



ALTAIR

Altair PBS Professional 2020.1

Plugins (Hooks) Guide

You are reading the Altair PBS Professional 2020.1

Hooks Guide (HG)

Updated 7/19/20

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About PBS Documentation

The PBS Professional guides and release notes apply to the *commercial* releases of PBS Professional.

Document Conventions

Abbreviation

The shortest acceptable abbreviation of a command or subcommand is underlined

Attribute

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

Command

Commands such as `qmgr` and `scp`

Definition

Terms being defined

File name

File and path names

Input

Command-line instructions

Method

Method or member of a class

Output

Output, example code, or file contents

Syntax

Syntax, template, synopsis

Utility

Name of utility, such as a program

Value

Keywords, instances, states, values, labels

Notation

Optional arguments are enclosed in square brackets. For example:

```
qstat [-E]
```

Variables are enclosed in angle brackets. A variable is something the user must fill in with the correct value. In the following example, the user replaces *vnode name* with the name of the vnode:

```
pbsnodes -v <vnode name>
```

About PBS Documentation

Optional variables are enclosed in angle brackets inside square brackets. For example:

```
qstat [<job ID>]
```

Literal terms appear exactly as they should be used. For example, to get the version of the `qstat` command, type the following exactly:

```
qstat --version
```

List of PBS Professional Documentation

The PBS Professional guides and release notes apply to the *commercial* releases of PBS Professional.

PBS Professional Release Notes

Supported platforms, what's new and/or unexpected in this release, deprecations and interface changes, open and closed bugs, late-breaking information. For administrators and job submitters.

PBS Professional Big Book

All your favorite PBS guides in one place: *Installation & Upgrade*, *Administrator's*, *Hooks*, *Reference*, *User's*, and *Programmer's* guides in a single book.

PBS Professional Installation & Upgrade Guide

How to install and upgrade PBS Professional. For the administrator.

PBS Professional Administrator's Guide

How to configure and manage PBS Professional. For the PBS administrator.

PBS Professional Hooks Guide

How to write and use hooks for PBS Professional. For the PBS administrator.

PBS Professional Reference Guide

Covers PBS reference material.

PBS Professional User's Guide

How to submit, monitor, track, delete, and manipulate jobs. For the job submitter.

PBS Professional Programmer's Guide

Discusses the PBS application programming interface (API). For integrators.

PBS Professional Manual Pages

PBS commands, resources, attributes, APIs.

PBS Works Licensing Guide

How to configure licensing for PBS Works products. For the PBS Works administrator.

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New Hook Features

This chapter briefly lists new features by release, with the most recent listed first. This chapter also lists deprecated elements, such as options, keywords, etc.

The *Release Notes* included with this release of PBS Professional list all new features in this version of PBS Professional, and any warnings or caveats. Be sure to review the Release Notes, as they may contain information that was not available when this book was written.

1.1 New Features in PBS 2020.1

Improved Cgroups Hook

The cgroups hook is improved for 2020.1. See ["Configuring and Using PBS with Cgroups" on page 559 in the PBS Professional Administrator's Guide](#).

Faster Read of Custom Job Resources by Execution Hooks

You can specify which custom job resources are cached at MoMs so that execution hooks can read them faster. See ["Allowing Execution Hooks to Read Custom Job Resources Faster" on page 261 in the PBS Professional Administrator's Guide](#).

New Post-suspend and Pre-resume Hooks

PBS has two new hook events for just after suspending a job and just before resuming it. See [section 6.3.1, "Event Types", on page 87](#).

Python Version Changed to 3.6

PBS 19.4.1 uses Python version 3.6.

1.2 Changes in Previous Releases

Hooks Support Reliable Job Startup and Run (19.2)

Hooks have been enhanced to allow you to provide jobs with extra vnodes in case of vnode failure. See ["Vnode Fault Tolerance for Job Start and Run" on page 426 in the PBS Professional Administrator's Guide](#).

New Reservation End Hook (19.2)

You can create hooks for the end of a reservation. See ["resv_end: Event when Reservation Ends" on page 90 in the PBS Professional Hooks Guide](#).

Python Version Changed to 2.7.1 (18.2.3)

PBS 18.2.3 uses Python 2.7.1. The use of Python 2.5.1 is deprecated.

Periodic Server Hook (18.2.3)

PBS has a periodic hook that runs at the server. See [section 6.3.1.7, "periodic: Periodic Event at Server Host", on page 95](#).

Hook to Run Job Start Time Estimator (18.2.3)

PBS has a built-in hook named `PBS_est` that can run the job start time estimator. See ["Estimating Job Start Time" on page 131 in the PBS Professional Administrator's Guide](#).

Configurable Python Interpreter Restarts (18.2.3)

You can configure how often you want the Python interpreter to restart. See [section 4.3, "Restarting the Python Interpreter", on page 23](#).

PBS Can Report Custom Resources Set in Hooks (18.2.3)

MoM can accumulate and report custom resources that are set in a hook. See [section 5.2.4.12, "Setting Job Resources in Hooks", on page 49](#).

The `execjob_prologue` Hook Runs on All Sister MoMs (18.2.3)

The `execjob_prologue` hook runs on all sister MoMs. See [section 6.3.1.9, "execjob_prologue: Event Just Before Execution of Top-level Job Process", on page 97](#).

New Hook Events (13.0)

PBS provides three new hook events:

- An `execjob_launch` hook runs just before MoM runs the user's program
- An `execjob_attach` hook runs when `pbs_attach` is called
- An `execest_startup` hook runs when MoM starts up or is HUPed

See [section 4.1.2, "When Hooks Run", on page 15](#), [section 6.3.1.10, "execjob_launch: Event when Execution Host Receives Job", on page 98](#), [section 6.3.1.11, "execjob_attach: Event when pbs_attach\(\) runs", on page 100](#), and [section 6.3.1.17, "execest_startup: Event When Execution Host Starts Up", on page 106](#).

Configuration Files for Hooks (13.0)

You can use configuration files with hooks. See [section 5.1.6, "Using Hook Configuration Files", on page 32](#).

Configuring Vnodes in Hooks (13.0)

You can use hooks to configure vnode attributes and resources. See [section 5.2.4.11, "Setting and Unsetting Vnode Resources and Attributes", on page 48](#).

Adding Custom Resources in Hooks (13.0)

You can use hooks to add custom non-consumable host-level resources. See [section 5.2.7, "Adding Custom Non-consumable Host-level Resources", on page 64](#).

Node Health Hook Features (13.0)

PBS has node health checking features for hooks. You can offline and clear vnodes, and restart the scheduling cycle. See [section 5.2.12.4, "Offlining and Clearing Vnodes Using the fail_action Hook Attribute", on page 66](#) and [section 5.2.6, "Restarting Scheduler Cycle After Hook Failure", on page 63](#).

Hook Debugging Enhancements (13.0)

You can get hooks to produce debugging information, and then read that information in while debugging hooks. See [Chapter 8, "Debugging Hooks", on page 159](#).

Managing Built-in Hooks (13.0)

You can enable and disable built-in hooks. See [Chapter 7, "Built-in Hooks", on page 155](#).

Scheduler Does not Trigger `modifyjob` Hooks (13.0)

The scheduler does not trigger `modifyjob` hooks. See [Chapter 5, "Creating and Configuring Hooks", on page 29](#).

`runjob` Hook can Modify Job Attributes (12.2)

The `runjob` hook can modify a job's attributes and resources. See [section 5.2.4, "Using Attributes and Resources in Hooks", on page 44](#).

Execution Event and Periodic Hooks (12.0)

You can write hooks that run at the execution host when the job reaches the execution host, when the job starts, ends, is killed, and is cleaned up. You can also write hooks that run periodically on all execution hosts. See [Chapter 5, "Creating and Configuring Hooks", on page 29](#).

Vnode Access for Hooks (11.0)

Hooks have access to vnode attributes and resources. See [Chapter 5, "Creating and Configuring Hooks", on page 29](#).

Provisioning (10.2)

PBS provides automatic provisioning of an OS or application on vnodes that are configured to be provisioned. When a job requires an OS that is available but not running, or an application that is not installed, PBS provisions the vnode with that OS or application. See [Chapter 7, "Provisioning", on page 327](#).

New Hook Type (10.2)

PBS has a new hook type which can be triggered when a job is to be run. See ["Creating and Configuring Hooks" on page 29](#).

Hooks (10.0)

Hooks are custom executables that can be run at specific points in the execution of PBS. They accept, reject, or modify the upcoming action. This provides job filtering, patches or workarounds, and extends the capabilities of PBS, without the need to modify source code. See [Chapter 5, "Creating and Configuring Hooks", on page 29](#).

1.3 Deprecations and Removals

The use of Python 2.x is **deprecated**. PBS now uses Python 3.6. (19.4.1)

Introduction to Hooks

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

This chapter describes how hooks can be used, how they work, the interface to hooks provided by the `pbs` module, how to create and deploy hooks, and how to get information about hooks.

Please read the entire chapter, and the “Special Notes (Hooks)” section of the release notes, before writing any hooks.

2.1 Introduction to Hooks

A hook is a block of Python code that PBS executes at certain events, for example, when a job is queued. As long as the Python code conforms to the rules we describe, you can have it do whatever you want. Each hook can *accept* (allow) or *reject* (prevent) the action that triggers it. The hook can modify the input parameters given for the action. The hook can also make calls to functions external to PBS. The hook can use a configuration file that you provide. PBS provides an interface for use in hooks. This interface allows hooks to read and/or modify things such as job, server, vnode, and queue attributes, and the event that triggered the hook.

2.1.1 Built-in Hooks

Some functions of standard PBS are accomplished through built-in hooks. We use the keyword `pbshook` with these hooks. These hooks are not designed to be altered, so they have some restrictions placed on them. See [Chapter 7, "Built-in Hooks", on page 155](#).

2.2 Glossary

Accept an action

The hook allows the action to take place.

Action

A PBS operation or state transition. Also called an *event*. For a list of events, see [section 6.3.1, “Event Types”, on page 87](#).

Built-in hook

A hook that is supplied as part of PBS. These hooks cannot be created or deleted by administrators.

Creating a hook

When you “create a hook” using `qmgr`, you’re telling PBS that you want it to make you an empty hook object that has no characteristics other than a name.

Event

A PBS operation or state transition. Also called *action*. For a list of events, see [section 6.3.1, “Event Types”, on page 87](#).

Execution event hook, MoM hook

A hook that runs at an execution host. These hooks run after a job is received by MoM. Execution event hooks have names prefixed with “*execjob_*”.

Failure action

The action taken when a hook fails to execute. Specified in the `fail_action` hook attribute. See [section 5.1.9.2, “Using the fail_action Hook Attribute”, on page 37](#).

Hook configuration file

Configuration file specific to a particular hook. See [section 5.1.6, “Using Hook Configuration Files”, on page 32](#).

Importing a hook

When you “import a hook” using `qmgr`, you’re telling PBS which Python script to run when the hook is triggered.

Importing a hook configuration file

When you “import a hook configuration file” using `qmgr`, you’re telling PBS which file should be stored as the configuration file for the specified hook.

MoM hook, execution event hook

A hook that runs at an execution host. These hooks run after a job is received by MoM. Execution event hooks have names prefixed with “*execjob_*”.

Non-job event hook

A hook that is not directly related to a specific job. Non-job event hooks are periodic hooks, startup hooks, provisioning hooks, and reservation creation hooks.

pbshook

PBS keyword for a built-in hook.

pbs module

The *pbs module* provides an interface to PBS and the hook environment. The interface is made up of Python objects, object members, and methods. You can operate on these objects using Python code.

Pre-execution event hook, server hook

A hook that runs at the PBS server. A server hook runs before the job is sent to MoM. These hooks do not run on execution hosts. Pre-execution event hooks are for job submission, moving a job, altering a job, or just before sending a job to an execution host.

Reject an action

The hook prevents the action from taking place. For example, if a `runjob` hook rejects a job, the job is requeued.

Server hook, pre-execution event hook

A hook that runs at the PBS server. A server hook runs before the job is sent to MoM. These hooks do not run on execution hosts. Pre-execution event hooks are for job submission, moving a job, altering a job, or just before sending a job to an execution host.

2.3 Prerequisites and Requirements for Hooks

- To create a hook under Linux, you must be logged into the primary or secondary server host as root. You must create any hooks at the primary or secondary server host.
- When creating hooks, make sure that each execution host where execution or periodic hooks should run has the `$reject_root_scripts` MoM parameter set to *False*. The default for this parameter is *False*.
- In order for execution event hooks to function, either the `query_other_jobs` server attribute must be set to *True*, or root at every execution host must be added to the managers list (`root@hostname` must be added to the `managers` server attribute). If you have any hooks running with `user` set to *pbsuser*, you will have to set `query_other_jobs` to *True* (you probably don't want to add *pbsuser* to managers).

A normal, non-privileged, user cannot circumvent, disable, add, delete, or modify hooks or the environment in which the hooks are run.

2.4 Uses for Hooks

2.4.1 Routing Jobs

- Route jobs into specific queues or between queues:
 - Automatically route interactive jobs into a particular execution queue
 - Move a job to another queue; for example, if project allocation is used up, move job to “background” queue
- Reject job submissions that do not specify a valid queue, printing an error message explaining the problem
- Enable project-based ACLs for queues to make sure the appropriate job runs in the correct queue

2.4.2 Managing Resource Requests and Usage

- Reject improperly specified jobs:
 - Reject jobs which do not specify `walltime`
 - Reject jobs that request a number of processors that is not a multiple of 8
 - Reject jobs requesting a specific queue, but not requesting memory
 - Reject jobs whose processors per node is not specified or is not numeric
- Modify job resource requests:
 - Apply default memory limit to jobs that request a specific queue
 - Check on requested CPU and memory and modify these or supply them if missing
 - Adjust for the fact that users ask for 2GB on a machine that has 2GB physical memory, but only 1.8 GB available memory, by changing the memory request to 1.8GB
- Reject parallel jobs for some queues.
- Set default properties, for example, if “`myri`” is not set, set it to “`False`” to ensure Myrinet is used only for Myrinet jobs.
- Convert from ALPS-specific resource request strings into PBS-specific job requirements.
- Automatically translate old syntax to new syntax.
- Compensate for dissimilar system capabilities; for example, allow users to use more CPUs only if they use old, slow machines.
- Limit reservations submitted by users to a maximum amount of resources and `walltime`, but do not limit reservations submitted by PBS administrators.
- Define resources and set values.

2.4.3 Ensuring that Jobs Run Properly

- Make sure that jobs, or all jobs in a queue, request exclusive access (`-l place=excl`).
- Reject multi-host jobs, restricting each job to a single machine.
- Put a hold on the job if there isn't enough scratch space when the job is submitted.
- Reject jobs that could cause problems, based on the user and type of job that have caused previous problems. For example, if Bill's Abaqus jobs crash the system, reject new Abaqus jobs from Bill.
- Validate an input deck before the job is submitted.
- Modify a job's dependency list when the job is rejected.
- Modify a job's list of environment variables before it gets to the execution host(s).

2.4.4 Managing Job Output

- Manage where output goes by modifying a job's output path with the job's ID.

2.4.5 Controlling Interactive Jobs

- Control interactive job submission; for example, enable or disable interactive jobs at the server or queue level

2.4.6 Helping Schedule Jobs

- Increase the priority of an array job once the first subjob runs, by modifying the value of a job resource used in the job sorting formula
- Change scheduling according to user and job:
 - Set initial user-dependent coefficients for the scheduling formula. For example, set values of custom resources based on job attributes and user
 - Set whether or not the job is rerunnable, based on user
 - Calculate CPH ($CPH == \text{total ncpus} * \text{walltime in hours}$) and set a custom CPH job resource to the value
- Set initial priorities for jobs
- Periodically run the job start time estimator named `pbs_est` at the server. See [“Estimating Job Start Time” on page 131 of the PBS Professional Administrator’s Guide](#).

2.4.7 Communicating Information to Users

- Report useful error messages back to the user, e.g., "You do not have sufficient walltime left to run your job for 1:00:00. Your walltime balance is 00:30:00."

2.4.8 Managing User Activity

- Reject jobs from blacklisted users
- Prevent users from using `qalter` to change their jobs in any way, allowing only administrators to `qalter` jobs
- Prevent users from bypassing controls: disallow a job being submitted to `queueA` in a held state and then being moved to `queueB` where the job would not have passed hook checks for `queueB` initially. For example, if a `queue-job` hook disallows interactive jobs for `queueB`, the administrator also needs to ensure that an interactive job is not initially submitted to `queueA` and later moved to `queueB`
- Prevent users from overriding `node_group_key` with `qsub -lplace = group = X`, or with `qalter`
- Restrict the ability to submit a reservation to PBS administrators only

2.4.9 Enabling Accounting and Validation

- Make sure correct project designation is used: if no project or account string is found, look up username in database to find appropriate project to use and add it as project or account string before submission
- Submit job to correct queue based on project: check for project number and submit job to queues based on project type, e.g. project number 1234 jobs get submitted into “challenge” queue; similarly for “standard” queue, etc
- Validate project before the job executes; if validation fails, do not start job, and print error message. Validation can be based on project name, or for example requested resources, such as CPU hours

2.4.10 Allocation Management

- You can use a job submission (`queuejob`) hook to check whether an entity has enough resources allocated to accept the job.
- You can use a hook that runs just before the job is sent to the execution host (`runjob`) to perform allocation management tasks such as deducting requested amounts of resources from an entity’s allocation.
- You can use a hook that runs after a job finishes (`execjob_epilogue`) to perform final allocation management tasks such as allocation reconciliation.

2.4.11 Managing Job Execution

Hooks that run periodically at execution hosts can do the following:

- Modify job environment variables
- Check vnode health
- Report I/O wait time
- Report memory usage integral (MB*time used)
- Report energy usage to run a given job, if you have power sensors on vnodes
- Report actual usage of accelerator hardware (FPGAs, GPUs, etc)
- Interrogate HW performance counters so that you can flag codes that are not running efficiently (e.g. FLOPS < 5% of peak FLOPS)
- Record how much disk space a job has accumulated in PBS_JOBDIR
- Record power usage, energy usage, and disk space usage

Hooks that run just before the user's program executes can do the following:

- Change the job shell or executable
- Change the job shell or executable arguments
- Change the job's environment variables

2.4.12 Configuring Vnodes

Hooks that run when an execution host starts can do the following:

- Configure vnodes on the local host
- Create custom resources for vnodes
- Offline vnodes that are not ready for use
- Return vnodes to use that have been offlined

2.4.13 Provisioning Vnodes

- Provision a vnode with a new AOE. See [Chapter 7, "Provisioning", on page 327](#).

2.4.14 Accepting or Rejecting Job Task Attachment

- Allow or disallow action when MoM is about to attach a process for a job

Quick Start with Hooks

3.1 Simple How-to for Writing Hooks

We will go into the details of what goes into a hook later in the chapter, but here we show the basics of how to create a hook. Steps for creating a hook:

1. Log into the server host as root
2. Write the hook script
3. Create an empty hook via `qmgr`
4. Set the attributes of the hook so that it triggers when you want, etc
5. If the hook will use a configuration file:
 - a. Write the hook configuration file
 - b. Import the hook configuration file
6. Import the hook script into the empty hook. You do not need to restart the MoM, unless it's an `exechost_startup` hook. Since `exechost_startup` hooks run only when MoM starts up or is HUPed, if you want the hook to run now, restart or `kill -HUP` the MoM.

3.2 Writing Hooks: Basic Hook Structure

- Import the `pbs` and `sys` modules:


```
import pbs
import sys
```
- Use the `try... except` construction, where you test for conditions in the `try` block, and accept or reject the event:


```
try:
    ...
except:
```

Consider either rerunning the job or deleting the job inside the `except:` block.
- Treat the `SystemExit` exception as a normal occurrence, and pass if it occurs:


```
except SystemExit:
    pass
```
- Reject the event, or rerun or delete the job, if any other exception occurs:


```
except:
    pbs.event().reject("%s hook failed with %s")
```
- If the requestor is the scheduler, and where appropriate, the server or MoM, allow the action to take place:


```
if pbs.event().requestor in ["PBS_Server", "Scheduler", "pbs_mom"]:
    pbs.event().accept()
```

The following code fragment is a basic hook skeleton:

```
import pbs
import sys

e=pbs.event()
j=e.job
try:
    if e.requestor in ["Scheduler"]:
        e.accept()
        ...

except SystemExit:
    pass

except:
    j.rerun()
    e.reject("%s hook failed with %s. Please contact Admin" % (e.hook_name, sys.exc_info()[2]))
```

3.3 Example of Simple Hook

Example 3-1: Set job priority

Set a job's priority

```
import pbs
import sys

e = pbs.event()

try:
    # Get the hook event information and parameters
    # This will be for the 'modifyjob' event type.

    # Ignore requests from scheduler or server
    if e.requestor in ["PBS_Server", "Scheduler"]:
        e.accept()

    # Get the information for the job being queued
    j = e.job
    # Set the job's priority
    j.Priority = 7
    # accept the event
    e.accept()
except SystemExit:
    pass
except:
    e.reject("Failed to set job priority")
```

3.4 Importing Hook Configuration File

If you want your hook to use a configuration file, you can import the configuration file. A configuration file is not required.

Syntax for importing a configuration file:

```
Qmgr: import hook <hook_name> application/x-config <content-encoding>
      <input_config_file>
```

Here, *<content-encoding>* can be “*default*” (7-bit) or “*base64*”.

See [section 5.1.6, “Using Hook Configuration Files”, on page 32](#).

3.5 Creating and Importing Your Hook

When you “create a hook” using `qmgr`, you’re telling PBS that you want it to make you an empty hook object that has no characteristics other than a name. When you “import a hook” using `qmgr`, you’re telling PBS which Python script to run when the hook is triggered.

Syntax for creating a hook:

```
Qmgr: create hook <hook name>
```

Simple syntax for importing a hook:

```
Qmgr: import hook <hook name> application/x-python <content-encoding> <input_file>
```

This uses the script named *<input_file>* as the contents of your hook.

- The *<input_file>* must be encoded with *<content-encoding>*.
- The allowed values for *<content-encoding>* are “*default*” (7 bit) and “*base64*”.
- *<input_file>* must be locally accessible to both `qmgr` and the batch server.
- A relative path in *<input_file>* is relative to the directory where `qmgr` was executed.
- If your hook already has a content script, then that is overwritten by this import call.
- If the name of *<input_file>* contains spaces, *<input_file>* must be quoted.

3.6 Setting Attributes for Your Hook

Hooks have attributes that control their behavior, such as which events trigger the hook, the time to allow the hook to execute, etc. The only attribute you must set for a simple hook is the event(s) that will trigger the hook. Choose your hook type according to the event you want, by looking in [Table 5-1, “Hook Trigger Events,” on page 31](#).

Syntax for setting the hook event(s):

```
Qmgr: set hook <hook name> event = <event name>
      <hook name> event = "<event name>, <event name>"
```

For more details on setting hook trigger events, see [section 5.1.5, “Setting Hook Trigger Events”, on page 31](#).

You can set the rest of the hook’s attributes if you wish. To set a hook attribute:

```
Qmgr: set hook <hook name> <attribute> = <value>
```

For a list of all the hook attributes, see [section 5.1.9.3, “List of Hook Attributes”, on page 37](#).

Hook Basics

4.1 Hook Basics

4.1.1 Accepting or Rejecting Actions

Hooks accept (allow) or reject (prevent) actions, modify input parameters, modify job attributes, environment variables, programs, program arguments, and change internal or external values.

Each action can have zero or more hooks. Each hook must either accept or reject its action. All of an action's hooks are run when that action is to be performed. For PBS to perform an action, all hooks enabled for that action must accept the action. If any hook rejects the action, the action is not performed by PBS. If a hook script doesn't call `accept()` or `reject()`, and it doesn't encounter an exception, PBS behaves as if the hook accepts the action. An action is always accepted, unless:

- `pbs.event().reject()` is called
- An unhandled exception is encountered
- The hook alarm has been triggered due to hook timeout being reached

When PBS executes the hooks for an action, it stops processing hooks at the first hook that rejects the action.

4.1.1.1 Examples of Accepting and Rejecting Actions

Example 4-1: Accepting an action: In this example, userA submits a job to queue Queue1, and the job submission action has two hooks: hook1 disallows jobs submitted by UserB, and hook2 disallows jobs being submitted directly to Queue2. Both hook1 and hook2 accept userA's job submission to Queue1, so the submission goes ahead.

Example 4-2: Rejecting an action: In this example, userA uses the `qmove` command to try to move jobA from Queue1 to Queue2. The job move action has two hooks: hook3 disallows jobs being moved into Queue2, and hook4 disallows userB moving jobs out of Queue1. In this example, hook3 rejects the action, so the move operation is disallowed, even though hook4 would have accepted the action.

