” similar to

```
r1i0n0: compute-sles10sp1 2.6.26.46-0.12-smp
```

Thus node r1i0n0 is running the image “*compute-sles10sp1*” and the kernel version “*2.6.26.46-0.12-smp*”. For the remaining steps, it is assumed that those are the images and kernel available.

3. List the available images:

```
cimage --list-images
```

which will list the images available for the compute nodes. Each image may have multiple kernels.

4. Unless you are experienced in managing the image files, it is suggested that you create a copy of the image in use and install PBS in that copy. To copy an image:

```
cinstallman --create-image --clone --source compute-sles10sp1 --image compute-sles10sp1pbs
```

5. The image file lives in the directory `/var/lib/systemimager/images`, so change into the `tmp` directory found in the new image just cloned:

```
cd /var/lib/systemimager/images/  
compute-sles10sp1pbs/tmp
```

6. Copy the PBS install package into this `tmp` directory, unzip and untar it.
7. Change back to the root home directory and chroot to the new image file:

```
chroot /var/lib/systemimager/images/  
compute-sles10sp1pbs /bin/sh
```

The new root is in effect.

8. Change directory into the PBS directory which was created below `tmp` when the PBS package was untarred. This is `/tmp/PBSPro_<version>`, which was cre-

ated for the image when the PBS package was untarred on the Admin node:

```
cd /tmp/PBSPro_<version>
```

9. Run the INSTALL script to install the PBS programs into the normal execution directory /opt/pbs/M.N.P.S in this system image.

```
./INSTALL
```

- a. Accept the default directories.
- b. Choose install option 2 (execution).
- c. Answer “No” when you are asked whether you wish to start PBS now.

10. The default MoM does not use cpusets. To use cpusets, replace the default pbs\_mom executable with PBS\_EXEC/sbin/pbs\_mom.cpuset.

```
cp PBS_EXEC/sbin/pbs_mom.cpuset PBS_EXEC/sbin/pbs_mom
```

PBS\_EXEC is the path to the location where the PBS binaries were installed.

11. Exit from the chroot shell and return to root's normal home directory.
12. Power down each rack of compute nodes:

```
for n in `cnodes --compute` ; do
    cpower --down $n
done
```

13. Publish the new system image to the compute nodes:

```
cimage --push-rack compute-sles10sp1pbs r\*
```

This instruction will take several minutes to finish.

14. Set the new image and kernel to be booted. This set need not be done if: (1) rather than cloning a new image, you have installed PBS into the image already running on the compute nodes; or (2) you are using an image that was already pushed to the nodes.

```
cimage --set compute-sles10sp1pbs 2.6.26.46-0.12-smp r\*i\*n\*
```

15. Power up the compute nodes:

```
for n in `cnodes --compute` ; do
    cpower --up $n
done
```

It will take several minutes for the compute nodes to reboot.



### 3.4.9.8 Adding Compute Nodes

1. Log on to the service node as root
2. On the Service node, start the PBS Server and Scheduler:

```
/etc/init.d/pbs start
```

3. Using `qmgr`, add the compute nodes to the PBS configuration:

```
for N in `cnodes --compute`  
do  
    qmgr -c "create node $N"  
done
```

### 3.4.9.9 Configuring Placement Sets on the SGI ICE/XE

If you are not already using PBS to manage the placement sets on the ICE/XE (you are running the standard MoM), you may wish to configure placement sets. This will improve job placement on execution nodes. See [section 4.8.32, "Placement Sets" on page 210 in the PBS Professional Administrator's Guide](#).

Placement sets can be defined only after you have defined the compute nodes as in the previous section.

1. Shut down the server.
2. Add a resource named "router" to the `PBS_HOME/server_priv/resource-def` file, by adding the following line:

```
router type=string_array flag=h
```

3. Restart the server
4. Run the placement set generation script:

```
PBS_EXEC/lib/init.d/sgiICEplacement.sh
```

5. Verify the result:
  - a. Run the `pbsnodes -a` command
  - b. Look for the line "`resources_available.router`" in each node. The value assigned to the "router" resource should be in the form "`r#,r##i#`", where *r* identifies the rack number and *i* identifies the IRU number.

## 3.4.10 Installing PBS on the Cray

### 3.4.10.1 Before Installing

Please do not jump straight to this section in your reading. Before downloading and installing PBS, please make sure that you have read the following and taken any required steps:

- Prerequisites: All of [Section 2.1, "Prerequisites for Running PBS"](#), [Section 2.2, "Single Execution System"](#), [Section 2.3, "Multiple Execution Systems"](#), and [Section 2.4, "User Requirements on UNIX/Linux"](#) and their subsections.
- Please read [Section 3.1, "Overview of Installation"](#).
- Please start your installation by following the steps in [Section 3.2, "Major Steps for Installing PBS Professional"](#).
- Please check all of [Section 3.3, "All Installations"](#) and its subsections to make sure you have prepared properly.
- Installation steps: [Section 3.4.1, "Create Required Accounts"](#), [Section 3.4.2, "Permissions"](#), [Section 3.4.3, "Installation Programs"](#), [Section 3.4.4, "If You Have Multiple Execution Hosts"](#), [Section 3.4.6, "Installation Procedure \(Most Systems\)"](#), and [Section 3.4.5, "Systems With Prior Versions of PBS"](#), and their subsections.

### 3.4.10.2 About Installation on the Cray

This installation procedure differs considerably from the procedures for prior versions of PBS. Please review this section carefully before starting to install PBS Professional on the Cray. The installation instructions given in this section are for an initial installation only. If there is an older version of PBS Professional installed on your system, perform an upgrade, following the instructions in [section 6.10.1, "Installing PBS To Upgrade on the Cray", on page 153](#).

The PBS Professional package supports CLE.

One instance of the `pbs_mom` daemon is run on each login node of the Cray system, allowing PBS Professional to select the login node to which a job is assigned.

The PBS Professional installation script, `INSTALL`, will detect that it is running on a Cray and perform special actions to manage `PBS_EXEC`, `/etc/pbs.conf`, and `PBS_HOME`.

On Cray systems only, if the directory `/opt/modulefiles` exists, a module description file is installed in `/opt/modulefiles/pbs/M.N.P.S`.

For information on the functionality provided by modulefiles see the man pages for `module(1)` and `modulefile(4)` on Cray systems.

---

### 3.4.10.3 Caveats

The PBS Professional software may have been installed on your Cray System as part of the initial setup of the machine. If it is already installed and you perform an initial installation, that may destroy the pre-installed system software.

To verify whether PBS Professional software is currently installed, log in as root to your Cray system and execute the following command:

```
/opt/pbs/default/bin/qstat --version
```

If PBS Professional is already installed, you must follow the steps for an upgrade. See [section 6.10.1, “Installing PBS To Upgrade on the Cray”, on page 153](#).

#### 3.4.10.3.i Not Supported

Kerberos is not supported on the Cray.

### 3.4.10.4 Prerequisites

#### 3.4.10.4.i Required Libraries

The XML library, `libexpat.a`, must be available on the login nodes. This is fairly standard in Linux distributions.

#### 3.4.10.4.ii Use Correct Version Number

You must know the version number of the PBS Professional package you are installing. The following examples use version number 11.3.0.121723. The version number of the package you are installing will be different. Please be sure to use the version number of your package.

#### 3.4.10.4.iii Hardware and Software Requirements

Confirm the following before beginning installation:

- You must have root permission.
- Make sure that all configuration files have been updated appropriately for your site.
- On the login nodes and on the host or node on which the PBS Server and Scheduler will run, make sure that the `/var` directory is owned by root.
- Determine whether you need to set up a License Server, get socket licenses, or request a new PBS Professional license key from Altair Engineering. For more information on generating and installing license keys, see the Altair License Management System Installation and Operations Guide, available on the Altair website at [www.altair.com](http://www.altair.com).
- Compute nodes must be in the “batch mode” before they can be used by jobs under the

control of PBS Professional. To set all of the compute nodes in the batch mode:

On the boot node execute:

```
xtprocdadmin -k m batch
```

#### **3.4.10.4.iv Choosing Host for Server/scheduler**

The PBS Professional scheduler and server can be run on any UNIX/Linux machine or node that fits the requirements. Usually the server and scheduler run on a service node, or an external host. We include instructions for both options.

- Make sure you choose the correct PBS package for the server/scheduler host or node.
- If using floating licenses via the Altair license server, make sure that the server/scheduler host or node can reach the license server host.
- Make sure that the server/scheduler host or node can communicate with the login nodes where PBS MoMs are running.
- Make sure that the server/scheduler host meets the minimum requirements to run PBS. See [section 2.1.2, “Resources Required by PBS”, on page 5](#).

---

### 3.4.10.5 Installing PBS Daemons on Cray

For all installations, the following is necessary, whether you install the server/scheduler on the Cray or on a non-Cray host. Begin by installing PBS from the boot node:

1. Obtain the current distribution of PBS Professional. This is a gzipped tar file, for example:

```
PBSPro_11.3.0-linux24_x86_64_crayxt.tar.gz
```

2. Create a temporary install directory on the boot node:

```
smw:~# ssh root@boot mkdir /rr/current/software/pbs-install
```

3. Copy the distribution file to that directory:

```
smw:~# scp PBSPro_11.3.0-linux24_x86_64_crayxt.tar.gz root@boot:/rr/current/software/pbs-install
```

4. Log in as root to the boot node.

5. Change to the temporary install directory.

6. Unzip and untar the distribution:

```
smw:~# ssh root@boot boot001:~  
# cd /rr/current/software/pbs-install  
# gunzip PBSPro_11.3.0-linux24_x86_64_crayxt.tar.gz  
# tar xf PBSPro_11.3.0-linux24_x86_64_crayxt.tar
```

7. Change into the directory created when the package was untarred:

```
cd PBSPro_11.3.0
```

8. Run the INSTALL script in this directory:

```
# ./INSTALL
```

9. The install script checks to see whether you are using a supported version of ALPS. The script notifies you whether or not your version of ALPS is supported. If ALPS is not a supported version, the script prints a warning and asks whether to continue.

You may continue the installation, or you can halt it at this point. If you choose to continue, the behavior of PBS is not known.

10. Accept the default location for the installed binaries, for example:

```
PBS_EXEC=PBSPro_11.3.0.121723
```

11. Accept the default location for the PBS working directories , in

```
PBS_HOME=/var/spool/PBS
```

12. Get the host name of the host or node where the server will run.

**hostname**

13. When asked for the name of the host or node on which the server and scheduler will be run, enter the result of the `hostname` command.

14. When asked for the type of PBS installation:

- if you will run the PBS server and scheduler on a Cray service node (usually the `sdb`

---

node), choose “1”.

1. Server, execution and commands.
  - If you will run the PBS server and scheduler on a non-Cray host, choose “2”.
2. Execution only.
15. When asked for the “License File Location(s)”, follow the instructions in [section 3.3.2, “Setting PBS License Server Location”, on page 35](#).
16. When upgrading, you are asked “Would you like to complete the install and switch to the new version of PBS?” Answer “yes”.

The post-install procedure is automatically run.

17. When asked “Would you wish to start PBS now?”, answer “no”.
18. Verify that the new PBS Professional configuration file `/etc/pbs.conf` exists in the shared view of the default shared root file system. The file should look like the following:

```
PBS_SERVER=<server host or node>
PBS_EXEC=/opt/pbs/default
PBS_HOME=/var/spool/PBS
PBS_START_SERVER=0
PBS_START_SCHED=0
PBS_START_MOM=0
```

19. Remove the temporary install directory:

```
cd $HOME
rm -fr /rr/current/software/pbs-install
```

### 3.4.10.6 Configuring Service Node to Run Server and Scheduler

If you will run the PBS server and scheduler on a non-Cray host, skip this section. Configure the service node to run the PBS server and scheduler:

1. Log into the boot node.
2. Determine the node ID , or NID, of the node on which you plan to run the PBS server and scheduler.
3. Tailor the install to run the PBS server and scheduler on the service node:

Use the `xtopview` command:

```
# xtopview -m "pbs.conf for Server" -n <NID>
```

Run the `xtspec` command to specialize the change to `/etc/pbs.conf` for the service node:

```
<nodeID>: # xtspec /etc/pbs.conf
```

4. Enable the server and scheduler on the service node. Edit the `/etc/pbs.conf` file or verify that it contains the following lines:

```
PBS_START_SERVER=1
PBS_START_SCHEDULER=1
```

5. Verify that the MoM start line in `/etc/pbs.conf` is:

```
PBS_START_MOM=0
```

6. Ensure that the `PBS_SERVER` entry in `pbs.conf` names the node on which you plan to run the Server and Scheduler and that `PBS_EXEC` is set to `/opt/pbs/default`.

7. Exit from `xtopview`.

### 3.4.10.7 Start PBS Server

1. Log in as root to the node on which the PBS Server `pbs_server` will be running.

```
# ssh root@<service node>
```

2. At this point, you **must** start the PBS Server with the `init.d/pbs` script. Do not start the server by any other means.

```
<service node> # /etc/init.d/pbs start
```

This will create or update the PBS working directories, `PBS_HOME`, in `/var/spool`.



---

### 3.4.10.8 Installing PBS Server and Scheduler on Non-Cray Host

If you will run the PBS server and scheduler on the Cray, skip this section.

1. Log on to the server host as root.
2. Unzip and untar the install package.
3. Change to the directory created when the package was untarred.
4. Run the INSTALL script: accept the default locations, and select the number 1 (Server, execution and commands) option.
5. When asked if you wish to start PBS, answer “no”.
6. Make sure that MoM does not run on the server/scheduler host. Modify `/etc/pbs.conf` by changing the line “`PBS_START_MOM=1`” to “`PBS_START_MOM=0`”.
7. Ensure that the `PBS_SERVER` entry in `pbs.conf` names the machine on which you plan to run the Server and Scheduler and that `PBS_EXEC` is set to `/opt/pbs/default`.
8. Log in as root to the host on which the PBS Server `pbs_server` will be running.

```
# ssh root@<server host>
```

9. At this point, you **must** start the PBS Server with the `init.d/pbs` script. Do not start the server by any other means.

```
<host name> # /etc/init.d/pbs start
```

This will create or update the PBS working directories, `PBS_HOME`, in `/var/spool`.

---

### 3.4.10.9 Configuring PBS Server and Scheduler

1. If you are on a Cray node, load the pbs module:  
`<service node>: # module load pbs`
2. Using the `qmgr` command, create the PBS execution node or nodes, which are the login nodes.

When creating a vnode to represent a login node, use the short name returned by the `hostname` command on the login node. For example, if `hostname` returns *HostA*, do the following:

**Qmgr: create node HostA**

If you create a vnode with a different name from the short name returned by `hostname`, the following happens:

- MoM creates a vnode whose name is the short name returned by `hostname`
  - The vnode you created is not recognized by MoM, and is marked *stale*
3. The execution queue *workq* is automatically created during the normal PBS post-install procedure.
  4. Make sure that `flatuid` is set to *True* in the PBS server configuration:

```
<server host>: # qmgr -c "list server"
```

If `flatuid` is not set to true, set it to true:

```
<server host>: # qmgr -c "set server flatuid=true"
```

5. To ensure that scheduling of jobs is initiated when PBS is restarted, set the Server's scheduling attribute to true:

```
<server host>: # qmgr -c "set server scheduling=true"
```

6. Shut down the PBS daemons using the following command:

```
/etc/init.d/pbs stop
```

---

### 3.4.10.10 Configuring PBS Daemons on the Cray

Configure each login node to run a PBS MoM:

1. As root, log in to the boot node:

```
# ssh root@boot
```

2. Tailor the install to run MoMs on the login nodes:

Use the `xtopview` command:

```
xtopview -m "pbs.conf for login" -c login
```

Run the `xtspec` command to specialize the change to `/etc/pbs.conf` for the login nodes:

```
class/login/: # xtspec /etc/pbs.conf
```

3. Enable MoM. Edit `/etc/pbs.conf` ensuring the following lines are present:

```
PBS_START_MOM=1
```

4. Make sure that the Server and Scheduler do not start:

```
PBS_START_SERVER=0
```

```
PBS_START_SCHED=0
```

5. Ensure that the `PBS_SERVER` entry names the host or node on which you plan to run the Server and Scheduler.
6. Ensure that `PBS_EXEC` is set to `/opt/pbs/default`.
7. Ensure that `/opt/pbs/default` is a symbolic link to the location you specified for the binaries.
8. Exit from `xtopview`.

---

On each login node, log in and perform the following steps:

1. Start the PBS MoM daemon with the `init.d/pbs` script. Do not use any other means to start `pbs_mom`. This will create or update the PBS working directories, `PBS_HOME`, in `/var/spool`.

```
Login:~ # /etc/init.d/pbs start
```

2. Stop the MoM daemon by running the `init.d/pbs` script:

```
Login:~ # /etc/init.d/pbs stop
```

3. Add the following directives in the `pbs_mom` configuration file, `PBS_HOME/mom_priv/config`:

For CLE:

```
$clienthost <server host or node>
$alps_client /usr/bin/apbasil (CLE 4.1 and earlier)
$alps_client /opt/cray/alps/default/bin/apbasil (CLE 5.0 and later)
```

The sample configuration is now complete.

4. HUP the MoM.

### 3.4.10.11 Configuring PBS Professional Startup and Shutdown

The PBS start/stop script is located in `/etc/init.d/pbs`. To use the `init.d` script and the `chkconfig` command to start up PBS Professional, execute the following steps:

1. If you will run the PBS server and scheduler on a Cray service node, find the node ID (NID) of the node on which the PBS Server and Scheduler will run. For example, on the `sdb` node:

```
grep sdb /etc/hosts
```

2. If you will run the PBS server and scheduler on a Cray service node, enable PBS startup for the server and scheduler on the service node. This example uses an NID of 3.

```
boot001: # xtopview -n 3
node/3:/ # chkconfig pbs on
node/3:/ # exit
```

3. Enable PBS startup for the MoM on each login node:

```
# xtopview -c login
class/login:/ # chkconfig pbs on
class/login:/ # exit
```

---

### 3.4.10.12 Configuring PBS to Support Cray

Do not skip this step. PBS provides tight integration with Cray. To take advantage of the tight integration, go to [section 11.3, "Support for Cray Systems" on page 795 in the PBS Professional Administrator's Guide](#).

## 3.5 Installation on Windows Systems

### 3.5.1 Licensing for Windows

For Windows, PBS uses the Altair license server to provide floating licenses for jobs. PBS does not use socket licenses with Windows.

### 3.5.2 Before Installing

Please do not jump straight to this section in your reading. Before downloading and installing PBS, please make sure that you have read the following and taken any required steps:

- Prerequisites: All of [Section 2.1, "Prerequisites for Running PBS"](#), [Section 2.2, "Single Execution System"](#), [Section 2.3, "Multiple Execution Systems"](#), [Section 2.5, "Recommended PBS Configurations for Windows"](#), [Section 2.6, "Windows User Authorization"](#), and [Section 2.8, "Windows Caveats"](#) and their subsections.
- Please read [Section 3.1, "Overview of Installation"](#).
- Please start your installation by following the steps in [Section 3.2, "Major Steps for Installing PBS Professional"](#).
- Please check all of [Section 3.3, "All Installations"](#) and its subsections to make sure you have prepared properly.

### 3.5.3 Installation Locations

On 32-bit Windows systems, PBS is installed in `\Program Files\PBS Pro\`, and on 64-bit Windows systems, PBS is installed in `\Program Files (x86)\PBS Pro\`. We use `INSTALLATION_BASE` to indicate `\Program Files\` or `\Program Files (x86)\`. When reading these instructions, replace `INSTALLATION_BASE` with the appropriate directory.

When PBS is installed on a complex, the MoM must be run on each execution host. The Server and Scheduler only need to be installed on one of the hosts or on a front-end system. For Windows clusters, PBS is provided in a single package containing the following:

- PBS Professional software
- Supporting text files (software license, README, release notes, etc.)

### **3.5.4 PBS Windows Considerations**

PBS Professional is supported if the domain controller server is configured “native”. Running PBS in an environment where the domain controllers are configured in “mixed-mode” is not supported.

You must install PBS Professional from an Administrator account.

Before you install PBS on Windows, make sure you are using the correct type of account. See [section 2.5.3, “Windows Configuration in a Domained Environment”, on page 18](#).

PBS Professional requires that the drive that PBS was installed under (e.g. `\Program Files\PBS Pro` or `\Program Files (x86)\PBS Pro`) be configured as an NTFS filesystem.

Before installing PBS Professional, be sure to uninstall any old PBS Professional files. For uninstalling versions 5.4.2 through 8.0, use a domain admin account. For details see [“Uninstalling PBS Professional on Windows” on page 85](#).

You can specify the destination folder for PBS using the “Ask Destination Path” dialog during setup. After installation, icons for the `xpbs` and `xpbsmon` GUIs will be placed on the desktop and a program file menu entry for PBS Professional will be added. You can use the GUIs to operate on PBS or use the command line interface via the command prompt.

The PBS data service account is the same as the PBS service account. You do not need to create a separate data service account.

### **3.5.5 Pre-installation Configuration**

Before installing PBS Professional on a Windows cluster, perform the following system configuration steps first.

The following discussion assumes that the `pbs_server` and `pbs_sched` services will be installed on a front-end host called “hostA”, and the `pbs_mom` service will be installed on all the vnodes in the complex that will be running jobs, “hostB ... hostZ”.

1. Be sure that hostA, hostB, ..., hostZ consistently resolve to the correct IP addresses. A wrong IP address to hostname translation can cause errors for PBS. Make sure the following are done:
  - Configure your system to talk to a properly configured and functioning DNS server
  - Add the correct host entries to the following files:

On Windows XP:

**`c:\windows\system32\drivers\etc\hosts`**

For example, if your Server is `serverA.example.com` with address 192.0.0.231, then add the entry:

**192.0.0.231 serverA.example.com serverA**

2. Set up any user accounts that will be used to run PBS jobs. They should not be Administrator-type of accounts, that is, not a member of the “Administrators” group so that basic authentication using `hosts.equiv` can be used.

The accounts can be set up using either of the following:

Start->Control Panel->Administrative Tools->Computer Management->Local Users & Groups

- or -

**Start->Control Panel->User Manager**

3. Once the accounts have been set up, edit the `hosts.equiv` file on all the hosts to include hostA, hostB, ..., hostZ to allow accounts on these hosts to access PBS services, such as job submission and remote file copying.

The `hosts.equiv` file can usually be found in either of the following locations:

**C:\winnt\system32\drivers\etc\hosts.equiv**

**C:\windows\system32\drivers\etc\hosts.equiv**

4. Create required accounts. Before you install PBS, you must create the accounts that PBS requires. PBS has different requirements for these accounts, depending on whether it is in a domained or standalone environment.

For installation in a domained environment, see [section 2.5.3.2, “Installation Account”, on page 18](#) and [section 2.5.3.3, “The PBS Service Account”, on page 18](#).

For installation in a standalone environment, see [section 2.5.4.2, “Installation Account”, on page 21](#) and [section 2.5.4.3, “The PBS service account for Standalone Environments”, on page 21](#).

Create the following accounts, following the instructions for the environment:

#### *installation account*

The installation account is the account from which you will execute the PBS INSTALL program.

#### *PBS service account*

The PBS service account will actually run the PBS services: `pbs_server`, `pbs_mom`, `pbs_sched`, and `pbs_rshd`. The PBS service account is also recommended for performing any updates of the PBS configuration files.



---

## 3.5.6 Software Installation

Next you will need to install the PBS software on each execution host of your complex. The PBS Professional installation program will walk you through the installation process.

### 3.5.6.1 Installation Account

PBS must be installed from a local or domain account. A local account has local administrator privilege on the install host (i.e. the account must be a member of the local "Administrators" group on the local machine). A domain account has either domain administrator privileges (i.e. a member of "Domain Admins" group) or is a member of the local Administrators group on the local (install) host. The `INSTALL` program must be executed from a domain account which is a member of the "Domain Admins". See [section 2.5, "Recommended PBS Configurations for Windows", on page 16](#).

---

### 3.5.6.2 Installation Steps

1. If you are installing from the PBS Professional CD-ROM, insert the CD-ROM into your computer's CD-ROM drive, browse to your CD-ROM drive, and click on the PBS Professional program icon.

Alternatively, you can download the latest PBS Professional package from the PBS Web site, and save it to your hard drive. Run the self-extracting `pbspro.exe` package, and then the installation program, as shown below.

**Admin> PBSPro\_11.3.0-windows.exe**

On Windows XP, Service Pack 2 (SP2), upon launching the installer, a window may be displayed saying the program is from an unknown publisher. In order to proceed with the installation of PBS, click the “*Run*” button.

2. Review and accept the License Agreement, then click *Next*.
3. Supply your Customer Information, then click *Next*.
4. Review the installation destination location. You may change it to a location of your choice, provided the new location meets the requirements stipulated in [section 2.5, “Recommended PBS Configurations for Windows”, on page 16](#). Then click *Next*.
5. When installing on an execution host in the complex, select the “Execution” option from the *install* tool, then click *Next*.
6. You will be prompted for the name of the PBS service account. Enter your choice, then click *Next*.
7. You will then be prompted to enter a password for the PBS service account (as discussed in the previous section). The password typed will be masked with “\*”. An

---

empty password will not be accepted. Enter your chosen password twice as prompted, then click *Next*.

You may receive the following “error 2245” when PBS creates the PBS service account. This means “The password does not meet the password policy requirements. Check the minimum password length, password complexity and password history requirements.”

You *must* use the same password when installing PBS on additional execution hosts as well as on the PBS Server host.

8. The installation tool will show two screens with informative messages. Read them; click *Next* on both.
9. On the “Editing PBS.CONF file” screen, specify the hostname on which the PBS Server service will run, then click *Next*.
10. On the “Editing HOSTS.EQUIV file” screen, follow the directions on the screen to enter any hosts and/or users that will need access to this local host. Then click *Next*.
11. On the “Editing PBS MoM config file” screen, follow the directions on the screen to enter any required MoM configuration entries (as discussed in [“MoM Parameters” on page 267 of the PBS Professional Reference Guide](#)). Then click *Next*.
12. Lastly, when prompted, select *Yes* to restart the computer and click *Finish*.

Repeat the above steps for each execution host in your complex. When complete you are ready to install PBS Professional on the host that will become the PBS Server host.

1. Install PBS Professional on hostA, selecting the “*All*” option. Next, you will be prompted for your license server location. Following this, the install program will prompt for information needed in setting up the `hosts.equiv` file, etc. Enter the information requested for hosts hostB, hostC, ..., hostZ, clicking *Next* to move between the different input screens.
2. Finally, run `pbsnodes -a` on hostA to see if it can communicate with the execution hosts in your complex. If some of the hosts are seen to be down, then go to the problem host and restart the MoM, using the commands:

```
Admin> net stop pbs_mom
Admin> net start pbs_mom
```

### 3.5.7 Post Installation Considerations

The installation process will automatically create the following file,

```
[PBS Destination folder]\pbs.conf
```

containing at least the following entries:

```
PBS_EXEC=[PBS Destination Folder]\exec
PBS_HOME=[PBS Destination Folder]\home
PBS_SERVER=server-name
```

where `PBS_EXEC` will contain subdirectories where the executable and scripts reside, `PBS_HOME` will house the log files, job files, and other processing files, and `server-name` will reference the system running the PBS Server. The `pbs.conf` file can be edited by calling the PBS program “`pbs-config-add`”. For example, on 32-bit Windows systems:

```
\Program Files\PBS Pro\exec\bin\pbs-config-add "PBS_SCP=\winnt\scp.exe"
```

or on 64-bit Windows systems:

```
\Program Files (x86)\PBS Pro\exec\bin\pbs-config-add
  "PBS_SCP=\winnt\scp.exe"
```

Don't edit `pbs.conf` directly as the permission on the file could get reset causing other users to have a problem running PBS.

The auto-startup of the services is controlled by the PBS `pbs.conf` file as well as the Services dialog. This dialog can be invoked via selecting *Settings->Control Panel->Administrative Tools->Services*. If the services fail to start up with the message, “incorrect environment”, it means that the `PBS_START_SERVER`, `PBS_START_MOM`, and `PBS_START_SCHED` `pbs.conf` variables are set to *0 (False)*.

Upon installation, special files in PBS home directory are set up so that some directories and files are restricted in access. The following directories will have files that will be readable by the `\Everyone` group but writable only by Administrators-type accounts:

```
PBS_HOME/server_name
PBS_HOME/mom_logs/
PBS_HOME/sched_logs/
PBS_HOME/spool/
PBS_HOME/server_priv/accounting/
```

The following directories will have files that are only accessible to Administrators-type of accounts:

```
PBS_HOME/server_priv/
PBS_HOME/mom_priv/
PBS_HOME/sched_priv/
```

You should review the recommended steps for setting up user accounts and home directories, as documented in [section 2.6, “Windows User Authorization”, on page 24](#).

---

### 3.5.8 Uninstalling PBS Professional on Windows

For uninstalling the old PBS with version between 5.4.2 and 8.0, an account that is a member of the “Domain Admins” group will still have to be used.

To remove PBS from a Windows system, do one of the following:

- Go to *Start Menu->Control Panel->Add/Remove Programs* (Windows XP) menu and select the PBS Professional entry and click “*Change/Remove*”
- Double-click on the PBS Windows installation package icon to execute. This will automatically delete any previous installation.

If the uninstallation process complains about not completely removing the PBS installation directory, then remove it manually, for example by typing:

```
cd \Program Files
```

or

```
cd \Program Files (x86)
rmdir /s "PBS Pro"
```

Under some conditions, if PBS is uninstalled by accessing the menu options (discussed above), the following error may occur:

```
...Ctor.dll: The specified module could not be found
```

To remedy this, do the uninstall by running the original PBS Windows installation executable (e.g. `PBSPro_11.3.0-windows.exe`), which will remove any existing instance of PBS.

During uninstallation, PBS will not delete the PBS service account because there may be other PBS installations on other hosts that could be depending on this account. However, the account can be deleted manually using an administrator-type of account as follows:

In a domain environment:

```
net user <name of PBS service account> /delete /domain
```

In a non-domain environment:

```
net user <name of PBS service account> /delete
```

At the end of uninstallation, it is recommended to check that the PBS services have been completely removed from the system. This can be done by opening up the Services dialog. In Windows XP, go to *Start Menu->Control Panel->Performance and Maintenance->Administrative Tools->Services* and check to make sure `PBS_SERVER`, `PBS_MOM`, `PBS_SCHED`, and `PBS_RSHD` entries are completely gone. If any one of them has a state of “*DISABLED*”, then you must restart the system to get the service removed.

During uninstallation, you can choose to remove all files in `PBS_HOME/datastore`.



# Chapter 4

## Initial Configuration

### 4.1 Overview

After you have installed PBS Professional, perform the following steps:

- Validate the installation:
  - Check file paths: see [section 4.2.1.1, “Check Directories and Files”, on page 89](#)
  - Check PBS version: see [section 4.2.1.2, “Check PBS Version”, on page 89](#)
  - Check hostname resolution: see [section 4.2.1.3, “Check Hostname Resolution”, on page 89](#)
  - Windows: turn firewall off: see [section 9.13, “Windows XP SP2 Firewall” on page 700 in the PBS Professional Administrator’s Guide](#)
- Support PBS features:
  - Define PATHs for users: see [section 4.2.2.1, “Setting Command and Man Page Paths”, on page 89](#)
  - Support X forwarding: see [section 4.2.2.2, “Supporting X Forwarding for Interactive Jobs”, on page 90](#)

Depending on your site, you may need to do the following:

- Create and configure vnodes: see [section 3.1, “Vnodes: Virtual Nodes” on page 35 in the PBS Professional Administrator’s Guide](#)
- Create and configure queues: see [section 2.2, “Queues” on page 16 in the PBS Professional Administrator’s Guide](#)
- Enable passwordless authentication: see [section 13.8, “Enabling Passwordless Authenti-](#)

- 
- [cation" on page 896 in the PBS Professional Administrator's Guide](#)
- Set up desired file transfer mechanism: see [section 13.9, "Setting File Transfer Mechanism" on page 897 in the PBS Professional Administrator's Guide](#)
  - Configure resources: see [section , "PBS Resources" on page 287 in the PBS Professional Administrator's Guide](#)
  - Define scheduling policy: see [section , "Scheduling" on page 61 in the PBS Professional Administrator's Guide](#)
  - Integrate with an MPI: see [section 11.1, "Integration with MPI" on page 767 in the PBS Professional Administrator's Guide](#)
  - Set up resource limits: see [section 5.15, "Managing Resource Usage" on page 367 in the PBS Professional Administrator's Guide](#)
  - Use provisioning: see [section , "Provisioning" on page 613 in the PBS Professional Administrator's Guide](#)
  - Create hooks: see [section , "Hooks" on page 415 in the PBS Professional Administrator's Guide](#)
  - Set up failover: see [section 10.2, "Failover" on page 704 in the PBS Professional Administrator's Guide](#)
  - Set up checkpointing: see [section 10.3, "Checkpoint and Restart" on page 730 in the PBS Professional Administrator's Guide](#)
  - Minimize communication problems: see [section 10.4, "Preventing Communication and Timing Problems" on page 752 in the PBS Professional Administrator's Guide](#)
  - Configure PBS for a Cray: see [section 11.3, "Support for Cray Systems" on page 795 in the PBS Professional Administrator's Guide](#)
  - Configure PBS for IBM AIX: see [section 11.2, "Support for IBM AIX" on page 789 in the PBS Professional Administrator's Guide](#)
  - Configure PBS for an SGI machine: see [section 11.4, "Support for SGI" on page 826 in the PBS Professional Administrator's Guide](#)
  - Enable metascheduling with HPC Basic Profile: see [section , "Metascheduling Using HPC Basic Profile" on page 595 in the PBS Professional Administrator's Guide](#)
  - Manage security features: see [section , "Security" on page 659 in the PBS Professional Administrator's Guide](#)



---

## 4.2 After Installation

### 4.2.1 Post-Installation Validation

#### 4.2.1.1 Check Directories and Files

If you wish to validate the installation of PBS Professional, at any time, run the `pbs_probe` command. It will review the installation (installed files, directory and file permissions, etc) and report any problems found. For details, see [“pbs\\_probe” on page 71 of the PBS Professional Reference Guide](#). (The `pbs_probe` command is not available under Windows.)

#### 4.2.1.2 Check PBS Version

Use the `qstat` command to find out what version of PBS Professional you have.

```
qstat -fB
```

#### 4.2.1.3 Check Hostname Resolution

- At the server, use the `pbs_hostn` command with the name of each host in the complex. This should complain if hostname resolution is not working correctly. See [“pbs\\_hostn” on page 49 of the PBS Professional Reference Guide](#).
- Make sure that `rpc` and/or `scp` work correctly. They must work outside of PBS before PBS can use them. Run `rpc` and/or `scp` between machines in the complex to make sure they work. If there are problems, see [section 2.1.3, “Name Resolution and Network Configuration”, on page 7](#).

## 4.2.2 Providing Support for PBS Features

### 4.2.2.1 Setting Command and Man Page Paths

Set paths for all users to include PBS commands and man pages. For paths, see [section 3.3.7, “Default Installation Locations”, on page 40](#). Administrator commands are in `PBS_HOME/sbin`, and user commands are in `PBS_HOME/bin`. Man pages are `PBS_HOME/man`.

---

### 4.2.2.2 Supporting X Forwarding for Interactive Jobs

To support X forwarding, do one of the following:

- Edit each MoM's `PATH` variable to include the directory containing the `xauth` utility.
- Add the path to the `xauth` binary to each MoM's `pbs_environment` file. For example, if you start with this path:

```
/bin:/user/bin
```

and the `xauth` utility is here:

```
/usr/bin/X11/xauth
```

The entry in the `pbs_environment` file would be the following:

```
PATH=/bin:/usr/bin:/usr/bin/X11
```

In the `ssh_config` file for each machine that will use X forwarding, put this line:

```
ForwardX11Trusted yes
```

X forwarding is not available under Windows.

# Chapter 5

## Licensing

### 5.1 Overview of Licensing for PBS Jobs

You can license your PBS jobs in the following ways:

- You use socket licenses to license hosts.
- You use floating CPU licenses that work for any PBS-managed jobs. These licenses are used for any portions of jobs not running on socket-licensed hosts.

In order for PBS to run a job, there must be enough floating CPU licenses for any CPUs assigned from vnodes that have not been assigned socket licenses.

#### 5.1.1 Socket Licenses for PBS Hosts

You can obtain socket licenses either from equipment manufacturers or from Altair, at [www.altair.com](http://www.altair.com). These socket licenses are assigned to hosts, not jobs. If a host is to be licensed using sockets, all sockets on the host must be licensed this way. If there are not enough socket licenses to cover a host, no part of that host gets socket licenses.

On the Cray, if you will use socket licenses for any compute nodes, you must use socket licenses for all compute nodes.

Socket licenses are managed as a file, which you place somewhere accessible to the PBS server host, or, if you are using failover, accessible to both PBS servers. You can use `PBS_HOME`.

Socket-based licenses are not supported on virtual machines.

### 5.1.1.1 Choosing Hosts for Socket Licenses

If you have enough socket licenses for all of your hosts, you can start the MoMs in any order.

You choose which hosts get socket licenses by starting the MoMs in the order in which you want them to get socket licenses. The **first** time you start PBS with socket licenses, PBS assigns the socket licenses to hosts. Once you have assigned the socket licenses, PBS remembers where they go. If you restart PBS, socket licenses stay with their hosts regardless of the order in which the MoMs start.

Licenses are assigned first-come, first-served. When there are not enough licenses for the next host to start, that host is not licensed, but the host following it may be licensed if it requires fewer licenses. For example, you have 6 socket licenses, and three hosts: hostA with four sockets, hostB with four sockets, and hostC with 2 sockets. If you start the MoMs in the order hostA, hostB, hostC, then hostA is licensed, hostB is skipped because it requires four licenses and there are just two remaining, and hostC is licensed.

If you have enough socket licenses for all of your hosts, you can start the MoMs in any order.

## 5.1.2 Floating Licenses for PBS Jobs

As of 11.0, PBS uses a new Altair license server for floating licenses. If you have hosts that are not socket-licensed, you **must** install and configure this new license server for PBS to function. This licensing is independent of application licensing. Applications are licensed by whichever server is required by the application.

The Altair license server makes a number of floating licenses available to run PBS jobs on hosts in a network. PBS uses a units-based or token-based licensing scheme. The number of licenses needed is proportional to the number of CPUs requested by a job. You can use floating or node-locked licenses. Floating licenses are used for the CPUs used by a job, instead of for hosts. Node-locked licenses license the sockets on the host, and do not float.

Multiple PBS complexes can use the same Altair license server.

The default port for the Altair license server is 6200.

## 5.1.3 Tracking License Use

### 5.1.3.1 Tracking Floating License Use

The PBS server can keep floating licenses available locally. It checks the floating licenses out of the Altair license server. The floating licenses are checked out of the server, whether or not they are being used by jobs. The PBS server hands them out to jobs as needed. The PBS server keeps track of these floating licenses in the `license_count` server attribute. In this

---

attribute, the PBS server tracks how many floating licenses are checked out by the PBS server in the `Avail_Local` parameter, and how many are in use in the `Used` parameter. See [“Server Attributes” on page 316 of the PBS Professional Reference Guide](#).

The minimum number of floating licenses to keep checked out is specified in the `pbs_license_min` server attribute.

The number of seconds to keep unused CPU floating licenses, when the number of floating licenses is above `pbs_license_min`, is specified in `pbs_license_linger_time`.

If floating licenses are released when a job finishes, the PBS server waits `pbs_license_linger_time` seconds before checking them back into the license server, during which time they will be kept under the `avail_local` parameter of the `license_count` attribute.

The `Avail_Global` parameter of the `license_count` attribute tracks how many floating licenses are kept by the Altair license server; that is, that have not been checked out from the license server.

### 5.1.3.2 Tracking Available and Unused Socket Licenses

The `license_count` server attribute tracks available socket licenses in the value for `Avail_Sockets`, and unused socket licenses in `Unused_Sockets`.

## 5.1.4 Recommendations for Floating Licenses

We recommend that you set `pbs_license_min` to the number of CPUs in the PBS complex. This way, other applications can't grab the floating licenses and prevent PBS from running a job.

## 5.1.5 License Server Versions and PBS Releases

Each feature in the license file for floating licenses has a version number associated with it. You need to have a license file in which the feature version is at least as new as the PBS Professional version. You can use PBS Professional when its version is older than or the same as the features in the license file.

You will need an Altair license file when you upgrade PBS Professional or when your floating license expires. If you need additional floating licenses in the mean time, contact Altair Support.

---

## 5.1.6 Old Licensing Model Used for Pre-9.0 Versions and Trial Licenses

The old PBS licensing scheme required that a license key be provided to PBS via "PBS\_SERVER/server\_priv/license\_file". This key determined whether a job could be run on a number of CPUs on one or more hosts. This proprietary license model accepted either a regular license or a trial license, which had a short expiration time. For regular licenses, there were 3 types: UNIX/Windows license (type '5'), Linux licenses (type 'L'), and floating licenses (type 'F').

The old PBS proprietary license model will continue to license PBS Professional versions 8.0 and earlier. Customers who upgrade from version 8.0 and earlier to 9.0 and later will need to download, install and configure the Altair license server. For information on downloading and installing the license server(s), see the Altair License Management System Installation and Operations Guide, available at [www.altair.com](http://www.altair.com). For instructions on configuring PBS to use the Altair license server, see [section 5.3, "Configuring PBS for Licensing", on page 95](#).

## 5.2 Definitions

### Floating License

A unit of floating 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). The floating licenses discussed in this chapter license PBS.

### License Manager Daemon (**lmserv-altair**)

Daemon that functions as the license server for floating licenses. See the Altair License Management System Installation and Operations Guide, available at the Altair website, [www.altair.com](http://www.altair.com).

### License Server

Manages floating licenses for PBS jobs.

### Memory-only Vnode

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

### Redundant License Server Configuration

Allows floating licenses to continue to be available should one or more license servers fail. Available configurations: three-server configuration, license server list.

**Socket License**

A per-socket license for a specific host. This license is not intended to move from host to host. Not managed by license server; managed by PBS.

**Three-Server Configuration**

A redundant license server configuration. One primary license server, one secondary license server, and one tertiary license server. Identified by three “port@host” specifiers, in that order. Specifiers are separated by a colon on UNIX/Linux and a semi-colon on Windows. Each server on the list is tried in turn. Each server has access to the same floating license file.

**License Server List**

List of license servers. Each server has some of the floating licenses, and PBS tries each in turn. The first running server is the only server queried. The list can contain any number of servers.

## 5.3 Configuring PBS for Licensing

### 5.3.1 Configuring PBS for Licensing

To configure PBS for licensing:

1. Specify the socket license file and the floating license server port and hostname by setting the server’s `pbs_license_info` attribute. See ["Server Licensing Attributes" on page 96](#) and ["Setting Server Licensing Attributes" on page 98](#).
2. Optionally, specify the minimum number of floating licenses to keep permanently checked out of the license server and ready to be used by jobs, by setting the server’s `pbs_license_min` attribute. It is recommended that you set this to the total number of CPUs in the complex. This is the total for all `resources_available.ncpus` configured for each vnode. See [section 5.3.3.2, "Setting pbs license min", on page 100](#).

Setting `pbs_license_min` to the total number of CPUs in the complex is especially useful if you are running both PBS and HyperWorks from one license server. This way, other applications won’t prevent PBS from starting jobs.

Also see [section 5.6.4, "Floating Licenses and Reservations", on page 109](#).

3. Optionally, specify the maximum number of CPUs to be licensed at any time by setting the server’s `pbs_license_max` attribute.
4. Optionally, specify the number of seconds to keep an unused floating license before returning it to the pool when there are more than the minimum number of floating

licenses checked out by setting the server's `pbs_license_linger_time` attribute. Set this to a value that will prevent floating licenses from being checked in and out constantly. The default value is 31536000 seconds, which is one year (365 \* 24 \* 60 \* 60).

### 5.3.2 Server Licensing Attributes

Licensing is controlled by the server attributes listed below:

#### FLicenses

The number of floating CPU licenses available to PBS. Equal to the `Avail_Global` + `Avail_Local` of the `license_count` attribute. Integer. Set by the server. Readable by all. Default: zero.

#### license\_count

`license_count= Avail_Global:<value> Avail_Local:<Y> Used:<value> High_Use:<value> Avail_Sockets:<value> Unused_Sockets:<value>`

*Avail\_Global* is the number of PBS CPU floating licenses still kept by the Altair License Server (checked in).

*Avail\_Local* is the number of PBS CPU floating licenses in the internal PBS floating license pool (checked out).

*Used* is the number of PBS CPU floating licenses currently in use.

*High\_Use* is the highest number of CPU floating licenses checked out and used at any given time while the current instance of the PBS server is running.

*Avail\_Sockets* is the total number of socket licenses in the license file.

*Unused\_Sockets* is the number of unused socket licenses.

“*Avail\_Global*” + “*Avail\_Local*” + “*Used*” is the total number of CPU floating licenses configured for one PBS complex.

Format: string. Set by Server. Readable by all. Default: zero.

#### pbs\_license\_info

Port@host for one or more license servers, and/or local pathname to the socket license file. String. Set by PBS Manager. Readable by all.

Default value: empty string, meaning no server to contact and no license file.

Default port: 6200.