4.1.2 When Hooks Run

Each type of event has a corresponding type of hook. The following are the events where you can run hooks, with the hook type:

4.1.2.1 Job-related Hooks that Run Before Execution

Hooks that run before a job is received by an execution host (pre-execution event hooks):

`queuejob`: Queueing a job

`modifyjob`: Modifying a job, except when scheduler makes the modification (can also run after job is received by execution host)

`movejob`: Moving a job

`runjob`: Just before a job is sent to an execution host

4.1.2.2 Job-related Hooks that Run at Execution Host

Hooks that run after a job is received by an execution host (execution event hooks):

- `execjob_begin`: When a job is received by an execution host, after stagein
- `execjob_prologue`: Just before starting a job's shell
- `execjob_launch`: Just before starting the user's program
- `execjob_attach`: When running `pbs_attach()`
- `execjob_preterm`: Just before killing a job
- `execjob_epilogue`: Just after executing or killing a job, but before job is cleaned up
- `execjob_end`: Just after cleaning a job up
- `execjob_postsuspend`: Just after suspending a job
- `execjob_preresume`: Just before resuming a job

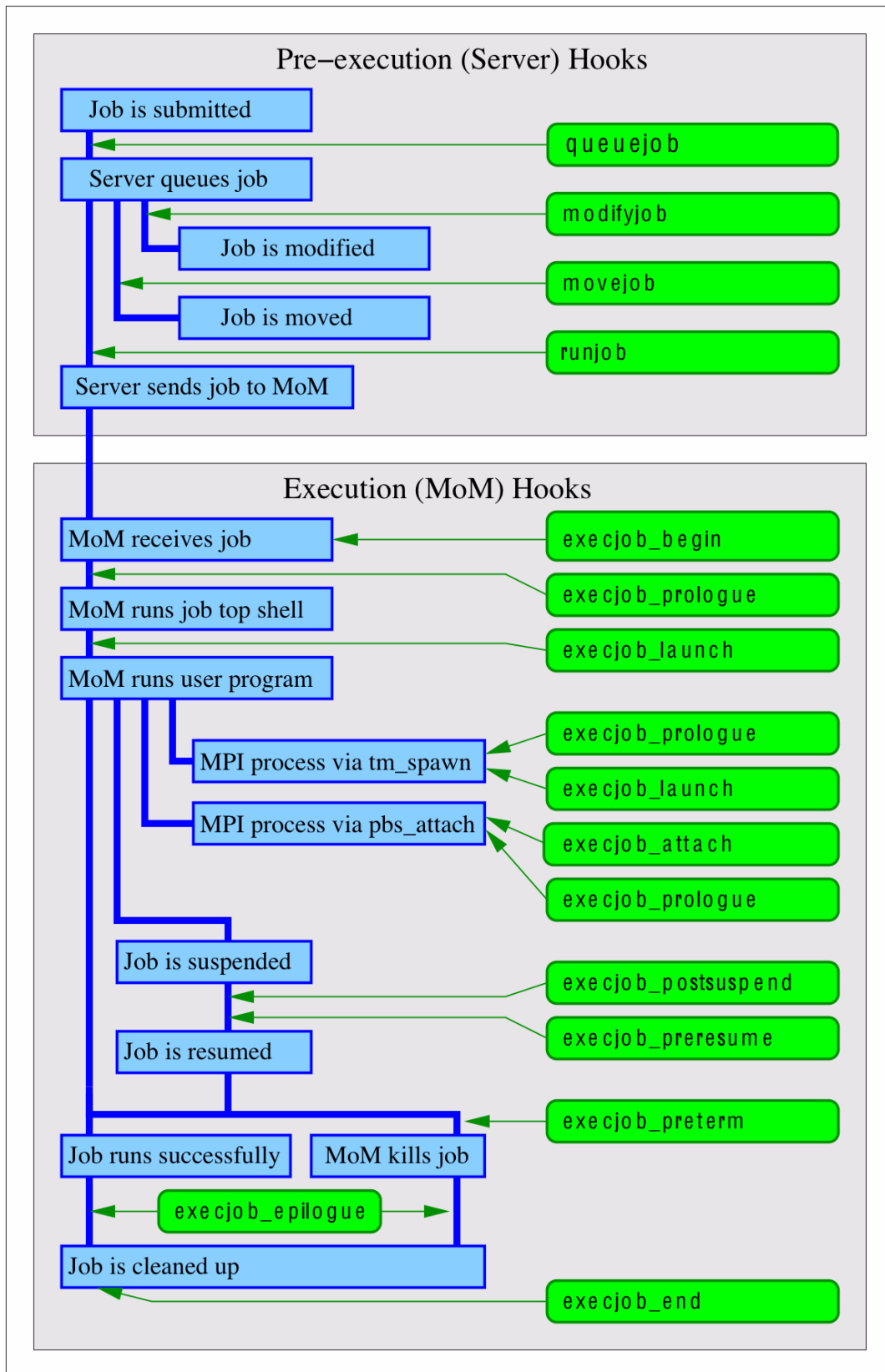


Figure 4-1: Simplified view of trigger timing for job-related hooks

4.1.2.3 Non-job-related Hooks

Hooks that are not directly related to a specific job (non-job event hooks):

`resvsub`: Submitting a PBS reservation

`resv_end`: When a PBS reservation ends

`provision`: Provisioning a vnode

`exechost_periodic`: Periodically on all execution hosts

`exechost_startup`: When an execution host is started or receives a HUP

`periodic`: periodically at the server

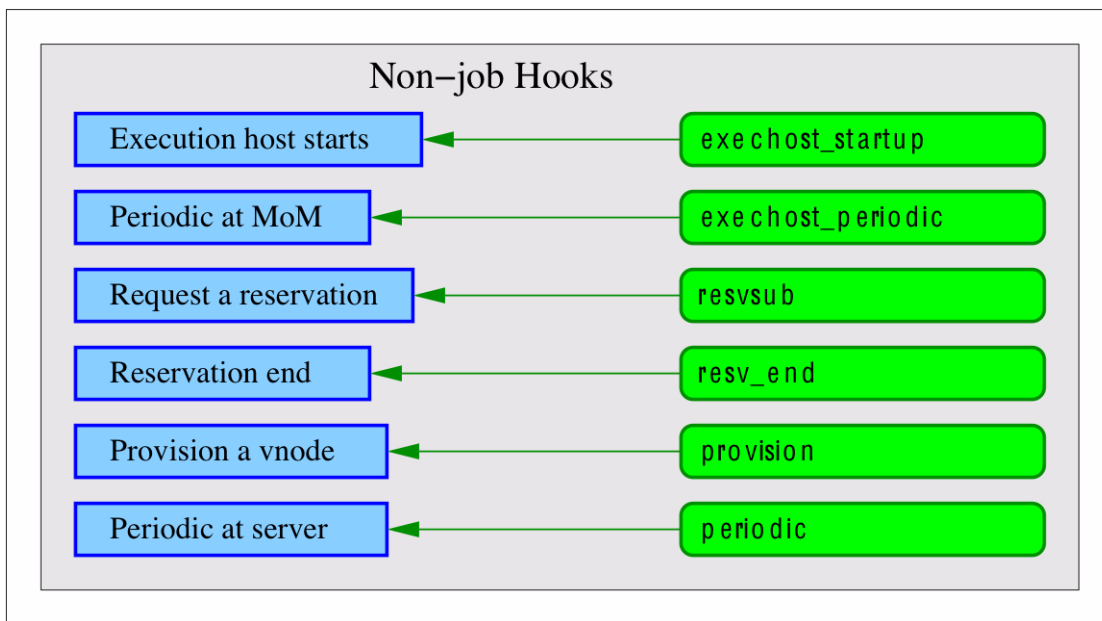


Figure 4-2: Simplified view of trigger timing for non-job-related hooks

4.1.2.4 Each Triggering Event Runs One Hook Instance

Each time an event triggers a hook, the hook runs for that instance of the event. If you have written a hook that runs at job submission, this hook will run for each job that is submitted to this server. Each MoM runs one copy of each of her execution hooks per job. Execution hooks run one per job at the MoM, not one per vnode. For a job that runs on four vnodes of a multi-vnoded machine where all the vnodes are managed by one MoM, where you have written one execution hook, only one instance of the hook runs for that job.

Each time a job goes through a triggering event, PBS runs any relevant hooks. This means that if you run a job, that triggers a `runjob` hook. If the job is killed and requeued and runs again, the `runjob` hook runs again.

If the scheduler modifies a job, any `modifyjob` hooks are not triggered.

When you are using peer scheduling, and a job is pulled from one complex to another, the pulling complex applies its hooks as if the job had been submitted locally, and the furnishing complex applies its `movejob` hooks. [Figure 4-3](#) shows an example of the hooks that are triggered when a job is moved from a complex containing a `movejob` hook to a complex containing a `queuejob` hook.

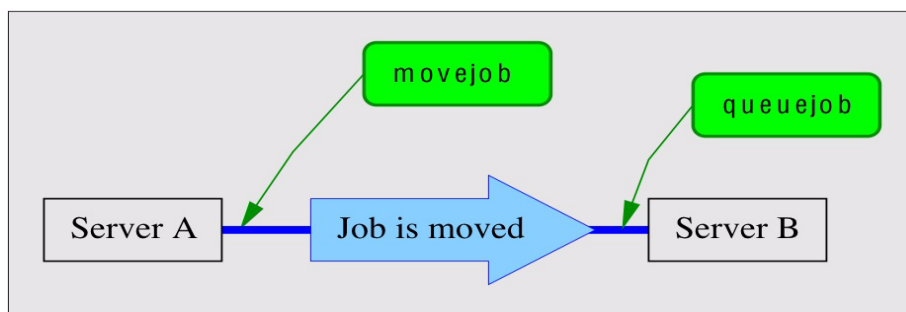


Figure 4-3: Hooks that run when job is moved

4.1.2.5 Execution Event Hook Triggers in Lifecycle of Job

The hooks triggered for an MPI job depend on whether MPI processes are spawned using the PBS TM interface via `tm_spawn()`, or are spawned using `pbs_attach()`. When a process is spawned using `tm_spawn()`, MoM starts the process. When a process uses `pbs_attach()`, `pbs_attach()` starts the process and informs MoM of the process ID.

The following shows where execution event hooks are triggered in the lifecycle of a normal, successful job. We show the timing for hooks on the primary execution host, on a sister vnode where a process is spawned using `tm_spawn()`, and on a sister vnode where a process is spawned using `pbs_attach()`.

Table 4-1: Execution Event Hook Timing

Job Lifecycle	Hooks Are Triggered		
	Primary Execution Host	Sister (<code>tm_spawn</code>)	Sister (<code>pbs_attach</code>)
Application licenses are checked out			
Any required job-specific staging and execution directories are created			
PBS_JOBDIR and job's <code>jobdir</code> attribute are set to pathname of staging and execution directory			
Files are staged in			
	<code>execjob_begin</code>	<code>execjob_begin</code>	<code>execjob_begin</code>
Job is sent to MoM			
	<code>execjob_prologue</code> If there is no <code>execjob_prologue</code> hook, the prologue script runs		
Server writes accounting log "S" record			
Primary execution host tells sister MoMs they will run job task(s)			

Table 4-1: Execution Event Hook Timing

Job Lifecycle	Hooks Are Triggered		
	Primary Execution Host	Sister (tm_spawn)	Sister (pbs_attach)
If necessary, MoM creates work directory			
MoM creates temporary directory for job			
MoM sets TMPDIR, JOBDIR, and other environment variables in job's environment			
MoM performs hardware-dependent setup: The job's cpusets are created, ALPS reservations are created			
	execjob_launch		
The job script starts			
Job starts an MPI process on sister vnode			
		execjob_prologue	execjob_prologue
		execjob_launch, for all tasks on this sister	
			execjob_attach, for all tasks on this sister
Job is suspended			
	execjob_postsuspend	execjob_postsuspend	execjob_postsuspend
	execjob_preresume		
		execjob_preresume (if successful on primary MoM)	execjob_preresume (if successful on primary MoM)
Job is resumed			
The job script finishes			
	execjob_epilogue If there is no execjob_epilogue hook, the epilogue script runs	execjob_epilogue	execjob_epilogue
The obit is sent to the server			
Server writes accounting log "E" record			
Any specified file staging out takes place, including stdout and stderr			
Files staged in or out are deleted			
Any job-specific staging and execution directories are removed			

Table 4-1: Execution Event Hook Timing

Job Lifecycle	Hooks Are Triggered		
	Primary Execution Host	Sister (tm_spawn)	Sister (pbs_attach)
The job's cpusets are destroyed			
Job files are deleted			
	execjob_end	execjob_end	execjob_end
Application licenses are returned to pool			

4.1.3 Account Under Which Hooks Run

A hook runs as the administrator or as the job owner, depending on the value of the hook's `user` attribute. If this is set to `pbsadmin`, the hook runs as the Administrator. If this is set to `pbsuser`, the hook runs as the job owner.

4.1.4 Where Hooks Run

Pre-execution event, periodic, provision, and reservation hooks run on the primary server host, or the secondary server host during failover. For most Linux systems, execution event, startup, and `exechoost_periodic` hooks run on the execution host(s). However, on Cray, execution event, startup, and `exechoost_periodic` hooks run on the host(s) where MoM runs.

4.1.5 Permissions and Location for Hook Creation and Modification

Hooks can be created or modified only by the administrator, and only at the hosts on which the primary and secondary servers run.

4.1.6 Failover

The secondary server uses the same filesystem as the primary server. Any hooks created are stored in the same place and are accessible by both servers, whether the primary or the secondary server is running.

When the secondary server takes over for the primary server after the primary's host has gone down or becomes inaccessible, any hooks created at the primary server continue to function under the secondary server.

If you create a new hook while the secondary server has control, that hook will persist once the primary server takes over: if the primary server comes back up and takes over, hooks created while the secondary server had control continue to function.

4.1.7 What Hooks Cannot Access or Do

- Hooks cannot read or modify anything not presented in the PBS hook interface
- Hooks cannot modify the server or any queues
- Pre-execution event hooks cannot read or set vnode attributes or resources, except that the runjob hook can set the `state` attribute for any vnode to be used by the job
- Hooks do not have access to other servers besides the default server:
 - Hooks cannot change the destination server to a non-default server
 - Hooks can allow a job submission or a `qmove` to a non-default server, and can change the destination server from a remote server to the default server
- Hooks cannot directly print to `stdout` or `stderr` or read from `stdin`.
- `movejob` hooks do not run on `pbs_rsub -Wqmove=<job ID>`

4.1.8 What Hooks Should Not Do

- Hooks should not edit configuration files directly, meaning hooks should not edit the following:
 - `PBS_HOME/sched_priv/sched_config`
 - `PBS_HOME/sched_priv/fairshare`
 - `PBS_HOME/sched_priv/dedicated`
 - `PBS_HOME/sched_priv/holidays`
 - `/etc/pbs.conf`
 - `PBS_HOME/server_priv/resourcedef`
 - `PBS_HOME/mom_priv/config`
- Hooks should not execute PBS commands

4.2 Viewing Hook Information

4.2.1 Listing Hooks

To list one hook and its attributes on the current server:

```
Qmgr: list hook <hook name>
```

To list all hooks and their attributes on the current server:

```
Qmgr: list hook
```

4.2.2 Viewing Hook Contents

To view the contents of a hook, export the hook's contents:

```
qmgr -c "export hook <hook_name> <content-type> <content-encoding>" > [<output_file>]
```

You cannot export the contents of a built-in hook.

4.2.3 Printing Hook Creation Commands

To view the commands to create one hook, including any configuration file:

```
Qmgr: print hook <hook name>
```

To view the commands to create all the hooks on the default server, including their configuration files:

```
Qmgr: print hook
```

or

```
qmgr -c "print hook"
```

For example, to see the commands used to create hook1 and hook2:

```
# qmgr -c "print hook"
create hook hook1
import hook hook1 application/x-python base64 - cHJpbmQgImh1bGxvLCB3b3JsZCtIK

set hook hook1 event=movejob
set hook hook1 alarm=10
set hook hook1 order=5
create hook hook2
import hook hook2 application/x-python base64 - servaJLSDFSESF

set hook hook2 event=queuejob
set hook hook2 alarm=15
set hook hook2 order=60
...
```

4.2.4 Re-creating Hooks

To re-create a hook, including its configuration file, you feed `qmgr` hook descriptions back into `qmgr`. These hook descriptions are the same information that `qmgr` prints out. To print out the statements needed to recreate a hook, use the `print hook` or `print hook <hook name>` `qmgr` commands.

For example, to save information for hook1 and hook2:

```
# qmgr -c "print hook" > hookInfo
```

To re-create hook1 and hook2, with their configuration files:

```
# qmgr < hookInfo
```

4.3 Restarting the Python Interpreter

PBS keeps track of the number of hooks serviced, the number of objects created, and the time since the Python interpreter was last restarted. You can set a limit for the number of hooks created in the `python_restart_max_hooks` server attribute, a limit for the number of objects created in the `python_restart_max_objects` server attribute, and a limit for the minimum time interval at which to restart the Python interpreter in the `python_restart_min_interval` server attribute.

python_restart_max_hooks

The maximum number of hooks to be serviced before the Python interpreter is restarted. If this number is exceeded, and the time limit set in `python_restart_min_interval` has elapsed, the Python interpreter is restarted.

Type: integer

Default: *100*

Python type: int

python_restart_max_objects

The maximum number of objects to be created before the Python interpreter is restarted. If this number is exceeded, and the time limit set in `python_restart_min_interval` has elapsed, the Python interpreter is restarted.

Type: integer

Default: *1000*

Python type: int

python_restart_min_interval

The minimum time interval before the Python interpreter is restarted. If this interval has elapsed, and either the maximum number of hooks to be serviced (set in `python_restart_max_hooks`) has been exceeded or the maximum number of objects to be created (set in `python_restart_max_objects`) has been exceeded, the Python interpreter is restarted.

Type: integer seconds or [[HH:]MM:]SS

Default: *30*

Python type: `pbs.duration`

4.4 Attributes and Parameters Affecting Hooks

- Each hook's attributes affect the behavior of that hook. Hook attributes are listed in [“Hook Attributes” on page 349 of the PBS Professional Reference Guide](#).
- The `$reject_root_scripts` MoM parameter controls whether MoM accepts new hook scripts.
- The server attributes that control when the Python interpreter is restarted are listed in [Chapter 4, “Restarting the Python Interpreter”, on page 23](#).

4.5 Python Modules and PBS

When you run a hook inside `pbs_python`, the hook has access to modules here:

- In `PBS_EXEC/python`
- In `PBS_EXEC/lib/python/altair`

Your hook can use other modules if you specify them in the hook.

The `PBS_EXEC/python` modules are in the following directories:

```
PBS_EXEC/python/lib/python36.zip
PBS_EXEC/python/lib/python3.6
PBS_EXEC/python/lib/python3.6/plat-linux2
PBS_EXEC/python/lib/python3.6/lib-tk
PBS_EXEC/python/lib/python3.6/lib-dynload
PBS_EXEC/python/lib/python3.6/site-packages
```

4.5.1 Python Module Caveats

In order to use `PBS_EXEC/python/lib/python3.6/site-packages`, you must first call the following:

```
import site
```

4.5.2 Modifying Python Modules

If you need to use other modules, we recommend that you put the modules in a different directory from `PBS_EXEC/lib/python`.

To use other modules besides the ones in `PBS_EXEC/lib/python`, specify the path in the hook.

If you are adding modules that are not in `PBS_EXEC/lib/python`, you can do this:

```
import sys
if '/usr/lib64/python3.6' not in sys.path:
    sys.path.append('/usr/lib64/python3.6')
import pbs
```

If you need to include user-defined paths ahead of the default modules, you can do the following. For example, if you put a module in `/usr/lib64/python3.6`, in `/usr/local/lib64/python3.6`, and in `/usr/local/lib64/custom/python` and you want to load them before the PBS-provided modules, add them to your hook this way:

```
import sys
my_paths = ['/usr/lib64/python3.6',
            '/usr/local/lib64/python3.6',
            '/usr/local/lib64/custom/python']
for my_path in my_paths:
    if my_path not in sys.path:
        sys.path.insert(0, my_path)
import pbs
```

4.5.2.1 Caveats for Modifying Python Modules

If you change a Python module in a pre-execution event hook (`queuejob`, `movejob`, `modifyjob`, `runjob`), you must restart the server in order to use the new module, because "import" is cached.

4.5.3 List of Modules in pbs_python

The following are the modules that are available via `PBS_EXEC/lib/python`:

Table 4-2: Modules in pbs_python

Module Name			
cElementTree	handler	pulldom	stringprep
collections	handlers	pydoc	symbol
config	itertools	re	time
copy	linecache	repr	token
copy_reg	math	saxutils	tokenize
cStringIO	md5	select	types
datetime	minicompat	sre	UserDict
dis	minidom	sre_compile	UserList
domreg	NodeFilter	sre_constants	UserString
ElementInclude	opcode	sre_parse	uuid
ElementPath	operator	stat	xmlbuilder
ElementTree	os	statvfs	xmlreader
expat	parser	string	zipfile
expatbuilder	pkgutil	StringIO	_exceptions
expatreader	posixpath	stringold	_socket

4.6 See Also

For a description of the PBS hook APIs, see the PBS Professional Programmer’s Guide. Each PBS object’s attribute’s Python type is listed in its description in [“Attributes” on page 277 of the PBS Professional Reference Guide](#). For example, [“Server Attributes” on page 281 of the PBS Professional Reference Guide](#) lists the Python type for the `job_sort_formula` server attribute.

The following man pages and equivalent sections contain useful information:

Table 4-3: See Also

Man Page	Guide Section
<code>pbs_module(7B)</code>	section 8.3.1, “The pbs Module”, on page 110 of the PBS Professional Programmers Guide
<code>pbs_stathook(3B)</code>	section 8.4.2, “The pbs_stathook() API”, on page 116 of the PBS Professional Programmers Guide
<code>pbs_hook_attributes(7B)</code>	“Hook Attributes” on page 349 of the PBS Professional Reference Guide
<code>pbs_job_attributes(7B)</code>	“Job Attributes” on page 328 of the PBS Professional Reference Guide

Table 4-3: See Also

Man Page	Guide Section
pbs_server_attributes(7B)	“Server Attributes” on page 281 of the PBS Professional Reference Guide
pbs_queue_attributes(7B)	“Queue Attributes” on page 311 of the PBS Professional Reference Guide
pbs_node_attributes(7B)	“Vnode Attributes” on page 320 of the PBS Professional Reference Guide
qmgr(1B)	“qmgr” on page 149 of the PBS Professional Reference Guide
qsub(1B)	“qsub” on page 213 of the PBS Professional Reference Guide
qmove(1B)	“qmove” on page 172 of the PBS Professional Reference Guide
qalter(1B)	“qalter” on page 127 of the PBS Professional Reference Guide
pbs_rsub(1B)	“pbs_rsub” on page 96 of the PBS Professional Reference Guide
pbs_manager(3B)	“pbs_manager” on page 41 of the PBS Professional Programmers Guide

Creating and Configuring Hooks

5.1 Creating and Configuring Hooks

In this chapter we describe how to create and configure site-defined hooks. For information about operating on built-in hooks, see [Chapter 7, "Built-in Hooks", on page 155](#).

5.1.1 Introduction to Creating and Configuring Hooks

Hooks can only be created, run, or modified by the Administrator, and only on the host(s) on which the primary or secondary server runs.

You create hooks using the `qmgr` command to create, delete, import, or export the hook. The `qmgr` command operates on the *hook* object.

Syntax for operating on hooks:

```
qmgr -c "<command> hook <hook name> [<arguments to command>]"
```

where

command is *create*, *delete*, *set*, *unset*, *list*, *print*, *import*, *export*

5.1.1.1 Hook Name Restrictions

- Each hook must have a unique name.
- The name must be alphanumeric, and start with an alphabetic character.
- The name must not begin with “*PBS*”.
- The name of a hook can be a legal PBS object name, such as the name of a queue.
- Hook names are case-sensitive.

5.1.2 Overview of Creating and Configuring a Hook

The following is an overview of the steps to create a hook. Each step is described in the following sections. You must be logged into the primary or secondary server host as root.

1. Use the `create hook qmgr` command to create an empty hook with the name you specify
2. Import the contents of a hook script into the hook
3. Set the hook's trigger event
4. If the hook will use a configuration file, write and import the configuration file
5. Set the hook's order of execution, if there is another hook for the same event
6. Optionally, set the hook's timeout
7. Make sure that the `$reject_root_scripts` MoM configuration parameter is set to *False* on all execution hosts where you want hooks to run. The default for this parameter is *False*.

You do not need to restart the MoM.

5.1.2.1 Example of Creating and Configuring a Hook

Create the hook:

```
Qmgr: create hook hook1
```

Import the hook script named `hook1_script.py` into the hook:

```
Qmgr: import hook hook1 application/x-python default /hooks/hook1_script.py
```

Make `hook1` a `queuejob` hook:

```
Qmgr: set hook hook1 event = queuejob
```

Make this the second `queuejob` hook:

```
Qmgr: set hook hook1 order = 2
```

Set the hook to time out after 60 seconds:

```
Qmgr: set hook hook1 alarm = 60
```

Look at the `$reject_root_scripts` MoM configuration parameter where you want the hook to run, and make sure it is set to *False*.

5.1.3 Creating Empty Hooks

To create a hook, use the `create hook` command in `qmgr` to create an empty hook with the name you specify:

The `create hook qmgr` command creates an empty hook.

Syntax for creating a hook:

```
Qmgr: create hook <hook name>
```

5.1.3.1 Example of Creating an Empty Hook

To create the hook named “hook1”, specify a filename, for example “/hooks/hook1.py”, that is locally accessible to `qmgr` and the PBS server:

```
Qmgr: create hook hook1
```

5.1.4 Deleting Hooks

To delete a hook, you use the `delete hook` command in `qmgr`.

Syntax for deleting a hook:

```
Qmgr: delete hook <hook name>
```

5.1.4.1 Example of Deleting a Hook

To delete hook `hook1`:

```
Qmgr: delete hook hook1
```

5.1.5 Setting Hook Trigger Events

To set the events that will cause a hook to be triggered, use the `set hook <hook name> event` command in `qmgr`. You can add triggering events to a hook.

To set one event:

```
Qmgr: set hook <hook name> event = <event name>
```

Designate triggers for a hook by setting `<event name>` to one of the following events:

Table 5-1: Hook Trigger Events

Action (Event)	Event Name
Accepting job into queue	<i>queuejob</i>
Modifying job, except when scheduler makes modification	<i>modifyjob</i>
Moving job	<i>movejob</i>
Before a job is sent to an execution host	<i>runjob</i>
Periodically on server host	<i>periodic</i>
When a job is received by an execution host, after stagein	<i>execjob_begin</i>
When <code>pbs_attach()</code> is called	<i>execjob_attach</i>
Just before executing a job's top shell	<i>execjob_prologue</i>
Just before executing the user's program	<i>execjob_launch</i>
Just after suspending a job	<i>execjob_postsuspend</i>
Just before resuming a job	<i>execjob_preresume</i>
Just after executing or killing a job, but before job is cleaned up	<i>execjob_epilogue</i>
Just before killing a job	<i>execjob_preterm</i>
Just after cleaning up a job that has finished or been killed	<i>execjob_end</i>
When an execution host starts up or receives a HUP	<i>execheost_startup</i>
Periodically on all execution hosts	<i>execheost_periodic</i>

Table 5-1: Hook Trigger Events

Action (Event)	Event Name
Provisioning a vnode	<i>provision</i>
Submitting reservation	<i>resvsub</i>
When reservation ends	<i>resv_end</i>

To add an event:

```
Qmgr: set hook <hook name> event += <event name>
```

For a detailed description of each event, see [section 6.3.1, “Event Types”, on page 87](#).

5.1.5.1 Example of Setting Hook Trigger Events

To set an event that will cause hook “UserFilter” to be triggered:

```
Qmgr: set hook UserFilter event = queuejob
```

Add another event:

```
Qmgr: set hook UserFilter event += modifyjob
```

Set two events at once:

```
Qmgr: set hook UserFilter event = "queuejob, modifyjob"
```

You must enclose the value in double quotes if it contains a comma.

5.1.6 Using Hook Configuration Files

You can customize the behavior of a hook by providing a configuration file for the hook. You write the hook so that it reads and acts on its configuration file. Hooks are not required to use configuration files. A configuration file can contain whatever information is useful to the hook. A configuration file is just a file of whatever information you want; the way the hook reads and uses the contents of a configuration file is up to you. The hook itself processes the configuration file.

5.1.6.1 Format of Configuration File

PBS supports several file formats for configuration files. The format of the file is specified in its suffix. Formats can be specified in any of the following ways:

- `.ini`
- `.json`
- `.txt` (generic, no special format)
- `.xml`
- No suffix: treat the input file as if it is a `.txt` file
- The dash (-) symbol: configuration file content will be taken from STDIN. The content is treated as if it is a `.txt` file.

For example, to import a configuration file in `.json` format:

```
# qmgr -c "import hook <hook_name> application/x-config default input_file.json"
```


5.1.6.2 Importing Configuration File

To provide a configuration file for a hook, you import the configuration file into the hook. The import command is the same as for a hook, except that you set *<content-type>* to “*application/x-config*”. Syntax for importing a configuration file:

```
Qmgr: import hook <hook_name> application/x-config <content-encoding>
      <input_config_file>
```

or

```
# qmgr -c "import hook <hook_name> application/x-config <content-encoding> <input_config_file>"
```

where *<content-encoding>* is “*default*” (7-bit) or “*base64*”.

This uses the contents of *<input_config_file>* or `stdin (-)` as the contents of configuration file for hook *<hook_name>*.

- The *<input_config_file>* or `stdin (-)` data must have a format *<content-type>* and must be encoded with *<content-encoding>*.
- The allowed values for *<content-encoding>* are “*default*” (7bit) and “*base64*”.
- If the source of input is `stdin (-)` and *<content-encoding>* is “*default*”, then `qmgr` expects the input data to be terminated by EOF.
- If the source of input is `stdin (-)` and *<content-encoding>* is “*base64*”, then `qmgr` expects input data to be terminated by a blank line.
- *<input_config_file>* must be locally accessible to both `qmgr` and the requested batch server.
- A relative path *<input_config_file>* is relative to the directory where `qmgr` was executed.
- If a hook already has a configuration file, then that is overwritten by this import call.
- If *<input_config_file>* name contains spaces, *<input_config_file>* must be quoted.
- There is no restriction on the size of the hook configuration file.

5.1.6.2.i Examples of Importing Configuration Files

Importing a Python configuration file:

```
# qmgr -c 'import hook hook1 application/x-config default hello.py'
```

Importing a JSON configuration file:

```
# qmgr -c 'import hook hook1 application/x-config default hello.json'
```

5.1.6.3 Exporting Configuration Files

To edit or display the content of a hook configuration file associated with the hook named *<hook_name>*, export the configuration file. Use the export command:

```
qmgr -c "export hook <hook_name> application/x-config default" > <output file>
```

5.1.6.4 How Hooks Find Configuration Files

There are two ways to retrieve a configuration file in a hook.