Delimiter between items is colon (":") for UNIX/Linux and semi-colon (";") for Windows.



When setting to three-server configuration, put primary first, secondary second, and tertiary third. When setting to a server list, list servers in the order in which they should be queried.

To set `pbs_license_info` to the hostnames of the license servers:

```
Qmgr: set server
      pbs_license_info=<port1>@<host1>:<port2>@<host2>:...:<portN>@<
      hostN>
```

where `<host1>`, `<host2>`, ..., `<hostN>` can be IP addresses.

To set this attribute to a socket license file and a three-server configuration:

```
Qmgr: set server pbs_license_info=<license file>:<port>@<pri-
      mary>:<port>@<secondary>:<port>@<tertiary>
```

**Windows:** Use semicolons (;) instead of colons (:), and enclose the path list in double quotes if it contains any spaces or when you are listing more than one port/server. For example:

```
Qmgr: set server
      pbs_license_info="<port1>@<host1>;<port2>@<host2>;...;<portN>@
      <hostN>"
```

To unset `pbs_license_info` value:

```
Qmgr: unset server pbs_license_info
```

### `pbs_license_linger_time`

The number of seconds to keep an unused CPU floating license, when the number of floating licenses is above the value given by `pbs_license_min`. Time. Set by PBS Manager. Readable by all.

Default: 31536000 seconds (1 year)

To set `pbs_license_linger_time`:

```
Qmgr: set server pbs_license_linger_time=<Z>
```

To unset `pbs_license_linger_time`:

```
Qmgr: unset server pbs_license_linger_time
```

### `pbs_license_max`

Maximum number of floating licenses to be checked out at any time, i.e. maximum number of CPU floating licenses to keep in the PBS local floating license pool. Sets a cap on the number of CPUs that can be licensed at one time. Long. Set by PBS Manager. Readable by all. Default: maximum value for an integer.

To set `pbs_license_max`:

```
Qmgr: set server pbs_license_max=<Y>
```

To unset `pbs_license_max`:

```
Qmgr: unset server pbs_license_max
```

`pbs_license_min`

Minimum number of floating licenses to permanently keep checked out of the license server and ready to be used by jobs, i.e. the minimum number of CPU floating licenses to keep in the PBS local floating license pool. It is recommended that you set `pbs_license_min` to the total number of CPUs in your complex. This is the total for all `resources_available.ncpus` configured for each vnode. Long. Set by PBS Manager. Readable by all. Default: zero.

To set `pbs_license_min`:

```
Qmgr: set server pbs_license_min=<X>
```

To unset `pbs_license_min`:

```
Qmgr: unset server pbs_license_min)
```

### 5.3.3 Setting Server Licensing Attributes

The administrator can define the following server attributes via `qmgr`:

#### 5.3.3.1 Setting the Licensing Information in `pbs_license_info`

For floating licenses, to set `pbs_license_info` to the hostname of the license server(s), run the following as a PBS manager or administrator (i.e. root):

```
Qmgr: set server pbs_license_info=  
  <port1>@<host1>:<port2>@<host2>:...:<portN>@ <hostN>
```

where `<host1>`, `<host2>`, ..., `<hostN>` can be IP addresses.

When setting to three-server configuration, put primary first, secondary second, and tertiary third. When setting to a server list, list servers in the order in which they should be queried.

For socket licenses, to set this attribute to a socket license file:

```
Qmgr: set server pbs_license_info=<license file>
```

To set this attribute to a socket license file and a three-server configuration:

```
Qmgr: set server pbs_license_info=<license  
  file>:<port>@<primary>:<port>@<secondary>:<port>@<tertiary>
```

You can list the file first or last.

The default value is empty, meaning no external license server is contacted.

Default port: 6200.

These actions follow:

- If the `pbs_license_info` is currently set to a non-empty value, then it is set to the new value. All previous floating licenses are checked back into the previous license server, and the connection to that server is terminated.
- If the `pbs_license_info` is currently unset, then it is set to the new value. If the PBS complex was licensed by a trial license key, then the trial licensing is discontinued. An attempt is made to initialize connection to the license server whose location is described in `pbs_license_info`. If the connection fails, `qmgr` and `server_logs` contain a warning:

```
"Unable to connect to license server at pbs_license_info=<X>"
```

The attribute is still set to this new value.

Upon successful connection to the license server, PBS tries to re-license the running jobs (which ran previously via trial licenses). Any jobs that are currently running continue to run, even if not all the necessary licenses are obtained for these jobs.

**Windows:** Use semicolons (;) instead of colons (:), and enclose the path list in double quotes if it contains any spaces or when you are listing more than one port/server. For example:

```
qmgr> set server pbs_license_info=
    "<port1>@<host1>;<port2>@<host2>;...;<portN>@<hostN>"
```

To unset `pbs_license_info`, simply run the following as PBS Manager or Administrator (i.e. root):

```
Qmgr> unset server pbs_license_info
```

These actions follow:

- The `pbs_license_info` attribute is set to the empty string, previous floating licenses are checked back into the previous license server, and connection to this license server is shut down.
- Currently running jobs are allowed to run to completion.

Once PBS is installed, the license file location can be changed (if, for example, the Altair license server is moved to another host), by setting the following server attribute via `qmgr`:

```
Qmgr: set server pbs_license_info= <port1>@<host1>
```

---

### 5.3.3.2 Setting `pbs_license_min`

It is recommended that you set `pbs_license_min` to the total number of CPUs in your complex. This is the total for all `resources_available.ncpus` configured for each vnode. To set `pbs_license_min`, run the following as a PBS manager or administrator (i.e. root):

```
qmgr: set server pbs_license_min=<X>
```

These actions follow:

- If `<X>` is not numeric, or is less than 0, or is greater than the value of `pbs_license_max`, then the attribute is not set, and `qmgr` outputs an error and returns a non-zero value.
- The next time PBS updates its floating license pool (usually every 5 minutes or when a job is started/exited), the new value for `pbs_license_min` is known internally to the PBS server.

If the server cannot obtain the amount of CPU floating licenses given by `pbs_license_min` from the license server, then it will try to obtain as many as possible, log the error, and keep trying to get more up to the correct value over some period of time.

To unset `pbs_license_min`, run the following as a PBS manager or administrator (i.e. root):

```
qmgr: unset server pbs_license_min
```

This will cause `pbs_license_min` to revert to its default value.

The next time PBS updates its floating license pool (usually every 5 minutes or when a job is started/exited), the value of `pbs_license_min` will have a default value, and unused floating licenses are returned to the license server. The return of the floating license(s) to the pool is constrained by `pbs_license_linger_time`.

### 5.3.3.3 Setting `pbs_license_max`

To set `pbs_license_max`, run the following as a PBS manager or administrator (i.e. root):

```
qmgr: set server pbs_license_max=<Y>
```

These actions follow:

If `<Y>` is not numeric, or is less than 0, or is less than the value of `pbs_license_min`, then the attribute is not set, and `qmgr` outputs an error and returns a non-zero value.

The next time PBS updates its floating license pool (usually every 5 minutes or when a job is started/exited), the new value for `pbs_license_max` is known internally to the PBS server.

---

If the new value for `pbs_license_max` is less than the previous value, the value is not adjusted by taking away the floating licenses that are currently in use by running jobs. This allows the jobs to continue to run. However, as jobs exit, the PBS server will adjust the internal floating license pool to have no more than the number of floating licenses given by `pbs_license_max`.

To unset `pbs_license_max`, run the following as a PBS manager or administrator (i.e. root):

```
Qmgr: unset server pbs_license_max
```

This causes the `pbs_license_max` value to revert to its default value. The next time PBS updates its floating license pool (usually every 5 minutes or when a job is started/exited), the value of `pbs_license_max` is set to its default.

### 5.3.3.4 Setting `pbs_license_linger_time`

To set `pbs_license_linger_time`, run the following as a PBS manager or administrator (i.e. root):

```
Qmgr> set server pbs_license_linger_time=<Z>
```

These actions follow:

- If `<Z>` is not numeric, or is less than or equal to 0, then the attribute is not set, and `qmgr` outputs an error and returns a non-zero value.
- The next time PBS updates its floating license pool (usually every 5 minutes or when a job is started/exited), the new value for `pbs_license_linger_time` is known internally to the PBS server.

To unset `pbs_license_linger_time`, run the following as PBS manager or administrator (i.e. root):

```
Qmgr: unset server pbs_license_linger_time
```

This causes the value of `pbs_license_linger_time` to revert to its default. The next time PBS updates its floating license pool (usually every 5 minutes or when a job is started/exited), the value of `pbs_license_linger_time` is at the default.

## 5.3.4 Licensing and PBS Server Failover

The server attribute values for `pbs_license_info`, `pbs_license_min`, `pbs_license_max`, and `pbs_license_linger_time` are set through the primary server. Since these values are saved in a shared location, the secondary server can use these licensing parameters. No additional licensing steps are needed for the secondary server to work properly.

If you are using socket licenses and failover, put the socket license file where both PBS servers can reach it. You can use `PBS_HOME`.

## 5.4 Redundant License Servers

You can use Altair license servers in a redundant license server system. See the Altair License Management System Installation and Operations Guide, available at the Altair website, [www.altair.com](http://www.altair.com).

If you have redundant license servers, some or all of the floating licenses used by your site will be available if a license server host crashes. You can use the PBS Server/Scheduler host as one of the license server hosts. There are two ways to set up your license servers for redundancy:

1. The three-server configuration, where two of the three servers must be up for PBS to get floating licenses
2. The license server list, where PBS tries each license server in turn until it finds a working license server

In the three-server configuration, as long as at least two of the servers are up, PBS can get all the floating licenses. In this arrangement, each of the servers has the same floating license file.

In the license server list arrangement, each server has some of the floating licenses, and PBS will try each in turn. The first running server is the only server queried. This arrangement is better where the network is unreliable. You can have as many Altair license servers in a license server list as you want.

Set up redundancy before starting PBS.

When choosing license server hosts, choose machines that are stable and unlikely to be rebooted, and that have excellent communication.

For information on redundant license servers, see the Altair License Management System Installation and Operations Guide, available on the Altair website at [www.altair.com](http://www.altair.com).

### 5.4.1 To Use the Three-server Redundant Setup

1. Make sure that the three servers are configured correctly according to the guidelines for the three-server arrangement.
5. Set the server's `pbs_license_info` attribute to point to the servers, in the order primary, secondary, tertiary. The delimiter depends on the platform; for UNIX/Linux it is a colon (":"), and for Windows it is a semi-colon (";"):

```
Qmgr: set server pbs_license_info=  
<port>@<primary>:<port>@<secondary>:<port>@<tertiary>
```

For Windows, use semicolons instead of colons, and enclose the path list in double

quotes if any of the paths contains spaces.

## 5.4.2 To Use the License Server List

1. Make sure that the servers are configured correctly according to the guidelines for the server list.
2. Set the server's `pbs_license_info` attribute to point to the list. The delimiter depends on the platform; for UNIX/Linux it is a colon (":"), and for Windows it is a semi-colon (";").

On UNIX/Linux:

```
Qmgr: set server pbs_license_info=
  <port1>@<host1>:<port2>@<host2>:<port3>@<host3>:...:<portN>
  @<hostN>
```

On Windows:

```
Qmgr: set server pbs_license_info=
  <port1>@<host1>;<port2>@<host2>;<port3>@<host3>;...;<portN>
  @<hostN>
```

For Windows, use semicolons instead of colons, and enclose the path list in double quotes if any of the paths contains spaces.

## 5.5 Displaying Licensing Information

### 5.5.1 Viewing License Information in Server Attributes

To see the information in the server attributes including `Flicenses`, `pbs_license_info`, `pbs_license_min`, etc, run the following:

```
qstat -Bf
```

or

```
qmgr -c "list server"
```

### 5.5.2 Viewing the Number of Available Floating Licenses

If license tools such as `lmxendutil` are installed on the PBS server host, the user can use them to discover the number of actual floating licenses available. These are reported in units that are a multiple of the number of CPUs. For information about viewing floating licenses if

---

`lmxendutil` is not installed on the PBS server host, see the Altair License Management System Installation and Operations Guide, available at the Altair website, [www.altair.com](http://www.altair.com).

### 5.5.3 Viewing the Number of Available Socket Licenses

To see the number of available socket licenses, run the following:

```
qstat -Bf
```

and look for the `license_count` attribute.

### 5.5.4 Viewing the Number of Sockets

To see the number of sockets, run the following on the server host:

```
pbs_topologyinfo -a -s
```

The `pbs_topologyinfo` command shows the number of sockets or their equivalents reported, rather than licensed, for each vnode.



---

## 5.6 PBS Jobs and Licensing

### 5.6.1 Examples of Licensing PBS Jobs Using Floating Licenses

The following examples show how PBS licenses jobs using floating licenses.

1. Fit in a single host such as an Altix, packed on the fewest vnodes:

```
qsub -l ncpus=10:mem=20gb -l place=pack
```

This job requests 10 CPUs, so PBS will check out 10 floating licenses.

2. Request 4 chunks, each with 1 CPU and 4 gb of memory taken from anywhere:

```
qsub -l select=4:ncpus=1:mem=4gb -l place=free
```

The job is requesting 4 CPUs, so PBS will check out 4 floating licenses.

3. Request 4 vnodes where the arch is *linux* and each vnode is on a separate host:

```
qsub -l select=4:mem=2gb:ncpus=2:arch=linux -l place=scatter
```

Each vnode has 2 CPUs and 2GB memory allocated to the job. The job requests 8 CPUs so PBS will check out 8 floating licenses.

4. Request to run on a specific host:

```
qsub -l select=1:ncpus=2:mem=50gb:host=zooland
```

The job requests 2 CPUs, so PBS needs to check out 2 floating licenses.

5. Request resources on different hosts:

```
qsub -l select=2:ncpus=3:mem=6gb -l place=scatter
```

The job requests 6 CPUs, so PBS will check out 6 floating licenses to run the job.

6. Cpusets: An odd-size job that will fit on a single Altix, but not on any one nodeboard, and the request is not shared:

```
qsub -l select=1:ncpus=3:mem=6gb -l place=pack:excl
```

The job is specifically requesting 3 CPUs, so PBS needs to check out 3 floating licenses.

7. Cpusets: Request a small number of CPUs but a large amount of memory, exclusively:

```
qsub -l select=1:ncpus=1:mem=25gb -l place=pack:excl
```

The job is requesting 1 CPU, so PBS checks out 1 floating license.

8. Cpusets: Align a large job within one router, if it fits within a router.

```
qsub -l select=1:ncpus=100:mem=200gb -l place=pack:group=router
```

The job requests 100 CPUs, requiring PBS to check out 100 floating licenses.

9. Assignment of resources involving memory-only vnodes (nodeboard):

Given 3 vnodes available where

V1 has 4 CPUs and 2 GB

V2 has no CPUs and 3 GB

V3 has no CPUs and 4 GB

V4 has 2 CPUs and 5GB

V1, V2, V3, V4 have sharing attribute set to “*default\_shared*”

Case 1: Job requesting no CPUs:

```
qsub -l select=1:ncpus=0:mem=3gb
```

This job would not run since it asks for no CPUs. No floating licenses would be checked out. Note that that even though a chunk within a job can ask for 0 CPUs, the job as a whole must request at least one CPU.

Case 2: Job requesting a combination of vnodes with CPUs and memory-only vnodes, non-exclusively:

```
qsub -l select=1:ncpus=1:mem=7gb
```

Even though this job may get assigned 2 GB of V1, 3 GB of V2, and 2 GB of V3, the job has requested 1 CPU so PBS needs to check out only 1 floating license.

Case 3: Job requesting a combination of vnodes with CPUs and memory-only vnodes **exclusively**:

```
qsub -l select=1:ncpus=1:mem=14gb -l place=pack:excl
```

Even though the job may get assigned V1, V2, V3, and V4, the job has requested only 1 CPU so PBS needs to check out 1 floating licenses.

Case 4: Job not requesting memory-only vnodes:

```
qsub -l select=1:ncpus=2 -lplace=pack:excl
```

Even though this job may get assigned all CPUs (4) of V1 exclusively, this job has only requested 2 CPUs so PBS will check out 2 floating licenses.

Sub-Case 4a:

```
qsub -lselect=1:ncpus=2:mem=10gb -lplace=excl
```

Scheduler runs job on:

V2: 0 CPU 1 GB

V3: 0 CPU 4 GB

V4: 3 CPUs 5 GB

The job has exclusive use of the vnodes, but the user only requested 2 CPUs, so 2 floating licenses are needed to run the job.

Sub-Case 4b:

```
qsub -l select=1:ncpus=2:mem=10gb -lplace=excl
```

Scheduler runs job on:

V1: 0 CPU 1 GB

V3: 0 CPU 4 GB

V4: 3 CPUs 5 GB

It doesn't matter how the scheduler assigned the vnodes, the number of CPUs requested is always honored for figuring the number of floating licenses to get. This also requires 2 floating licenses.

#### 10. Complex request:

```
qsub -l select=2:ncpus=1+5:ncpus=2
```

This requires 12 floating licenses.

#### 11. Licensing virtual CPUs:

Given hostA which has 2 physical CPUs, with `resources_available.ncpus` set to 4 on the vnode representing the host:

```
qsub -l select=1:ncpus=3:host=hostA
```

PBS will check out 3 floating licenses for the job.

#### 12. Licensing on a Hyperthreaded Machine:

A hyperthreaded hostB has 2 physical CPUs, where the OS reports 4 logical CPUs. The vnode representing the host has the default value for `resources_available.ncpus` of 2 and `pcpus=2`. Now set `resources_available.ncpus=4`:

```
qsub -l select=ncpus=4:host=hostB
```

---

PBS will need 4 floating licenses to run the job.

**13.** Licensing multi-core systems:

On multi-core systems, the number of CPUs requiring floating licenses is the number requested by the job.

On a host with two dual core chips (4 CPUs), a job asking for 2 CPUs would require 2 floating licenses.

## 5.6.2 Floating Licenses and Job States

When a job finishes execution (i.e. job has exited), the floating licenses assigned to the job are returned to the PBS floating license pool. The pool is then subject to the constraints given in `pbs_license_min` and `pbs_license_linger_time`.

A job that is held is treated as if the job has finished execution. Floating licenses assigned to it are released to the PBS local floating license pool.

The floating licenses assigned to a suspended job also return to the PBS floating license pool in order to be available to other PBS jobs. The returned floating licenses are also subject to the `pbs_license_min` and `pbs_license_linger_time` constraints.

The scheduler makes sure floating licenses are available before resuming any job. If the floating licenses are not available, a scheduler log message and job comment are provided to warn of the situation.

Example:

JobA has been submitted as follows:

```
qsub -l select=4:ncpus=1:mem=2gb <job.script>
```

The PBS server checked out 4 floating licenses and executed JobA.

At some point, the scheduler decided to suspend JobA to execute higher priority jobs. The 4 floating licenses checked out initially are checked back into the PBS floating license pool (not the license server.) They can be reused by other jobs, and also be made available when JobA gets resumed.

JobA successfully resumes after high priority jobs complete, and PBS was able to get 4 floating licenses from its pool of floating licenses.

## 5.6.3 PBS Jobs and HyperWorks

PBS jobs and HyperWorks applications check out floating licenses from the same server, but the floating licenses have distinguishing “features”, as in “PBSprofessional” feature GWUs (GridWorks units), and “Hyperworks” feature HWUs (HyperWorks Units).

---

## 5.6.4 Floating Licenses and Reservations

For advance and standing reservations to work, make sure that there are enough socket and floating licenses. Set the `pbs_license_min` to the total number of CPUs, including virtual CPUs, in the PBS complex, for the hosts that are not socket licensed. Floating licenses are not needed on socket-licensed hosts.

When the scheduler confirms a reservation, the server makes sure the resources requested by the reservation (e.g. vnodes/CPU) are available for the reservation. If the PBS server always has floating licenses for the total number of non-socket-licensed CPUs in the complex always checked out, this guarantees that there will be floating licenses available to satisfy these reservations.

If you are not using socket licenses, then upon confirming a reservation, the PBS server gives a warning if `pbs_license_min` is less than the total number of non-socket-licensed CPUs in the complex. However, if you are using socket licenses, this warning will never appear.

If the `pbs_license_min` attribute has not been set in the manner recommended, then when the reservation starts, there's a chance that some of the reservation jobs won't run due to a shortage of floating licenses available. In this case, a job comment and scheduler log entry will be provided.

Example:

The user creates the following reservation requesting 10 CPUs:

```
pbs_rsub -R 1500 -E 1600 -lselect=ncpus=10  
<resv-id> confirmed
```

The user submits jobs to the reservation queue:

```
qsub -q <resv_queue> -l select=ncpus=5 compute_job  
qsub -q <resv_queue> -l select=ncpus=5 compute_job2
```

At the start of the reservation, the two jobs run, each getting 5 floating licenses.

## 5.6.5 Suspended Jobs

If you set the server's `pbs_license_min` attribute to the number of non-socket-licensed CPUs in the complex, suspended jobs will be able to resume when they are ready. Jobs are suspended, and release their floating licenses, for preemption, and via `qsig -s suspend`. See section 5.9.6.2, "Job Suspension and Resource Usage", on page 314 of the PBS Professional Administrator's Guide.

## 5.7 Upgrading

When you upgrade PBS, you transfer your licensing information to the new PBS, unless you are changing how you license jobs, for example, adding socket licenses to hosts. Instructions for transferring or updating licensing information are included in ["Upgrading PBS Professional" on page 113](#).

## 5.8 Troubleshooting Licensing Errors

### 5.8.1 Server Becomes Unresponsive on Startup

If the server becomes unresponsive on startup, the server may be trying to contact the wrong license server. For recovery instructions, see [section 14.2, "Server Host Bogs Down After Startup" on page 907 in the PBS Professional Administrator's Guide](#).

### 5.8.2 Licensing and Loss of Communication to License Server

If PBS loses contact with the Altair License Server, any jobs currently running will not be interrupted or killed. The PBS server will continually attempt to reconnect to the license server, and re-license the assigned vnodes once the contact to the license server is restored.

No new jobs will run if PBS server loses contact with the license server.

If PBS cannot detect a license server host and port when it starts up, the server logs an error message:

```
"Did not find a license server host and port (pbs_license_info=<X>). No
external license server will be contacted"
```

If the PBS scheduler cannot obtain the floating licenses to run or resume a job, the scheduler will log a message:

```
"Could not run job <job>; unable to obtain <N> CPU licenses. avail
licenses=<Y>"
```

```
"Could not resume <job>; unable to obtain <N> CPU licenses. avail
licenses=<Y>"
```

If PBS cannot contact the license server, the server will log a message:

```
"Unable to connect to license server at pbs_license_info=<X>"
```

If the value of the `pbs_license_min` attribute is less than the number of CPUs in the PBS complex when a reservation is being confirmed, the server will log a warning:

```
"WARNING: reservation <resid> confirmed, but if reservation starts now, its
  jobs are not guaranteed to run as pbs_license_min=<X> < <Y> (# of CPUs
  in the complex)"
```

If the PBS server cannot get the number of floating licenses specified in `pbs_license_min` from the license server, the server will log a message:

```
"checked-out only <X> CPU licenses instead of pbs_license_min=<Y> from
  license server at host <H>, port <P>. Will try to get more later."
```

If the PBS server encounters a proprietary license key that is of not type “-T”, then the server will log the following message:

```
"license key #1 is invalid: invalid type or version".
```

### 5.8.3 Manually Refreshing Floating License Counts

If the license server becomes temporarily unavailable, PBS may not be able to license new jobs. Normally the scheduler won't query the license server for floating licenses until a new job is submitted or deleted. However, you can force PBS to contact the license server and refresh the floating license counts by doing the following:

```
qmgr -c "set server pbs_license_info = <...>"
```

### 5.8.4 User Error Messages

If a user's job could not be run due to unavailable floating licenses, the job will get a comment:

```
"Could not run job <job>; unable to obtain <N> CPU licenses.
  avail_licenses=<Y>"
```

### 5.8.5 Checking Trial License Lifetime

If you are not sure how many more days your trial license will last, do the following:

1. Using `qmgr`, clear the comment:  
**qmgr -c "unset server comment"**
2. Restart the Server
3. Recheck the message in the server's comment attribute.

---

The comment now contains a message with the number of days left in the trial license. The trial (T) license is good for a maximum of 90 days from the installation of PBS Professional, not from when the license was installed.

## 5.9 Licensing Restrictions

- Socket licenses are not supported on virtual machines.
- Time zone of the system must match zone of licensing features.

## 5.10 Licensing Advice

- If your license server logs are filling up with lots of small license checkouts, consider setting `pbs_license_min` to a larger number.
- Set your licensing system up so that a single failure won't cripple your entire installation. If you are using the Altair license server, we recommend that you set up three servers either in a list or in the three-server configuration. If you are using failover, we recommend that you put the license servers on the PBS primary host, the PBS secondary host, and a separate license server host.
- If you change the number of licenses and then restart the Altair license server, it's a good idea to refresh PBS's notion of the available licenses:

```
# qmgr -c "set server pbs_license_info = <port>@<host>"
```



## Chapter 6

# Upgrading PBS Professional

This chapter shows how to upgrade from a previous version of PBS Professional. If PBS Professional is not installed on your system, you can skip this chapter.

## 6.1 Types of Upgrades

There are two types of upgrades available for PBS Professional. In both, the installation program creates a versioned directory and puts the new PBS binaries in that directory. The existing PBS binaries can remain where they are, except on Solaris, where the package manager allows only one version at a time to be installed.

### **overlay upgrade**

Installs the new `PBS_HOME` on top of the old one. The new `PBS_EXEC` is in its own versioned directory. Jobs stay in place, and can continue to run, except on the Altix or UV.

### **migration upgrade**

Installs the new `PBS_HOME` in a separate location from the old `PBS_HOME`. The new `PBS_HOME` can be in the standard location if the old version has been moved. Jobs are moved from the old server to the new one, and cannot be running during the move. Must be used for Windows.

For specific upgrade recommendations and updates, see the Release Notes.

## 6.1.1 Systems Requiring Migration Upgrade

Usually, UNIX systems can have overlay upgrades. Some systems and circumstances require migration upgrades. The following require migration upgrades:

- The Cray
- Windows machines
- When moving between 32-bit and 64-bit versions of PBS
- When certain European or Japanese characters are stored in datastore
- When your existing version of PBS is older than 5.3

### 6.1.1.1 Upgrading on the Cray

When upgrading PBS on a Cray from any prior version of PBS to 11.0 release of PBS, a migration upgrade is required. An overlay upgrade will not convert mpp\* jobs, and existing queued jobs will not execute properly.

In a migration upgrade, it is possible (but unlikely) for jobs that were previously queued to be rejected by the new PBS installation during the `qmove` process. If this happens, check the old PBS system for any jobs that were not successfully moved to the new PBS installation. A job can fail to move to the new system for the following reasons:

- The job uses a mixture of `-lmpp*` and `-lselect/-lplace` syntax
- The `mppnodes` range is ordered from high to low (i.e. `mppnodes="8-6"`)
- There are no `vnodes` whose `PBScraynid` values match the given `mppnodes` values

If it is not clear why a job failed to move, look in the new system's server logs for more details.

### 6.1.1.2 Upgrading on Windows

For instructions on upgrading on Windows, see [section 6.11, "Upgrading Under Windows"](#), [on page 157](#).

## 6.2 Differences from Previous Versions

### 6.2.1 Change in Licensing

You can license your PBS jobs in the following ways:

- You use socket licenses for licensing specific hosts. Socket licenses are managed via a

---

file; you can install this file and configure PBS to use it after you upgrade PBS.

- You use floating licenses that work for any PBS-managed jobs. These licenses are used for any jobs not running on socket-licensed hosts. They are managed by the Altair license server. If you are using floating licenses, PBS starts up faster if this license server is installed and configured before installing PBS. See the Altair License Management System Installation and Operations Guide, available at [www.altair.com](http://www.altair.com).

## 6.2.2 Location of `PBS_EXEC` and `PBS_HOME`

`PBS_EXEC` is the directory that contains the PBS binaries. The PBS installation program creates a versioned directory for the new version of `PBS_EXEC` and puts the binaries there. `PBS_HOME` is the directory where PBS information is stored. The location of `PBS_EXEC` has changed. Please read [section 3.3.5, “Versioned Installation”, on page 39](#), [section 3.3.6, “Pathname Conventions”, on page 39](#), and [section 3.3.7, “Default Installation Locations”, on page 40](#). Also please read [section 3.4.5.2, “Automatic Archiving and User Path Preservation”, on page 44](#) and [section 3.4.5.1.i, “Switching To New Version Now”, on page 44](#).

## 6.2.3 Conversion of Properties

The server will convert the old style properties, used in PBS Professional 7.0 and before, to boolean resources.

## 6.2.4 Change in Home Directory for AIX

The default `PBS_HOME` directory for AIX was changed from

```
/usr/spool/PBS
```

to

```
/usr/local/spool/PBS.
```

## 6.2.5 Change in Server Start During Overlay Upgrade

During an overlay upgrade, the PBS server must be started so that the server is initialized correctly. If you start PBS using the start script, this is handled automatically. The instructions in this manual for overlay upgrading specify using the start script.

## 6.3 Caveats and Advice

### 6.3.1 Make Sure Licensing is Configured

Before you perform the upgrade, the server's `pbs_license_info` attribute may be unset or set to some previous value. You must set it to the correct value. See [section 5.3.3, "Setting Server Licensing Attributes"](#), on page 98.

If you are using floating licenses, PBS starts faster if you install, configure, and start the new Altair license server before starting PBS. We recommend that you follow the steps for installing and starting the license server before upgrading. See the Altair License Management System Installation and Operations Guide, available at [www.altair.com](http://www.altair.com). Do not attempt to use any license server other than the Altair license server.

### 6.3.2 Overlay Upgrades

On an overlay upgrade, the old MoM is killed, and the new MoM is started with the "`pbs_mom -p`" option to allow existing jobs to run. When the 9.0 or later server comes up, the new server will also allow already running jobs to continue. PBS will try to re-license the jobs, but won't kill the jobs if there are not enough licenses.

### 6.3.3 Making Time to Upgrade

If you want to avoid having to work around running jobs when you perform an upgrade, you can set PBS up so that there are no running jobs when you want to do the upgrade. Follow these steps:

1. Figure out what the longest-running jobs are likely to need for `walltime`, e.g. two weeks
  2. Pick a time greater than that in the future, e.g. 3 weeks
  3. On all PBS hosts, create dedicated time or a reservation for the amount of time you think the upgrade will require, e.g. a day
- You can use a dedicated time slot, making it so that no jobs will be scheduled for that dedicated time. The system can be shut down all at once at the start of the dedicated time. See [section 4.8.10, "Dedicated Time" on page 152 in the PBS Professional Administrator's Guide](#).
  - You can create a reservation that reserves an entire host by using `-1 place=exclhost`. The following reservation creates a reservation for the host `mars`,

---

from 10am to 10pm:

```
pbs_rsub -R 1000 -D 12:00:00 -l select = host=mars -l place=exclhost
```

For more on creating reservations, see [“pbs\\_rsub” on page 79 of the PBS Professional Reference Guide](#).

### 6.3.4 Multi-vnode Jobs Won’t Survive Overlay Upgrade

Multi-vnode jobs cannot survive an overlay upgrade. A multi-vnode job is killed and requeued when any of its MoMs is restarted. If the MoM on the primary vnode is restarted, the job is killed and requeued according to the `node_fail_requeue` server attribute; see [section 10.4.2, “Node Fail Requeue: Jobs on Failed Vnodes” on page 753 in the PBS Professional Administrator’s Guide](#).

To avoid this, you can allow the jobs to finish before upgrading. You can set vnodes offline, and then wait until their jobs finish, then upgrade.

### 6.3.5 Nodes File and Downgrading

If you downgrade after upgrading to version 11 and later, you must use the nodes file from the older version of PBS. The version 11 and later nodes file is incompatible with version 10.4 and earlier servers.

### 6.3.6 Upgrading Hooks

If you are performing an overlay upgrade, you do not need to take any steps for hooks. Your hooks will be left untouched.

If you are performing a migration upgrade, you must print the hooks out before the upgrade, then read them in after the upgrade.

```
qmgr -c 'print hook' > hook.qmgr
```

```
qmgr < hook.qmgr
```

### 6.3.7 New Server Requires New MoMs

As of version 12.0, you must **not** attempt to run newer MoMs with an older server. You must start the new server only when all MoMs have been upgraded. Follow the steps in this chapter.

### 6.3.8 Do Not Unset `default_chunk.ncpus`

Do not unset the value for the `default_chunk.ncpus` server attribute. It is set by the server to 1. You can set it to another non-zero value, but a value of 0 will produce undefined behavior. When the PBS Server initializes and the `default_chunk` server attribute has not been specified during a prior run, the Server will internally set the following:

```
default_chunk.ncpus=1
```

This ensures that each "chunk" of a job's select specification requests at least one CPU.

If the Administrator explicitly sets the `default_chunk` server attribute, that setting will be retained across server restarts.

### 6.3.9 Unset `PBS_EXEC` Environment Variable

On Cray, perform this step on the server host or node.

Make sure that the `PBS_EXEC` environment variable is unset.

## 6.4 Before Upgrading from 10.x or Older to 11.x or Later

### 6.4.1 Create Data Service Account for UNIX/Linux

When upgrading from 10.x or older to 11.x or later, create an account for the data service. For UNIX/Linux, follow the guidelines in [section 3.4.1, "Create Required Accounts", on page 42](#). On Windows, the data service account is the same as the PBS service account.

### 6.4.2 Ensure that Licensing Will Work

- Get a new license file from Altair. Contact Altair support.
- Make sure that floating licenses work correctly. See [section 6.3.1, "Make Sure Licensing is Configured", on page 116](#).

---

## 6.5 After Upgrading

If you were using `vmem` at the queue or server level before the upgrade, then after upgrading you must add `vmem` to the new `resource_unset_infinite sched_config` option. Otherwise jobs requesting `vmem` will not run.

You may wish to make the upgrade transparent for users, if the installation program hasn't done that already. See [section 3.4.5.2.i, “Archiving Prior Version”, on page 45](#) and [section 3.4.5.2.iii, “Re-creating User Paths By Hand”, on page 45](#).

## 6.6 Introduction to Upgrading Under UNIX/Linux

When you get your new version of PBS, unpack it (`unzip`, `untar`) as a non-privileged user. When you follow the upgrading instructions below, all of the steps should be performed as root.

### 6.6.1 Directories

The locations of `PBS_HOME` and `PBS_EXEC` are specified in the file `/etc/pbs.conf`. In the following instructions, replace `PBS_HOME` or `PBS_EXEC` with the appropriate values.

For example, if `pbs.conf` specifies `PBS_HOME` as `/var/spool/PBS`, and an instruction says

```
"mv PBS_HOME PBS_HOME.old",
```

then type

```
"mv /var/spool/PBS /var/spool/PBS.old".
```

### 6.6.2 Managing Integrations

If you used the `pbsrun_wrap` mechanism with your old version of PBS, you must first unwrap any MPIs that you wrapped. This would include MPICH-GM, MPICH-MX, Intel MPI, MPICH2, etc.

If you are upgrading from a version prior to 9.0 and you had linked the `poe` command to `pbs_poe`, you must remove the link. The new version of PBS uses the `pbsrun_wrap` method; see the PBS Professional Administrator's Guide.

---

You can wrap your MPIs after upgrading PBS. See the PBS Professional Administrator’s Guide.

### 6.6.3 Upgrading on Multiple Machines

Instead of running the installer by hand on each machine, you can use a command such as `pdsh` with NFS-mounted common directories on all hosts to distribute the installation to each host. The general form to distribute commands to a large number of hosts is

```
# for hosts node001-005
pdsh -w node[001-005] command
```

When using the PBS `INSTALL` command you can make a simple text file called “`answers`” with the answers to the installation prompts, and redirect them into the `INSTALL` script:

```
./INSTALL < answers
```

where `answers` contains the answers for a MoM-only installation:

```
<newline>
<newline>
2
y
<server name>
y
y or n (use appropriate answer)
```

The complete command line would be:

```
pdsh -w node[001-005] ./INSTALL < answers
```

### 6.6.4 Upgrading on an Altix or UV

When upgrading on an Altix or UV that will be using cpusets, follow the instructions in [section 6.8, “Overlay Upgrade on One or More Altixes or UVs”, on page 127](#). When upgrading on an Altix or UV that will not be using cpusets, follow the instructions in [section 6.9, “Migration Upgrade Under UNIX and Linux”, on page 135](#).



## 6.7 Overlay Upgrade Under UNIX/Linux

Except on the Altix or UV, use the following steps to perform an overlay upgrade. For the Altix or UV, see [section 6.8, “Overlay Upgrade on One or More Altixes or UVs”, on page 127](#). You will probably want to keep any running jobs running. Multi-vnode jobs cannot survive an overlay upgrade. A multi-vnode job is killed and requeued when any of its MoMs is restarted.

The following commands must be run as “root”.

### 6.7.1 Back Up Your Existing PBS

Make a tar file of the PBS\_HOME and PBS\_EXEC directories.

1. Make a backup directory. If you are using failover, do this on both server hosts:
 

```
mkdir /tmp/pbs_backup
```
2. Make a tar file of PBS\_HOME:
 

```
cd PBS_HOME/..
tar -cvf /tmp/pbs_backup/PBS_HOME_backup.tar PBS_HOME
```
3. Make a tar file of PBS\_EXEC:
 

```
cd PBS_EXEC/..
tar -cvf /tmp/pbs_backup/PBS_EXEC_backup.tar PBS_EXEC
```
4. Make a copy of your configuration file. If you have configured failover, do this for each server:
 

```
cp /etc/pbs.conf /tmp/pbs_backup/pbs.conf.backup
```
5. If they exist (PBS 8.0 and later), make a copy of the Version 2 configuration files:
 

```
mkdir /tmp/pbs_backup/mom_configs
$PBS_EXEC/sbin/pbs_mom -s list | egrep -v '^PBS' | while read file
do
    $PBS_EXEC/sbin/pbs_mom -s show $file > /tmp/pbs_backup/mom_configs/
    $file
done
PBS_EXEC
```
6. Make a copy of the scheduler’s directory to modify:
 

```
cp -r PBS_HOME/sched_priv /tmp/pbs_backup/sched_priv.work
```

## 6.7.2 Shut Down Your Existing PBS

Shut down PBS, keeping running jobs running. The `qterm` command will use the `-t quick` option unless you specify otherwise. If you are using failover, this will shut down both primary and secondary servers.

(PBS versions PBSPro\_5.4.0 and later):

```
qterm -m -s -f
```

(PBS versions prior to PBSPro\_5.4.0):

```
qterm -m -s
```

If you wish to requeue and/or kill running jobs during shutdown, see [section 7.1.7, “Impact of Shutdown / Restart on Running UNIX/Linux Jobs”](#), on page 187.

## 6.7.3 Install the New Version of PBS

For an overlay upgrade, you install the new PBS into the same location as the existing PBS. When the installer asks for an installation location, it displays the location in the current `pbs.conf` file. In order to install the new PBS in the same location as the current PBS, accept this location by hitting “enter”.

### 6.7.3.1 Solaris

Solaris requires a slightly different set of steps when you run the installation program.

1. See [section 3.4.7.2, “Notes About Solaris”](#), on page 55
2. From the directory containing the installation script:

```
./INSTALL
```

The installation program will pick up your existing installation parameters from `/etc/pbs.conf`, and prompt you to confirm that you wish to use them.

When the install script prompts you whether or not to switch to the new version of PBS, you can answer “y” for “yes”.

When the install script prompts you whether or not to start PBS, if you are on a system running a MoM, answer “n” for “no”. Do **not** start `pbs_mom` now. Instead use `pbs_mom -p`, which will preserve running jobs. See the `pbs_mom(8B)` man page.

### 6.7.3.2 Other UNIX/Linux Platforms

For other UNIX/Linux platforms, install the new version of PBS on all hosts without uninstalling the previous version. The installation program will read your existing installation parameters from `/etc/pbs.conf`, and prompt you to confirm that you wish to use them.

On each host, go to the directory where you put the PBS installation script. Type:

```
./INSTALL
```

When the install script prompts you whether or not to switch to the new version of PBS, you can answer “y” for “yes”.

When the install script prompts you whether or not to start PBS, if you are on a system running a MoM, answer “n” for “no”. Do **not** start `pbs_mom` now.

### 6.7.4 Prepare the New Scheduler’s Configuration File

1. Make a copy of the new `sched_config`, which is in `PBS_EXEC/etc/pbs_sched_config`.  

```
cp PBS_EXEC/etc/pbs_sched_config PBS_EXEC/etc/pbs_sched_config.new
```
2. Update `PBS_EXEC/etc/pbs_sched_config.new` with any modifications that were made to the current `PBS_HOME/sched_priv/sched_config`. This is saved in the backup directory `/tmp/pbs_backup/sched_priv.work`
3. If it exists, replace the `strict_fifo` option with `strict_ordering`. If you do not, a warning will be printed in the log when the scheduler starts.
4. If you copied over your scheduler log filter setting, make sure the new configuration file has 1024 added to it. If the value is less than 1024, add 1024 to it:

```
Edit PBS_EXEC/etc/pbs_sched_config.new.
```

If your previous log filter line was:

```
log_filter:256
```

change it to:

```
log_filter:1280
```

If you do not, you will be inundated with logging messages.

5. Move `PBS_EXEC/etc/pbs_sched_config.new` to the correct name and location, i.e. `PBS_HOME/sched_priv/sched_config`.

```
mv PBS_EXEC/etc/pbs_sched_config.new PBS_HOME/sched_priv/sched_config
```

## 6.7.5 Modify the New Server's Resource File

Add the “h” flag to those vnode-level resources listed in the server's `PBS_HOME/server_priv/resourcedef` file that have the “n” or “f” flag. For example, if you had:

```
switch type=string flag=n
```

This would become:

```
switch type=string flag=nh
```

## 6.7.6 Update Fairshare Entities and Database

This step is only necessary if you were not using `egroup:euser` as your fairshare entity, but wish to do so now. Follow the procedures in [section 6.9.32, “Updating Fairshare Definitions for `egroup:euser`”, on page 151](#).

## 6.7.7 Configure Licensing

6. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

7. If you will use socket licenses, get a socket license file from Altair, and put it where the PBS server can reach it.
8. If you are using failover, install the socket license file where both servers can reach it. You can use `PBS_HOME`.
9. Set the server's `pbs_license_info` attribute to point to the license file and/or Altair license server. See [section 5.3.3.1, “Setting the Licensing Information in `pbs\_license\_info`”, on page 98](#).
10. Stop both servers:

```
qterm -f
```

## 6.7.8 Start New PBS Server and MoMs (If Using Failover)

If you are not using failover, skip this step. If you are using failover, this pair of start and stop steps really is necessary. Bear with us.

If all of your hosts or none of your hosts are socket licensed, start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

---

If some but not all of your hosts are socket licensed:

1. If you will run a MoM on the server host, disable MoM start in `pbs.conf`, so that it contains this:

```
PBS_START_MOM=0
```

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

3. Re-enable MoM start in `pbs.conf`, so that it contains this:

```
PBS_START_MOM=1.
```

### 6.7.9 Stop the New PBS (If Using Failover)

If you are not using failover, skip this step.

Shut down PBS, keeping running jobs running. The `qterm` command will use the `-t quick` option unless you specify otherwise. If you are using failover, this will shut down both primary and secondary servers.

(PBS versions PBSPro\_5.4.0 and later):

```
qterm -m -s -f
```

(PBS versions prior to PBSPro\_5.4.0):

```
qterm -m -s
```

### 6.7.10 Modify the New PBS Configuration File

Your new `pbs.conf` needs to reflect any changes that you made to the old file. Do the following:

- On the primary server host, edit the new `pbs.conf`. Make any updates to this file that you made to the old `pbs.conf`.
- If you are using failover, on the secondary server host, edit the new `pbs.conf`. Make any updates to this file that you made to the old `pbs.conf`.

### 6.7.11 Start New PBS Server and MoMs

If all of your hosts or none of your hosts are socket licensed, start PBS as follows:

1. Start PBS on the execution hosts. On each execution host, type:

```
PBS_EXEC/etc/pbs_habitat
PBS_EXEC/sbin/pbs_mom -p
```

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

If some but not all of your hosts are socket licensed:

1. If you will run a MoM on the server host, disable MoM start in `pbs.conf`, so that it contains this:

```
PBS_START_MOM=0
```

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

3. Choose the order in which to start MoMs. Socket licenses are handed out first-come, first-served. See [section 5.1.1.1, "Choosing Hosts for Socket Licenses", on page 92](#). On each execution host, type:

```
PBS_EXEC/etc/pbs_habitat
PBS_EXEC/sbin/pbs_mom -p
```

4. Re-enable MoM start on the server host, so that `pbs.conf` contains this:

```
PBS_START_MOM=1
```

5. Restart PBS on the server's host:

```
<path to init.d>/init.d/pbs restart
```

### 6.7.12 Set the Server's pbs\_license\_info Attribute

1. Set the server's `pbs_license_info` attribute to point to the license file and/or license server(s). See [section 5.3.3.1, "Setting the Licensing Information in pbs\\_license\\_info", on page 98](#).
2. Restart PBS on the server's host:

```
<path to init.d>/init.d/pbs restart
```

---

## 6.8 Overlay Upgrade on One or More Altixes or UVs

This section contains instructions for an overlay upgrade of an Altix or UV on which PBS will manage the cpusets. If you want to configure PBS on the Altix or UV to manage cpusets, run `pbs_mom.cpuset`. Jobs cannot be running on an Altix or UV during the upgrade. Jobs on the Altix or UV can be requeued, killed, or allowed to finish running. Multi-vnode jobs cannot survive an overlay upgrade. A multi-vnode job is killed and requeued when any of its MoMs is restarted.