- PBS puts the configuration file in a location that can be read by the hook, and sets the `PBS_HOOK_CONFIG_FILE` environment variable to that path. Your hook script can use this path:


```
import os
import ConfigParser

if "PBS_HOOK_CONFIG_FILE" in os.environ:
    config_file = os.environ["PBS_HOOK_CONFIG_FILE"]
    config = ConfigParser.RawConfigParser()
    config.read(os.environ["PBS_HOOK_CONFIG_FILE"])
```
- Your hook can use the `pbs.hook_config_filename` variable, which contains the path to the configuration file. See ["pbs.hook_config_filename" on page 135](#).

If there is no configuration file, this variable returns *None*.

5.1.6.5 Changing a Hook Configuration File

To replace the content of a hook configuration file, export the file, edit it, and issue another “import” hook command with updated `<input_config_file>` content.

5.1.6.6 Validation and Errors

- PBS pre-validates `<input_config_file>` according to its file format, and returns an error in `qmgr`'s `STDERR` if validation fails. For example:


```
# qmgr -c "import hook submit application/x-config default file.json"
"Failed to validate config file, hook 'submit' config file not overwritten"
```
- If the input configuration file given is of unrecognized suffix, the following message is returned in `qmgr`'s `STDERR`.


```
<input-file> contains an invalid suffix, should be one of: .json .py .txt .xml .ini"
```
- If you import a configuration file and PBS cannot open the file because it is non-existent, has permission problems, or has another system-related error, the following error message is printed in `STDERR`:


```
"qmgr: hook error: failed to open <filename> - <error message>"
```
- If you attempt to export a hook configuration file, but the file is unwriteable due to ownership or permission problems, the following error message is printed to `STDERR`:


```
"qmgr: hook error: <output_file> permission denied"
```

5.1.7 Importing Hooks

To import a hook, you import the contents of a hook script into the hook. You must specify a filename that is locally accessible to `qmgr` and the PBS server.

Syntax for importing a hook:

```
Qmgr: import hook <hook_name> <content-type> <content-encoding> {<input_file>|-}
```

This uses the contents of `<input_file>` or `stdin (-)` as the contents of hook `<hook_name>`.

- The `<input_file>` or `stdin (-)` data must have a format `<content-type>` and must be encoded with `<content-encoding>`.
- For script files, the only `<content-type>` currently supported is “`application/x-python`”.
- The allowed values for `<content-encoding>` are “`default`” (7 bit) and “`base64`”.
- If the source of input is `stdin (-)` and `<content-encoding>` is “`default`”, then `qmgr` expects the input data to be terminated by EOF.
- If the source of input is `stdin (-)` and `<content-encoding>` is “`base64`”, then `qmgr` expects input data to be terminated by a blank line.
- `<input_file>` must be locally accessible to both `qmgr` and the requested batch server.
- A relative path in `<input_file>` is relative to the directory where `qmgr` was executed.
- If a hook already has a content script, then that is overwritten by this import call.
- If the name of `<input_file>` contains spaces, `<input_file>` must be quoted.
- There is no restriction on the size of the hook script.

5.1.7.1 Examples of Importing Hooks

Example 5-1: Given a Python script in ASCII text file “`hello.py`”, this makes its contents into the script contents of hook1:

```
#cat hello.py
import pbs
pbs.event().job.comment="Hello, world"
# qmgr -c 'import hook hook1 application/x-python default hello.py'
```

Example 5-2: Given a base64-encoded file “`hello.py.b64`”, `qmgr` unencodes the file's contents, and then makes this script the contents of hook1:

```
# cat hello.py.b64
cHJpbnQgImh1bGxvLCB3b3JsZCIK
# qmgr -c 'import hook hook1 application/x-python base64 hello.py.b64'
```

Example 5-3: Read `stdin` for text containing data until EOF, and make this into the script contents of hook1:

```
# qmgr -c 'import hook hook1 application/x-python default -'
import pbs
pbs.event().job.comment="Hello from stdin"
Ctrl-D
```

Example 5-4: Read `stdin` for a base64-encoded string of data terminated by a blank line. PBS unencodes the data and makes this script the contents of hook1.

```
# qmgr -c 'import hook hook1 application/x-python base64 -'
cHJpbnQgImh1bGxvLCB3b3JsZCIK
Ctrl-D
```

5.1.8 Exporting Hooks

Syntax for exporting a hook:

```
qmgr -c "export hook <hook_name> <content-type> <content-encoding>" > <output_file>
```

This dumps the script contents of hook `<hook_name>` into `<output_file>`, or `stdout` if `<output_file>` is not specified.

- The resulting `<output_file>` or `stdout` data is of `<content-type>` and `<content-encoding>`.
- The only `<content-type>` currently supported for scripts is “`application/x-python`”.
- The allowed values for `<content-encoding>` are “`default`” (7bit) and “`base64`”.
- `<output_file>` must be a path that can be created by `qmgr`.
- Any relative path in `<output_file>` is relative to the directory where `qmgr` was executed.
- If `<output_file>` already exists it is overwritten. If PBS is unable to overwrite the file due to ownership or permission problems, then an error message is displayed in `stderr`.
- If the `<output_file>` name contains spaces, `<output file>` must be enclosed in quotes.

5.1.8.1 Examples of Exporting Hooks

Example 5-5: Dumps hook1's script contents directly into the file "hello.py.out":

```
# qmgr -c "export hook hook1 application/x-python default" > hello.py
# cat hello.py
import pbs
pbs.event().job.comment="Hello, world"
```

Example 5-6: To dump the script contents of a hook 'hook1' into a file in “\My Hooks\hook1.py”:

```
qmgr -c "export hook hook1 application/x-python default" > "\My Hooks\hook1.py"
```

Example 5-7: Dump hook1's script contents base64-encoded into a file called "hello.py.b64":

```
# qmgr -c "export hook hook1 application/x-python base64" > hello.py.b64
# cat hello.py.b64
cHJpbmQgImh1bGxvLCB3b3JsZC1K
```

Example 5-8: Dump hook1's script contents directly to `stdout`:

```
# qmgr -c "export hook hook1 application/x-python default"
import pbs
pbs.event().job.comment="Hello, world"
```

Example 5-9: Dump hook1's script contents base64-encoded into `stdout`:

```
# qmgr -c "export hook hook1 application/x-python base64"
cHJpbmQgImh1bGxvLCB3b3JsZC1K
```

5.1.9 Setting and Unsetting Hook Attributes

You configure a hook using the `qmgr` command to set or unset its attributes. An unset hook attribute takes the default value for that attribute.

Hook attributes can be viewed via `qmgr`:

```
Qmgr: list hook <hook name>
```

To set a hook attribute:

```
Qmgr: set hook <hook name> <attribute> = <value>
```

To unset a hook attribute:

```
Qmgr: unset hook <hook name> <attribute>
```

For example, to unset hook1's `alarm` attribute, causing its value to revert to its default value:

```
Qmgr: unset hook hook1 alarm
```

This causes hook1's `alarm` to revert to the default of *30 seconds*.

5.1.9.1 Caveats for Setting Hook Attributes

You cannot set the `type` attribute for a built-in hook.

5.1.9.2 Using the `fail_action` Hook Attribute

The `fail_action` hook attribute is a `string_array` and can take on multiple values:

None

No action is taken.

offline_vnodes

After unsuccessful hook execution, offlines the vnodes managed by the MoM executing the hook. Can be set for `execjob_begin`, `execjob_prologue`, and `exechoost_startup` hooks only.

clear_vnodes_upon_recovery

After successful hook execution, clears vnodes previously offlined via `offline_vnodes` fail action. Can be set for `exechoost_startup` hooks only.

scheduler_restart_cycle

After unsuccessful hook execution, restarts scheduling cycle. Can be set for `execjob_begin` and `execjob_prologue` hooks only.

Default value: “None”

If you specify offlining or clearing vnodes in addition to restarting the scheduler, the scheduler restart happens last. The order of the values is not important.

To set the attribute:

```
# qmgr -c "set hook <hook_name> fail_action = <fail_action value>"
# qmgr -c "set hook <hook_name> fail_action = '<fail_action value>,<fail_action value>'"
```

To add a value to the list of values:

```
# qmgr -c "set hook <hook_name> fail_action += <fail_action value>"
```

To remove a value from the list of values:

```
# qmgr -c "set hook <hook_name> fail_action -= <fail_action value>"
```

To find out what the values are:

```
# qmgr -c "list hook <hook_name> fail_action"
<hook_name>
    fail_action = <fail_action value>
```

To unset the attribute:

```
# qmgr -c "unset hook <hook_name> fail_action"
```

See [section 5.2.12.4, “Offlining and Clearing Vnodes Using the fail_action Hook Attribute”](#), on page 66 and [section 5.2.6, “Restarting Scheduler Cycle After Hook Failure”](#), on page 63.

5.1.9.3 List of Hook Attributes

Hook attributes are listed in [“Hook Attributes” on page 349 of the PBS Professional Reference Guide](#).

5.1.10 Enabling and Disabling Hooks

A hook is either *enabled*, and will run when its action happens, or is *disabled*, and will not run. Hooks are enabled by default.

Syntax to enable a hook:

```
Qmgr: set hook <hook name> enabled=True
```

Syntax to disable a hook:

```
Qmgr: set hook <hook name> enabled=False
```

5.1.10.1 Example of Enabling and Disabling Hooks

To enable hook1:

```
Qmgr: set hook hook1 enabled=True
```

To disable hook1:

```
Qmgr: set hook hook1 enabled=False
```

5.1.11 Setting the Relative Order of Hook Execution

When there are multiple hooks of the same type for one action, you may wish to specify the order in which these hooks are run. The order in which the hooks for an action are run is determined by each hook's `order` attribute. Hooks with a lower value for `order` will run before hooks with a higher value. To set the relative order in which the hooks for an action will be run, set each hook's `order` attribute.

Syntax:

```
Qmgr: set hook <hook name> order=<ordering>
```

<ordering> is an integer. Hooks with lower values for <ordering> run before those with higher values; a hook with `order=1` runs before a hook with `order=2`.

Valid values for order:

- Built-in hooks can be from *-1000* to *2000*
- Site hooks can be from *1* to *1000*

The order in which hooks of the same type for unrelated actions execute is undefined. For example, there are two `queuejob` hooks, Hook1 and Hook2, and userA submits jobA and userB submits jobB. While Hook1 always runs before Hook2 for the same job, the order of execution is undefined for different jobs. So the order could be:

```
Hook1 (jobB)
```

```
Hook1 (jobA)
```

```
Hook2 (jobA)
```

```
Hook2 (jobB)
```

5.1.11.1 Example of Setting Relative Order of Hook Execution

To set hookA to run first and hookB to run second:

```
Qmgr: set hook hookA order=2
```

```
Qmgr: set hook hookB order=5
```

5.1.11.2 Caveats for Setting Relative Order of Hooks

The order attribute is ignored for `execlist_periodic` and `periodic` hooks.

5.1.12 Setting Hook Timeout

You may wish to specify how long PBS should wait for a hook to run. Execution for each hook times out after the number of seconds specified in the hook's `alarm` attribute. If the hook does not run in the specified time, PBS aborts the hook and rejects the hook's action.

Syntax:

```
Qmgr: set hook <hook name> alarm=<timeout>
```

<timeout> is the number of seconds PBS will allow the hook to run.

When a hook timeout is triggered, the hook script gets a Python KeyboardInterrupt from the PBS server. The server logs show:

```
06/17/2008 17:57:16;0001;Server@host2;Svr;Server@host2;PBS server internal error (15011) in
  Python script received a KeyboardInterrupt, <type 'exceptions.KeyboardInterrupt'>
```

5.1.12.1 Example of Setting Hook Timeout

To set the number of seconds that PBS will wait for hook `hook1` to execute before aborting the hook and reject the action:

```
Qmgr: set hook hook1 alarm=20
```

5.1.13 Setting Hook Interval (Frequency)

You can specify the interval at which a periodic hook runs. You can do this only for hooks whose event type is `execlist_periodic` or `periodic`.

Syntax:

```
Qmgr: set hook <hook name> freq=<interval>
```

<interval> is the number of seconds elapsed between calls to this hook.

5.1.13.1 Example of Setting Hook Interval (Frequency)

To set the number of seconds between calls to an `execlist_periodic` or `periodic` hook:

```
Qmgr: set hook hook1 freq=200
```

5.1.14 Setting Hook User Account

You can specify the account under which a hook runs.

Syntax:

```
Qmgr: set hook <hook name> user=<pbsadmin | pbsuser>
```

`pbsadmin` specifies that the hook runs as root or as administrator.

`pbsuser` specifies that the hook runs as the job owner.

You can specify that a hook runs as the job owner only for `execjob_prologue`, `execjob_epilogue`, and `execjob_preterm` hooks.

If you do not set the account, it defaults to `pbsadmin`.

5.1.14.1 Example of Setting Hook User Account

To set the account under which a hook runs:

```
Qmgr: set hook hook1 user=pbsuser
```

5.2 Writing Hook Scripts to Operate on PBS Elements

5.2.1 How We Define and Refer to Objects and Methods

5.2.1.1 Scope of Object or Method

When we define an object or method, we show the scope of the object or method. For example, the scope of a job is the pbs module, so we call it a *pbs.job*, and a server has the same scope, so it is a *pbs.server*. Similarly, the `logjobmsg()` method has module-wide scope, and is defined as *pbs.logjobmsg()*.

However, the scope of a job ID object is the job, not the module, so it is defined as a *pbs.job.id*, and the scope of the job's `is_checkpointed()` method is the job, so it is defined as *pbs.job.is_checkpointed()*.

5.2.1.2 Referring to Objects

In a hook, you refer to the triggering event using `pbs.event()`. In a hook that is triggered by a job-related event, such as a `movejob` or `execjob_begin` hook, the event has an associated `pbs.job` object representing the job that triggered the event, and you refer to it using `pbs.event().job`. You can refer to members of that job object using `pbs.event().job.<member>`. For example, to refer to the ID of the job associated with the event, you use `pbs.event().job.id`. To use the `is_checkpointed()` method on the job associated with the event, you use `pbs.event().job.is_checkpointed()`. You can use shortcuts:

```
e = pbs.event()
j = e.job
c = j.is_checkpointed()
```

5.2.1.3 How to Retrieve Objects: Event vs. Server

Each event has access to specific objects, listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#). You can manipulate many of these objects through the event. To retrieve the job that triggered an event, you refer to it this way: `pbs.event().job`.

The server has read access to all objects in the pbs module. You refer to these objects through the server. For example, to retrieve a job whose ID is “1234” through the server, you use `pbs.server().job(“1234”)`. **You cannot manipulate an object that is retrieved through the server.**

5.2.1.3.i Retrieving Jobs

The way you retrieve a job determines how much access you have to that job. You can retrieve a job either through the event, via `pbs.event().job`, or through the server, via `pbs.server().job()`.

If you retrieve a job through an event, the event gives you the job itself, represented as an object. You can see and alter some job attributes for an event-retrieved job object. To get the job object representing the job associated with the current event, on which you can operate, use `pbs.event().job`. We show which hooks can see and set each job attribute in [Table 5-6, “Job Attributes Readable & Settable via Events,” on page 55](#).

However, if you retrieve a job through the server, the server gives you an instantiated job object that contains a **copy** of the job. You cannot set any job attributes for a server-retrieved job object, and trying to operate on a server-retrieved copy of the job causes an exception. In order to get read-only information about a particular job with ID `<id>`, use `pbs.server().job("<job ID>")`. This returns a read-only copy of the job.

You can see all of the attributes for a server-retrieved job object, except in a `queuejob` hook. In a `queuejob` hook, the event gives you the job as it exists before the server sees it, but the server cannot retrieve it, because the job has not yet made it to the server.

5.2.1.3.ii Retrieving Vnodes

Vnode objects behave like job objects. If you retrieve a vnode object through an event, via `pbs.event().vnode_list[]`, you can see some of the vnode's attributes, and set vnode attributes. We show which hooks can see and set each vnode attribute in [Table 5-7, "Vnode Attributes Readable & Settable via Events," on page 57](#).

If you retrieve a vnode object through the server, via `pbs.server().vnode()`, you have a **copy** of the vnode, and you can see all of the vnode's attributes, but you cannot set any of them.

5.2.1.3.iii Retrieving Queues

You can retrieve queues through the server only, using `pbs.server().queue("<queue name>")`, or using `pbs.server().queues()`. You cannot make any changes to queue objects in hooks. These are read-only.

You can change a job's destination queue, but only to a queue at the local server. Hooks have access only to the local server. Hooks can allow a job submission to a remote server, but they **cannot** specify a remote server. See [section 5.3.9.1, "Local Server Only," on page 72](#). Hooks can specify the destination queue at a local server for a `queuejob` or `movejob` event, whether the original destination queue was at the local server or a remote server.

To specify a destination queue at the local server:

```
pbs.event().job.queue = pbs.server().queue("<local_queue>")
```

Do not specify a queue at a remote server in a hook script.

5.2.1.3.iv Retrieving Reservations

In order to get information about a reservation being created in a `resvsub` event, use `pbs.event().resv`. `pbs.server()` cannot return information about the reservation, because the reservation has not yet been created.

5.2.2 Recommended Hook Script Structure

5.2.2.1 Catch Exceptions

Your hook script should catch all exceptions except for `SystemExit`. We recommend that you catch exceptions via `try...except` and accompany them with a call to `pbs.event().reject()`.

It is helpful if it displays a useful error message in the `stderr` of the command triggering the hook. The error message should show the type of the error and should describe the error.

Here is the recommended script structure:

```
import pbs
import sys

try:
    ...

except SystemExit:
    pass

except:
    pbs.event().job.rerun()
    pbs.event().reject("%s hook failed with %s. Please contact \
        Admin" % (pbs.event().hook_name, sys.exc_info()[2]))
```

5.2.2.1.i Example of Catching Exceptions

This example shows how a coding error in the hook is caught with the `except` statement, and an appropriate error message is generated. In line 7, the statement `k=5/0` generates a divide-by-zero error. The hook script is designed to reject interactive jobs that are submitted to queue “nointer”.

```
import pbs
import sys

try:

    batchq = "nointer"
    e = pbs.event()
    j = e.job
    k = 5/0
    if j.queue and j.queue.name == batchq and j.interactive:
        e.reject("Can't submit an interactive job in '%s' queue" %
            (batchq))

except SystemExit:

    pass

except:
    e.reject("%s hook failed with %s. Please contact Admin" % (e.hook_name, sys.exc_info()[2]))
```

The hook is triggered:

```
% qsub job.scr
qsub: c1 hhook failed with (<class 'ZeroDivisionError'>, ZeroDivisionError('division by zero',)).
Please contact Admin
```

5.2.2.1.ii Table of Exceptions

The following exceptions may be raised when using the pbs.* objects:

Table 5-2: Exceptions Raised When Using pbs.* Objects

Object	Exception
pbs.BadAttributeValueError	Raised when setting member value of a pbs.* object to an invalid value.
pbs.BadAttributeValueTypeError	Raised when setting member value of a pbs.* object to an invalid type.
pbs.BadResourceValueError	Raised when setting resource value of a pbs.* object to an invalid value.
pbs.BadResourceValueTypeError	Raised when setting resource value of a pbs.* object to an invalid type.
pbs.EventIncompatibleError	Raised when referencing a nonexistent member in pbs.event. Example: calling pbs.event().resv for pbs.event().type of pbs.QUEUEJOB
pbs.UnsetAttributeNameError	Raised when referencing a non-existent member name of a pbs.* object.
pbs.UnsetResourceNameError	Raised when referencing a non-existent resource name of a pbs.* object.
SystemExit	1. Raised when pbs.event().reject() terminates hook execution. 2. Raised when pbs.event().accept() terminates hook execution.

5.2.3 Hook Alarm Calls and Unhandled Exceptions

- An execjob_begin or exechoost_startup hook can cause a failure action to take place when the hook script fails due to an alarm call or an unhandled exception. Otherwise, the following happens:

If a pre-execution event or execution event hook encounters an unhandled exception:

- PBS rejects the corresponding action. The command that initiates the action results in the following message in stderr:

```
"<command_name>: request rejected as filter hook <hook_name> encountered an exception. Please inform Admin"
```

- The following message appears in the appropriate PBS daemon log, logged under PBSEVENT_DEBUG2 event class:

```
"<request type> hook <hook_name> encountered an exception, request rejected"
```

- The job is left unmodified.

- If an `exechoost_startup` hook script encounters an unexpected error causing an unhandled exception, vnode changes do not take effect, but MoM continues to run, and the following message appears at level PBSEVENT_DEBUG2 in `mom_logs`:

```
"exechoost_startup hook <hook_name> encountered an exception, request rejected"
```

- The following statements will cause an unhandled exception if they appear in a hook script as is:

- ZeroDivisionError exception raised:

```
val = 5/0
```

- BadAttributeValueError exception raised; `pbs.hold_types` and strings don't mix:

```
pbs.event().job.Hold_Types = "z"
```

- EventIncompatibleError exception raised for the following `runjob` event; `runjob` event has `job` attribute, not `resv` attribute:

```
r = pbs.event().resv
```

- You can use `execjob_begin` and `exechoost_startup` hooks to offline vnodes when those hooks encounter alarm calls or unhandled exceptions. See [“Offlining and Clearing Vnodes Using the fail action Hook Attribute” on page 66 of the PBS Professional Reference Guide](#). You can then clear the offline state from those vnodes later when an `exechoost_startup` hook runs successfully.
- You can use an `execjob_begin` hook restart the scheduler cycle when the hook encounters an alarm call or unhandled exception. See [“Restarting Scheduler Cycle After Hook Failure” on page 63 of the PBS Professional Reference Guide](#).

For a list of exceptions, see [Table 5.2.2.1.ii, “Table of Exceptions,” on page 43](#).

5.2.4 Using Attributes and Resources in Hooks

5.2.4.1 Using Built-in vs. Custom Resources in Hooks

Hooks have more access to built-in resources than they do to custom resources. All hooks can read built-in resources. All event hooks that run at the server can read all custom resources via `pbs.event()`, as well as via `pbs.server()`. However, hooks that run at the execution host can read custom resources only via `pbs.server()`. So for example if a job requests a custom resource, a `runjob` hook can read the resource, but an `exechoost_begin` hook cannot.

5.2.4.2 Creating and Setting Custom Resources in Hooks

You can create a custom resource only in an `exechoost_startup` hook. You can set a custom resource in a hook that runs at the server or using an `exechoost_startup` hook. To create and set a custom resource in a vnode's `resources_available` attribute via an `exechoost_startup` hook:

```
# qmgr -c "create hook start event=exechoost_startup"
# qmgr -c "import hook start application/x-python default start.py"
# qmgr -c "export hook start application/x-python default"
```

Hook script:

```
import pbs
e=pbs.event()
localnode=pbs.get_local_nodename()

e.vnode_list[localnode].resources_available['foo_i'] = 7
e.vnode_list[localnode].resources_available['foo_f'] = 5.0
e.vnode_list[localnode].resources_available['foo_str'] = "seventyseven"
```

Note that while an `exehost_startup` hook cannot read an existing custom resource, it can create and set a new one.

When you create a custom job resource in an `exehost_startup` hook, the `m` flag is set by default. See ["Allowing Execution Hooks to Read Custom Job Resources Faster" on page 261 in the PBS Professional Administrator's Guide](#).

5.2.4.3 Determining Whether to Use Creation Method to Set Attribute or Resource

The way you set an attribute or resource depends on the type of the attribute or resource:

- If the attribute or resource is a string (`str`), an integer (`int`), a Boolean (`bool`), a long (`long`), or a floating point (`float`), you can set it directly:

```
pbs.event().job.<attribute name> = <attribute value>
pbs.event().job.Resource_List["<resource name>"]=<resource value>
```

For example:

```
jobA = pbs.event().job
jobA.Account_Name = "AccountA"
jobA.Priority = 100
```

- However, if the attribute or resource is any other type, you must use the corresponding creation method to instantiate an object of the correct type with the desired value as a formatted input string, then assign the object to the job. For example:

```
pbs.event().job.Hold_Types = pbs.hold_types("uo")
```

For creation methods, see [section 6.13.3, "PBS Types and Their Methods", on page 143](#).

5.2.4.3.i Caveat for Objects Requiring Creation Method

You can operate on these objects only as if they are strings. Use `repr()` on the object to get its full string representation. You can then manipulate this representation using the built-in methods for Python `'str'`.

5.2.4.3.ii Python Types not Requiring Creation Method

The following Python types do not require you to use an explicit creation method:

```
bool
float
int
str
```

5.2.4.4 How to Unset an Attribute or Resource

To unset an attribute or resource, set `<attribute value>` to `None`:

```
pbs.event().job.<attribute name> = None
```

When you unset an attribute or resource, it takes its default value.

5.2.4.4.i How to Unset an Attribute or Resource Requiring Creation Method

You can unset a job attribute or resource that has a creation method by setting it to *None*.

Example:

```
pbs.event().job.Hold_Types = None
```

5.2.4.5 Using Attributes in Hooks: Reading vs. Setting

All hooks can read, but not set, all job, vnode, server, queue, and reservation attributes via `pbs.server().job()`, `pbs.server().vnode()`, `pbs.server().queue()`, etc.

We list which job attributes can be read or set when the job is retrieved through an event in [Table 5-6, “Job Attributes Readable & Settable via Events,” on page 55](#).

We list which vnode attributes can be read or set when the vnode is retrieved through an event in [Table 5-7, “Vnode Attributes Readable & Settable via Events,” on page 57](#).

We list which reservation attributes can be read or set when the reservation is retrieved through an event in [Table 5-8, “Reservation Attributes Readable & Settable in resvsub and resv_end Hooks,” on page 59](#).

No hooks can see or set any scheduler attributes.

The job, vnode, or reservation object’s attributes appear to the hook as they would be after the event, not before it, for all hooks except `runjob` hooks.

5.2.4.6 Setting Time Attributes

For the job attributes `Execution_Time`, `ctime`, `etime`, `mtime`, `qtime`, and `stime`, the `pbs.job` object expects or shows the number of seconds since Epoch. The only one of these that can be set is `Execution_Time`.

For the reservation attributes `reserve_start`, `reserve_end`, and `ctime`, the `pbs.resv` object expects and shows the number of seconds since Epoch. The `ctime` attribute cannot be set.

If you wish to set the value for `Execution_Time`, `reserve_start`, or `reserve_end` using the `[[CCYY]MMDDhhmm[.ss]` format, or to see the value of any of the time attributes in the ASCII time format, load the Python `time` module and use the functions `time.mktime([CCYY, MM, DD, hh, mm, ss, -1, -1, -1])` and `time.ctime()`.

Example:

```
import time
job.Execution_Time = time.mktime([07, 11, 28, 14, 10, 15, -1, -1, -1])
time.ctime(job.Execution_Time)
'Wed Nov 28 14:10:15 2007'
```

If `reserve_duration` is unset or set to *None*, the reservation’s duration is taken from the `walltime` resource attribute associated with the reservation request. If `reserve_duration` and `walltime` are both specified, meaning not set to *None*, `reserve_duration` will take precedence.

5.2.4.7 Special Characters in Variable_List Job Attribute

When special characters are used in Variable_List job attributes, they must be escaped. For this attribute, special characters are comma (,), single quote (‘), double quote (“), and backslash (\). PBS requires each of these to be escaped with a backslash. However, Python requires that double quotes and backslashes also be escaped with a backslash. If the special character inside a string is a single quote, you must enclose the string in double quotes. If the special character inside the string is a double quote, you must enclose the string in single quotes. The following rules show how to use special characters in a Variable_List attribute when writing a Python script:

Table 5-3: How to Use Special Characters in Python Scripts

Character	Example Value	How Value is Represented in Python Script
, (comma)	<i>a,b</i>	“a\\,b” or ‘a\\,b’
' (single quote)	<i>c'd</i>	“c\\'d”
" (double quote)	<i>f"g"h</i>	'f\\"g\\"h'
\ (backslash)	<i>\home\dir\files</i>	“\\home\\dir\\files” or ‘\\home\\dir\\files’

For example, if the path is:

```
"\Documents and Settings\pbstest\bin:\windows\system32"
```

This is how the path shows up in a script:

```
job.Variable_List["PATH"] = "\\Documents and Settings\\pbstest\\bin:\\windows\\system32"
```

5.2.4.8 Using string_array Attributes and Resources

5.2.4.8.i Handling Literal Values and Special Characters in string_array Format

In order to capture a literal value or special characters in a string_array attribute or resource, enclose the entire string array in single quotes.