If you want PBS to manage cpusets after the upgrade, you must have a vnode definitions file. The vnode definitions file is generated automatically for an Altix or UV running a supported version of ProPack or Performance Suite.

## 6.8.1 Back Up Your Existing PBS Professional

Make a tar file of the PBS\_HOME and PBS\_EXEC directories.

1. Make a backup directory:

```
mkdir /tmp/pbs_backup
```

2. Make a tar file of PBS\_HOME:

```
cd PBS_HOME/..  
tar -cvf /tmp/pbs_backup/PBS_HOME_backup.tar PBS_HOME
```

3. Make a tar file of PBS\_EXEC:

```
cd PBS_EXEC/..  
tar -cvf /tmp/pbs_backup/PBS_EXEC_backup.tar PBS_EXEC
```

4. Make a copy of your configuration file:

```
cp /etc/pbs.conf /tmp/pbs_backup/pbs.conf.backup
```

5. If they exist (PBS 8.0 and later), make a copy of the Version 2 configuration files on each machine:

```
mkdir /tmp/pbs_backup/mom_configs  
$PBS_EXEC/sbin/pbs_mom -s list | egrep -v '^PBS' | while read file  
do  
    $PBS_EXEC/sbin/pbs_mom -s show $file > /tmp/pbs_backup/mom_configs/  
    $file  
done
```

6. Save a list of the hosts:

```
pbsnodes -a > /tmp/pbs_backup/hostlist
```

7. Save the server's node configuration:

```
qmgr: print nodes @default > /tmp/pbs_backup/newnodes
```

8. If you are upgrading from a pre-8.0 version, ensure that each Altix or UV host has its values for resources\_available.(mem|vmem|ncpus) unset:

```
qmgr: unset node <hostname> resources_available.mem  
qmgr: unset node <hostname> resources_available.ncpus  
qmgr: unset node <hostname> resources_available.vmem
```

9. Make a copy of the scheduler's directory to modify:

```
cp -r PBS_HOME/sched_priv /tmp/pbs_backup/sched_priv.work
```



## 6.8.2 Stop New Jobs From Starting

You must stop any jobs from starting. Do this by stopping scheduling.

Stop scheduling:

```
qmgr: set server scheduling=false
```

## 6.8.3 Stop Jobs Running on the Altix or UV

Jobs cannot be running on an Altix or UV during an upgrade from a version before 8.0 to 8.0 or later. You can do one of the following:

- Requeue any jobs running on the Altix or UV
- Kill the jobs on the Altix or UV
- Drain the Altix or UV by letting existing jobs on the Altix or UV finish running
- Requeue all Altix or UV and non-Altix and non-UV jobs in the complex

If you choose to requeue all Altix, UV, non-Altix, and non-UV jobs, you can skip to [section 6.8.4, “Shut Down Your Existing PBS”, on page 130](#). This section has instructions for requeueing all jobs in the complex. Note that if you choose to requeue jobs, those jobs that are marked non-rerunnable will be killed.

To requeue only jobs running on the Altix or UV:

1. List the jobs on the Altix or UV. This will list some jobs more than once. You only need to requeue each job once:

```
pbsnodes <hostname> | grep Jobs
```

2. Requeue the jobs:

```
qrerun <job ID> <job ID> ...
```

To kill the jobs on the Altix or UV:

1. List the jobs on the Altix or UV. This will list some jobs more than once. You only need to kill each job once:

```
pbsnodes <hostname> | grep Jobs
```

2. Use the `qdel` command to kill each job by job ID:

```
qdel <job ID> <job ID> ...
```

To drain the Altix or UV, wait until any jobs running on the Altix or UV have finished.

## 6.8.4 Shut Down Your Existing PBS

You can let any non-Altix and non-UV jobs continue to run, or you can requeue or kill all jobs.

To let running jobs continue to run on non-Altix and non-UV hosts:

Shut down PBS. The `qterm` command will use the `-t quick` option unless you specify otherwise.

(PBS versions prior to PBSPro\_5.4.0)

```
qterm -m -s
```

(PBS versions PBSPro\_5.4.0 and later)

```
qterm -m -s -f
```

If your server is not running in a failover environment, the “-f” option is not required.

To requeue or kill all jobs:

Shut down PBS. The `qterm -t immediate` command will requeue any jobs that can be requeued and kill those that cannot:

```
qterm -t immediate -m -s -f
```

If your server is not running in a failover environment, the “-f” option is not required.

## 6.8.5 Install the New Version of PBS

On any non-Altix and non-UV platforms, follow the instructions in [section 6.7.3, “Install the New Version of PBS”, on page 122](#).

On an Altix or UV, follow the instructions in [section 3.4.8.2, “Download and Install the New PBS”, on page 58](#).

## 6.8.6 Prepare the New Scheduler's Configuration File

1. Make a copy of the new `sched_config`, which is in `PBS_EXEC/etc/pbs_sched_config`.  
**cp PBS\_EXEC/etc/pbs\_sched\_config PBS\_EXEC/etc/pbs\_sched\_config.new**
2. Update `PBS_EXEC/etc/pbs_sched_config.new` with any modifications that were made to the current `PBS_HOME/sched_priv/sched_config`.
3. If it exists, replace the `strict_fifo` option with `strict_ordering`. If you do not, a warning will be printed in the log when the scheduler starts.
4. If you are upgrading from a version prior to 7.1 and copied over your scheduler log filter setting, make sure the new configuration file has 1024 added to it. If the value is less than 1024, add 1024 to it:

Edit `PBS_EXEC/etc/pbs_sched_config.new`.

If your previous log filter line was:

```
log_filter:256
```

change it to:

```
log_filter:1280
```

If you do not, you will be inundated with logging messages.

5. Move `PBS_EXEC/etc/pbs_sched_config.new` to the correct name and location, i.e. `PBS_HOME/sched_priv/sched_config`.

```
mv PBS_EXEC/etc/pbs_sched_config.new PBS_HOME/sched_priv/sched_config
```

## 6.8.7 Update Fairshare Entities and Database

This step is only necessary if you were not using `egroup:euser` as your fairshare entity, but wish to do so now. Follow the procedures in [section 6.9.32, "Updating Fairshare Definitions for egroup:euser"](#), on page 151.

## 6.8.8 Modify the New Server's Resource File

If you are upgrading from a version prior to 7.1, add the "h" flag to those vnode-level resources listed in the server's `PBS_HOME/server_priv/resourcedef` file that have the "n" or "f" flag. For example, if you had:

```
switch type=string flag=n
```

This would become:

```
switch type=string flag=nh
```

See [section 5.14.2.5, "Resource Accumulation Flags" on page 326 in the PBS Professional Administrator's Guide](#).

## 6.8.9 Configure Licensing

1. If you will use socket licenses, get a socket license file from Altair, and put it where the PBS server can reach it. If you are using failover, put the license file where both servers can reach it. You can use `PBS_HOME`.

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

3. Set the server's `pbs_license_info` attribute to point to the license file and/or Altair license server. See [section 5.3.3.1, "Setting the Licensing Information in pbs\\_license\\_info", on page 98](#).

4. Stop the server(s):

```
qterm -f
```

## 6.8.10 Start New PBS Server and MoMs (If Using Failover)

If you are not using failover, skip this step. If you are using failover, this pair of start and stop steps really is necessary. Bear with us.

If all of your hosts or none of your hosts are socket licensed, start PBS on the server host. For the location of the startup script, see [section 7.1, "Starting and Stopping PBS: UNIX and Linux", on page 179](#).

```
<path to script>/init.d/pbs start
```

If some but not all of your hosts are socket licensed:

1. If you will run a MoM on the server host, disable MoM start in `pbs.conf`, so that it contains this:

```
PBS_START_MOM=0
```

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

---

### 6.8.11 Stop the New PBS (If Using Failover)

If you are not using failover, skip this step.

Shut down PBS, keeping running jobs running. The `qterm` command will use the `-t quick` option unless you specify otherwise. If you are using failover, this will shut down both primary and secondary servers.

(PBS versions PBSPro\_5.4.0 and later):

```
qterm -m -s -f
```

(PBS versions prior to PBSPro\_5.4.0):

```
qterm -m -s
```

### 6.8.12 Modify the New PBS Configuration File

Your new `pbs.conf` needs to reflect any changes that you made to the old file. In addition, if you are using failover, you need to re-enable it. Do the following:

- On the primary server host, edit the new `pbs.conf`. Make any updates to this file that you made to the old `pbs.conf`.
- If you are using failover, on the secondary server host, edit the new `pbs.conf`. Make any updates to this file that you made to the old `pbs.conf`.

### 6.8.13 Edit the Altix or UV Configuration File

When changing from ProPack 2 or 3 to Propack 6 or 7 or Performance Suite 1 or later, remove any `cpuset_create_flags <flags>` initialization other than `CPUSET_CPU_EXCLUSIVE` from the Version 1 MoM config file. See the `pbs_mom(8B)` manual page.

### 6.8.14 Start New PBS Server and MoMs

If all of your hosts or none of your hosts are socket licensed, start PBS as follows:

1. Start PBS on the execution hosts. On each execution host, type:

```
PBS_EXEC/etc/pbs_habitat
```

```
PBS_EXEC/sbin/pbs_mom -p
```

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

If some but not all of your hosts are socket licensed:

1. If you will run a MoM on the server host, disable MoM start in `pbs.conf`, so that it contains this:

```
PBS_START_MOM=0
```

2. Start PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

3. Choose the order in which to start MoMs. Socket licenses are handed out first-come, first-served. See [section 5.1.1.1, "Choosing Hosts for Socket Licenses", on page 92](#). Start MoMs in the order you want them licensed.

- On any non-Altix, non-UV execution hosts, start PBS. On each of these machines, type:

```
PBS_EXEC/etc/pbs_habitat
```

```
PBS_EXEC/sbin/pbs_mom -p
```

- On any Altixes or UVs, start PBS. For the location of the startup script, see [section 7.1, "Starting and Stopping PBS: UNIX and Linux", on page 179](#).

```
<path to script>/pbs start
```

4. Re-enable MoM start in `pbs.conf`, so it contains this:

```
PBS_START_MOM=1
```

5. Restart PBS on the server's host:

```
<path to init.d>/init.d/pbs restart
```

### 6.8.15 Read the Nodes Information Back Into `qmgr`

Read the nodes information back into `qmgr`:

```
qmgr < /tmp/pbs_backup/newnodes
```

### 6.8.16 Define Resources for the Altix or UV

If you are upgrading an Altix or UV from a pre-8.0 version of PBS Professional, you must change how resources are defined. The script "`au-nodeupdate.pl`" does this for you. It takes the list of hosts as an argument, and defines each resource on the host's natural vnode, then defines the resources indirectly on each of the hosts' vnodes. It does this for each resource defined on the host that is not `mem`, `vmem` or `ncpus`.

```
PBS_EXEC/etc/au_nodeupdate.pl /tmp/pbs_backup/hostlist
```

---

### 6.8.17 Set the Server's `pbs_license_info` Attribute

1. Set the server's `pbs_license_info` attribute to point to the license file and/or license server(s). See [section 5.3.3.1, "Setting the Licensing Information in `pbs\_license\_info`", on page 98.](#)

2. Shut down both servers:

```
qterm -f
```

3. Restart PBS on the server's host:

```
<path to init.d>/init.d/pbs start
```

## 6.9 Migration Upgrade Under UNIX and Linux

Follow these instructions if you are upgrading a Cray, an Altix, or a UV on which PBS will **not** be managing the cpusets, that is, you will run the standard, non-cpuset MoM, or if you are upgrading from a much older version of PBS Professional. See the PBS Professional Release Notes for recommendations on which versions require a migration upgrade.

`PBS_EXEC` is automatically created as a versioned directory. The installation program creates the directory for you. Each version of the PBS binaries is installed in its own versioned directory, so when you migrate from one version to another, you do not need to move the old version of PBS. You can let any jobs complete execution.

You will probably want to move jobs from the old PBS to the new. During a migration upgrade, jobs cannot be running. You can checkpoint, terminate and requeue all possible jobs and requeue non-checkpointable but rerunnable jobs. Your options with non-rerunnable jobs are to either let them finish or kill them.

The migration upgrade instructions here are generic. During the installation step, follow the directions for your operating system.

In the instructions below, file and directory pathnames are the PBS defaults. If you installed PBS in different locations, use your locations instead. `PBS_EXEC_OLD` refers to your existing, pre-upgrade location for `PBS_EXEC`.

The following commands must be run as "root".

## 6.9.1 Back Everything Up

### 6.9.1.1 Back Up Server/scheduler Host

Back up the server and vnode configuration information. You will use it later in the migration process. Do the following on the server/scheduler host:

1. On the server host, create a backup directory called `/tmp/pbs_backup`  
`mkdir /tmp/pbs_backup`
2. Print the server attributes to a backup file in the backup directory:  
`qmgr -c "print server" > /tmp/pbs_backup/server.backup`
3. Make a copy of the server's configuration for the new PBS:  
`cp /tmp/pbs_backup/server.backup /tmp/pbs_backup/server.new`
4. Print the vnode attributes and creation commands for the default server to a backup file in the backup directory. The default server is specified in `/etc/pbs.conf`.  
`qmgr -c "print node @default" > /tmp/pbs_backup/nodes.backup`
5. Make a copy of the vnode attributes for the new PBS:  
`cp /tmp/pbs_backup/nodes.backup /tmp/pbs_backup/nodes.new`
6. Make a copy of the server's `resourcedef` file for the new PBS:  
`cp PBS_HOME/server_priv/resourcedef /tmp/pbs_backup/resourcedef.new`
7. Make a copy of the scheduler's `sched_priv` directory for the new PBS:  
`cp -rp PBS_HOME/sched_priv/ /tmp/pbs_backup/sched_priv.work`
8. Copy the `pbs.conf` file to the backup directory:  
`cp /etc/pbs.conf /tmp/pbs_backup/pbs.conf.backup`
9. Print the scheduler attributes to a backup file in the backup directory:  
`qmgr -c "print sched" > /tmp/pbs_backup/sched.backup`
10. Make a copy of the scheduler's configuration for the new PBS:  
`cp /tmp/pbs_backup/sched.backup /tmp/pbs_backup/sched.new`



### 6.9.1.2 Preserve Hooks

11. If your old version of PBS used hooks, print hook creation commands to a backup file in the backup directory:

```
qmgr -c "print hook" > /tmp/pbs_backup/hooks.backup
```

### 6.9.1.3 Back Up Execution Hosts

On each execution host, back up the MoM configuration files:

1. Make a copy of the Version 1 configuration file:
2. If they exist (PBS 8.0 and later), make a copy of the Version 2 configuration files:

```
cp PBS_HOME/mom_priv/config /tmp/pbs_backup/config.backup
mkdir /tmp/pbs_backup/mom_configs
$PBS_EXEC_OLD/sbin/pbs_mom -s list | egrep -v '^PBS' | while read file
do
    $PBS_EXEC_OLD/sbin/pbs_mom -s show file > /tmp/pbs_backup/mom_configs/
    $file
done
```

Make a tar file of the PBS\_HOME and PBS\_EXEC\_OLD directories. This is a precaution.

1. Make a tarfile of PBS\_HOME:
 

```
cd PBS_HOME/..
tar -cvf /tmp/pbs_backup/PBS_HOME_backup.tar PBS_HOME
```
2. Make a tarfile of PBS\_EXEC\_OLD:
 

```
cd PBS_EXEC_OLD/..
tar -cvf /tmp/pbs_backup/PBS_EXEC_OLD_backup.tar PBS_EXEC_OLD
```
3. Make a backup of the existing /etc/pbs.conf:
 

```
cp /etc/pbs.conf /tmp/pbs_backup/pbs.conf.backup
```

## 6.9.2 Replace Properties with Boolean Resources, Update Resources

You must replace properties with Boolean resources.

1. Manually edit the vnodes configuration file for the new PBS, `/tmp/pbs_backup/nodes.new`. Where you find a line of the form:

```
set node NAME properties=PROP
```

or

```
set node NAME properties+=PROP
```

Replace with the line:

```
set node NAME resources_available.PROP=True
```

For example, if the `qmgr` output contained the following lines:

```
set node node01 properties=red
set node node01 properties+=green
set node node02 properties=red
set node node02 properties+=blue
```

replace those lines with:

```
set node node01 resources_available.red=True
set node node01 resources_available.green=True
set node node02 resources_available.red=True
set node node02 resources_available.blue=True
```

2. Create Boolean resources to replace properties. For each property being replaced, create or append to the new `/tmp/pbs_backup/resourcedef.new` file a line of the form:

```
PROP type=boolean flag=h
```

In the previous step's example, you would add the following lines to `/tmp/pbs_backup/resourcedef.new`:

```
red type=boolean flag=h
green type=boolean flag=h
blue type=boolean flag=h
```

You only need to add each former property once.

3. Add the "h" flag to the "n" or "f" flag for vnode-level resources listed in the new server's `/tmp/pbs_backup/resourcedef.new` file. For example, if you

---

had:

```
switch type=string flag=n
```

This would become:

```
switch type=string flag=nh
```

### 6.9.3 Remove Deprecated Terms From Server and Vnode Configurations

1. On the server host, manually edit the vnodes configuration file for the new PBS, /tmp/pbs\_backup/nodes.new. Delete all occurrences of:

```
ntype=cluster
```

or

```
ntype=time-shared
```

Otherwise you will get a harmless error.

2. Manually edit the server's configuration file for the new PBS, /tmp/pbs\_backup/server.new. Delete all lines of the form:

```
resources_default.neednodes=X
```

### 6.9.4 Preserve Reservation Information

After the upgrade, you will have to re-create any reservations that exist on your old server. You can print all of your reservation information to a file.

Print the reservation information to the file /tmp/pbs\_backup/reservations.

```
pbs_rstat -f > /tmp/pbs_backup/reservations
```

## 6.9.5 Prevent Jobs From Being Enqueued or Started

You must deactivate the scheduler and queues. When the server's `scheduling` attribute is `false`, jobs are not started by the scheduler. When the queues' `enabled` attribute is `false`, jobs cannot be enqueued.

1. Prevent the scheduler from starting jobs:

```
qmgr -c "set server scheduling = false"
```

2. Print a list of all queues managed by the server. Save the list of queue names for the next step.

```
qstat -q
```

3. Disable queues to stop jobs from being enqueued. Do this for each queue in your list from the previous step.

```
qdisable <queue name>
```

## 6.9.6 Allow Running Jobs to Finish, or Requeue Them

You cannot perform a migration upgrade while jobs are running. Either let running jobs finish, or requeue them. (You can also delete them.)

To requeue any jobs running:

1. List the jobs. This will list some jobs more than once. You only need to requeue each job once:

```
pbsnodes <hostname> | grep Jobs
```

2. Requeue the jobs:

```
qrerun <job ID> <job ID> ...
```

To kill the jobs:

1. List the jobs. This will list some jobs more than once. You only need to kill each job once:

```
pbsnodes <hostname> | grep Jobs
```

2. Use the `qdel` command to kill each job by job ID:

```
qdel <job ID> <job ID> ...
```

To drain the host, wait until any running jobs have finished.

---

Make sure that there are no old job files on any execution hosts. Remove any of the following:

```
PBS_HOME/mom_priv/jobs/*.JB
```

## 6.9.7 Shut Down PBS Professional

You can now shut down the server, scheduler, and MoM daemons. Use the `-t immediate` option to `qterm` so that all possible running jobs will be queued. If you are using failover, this will stop the secondary server as well:

1. Shut down PBS:

```
qterm -t immediate -m -s -f
```

If your server is not running in a failover environment, the “-f” option is not required.

2. Verify that PBS daemons are not running in the background:

```
ps -ef | grep pbs
```

If you see the `pbs_server`, `pbs_sched`, or `pbs_mom` process running, you will need to manually terminate that process. If using failover, check both primary and secondary server hosts:

```
kill -9 <pid>
```

## 6.9.8 Back Up the Server’s Jobs Directory

You must back up any jobs that were queued when the server was shut down, in order to move them to the new version of PBS. Do the following on the server host:

- Make a tarfile of the jobs directory, and save it in the backup directory:

```
cd PBS_HOME/server_priv
```

```
tar -cvf /tmp/pbs_backup/pbs_jobs_save.tar jobs
```

## 6.9.9 Back Up PBS Directories and Configuration Files

Back up the `PBS_HOME` directory and PBS configuration files. You will use this later.

- Rename the `PBS_HOME` directory:

```
mv PBS_HOME PBS_HOME.backup
```

### 6.9.10 Install the New Version of PBS

For Cray, follow the instructions in [section 6.10.1, “Installing PBS To Upgrade on the Cray”](#), on page 153.

For other UNIX/Linux platforms:

1. On each host, go to the directory containing the package for the new version of PBS. Unzip and untar or otherwise unpack the new version of PBS. Install the new version of PBS.

```
cd <location of package>
tar -xvf <pbs package>
./INSTALL
```

2. If that machine will be the server and scheduler host, select option #1.
3. If that machine will be the secondary server and scheduler host for failover, select option #1.
4. When asked for the “License File Location(s)”, follow the instructions in [section 3.3.2, “Setting PBS License Server Location”](#), on page 35.
5. When asked whether to start PBS, DO NOT start PBS daemons. You will manually start the server later.
6. Create the subdirectories under PBS\_HOME. On the new PBS server host and on each execution host:

```
{PBS_EXEC}/etc/pbs_habitat
```

### 6.9.11 Transfer MoM Configuration Information

On each execution host (for Cray, login node), follow these steps:

1. Make sure that any information from the backup of the Version 1 MoM configuration file goes into the new Version 1 MoM configuration file. Edit PBS\_HOME/mom\_priv/config to contain anything you need from the backup file.
2. If they exist (PBS 8.0 and later), restore the Version 2 MoM configuration files. For each of these that you backed up:

```
cd /tmp/pbs_backup/mom_configs
for file in *
do
  $PBS_EXEC/sbin/pbs_mom -s insert $file $file
done
```

---

## 6.9.12 Update Fairshare Entities and Database

This step is only necessary if you were not using `egroup:euser` as your fairshare entity, but wish to do so now. Follow the procedures in [section 6.9.32, “Updating Fairshare Definitions for `egroup:euser`”](#), on page 151.

## 6.9.13 Configure Socket Licensing

1. If you are already using socket licenses, and want to continue to use the same socket license file, copy it and put it where the new PBS server can reach it.
2. If you will use socket licenses for the first time, get a socket license file from Altair, and put it where the PBS server can reach it.
3. Start PBS on the server’s host:

```
<path to init.d>/init.d/pbs start
```

4. If you are using failover, install the socket license where it is available to both primary and secondary server. You can use `PBS_HOME`. Configure the `pbs_license_info` server attribute to include the license file. See [section 5.3, “Configuring PBS for Licensing”](#), on page 95.
5. Stop the server(s):

```
qterm -f
```

## 6.9.14 Copy Server’s Resource File

6. Copy the modified server resource file from the backup directory to the default directory:

```
cp /etc/pbs_backup/resourcedef.new PBS_HOME/server_priv/resourcedef
```

## 6.9.15 Modify the New PBS Configuration File

Your new `pbs.conf` needs to reflect any changes that you made to the old file. In addition, if you are using failover, you need to re-enable it. Do the following:

- On the primary server host, edit the new `pbs.conf`. Make any updates to this file that you made to the old `pbs.conf`.
- If you are using failover, on the secondary server host, edit the new `pbs.conf`. Make any updates to this file that you made to the old `pbs.conf`.

### 6.9.16 Start the New Server (If Using Failover)

If you are not using failover, skip this step. If you are using failover, this pair of start and stop steps really is necessary. Bear with us.

When the new server starts up it will have default queue “workq” and the server host already defined. You want to start the new server with empty configurations so that you can import your old settings.

- On the Cray, on the server host or node, start the new server:  
**<server host> # PBS\_EXEC/sbin/pbs\_server -t create**
- On other platforms, start the new server with empty queue and vnode configurations:  
**PBS\_EXEC/sbin/pbs\_server -t create**

A message will appear saying “Create mode and server database exists, do you wish to continue?”

Type “**y**” to continue.

Because of the new licensing scheme an additional message appears:

“One or more PBS license keys are invalid, jobs may not run”

This message is expected. Continue to the next step in these instructions.

### 6.9.17 Stop the New Server (If Using Failover)

If you are not using failover, skip this step.

1. Shut down PBS:  
**qterm -t immediate -m -s -f**
2. Verify that PBS daemons are not running in the background:

**ps -ef | grep pbs**

If you see the `pbs_server`, `pbs_sched`, or `pbs_mom` process running, you will need to manually terminate that process. If using failover, check both primary and secondary server hosts:

**kill -9 <pid>**



---

### 6.9.18 Start the New Server Without Defined Queues or Vnodes

When the new server starts up it will have default queue “workq” and the server host already defined. You want to start the new server with empty configurations so that you can import your old settings.

- On the Cray, on the server host or node, start the new server:  
`<server host> # PBS_EXEC/sbin/pbs_server -t create`
- On other platforms, start the new server with empty queue and vnode configurations:  
`PBS_EXEC/sbin/pbs_server -t create`

A message will appear saying “Create mode and server database exists, do you wish to continue?”

Type “**y**” to continue.

Because of the new licensing scheme an additional message appears:

"One or more PBS license keys are invalid, jobs may not run"

This message is expected. Continue to the next step in these instructions.

### 6.9.19 Set Server’s License Location Attribute

1. Set the server’s `pbs_license_info` attribute to point to the license file and/or Altair license server(s). See [section 5.3.3.1, “Setting the Licensing Information in pbs license info”](#), on page 98.
2. Restart the server. On the server host:  
`<path to init.d>/init.d/pbs restart`

## 6.9.20 Replicate Queue, Server, Scheduler, Hook, and Vnode Configurations

1. Give the new server the old server's configuration, but modified for the new PBS:

```
PBS_EXEC/bin/qmgr < /tmp/pbs_backup/server.new
```

2. Give the new scheduler the old scheduler's configuration:

```
PBS_EXEC/bin/qmgr < /tmp/pbs_backup/scheduler.new
```

3. Replicate vnode configuration, also modified for the new PBS:

```
PBS_EXEC/bin/qmgr < /tmp/pbs_backup/nodes.new
```

4. Verify the original configurations were read in properly:

```
PBS_EXEC/bin/qmgr -c "print server"
```

```
PBS_EXEC/bin/qmgr -c "print sched"
```

```
PBS_EXEC/bin/qmgr -c "print hook"
```

```
PBS_EXEC/bin/pbsnodes -a
```

### 6.9.20.1 Replicate Hooks

5. Replicate all hooks using the old hook configurations:

```
PBS_EXEC/bin/qmgr < /tmp/pbs_backup/hooks.backup
```

## 6.9.21 Re-create Reservations

You must re-create each reservation that was on the old server, using the `pbs_rsub` command. Each reservation is created as a new reservation. You can use all of the information about the old reservation except for its start time. Be sure to give each reservation a start time in the future. Use the information stored in `/tmp/pbs_backup/reservations`.

## 6.9.22 Change Port Specifications and PBS\_EXEC Path in `pbs.conf` for Old PBS

Skip this step on the Cray; it is covered in the Cray-specific instructions.

You must edit the `pbs.conf` file of the old PBS so that all old services use ports that won't clash with those of the new PBS. The old `pbs.conf` file was saved as `/etc/pbs.conf.pre.M.N.P.S`, where M.N.P.S is the version of the new PBS.

You must change the port numbers for all PBS related daemons: server, MoM, scheduler, and data service.

For example, if the old version of PBS is 11.0.2.110766, and the new one is 11.1.0.111247, the name of the old PBS configuration file is `/etc/pbs.conf.pre.11.1.0.111247`.

You must also make sure that the entry in `pbs.conf` for `PBS_EXEC` points to the path for the old `PBS_EXEC`.

Edit the old `pbs.conf` so that the entries look like those in the following table:

**Table 6-1: Entries in Old PBS Configuration File**

New Entry in <code>pbs.conf</code>	Description
<code>PBS_EXEC=/opt/pbs/11.0.2.110766</code>	This is the path for the old <code>PBS_EXEC</code>
<code>PBS_HOME=/var/spool/PBS.old</code>	This is the path for the old <code>PBS_HOME</code>
<code>PBS_START_SERVER=1</code>	Unchanged
<code>PBS_START_MOM=1</code>	Unchanged
<code>PBS_START_SCHED=1</code>	Unchanged
<code>PBS_SERVER=x17-64-rhel6</code>	Unchanged
<code>PBS_BATCH_SERVICE_PORT= 13001</code>	This is the changed port number for the old server
<code>PBS_DATA_SERVICE_PORT=13007</code>	This is the changed port number for the old data service
<code>PBS_MOM_SERVICE_PORT= 13002</code>	This is the changed port number for the old MoM
<code>PBS_SCHEDULER_SERVICE_PORT= 13003</code>	This is the changed port number for the old scheduler

### 6.9.23 Set Path to Old `pbs.conf`

On Cray, perform this step on the server host or node.

Set the `PBS_CONF_PATH` environment variable to point to the old PBS configuration file:

```
export PBS_CONF_FILE=/etc/pbs.conf.pre.11.1.0.111247
```

### 6.9.24 Start the Old Server

On Cray, perform this step on the server host or node.

You must start the old server in order to move jobs to the new server. The old server must be started on **alternate** ports. These are specified in the configuration file for the old PBS.

Start the old server daemon:

```
PBS_EXEC_OLD/sbin/pbs_server
```

### 6.9.25 Unset Path to Old pbs.conf

On Cray, perform this step on the server host or node.

Unset the PBS\_CONF\_PATH environment variable:

```
unset PBS_CONF_FILE
```

### 6.9.26 Move Existing Jobs to the New Server

On Cray, perform this step on the server host or node.

You must move existing jobs from the old server to the new server. To do this, you run the move commands from the old server, and give the new server's port number, 15001, in the destination. See the `qmove (1B)` man page. When moving jobs from reservation queues, be sure to move them into the equivalent new reservation queues.

If your jobs have dependencies, move them according to the order in which they appear in the dependency chain. If job A depends on the outcome of job B, move job B first.

This is for the special case where your old PBS version is older than 5.4.0 and the old server's host also runs a MoM:

- Delete the vnode on the server's host:

```
PBS_EXEC_OLD/bin/qmgr -c "d n <old server host>" <old server host>:13001
```

If you see the message, "Cannot delete busy object":

- a. Get a list of jobs running on that vnode:

```
PBS_EXEC_OLD/bin/qstat @<old server host>:13001
```

- b. Either requeue or kill the jobs on the server's host:

```
PBS_EXEC_OLD/bin/qrerun -W force <job id>
```

For PBS versions 5.4.0 and later, if your old server's host also ran a MoM, you will need to delete that vnode from the old server.

Delete the vnode on the old server's host:

```
PBS_EXEC_OLD/bin/qmgr -c "d n <old server host>" <old server host>:13001
```

Move jobs from the old server to the new one:

1. Print the list of jobs on the old server:

```
PBS_EXEC_OLD/bin/qstat @<old server host>:13001
```

2. Move each job from each queue:

```
PBS_EXEC_OLD/bin/qmove <new queue name>@<new server host>:15001 <job id>@<old server host>:13001
```

You can use `qselect` to select all the jobs within a queue instead of moving each job individually.

3. Move all jobs within a queue:

```
PBS_EXEC_OLD/bin/qmove <queue name>@<new server host>:15001 `PBS_EXEC_OLD/bin/qselect -q <queue name>@<old server host>:13001`
```

If you see the error message “Too many arguments...”, there are too many jobs to fit in the shell's command line buffer. You can continue moving jobs one at a time until there are few enough.

### 6.9.27 Shut Down Old Server

On Cray, perform this step on the server host or node.

Shut down the old server daemon:

```
PBS_EXEC_OLD/bin/qterm -t quick <old server host>:13001
```

### 6.9.28 Update New `sched_config`

On Cray, perform this step on the server host or node.

---

Update the new scheduler's configuration file, in `PBS_HOME/sched_priv/sched_config`, with any modifications that were made to the old `PBS_HOME.old/sched_priv/sched_config`.

1. If you copied over your old scheduler log filter value, make sure that it has had 1024 added to it. If the value is less than 1024, add 1024 to it. For example, if the old log filter line is:  
`log_filter:256`  
change it to:  
`log_filter:1280`
2. If it exists, replace the `strict_fifo` option with `strict_ordering`. If you do not, a warning will be printed in the log when the scheduler starts.

### 6.9.29 Start New Scheduler

On Cray, perform this step on the server host or node.

Start the scheduler daemon, on the server's host:

```
PBS_EXEC/sbin/pbs_sched
```

### 6.9.30 Start New MoMs

If all or none of your hosts are socket licensed, you can start the MoMs in any order.

If some but not all of your hosts are socket licensed, choose the order in which to start MoMs. Socket licenses are handed out first-come, first-served. See [section 5.1.1.1, "Choosing Hosts for Socket Licenses", on page 92](#). Start MoMs in the order you want them licensed, not necessarily the order shown here:

On Cray, perform this step on the login nodes.

- Run the start script on each execution host, so that the subdirectories for `PBS_HOME` are created. On each execution host:

```
<path to init.d>/init.d/pbs start
```

- Optionally start a MoM on the new server host

If your old configuration had a MoM running on the server's host, and you wish to replicate the configuration, you can start a MoM on that machine.

Start the MoM daemon on the new server's host:

```
PBS_EXEC/sbin/pbs_mom
```

---

### 6.9.31 Enable Scheduling in New Server

On Cray, perform this step on the server host or node.

You must set the new server's scheduling attribute to true so that the scheduler will start jobs.

Enable scheduling for the new server:

```
PBS_EXEC/bin/qmgr -c "s s scheduling=1"
```

### 6.9.32 Updating Fairshare Definitions for egroup:euser

On Cray, perform this step on the server host or node.

This step is only necessary if you were not using `egroup:euser` as your fairshare entity, but wish to do so now.

On the server/scheduler host:

1. Update `/tmp/pbs_backup_sched_priv.work/resource_group`, with the new `egroup:euser` entities.

If you previously had an euser named Bob, the new entry for Bob in the `resource_group` file will look like this:

```
pbsgroup1:Bob          101    Phys      20
```

2. Restore the modified contents of the scheduler's directory:

```
cp -r /tmp/pbs_backup/sched_priv.work PBS_HOME/sched_priv
```

If you wish to keep your old fairshare resource usage data, use the `pbsfs` command to update the data. See the `pbsfs` (8B) manual page.

When you display the usage data, both the old and the new entities will appear. Entities defined before the upgrade will appear in the unknown group. Entities defined in the previous step will be in the correct department but have no usage.

1. Display the usage data:

```
% pbsfs -p
```

If the old entity was Bob:

```
Bob : group: 1 cgrp: 5 shares: 10 Usage: 1005 Perc: 50%
```

You will see usage of 1005 for Bob, as shown above. The newly defined entity is pbsgroup1:Bob, and it will appear like this:

```
pbsgroup1:Bob 5 4 root 10
```

2. Assign Bob's usage to pbsgroup1:Bob:

```
% pbsfs -s pbsgroup1:Bob 1005
```

3. Remove the old entities:

```
% pbsfs -e
```

If your previous entities were euser, and now you have egroup:euser, and you have a user who is in more than one group, you will need to make an entry in /tmp/pbs\_backup\_sched\_priv.work/resource\_group for Bob in each of his groups, then assign a portion of the Bob's usage to each group.

For example, if you wish to have Bob be in two groups, pbsgroup1 and pbsgroup2, you may want Bob's usage to be split between the groups. Bob will show up as pbsgroup1:Bob and pbsgroup2:Bob.

1. Update /tmp/pbs\_backup\_sched\_priv.work/resource\_group, putting Bob into pbsgroup1 and pbsgroup2.

The entries for Bob in the resource\_group file will look like this:

```
pbsgroup1:Bob      101    Phys      20
pbsgroup2:Bob      102    Math      20
```

2. Assign half of Bob's usage to each of pbsgroup1:Bob and pbsgroup2:Bob:

```
% pbsfs -s pbsgroup1:Bob 502
```

```
% pbsfs -s pbsgroup2:Bob 503
```



---

### 6.9.33 After Upgrading on Cray

#### 6.9.33.1 Check `qstat` Wrappers and Scripts

You must check any `qstat` wrappers or scripts. Either replace any `mpp*` resources, or modify the wrapper or script to use values in the job's `Submit_arguments` attribute. This attribute contains the original job submission line.

#### 6.9.33.2 Replace Old `mpp*` Server and Queue Settings

As of PBS version 11.0, `mpp*` syntax is not supported. It is recommended that you replace `mpp*` settings for the server and queue. See section 11.3.7, "Recommended Manual Configuration", on page 805 of the PBS Professional Administrator's Guide for detailed instructions.

#### 6.9.33.3 Configure PBS to Support Cray

PBS provides tight integration with Cray. To take advantage of the tight integration, go to [section 11.3, "Support for Cray Systems" on page 795 in the PBS Professional Administrator's Guide](#)

## 6.10 Upgrade Installation Instructions

### 6.10.1 Installing PBS To Upgrade on the Cray

For the Cray, a migration upgrade is required.

These are the instructions for the software installation process only. In order to perform an upgrade of PBS, you must follow the complete set of migration upgrade instructions. See [section 6.9, "Migration Upgrade Under UNIX and Linux", on page 135](#).

The installation/upgrading procedures here are new. Please read this section carefully.

PBS can license hosts through socket licenses, or jobs through floating licenses. If you intend to use socket licenses for your Cray, you must have enough socket licenses for all of the sockets on the entire machine. If you will use floating licenses, you must install and configure the Altair license server before you install PBS. See the Altair License Management System Installation and Operations Guide, available at [www.altair.com](http://www.altair.com) for information on installing and configuring the Altair license server(s). For information on configuring PBS to use the Altair license server, see [section 5.3, "Configuring PBS for Licensing", on page 95](#).

The PBS Professional package supports CLE.

The PBS Professional Scheduler and Server can be run on an external host; they do not have to run on your Cray system. One instance of the `pbs_mom` daemon is run on each login node of the Cray system, allowing PBS Professional to select the login node to which a job is assigned.

The PBS Professional installation script, `INSTALL`, will detect that it is running on a Cray and perform special actions to manage `PBS_EXEC`, `/etc/pbs.conf`, and `PBS_HOME`.

### 6.10.1.1 Not Supported

Kerberos is not supported on the Cray.

### 6.10.1.2 Required Libraries

The XML library, `libexpat.a`, must be available on the login nodes. This is fairly standard in Linux distributions.

### 6.10.1.3 Prerequisites

#### 6.10.1.3.i Use Correct Version Number

You must know the version number of the PBS Professional package you are installing. The following examples use version number 11.3.0.08470. The version number of the package you are installing will be different. Please be sure to use the version number of your package.

#### 6.10.1.3.ii Hardware and Software Requirements

Check the requirements in [section 3.4.10.4.iii, “Hardware and Software Requirements”, on page 67](#).

#### 6.10.1.3.iii Choosing Host for Server/scheduler

Choose the server/scheduler host according to the rules in [section 3.4.10.4.iv, “Choosing Host for Server/scheduler”, on page 68](#).

### 6.10.1.4 Back Up Your Current Configuration

1. We recommend that you back up your current configuration. If the upgrade process should fail unexpectedly, you can restore your existing server database and configu-

---

ration files. Log in to the boot node as root, and then log in to the server host or node. Archive the existing directories.

```
smw:~# ssh root@boot
```

```
boot001:~# ssh root@<server host>
```

```
<server host>:~# tar -cvzf /var/PBS-host_name.tar.gz /var/spool/PBS
```

2. Verify that the machine is running a supported version of CLE.

### 6.10.1.5 Installation and Configuration Steps for Cray

1. Install the PBS daemons that will run on the Cray. Follow the steps in [section 3.4.10.5, “Installing PBS Daemons on Cray”](#), on page 69
2. If you will run the server and scheduler on a non-Cray host, install the server there. Follow the steps in [section 3.4.10.8, “Installing PBS Server and Scheduler on Non-Cray Host”](#), on page 73

The new version of the PBS Professional software is now installed, and you are ready to proceed with configuration.

3. If you will run the server and scheduler on a service node, configure the service node to run the server and scheduler. Follow the steps in [section 3.4.10.6, “Configuring Service Node to Run Server and Scheduler”](#), on page 72
4. Configure the PBS server and scheduler. Follow the steps in [section 3.4.10.9, “Configuring PBS Server and Scheduler”](#), on page 74
5. Configure the PBS MoMs. Follow the steps in [section 3.4.10.10, “Configuring PBS Daemons on the Cray”](#), on page 75
6. Tell the old version of PBS to use alternate paths and start up on alternate ports. See the table titled [“Entries in Old PBS Configuration File” on page 147](#) for port numbers.
  - a. As root, on the boot node:
 

```
# xtopview -n <server node NID> -m "alternate ports for old PBS"
xtspec /etc/pbs.conf.pre.<M.N.P.S>
```
  - b. Modify /etc/pbs.conf.pre.<M.N.P.S> according to the table titled [“Entries in Old PBS Configuration File” on page 147](#).
7. Exit from `xtopview`.
8. Log in as root to the node on which the PBS server will be running.
 

```
# ssh root@<server host>
```
9. This step is optional. Configure startup for PBS Professional only if you need to change your startup configuration. Follow the steps in [section 3.4.10.11, “Configuring PBS Professional Startup and Shutdown”](#), on page 76
10. Do **NOT** start the new PBS Server yet.

### 6.10.1.6 Return to Generic Migration Upgrade

Perform the rest of the migration upgrade steps, starting with [section 6.9.11, “Transfer MoM Configuration Information”](#), on page 142.

## 6.11 Upgrading Under Windows

You must use a migration upgrade under Microsoft Windows.

When you do a migration upgrade under Windows, you can install the new version of PBS in the same place or in a new location. You can install PBS in the default location or a non-default location.

You will probably want to move jobs from the old system to the new. During a migration upgrade, jobs cannot be running. You can requeue rerunnable jobs. You can let non-rerunnable jobs finish, or you can kill them.

If you are migrating from a version before 9.0 to 9.0 or later, all the following steps must be done by a domain administrator. If the migration is taking place in a domain environment, this Administrator account should be a member of the "Domain Admins" group. If the migration is taking place in a standalone environment, this Administrator account should be a member of the local “Administrators” group.

If you want the PBS service account not to be a domain administrator for the new version of PBS, follow the steps specified in [section 6.11.28, “Optionally Change PBS Service Account to Non-domain Administrator Account”](#), on page 177 before starting PBS.

In the instructions below, file and directory pathnames are the PBS defaults. If you installed PBS in different locations, use your locations instead. Where you see %WINDIR%, it will be automatically replaced by the correct directory. For Windows XP, that is \WINDOWS.

The default server is specified on 32-bit Windows systems in \Program Files\PBS Pro\pbs.conf and on 64-bit Windows systems in \Program Files (x86)\PBS Pro\pbs.conf.

Note that in version 8.0 and later, job scripts under Windows are executed differently. Any .bat files that are to be executed within a PBS job script will have to be prefixed with "call" as in:

```
---[job_b.bat]-----
    @echo off
    call E:\step1.bat
    call E:\step2.bat
-----
```

---

Without the "call", only the first .bat file gets executed, and it doesn't return control to the calling interpreter.

on 32-bit Windows systems, PBS is installed in `\Program Files\PBS Pro\`, and on 64-bit Windows systems, PBS is installed in `\Program Files (x86)\PBS Pro\`. In the following instructions, we use `INSTALLATION_BASE` to indicate `\Program Files\` or `\Program Files (x86)\`. When you follow the instructions, replace `INSTALLATION_BASE` with the appropriate directory.

### 6.11.1 Prevent Jobs From Being Enqueued or Started

You must deactivate the scheduler and queues. When the server's `scheduling` attribute is `false`, jobs are not started by the scheduler. When the queues' `enabled` attribute is `false`, jobs cannot be enqueued.

1. Prevent the scheduler from starting jobs:

```
qmgr -c "set server scheduling = false"
```

2. Print a list of all queues managed by the server. Save the list of queue names. You will need it in the next step and when moving jobs.

```
qstat -q
```

3. Disable queues to stop jobs from being enqueued. Do this for each queue in your list from the previous step.

```
qdisable <queue name>
```

## 6.11.2 Back Everything Up

Back up the server and vnode configuration information. You will use it later in the migration process.