For an attribute or resource whose type is string_array and whose value contains one or more commas (“,”), the whole string must be enclosed in single quotes, outside of its double quotes. For example:

If our string array has a single element consisting of “glad, elated”:

```
job.Resource_List["test_string_array"] = ' "glad, elated" '
```

If our string array has two elements, where one is “glad, elated” and the other is “happy”:

```
job.Resource_List["test_string_array"] = ' "glad, elated", "happy" '
```

5.2.4.9 Using Resources in Hooks: Reading vs. Setting

All hooks can read, but not set, all job, vnode, server, queue, and reservation resources via pbs.server().job(), pbs.server().vnode(), pbs.server().queue(), etc.

The resources that can be read or set via pbs.event() vary by hook:

We list the job resources that can be read and set via an event in each kind of hook in [Table 5-9, “Built-in Job Resources Readable & Settable by Hooks via Events,” on page 60.](#)

We list the vnode resources that can be read and set via an event in each kind of hook in [Table 5-10, “Vnode Resources Readable & Settable by Hooks via Events,” on page 61.](#)

We give an overview of the resources that can be read and set by each hook in [Table 5-4, “Overview of Resources Readable & Settable by Hooks via Pre-execution and Provision Events,” on page 52](#) and [Table 5-5, “Overview of Resources Readable & Settable by Hooks via execjob_ and exechost_ Events,” on page 52](#). In these tables, if we say that a hook can read or set a group of resources, for example the server’s `resources_available` attribute, that means that the hook can read or set all of the resources for that group.

5.2.4.10 Reading Resources in Hooks

PBS resources are represented as objects of type `pbs.pbs_resource`, where the resource names are the keys. This type is described in [section 6.13.3.19, “Method to Create or Set Resource List”, on page 146](#). Built-in resources are listed in [“List of Built-in Resources” on page 259 of the PBS Professional Reference Guide](#).

You can read a resource through objects such as the server, the event that triggered the hook, or the vnode to which a resource belongs. For example:

```
pbs.server().resources_available["<resource name>"]
pbs.event().job.Resource_List["<resource name>"]
pbs.event().vnode_list[<vnode name>].resources_available["ncpus"]
```

The resource name must be in quotes.

Example: Get the number of CPUs in a job’s `Resource_List` attribute:

```
ncpus=pbs.event().job.Resource_List["ncpus"]
```

5.2.4.10.i Converting walltime to Seconds

If you want to see a job’s walltime in seconds:

```
int(pbs.event().job.Resource_List["walltime"])
```

For example:

```
pbs.logmsg(pbs.LOG_DEBUG, "walltime=%d" % (int(pbs.event().job.Resource_List["walltime"])))
```

If walltime is "00:30:15", this results in the following:

```
walltime=1815
```

5.2.4.11 Setting and Unsetting Vnode Resources and Attributes

You can set and unset vnode resources and attributes using the `vnode_list[]` object in an `exechost_startup` or `exechost_periodic` hook. Any changes made this way are merged with those defined in a Version 2 vnode configuration file.

To set the attributes and resources for a particular vnode:

```
pbs.event().vnode_list[<vnode name>].<attribute> = <value>
```

```
pbs.event().vnode_list["<vnode name>"].resources_available["<resource name>"] = <resource value>
```

Resource names and string values must be quoted.

Some examples:

```
pbs.event().vnode_list["V2"].pcpus = 5
pbs.event().vnode_list["V2"].resources_available["ncpus"] = 3
pbs.event().vnode_list["V2"].resources_available["mem"] = pbs.size("100gb")
pbs.event().vnode_list["V2"].arch = "linux"
pbs.event().vnode_list["V2"].state = pbs.ND_OFFLINE
pbs.event().vnode_list["V2"].sharing = pbs.ND_FORCE_EXCL
```


To unset a resource value, specify “None” as its value:

```
pbs.event().vnode_list[<vnode_name>].resources_available[<res>] = None
pbs.event().vnode_list[<vnode_name>].<attribute> = None
```

5.2.4.12 Setting Job Resources in Hooks

You can set a job’s Resource_List in pre-execution event hooks listed in [Table 5-9, “Built-in Job Resources Readable & Settable by Hooks via Events,” on page 60](#).

You can use an execution event hook (execjob_prologue, execjob_epilogue, and exechost_periodic) to set the value of a job’s resources_used for host-level resources. The values of these resources are then reported in the job’s resources_used attribute. For multi-vnode jobs, numeric values are summed and string resources are aggregated on a per-MoM basis.

5.2.4.12.i Steps for Setting Job Resources in Hooks

You can set values for a job’s Resource_List or resources_used attributes as follows:

```
pbs.event().job.Resource_List["<resource name>"] = <resource value>
pbs.event().job.resources_used["<resource name>"] = <resource value>
```

For example:

```
pbs.event().job.Resource_List["mem"] = 8gb
```

5.2.4.12.ii String Resource Format for Python

Each string value returned by a MoM is a JSON object (a Python dictionary), which is an unordered set of key-value pairs, where each object begins with a left curly brace (“{”), and ends with a right curly brace (“}”). Each key is followed by a colon (“:”), and the key-value pairs are separated using a comma (“,”). The key is enclosed in double quotes (allowing backslash escapes).

5.2.4.12.iii Setting String Job Resources in Hooks

When all values are in JSON format, the resulting string resource value is a union of all dictionary items, shown in `qstat -f` output and accounting logs as:

```
resources_used.<resource_name> = {<MoMA_JSON_item_value>, <MoMB_JSON_item_value>,
  <MoMC_JSON_item_value>, ..}
```

Example 5-10: If MoMA returns '{ "a":1, "b":2 }', MoMB returns '{ "c":1 }', and MoMC returns '{ "d":4}' for resources_used.foo_str. We see the following:

```
resources_used.foo_str='{ "a": 1, "b": 2, "c":1, "d": 4}'
```

If two or more values have the same value for the key, only one of them is retained, depending on Python’s operation of merging dictionary items. We recommend that hook writers make the keys unique; you can do this by using the value returned by `pbs.get_local_nodename()` as part of the key.

When at least one of the values obtained from a sister MoM is not of JSON format, the string cannot be accumulated, and resources_used remains unset. PBS writes an error message in the MoM logs as follows:

```
"Job <jobid> resources_used.<string_resource> cannot be accumulated: value <input value> from MoM
  <hostname> not JSON-format: <exception_error_message>."
```

5.2.4.12.iv Example of Setting Resources in Hooks

Example 5-11: Using an epilogue hook that runs on all the MoMs, we set different `resources_used` values depending on whether the hook executes on the primary execution host or a sister MoM:

```
#: qmgr -c "list hook epi"
Hook epi
type = site
enabled = true
event = execjob_epilogue
user = pbsadmin
alarm = 30
order = 1
debug = false
fail_action = none
# qmgr -c "e h epi application/x-python default"
import pbs
e=pbs.event()
pbs.logmsg(pbs.LOG_DEBUG, "executed epilogue hook")
if e.job.in_ms_mom(): #set in MS mom
    e.job.resources_used["vmem"] = pbs.size("9gb")
    e.job.resources_used["foo_i"] = 9
    e.job.resources_used["foo_f"] = 0.09
    e.job.resources_used["foo_str"] = '{"nine":9}'
    e.job.resources_used["cput"] = 10
    e.job.resources_used["foo_assn2"] = '{"vn1":1,"vn2":2,"vn3":3}'
else: # set in sister mom
    e.job.resources_used["vmem"] = pbs.size("10gb")
    e.job.resources_used["foo_i"] = 10
    e.job.resources_used["foo_f"] = 0.10
    e.job.resources_used["foo_str"] = '{"ten":10}'
    e.job.resources_used["cput"] = 20
    e.job.resources_used["foo_assn2"] = '{"vn4":4,"vn5":5,"vn6":6}'
```

Using two execution hosts, submit the following job:

```
% cat job.scr2
PBS -l select=2:ncpus=1
pbsdsh -n 1 hostname
sleep 300

% qsub job.scr2
102.corretja
```

When the job completes, we can see values for `resources_used`. With server `job_history_enabled=True`, we can check the values in a finished job. Values in bold show resources accumulated from both MoMs:

```
% qstat -x -f 102
...
resources_used.cpubercent = 0
resources_used.cput = 00:00:30
resources_used.vmem = 19gb
resources_used.foo_f = 0.19
resources_used.foo_i = 19
resources_used.foo_str = '{"nine": 9, "ten": 10}'
resources_used.foo_assn2='{"vn1": 1, "vn2": 2, "vn3": 3, "vn4": 4, "vn5": 5, "vn6": 6}'
resources_used.mem = 0kb
resources_used.ncpus = 2
resources_used.walltime = 00:00:05
```

The accounting logs show the same values:

```
8/03/2016 18:28:13;E;102.corretja;user=alfie group=users project= pbs_project_default
jobname=job.scr2 queue=workq ctime=1470263288 qtime=1470263288 etime=1470263288
start=1470263288 exec_host=corretja/0+nadal/0 exec_vnode=(corretja:ncpus=1)+(nadal:ncpus=1)
Resource_List.ncpus=2 Resource_List.nodect=2 Resource_List.place=free
Resource_List.select=2:ncpus=1 session=16986 end=1470263293 Exit_status=143
resources_used.cpubercent=0 resources_used.cput=00:00:30 resources_used.vmem=19gb
resources_used.foo_f=0.19 resources_used.foo_i=19 resources_used.foo_str='{"nine": 9, "ten":
10}' resources_used.foo_assn2='{"vn1": 1, "vn2": 2, "vn3": 3, "vn4": 4, "vn5": 5, "vn6": 6}'
resources_used.mem=0kb resources_used.ncpus=2 resources_used.walltime=00:00:05 run_count=1
```

5.2.4.12.v Setting Built-in Job Resource in Hook Prevents MoM from Updating Resource

If you use a hook to set the value of a built-in host-level resource for a specific job, MoM no longer updates the value of the resource for that job; she leaves that to you. You can get MoM to resume updating the resource for that job only by changing the hook so that it doesn't set the resource, and restarting the job.

Under Linux, job `resources_used` that MoM does not modify if they've been set in a hook are `cput`, `walltime`, `mem`, `vmem`, `ncpus`, and `cpupercent`.

Under Windows, job `resources_used` that MoM does not modify if they've been set in a hook are `cput`, `walltime`, `mem`, and `ncpus`.

5.2.4.13 Overview of Readable & Settable Resources

Here we list an overview of which resources can be read or set in hooks. An “r” indicates read, an “s” indicates set, and an “o” indicates that this resource can be set but the action has no effect. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect. The following table shows which resource categories are readable or settable in pre-execution and provision hooks:

Table 5-4: Overview of Resources Readable & Settable by Hooks via Pre-execution and Provision Events

Resource Category	queuejob	modifyjob (before run)	movejob	runjob	resvsub	resv_end	provision
Job Resource_List (Varies; see Table 5-9)	r, s	r, s	r	Table 5-9	---	---	---
Job resources_used	o	r	r	r	r	---	---
Vnode resources_available	---	---	---	---	---	---	---
Vnode resources_assigned	r	r	r	r	r	---	r
Server resources_available	r	r	r	r	r	r	r
Server resources_assigned	r	r	r	r	r	r	r
Server resources_default	r	r	r	r	r	r	r
Server resources_max	r	r	r	r	r	r	r
Queue resources_available	r	r	r	r	r	r	r
Queue resources_assigned	r	r	r	r	r	r	r
Queue resources_default	r	r	r	r	r	r	r
Queue resources_max	r	r	r	r	r	r	r
Queue resources_min	r	r	r	r	r	r	r
Reservation Resource_List	r	r	r	r	r, s	r	---

The following table lists an overview of which resources can be read or set in `execjob` and `execlist` hooks.

Table 5-5: Overview of Resources Readable & Settable by Hooks via `execjob_` and `execlist_` Events

Resource Category	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execlist_startup	execlist_periodic
Job Resource_List (except for custom resources)	r	r	r	r	r	r	r	r	r	r	r
Job resources_used	r, s	r	r, s	r, s	r	r	r	r, s	r, s	r	r, s
Vnode resources_available	r, s	r	r, s	r	r	r	r	r, s	r, s	r, s	r, s
Vnode resources_assigned	r	r	r	r	r	r	r	r	r	r	r
Server resources_available	r	r	r	r	r	r	r	r	r	r	r
Server resources_assigned	r	r	r	r	r	r	r	r	r	r	r
Server resources_default	r	r	r	r	r	r	r	r	r	r	r

Table 5-5: Overview of Resources Readable & Settable by Hooks via `execjob_` and `execheost_` Events

Resource Category	<code>execjob_begin</code>	<code>execjob_attach</code>	<code>execjob_prologue</code>	<code>execjob_launch</code>	<code>execjob_postsuspend</code>	<code>execjob_preresume</code>	<code>execjob_end</code>	<code>execjob_epilogue</code>	<code>execjob_preterm</code>	<code>execheost_startup</code>	<code>execheost_periodic</code>
Server <code>resources_max</code>	r	r	r	r	r	r	r	r	r	r	r
Queue <code>resources_available</code>	r	r	r	r	r	r	r	r	r	r	r
Queue <code>resources_assigned</code>	r	r	r	r	r	r	r	r	r	r	r
Queue <code>resources_default</code>	r	r	r	r	r	r	r	r	r	r	r
Queue <code>resources_max</code>	r	r	r	r	r	r	r	r	r	r	r
Queue <code>resources_min</code>	r	r	r	r	r	r	r	r	r	r	r
Reservation <code>Resource_List</code>	r	r	r	r	r	r	r	r	r	r	r

5.2.4.14 Caveats for Setting and Unsetting Attributes and Resources

5.2.4.14.i When to Change Reservation Attributes

The only time that a reservation’s attributes can be altered is during the creation of that reservation in a `resvsub` hook.

5.2.4.14.ii Caution About Unsetting Reservation `walltime` Resource

The `walltime` resource is used to determine the reservation’s `reserve_duration` parameter when the reservation’s `reserve_duration` attribute is not set or is set to *None*. If a `resvsub` hook attempts to unset the `walltime` parameter, for example:

```
pbs.event().resv.Resource_List["walltime"] = None
```

This will result in the following error:

```
% pbs_rsub -R 1800 -l ncpus=1
pbs_rsub: Bad time specification(s)
```

5.2.4.14.iii Changing Job Attributes for a Running Job

When a job is running, only the `cput` and `walltime` attributes can be modified. Attempting to change any other attributes for a running job will cause the corresponding `qalter` action to be rejected. For example, if the job is running, this line in a hook will cause `qalter` to be rejected:

```
pbs.event().job.Resource_List["mem"] = pbs.size("10mb")
```

To avoid having the `qalter` action rejected, check to see whether the job is running, and follow up accordingly. For example:

```
e = pbs.event()
if e.job.job_state in [ pbs.JOB_STATE_RUNNING, pbs.JOB_STATE_EXITING, pbs.JOB_STATE_TRANSIT ]:
    e.accept()
```

5.2.4.14.iv Do Not Unset Array Job Indices

Do not unset `pbs.event().job.array_indices_submitted` for an array job in a `modifyjob` hook. For example:

```
pbs.event().job.array_indices_submitted = None
```

If the hook script is executed for a job array, the `qalter` request will fail with the message:

```
Cannot modify attribute while job running <job array ID>
```

5.2.4.14.v Do Not Create Job or Reservation Variable List

Hooks are not allowed to create job or reservation `Variable_List` attributes. Hooks can modify the existing `Variable_List` job attribute which is supplied by PBS, by modifying values in the list. The following are disallowed in a hook:

```
pbs.event().job.Variable_List = dict()
pbs.event().resv.Variable_List = dict()
```

These calls will cause the following exception:

```
04/07/2008 11:22:14;0001;Server@host2;Svr;Server@host2;PBS server internal error (15011) in Error
evaluating Python script, attribute 'Variable_List' cannot be directly set.
```

To modify the `Variable_List` attribute:

```
pbs.event().job.Variable_List["SIMULATE"] = "HOOK1"
```

5.2.4.14.vi Changing Vnode state Attribute

A vnode's state can be set within a `runjob` hook only if the `runjob` hook execution concludes with a `pbs.event().reject()` call. This means that if a statement that sets a vnode's state appears in a `runjob` hook script, it takes effect only if the following is the last line to be executed:

```
pbs.event().reject()
```

To set a vnode's state, the syntax is one of the following:

```
pbs.vnode.state = <vnode state constant>
```

```
pbs.vnode.state += <vnode state constant>
```

```
pbs.vnode.state -= <vnode state constant>
```

where `<vnode state constant>` is one of the constant objects listed in [section 6.10.4, "Vnode State Constant Objects", on page 135](#).

Examples of changing a vnode's state attribute:

- To offline a vnode:
`pbs.vnode.state = pbs.ND_OFFLINE`
- To add another value to the list of vnode states:
`pbs.vnode.state += pbs.ND_DOWN`
- To remove a value from the list of vnode states:
`pbs.vnode.state -= pbs.ND_OFFLINE`

When a vnode's `state` attribute has no states set, the vnode's state is equivalent to `free`. This means that you can remove all values, and the vnode will become `free`.

When a vnode's state is successfully set, the following message is displayed and logged at event class 0x0004:

```
Node;<vnode-name>;attributes set: state - <vnode state constant> by <hook_name>
```

You can set a vnode's `state` attribute in any execution hook and in a periodic hook, and changes to vnode attributes take effect whether the execution hook or periodic hook calls `accept()` or `reject()`.

5.2.4.14.vii Attribute Change Failure is Silent

If you attempt to change the value for an attribute in an unsupported way, PBS does not warn you that your attempt failed.

5.2.4.14.viii Lengthened walltime Can Interfere with Reservations

If a hook lengthens the walltime of a running job, you run the risk that the new walltime will interfere with existing reservations etc.

5.2.4.14.ix Setting Vnode Resources in Hooks Overwrites Previous Value

When you set `resources_available` for a vnode, inside or outside of a hook, you are overwriting the previous value. There is no way in a hook to know whether a value was set inside or outside a hook (for example, using `qmgr` or a vnode definition file). There is no way to prevent a value set inside a hook from being modified outside of the hook.

5.2.4.14.x Changing Resources in Accounting Logs

If you use a non-`execjob_end` execution hook to set a value for `resources_used`, the new value for `resources_used` appears in the accounting logs.

5.2.4.14.xi When Setting Resources Has No Effect

- If you use an `execjob_end` execution hook to set a value for `resources_used`, it has no effect, because MoM has already sent the final values for `resources_used` to the server.
- You cannot use a hook to set a server-level resource. PBS ignores these actions in a hook.
- You cannot use the `qmgr` command to set `resources_used` for a job.

5.2.4.15 Table: Reading & Setting Job Attributes in Hooks

The following table lists the job attributes that can be read or set when the job is retrieved via an event. An “r” indicates read, an “s” indicates set, and an “o” indicates that this attribute can be set but the action has no effect. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect.

Table 5-6: Job Attributes Readable & Settable via Events

Job Attribute	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	resvsub	resv_end	periodic	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic
accounting_id	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Account_Name	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
accrue_type	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
alt_id	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
argument_list	---	---	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
array	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
array_id	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
array_index	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
array_indices_remaining	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
array_indices_submitted	r, s	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
array_state_count	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
block	---	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Checkpoint	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
comment	---	---	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
create_resv_from_job	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s	r, s

Table 5-6: Job Attributes Readable & Settable via Events

Job Attribute	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	resvsub	resv_end	periodic	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic
ctime	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
depend	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
egroup	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
eligible_time	---	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Error_Path	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r
estimated	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
etime	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
euser	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Executable	r, s	---	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Execution_Time	r, s	r, s	r	r, s	r	---	---	---	r, s	r	r, s	r, s	r	r	r	r, s	r, s	---	r, s
exec_host	---	---	r	---	---	---	---	---	r	r	r	r	r	r	r	r	r	---	r
exec_vnode	---	---	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Exit_status	---	r	r	r	r	---	---	---	---	r	---	---	r	r	r	r	---	---	---
group_list	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
hashname	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Hold_Types	r, s	r, s	r	r, s	r	---	---	---	r, s	r	r, s	r, s	r	r	r	r, s	r, s	---	r, s
interactive	r, s	r, o	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
jobdir	---	r	r	---	---	---	---	---	---	---	---	---	---	---	---	r	---	---	---
Job_Name	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Job_Owner	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
job_state	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Join_Path	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Keep_Files	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Mail_Points	r, s	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Mail_Users	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
mtime	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
no_stdio_sockets	---	---	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Output_Path	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Priority	r, s	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
project	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
pset	---	---	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
qtime	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
queue	r, s	r	r, s	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
queue_rank	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
queue_type	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
release_nodes_on_stage out	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rerunable	r, s	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
resources_released	r	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
resources_released_list	r	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
resources_used	---	r	r	r	r	---	---	---	r, s	r	r, s	r, s	r	r	r	r, s	r, s	r, s	r, s

Table 5-6: Job Attributes Readable & Settable via Events

Job Attribute	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	resvsub	resv_end	periodic	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	exechost_startup	exechost_periodic
Resource_List (with restrictions; see Table 5-9)	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r
run_count	r, s	r, s	r	r	r	---	---	---	r, s	r	r, s	r, s	r	r	r	r, s	r, s	---	r, s
run_version	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
sandbox	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
schedselect	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
sched_hint	---	---	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
server	---	r	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
session_id	---	---	---	---	---	---	---	---	---	---	---	---	r	r	r	r	r	---	---
Shell_Path_List	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
stagein	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
stageout	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
Stageout_status	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
stime	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Submit_arguments	---	---	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
substate	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
sw_index	---	r	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
umask	r, s	r, s	r	r	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r
User_List	r, s	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Variable_List	r, s	r, s	r	r, s	r, s	---	---	---	r, s	r	r	r	r	r	r	r	r	---	r, s

5.2.4.16 Table: Reading & Setting Vnode Attributes in Hooks

The following table shows the vnode attributes that can be read or set when the vnode object is retrieved via an event. An “r” indicates read, an “s” indicates set, and an “o” indicates that this attribute can be set but the action has no effect. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect.

Table 5-7: Vnode Attributes Readable & Settable via Events

Vnode Attribute	queuejob	modifyjob (before run)	movejob	runjob	resvsub	resv_end	periodic	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	exechost_startup	exechost_periodic	provision
comment	r, s	r, s	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
current_aoe	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
hpcbp_enable	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---

Table 5-7: Vnode Attributes Readable & Settable via Events

Vnode Attribute	queuejob	modifyjob (before run)	movejob	runjob	resvsub	resv_end	periodic	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
hpcbp_stage_protocol	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
hpcbp_user_name	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
hpcbp_webservice_address	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
in_multivnode_host	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
jobs	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
license	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
license_info	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Mom	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
name	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
no_multinode_jobs	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
ntype	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
pbs_version	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r	r	---
pcpus	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r	r	---
pnames	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
Port	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
Priority	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
provision_enable	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
queue	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
resources_assigned	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r	r	---
resources_available	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
resv	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
resv_enable	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
sharing	---	---	---	---	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
state	---	---	---	r, s	---	---	---	r, s	r	r, s	r, s	r	r	r, s	r, s	r, s	r, s	r, s	---
topology_info	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	r	r	---

5.2.4.17 Table: Reading & Setting Reservation Attributes in resvsub and resv_end Hooks

Reservation attributes can be read and set through an event only in resvsub and resv_end hooks. No other hooks can read or set reservation attributes through an event. All hooks can read, but not set, all reservation attributes by retrieving the reservation object through the server, using `pbs.server().resv()`. The following table shows the reservation attributes that can be read or set when the reservation object is retrieved via an event, in a resvsub or resv_end hook:

Table 5-8: Reservation Attributes Readable & Settable in resvsub and resv_end Hooks

Reservation Attribute	resvsub	resv_end
Account_Name	r	r
Authorized_Groups	r, s	r
Authorized_Hosts	r, s	r
Authorized_Users	r, s	r
ctime	r	r
group_list	r, s	r
hashname	r	r
interactive	r, s	r
Mail_Points	r, s	r
Mail_Users	r, s	r
mtime	r	r
Priority	r	r
queue	r	r
reserve_count	r	r
reserve_duration	r, s	r
reserve_end	r, s	r
reserve_ID	r	r
reserve_index	r	r
reserve_job	r	r
Reserve_Name	r, s	r
Reserve_Owner	r	r
reserve_retry	r	r
reserve_rrule	r, s	r
reserve_start	r, s	r
reserve_state	r	r
reserve_substate	r	r
reserve_type	r	r

Table 5-8: Reservation Attributes Readable & Settable in resvsub and resv_end Hooks

Reservation Attribute	resvsub	resv_end
Resource_List	r, s	r
resv_nodes	r	r
server	r, s	r
User_List	r	r
Variable_List	r, s	r

5.2.4.18 Table: Reading & Setting Built-in Job Resources in Hooks

The following table shows the built-in members of the job’s Resource_List attribute that can be read or set in each type of hook, when retrieving the object through an event.

An “r” indicates read, an “s” indicates set, and an “o” indicates that this resource can be set but the action has no effect. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect. For more about custom resources, see [section 5.2.4.1, “Using Built-in vs. Custom Resources in Hooks”, on page 44](#).

Table 5-9: Built-in Job Resources Readable & Settable by Hooks via Events

Resource in Resource_List	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
accelerator	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
accelerator_memory	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
accelerator_model	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
aoe	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
arch	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
cput	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
exec_vnode	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
file	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
host	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
max_walltime	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
mem	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
min_walltime	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
mpiprocs	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
naccelerators	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
nchunk	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
ncpus	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
nice	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
nodect	r, s	r, s	r	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
nodes	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
ompthreads	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table 5-9: Built-in Job Resources Readable & Settable by Hooks via Events

Resource in Resource_List	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
pccput	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
pmem	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
pvmem	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
site	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
software	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
soft_walltime	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
start_time	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
vmem	r, s	r, s	r	r, s	r	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
vnode	r, s	r, s	r	r, s	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
vntype	r, s	r, s	r	r, s	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
walltime	r, s	r, s	r	r, s	r, s	---	---	---	r	r	r	r	r	r	r	r	r	---	r	---
PBScrayhost	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PBScraylabel_<label name>	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PBScraynid	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PBScrayorder	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
PBScrayseg	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

5.2.4.19 Table: Reading & Setting Vnode Resources in Hooks

The following table shows the built-in members of the vnode’s resources_available attribute that can be read or set in each type of hook, when retrieving the object through an event. An “r” indicates read, an “s” indicates set, and an “o” indicates that this resource can be set but the action has no effect. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect.

Table 5-10: Vnode Resources Readable & Settable by Hooks via Events

Resource in resources_available	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
accelerator	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
accelerator_memory	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
accelerator_model	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
aoe	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
arch	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
cpu	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---

Table 5-10: Vnode Resources Readable & Settable by Hooks via Events

Resource in resources_available	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
exec_vnode	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
file	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
host	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
max_walltime	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
mem	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
min_walltime	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
mpiprocs	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
naccelerators	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
nchunk	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
ncpus	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
nice	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
nodect	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
nodes	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
ompthreads	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
pcput	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
pmem	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
pvmem	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
site	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
software	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
start_time	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
vmem	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
vnode	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
vntype	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
walltime	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
PBSctrayhost	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
PBSctraylabel_<label name>	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
PBSctraynid	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
PBSctrayorder	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---
PBSctrayseg	---	---	---	---	---	---	---	---	r	r	r	r	r	r	r	r	r	r, s	r, s	---

5.2.5 Using select and place in Hooks

All hooks can read, but not set, a job’s select and place statements via `pbs.server().job()`, `pbs.server().vnode()`, `pbs.server().queue()`, etc. The following table shows the type of hook that can read or set a job’s select and place statements, when retrieving the object through an event. An “r” indicates *read*, an “s” indicates *set*. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect.