1. Make a backup directory:

```
mkdir "%WINDIR%\TEMP\PBS Pro Backup"
```

2. Print the server attributes to a backup file in the backup directory:

```
qmgr -c "print server" > "%WINDIR%\TEMP\PBS Pro Backup\server.backup"
```

3. Make a copy of the server's configuration for the new PBS:

```
copy "%WINDIR%\TEMP\PBS Pro Backup\server.backup" "%WINDIR%\TEMP\PBS Pro Backup\server.new"
```

4. Print the default server's vnode attributes to a backup file in the backup directory.

```
qmgr -c "print node @default" > "%WINDIR%\TEMP\PBS Pro Backup\nodes.backup"
```

5. Make a copy of the vnode attributes for the new PBS:

```
copy "%WINDIR%\TEMP\PBS Pro Backup\nodes.backup" "%WINDIR%\TEMP\PBS Pro Backup\nodes.new"
```

6. Make a backup of the existing `INSTALLATION_BASE\PBS Pro\pbs.conf`. This command is all one line:

```
copy "INSTALLATION_BASE\PBS Pro\pbs.conf" "%WINDIR%\TEMP\PBS Pro Backup\pbs.conf.backup"
```

7. Make a copy of `pbs.conf` for the new PBS. This command is all one line:

```
copy "%WINDIR%\TEMP\PBS Pro Backup\pbs.conf.backup" "%WINDIR%\TEMP\PBS Pro Backup\pbs.conf.new"
```

8. Make a backup of the server's existing `resourcedef` file. This command is all one line:

```
copy "INSTALLATION_BASE\PBS Pro\home\server_priv\resourcedef" "%WINDIR%\TEMP\PBS Pro Backup\resourcedef.backup"
```

9. Make a copy of the server's `resourcedef` for the new PBS. This command is all one line:

```
copy "%WINDIR%\TEMP\PBS Pro Backup\resourcedef.backup" "%WINDIR%\TEMP\PBS Pro Backup\resourcedef.new"
```

10. Make a backup of the existing `INSTALLATION_BASE\PBS`

---

Pro\home\sched\_priv. This command is all one line:

```
copy "INSTALLATION_BASE\PBS Pro\home\sched_priv" "%WINDIR%\TEMP\PBS Pro Backup\sched_priv.backup"
```

11. Make a copy of the scheduler's directory for the new PBS. This command is all one line:

```
copy "%WINDIR%\TEMP\PBS Pro Backup\sched_priv.backup" "%WINDIR%\TEMP\PBS Pro Backup\sched_priv.work"
```

### 6.11.3 Preserve Reservation Information

After the upgrade, you will have to re-create any reservations that exist on your old server. You can print all of your reservation information to a file.

1. Print the reservation information to a file:

```
pbs_rstat -f > "%WINDIR%\TEMP\PBS Pro Backup\reservations"
```

### 6.11.4 Shut Down PBS Professional

You can now shut down the server, scheduler, and MoM daemons. Use the `-t immediate` option to the `qterm` command so that all possible running jobs will be queued.

1. Shut down PBS. If your server is not running in a failover environment, the `-f` option is not required.

```
qterm -t immediate -m -s -f
```

2. Stop the `pbs_rshd` daemon:

```
net stop pbs_rshd
```

### 6.11.5 Copy the Old Version of PBS to a Temporary Location

You will run the old PBS server from this temporary location in order to move jobs. You must do a copy rather than a move, because the installation software depends on the old version of PBS being available for it to remove.



---

On the Server vnode, copy the existing PBS\_HOME and PBS\_EXEC hierarchies to a temporary location. This command is all one line.

```
xcopy /o /e "\Program Files\PBS Pro" "%WINDIR%\TEMP\PBS Pro Backup"
```

Specify “D” for directory when prompted.

If you get an “access denied” error message while it is moving a file:

- a. Bring up Start menu->*Programs*->*Accessories*->*Windows Explorer*
- b. Right-click to select this file and bring up a pop-up menu.
- c. Choose “*Properties*”, then “*Security*” tab, then “*Advanced*”, then “*Owners*” tab.
- d. Reset the ownership of the file to “Administrators”. “Administrators” must have permission to read the file.
- e. Rerun xcopy.

## 6.11.6 Replace Properties with Boolean Resources and Update Resources

You must replace properties with boolean resources, and add a new flag for vnode-level resources.

1. Manually edit the vnodes configuration file for the new PBS, `%WINDIR%\TEMP\PBS Pro Backup\nodes.new`. You will find a line of the form:

```
set node NAME properties=PROP
```

or

```
set node NAME properties+=PROP
```

Replace with the line as a single line:

```
set node NAME resources_available.PROP=True
```

For example, if the `qmgr` output contained the following lines:

```
set node node01 properties=red
set node node01 properties+=green
set node node02 properties=red
set node node02 properties+=blue
```

replace those lines with these. Each is one line:

```
set node node01 resources_available.red=True
set node node01 resources_available.green=True
set node node02 resources_available.red=True
set node node02 resources_available.blue=True
```

2. Create Boolean resources to replace properties. For each property being replaced, create or append to the new `%WINDIR%\TEMP\PBS Pro Backup\resource-def.new` file a line of the form:

```
PROP type=boolean flag=h
```

In the previous step's example, you would add the following lines to `%WINDIR%\TEMP\PBS Pro Backup\resource-def.new`:

```
red type=boolean flag=h
green type=boolean flag=h
blue type=boolean flag=h
```

You only need to add each former property once.

3. Add the “h” flag to the “n” or “f” flag for vnode-level resources listed in the new server’s `%WINDIR%\TEMP\PBS Pro Backup\resourcedef.new` file.

### 6.11.7 Remove Deprecated Terms from Server and Vnode Configurations

1. Manually edit the vnodes configuration file for the new PBS, `%WINDIR%\TEMP\PBS Pro Backup\nodes.new`. Delete all occurrences of:  
`ntype=cluster`  
or  
`ntype=time-shared`  
Otherwise you will get a harmless error.
2. Manually edit the server’s configuration file for the new PBS, `%WINDIR%\TEMP\PBS Pro Backup\server.new`. Delete all lines of the form:  
`resources_default.neednodes=X`

### 6.11.8 Install the New Version of PBS on Execution Hosts

You can install PBS from a CD or by downloading it.

If you are installing PBS from the CD, put it in the CD-ROM drive, browse to your CD-ROM drive, and click on the PBS Professional icon.

If you are installing PBS from a download, save it to your hard drive and run the self-extracting `pbsprom.exe` package, either in the same directory, or by giving the path to it.

You must use the same password on all hosts. Do the following on each execution host, **except** the server’s host.

Uninstall the old version of PBS:

1. Change your current directory so that it is not within `C:\INSTALLATION_BASE\PBS Pro`, and make sure there is no access occurring

on any file in that hierarchy. Otherwise you will have to remove the hierarchy by hand.

2. Run the installation program by either clicking on the icon, or typing:

**PBSpro\_<version>-windows.exe**

Under XP, SP2, you may see a warning saying, "The publisher could not be verified. Are you sure you want to run this software?" Ignore this message and click the "Run" button.

The installation package will ask whether you want to uninstall the previous version. Answer *yes*.

If you see a popup window saying the hierarchy could not be removed, remove the hierarchy manually by going to a command window and typing the following. Do not use the `del` command.

```
rmdir /S /Q "C:INSTALLATION_BASE\PBS Pro"
```

3. Reboot the execution host.

---

Install the new version of PBS:

1. Run the installation program by either clicking on its icon, or typing:

**PBSpro\_<version>-windows.exe**

Under XP, SP2, you may see a warning saying, "The publisher could not be verified. Are you sure you want to run this software?" Ignore this message and click the "Run" button.

2. Check the installation location. You can change it, as long as the new location meets the requirements given in [section 2.5, "Recommended PBS Configurations for Windows", on page 16](#).
3. Choose the "Execution" option.
4. Enter a non-empty password twice for the Administrator account. If you see "error 2245", check the password's length, complexity and history requirements. Look in the Active Directory guide or the Windows help page.
5. Give the server's hostname in the "Editing PBS.CONF file" window.
6. In the "Editing HOSTS.EQUIV file" window, enter any hosts and/or users that will need access to this execution host.
7. In the "Editing PBS MoM config file" window, accept the defaults.
8. Restart the execution host and log into it.
9. Stop the PBS MoM:

```
net stop pbs_mom
```

## 6.11.9 Install the New Version of PBS on the Server's Host

You must use the same password for the Administrator account on all hosts.

If you are installing PBS from the CD, put it in the CD-ROM drive, browse to your CD-ROM drive, and click on the PBS Professional icon.

If you are installing PBS from a download, save it to your hard drive and run the self-extracting `pbspro.exe` package, either in the same directory, or by giving the path to it.

Uninstall the old version of PBS:

1. Change your current directory so that it is not within `C:\INSTALLATION_BASE\PBS Pro`, and make sure there is no access occurring

on any file in that hierarchy. Otherwise you will have to remove the hierarchy by hand.

2. Run the installation program by either clicking on the icon, or typing:

**PBSpro\_<version>-windows.exe**

Under XP, SP2, you may see a warning saying, "The publisher could not be verified. Are you sure you want to run this software?" Ignore this message and click the "Run" button.

The installation package will ask whether you want to uninstall the previous version. Answer *yes*.

If you see a popup window saying the hierarchy could not be removed, remove the hierarchy manually by going to a command window and typing the following. Do not use the `del` command.

```
rmdir /S /Q "C:INSTALLATION_BASE\PBS Pro"
```

3. Reboot the server's host.

---

Install the new version of PBS:

1. Run the installation program by either clicking on the icon, or typing:

**PBSpro\_<version>-windows.exe**

Under Windows XP SP2, you may see a warning saying, "The publisher could not be verified. Are you sure you want to run this software?" Ignore this message and click the "Run" button.

2. Check the installation location. You can change it, as long as the new location meets the requirements given in [section 2.5, "Recommended PBS Configurations for Windows", on page 16](#).
3. Choose the "All" option.
4. When asked for the "License File Location(s)", follow the instructions in [section 3.3.2, "Setting PBS License Server Location", on page 35](#).
5. Enter a non-empty password twice for the PBS service account. If you see "error 2245", check the password's length, complexity and history requirements. Look in the Active Directory guide or the Windows help page.
6. In the "Editing HOSTS.EQUIV file" window, enter any hosts and/or users that will need access to the server's host.
7. In the "PBS Server Nodes File" window, accept the defaults.
8. In the "PBS MoM Config File for local node" window, accept the defaults.
9. Restart the server's host, and log into it.
10. Stop the PBS MoM on the server's host:

```
net stop pbs_mom
```

### 6.11.10 Copy Resource File

11. Copy the server's `resourcedef` file from the backup directory to the default directory. Type this command in a single line:

```
copy "%WINDIR%\TEMP\PBS Pro Backup\resourcedef.new" "INSTALLATION_BASE\PBS Pro\ home\server_priv\resourcedef"
```

## 6.11.11 Update Fairshare Definitions

This step is only necessary if you were not using `egroup:euser` as your fairshare entity, but wish to do so now. On the server/scheduler host:

1. Update `%WINDIR%\TEMP\PBS Pro Backup\sched_priv.work\resource_group`, with the new `egroup:euser` entities.
2. Restore the scheduler's modified directory:  

```
copy "%WINDIR%\TEMP\PBS Pro Backup\sched_priv.work" "INSTALLATION_BASE\PBS Pro\home\sched_priv\"
```
3. If you wish to keep your old fairshare resource usage data, use the `pbsfs` command to update the data.

Display the usage data. Both the old and the new entities will appear. Entities defined before the upgrade will appear in the unknown group. Entities defined in the previous step will be in the correct department but have no usage.

Display the usage data:

```
pbsfs -p
```

Assign the usage of the old entities to the new ones.

Be aware that the usage may not reflect what you want. For example, if your previous entities were `euser`, and now you have `egroup:euser`, and you have a user who is in more than one group, you will need to divide the user's usage so that it shows the usage by group that you want.

Old entity: Bob

```
% pbsfs -p
```

```
Bob : group: 1  cgrp: 5  shares: 10  Usage: 1005  Perc: 50%
```

The useful information is the name "Bob" and the usage of 1005

The newly defined entity is Math:Bob

```
Math:Bob  5      4      root      10
```

Assign Bob's usage to Math:Bob:

```
% pbsfs -s math:bob 1005
```

Remove the old entities:

```
% pbsfs -e
```



---

### 6.11.12 Start the New Server Without Defined Queues or Vnodes

When the new server starts it will have the default queue, workq, and server vnode already defined. You want to start the new server with empty configurations so that you can import your old settings.

1. Stop the new server:

```
qterm
```

2. Start the new server as a standalone, having it create a new database. Type this command in a single line:

```
"INSTALLATION_BASE\PBS Pro\exec\sbin\pbs_server" -N -t create
```

A message will appear saying "Create mode and server database exists, do you wish to continue?"

Type "y" to continue. The standalone server will exit after it creates the database.

Type `Ctrl-C` in order to get the terminal/command prompt back.

3. Start the new server as a Windows service:

```
net start pbs_server
```

4. Start the new scheduler as a Windows service:

```
net start pbs_sched
```

### 6.11.13 Set Server's License Location Attribute

Follow the steps in [section 5.3.3.1, "Setting the Licensing Information in pbs\\_license\\_info", on page 98](#).

## 6.11.14 Replicate Queues, Server and Vnodes Configuration

1. Give the new server the old server's configuration, but modified for the new PBS.

Type this command in a single line:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" < "%WINDIR%\TEMP\PBS Pro Backup\server.new"
```

2. List the queues in the new server:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qstat" -Q
```

3. Enable the queues in the new server. For each queue where its `enabled` attribute is `false`:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qenable" <queue name>
```

4. Replicate vnodes configuration, also modified for the new PBS. Type this command in a single line:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" < "%WINDIR%\TEMP\PBS Pro Backup\nodes.new"
```

5. Verify that the original configurations were read in properly. Type this command in a single line:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" -c "print server"  
"INSTALLATION_BASE\PBS Pro\exec\bin\pbsnodes" -a
```

## 6.11.15 Re-create Reservations

You must re-create each reservation that was on the old server, using the `pbs_rsub` command. Each reservation is created as a new reservation. You can use all of the information about the old reservation except for its start time. Be sure to give each reservation a start time in the future. Use the information stored in `%WINDIR%\TEMP\PBS Pro Backup\reservations`.

## 6.11.16 Change Port Specifications and PBS\_EXEC Path in `pbs.conf` for Old PBS

You must edit the `pbs.conf` file of the old PBS so that all old services use ports that won't clash with those of the new PBS. The old `pbs.conf` file was saved as `%WINDIR%\TEMP\PBS Pro Backup\pbs.conf`.

You must change the port numbers for all PBS related daemons: server, MoM, scheduler, and data service.

You must also make sure that the entry in `pbs.conf` for `PBS_EXEC` points to the path for the old `PBS_EXEC`.

Edit the old configuration file so that the entries look like those in the following table:

**Table 6-2: Entries in Old PBS Configuration File**

New Entry in <code>pbs.conf</code>	Description
<code>PBS_EXEC= %WINDIR%\TEMP\PBS Pro Backup\exec</code>	This is the path for the old <code>PBS_EXEC</code>
<code>PBS_HOME=%WINDIR%\TEMP\PBS Pro Backup\home</code>	This is the path for the old <code>PBS_HOME</code>
<code>PBS_START_SERVER=1</code>	Unchanged
<code>PBS_START_MOM=1</code>	Unchanged
<code>PBS_START_SCHED=1</code>	Unchanged
<code>PBS_SERVER=x17-64-rhel6</code>	Unchanged
<code>PBS_BATCH_SERVICE_PORT= 13001</code>	This is the changed port number for the old server
<code>PBS_DATA_SERVICE_PORT=13007</code>	This is the changed port number for the old data service
<code>PBS_MOM_SERVICE_PORT= 13002</code>	This is the changed port number for the old MoM
<code>PBS_SCHEDULER_SERVICE_PORT= 13003</code>	This is the changed port number for the old scheduler

### 6.11.17 Start the Old Server

You must start the old server in order to move jobs to the new server. The old server must be started on alternate ports. Type the following commands without breaking the lines.

1. If you are upgrading from PBS Pro\_5.3.3-wpl:  

```
del "%WINDIR%\TEMP\PBS Pro Backup\home\server_priv\server.lock"
```
2. Tell PBS to use the `pbs.conf` file you saved in the backup directory, and to use the backup `exec` and `home` directories.

Do not put any double quotes in either path:

```
set PBS_CONF_FILE=%WINDIR%\TEMP\PBS Pro Backup\pbs.conf
pbs-config-add "PBS_EXEC=%WINDIR%\TEMP\PBS Pro Backup\exec"
pbs-config-add "PBS_HOME=%WINDIR%\TEMP\PBS Pro Backup\home"
```

3. Verify that the old server is using the `pbs.conf` saved in the backup directory:  

```
echo %PBS_CONF_FILE%
```
4. Verify that `pbs.conf` contains the `exec` and `home` locations in the backup directory:  

```
type %PBS_CONF_FILE%
```
5. Start the old server daemon in the same command prompt window as above, and assign these alternate port values:

```
"%WINDIR%\TEMP\PBS Pro Backup\exec\sbin\pbs_server" -N
```

For more information see [section 7.2, "Starting and Stopping PBS: Windows"](#), on page 189 and ["pbs\\_server"](#) on page 90 of the [PBS Professional Reference Guide](#).

After you start the old server, the command prompt will appear to hang, which is normal. Minimize this window and use a different command prompt. Closing the window or issuing `<Ctrl +C>` will stop the old server. If this happens, you will not be able to connect to the old server.

### 6.11.18 Set Configuration File Path to be Used by New Server

6. Tell PBS to use the new `pbs.conf` file, and to use the new `exec` and `home` directories.

Do not put any double quotes in either path:

```
set PBS_CONF_FILE=INSTALLATION_BASE\PBS Pro\pbs.conf
```

### 6.11.19 Verify Old Server is Running on Alternate Ports

Verify that the old `pbs_server` is running on the alternate ports by going to another cmd prompt window and running, typed as a single line:

```
"%WINDIR%\TEMP\PBS Pro Backup\exec\bin\qstat" @<old server host>:13001
```

### 6.11.20 Migrate User Passwords From the Old Server to the New Server

You will want to migrate user passwords to the new server if possible. Passwords can only be migrated if both the old and new servers' `single_signon_password_enable` attributes are *True*. The following commands should be given in a single line:

1. Find out whether the old server's `single_signon_password_enable` attribute is *True*:

```
"%WINDIR%\TEMP\PBS Pro Backup\exec\bin\qmgr" -c "list s
single_signon_password_enable" <old server host>:13001
```

2. Find out whether the new server's `single_signon_password_enable` attribute is *True*:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" <new server host>:15001
Qmgr: list s single_signon_password_enable
```

3. If both attributes are *True*, you can migrate user passwords from the old server to the new server:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\ pbs_migrate_users" <old server
host>:13001 <new server host>:15001
```

### 6.11.21 Move Existing Jobs to the New Server

You must move existing jobs from the old server to the new server. To do this, you run the new `qselect` and `qmove` commands, and give the new server's port number, 15001, in the destination. See [“qmove” on page 171 of the PBS Professional Reference Guide](#). When moving jobs from reservation queues, be sure to move them into the equivalent new reservation queues.

If your jobs have dependencies, move them according to the order in which they appear in the dependency chain. If job A depends on the outcome of job B, move job B first.

There is one special case requiring an extra step. This is when the old server's `single_signon_password_enable` attribute is *False* and the new server's is *True*.

Give commands in a single line.

1. If the new server's `single_signon_password_enable` attribute is *True* and the old server's is *False*, temporarily set the new server's `single_signon_password_enable` to *False*:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" <new server host>:15001
Qmgr: set server single_signon_password_enable=false
```

2. You will need to verify later that all jobs have been moved. Print the list of jobs on the old server:

```
"%WINDIR%\TEMP\PBS Pro Backup\exec\bin\qstat" @<old server host>:13001
```

3. In another command prompt window, move each job in each queue.

This command may tie up the terminal. Create a file called `movejobs.bat`, containing the following lines. Replace `<old server host>` with the old server's host:

```
REM movejobs.bat
REM execute as follows:
REM
REM   movejobs <queue name>   (e.g. movejobs workq)
REM
setlocal ENABLEDELAYEDEXPANSION
for /F "usebackq" %%j in
    ( "INSTALLATION_BASE\PBS Pro\exec\bin\qselect" -q %1@<old server
    host>:13001^ )
do ( "INSTALLATION_BASE\PBS Pro\exec\bin\qmove"
    %1@<new server host>:15001
    %%j@<old server host>:13001
    )
```

Run `movejobs.bat` for each queue. Use the list of queue names saved when you disabled the queues.

For example, to move the jobs in `queue1` and `workq`, you would type:

```
cmd>movejobs queue1
cmd>movejobs workq
```

4. Verify that all jobs have been moved. Print the jobs on the new server:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qstat" @<new server host>:15001
```

5. Special case: If the old server's `single_signon_password_enable` attribute is *False* and the new server's was *True* (but is temporarily *False*), you must do the

following three steps:

- a. Apply a bad password hold to all the jobs on the new server. Create a file called `pholdjobs.bat`, containing the following lines. Replace `<new server host>` with the new server's host:

```
REM pholdjobs.bat
REM execute as follows:
REM
REM   pholdjobs
REM
setlocal ENABLEDELAYEDEXPANSION
for /F "usebackq" %%j in
    ( ^"INSTALLATION_BASE\PBS Pro\exec\bin\
      qselect" -q @<new server host>:15001`
    do (
        "INSTALLATION_BASE\PBS
        Pro\exec\bin\qhold"
        -h p %%j@<new server host>:15001
    )
```

Run `pholdjobs.bat` by typing:

```
pholdjobs
```

- b. Change the new server's attribute back to *True*:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" <new server
host>:15001
Qmgr: set server single_signon_password_enable=true
```

- c. Each user with jobs on the new server must specify a password via `pbs_password`. See [“pbs\\_password” on page 69 of the PBS Professional Reference Guide](#). Each user will type `pbs_password` and be prompted for a password.

## 6.11.22 Shut Down Old Server

1. Shut down the old server daemon:

```
"%WINDIR%\TEMP\PBS Pro Backup\exec\bin\qterm" -t quick <old server
host>:13001
```

### 6.11.23 Update New `sched_config`

Update the new scheduler's configuration file, in `INSTALLATION_BASE\PBS Pro\home\sched_priv\sched_config`, with any modifications that were made to the old `%WINDIR%\TEMP\PBS Pro Backup\sched_priv.work\sched_config`.

1. If you copied over your old scheduler log filter value, make sure that it has had 1024 added to it. If the value is less than 1024, add 1024 to it. For example, if the old log filter line is:  
`log_filter:256`  
change it to:  
`log_filter:1280`
2. If it exists, replace the `strict_fifo` option with `strict_ordering`. If you do not, a warning will be printed in the log when the scheduler starts.

### 6.11.24 Start MoMs on Execution Hosts

1. On each execution host, start the MoM daemon as a Windows service:  
`net start pbs_mom`

### 6.11.25 Optionally Start MoM on New Server's Host

If your old configuration had a MoM running on the server's host, and you wish to replicate the configuration, you can start a MoM on that machine.