Table 5-11: Hooks that Can Read & Set Job select and place Statements via Events

Select or Place	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
Job place statement	r, s	r, s	r	r, s	r	---	---	---	---	---	r	r	r	r	r	---	---	---
Job select statement	r, s	r, s	r	r, s	r	---	---	---	---	---	r, s	r, s	r	r	r	---	---	---

5.2.5.1 How to Set select and place in Hooks

You must use the associated creation method to instantiate an object of the correct type with the desired value, then assign the object to the job. Syntax:

```
job.Resource_List["place"] = pbs.place("[arrangement]:[sharing]:[group]")
job.Resource_List["select"] = pbs.select("[N:]res=val[:res=val][+[:N:]res=val[:res=val] ... ]")
```

Example 5-12: Set a job’s select and place directives:

```
jobB = pbs.event().job
jobB.Resource_List["place"] = pbs.place("pack:exclhost")
jobB.Resource_List["select"] = pbs.select("2:mem=2gb:ncpus=1+6:mem=8gb:ncpus=16")
```

See ["pbs.select\(\)" on page 147](#) and ["pbs.place\(\)" on page 147](#).

For modifying a job’s select statement when allowing jobs access to extra vnodes, see [section 6.13.3.24, “Method to Increment select Object Chunks”, on page 148](#) and [section 6.6.4.4, “Job Object Method to Release Vnodes”, on page 128](#). For more about making jobs more reliable, see [“Vnode Fault Tolerance for Job Start and Run” on page 426 of the PBS Professional Administrator’s Guide](#).

5.2.5.2 Caveats for Using select and place in Hooks

You may want to check resource requests for a queuejob hook. If a user submits a job using old `-lnodes` or `-lncpus` syntax, this is translated to a select statement, but only after a queuejob hook has run.

5.2.6 Restarting Scheduler Cycle After Hook Failure

You can restart the scheduler after an `execjob_begin` hook fails due to an alarm call or unhandled exception, or when the hook fails due to an internal error such as a full disk or not enough memory on the host, for example, a `malloc()` error. To restart the scheduler after failure of an `execjob_begin` hook, set the value of an `execjob_begin` or `execjob_prologue` hook’s `fail_action` attribute to include `“scheduler_restart_cycle”`.

```
# qmgr -c "set hook <hook_name> fail_action += scheduler_restart_cycle"
```

See [section 5.1.9.2, “Using the fail_action Hook Attribute”, on page 37](#).

5.2.7 Adding Custom Non-consumable Host-level Resources

You can add new custom host-level, non-consumable resources and set their values in `resources_available` for a `vnode` by using `vnode_list[]` in an `exehost_startup` hook. Any changes made this way are merged with those defined in a Version 2 `vnode` configuration file. Upon startup, MoM reads configuration files before executing the `exehost_startup` hook.

To add a new custom host-level resource, and set its value:

```
v = pbs.event().vnode_list[ <vnode name>]
v.resources_available[<new_resource>] = <value>
```

The type of the resource is inferred from the value assigned to the resource. Python types map to PBS types as shown in the following table:

Table 5-12: Resource Types when Adding via `vnode_list`

Python Type	Type
<i>int</i>	<i>Long</i>
<i>str</i>	<i>String</i>
<i>bool</i>	<i>Boolean</i>
<i>pbs.size</i>	<i>Size</i>
<i>pbs.duration</i>	<i>Long</i>
<i>float</i>	<i>Float</i>
Any Python type without an explicit match	<i>String</i>

You must also make the resource usable by the scheduler: see [section 5.14.2.6, “Allowing Jobs to Use a Resource”, on page 265](#).

To delete a custom resource created in a hook, use `qmgr`. See [section 5.14.2.4.iii, “Deleting Custom Resources”, on page 263](#).

Example 5-13: Adding custom resources:

If you have these instructions in a hook:

```
vn.resources_available["fab_int"] = 9
vn.resources_available["fab_str"] = "happy"
vn.resources_available["fab_bool"] = False
vn.resources_available["fab_size"] = pbs.size("7mb")
vn.resources_available["fab_time"] = pbs.duration("00:30:00")
vn.resources_available["fab_float"] = 7.0
```

This is equivalent to the following `qmgr` commands:

```
qmgr -c "create resource fab_int type=long,flag=h"
qmgr -c "create resource fab_str type=string,flag=h"
qmgr -c "create resource fab_bool type=boolean,flag=h"
qmgr -c "create resource fab_size type=size,flag=h"
qmgr -c "create resource fab_time type=long,flag=h"
qmgr -c "create resource fab_float type=float,flag=h"
```


5.2.8 Printing And Logging Messages

Hooks can log a custom string in the local daemon's log, at message log event class `pbs.LOG_DEBUG (0x0004)`. This is done using the `pbs.logjobmsg(job ID, message)` facility. See ["pbs.logjobmsg\(\)" on page 151](#).

Hooks can specify a message for use when the corresponding action is rejected. This message is printed to `stderr` by the command that triggered the event, and is printed in the daemon's log. This is done using the `pbs.event().reject(<message>)` function. See ["pbs.event\(\).reject\(\)" on page 116](#) for information on how to specify a rejection message.

Hooks cannot directly print to `stdout` or `stderr`, or read from `stdin`. See [section 5.3.8.1, "Avoid Hook File I/O", on page 71](#), and [section 8.10.2.8, "Hooks Attempting I/O", on page 225](#).

5.2.9 Capturing Return Code

To capture an application's return code, you capture the return code in Python and then return it from the hook. You can use the Python `subprocess` module. Here is an example snippet:

```
import sys
if "<path to subprocess module>" not in sys.path:
    sys.path.append("<path to subprocess module>")
import subprocess

try:
    retcode = subprocess.call("mycommand myarg", shell=True)
except OSError:
    retcode = -1

return retcode
```

5.2.10 When You Need Persistent Data

If you need your data to be persistent, your hook(s) must be able to save and retrieve the information. Hooks are stateless, and each invocation of a hook has no knowledge of prior state of jobs, vnodes, etc. If you want to retain state across invocations of a hook, you can have the hook write what you need to a well-known location such as `PBS_HOME`. When the hook is invoked, it can read in the data, and before the hook exits, it can update the data. You can use whatever format you like for the data.

5.2.11 Setting Up Job Environment on Sisters

If you need to set up the job's environment on sister MoMs, use an `execjob_begin` hook. This hook can set up the desired environment on sister MoMs so that the job can use the new environment.

If job tasks are spawned on sister MoMs via a tightly-integrated MPI that uses `tm_spawn()`, any `execjob_prologue` and `execjob_launch` hooks run on the sister MoMs. However, if job tasks are started using `pbs_attach()`, `execjob_attach` and `execjob_prologue` (on the first task attached) hooks run on sister MoMs instead. For a detailed description of the order in which hooks run on the primary and secondary execution hosts, see [Table 4-1, "Execution Event Hook Timing," on page 19](#).

The old-style prologue runs only on the primary execution host; you cannot use it to set up the environment on sister MoMs.

All job tasks running on vnodes managed by the same MoM get the same environment.

5.2.12 Offlining Bad Vnodes

5.2.12.1 General Method for Offlining Bad Vnodes

If you need to offline a bad vnode where a hook is running:

```
this_vnode = pbs.event().vnode_list[pbs.get_local_nodename()]
this_vnode.state = pbs.ND_OFFLINE
this_vnode.comment = "offlining this vnode"
```

5.2.12.2 Offlining Vnodes Associated with an Event

For example, in a job-related event, you can offline the vnodes and reject the job:

```
for v in pbs.event().vnode_list.keys():
    pbs.event().vnode_list[v].state = pbs.ND_OFFLINE
    pbs.event().vnode_list[v].comment = "Offlining this vnode"
pbs.event().reject("Job tried to run on bad vnodes")
```

5.2.12.3 Using List of Failed Vnodes to Offline Vnodes that Have Gone Bad During Start or Run

For each `execjob_prologue` and `execjob_launch` event, PBS records the list of vnodes, with their assigned resources, that are marked as bad by MoM. This list can include those vnodes from sister MoMs that failed to join the job, that rejected an `execjob_begin` hook or `execjob_prologue` hook request, or that encountered a communication error while the primary MoM was polling the sister MoM host. PBS records this list in the `pbs.event().vnode_list_fail[]` hook parameter. This parameter is a *dict* (dictionary of `pbs.vnode` objects keyed by vnode name).

You can use a hook to walk through this list and offline the bad vnodes. Here is a code snippet:

```
for vn in e.vnode_list_fail:
    v = e.vnode_list_fail[vn]
    pbs.logmsg(pbs.LOG_DEBUG, "offlining %s" % (vn,))
    v.state = pbs.ND_OFFLINE
```

5.2.12.4 Offlining and Clearing Vnodes Using the fail_action Hook Attribute

The way this works is that when a vnode fails a health check in an `execjob_begin` hook, it is offlined via “`offline_vnodes`”. Once the vnode is offlined, no other jobs are sent to the vnode, so no other `execjob_begin` hooks will run until the vnode is cleared. You then use “`clear_vnodes_upon_recovery`” in an `exehost_startup` hook which runs when the MoM starts up or is HUPed.

5.2.12.4.i Offlining Vnodes Using the fail_action Hook Attribute

You can offline vnodes when an `execjob_prologue`, `execjob_begin` or `exehost_startup` hook fails due to an alarm call or unhandled exception, or when the hook fails due to an internal error such as a full disk or not enough memory on the host, for example, a `malloc()` error.

To offline vnodes upon failure, set the value of the hook’s `fail_action` attribute to include “`offline_vnodes`”. This marks the vnodes managed by the hook’s MoM as *offline*.

```
# qmgr -c "set hook <hook_name> fail_action += offline_vnodes"
```

When a vnode is offlined using the `fail_action` attribute, the vnode's `comment` attribute is set to an explanation:

```
"offlined by hook <hook_name> due to hook error"
```

See [section 5.1.9.2, "Using the fail_action Hook Attribute", on page 37](#).

5.2.12.4.ii Clearing Vnodes Using the `fail_action` Hook Attribute

When an `exechost_startup` hook runs successfully and does not encounter any uncaught exception or alarm timeout, you can clear the `offline` state from vnodes that were previously marked `offline` via `fail_action`.

To clear the `offline` state from vnodes that were previously offlined via the `offline_vnodes` `fail_action` attribute, set the value of the `exechost_startup` hook's `fail_action` attribute to include "`clear_vnodes_upon_recovery`". This clears the `offline` state from the vnodes managed by the hook's MoM.

```
# qmgr -c "set hook <hook_name> fail_action += clear_vnodes_upon_recovery"
```

If you have fixed your `execjob_begin` script, and want to send jobs again to the vnodes managed by the MoM where the script runs, clear the `offline` states and comments from the vnodes managed by that MoM:

- Clear the `offline` state:

```
# pbsnodes -r <MoM host>
```

- Clear the comment:

```
qmgr -c "u n <vn1>,<vn2>,... comment"
```

Or for long lists of vnodes:

```
# qmgr -c "unset node `pbsnodes -v1 | awk '{if( NR == 1 ) {printf "%s", $1} else {printf ",%s", $1}}'` comment"
```

You can write an `exechost_periodic` hook that monitors the states of the vnodes, so that when it finds offlined vnodes with vnode comment messages matching "offlined by hook...", the hook clears the comment and `offline` states.

See [section 5.1.9.2, "Using the fail_action Hook Attribute", on page 37](#).

5.3 Advice and Caveats for Writing Hooks

5.3.1 Rules for Hook Access and Behavior

The following are rules and recommendations for writing hooks:

- Use only the documented interfaces. Hooks which access PBS information or modify PBS in any way except through these interfaces are erroneous and unsupported.
- Do not attempt to manipulate the hook stored by PBS, except as specified in [Chapter 7, "Built-in Hooks", on page 155](#).
- Don't delete attributes.
- Don't change environment variables set by PBS. See ["Environment Variables" on page 230 of the PBS Professional Reference Guide](#) for a list of these environment variables.
- Do not try to access the following (a well-written, portable hook will not depend on any of the following information):
 - Server configuration information: `qmgr`, `resourcedef` and `pbs.conf`
 - Scheduling information: `qmgr`, `sched_config`, `fairshare`, `dedicated`, `holidays`
- Do not write hooks that depend on the behavior of other hooks.
- Do not make assumptions about the value of `PATH`; use `import sys` and modify `sys.path`
- Do not make assumptions about the value of the current working directory.
- For information about `umask`, see ["qalter" on page 127 of the PBS Professional Reference Guide](#), ["qsub" on page 213 of the PBS Professional Reference Guide](#), and ["Job Attributes" on page 328 of the PBS Professional Reference Guide](#).
- Do not depend on order of execution of unrelated hooks. For example, do not depend on one job submission's `queuejob` hooks running entirely before another job submission's `queuejob` hooks. It is not guaranteed that all of one job's hooks will finish before another job's hooks start.
- The `Resource_List` attribute, like others, is a `pbs.pbs_resource`. These objects support a restricted set of operations. They can reference values by index. Other features, such as `has_key()`, are not available. See [section 6.13.3.19, "Method to Create or Set Resource List", on page 146](#).
- Hooks which execute PBS commands are erroneous and unsupported. The behavior of executing PBS commands inside a hook is undefined (and is likely to cause the hook to hang).

5.3.2 Check for Parameter Validity

To make hook scripts more robust, check first for the validity of the event parameters before using them, by comparing against *None*:

```
if pbs.event().job != None:
If pbs.event().job_o != None:
If pbs.event().src_queue != None:
If pbs.event().resv != None:
If pbs.event().vnode != None:
If pbs.event().aoe != None:
```

5.3.2.1 Resource Requests and queuejob Hooks

You may want to check resource requests for a queuejob hook. If a user submits a job using old `-lnodes` or `-lncpus` syntax, this is translated to a select statement, but only after a queuejob hook has run.

5.3.2.2 Example of Checking Validity

```
% cat t2245.ty
import pbs
e = pbs.event()
if e.type == pbs.QUEUEJOB && (e.job == None):
    e.reject("Event Job parameter is unset!")
elif e.type == pbs.MODIFYJOB && ((e.job == None) || (e.job_o == None)):
    e.reject("Event Job or Job_o parameter is unset!")
elif e.type == pbs.RESVSUB && (e.resv == None):
    e.reject("Event Resv parameter is unset!")
elif e.type == pbs.RUNJOB && (e.job == None):
    e.reject("Event Job parameter is unset!")
```

5.3.3 Make Changes Only On Acceptance

We recommend that your hook does not make changes unless the hook accepts its event. You do not want to have to back changes out upon a `reject()`.

5.3.4 Offline Vnodes when exechost_startup Hook Rejects

We recommend that before calling `pbs.event().reject()` in an `exechost_startup` hook, you set the vnodes managed by the local MoM offline with an accompanying comment. This stops jobs from being sent to the affected vnodes. For example:

```
vnlist = pbs.event().vnode_list
for v in vnlist.keys():
    vnlist[v].state = pbs.ND_OFFLINE
    vnlist[v].comment = "bad configuration"
pbs.event().reject("not accepting jobs")
```

5.3.5 Minimize Unnecessary Steps

To speed up your hooks, move any steps to where they are used the fewest times possible. For example, if you retrieve several pieces of information about a job, but only use them if one of them fits a certain criterion, put the bulk of the information-retrieval steps in the section where you do the work on the job.

5.3.6 Use Fast Operations

Some of the examples we provide could be faster. Instead of using “==”, you can use the bitwise ampersand operator (“&”).

5.3.7 Avoiding Interference with Normal Operation

5.3.7.1 Treat SystemExit as a Normal Occurrence

Both `pbs.event().accept()` and `pbs.event().reject()` terminate hook execution by throwing a `SystemExit` exception. A `try...except` clause without arguments will catch all exceptions. If hook content appears in a `try except` " clause, add the following to treat `SystemExit` as a normal occurrence:

```
except SystemExit:
    pass
```

Here is an example of an `except` clause that will catch `SystemExit`:

```
try:
    ...
except:
    ...
```

In the above case, we need to add the `except SystemExit`, so that it will look like this:

```
try:
    ...
except SystemExit:
    pass
except:
    ...
```

If the existing code has a specified exception, we don't need to add "except `SystemExit`:", since this hook script is only catching one particular exception and will not match `SystemExit`. For example:

```
try:
    ...
except pbs.BadAttributeValueError:
    ...
```

5.3.7.2 Allow the Server to Modify Jobs

The server uses the `qalter` command during normal operation to modify jobs. Therefore, if you have a `modifyjob` hook script, make sure you do not interfere with `qalter` commands issued by the server. Catch these cases by starting the hook with an `if` clause that accepts modification of jobs by PBS:

```
e = pbs.event()
if e.requestor in [ "PBS_Server" ]:
    e.accept()
```

While the scheduler also uses the `qalter` command to modify jobs, this does not trigger any `modifyjob` hooks.

5.3.7.3 Stay Within the Scheduler Alarm Time

Consider setting hook alarm values in `runjob` hooks so that they do not unduly delay the scheduler. The scheduler will wait for a hook to finish executing. The scheduler's cycle time has a default value of *20 minutes*, and is specified in the scheduler's `sched_cycle_length` attribute.

5.3.8 Avoiding Problems

5.3.8.1 Avoid Hook File I/O

When the PBS server is running, `stdout`, `stderr`, and `stdin` are closed. A hook script attempting I/O will get an exception. To avoid this, redirect input and output to a file. See [section 8.10.2.8, “Hooks Attempting I/O”, on page 225](#).

5.3.8.2 Avoid Contacting Bad Host

Be careful not to specify a bad host in `<job ID>` in `pbs.event().job.depend`. If it references a non-existent or heavily loaded PBS server, the current PBS server could hang for a few minutes as it tries to contact the bad host. For example:

```
pbs.event().job.depend = pbs.depend("after:23.bad_host")
```

The PBS server could hang while trying to contact "bad_host".

5.3.8.3 Avoid `os._exit()` Python Function

Do not use the `os._exit()` Python function. It will cause the PBS server to exit.

5.3.8.4 Avoid Attempting to Log Message Using Bad Job ID

If the `pbs.logjobmsg()` method is passed a bad job ID, it raises a Python `ValueError`.

5.3.8.5 Avoid Taking Up Lots of Memory

Certain function calls in PBS Python hooks are expensive to use in terms of memory. If they are called repeatedly in loops, they can use up a lot of memory, potentially causing the server to hang or crash. For example, the following is expensive since each iterative call to `pbs.server().vnodes()` causes internal allocation of memory, which won't be freed until after the hook executes.

In order to avoid this, produce the output only once, save it to memory, and iterate using the copy. For example:

```
vn1 = []
vni = pbs.server().vnodes()
for vn in vni:
    pbs.logmsg(pbs.LOG_DEBUG, "found vn.name=%s" %(vn.name))
    vn1.append(vn)
```

The following functions in PBS Python hooks return iterators, and should be used carefully:

- Iterate over a list of jobs:


```
pbs.server().jobs()
pbs.queue.jobs()
```
- Iterate over a list of queues:


```
pbs.server().queues()
```
- Iterate over a list of vnodes:


```
pbs.server().vnodes()
```
- Iterate over a list of reservations:


```
pbs.server().resvs()
```

5.3.8.6 Testing Vnode State

To see whether a vnode has a particular state set:

```
If v.state == pbs.ND_OFFLINE:  
    pbs.logmsg(pbs.LOG_DEBUG, "vnode %s is offline!" % (v.name))
```

5.3.9 Restrictions

5.3.9.1 Local Server Only

Hooks cannot access a server other than the local server. Hooks also cannot specify a non-default server. So for example if a job submission specifies a queue at a server other than the default, the hook can allow that submission, or can change it to the default server, but cannot change it to another non-default server.

5.3.9.2 Dictionary Data Type Restriction

The Python types listed as dictionaries, such as `pbs.event().env`, support a restricted set of operations. They can reference values by index. Other features, such as `has_key()`, are not available.

5.3.10 Scheduling Impact of Hooks

5.3.10.1 Effect of runjob Hooks on Preemption

With preemption turned on, the scheduler preempts low-priority jobs to run a high-priority job. If the high-priority job is rejected by a `runjob` hook, then the scheduler undoes the preemption of the low-priority jobs. Suspended jobs are resumed, and checkpointed jobs are restarted.

5.3.10.2 Effect of runjob Hooks with Strict Ordering

When `strict_ordering` is set to `True` and `backfill_depth` is set to `0`, a most-deserving job that is repeatedly rejected by a `runjob` hook will prevent other jobs from being able to run. A well-written hook would put the job on hold or requeue the job with a later execution time to prevent idling the system.

5.3.10.3 Effect of runjob Hooks with `round_robin` and `by_queue`

With `round_robin` and `by_queue` set to `True`, a job continually rejected by a `runjob` hook may prevent other jobs from the same queue from being run. A well-written hook would put the job on hold or requeue the job with a later execution time to allow other jobs in the same queue to be run.

A `runjob` hook's performance directly affects the responsiveness of the PBS scheduler. Consider carefully the trade-off between the work such a hook needs to do and your scheduler's required performance.

5.3.10.4 Peer Scheduling and Hooks

When a job is pulled from one complex to another, the following happens:

- Hooks are applied at the new complex as if the job had been submitted locally
- Any `movejob` hooks at the furnishing server are run

5.3.10.5 Performance Considerations

5.3.10.5.i Cost of Accessing Data

- Using `pbs.server()` to get data about server, queues, jobs, vnodes, or reservations can be slow if run in an execution hook. This is because of the overhead involved when the function has to directly connect to the server and pass requests (via TCP). However, you can speed up reading of custom job resources by setting the `m` flag. See "[Allowing Execution Hooks to Read Custom Job Resources Faster](#)" on page 261 in the *PBS Professional Administrator's Guide*.
- Making queries to `pbs.server().resources_available[]` can be slow.

5.3.10.5.ii Cost of Different Hooks

- Any `queuejob` hooks execute once per job submission
- Any `runjob` hooks execute once per attempt to run a job, after the scheduler has found a place for it

What this means to the hook writer:

- Your `queuejob` hooks can generally get away with longer run times
- Any hook that needs to listen to `queuejob` events needs to be quick to decide whether it is needed or not

For a fast hook, avoid these:

- Running external commands
- Network connections
- File I/O and logging
- Storing information in server or vnode settings
- Using `pbs.server().resources_available`
- Iterating over the entire set of vnodes or jobs using `pbs.server().vnodes()` or `pbs.server().jobs()`.

In addition, see [section 5.3.5, "Minimize Unnecessary Steps"](#), on page 69 and [section 5.3.6, "Use Fast Operations"](#), on page 69.

5.3.10.6 Effect of Hooks on Job Eligible Time

When eligible time is enabled and a job is blocked by a `queuejob` hook, the job accrues `initial_time`. When a job is accepted or rejected by `modifyjob` or `movejob` hooks, the job continues to accrue whatever kind of time it was accruing. When a job is requested by a `runjob` hook or an execution event hook, the scheduler evaluates what kind of time the job should accrue based on resources and policy.

5.3.11 Windows Caveats

5.3.11.1 Special Characters in Pathnames

On Windows, where backslashes may appear in pathnames, escape each backslash with another backslash, or use the raw (`r`) operator to form the string. Both of the following work:

```
e = pbs.event()
e.progname = "C:\\Program Files\\PBS\\exec\\bin\\pbsnodes.exe"
e.progname = r"C:\Program Files\PBS\exec\bin\pbsnodes.exe"
```

See [section 6.3.3, "Event Object Member Caveats"](#), on page 115.

5.3.11.2 Importing and Exporting Hooks

If the name of `<input_file>` contains spaces, `<input_file>` must be quoted.

5.3.11.3 Modifying Events

On Windows, in a multi-vnoded job, be careful modifying `pbs.event().progname` and `pbs.event().argv[]` parameters; some values are tacked on by `pbs_mom` and are required. See [section 6.3.3.1, “Modifying progname or argv\[\] Under Windows”, on page 115](#).

5.3.11.4 Using Sleep in a Hook Script

Under Windows, the PBS server or MoM cannot interrupt a hook script executing the Python `time.sleep()`. The server needs to be able to interrupt the script if the script reaches its timeout. In order to be able to interrupt the script, create a sleep that incrementally sleeps for 1 second. The server can then interrupt the hook script in between the sleeps. For example:

```
import time
def mysleep(sec):
    for i in range(sec):
        time.sleep(1)
mysleep(30)          <-- pseudo sleep for 30 seconds
```

6

Hook Objects and Methods

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6.1 The pbs Module

The *pbs module* provides an interface to PBS and the hook environment. The interface is made up of Python objects, members, and methods. You can operate on the objects and use the methods in your Python code. In order to use the *pbs* module, you must begin your Python code by importing the *pbs* module. For example, in a script that modifies a job:

```
import pbs
pbs.event().job.comment="Modified this job"
```

For the contents of the *pbs* module, see [section 4.5, “Python Modules and PBS”, on page 24](#).

6.2 PBS Interface Objects

The PBS interface contains different kinds of objects:

- Objects to represent PBS entities, e.g. jobs, server, queues, vnodes, reservations, events, log messages, etc.
- Objects to represent job, server, vnode, queue, and reservation attributes.
- Objects to represent arguments to PBS commands, PBS version information, etc.
- Constant objects to represent event types, states, log event classes, queue types, and exceptions.

6.2.1 Table of PBS Interface Objects

PBS provides a set of interface objects for use in hooks. The following table lists all of the PBS objects in alphabetical order. Each of these objects is described in detail later in the chapter.

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
<code>pbs.acl</code>	Represents a PBS ACL. See section 6.13.3.1, “Method to Create or Set ACL”, on page 143 .
<code>pbs.args</code>	Represents a space-separated list of PBS arguments to commands such as <code>qsub</code> , <code>qdel</code> . See “Method to Create or Set Command Argument List” on page 143 .
<code>pbs.argv[]</code>	Argument strings to be passed to the program executed for the job. See section 6.3.2.2, “Job Program Arguments Event Member”, on page 109 .
<code>pbs.BadAttributeValueError</code>	Raised when setting the member value of a <code>pbs.*</code> object and the value given is invalid. See “Table of Exceptions” on page 43

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
<code>pbs.BadAttributeValueError</code>	Raised when setting the member value of a <code>pbs.*</code> object and the value type is invalid. See "Table of Exceptions" on page 43
<code>pbs.BadResourceValueError</code>	Raised when setting the resource value of a <code>pbs.*</code> object and the value given is invalid. See "Table of Exceptions" on page 43
<code>pbs.BadResourceValueTypeError</code>	Raised when setting the resource value of a <code>pbs.*</code> object and the value type is invalid. See "Table of Exceptions" on page 43
<code>pbs.checkpoint</code>	Represents a job's checkpoint attribute. See "Job Checkpoint Attribute Member" on page 124
<code>pbs.depend</code>	Represents a job's dependency attribute. See "Job depend Attribute Member" on page 124 .
<code>pbs.duration</code>	Represents a time interval. See "Method to Create or Set Duration from Time String or Integer" on page 143 .
<code>pbs.email_list</code>	Represents the set of users to whom mail may be sent. Example: Job's <code>Mail_Users</code> attribute. See "Method to Create or Set Email List" on page 144
<code>pbs.env[]</code>	Dictionary of environment variables. See section 6.3.2.5, "Job Environment Event Member", on page 110 .
<code>pbs.event</code>	Represents a PBS event. See "Event Objects" on page 87
<code>pbs.EventIncompatibleError</code>	Raised when referencing a nonexistent member in <code>pbs.event()</code> . See "Table of Exceptions" on page 43 .
<code>pbs.EXECHOST_PERIODIC</code>	Type for an <code>execlist_periodic</code> hook event. See section 6.3.1.18, "execlist_periodic: Periodic Events on All Execution Hosts", on page 107 .
<code>pbs.EXECHOST_STARTUP</code>	Type for an <code>execlist_startup</code> hook event. See section 6.3.1.17, "execlist_startup: Event When Execution Host Starts Up", on page 106 .
<code>pbs.EXECJOB_ATTACH</code>	Type for an <code>execjob_attach</code> hook event. See section 6.3.1.11, "execjob_attach: Event when pbs_attach() runs", on page 100 .
<code>pbs.EXECJOB_BEGIN</code>	Type for an <code>execjob_begin</code> hook event. See section 6.3.1.8, "execjob_begin: Event when Execution Host Receives Job", on page 96 .
<code>pbs.EXECJOB_END</code>	Type for an <code>execjob_end</code> hook event. See section 6.3.1.16, "execjob_end: Event After Job Cleanup", on page 105 .

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.EXECJOB_EPILOGUE	Type for an <code>execjob_epilogue</code> hook event. See section 6.3.1.15, “execjob_epilogue: Event Just After Killing Job Tasks” , on page 104.
pbs.EXECJOB_LAUNCH	Type for an <code>execjob_launch</code> hook event. See section 6.3.1.10, “execjob_launch: Event when Execution Host Receives Job” , on page 98.
pbs.EXECJOB_POSTSUSPEND	Type for an <code>execjob_postsuspend</code> hook event. See section 6.3.1.12, “execjob_postsuspend: Event Just After Suspending Job” , on page 101.
pbs.EXECJOB_PRERESUME	Type for an <code>execjob_preresume</code> hook event. See section 6.3.1.13, “execjob_preresume: Event Just Before Resuming Job” , on page 102.
pbs.EXECJOB_PRETERM	Type for an <code>execjob_preterm</code> hook event. See section 6.3.1.14, “execjob_preterm: Event Just Before Killing Job Tasks” , on page 103.
pbs.EXECJOB_PROLOGUE	Type for an <code>execjob_prologue</code> hook event. See section 6.3.1.9, “execjob_prologue: Event Just Before Execution of Top-level Job Process” , on page 97.
pbs.PERIODIC	Type for a periodic hook. See section 6.3.1.7, “periodic: Periodic Event at Server Host” , on page 95.
pbs.exec_host	Represents a job’s <code>exec_host</code> attribute. See “job.exec_host” on page 124 .
pbs.exec_vnode	Represents a job’s <code>exec_vnode</code> attribute. See “job.exec_vnode” on page 124 .
pbs.group_list	Represents a list of group names. See “job.group_list” on page 124.
pbs.hold_types	Represents the <code>Hold_Types</code> attribute of a job. See “job.Hold_Types” on page 124.
pbs.job	Represents a PBS job. See “Job Objects” on page 122
pbs.job_list[]	List of <code>pbs.job</code> objects. See “pbs.event().job_list” on page 111.
pbs.job_sort_formula	Represents the <code>job_sort_formula</code> server attribute. See “pbs.job_sort_formula()” on page 145
pbs.JOB_STATE_BEGUN	Job arrays only. Job array has started. See “Job job_state Attribute Member” on page 125

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.JOB_STATE_EXITING	Job is exiting after having run. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_EXPIRED	Subjobs only. Subjob is finished (expired). See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_FINISHED	Job is finished: job executed successfully, job was terminated while running, job execution failed, or job was deleted before execution. See "Job job_state Attribute Member" on page 125 .
pbs.JOB_STATE_HELD	Job is held. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_MOVED	Job has been moved to another server. See "Job job_state Attribute Member" on page 125 .
pbs.JOB_STATE_QUEUED	Job is queued, eligible to run or be routed. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_RUNNING	Job is running. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_SUSPEND	Job is suspended by server. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_SUSPEND_USERACTIVE	Job is suspended due to workstation becoming busy. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_TRANSIT	Job is in transit. See "Job job_state Attribute Member" on page 125
pbs.JOB_STATE_WAITING	Job is waiting for its requested execution time to be reached, or the job's stagein request has failed. See "Job job_state Attribute Member" on page 125
pbs.join_path	Represents the job's Join_Path attribute. See "Job Join_Path Attribute Member" on page 125 .
pbs.keep_files	Represents the Keep_Files job attribute. See "Job Keep_Files Attribute Member" on page 125
pbs.license_count	Represents a set of licensing-related counters. Server attribute. See section 6.13.3.14, "Method to Create or Set license_count Object", on page 145 .
pbs.LOG_DEBUG	Log event class. See "Message Log Level Objects" on page 152
pbs.LOG_ERROR	Log event class. See "Message Log Level Objects" on page 152

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.LOG_WARNING	Log event class. See "Message Log Level Objects" on page 152
pbs.mail_points	Represents the Mail_Points attribute of a job. See "Job Mail_Points Attribute Member" on page 126.
pbs.MODIFYJOB	The modifyjob hook event type. Triggered by qalter or pbs_alterjob() API call. Not triggered by scheduler job modification. See "Event Types" on page 87.
pbs.MOVEJOB	The movejob hook event type. Triggered by qmove or pbs_movejob() API call. See "Event Types" on page 87
pbs.ND_BUSY	Represents <i>busy</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.
pbs.ND_DEFAULT_EXCL	Represents <i>default_excl</i> sharing vnode attribute value. See section 6.10.3, "Vnode Sharing Constant Objects" , on page 135.
pbs.ND_DEFAULT_SHARED	Represents <i>default_shared</i> sharing vnode attribute value. See section 6.10.3, "Vnode Sharing Constant Objects" , on page 135.
pbs.ND_DOWN	Represents <i>down</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.
pbs.ND_FORCE_EXCL	Represents <i>force_excl</i> sharing vnode attribute value. See section 6.10.3, "Vnode Sharing Constant Objects" , on page 135.
pbs.ND_FREE	Represents <i>free</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.
pbs.ND_IGNORE_EXCL	Represents <i>ignore_excl</i> sharing vnode attribute value. See section 6.10.3, "Vnode Sharing Constant Objects" , on page 135.
pbs.ND_JOBBUSY	Represents <i>job-busy</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.
pbs.ND_JOB_EXCLUSIVE	Represents <i>job-exclusive</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.
pbs.ND_OFFLINE	Represents <i>offline</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.
pbs.ND_PBS	Represents <i>pbs</i> value for vnode ntype attribute. See section 6.10.2, "Vnode Type Constant Objects" , on page 134
pbs.ND_PROV	Represents <i>provisioning</i> vnode state. See section 6.10.4, "Vnode State Constant Objects" , on page 135.

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.ND_RESV_EXCLUSIVE	Represents <i>resv-exclusive</i> vnode state. See section 6.10.4, “Vnode State Constant Objects” , on page 135.
pbs.ND_STALE	Represents <i>stale</i> vnode state. See section 6.10.4, “Vnode State Constant Objects” , on page 135.
pbs.ND_STATE_UNKNOWN	Represents <i>state-unknown, down</i> vnode state. See section 6.10.4, “Vnode State Constant Objects” , on page 135.
pbs.ND_UNRESOLVABLE	Represents <i>unresolvable</i> vnode state. See section 6.10.4, “Vnode State Constant Objects” , on page 135.
pbs.ND_WAIT_PROV	Represents <i>wait-provisioning</i> vnode state. See section 6.10.4, “Vnode State Constant Objects” , on page 135.
pbs.node_group_key	Represents the <code>node_group_key</code> attribute. See “Method to Create or Set node_group_key Object” on page 145.
pbs.path_list	Represents a list of pathnames. See “Method to Create or Set path_list Object” on page 146.
pbs.pbs_conf[]	Dictionary of entries in <code>pbs.conf</code> . See “pbs.pbs_conf[]” on page 136.
pbs.pbs_resource	List of resource names and values. See section 6.13.3.19, “Method to Create or Set Resource List” , on page 146.
pbs.pid	Represents the process ID of a process belonging to a job.
pbs.place	Represents the place specification when submitting a job. See section 6.13.3.20, “Method to Create or Set place Object” , on page 147.
pbs.progname	Path of job shell or executable. See section 6.3.2.15, “Job Executable Event Member” , on page 112.
pbs.QTYPE_EXECUTION	Represents <i>execution</i> value for <code>queue_type</code> queue attribute. See “Queue Type Constant Objects” on page 122
pbs.QTYPE_ROUTE	Represents <i>route</i> value for <code>queue_type</code> queue attribute. See “Queue Type Constant Objects” on page 122
pbs.queue	Represents a PBS queue. See “Queue Objects” on page 121
pbs.QUEUEJOB	The <code>queuejob</code> hook event type. Triggered by <code>qsub</code> or <code>pbs_submit()</code> API call. See section 6.3.1.3, “queuejob: Event when Job is Queued” , on page 91.

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.range	Represents a range of numbers referring to job array indices. See section 6.13.3.21, “Method to Create or Set range Object” , on page 147.
pbs.resv	Represents a PBS reservation. See “Reservation Objects” on page 131
pbs.RESVSUB	The <code>resvsub</code> hook event type. Triggered by <code>pbs_rsub</code> or <code>pbs_submitresv()</code> API call. See section 6.3.1.1, “resvsub: Event when Reservation is Created” , on page 90.
pbs.RESV_END	The <code>resv_end</code> hook event type. Triggered by end of reservation. See section 6.3.1.2, “resv_end: Event when Reservation Ends” , on page 90.
pbs.RESV_STATE_BEING_DELETED	The reservation state <code>RESV_BEING_DELETED</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_CONFIRMED	The reservation state <code>RESV_CONFIRMED</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_DEGRADED	The reservation state <code>RESV_DEGRADED</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_DELETED	The reservation state <code>RESV_DELETED</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_DELETING_JOBS	The reservation state <code>RESV_DELETING_JOBS</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_FINISHED	The reservation state <code>RESV_FINISHED</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_NONE	The reservation state <code>RESV_NONE</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_RUNNING	The reservation state <code>RESV_RUNNING</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_TIME_TO_RUN	The reservation state <code>RESV_TIME_TO_RUN</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_UNCONFIRMED	The reservation state <code>RESV_UNCONFIRMED</code> . See “Reservation State Constant Objects” on page 133
pbs.RESV_STATE_WAIT	The reservation state <code>RESV_WAIT</code> . See “Reservation State Constant Objects” on page 133
pbs.route_destinations	Represents <code>route_destinations</code> queue attribute. See “Method to Create or Set route_destinations Object” on page 147.

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.RUNJOB	The runjob hook event type. Triggered by <code>qrun</code> or <code>pbs_runjob()</code> API call. See section 6.3.1.6, “runjob: Event Before Job is Received by MoM” , on page 94.
pbs.select	Represents the <code>select</code> specification when submitting a job. See “Method to Create or Set select Object” on page 147.
pbs.server	Represents the local PBS server. See “Server Objects” on page 118
pbs.size	Represents a PBS size type. See “Method to Create or Set size Object” on page 150.
pbs.software	Represents a site-dependent software specification resource. See “Method to Create or Set Software Resource Object” on page 150.
pbs.staging_list	Represents a list of file stagein or stageout parameters. See “Job stagein and stageout Attribute Members” on page 126.
pbs.state_count	Represents a set of job-related state counters. See “Method to Create or Set state_count Object” on page 151.
pbs.SV_STATE_ACTIVE	Server state is <i>Scheduling</i> . See “Server State Member” on page 119
pbs.SV_STATE_HOT	Server state is <i>Hot_Start</i> . See “Server State Member” on page 119
pbs.SV_STATE_IDLE	Server state is <i>Idle</i> . See “Server State Member” on page 119
pbs.SV_STATE_SHUTDEL	Server state is <i>Terminating, Delayed</i> . See “Server State Member” on page 119
pbs.SV_STATE_SHUTIMM	Server state is <i>Terminating</i> . See “Server State Member” on page 119
pbs.SV_STATE_SHUTSIG	Server state is <i>Terminating</i> . See “Server State Member” on page 119
pbs.UnsetAttributeNameError	Raised when referencing a non-existent member name of a <code>pbs.*</code> object. See “Table of Exceptions” on page 43
pbs.UnsetResourceNameError	Raised when referencing a non-existent resource name of a <code>pbs.*</code> object. See “Table of Exceptions” on page 43
pbs.user_list	Represents a list of user names. See section 6.13.3.29, “Method to Create or Set user_list Object” , on page 151.
pbs.vchunk	Represents a job chunk. See section 6.8, “Chunk Objects” , on page 131.

Table 6-1: PBS Interface Objects

PBS Interface Object	Description
pbs.version	Represents version information for PBS. See section 6.13.3.30, “Method to Create or Set PBS Version Object” , on page 151.
pbs.vnode	Represents a PBS vnode. See section 6.10, “Vnode Objects” , on page 133.
pbs.vnode_list[]	Represents a list of pbs.vnode objects. See section 6.3.2.22, “The Vnode List Event Member” , on page 114
pbs.vnode_list_fail[]	Represents a list of unhealthy vnodes as pbs.vnode objects. See section 6.3.2.23, “The Failed Vnode List Event Member” , on page 115
SystemExit	Raised when accepting or rejecting an action. See “Table of Exceptions” on page 43

6.2.2 Maps of Object Members and Methods

Figure 6-1 shows a map of the PBS Python objects. All hook event objects have the methods listed in “global methods”. Each object also has its own members and methods, as shown. We expand hook event objects in Figure 6-2.

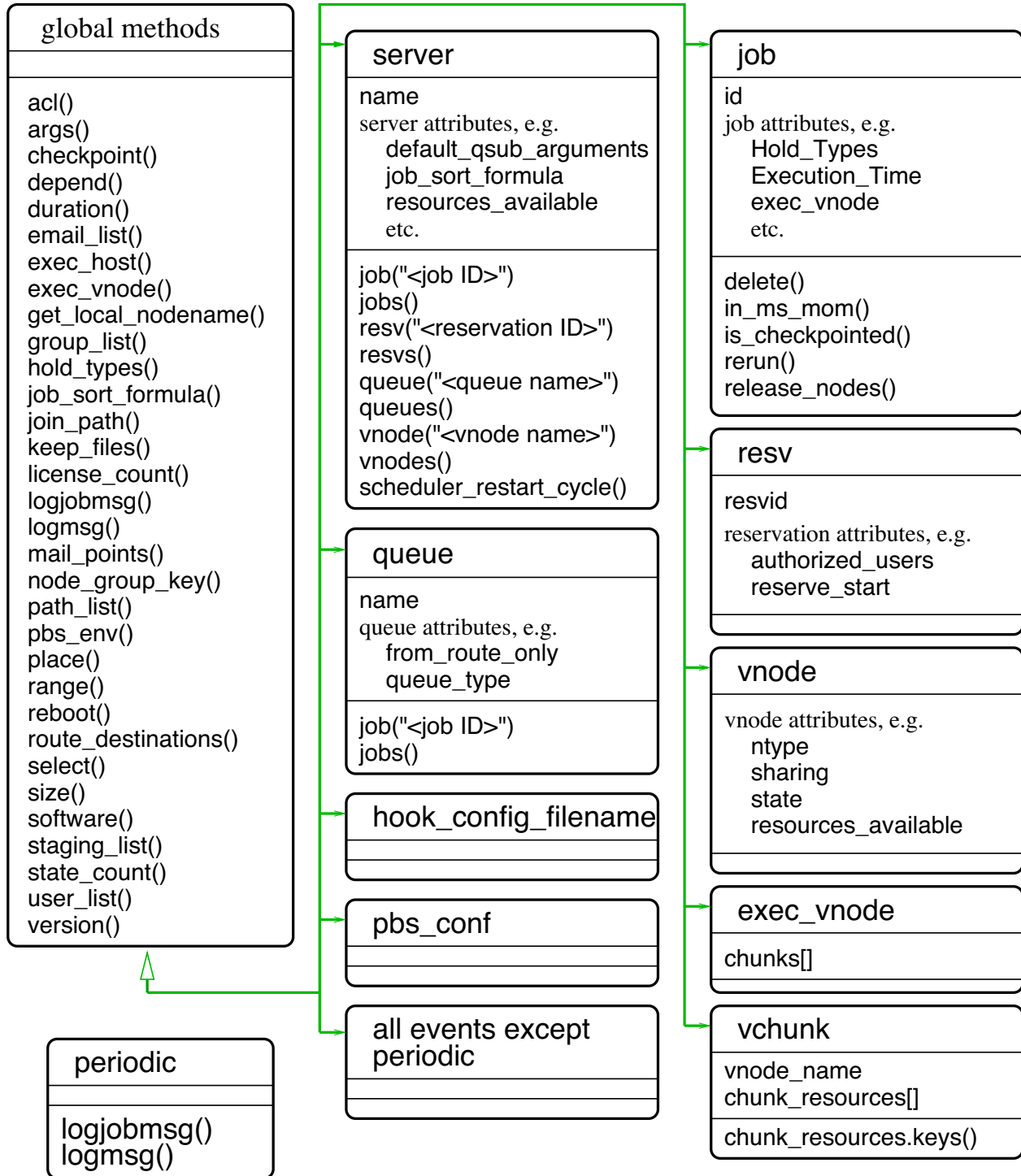


Figure 6-1: Map of members and methods for major PBS objects

Figure 6-2 shows an expanded view of hook event objects. All hook events have the members and methods listed in Figure 6-1, which shows events inheriting global methods. Each type of event also has its own members and/or methods. For example, movejob events have a job member and a src_queue member, in addition to the type, hook_name, requestor, requestor_host, and hook_type members, and the accept(), get_local_nodename(), logjobmsg(), logmsg(), and reject() methods shared by all events. For a description of event objects, see section 6.3, “Event Objects”, on page 87.

Event Object Members and Methods



Figure 6-2: Expanded view of event object members and methods

6.3 Event Objects

pbs.event

The event object represents the event that has triggered the hook. You can pass the object to the hook script, and use it in the script. To retrieve objects associated with the event, use this:

```
pbs.event().<object>
```

For example, to retrieve the job that triggered an event:

```
pbs.event().job
```

There are several types of events. Each type of event is triggered by a different occurrence, and each type has a corresponding hook type. Each type of event has access to different data, and can perform different operations. Some data and operations are common to all events.

Each type of event hook can read and set different job, vnode, and reservation attributes and resources. Each type of event can read different server and queue attributes and resources. We list which attributes and resources can be set for each event in [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44](#).

6.3.1 Event Types

pbs.event().type

The type of the event. Represents the type attribute of the hook. This object can take one or more of the values shown here. The following table summarizes the event types, their constant objects, their triggers, and when and where they run, and gives a pointer to a complete description of the associated hook:

Table 6-2: Event Types and Objects

Event Type & Constant Object	Trigger	Where Run	Description
resvsub pbs.RESVSUB	Triggered by <code>pbs_rsub</code> and the <code>pbs_submitresv()</code> API call. A <code>resvsub</code> hook is executed after all processing of <code>pbs_rsub</code> input, and just before a reservation is created.	At server	See section 6.3.1.1, “resvsub: Event when Reservation is Created”, on page 90 .
resv_end pbs.RESV_END	Triggered by end of reservation. A <code>resv_end</code> hook is executed when a reservation ends, just before jobs are deleted from the reservation queue.	At server	See section 6.3.1.2, “resv_end: Event when Reservation Ends”, on page 90 .
queuejob pbs.QUEUEJOB	Triggered by <code>qsub</code> and the <code>pbs_submit()</code> API call. Not triggered by requeueing a job (<code>qrun</code>) or on <code>node_fail_requeue</code> , when a job is discarded by the MoM because the execution host went down. A <code>queuejob</code> hook is executed after all processing of <code>qsub</code> input, and just before the job is queued.	At server	See section 6.3.1.3, “queuejob: Event when Job is Queued”, on page 91 .

Table 6-2: Event Types and Objects

Event Type & Constant Object	Trigger	Where Run	Description
modifyjob pbs.MODIFYJOB	Triggered by <code>qalter</code> , the <code>pbs_alterjob()</code> API call, calculating eligible time, and setting the job's comment. A <code>modifyjob</code> hook is executed after all processing of <code>qalter</code> input, and just before the job's attributes are modified. Not triggered when the scheduler modifies a job.	At server	See section 6.3.1.4, “modifyjob: Event when Job is Altered” , on page 92.
movejob pbs.MOVEJOB	Triggered by <code>qmove</code> and the <code>pbs_movejob()</code> API call. Not triggered by <code>pbs_rsub -Wqmove=<job ID></code> . A <code>movejob</code> hook is executed after <code>qmove</code> arguments are processed, but before a job is moved from one queue to another.	At server	See section 6.3.1.5, “movejob: Event when Job is Moved” , on page 92.
runjob pbs.RUNJOB	Triggered by <code>qrun</code> and the <code>pbs_runjob()</code> API call. A <code>runjob</code> hook is executed just before a job is sent to an execution host.	At server	See section 6.3.1.6, “runjob: Event Before Job is Received by MoM” , on page 94.
periodic pbs.PERIODIC	A periodic hook is executed at specified intervals.	At server	See section 6.3.1.7, “periodic: Periodic Event at Server Host” , on page 95
execjob_begin pbs.EXECJOB_BEGIN	An <code>execjob_begin</code> hook is executed when MoM receives the job, after any files or directories are staged in.	On primary MoM host, and if successful, on all sister MoM hosts allocated to job	See section 6.3.1.8, “execjob_begin: Event when Execution Host Receives Job” , on page 96.
execjob_prologue pbs.EXECJOB_PROLOGUE	An <code>execjob_prologue</code> hook is executed just before the first job process is started.	On primary MoM host, and on all sister MoM hosts where any job task is spawned or attached	See section 6.3.1.9, “execjob_prologue: Event Just Before Execution of Top-level Job Process” , on page 97.
execjob_launch pbs.EXECJOB_LAUNCH	An <code>execjob_launch</code> hook is executed just before the user's program is run.	On primary MoM host, and on all sister MoM hosts where MPI tasks are started with <code>tm_spawn()</code>	See section 6.3.1.10, “execjob_launch: Event when Execution Host Receives Job” , on page 98

Table 6-2: Event Types and Objects

Event Type & Constant Object	Trigger	Where Run	Description
execjob_attach pbs.EXECJOB_ATTACH	An execjob_attach hook is executed before any execjob_prologue hooks run	On each MoM host where pbs_attach() runs	See section 6.3.1.11, “execjob_attach: Event when pbs_attach() runs” , on page 100.
execjob_postsuspend pbs.EXECJOB_POSTTERM	An execjob_postsuspend hook is executed just after successfully suspending the job	On all MoM hosts allocated to the job	See section 6.3.1.12, “execjob_postsuspend: Event Just After Suspending Job” , on page 101.
execjob_preresume pbs.EXECJOB_PRETERM	An execjob_preresume hook is executed just before resuming the job	First on the primary MoM host, and if that is successful, on the sister MoM hosts	See section 6.3.1.13, “execjob_preresume: Event Just Before Resuming Job” , on page 102.
execjob_preterm pbs.EXECJOB_PRETERM	An execjob_preterm hook is executed when the job receives a termination signal.	On all MoM hosts allocated to the job	See section 6.3.1.14, “execjob_preterm: Event Just Before Killing Job Tasks” , on page 103.
execjob_epilogue pbs.EXECJOB_EPILOGUE	An execjob_epilogue hook is executed after all of the job processes have terminated, after executing or killing a job, but before job is cleaned up	On all MoM hosts allocated to the job	See section 6.3.1.15, “execjob_epilogue: Event Just After Killing Job Tasks” , on page 104.
execjob_end pbs.EXECJOB_END	An execjob_end hook is executed on all hosts allocated to a job, at the end of all job processing	On all MoM hosts allocated to the job	See section 6.3.1.16, “execjob_end: Event After Job Cleanup” , on page 105.
execlist_startup pbs.EXECHOST_STARTUP	An execlist_startup hook is executed when a MoM starts up or receives a HUP (Linux).	On all MoM hosts in the complex.	See section 6.3.1.18, “execlist_periodic: Periodic Events on All Execution Hosts” , on page 107.
execlist_periodic pbs.EXECHOST_PERIODIC	An execlist_periodic hook is executed at specified intervals	On all MoM hosts in the complex	See section 6.3.1.18, “execlist_periodic: Periodic Events on All Execution Hosts” , on page 107.

6.3.1.1 resvsub: Event when Reservation is Created

6.3.1.1.i Modifying Reservation Creation (`pbs_rsub`)

- When an advance, standing, or job-specific reservation is created via `pbs_rsub`, `resvsub` hooks can modify the reservation's attributes that can be set via `pbs_rsub`
- When an advance, standing, or job-specific reservation is created, `resvsub` hooks can specify additional attributes that can be specified via `pbs_rsub`
- The input reservation attributes on which `resvsub` hooks operate are those that exist after all `pbs_rsub` processing of command line arguments is completed
- For `resvsub` hooks, the input reservation attributes do not include:
 - Server or queue `resources_default` or `default_chunk`.
 - Conversions from old syntax (`-lnodes & -lncpus`) to new `select` and `place` syntax

The only time that a reservation can be modified is during its creation. A `resvsub` event hook can set any settable reservation attribute and any resource that can be specified via `pbs_rsub`. See [Table 5-8, “Reservation Attributes Readable & Settable in `resvsub` and `resv_end` Hooks,” on page 59](#) for a complete list of the reservation attributes that this hook can read and set.

6.3.1.1.ii The `resvsub` Hook Interface

The type for this event is `pbs.RESVSUB`.

A `resvsub` hook is executed after all processing of `pbs_rsub` input, and just before a reservation is created. The hook is triggered by `pbs_rsub` and the `pbs_submitresv()` API call.

A reservation object's attributes appear to a `resvsub` hook as they would be after the event, not before it.

A `pbs.RESVSUB` event has the following member, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().resv`

A `pbs.resv` object containing the attributes and resources specified for the reservation being requested. See [section 6.9, “Reservation Objects,” on page 131](#).

A `pbs.event().accept()` terminates hook execution and allows creation of the reservation, and any changes to reservation resources take effect.

A `pbs.event().reject()` terminates hook execution and causes the reservation not to be created.

6.3.1.2 resv_end: Event when Reservation Ends

A `resv_end` event hook can read server and reservation attributes. See [Table 5-8, “Reservation Attributes Readable & Settable in `resvsub` and `resv_end` Hooks,” on page 59](#) for a complete list of the reservation attributes that this hook can read.

6.3.1.2.i The `resv_end` Hook Interface

The type for this event is `pbs.RESV_END`.

A `resv_end` hook is executed when a confirmed reservation ends, and just before jobs are deleted from the reservation queue.

A `pbs.RESV_END` event has the following member, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().resv`

A `pbs.resv` object containing the attributes and resources specified for the reservation being requested. See [section 6.9, “Reservation Objects,” on page 131](#).

A `pbs.event().reject()` does not interrupt the execution of the process invoking it.

6.3.1.3 queuejob: Event when Job is Queued

6.3.1.3.i Modifying Job Submission (`qsub`)

- When a job is submitted via `qsub`, `queuejob` hooks can modify the following things explicitly specified in the job submission:
 - Job attributes that can be set via `qsub`
 - Job comment
 - Resources requested by the job
- When a job is submitted via `qsub`, `queuejob` hooks can add resource requests to those specified in the job submission
- The input job attributes on which `queuejob` hooks operate are those that exist after all `qsub` processing is completed. These input attributes include:
 - Command line arguments
 - Script directives
 - Server `default_qsub_arguments`
- When a `queuejob` hook runs at job submission, the hook can affect only that job.
- For `queuejob` hooks, the input job attributes do not include:
 - Server or queue `resources_default` or `default_chunk`.
 - Conversions from old syntax (`-lnodes` or `-lncpus`) to new `select` and `place` syntax

See [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44](#), for a complete listing of attributes and resources that this hook can modify.

6.3.1.3.ii The `queuejob` Hook Interface

The event type for this event is `pbs.QUEUEJOB`.

A `queuejob` hook runs after all processing of `qsub` input, just before the job reaches the server, and before the job is queued, including when a job is peer queued to a server that has a `queuejob` hook. (See [Figure 4-3](#).) The hook is triggered by `qsub` or the `pbs_submit()` API call. A `queuejob` hook is not triggered by requeueing a job (`qrerun`) or on `node_fail_requeue`, when a job is discarded by the MoM because the execution host went down. A `queuejob` hook runs once per job array.

In a `queuejob` event, the event’s job object members are as they would be if the job were to be successfully submitted.

A `pbs.QUEUEJOB` event has the following member, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().job`

A `pbs.job` object with the attributes and resources specified at submission for the job being queued. See [section 6.6, “Job Objects”, on page 122](#).

A `pbs.event().accept()` terminates hook execution and allows the job to be queued, and any changes to job attributes or resources take effect.

A `pbs.event().reject()` terminates hook execution and causes the job not to be queued. The job is not accepted by the server, and is not assigned a job ID.