Start the MoM daemon on the new server's host as a Windows service:

```
net start pbs_mom
```

### 6.11.26 Verify Communication Between Server and MoMs

Run `pbsnodes -a` on the server's host to see if it can communicate with the execution hosts in your complex. If a host is down, go to the problem host and restart the MoM:

```
net stop pbs_mom
net start pbs_mom
```



---

### 6.11.27 Enable Scheduling in the New Server

You must set the new server's scheduling attribute to *True* so that the scheduler will start jobs.

Enable scheduling in the new server:

```
"INSTALLATION_BASE\PBS Pro\exec\bin\qmgr" -c "set server scheduling=1"
```

### 6.11.28 Optionally Change PBS Service Account to Non-domain Administrator Account

If you want to run PBS Professional from a PBS service account which is not a domain administrator account, follow these steps:

1. Stop all PBS services:

```
net stop pbs_rshd
net stop pbs_mom
net stop pbs_server
net stop pbs_sched
```

2. Add the PBS service account to the local Administrators group:

```
net localgroup Administrators <domain name>\<name of PBS service account>
/add
```

3. Go to Active Directory, and make the PBS service account be only a member of the "Domain Users" group. Add the account to "Domain Users" on the local computer, and make it the primary group. Then remove the PBS service account's membership in the "Domain Admins" group.

4. Delegate explicit domain read privilege to the PBS service account. See [section 2.5.3.4, "Delegating Read Access", on page 19](#).

5. Restart the PBS services:

```
net start pbs_rshd
net start pbs_mom
net start pbs_server
net start pbs_sched
```



# Chapter 7

## Starting and Stopping PBS

This chapter covers starting and stopping PBS.

### 7.1 Starting and Stopping PBS: UNIX and Linux

#### 7.1.1 Methods for Starting Daemons

The PBS daemons can be started by two different methods. These methods are not equivalent. The first method is to use the PBS start/stop script, and the second is to run the command that starts the daemon. When you run the PBS start/stop script, PBS will create any vnode definition files. These are not created through the method of running the command that starts a daemon.

#### 7.1.2 Recommendation to Start MoM First

We recommend starting MoMs before starting the server. This way, MoM will be ready to respond to the Server's "are you there?" ping, preventing the server from attempting to contact a MoM that is still down. This will cut down on inter-daemon traffic, especially in larger complexes.

#### 7.1.3 The PBS Start/Stop Script

The PBS start/stop script is named `pbs`. To run it, you type the following:

```
<path to script>/pbs [start|stop|restart|status]
```

The script starts, stops, or restarts PBS daemons on the local machine. It can also be used to report the PID of any PBS daemon on the local machine. The PBS start/stop script reads the `pbs.conf` file to determine which components should be started.

The start/stop script runs at boot time, starting PBS upon bootup. You can run the script manually. The start/stop script runs on and affects only the local host.

When you run the PBS start/stop script, PBS will create any vnode definition files. These are not created through the method of running the command that starts a daemon.

The location of the PBS start/stop script depends on the OS, as shown in the following table:

**Table 7-1: Location of Start/Stop Script**

OS	Location of PBS Start/Stop Script
AIX	<code>/etc/rc.d/rc2.d/S90pbs</code>
Cray	If <code>/etc/init.d</code> exists: <code>/etc/init.d/pbs</code> Else: <code>/etc/rc.d/init.d/pbs</code>
HP-UX	<code>/sbin/init.d/pbs</code>
Linux	If <code>/etc/init.d</code> exists: <code>/etc/init.d/pbs</code> Else <code>/etc/rc.d/init.d/pbs</code>
Solaris	<code>/etc/init.d/pbs</code>

The command-line syntax for the start/stop script is:

```
<path to start/stop script>/pbs < status | stop | start | restart >
```

See [“pbs” on page 52 of the PBS Professional Reference Guide](#).

### 7.1.3.1 Creation of Vnode Definition Files

When MoM is started via the PBS start/stop script, PBS creates any PBS reserved MoM configuration files, which contain vnode definitions. These are not created by the MoM itself, and will not be created when MoM is started using the `pbs_mom` command. Therefore, if you make changes to the number of CPUs or amount of memory that is available to PBS, or if a non-PBS process releases a cpuset, you should restart PBS in order to re-create the PBS reserved MoM configuration files. See [section 3.4, “MoM and Vnode Configuration Files” on page 44 in the PBS Professional Administrator’s Guide](#).

### 7.1.3.2 Effect of Start/Stop Script on Jobs

The PBS start script kills any running jobs when it is used.

### 7.1.3.3 Start/Stop Script Caveats

The PBS start/stop script uses the settings in `pbs.conf` to determine which daemons to start and stop. If you specify in `pbs.conf` that a daemon should not start, the script also will not stop it if it is running. Setting `PBS_START_MOM` to `0` effectively makes the start/stop script ignore the MoM. For example, if you do the following steps, the `pbs_mom` process is not stopped:

1. Start `pbs_mom`
2. Set `PBS_START_MOM` to `0`
3. Run the PBS start/stop script with `stop` as the argument

## 7.1.4 Starting Daemons Manually

### 7.1.4.1 Daemon Execution Requirements

The server, scheduler, and MoM processes must run with the real and effective UID of root.

### 7.1.4.2 Required Permission

You must run `pbs_server`, `pbs_mom`, and `pbs_sched` as root.

### 7.1.4.3 Manually Starting MoM

The PBS MoM is started manually using the `pbs_mom` command. See [“pbs\\_mom” on page 58 of the PBS Professional Reference Guide](#).

#### 7.1.4.3.i Restarting MoM

You can restart MoM with the following options:

**Table 7-2: MoM Restart Options**

Option	Effect on Jobs
<code>pbs_mom</code>	Job processes will continue to run, but the jobs themselves are requeued.

Table 7-2: MoM Restart Options

Option	Effect on Jobs
<code>pbs_mom -r</code>	Processes associated with the job are killed. Running jobs are returned to the Server to be requeued or deleted. This option should not be used if the system has just been rebooted as the process numbers will be incorrect and a process not related to the job would be killed.
<code>pbs_mom -p</code>	Jobs which were running when MoM terminated remain running.

#### 7.1.4.3.ii Preserving Existing Jobs When Restarting MoM

By default, when MoM is started, she allows running processes to continue to run, but tells the server to requeue her jobs. You can direct MoM to preserve running jobs and to track them, by using the `-p` option to the `pbs_mom` command. Start MoM with the command line:

```
PBS_EXEC/sbin/pbs_mom -p
```

Never use the `-p` option to `pbs_mom` after a reboot. See the next section.

#### 7.1.4.3.iii Restarting MoM After a Reboot

When a UNIX/Linux operating system is first booted, it begins to assign process IDs (PIDs) to processes as they are created. PID 1 is always assigned to the system "init" process. As new ones are created, they are either assigned the next PID in sequence or the first empty PID found, which depends on the operating system implementation. Generally, the session ID of a session is the PID of the top process in the session.

The PBS MoM keeps track of the session IDs of the jobs. If only MoM is restarted on a system, those session IDs/PIDs have not changed and apply to the correct processes.

If the entire system is rebooted, the assignment of PIDs by the system will start over. Therefore the PID which MoM thinks belongs to an earlier job will now belong to a different later process. If you restart MoM with `-p`, she will believe the jobs are still valid jobs and the PIDs belong to those jobs. When she kills the processes she believes to belong to one of her earlier jobs, she will now be killing the wrong processes, those created much later but with the same PID as she recorded for that earlier job.

Never restart `pbs_mom` with the `-p` or the `-r` option following a reboot of the host system.

#### 7.1.4.3.iv Killing Existing Jobs When Restarting MoM

If you wish to kill all existing processes, use the `-r` option to `pbs_mom`.

---

Start MoM with the command line:

```
PBS_EXEC/sbin/pbs_mom -r
```

#### 7.1.4.3.v Starting MoM on the Altix or UV

For a cpusetted Altix or UV, MoM should be started using the PBS start/stop script.

#### 7.1.4.3.vi Using Existing CPU and Memory for cpusets

By default, MoM removes existing cpusets when she starts. You can specify that MoM is to use existing CPU and memory allocations for cpusets by using the `-p` option to the `pbs_mom` command. This option also preserves running jobs. See [“Options to pbs\\_mom” on page 60 of the PBS Professional Reference Guide](#).

Vnode definition files are not created when the `pbs_mom` command is used; use this only when you know that they are up to date already.

### 7.1.4.4 Manually Starting the Server

To start the server manually, do the following:

```
PBS_EXEC/sbin/pbs_server [options]
```

If, when the server was shut down, running jobs were killed and requeued, then starting the server with the `-t hot` option puts those jobs back in the *Running* state first.

See [“pbs\\_server” on page 90 of the PBS Professional Reference Guide](#) for details and the options to the `pbs_server` command.

### 7.1.4.5 Manually Starting the Scheduler

To start the scheduler manually, do the following:

```
PBS_EXEC/sbin/pbs_sched [options]
```

There are no required options for the scheduler. See [“pbs\\_sched” on page 88 of the PBS Professional Reference Guide](#) for more information and a description of available options.

### 7.1.4.6 Running the Globus MoM

Globus can still send jobs to PBS, but PBS no longer supports sending jobs to Globus.

## 7.1.5 Stopping PBS

There are four ways to stop PBS. The first is to use the PBS start/stop script, the second is to use the `qterm` command, the third is to kill daemons by sending signals, and the fourth is to shut down the machine on which PBS is running.

### 7.1.5.1 Stopping PBS Using the Start/Stop Script

Stopping PBS using the start/stop script preserves running jobs.

When you use the PBS start/stop script, by typing “pbs stop” the following take place:

- The server gets a `qterm -t quick` (preserving jobs)
- MoM gets a SIGTERM: MoM terminates all running children and exits

### 7.1.5.2 Stopping PBS Using the `qterm` Command

The `qterm` command is used to shut down, selectively or inclusively, the various PBS components. If you have a failover server configured, then when the primary server is shut down, the secondary server becomes active unless you shut it down as well.

You can specify how running jobs are treated during shutdown by specifying the type of shutdown. The type of shutdown performed by the `qterm` command defaults to the following, which preserves running jobs:

```
qterm -t quick
```

The following command will shut down the primary server, the scheduler, and all MoMs in the complex. If configured, the secondary server will become active:

```
qterm -s -m
```

The following command will shut down the primary server, the secondary server, the scheduler, and all MoMs in the complex:

```
qterm -s -m -f
```

See [“qterm” on page 229 of the PBS Professional Reference Guide](#).

#### 7.1.5.2.i `qterm` Caveats

Shutting PBS down using the `qterm` command does not perform any of the other cleanup operations that are performed by the PBS start/stop script.



### 7.1.5.3 Stopping PBS by Sending Signals

The server does a quick shutdown, equivalent to receiving a `qterm -t quick`, upon receiving SIGTERM. See [“pbs\\_server” on page 90 of the PBS Professional Reference Guide](#).

You can stop the scheduler by sending it SIGTERM or SIGINT. These result in an orderly shutdown of the scheduler.

The PBS MoM handles the following signals:

**Table 7-3: Signals Handled by MoM**

Signal	Effect
SIGTERM	If a MoM is killed with the signal SIGTERM, jobs are killed before MoM exits. Notification of the terminated jobs is not sent to the Server until the MoM is restarted. Jobs will still appear to be in the “R” (running) state.
SIGINT	If a MoM is killed with this signal, jobs are not killed before the MoM exits. MoM exits after cleanly closing network connections.
SIGKILL	If a MoM is killed with this signal, jobs are not killed before the MoM exits.

### 7.1.5.4 Shutting Down Host

When a host running PBS is shut down or rebooted, PBS is shut down via the start/stop script.

## 7.1.6 Stopping & Restarting One MoM

Should you ever need to stop a single MoM but leave jobs managed by her running, you have two options. The first is to send MoM a SIGINT. This will cause her to shut down in an orderly fashion. The second is to kill MoM with a SIGKILL (-9).

Note that MoM will need to be restarted with the `-p` option in order reattach to the jobs.

The PBS MoM can be stopped using the following signals:

**Table 7-4: Signals to Stop MoM**

Signal	Effect
SIGTERM	If a MoM is killed with the signal SIGTERM, jobs are killed before MoM exits. Notification of the terminated jobs is not sent to the Server until the MoM is restarted. Jobs will still appear to be in the “R” (running) state.
SIGINT	If a MoM is killed with this signal, jobs are not killed before the MoM exits. MoM exits after cleanly closing network connections.
SIGKILL	If a MoM is killed with this signal, jobs are not killed before the MoM exits.

You can restart MoM with the following options:

**Table 7-5: MoM Restart Options**

Option	Effect on Jobs
<code>pbs_mom</code>	Job processes will continue to run, but the jobs themselves are requeued.
<code>pbs_mom -r</code>	Processes associated with the job are killed. Running jobs are returned to the Server to be requeued or deleted. This option should not be used if the system has just been rebooted as the process numbers will be incorrect and a process not related to the job would be killed.
<code>pbs_mom -p</code>	Jobs which were running when MoM terminated remain running.

### 7.1.6.1 Stopping and Starting a cpuset MoM

Use the start/stop script to stop a MoM that is managing cpusets, when you are not preserving running jobs.

When you are preserving running jobs on a cpusetted machine, stop MoM using a signal, then restart MoM using the `-p` option to the `pbs_mom` command. For example:

```
kill -9 <MoM PID>
```

---

...

```
PBS_EXEC/sbin/pbs_mom -p
```

## 7.1.7 Impact of Shutdown / Restart on Running UNIX/Linux Jobs

The methods you can use to shut down PBS, and which daemons are shut down, will affect running jobs differently. You can leave normal jobs running during shutdown, but not job arrays. Any running subjobs of a job array are killed and requeued when the server is shut down.

The impact of a shutdown (and subsequent restart) on running jobs depends on the following:

- Whether you use the PBS start/stop script, a command, or a signal to shut down PBS
- How the Server (`pbs_server`) is shut down
- How MoM (`pbs_mom`) is shut down
- How MoM is restarted

### 7.1.7.1 Whether to Use Script, Command, or Signal for Shutdown and Restart

Use the `qterm` command to shut the server down when running jobs must be checkpointed before shutdown, allowed to run to completion before shutdown, or preserved through shutdown and restart. To preserve running jobs, use the `-p` option to the `pbs_mom` command when restarting MoM.

When the PBS start/stop script is used to stop PBS, MoM kills her jobs and exits. Jobs are requeued when MoM restarts.

### 7.1.7.2 Shutting Down Daemons Using Command

Choose one of the following recommended sequences, based on the desired impact on jobs, to stop and restart PBS:

- To allow running jobs to continue to run:

Shutdown:

```
qterm -t quick -m -s
```

Restart:

```
pbs_server -t warm
```

```
pbs_mom -p
```

```
pbs_sched
```

- To checkpoint and requeue checkpointable jobs, requeue rerunnable jobs, kill any non-rerunnable jobs, then restart and run jobs that were previously running:

Shutdown:

```
qterm -t immediate -m -s
```

Restart:

```
pbs_mom
```

```
pbs_server -t hot
```

```
pbs_sched
```

- To checkpoint and requeue checkpointable jobs, requeue rerunnable jobs, kill any non-rerunnable jobs, then restart and run jobs without taking prior state into account:

Shutdown:

```
qterm -t immediate -m -s
```

Restart:

```
pbs_mom
```

```
pbs_server -t warm
```

```
pbs_sched
```

## 7.1.8 Checking Status of Daemons

You can check whether or not each daemon is running by using the PBS start script with the status option. To check the status of MoM, do the following on MoM's host:

```
<path to script>/pbs status
```

---

## 7.2 Starting and Stopping PBS: Windows

When PBS Professional is installed on Microsoft Windows, the PBS processes are registered as system services. As such, they will be automatically started and stopped when the system boots and shuts down. However, there may come a time when you need to manually stop or restart the PBS services (such as shutting them down prior to a PBS software upgrade).

### 7.2.1 Required Privilege

To stop or start PBS, you must have Administrator Privilege.

### 7.2.2 Methods for Stopping PBS on Windows

You can stop PBS on Windows using the `qterm` command or `net stop <service>`. For information on the `qterm` command, see [“qterm” on page 229 of the PBS Professional Reference Guide](#).

The following example illustrates how to manually stop the PBS services. These lines must be typed at a Command Prompt.

```
net stop pbs_sched
net stop pbs_mom
net stop pbs_server
net stop pbs_rshd
```

### 7.2.3 Methods for Starting PBS on Windows

To start PBS on Windows, use the `net start <service>` command. You can specify startup options for the services using the method shown in the next section.

The following example shows how to manually start the PBS services. These lines must be typed at a Command Prompt.

```
net start pbs_server
net start pbs_mom
net start pbs_sched
net start pbs_rshd
```

### 7.2.3.1 Startup Options to PBS Services

You can use the startup options to the `pbs_server`, `pbs_sched`, and `pbs_mom` commands when starting the PBS services.

The procedure to specify startup options to the PBS Windows Services is as follows:

1. Go to *Start Menu->Control Panel->Performance and Maintenance->Administrative Tools->Services* (in Windows XP).
2. Select the PBS service you wish to alter. For example, if you select “*PBS\_MOM*”, the MoM service dialog box comes up.
3. Enter the desired options in the “*Start parameters*” entry line. For example, to specify an alternate MoM configuration file, you might specify the following input:

On 32-bit Windows systems:

```
-c "\Program Files\PBS Pro\home\mom_priv\config2"
```

On 64-bit Windows systems:

```
-c "\Program Files (x86)\PBS Pro\home\mom_priv\config2"
```

4. Click on “*Start*” to start the specified service.

### 7.2.3.2 Startup Option Caveats

The Windows services dialog does not remember the “*Start parameters*” value when you close the dialog. You must specify the “*Start parameters*” value for each future restart.

## 7.2.4 Working with Version 2 Configuration Files on Windows

You can use the `pbs_mom` command to view and modify Version 2 configuration files, but you must use the command in standalone mode. For example, if you are inserting a new Version 2 configuration file, use the following:

```
pbs_mom -N -s insert <config file> <input script>
```

---

## 7.2.5 Running PBS Services in Standalone Mode

You can run the PBS services manually, in standalone mode and not as a Windows service, as follows:

```
Admin> pbs_server -N <options>
Admin> pbs_mom -N <options>
Admin> pbs_sched -N <options>
Admin> pbs_rshd -N <options>
```

## 7.2.6 Windows-specific Service Options

The PBS services have Windows-specific options:

```
pbs_server -C
    The Server starts up, creates the database, and exits.

-N
    (All services) The service runs in standalone mode, not as a Windows service.
```

## 7.2.7 Impact of Shutdown / Restart on Running Windows Jobs

The methods you can use to shut down PBS, and which daemons are shut down, will affect running jobs differently. You can leave normal jobs running during shutdown, but not job arrays. Any running subjobs of a job array are killed and requeued when the server is shut down.

The impact of a shutdown (and subsequent restart) on running jobs depends on whether you use `net stop` or the `qterm` command to shut down PBS, and how `pbs_mom` is restarted.

### 7.2.7.1 Choosing Shutdown and Restart Method

You can use either the `net stop` command or the `qterm` command to shut the server down.

When you use `net stop` to stop `pbs_server`, checkpointable jobs are checkpointed, killed and requeued, and all other jobs are killed and requeued. Jobs are not killed when `pbs_mom` is stopped via `net stop`; whether they are killed depends on how MoM is restarted.

Use the `qterm` command to shut the server down when running jobs must be checkpointed before shutdown, allowed to run to completion before shutdown, or preserved through shutdown and restart.

To preserve running jobs, use the `-p` option to the `pbs_mom` command when restarting MoM.

### 7.2.7.2 Shutting Down and Restarting Services

Choose one of the following recommended sequences, based on the desired impact on jobs, to stop and restart PBS.

- To allow running jobs to continue to run:

Shutdown:

```
qterm -t quick -m -s
```

Restart:

```
net start pbs_server (with -t warm startup option set)
```

```
net start pbs_mom (with -p startup option set)
```

```
net start pbs_sched
```

- To checkpoint and requeue checkpointable jobs, requeue rerunnable jobs, kill any non-rerunnable jobs, then restart and run jobs that were previously running:

Shutdown:

```
qterm -t immediate -m -s
```

or

```
net stop pbs_mom
```

```
net stop pbs_server
```

```
net stop pbs_sched
```

```
net stop pbs_rshd
```

Restart:

```
net start pbs_mom
```

```
net start pbs_server (with -t hot startup option set)
```

```
net start pbs_sched
```

- To checkpoint and requeue checkpointable jobs, requeue rerunnable jobs, kill any non-



---

rerunnable jobs, then restart and run jobs without taking prior state into account:

Shutdown:

```
qterm -t immediate -m -s
```

Restart:

```
net start pbs_mom
```

```
net start pbs_server (with -t warm startup option set)
```

```
net start pbs_sched
```

## 7.3 When to Restart PBS

- If you make changes to the hardware or a change occurs in the number of CPUs or amount of memory that is available to PBS, such as a non-PBS process releasing a cpuset, you should restart PBS, by typing the following:  
**<path-to-script>/pbs restart**
- After creating cpusets not managed by PBS on an Altix or UV running ProPack or Performance Suite. See [section 11.4.7.2, "Manual Creation of Cpusets Not Managed by PBS" on page 829 in the PBS Professional Administrator's Guide](#).
- After making changes to the `/etc/hosts` file. See [section 2.1.3, "Name Resolution and Network Configuration", on page 7](#).
- After changing the name of the PBS service account.
- After changing the PBS service account to a non-domain administrator account

## 7.4 Caveats and Recommendations

### 7.4.1 Recommendation to Start MoM First

We recommend starting MoMs before starting the server. This way, MoM will be ready to respond to the Server's "are you there?" ping, preventing the server from attempting to contact a MoM that is still down. This will cut down on inter-daemon traffic, especially in larger complexes.

## **7.4.2 Recommendation to Offline Vnodes Before Stopping MoM**

We recommend that you offline vnodes before stopping the MoM. The server tries to keep continual contact with each MoM. If you offline the vnode before stopping the MoM, the server does not try to stay in contact with the MoM. This reduces network traffic.

## **7.4.3 Start/Stop Script Caveats**

The PBS start/stop script uses the settings in `pbs.conf` to determine which daemons to start and stop. If you specify in `pbs.conf` that a daemon should not start, the script also will not stop it if it is running. See [section 7.1.3.3, “Start/Stop Script Caveats”, on page 181](#).

## **7.4.4 Effect of Start/Stop Script on Jobs**

The PBS start script kills any running jobs when it is used.

## **7.4.5 Starting MoM After Reboot**

Never use the `-p` option to `pbs_mom` after a reboot. See [section 7.1.4.3.iii, “Restarting MoM After a Reboot”, on page 182](#).

## **7.4.6 Caveats for Altix and UV**

For a cpusetted Altix or UV, MoM must be started using the PBS start/stop script.

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