6.3.1.3.iii Caveats for `queuejob` Hook

If a user submits a job using old `-lnodes` or `-lncpus` syntax, this is translated to a `select` statement, but only after a `queuejob` hook has run. The `queuejob` hook does have access to the job’s resource request.

6.3.1.4 modifyjob: Event when Job is Altered

6.3.1.4.i Modifying Job Change (qalter)

- When a job is changed via `qalter`, `modifyjob` hooks can modify the arguments passed to `qalter`
- When a `modifyjob` hook runs, it can change the attributes of the job that can be changed via `qalter`

Before the job runs, this hook can set any job attribute that can be changed via `qalter`, can set the job's comment, and can set any resource requested by the job.

While the job is running, the only job attributes and resources that the hook can set are those that can be changed via the `qalter` command: the job's `cput` and `walltime`. See [section 5.2.4, "Using Attributes and Resources in Hooks", on page 44](#), for a complete listing of attributes and resources that this hook can modify.

See ["qalter" on page 127 of the PBS Professional Reference Guide](#) and ["Job Attributes" on page 328 of the PBS Professional Reference Guide](#).

6.3.1.4.ii The modifyjob Hook Interface

The type for this event is `pbs.MODIFYJOB`.

A `modifyjob` hook is executed after all processing of `qalter` input, and just before the job's attributes are modified. The hook is triggered by the following:

- A `qalter` command, except when the scheduler calls the command
- The `pbs_alterjob()` API call
- Calculating eligible time
- Setting the job's comment

A `modifyjob` hook runs once per job array.

In a `modifyjob` event hook, the `pbs.event().job` object's attributes appear to a `modifyjob` hook as they would be after the job is modified, not before.

A `modifyjob` event hook shows the original job with all its attributes in `pbs.event().job_o`.

A `pbs.MODIFYJOB` event has the following members, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

A `pbs.job` object representing the job being modified. See [section 6.6, "Job Objects", on page 122](#). In this job object, only attributes and resources that are to be modified by the `qalter` command are populated. In this job object, attributes or resources that are not slated to be modified are not populated. This job object's attributes appear to a `modifyjob` hook as they would be after the job is modified, not before.

`pbs.event().job_o`

A `pbs.job` object representing the original job, before the job was modified via `qalter`. All attributes and resources are populated. See [section 6.3.2.12, "Original Job Event Member", on page 112](#).

A `pbs.event().accept()` terminates hook execution and allows the job to be altered, and any changes to job attributes or resources take effect.

A `pbs.event().reject()` terminates hook execution and causes the job not to be altered.

6.3.1.5 movejob: Event when Job is Moved

6.3.1.5.i Modifying Job Move (qmove)

- When a job is moved via `qmove`, `movejob` hooks can modify the arguments passed to `qmove`
- When a `movejob` hook runs, it can change the job's destination queue to any queue on the default server

A `movejob` hook can specify only local queues as the destination queue. Whether a job is submitted with a local queue or a remote queue as its destination, a `movejob` hook can change the destination to a local queue.

The only job attribute that a `movejob` event hook can set is the job's destination queue.

6.3.1.5.ii The `movejob` Hook Interface

The type for this event is `pbs.MOVEJOB`.

The server runs its `movejob` hooks when any of the following happens:

- This server is the furnishing server when peer scheduling a job
- A job is moved from this server to another server via the `qmove` command
- A job is moved between two queues on this server

A `movejob` hook is executed after `qmove` arguments are processed, but before a job is moved from one queue to another. This hook is triggered by `qmove` and the `pbs_movejob()` API call. `movejob` hooks are not triggered by `pbs_rsub -Wqmove=<job ID>`. A `movejob` hook runs once per job array.

A job object's attributes appear to a `movejob` hook as they would be after the event, not before it.

The hook shows the job's originating queue in the `pbs.event().src_queue` object member.

A `pbs.MOVEJOB` event has the following members, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

A `pbs.job` object representing the job being moved. See [section 6.6, "Job Objects", on page 122](#).

Note that `pbs.event().job.queue` refers to the destination queue, not the current queue.

`pbs.event().src_queue`

The `pbs.queue` object representing the originating queue where `pbs.event().job` came from.

A `pbs.event().accept()` terminates hook execution and allows the job to be moved, and any changes to job attributes or resources take effect.

A `pbs.event().reject()` terminates hook execution and causes the job not to be moved.

6.3.1.6 runjob: Event Before Job is Received by MoM

6.3.1.6.i Changes Before Job is Sent to MoM (qrun)

When the scheduler runs a job or the administrator runs a job using the `qrun` command, any `runjob` hooks are executed.

- On accepting a job, a `runjob` hook can modify the following:
 - The job's `Error_Path` attribute
 - The job's `Output_Path` attribute
 - All of the job's `Variable_List` attribute members
 - The following `Resource_List` attribute members:
 - `cput`
 - `exec_vnode`
 - `file`
 - `max_walltime`
 - `min_walltime`
 - `nice`
 - `pccput`
 - `pmem`
 - `pvmem`
 - `site`
 - `software`
 - `start_time`
 - `walltime`
- When a `runjob` hook rejects a job, it can do the following:
 - Set the job's `depend` attribute
 - Set any members of the job's `Variable_List` attribute
 - Place a hold on the job
 - Release a hold on the job
 - Set the job's `project` attribute
 - Change the time the job is allowed to begin execution
 - Set any of the job's `Resource_List` attribute members except `nodect`
 - Change the state of a `vnode` where the job would have run

See [Table 5-6, “Job Attributes Readable & Settable via Events,” on page 55](#) and [Table 5-9, “Built-in Job Resources Readable & Settable by Hooks via Events,” on page 60](#).

A `runjob` hook can modify a `vnode` only if the hook rejects the event, and the `vnode` is in the job's `exec_vnode` attribute. For a `vnode`, the hook can modify only the `state` attribute. The only pre-execution event hook that can change this attribute is a `runjob` hook.

6.3.1.6.ii The runjob Hook Interface

The event type is `pbs.RUNJOB`.

A `runjob` event occurs when one of the following happens:

- The administrator uses the `qrun` command
- The scheduler chooses to run a job and calls `pbs_runjob()`

A `runjob` hook is executed just before a job is sent to the execution host. It is triggered by `qrun` and the `pbs_runjob()` API call. A `runjob` hook runs once per subjob.

For a `runjob` hook only, job object attributes appear as they would be before the event takes place.

A `pbs.RUNJOB` event has the following member, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().job`

A `pbs.job` object representing the job being run. See [section 6.6, “Job Objects”, on page 122](#).

A `pbs.event().accept()` terminates hook execution and allows the job to be sent to the execution host, and any changes to job attributes or resources take effect.

A `pbs.event().reject()` terminates hook execution and causes the job to be requeued instead of being sent to the execution host. When a job is requeued by this hook, the scheduler considers it for execution in the next scheduling cycle.

6.3.1.7 periodic: Periodic Event at Server Host

6.3.1.7.i Periodic Events at Server Host

Periodically, at the server host, a periodic hook can:

- Run `qstat`, job start time estimator named `pbs_est`, etc.

6.3.1.7.ii The periodic Hook Interface

This event type is `pbs.PERIODIC`.

The `periodic` hook runs periodically on the server host, in the background. The hook begins periodic execution, and the interval timer is restarted, when any of the following happens:

- The hook is enabled
- The hook is imported
- The server starts

The `periodic` hook runs as `pbsadmin`.

The interval between calls to `periodic` hooks is specified in the `freq` hook attribute. See [section 5.1.13, “Setting Hook Interval \(Frequency\)”, on page 39](#).

A call to `pbs.event().accept()` causes any changes made to objects exposed in the hook to take effect.

A call to `pbs.event().reject(<message>)` prevents any changes from taking effect.

A call to `pbs.event().reject(<message>)` causes the following messages to appear in the server log:

```
"run_periodic_hook; request rejected by <hook_name>"
<message>
```

The `periodic` hook continues to be periodically called whether or not there are errors in hook script execution or a call to the `pbs.event().reject()` action. To stop the hook from being called, either disable it or delete it:

```
#qmgr -c "s h <periodic hook> enabled=f"
#qmgr -c "d h <periodic hook>"
```

If the `periodic` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, all changes do **not** take effect. In addition, one of the following messages appears in the MoM log at event class `PBSEVENT_DEBUG2`:

```
"periodic hook <hook_name> encountered an exception, request rejected"
"alarm call while running periodic hook '<hook_name>', request rejected"
```


6.3.1.7.iii Caveats for periodic Event Hooks

The order attribute is ignored for periodic hooks. It does **not** guarantee the execution order of a list of periodic hooks.

6.3.1.8 execjob_begin: Event when Execution Host Receives Job

6.3.1.8.i Changes When Job is Received by MoM

When MoM receives a job, an `execjob_begin` hook can:

- Modify the job's `Execution_Time`, `Hold_Types`, `Variable_List`, and `resources_used` attributes
- Flag the job to be rerun
- Kill the job
- Set attributes and resources on the vnode(s) managed by the MoM where this job executes

6.3.1.8.ii The `execjob_begin` Hook Interface

This event type is `pbs.EXECJOB_BEGIN`.

An `execjob_begin` hook executes on the primary MoM host and then, if successful, executes on all the sister MoM hosts allocated to the job. The hook executes when the host first receives the job, after any files or directories are staged in.

A `pbs.EXECJOB_BEGIN` event has the following members and methods, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that is about to run. See [section 6.6, “Job Objects,” on page 122](#).

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. See [section 6.3.2.22, “The Vnode List Event Member,” on page 114](#) for information about using `pbs.event().vnode_list[]`.

A call to `pbs.event().accept()` means the job can proceed with execution, and any changes to job attributes, resources, or the vnode list take effect.

A call to `pbs.event().reject(<message>)` automatically causes the job to be killed and tells the server to requeue the job. In addition, any changes to job attributes, resources, or vnode list take effect. When a job is requeued by this hook, the scheduler considers it for execution in the next scheduling cycle.

- If the `pbs.event().reject(<message>)` call is made on a primary execution host, the following message appears in the MoM log at log event class `PBSEVENT_DEBUG2`:

```
"execjob_begin request rejected by <hook_name>"
```

```
<message>
```

The rejection message `<message>` also appears in the `STDERR` of the program such as `qrun` invoking `pbs_runjob()` API:

- If the `pbs.event().reject(<message>)` call is made on a sister host, the following message appears in the MoM log at log event class `PBSEVENT_DEBUG2`:

```
"execjob_begin request rejected by <hook_name>"
```

```
<message>
```

In addition, this message appears in `mom_logs` on the primary execution host:

```
"job_start_error: <hook errno> from node <hostname> could not JOIN_JOB successfully."
```

- If `pbs_runjob()` was invoked by the scheduler, the following job comment appears:

```
"Not running: PBS Error: <message>"
```


If the `execjob_begin` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, the job is automatically killed and the server requeues the job. All job changes, vnode changes, or requests for host reboot or scheduler cycle restarts do **not** take effect. In this case, one of the the following messages appears in the MoM log at event class `PBSEVENT_DEBUG2`:

```
"execjob_begin hook <hook_name> encountered an exception, request rejected"
"alarm call while running execjob_begin hook '<hook_name>', request rejected"
```

6.3.1.9 `execjob_prologue`: Event Just Before Execution of Top-level Job Process

6.3.1.9.i Changes Before Job Shell is Executed

Just before a job's top shell is executed, an `execjob_prologue` hook can:

- Modify the job's `Execution_Time`, `Hold_Types`, and `resources_used` attributes
- Flag the job to be rerun
- Kill the job
- Set attributes and resources on the vnode(s) managed by the MoM where this job executes
- Modify a job's vnode request
- Put a bad vnode in the `pbs.event().vnode_list_fail[]` list

6.3.1.9.ii The `execjob_prologue` Hook Interface

This event type is `pbs.EXECJOB_PROLOGUE`.

An `execjob_prologue` hook runs on the primary MoM host. If the hook runs successfully on the primary MoM host, an `execjob_prologue` hook runs on each of the sister MoM hosts allocated to the job. On the primary MoM host, an `execjob_prologue` hook executes just prior to executing the top-level shell or `cmd` process of the job. This is where the prologue executes. On a sister MoM host, the hook executes just before the first task of the job on this host is spawned, and before any `execjob_launch` or `execjob_attach` hooks. See [Table 4-1, "Execution Event Hook Timing," on page 19](#).

An `execjob_prologue` hook overrides a prologue. If an `execjob_prologue` hook exists and is enabled, MoM executes the hook. Otherwise, she executes the prologue.

A `pbs.EXECJOB_PROLOGUE` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that is about to run. See [section 6.6, "Job Objects," on page 122](#).

`pbs.event().job.release_nodes()`

This method releases unneeded vnodes from a job's vnode request. See [section 6.6.4.4, "Job Object Method to Release Vnodes," on page 128](#).

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. See [section 6.3.2.22, "The Vnode List Event Member," on page 114](#) for information about using `pbs.event().vnode_list[]`.

This is a `pbs.job` object representing the job that is about to run. See [section 6.6, "Job Objects," on page 122](#).

`pbs.event().vnode_list_fail[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job but are marked as unhealthy. See [section 6.3.2.23, "The Failed Vnode List Event Member," on page 115](#) for information about `pbs.event().vnode_list_fail[]`.

A `pbs.event().accept()` allows the job to continue its normal execution, and any changes to job attributes, resources, or vnode list take effect.

A `pbs.event().reject(<message>)` causes the job to be killed, and the owning server to requeue the job. Any changes to job attributes, resources, or vnode list take effect. When a job is requeued by this hook, the scheduler considers it for execution in the next scheduling cycle.

- On the primary execution host, the following job-level `mom_logs` entries appear:

```
"execjob_prologue request rejected by <hook_name>"
<message>
```
- On a sister vnode, the following job-level `mom_logs` entries appear:

```
"execjob_prologue request rejected by <hook_name>"
<message>
```
- In addition, the following message appears in the `STDERR` of the program invoking the `tm_attach()` API, such as the `pbs_attach()` command:

```
"a hook has rejected the task manager request"
```

If the following setting is specified in the hook script, just before issuing a `pbs.event().reject()`, the job is deleted instead of being requeued:

```
pbs.event().job.delete()
```

If the `user` attribute of the `execjob_prologue` hook is set to `pbsuser`, the hook script executes under the context of the job owner (the value of the `euser` job attribute).

If the `execjob_prologue` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, the job is killed and the server requeues the job. All job changes, vnode changes, or requests for host reboot or scheduler cycle restarts, do **not** take effect. In addition, one of the following messages appears in the MoM log at event class `PBSEVENT_DEBUG2`:

```
"execjob_prologue hook <hook_name> encountered an exception, request rejected"
"alarm call while running execjob_prologue hook '<hook_name>', request rejected"
```

The standard output and standard error of an `execjob_prologue` hook script are not connected to the standard output and standard error of the job.

6.3.1.10 `execjob_launch`: Event when Execution Host Receives Job

6.3.1.10.i Changes Before User Program is Executed

Just before the user's program is executed, an `execjob_launch` hook can:

- Change the job's top shell or executable
- Change the arguments to the shell or executable
- Change the job's environment variables
- Modify job and vnode attributes
- Modify a job's vnode request
- Put a bad vnode in the `pbs.event().vnode_list_fail[]` list

An `execjob_launch` hook cannot modify anything else.

6.3.1.10.ii The `execjob_launch` Hook Interface

This event type is `pbs.EXECJOB_LAUNCH`.

An `execjob_launch` hook runs on the primary MoM host just before executing the user's program. The hook runs on the sister MoM hosts allocated to the job, just before executing the user's program as specified in a `tm_spawn()` API call, which is called from `pbsdsh` and `pbs_tm_rsh`.

Any `execjob_launch` hooks runs after `execjob_prologue` hooks.

This hook cannot use any of the job's methods.

A `pbs.EXECJOB_LAUNCH` event hook has access to the following members and methods, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().argv[]`

This is a `pbs.argv[]` object representing the arguments to the shell or executable. See [section 6.3.2.2, “Job Program Arguments Event Member,” on page 109](#).

`pbs.event().env`

This is a `pbs.env[]` object representing the job's environment variables. See [section 6.3.2.5, “Job Environment Event Member,” on page 110](#).

`pbs.event().job`

This is a `pbs.job` object representing the job that is about to run. See [section 6.6, “Job Objects,” on page 122](#).

`pbs.event().job.release_nodes()`

This method releases unneeded vnodes from a job's vnode request. See [section 6.6.4.4, “Job Object Method to Release Vnodes,” on page 128](#).

`pbs.event().programe`

This is a `pbs.programe` object representing the job shell or executable. See [section 6.3.2.15, “Job Executable Event Member,” on page 112](#).

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to the job that caused the `execjob_launch` hook to execute. See [section 6.3.2.22, “The Vnode List Event Member,” on page 114](#) for information about `pbs.event().vnode_list[]`. This object is read-only for this event. The vnode objects in `vnode_list[]` cannot be modified. Attempting to modify them result in the following:

- The `execjob_launch` hook is terminated
- The job ends prematurely with a non-zero `Exit_Status` value
- The following `PBSEVENT_DEBUG2` message appears in `mom_logs`:

```
“execjob_launch hook 'launch' encountered an exception, request rejected”
Can only set programe, argv, env event parameters under execjob_launch hook.”
```

`pbs.event().vnode_list_fail[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job but are marked as unhealthy. See [section 6.3.2.23, “The Failed Vnode List Event Member,” on page 115](#) for information about `pbs.event().vnode_list_fail[]`.

A call to `pbs.event().accept()` means the job can proceed with execution, and any changes to `programe`, `argv[]`, and `env[]` take effect. If the hook makes changes to the job's `programe`, `argv[]`, or `env[]` parameters, the appropriate `PBSEVENT_DEBUG2` message(s) appear in `mom_logs` for each change in a value:

```
“programe orig: <original_programe>”
“programe new: <updated_programe>”
“argv orig: <original_argv>”
“argv new: <updated_argv>”
“env orig: <original_env>”
“env new: <updated_env>”
```

A call to `pbs.event().reject(<message>)` causes the job to be terminated with a non-zero `Exit_Status` value, and the following `PBSEVENT_DEBUG2` messages to appear in `mom_logs`:

```
"execjob_launch" request rejected by '<hook_name>'
<message>
```

If the `execjob_launch` hook script encounters an unexpected error causing an unhandled exception, the job is terminated with a non-zero `Exit_Status` value, and the following `PBSEVENT_DEBUG2` messages appear in `mom_logs`:

```
"execjob_launch hook <hook_name> encountered an exception, request rejected"
```

If the `execjob_launch` hook script terminates due to a hook alarm, the job is terminated with a non-zero `Exit_Status` value, and the following `PBSEVENT_DEBUG2` messages appear in `mom_logs`:

```
"alarm call while running execjob_launch hook '<hook_name>', request rejected"
```

6.3.1.11 `execjob_attach`: Event when `pbs_attach()` runs

6.3.1.11.i Event when `pbs_attach()` Runs

When `pbs_attach()` is called, an `execjob_attach` hook can accept or reject the procedure where the process ID is attached to the job.

6.3.1.11.ii The `execjob_attach` Hook Interface

An `execjob_attach` hook runs on any MoM host where an MPI process is spawned using `pbs_attach()`. The `execjob_attach` hook runs for each process ID.

The `execjob_attach` hook runs before any `execjob_prologue` hooks run on behalf of the first task. See [Table 4-1, "Execution Event Hook Timing," on page 19](#).

An `execjob_attach` hook cannot modify any PBS objects.

A `pbs.EXECJOB_ATTACH` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that is about to run. See [section 6.6, "Job Objects," on page 122](#). For this hook, this job object is read-only.

`pbs.event().pid`

This is a Python `int` representing the process ID whose session ID is being added to the job tasks list. This hook cannot modify the value of the process ID.

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. The list of vnodes is read-only for this event. See [section 6.3.2.22, "The Vnode List Event Member," on page 114](#) for information about using `pbs.event().vnode_list[]`.

On a call to `pbs.event().accept()`, MoM proceeds as usual to add the session ID of the process ID to the job's task list.

On a call to `pbs.event().reject(<message>)`, the following happens:

- Hook execution terminates
- MoM does not get the session ID
- PBS prints the following message in `mom_logs` at log level `PBSEVENT_DEBUG2`:

```
"execjob_attach" request rejected by '<hook_name>'
<message>
```

If the `execjob_attach` hook script encounters an unhandled exception:

- Hook execution terminates
- MoM does not get the session ID of the process ID
- The following message appears in `mom_logs` at `PBSEVENT_DEBUG2`:
`"execjob_attach hook <hook_name> encountered an exception, request rejected"`

If the `execjob_attach` hook script terminates due to a hook alarm, MoM does not get the session ID of the process ID, and the following message appears in `mom_logs` at `PBSEVENT_DEBUG2`:

`"alarm call while running execjob_attach hook '<hook_name>', request rejected"`

6.3.1.11.iii Caveats for `execjob_attach` Hooks

- Do not attempt to modify `pbs.event().pid`. If you do:
 - Hook execution is terminated
 - MoM does not get the session ID of the process ID
 - The following messages appear in `mom_logs` at `PBSEVENT_DEBUG2`:
`"execjob_attach hook <hook_name> encountered an exception, request rejected"`
`"event attribute 'pid' is read-only"`
- Do not attempt to modify `pbs.event().job` or the objects in `pbs.event().vnode_list[]`. If you do:
 - Hook execution is terminated
 - MoM does not get the session ID of the process ID
 - The following messages appear in `mom_logs` at `PBSEVENT_DEBUG2`:
`"execjob_attach hook <hook_name> encountered an exception, request rejected"`
`"nothing is settable inside an execjob_attach hook!"`

6.3.1.12 `execjob_postsuspend`: Event Just After Suspending Job

6.3.1.12.i The `execjob_postsuspend` Hook Interface

This event type is `pbs.EXECJOB_POSTSUSPEND`.

This hook runs on all of the MoM hosts assigned to a job, after the job has been successfully suspended.

An `execjob_postsuspend` hook:

- Cannot modify any PBS objects
- Cannot be used to set a fail action
- Must run as `pbsadmin`
- Does not interrupt the flow of suspend/resume

A `pbs.EXECJOB_POSTSUSPEND` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that has just been suspended. See [section 6.6, "Job Objects," on page 122](#). For this hook, this job object is read-only.

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. The list of vnodes is read-only for this event. See [section 6.3.2.22, "The Vnode List Event Member," on page 114](#) for information about using `pbs.event().vnode_list[]`.

On a call to `pbs.event().accept()`, nothing happens.

On a call to `pbs.event().reject(<message>)`, the following happens:

- Hook execution terminates
- PBS prints the following message in `mom_logs` at log level `PBSEVENT_DEBUG2`:
`"execjob_postsuspend" request rejected by '<hook_name>'"`
`<message>`

6.3.1.13 `execjob_preresume`: Event Just Before Resuming Job

6.3.1.13.i The `execjob_preresume` Hook Interface

This event type is `pbs.EXECJOB_PRERESUME`.

This hook runs on the primary MoM host when this MoM receives a request to resume a job, and then if this is successful, the primary MoM sends a request to the sisters to resume the job, at which point this hook runs on the sister MoM hosts. All of the `execjob_preresume` hooks for a job must succeed in order for the job to resume.

An `execjob_preresume` hook:

- Cannot modify any PBS objects
- Cannot be used to set a fail action
- Must run as `pbsadmin`

A `pbs.EXECJOB_PRERESUME` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that has just been suspended. See [section 6.6, "Job Objects," on page 122](#). For this hook, this job object is read-only.

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. The list of vnodes is read-only for this event. See [section 6.3.2.22, "The Vnode List Event Member," on page 114](#) for information about using `pbs.event().vnode_list[]`.

On a call to `pbs.event().accept()`, nothing happens

On a call to `pbs.event().reject(<message>)`, the following happens:

- Hook execution terminates
- All MoMs where job processes were running are prevented from resuming the job
- PBS prints the following message in `mom_logs` at log level `PBSEVENT_DEBUG2`:
`"execjob_preresume" request rejected by '<hook_name>'"`
`<message>`

6.3.1.14 execjob_preterm: Event Just Before Killing Job Tasks

6.3.1.14.i Changes Before Job is Killed

Just before a job is killed, an `execjob_preterm` hook can:

- Modify the job's `Execution_Time`, `Hold_Types`, and `resources_used` attributes
- Flag the job to be rerun
- Kill the job
- Set attributes and resources on the vnode(s) managed by the MoM where this job executes
- Cause the job to keep running

6.3.1.14.ii The `execjob_preterm` Hook Interface

This event type is `pbs.EXECJOB_PRETERM`.

An `execjob_preterm` hook executes on all the MoM hosts allocated to a job. This hook runs only when a `qdel` has been issued. It does not run for any other job termination. For example, it does not run on a `qrerun` or when a job goes over its limit. On the primary MoM host, the hook executes when the job receives a signal from the server for the job to terminate. On a sister MoM host, this hook executes when the sister receives a request from the primary MoM host to terminate the job, just before the sister signals the task on this host to terminate.

A `pbs.EXECJOB_PRETERM` event has the following members and methods, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that is about to run (or be killed). See [section 6.6, “Job Objects,” on page 122](#).

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. See [section 6.3.2.22, “The Vnode List Event Member,” on page 114](#) for information about using `pbs.event().vnode_list[]`.

A `pbs.event().accept()` call allows job cancellation or deletion to happen, and any changes to job attributes, resources, or vnode list take effect.

A `pbs.event().reject()` call causes the job instance on a vnode to continue running, because the terminate signal is not delivered to the job. Any changes to job attributes, resources, or vnode list take effect.

- On the primary execution host, a `pbs.event().reject(<message>)` causes the following to appear in the `STDERR` of the program (`qdel`) invoking the `pbs_deljob()` API:

```
“hook rejected request”
```
- The following message appears in the MoM log at log event class `PBSEVENT_DEBUG2`:

```
“execjob_preterm request rejected by <hook_name>”  
<message>
```
- On a sister host, a `pbs.event().reject(<message>)` causes the following message to appear in the MoM log at log event class `PBSEVENT_DEBUG2`:

```
“execjob_preterm request rejected by <hook_name>”  
<message>
```

If the `user` attribute of the `execjob_preterm` hook is set to `pbsuser`, the hook script executes under the context of the job owner (the value of the `euser` job attribute).

If the `execjob_preterm` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, the job continues to run, and all job changes, vnode changes, requests for host reboot or scheduler cycle restarts, do **not** take effect. In addition, one of the the following messages appears in the MoM log at event class `PBSEVENT_DEBUG2`:

```
"execjob_preterm hook <hook_name> encountered an exception, request rejected"
"alarm call while running execjob_preterm hook '<hook_name>', request rejected"
```

6.3.1.15 `execjob_epilogue`: Event Just After Killing Job Tasks

6.3.1.15.i Changes After Job is Executed

Just after a job is executed, an `execjob_epilogue` hook can:

- Modify the job's `Execution_Time`, `Hold_Types`, and `resources_used` attributes
- Flag the job to be rerun
- Kill the job
- Set attributes and resources on the vnode(s) managed by the MoM where this job executes
- Use the job's exit status

6.3.1.15.ii The `execjob_epilogue` Hook Interface

This event type is `pbs.EXECJOB_EPILOGUE`.

An `execjob_epilogue` hook executes on all the MoM hosts allocated to the job. On a primary MoM host, the hook executes after all the job tasks/processes on the host have been killed, and basic CPU and memory resource usage information have been logged, but before job processes are cleaned up. This is where the epilogue executes. On a sister MoM host, the hook executes after the sister MoM receives a request to kill the job and has signaled the job tasks to terminate.

When an `execjob_epilogue` hook modifies the `resources_used` job attribute, it is modifying only the value counted at the local host. For example, if a job runs on two hosts, using four minutes of CPU time on each host, and the hook changes that to three minutes (and this hook runs at both hosts), the job's final CPU time total is six minutes instead of eight.

An `execjob_epilogue` hook overrides an epilogue. If an `execjob_epilogue` hook exists and is enabled, MoM executes the hook. Otherwise, she executes the epilogue.

A `pbs.EXECJOB_EPILOGUE` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

`pbs.event().job`

This is a `pbs.job` object representing the job that just finished. See [section 6.6, "Job Objects", on page 122](#).

`pbs.event().job.Exit_status`

A Python int that holds the exit value of the top level shell of the job script. This value is valid only if the hook is executing on a primary execution host.

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. See [section 6.3.2.22, "The Vnode List Event Member", on page 114](#) for information about using `pbs.event().vnode_list[]`.

A call to `pbs.event().accept()` continues the normal end-of-job processing, and any changes to job attributes, resources, or vnode list take effect.

A call to `pbs.event().reject()` causes the job on the current vnode to exit, and the owning server to completely delete the job. Any changes to job attributes, resources, or vnode list take effect.

- On a primary execution host, a `pbs.event().reject(<message>)` causes the following message to appear in the MoM log at log event class `PBSEVENT_DEBUG2`:
`"execjob_epilogue request rejected by <hook_name>"`
`<message>`
- On a sister host, a `pbs.event().reject(<message>)` causes the following message to appear in the MoM log at log event class `PBSEVENT_DEBUG2`:
`"execjob_epilogue request rejected by <hook_name>"`
`<message>`
- If the following call has been made prior to calling `pbs.event().reject()`, the owning server requeues the job:
`pbs.event().job.rerun()`

If the `user` attribute of the `execjob_epilogue` hook is set to `pbsuser`, the hook script executes under the context of the job owner (the value of the `euser` job attribute).

If the `execjob_epilogue` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, this causes the job on the current vnode to exit, and the owning server to completely delete the job. All job changes, vnode changes, requests for host reboot or scheduler cycle restarts, do **not** take effect. In addition, one of the following messages appears in the MoM log at event class `PBSEVENT_DEBUG2`:

```
"execjob_epilogue hook <hook_name> encountered an exception, request rejected"
"alarm call while running execjob_epilogue hook '<hook_name>', request rejected"
```

The standard output and standard error of an `execjob_epilogue` hook script are not connected to the standard output and standard error of the job.

6.3.1.16 execjob_end: Event After Job Cleanup

6.3.1.16.i Changes After Job Finishes or is Killed

Just after a job is cleaned up after it finishes execution or is killed, an `execjob_end` hook can:

- Set attributes and resources on the vnode(s) managed by the MoM where this job executes
- Use the job's exit status

An `execjob_end` hook cannot effectively modify the job's `Execution_Time` and `Hold_Types` attributes. These changes will not be visible to the server, because the job is already cleaned up and reported.

6.3.1.16.ii The execjob_end Hook Interface

This event type is `pbs.EXECJOB_END`.

An `execjob_end` hook executes on all the MoM hosts allocated to a job. The hook is executed after a job is cleaned up.

A `pbs.EXECJOB_END` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events,"](#) on page 108 and [Table 6-14, "Methods Available in Events,"](#) on page 141:

`pbs.event().job`

This is a `pbs.job` object representing the job that just ran. See [section 6.6, "Job Objects,"](#) on page 122.

`pbs.event().job.Exit_status`

A Python int that holds the exit value of the top level shell of the job script. This value is valid only when the hook executes on a primary execution host.

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are assigned to this job. See [section 6.3.2.22, “The Vnode List Event Member”, on page 114](#) for information about using `pbs.event().vnode_list[]`.

A call to `pbs.event().accept()` ends the job, and any changes to job attributes, resources, or vnode list take effect.

A call to `pbs.event().reject(<message>)` also ends the job, and any changes to job attributes, resources, or vnode list also take effect.

A call to `pbs.event().reject(<message>)` on a primary execution host causes the following message to appear in the MoM log at log event class `PBSEVENT_DEBUG2`:

```
“execjob_end request rejected by <hook_name>”
<message>
```

A call to `pbs.event().reject(<message>)` on a sister host causes the following message to appear in the MoM log at log event class `PBSEVENT_DEBUG2`:

```
“execjob_end request rejected by <hook_name>”
<message>
```

If the `execjob_end` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, the job terminates, and all job changes, vnode changes, requests for host reboot or scheduler cycle restarts, do **not** take effect. In addition, one of the following messages appear in the MoM logs at event class `PBSEVENT_DEBUG2`:

```
“execjob_end hook <hook_name> encountered an exception, request rejected”
“alarm call while running execjob_end hook '<hook_name>', request rejected”
```

6.3.1.17 exechost_startup: Event When Execution Host Starts Up

6.3.1.17.i Event when Execution Host Starts or Receives HUP

When an execution host starts up or receives a HUP, an `exechost_startup` hook can:

- Create vnodes on local host
- Create custom resources for vnodes
- Offline vnodes that are not ready for use
- Return vnodes to use that have been previously offlined
- Modify the attributes and resources of the vnodes managed by the local MoM

6.3.1.17.ii The exechost_startup Hook Interface

This event type is `pbs.EXECHOST_STARTUP`.

The `exechost_startup` hook runs on a MoM host every time its MoM starts up, or when a Linux `pbs_mom` receives a `SIGHUP` signal. This hook executes after MoM loads `pbs.conf` values, reads `mom_priv/config` values, and runs platform-specific initializations, for example `cpuset` initialization, including topology data gathering. If there are Version 2 configuration files, this hook sets vnode definitions from those Version 2 configuration files.

The `exechost_startup` hook runs independently of jobs; it depends only on MoM startup and HUP.

A `pbs.EXECHOST_STARTUP` event has the following members and methods, in addition to those listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#) and [Table 6-14, “Methods Available in Events,” on page 141](#):

`pbs.event().vnode_list[]`

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are managed by the MoM where the hook runs. See [section 6.3.2.22, “The Vnode List Event Member”, on page 114](#) for information about using `pbs.event().vnode_list[]`.

On a call to `pbs.event().accept()` or `pbs.event().reject()`, vnode changes take effect, and MoM continues to run.

A call to `pbs.event().reject(<message>)` causes the following messages to appear in the MoM log:

```
"exechost_startup" request rejected by hook <hook_name>
<message>
```

If the `exechost_startup` hook script encounters an unexpected error causing an unhandled exception:

- Vnode changes do not take effect
- MoM continues to run
- The following message appears at `PBSEVENT_DEBUG2` in `mom_logs`:

```
"exechost_startup hook <hook_name> encountered an exception, request rejected"
```

If the `exechost_startup` hook script terminates due to a hook alarm, vnode changes do not take effect, MoM continues to run, and the following message appears at `PBSEVENT_DEBUG2` in `mom_logs`:

```
"alarm call while running exechost_startup hook '<hook_name>', request rejected"
```

6.3.1.17.iii Advice on Using `exechost_startup` Hooks

- We recommend that your hook does not make changes unless the hook accepts its event. You do not want to have to back changes out upon a `reject()`.
- For exceptions, we recommend that you catch them via `try... except` and accompany them with a call to `pbs.event().reject()`.
- We recommend that before calling `pbs.event().reject()`, you set the vnodes managed by the local MoM offline with an accompanying comment. This stops jobs from being sent to the affected vnodes. For example:

```
vnlist = pbs.event().vnode_list
for v in vnlist.keys():
    vnlist[v].state = pbs.ND_OFFLINE
    vnlist[v].comment = "bad configuration"
pbs.event().reject("not accepting jobs")
```

6.3.1.18 `exechost_periodic`: Periodic Events on All Execution Hosts

6.3.1.18.i Periodic Events at Execution Hosts

Periodically, at each execution host, an `exechost_periodic` hook can:

- Set attributes and resources for any vnode managed by the MoM on the host where the hook runs. This means that an instance of a hook can affect more than one vnode only when the hook is running on a multi-vnode host.
- Set attributes or resources for each job managed by the local MoM.

6.3.1.18.ii The `exechost_periodic` Hook Interface

This event type is `pbs.EXECHOST_PERIODIC`.

The `exechost_periodic` hook runs periodically on all the MoM hosts in the complex.

The interval between calls to `exechost_periodic` hooks is specified in the `freq` hook attribute. See [section 5.1.13, "Setting Hook Interval \(Frequency\)", on page 39](#).

A `pbs.EXECHOST_PERIODIC` event has the following members and methods, in addition to those listed in [Table 6-3, "Using Event Object Members in Events," on page 108](#) and [Table 6-14, "Methods Available in Events," on page 141](#):

```
pbs.event().vnode_list[]
```

This is a dictionary of `pbs.vnode` objects, keyed by vnode name, listing the vnodes that are managed by the MoM where the hook runs. See [section 6.3.2.22, "The Vnode List Event Member", on page 114](#) for information about using `pbs.event().vnode_list[]`.

```
pbs.event().job_list[]
```

List of the `pbs.job` objects managed by the local MoM. This hook can set the attributes and resources for these jobs. See [section 6.3.2.11, “Job List Event Member”, on page 111](#).

A call to `pbs.event().accept()` or `pbs.event().reject(<message>)` causes any changes made to vnodes to take effect.

A call to `pbs.event().reject(<message>)` causes the following messages to appear in the MoM log:

```
"exechost_periodic" request rejected by hook <hook_name>"
<message>
```

The periodic hook continues to be periodically called whether or not there are errors in hook script execution or a call to the `pbs.event().reject()` action. To stop the hook from being called, either disable it or delete it:

```
#qmgr -c "s h <periodic hook> enabled=f"
#qmgr -c "d h <periodic hook>"
```

If the `exechost_periodic` hook script encounters an unexpected error causing an unhandled exception, or if the script terminates due to a hook alarm, all vnode changes, requests for host reboot or scheduler cycle restarts, do **not** take effect. In addition, one of the following messages appears in the MoM log at event class `PBSEVENT_DEBUG2`:

```
"exechost_periodic hook <hook_name> encountered an exception, request rejected"
"alarm call while running exechost_periodic hook '<hook_name>', request rejected"
```

6.3.1.18.iii Caveats for exechost_periodic Event Hooks

The order attribute is ignored for `exechost_periodic` hooks. It does **not** guarantee the execution order of a list of periodic hooks.

6.3.2 Event Object Members

Some event object members are hook attributes, and some exist as part of the event object but are not hook attributes. The following table summarizes the members for event objects, and shows which event objects have access to each member, and whether the event hook can read and set the member. An “r” indicates read, an “s” indicates set, and an “o” indicates that this member can be set but the action has no effect. See [Table 4-1, “Execution Event Hook Timing,” on page 19](#) for more information about why some operations have no effect.

Table 6-3: Using Event Object Members in Events

Event Object Member	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	exechost_startup	exechost_periodic	provision
pbs.event().alarm	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().argv[]	---	---	---	---	---	---	---	---	---	---	---	r, s	---	---	---	---	---	---	---	---
pbs.event().debug	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().enabled	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().env	---	---	---	---	---	---	---	---	---	---	---	r, s	---	---	---	---	---	---	---	---
pbs.event().fail_action	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().freq	---	---	---	---	r, s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().hook_name	r	r	r	r	r	---	r	r	r	r	r	r	r	r	r	r	r	r	r	r
pbs.event().hook_type	r	r	r	r	r	---	r	r	r	r	r	r	r	r	r	r	r	r	r	r

Table 6-3: Using Event Object Members in Events

Event Object Member	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	exechost_startup	exechost_periodic	provision
pbs.event().job	r, s	r, s	r, s	r, s	r, s	---	---	---	r, s	r	r, s	r	r	r	r, s	r, s	r, s	---	---	---
pbs.event().job_list (jobs)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	r, s	---
pbs.event().job_o	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().order	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().pid	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---	---	---
pbs.event().progname	---	---	---	---	---	---	---	---	---	---	r, s	---	---	---	---	---	---	---	---	---
pbs.event().requestor	r	r	r	r	r	---	r	r	r	r	r	r	r	r	r	r	r	r	r	r
pbs.event().requestor_host	r	r	r	r	r	---	r	r	r	r	r	r	r	r	r	r	r	r	r	r
pbs.event().resv	---	---	---	---	---	---	table 5-8	table 5-8	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().src_queue	---	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().type	r	r	r	r	r	---	r	r	r	r	r	r	r	r	r	r	r	r	r	r
pbs.event().user	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
pbs.event().vnode_list[]	---	---	---	---	---	---	---	---	r, s	r	r, s	r	r, s	r, s	r, s	r, s	r, s	r, s	r, s	---
pbs.event().vnode_list_fail[]	---	---	---	---	---	---	---	---	---	---	r	r	---	---	---	---	---	---	---	---

An event object (an object returned by `pbs.event()`) has one or more of the following members:

6.3.2.1 Hook Alarm Event Member

pbs.event().alarm

Hook attribute. Number of seconds to allow a hook to run before the hook times out. Must be greater than zero. See “alarm” on page 349 of the [PBS Professional Reference Guide](#).

Type: *Integer*

6.3.2.2 Job Program Arguments Event Member

pbs.event().argv[]

The list of arguments to be passed to the job script. The arguments can be modified in an `execjob_launch` hook.

Type: *Python list of strings*

To add another argument to the argument list, append it:

```
pbs.event().argv.append(<new_argument>)
```

To clear out existing `argv[]` entries and supply a new set of arguments, use the following:

```
pbs.event().argv = []    (sets argv[] to empty list)
pbs.event().argv.append(<arg0>)
pbs.event().argv.append(<arg1>)
...
pbs.event().argv.append(<argN>)
```

On Windows, where backslashes may appear in pathnames, escape each backslash with another backslash, or use the `raw` (`r`) operator to form the string. Both of the following work:

```
e = pbs.event()
e.progname = "C:\\Program Files\\PBS Pro\\exec\\bin\\pbsnodes.exe"
e.progname = r"C:\Program Files\PBS Pro\exec\bin\pbsnodes.exe"
```

See [section 6.3.3, “Event Object Member Caveats”, on page 115](#).

To log the arguments to the program, and update some of them:

```
for a in pbs.event().argv:
    pbs.logmsg(pbs.LOG_DEBUG, "a=%s" % (a,))

argv = pbs.event().argv
argv[1] = "beta"
argv[3] = "gamma"
```

6.3.2.3 Hook Debug Behavior Indicator Event Member

pbs.event().debug

Hook attribute. Specifies whether or not the hook produces debugging files under `PBS_HOME/server_priv/hooks/tmp` or `PBS_HOME/mom_priv/hooks/tmp`. Files are named `hook_<hook event>_<hook name>_<unique ID>.in`, `.data`, and `.out`. See [“Producing Files for Debugging” on page 159 in the PBS Professional Hooks Guide](#), and [“debug” on page 349 of the PBS Professional Reference Guide](#).

Type: *Boolean*

6.3.2.4 Hook Enable or Disable Event Member

pbs.event().enabled

Hook attribute. Specifies whether or not the hook is enabled. See [“enabled” on page 349 of the PBS Professional Reference Guide](#).

Type: *Boolean*

6.3.2.5 Job Environment Event Member

pbs.event().env

The job’s environment. Can be modified in an `execjob_launch` hook.

Type: dictionary of *environment* `<variable>=<value>` entries, with `<variable>` serving as the dictionary key.

To modify a particular environment entry:

```
pbs.event().env[<variable>] = <value>
```

To add more entries to the `env[]` dictionary:

```
pbs.event().env[<new_var>] = <value>
```

To clear out existing `env[]` entries and specify a new environment:

```
pbs.event().env = pbs.pbs_env()
pbs.event().env[<var1>] = <value1>
pbs.event().env[<var2>] = <value2>
...
pbs.event[<varN>.] = <valueN>
```

To unset an existing environment variable:

```
pbs.event().env[<var>] = None
```

To embed a comma in an environment variable, escape the value with single quotes:

```
pbs.event().env[<var>] = '<value>''
```

On Windows, where backslashes appear in pathnames, either escape the backslash with another backslash, or use the `raw` (`r`) operator to form the string. Both of the following examples will work:

```
e = pbs.event()
e.progname = "C:\\Program Files\\PBS Pro\\exec\\bin\\pbsnodes.exe"
e.progname = r"C:\Program Files\PBS Pro\exec\bin\pbsnodes.exe"
```

See [section 6.3.3, “Event Object Member Caveats”, on page 115](#).

Example 6-1: To log the contents of a job’s environment variables:

```
for v in pbs.event().env.keys():
    e = pbs.event().env[v]
    pbs.logmsg(pbs.LOG_DEBUG, "env[%s]=%s" % (v,e))
```

6.3.2.6 Failure Action Event Member

pbs.event().fail_action

Hook attribute. Action to take on hook failure or on subsequent successful execution. See [“fail_action” on page 351 of the PBS Professional Reference Guide](#).

6.3.2.7 Frequency Event Member

pbs.event().freq

Hook attribute. Frequency at which to run hook. See [“freq” on page 351 of the PBS Professional Reference Guide](#).

6.3.2.8 Hook Name Event Member

pbs.event().hook_name

Name of the hook being executed.

Type: *str*

6.3.2.9 Hook Type Event Member

pbs.event().hook_type

The type of the hook. The only valid value is `“site”`. Represents the `Type` hook attribute.

Type: *str*

6.3.2.10 Job Event Member

pbs.event().job

The job that triggered the event. A `pbs.job` object. See [section 6.6, “Job Objects”, on page 122](#).

6.3.2.11 Job List Event Member

pbs.event().job_list

The list of jobs managed by the local MoM. Each job is a `pbs.job`, described in [section 6.6, “Job Objects”, on page 122](#).

For a list of settable attributes and resources, see [Table 5-6, “Job Attributes Readable & Settable via Events,” on page 55](#) and [Table 5-9, “Built-in Job Resources Readable & Settable by Hooks via Events,” on page 60](#).

Type: dictionary of `pbs.job` objects

To print the jobs in the list:

```
for k in pbs.event().job_list.keys():
    print pbs.event().job_list[k]
```

To set a job attribute or resource for all jobs in the list:

```
for k in pbs.event().job_list.keys():
    pbs.event().job_list[k].<attribute> = <value>
```

In an `execlist_periodic` hook, attributes are set after the hook ends in a call to `pbs.event().accept()` or `pbs.event().reject()`, but not when the hook encounters an uncaught exception or hits an alarm call.

In an `execlist_periodic` hook, you can flag a job to be requeued using `rerun()` or deleted using `delete()` when the server is notified that the job has terminated.

Example 6-2: Rerun all jobs in this MoM’s job list:

```
% cat period.py
import pbs
for k in pbs.event().job_list.keys():
    pbs.event().job_list[k].rerun()
```

6.3.2.12 Original Job Event Member

pbs.event().job_o

This is a `pbs.job` object representing the original job, before the job was modified via `qalter`. All resources and attributes are populated.

See [section 6.6, “Job Objects”, on page 122](#).

6.3.2.13 Order Event Member

pbs.event().order

Hook attribute. Order in which to run hook. See [“order” on page 351 of the PBS Professional Reference Guide](#).

6.3.2.14 Process ID Event Member

pbs.event().pid

The process ID of a task belonging to a job.

Type: *int*

6.3.2.15 Job Executable Event Member

pbs.event().progrname

The path to the job shell or executable. This is settable in an `execjob_launch` hook as follows:

```
pbs.event().progrname = "<path_to_the_script>"
```

When setting the value, specify the full path. Otherwise, the path may not be found, and the shell or executable may not run.

Type: *str*

6.3.2.16 Requestor Event Member

pbs.event().requestor

The requestor of the event.

PBS daemons can request actions. If a daemon requests an action, the `requestor` member contains one of "PBS_Server", "Scheduler", or "pbs_mom". If the requestor is root, the member contains "root".

For Windows systems, if the requestor is the administrator, the member contains the account name of the administrator.

Type: *str*

6.3.2.17 Requestor Host Event Member

pbs.event().requestor_host

The name of the host from which the event was requested.

Type: *str*

6.3.2.18 Reservation Event Member

pbs.event().resv

The reservation being requested in a `resvsub` event or ending in a `resv_end` event. See [section 6.9, "Reservation Objects", on page 131](#).

6.3.2.19 Source Queue Event Member

pbs.event().src_queue

The `pbs.queue` object representing the original queue where `pbs.event().job` came from.

See [section 6.5, "Queue Objects", on page 121](#).

6.3.2.20 Event Type Event Member

pbs.event().type

Hook attribute. The event type, for example, `queuejob` or `movejob`. Valid values: one of the PBS event type constants listed in [section 6.3.1, "Event Types", on page 87](#). See "[type](#)" on page 351 of the [PBS Professional Reference Guide](#).

Type: A PBS event type constant, such as `pbs.QUEUEJOB`, `pbs.RESVSUB`

6.3.2.21 Event User Event Member

pbs.event().user

Hook attribute. The username under which the hook executes. See "[user](#)" on page 351 of the [PBS Professional Reference Guide](#).

Valid values: *pbsadmin*, *pbsuser*.

pbsadmin

On Linux, this is root. On Windows, this is simply a substitute for the PBS service account; it is not the name of the PBS service account.

pbsuser

The hook runs under the account of the job owner, which is the value of the `euser` job attribute. Can be used for `execjob_prologue`, `execjob_epilogue`, `execjob_preterm` events only.

Default value: *pbsadmin*

Type: *String, str*

6.3.2.22 The Vnode List Event Member

pbs.event().vnode_list[]

Execution event hooks have access to the list of vnodes assigned to the job. Periodic event hooks have access to the list of vnodes managed by the local MoM. The `exechoost_startup` hook can create and modify the vnodes managed by the local MoM.

When a vnode is in such a list, the hook has access to the attributes and resources of that vnode. [Table 6-3, “Using Event Object Members in Events,” on page 108](#) lists which hooks can operate on `vnode_list[]`. [Table 5-7, “Vnode Attributes Readable & Settable via Events,” on page 57](#) and [Table 5-10, “Vnode Resources Readable & Settable by Hooks via Events,” on page 61](#) show which hooks can read and/or set each vnode attribute or resource.

When this list is retrieved through an execution event, it is associated with a job, and only vnodes assigned to the job have attributes, `resources_available`, `resources_assigned.ncpus`, and `resources_assigned.mem` filled in; on other vnodes, only `pbs.vnode().name` is available. See [section 6.10, “Vnode Objects,” on page 133](#).

You can use an `exechoost_startup` hook to create vnodes on the host where the hook runs:

```
pbs.event().vnode_list[<new vnode>] = pbs.vnode(<new vnode name>)
```

If you want to use an `execjob_` hook to manipulate a vnode that is not assigned to the job, but is still managed by the hook’s MoM, you must first instantiate the object for that vnode with the name of the new vnode:

```
pbs.event().vnode_list[<new vnode>] = pbs.vnode(<new vnode name>)
```

Once you have instantiated your new vnode (which must still be managed by your hook’s MoM), you can operate on it as shown here:

- To list all vnodes:


```
for v in pbs.event().vnode_list.keys():
    pbs.logmsg(pbs.LOG_DEBUG, "found vnode %s" % (pbs.event().vnode_list[v].name))
```
- To get the vnode managed by the local MoM, use the `pbs.get_local_nodename()` function to return the local parent vnode name where this hook is executing, and then use `pbs.event().vnode_list[<local parent vnode name>]`.


```
local_node = pbs.get_local_nodename()
```
- To find the other vnodes managed by the hook’s MoM:
 - a. Query the server for its list of vnodes:


```
pbs.server().vnodes()
```
 - b. Look in the `Mom` attribute in the resulting list of vnodes for a match to the output of:


```
pbs.get_local_nodename()
```

On a Cray, the `Mom` attribute may be a comma-separated list of strings, and you may have to check each one. Furthermore, `get_local_nodename()` returns the short hostname, and you may need to use instead the canonical hostname. If the name resolution on the server is consistent with the name resolution on the execution nodes, you can use the following, which returns in `host_canon_name` the name to be matched against `Mom` attribute of each `vnode_list` element:

```
import socket
[...]
```

```
host_short_name = pbs.get_local_nodename()
host_canon_name, host_aliases, host_addresses = socket.gethostbyname_ex(host_short_name)
```

To run your code only for vnodes managed by the specified MoM:

```
vnlist = pbs.event().vnode_list
for v in vnlist.keys():
    if host_canon_name in vnlist[v].Mom.split(","):
        [code]
```

- Setting and unsetting attributes and resources:

To set the attributes and resources for a particular vnode:

```
pbs.event().vnode_list[<vnode name>].<attribute> = <value>
pbs.event().vnode_list[<vnode name>].<resources_available>["<resource name>"] = <value>
```

You can unset a resource value by specifying “None” as its value:

```
pbs.event().vnode_list[<vnode_name>].resources_available["<resource name>"] = None
```

Resource names and string values must be quoted.

For details and examples, see [section 5.2.4.11, “Setting and Unsetting Vnode Resources and Attributes”, on page 48](#).

- You can add new custom host-level, non-consumable resources and their values to `resources_available` for a vnode:

```
vnode_list[<vnode name>].resources_available[<new resource>] = <value>
```

For details and examples, see [section 5.2.7, “Adding Custom Non-consumable Host-level Resources”, on page 64](#).

You cannot modify a vnode that is managed by a different MoM from where the hook is running. If you try to do this, the following error message appears in the server’s log at log event class PBSEVENT_DEBUG2:

```
"<node_host_name>; Not allowed to update <vnode name>, as it is owned by a different mom"
```

A hook that runs as “*pbsuser*” (execjob_prologue, execjob_epilogue, execjob_preterm) is not allowed to manipulate `pbs.event().vnode_list[]`, unless the executing user is a PBS Manager or Operator. If a hook running as an unprivileged user tries to change `pbs.event().vnode_list[]`, the following error message appears in the server’s log at log event class PBSEVENT_DEBUG2:

```
"<node_host_name>; Not allowed to update vnodes or to request scheduler restart cycle, if run as a non-manager/operator user"
```

6.3.2.23 The Failed Vnode List Event Member

pbs.event().vnode_list_fail[]

For each execjob_prologue and execjob_launch event, PBS records the list of vnodes, with their assigned resources, that are marked as bad by MoM. This list can include those vnodes from sister MoMs that failed to join the job, that rejected an execjob_begin hook or execjob_prologue hook request, or that encountered a communication error while the primary MoM was polling the sister MoM host. PBS records this list in the `pbs.event().vnode_list_fail[]` hook parameter. For how vnodes are marked as failed, see [“Checking Vnodes and Marking Them as Failed” on page 429 of the PBS Professional Administrator’s Guide](#).

Type: *dict* (dictionary of `pbs.vnode` objects keyed by vnode name)

6.3.3 Event Object Member Caveats

6.3.3.1 Modifying progname or argv[] Under Windows

On Windows, in a multi-vnoded job, be careful modifying `pbs.event().progname` and `pbs.event().argv[]` parameters; some values are tacked on by `pbs_mom` and are required. For example, if a multi-vnode job has in its script:

```
pbsdsh -n 1 cmd.exe /C echo hi
```

This causes an installed `execjob_launch` hook to execute on the sister MoM specified at node index '1'. The `execjob_launch` hook sees:

```
pbs.event().programe=cmd.exe

pbs.event().argv[0]=cmd.exe
pbs.event().argv[1]=/c
pbs.event().argv[2]=C:/PROGRA~1/PBSPRO~1/exec/sbin/mom_open_demux.exe
pbs.event().argv[3]=174.host1
pbs.event().argv[5]=cmd.exe
pbs.event().argv[6]=/C
pbs.event().argv[7]=echo
pbs.event().argv[8]=hi
```

It is important not to modify `pbs.event().programe` and `pbs.event().argv[0],...,pbs.event().argv[3]`. These are automatically added by `pbs_mom` for execution and collecting output.

You can modify `pbs.event().argv[]` values starting at index 5, and you can use `pbs.event().argv.extend()` to add more arguments. Here we modify values for indices 5 through 8, and add `pbs.event().argv[9]`, making it “*hello*”:

```
pbs.event().argv[5] = "pbsnodes.exe"
pbs.event().argv[6] = "-a"
pbs.event().argv[7] = ""
pbs.event().argv[8] = ""
pbs.event().argv.extend(["hello"])
```

6.3.4 Event-only Methods

6.3.4.1 Event Method for Accepting Event

pbs.event().accept()

Terminates hook execution and causes PBS to perform the associated action.

6.3.4.2 Event Method for Rejecting Event

pbs.event().reject()

```
pbs.event().reject(["<error message>"], <error code>)
```

Terminates hook execution and instructs PBS to not perform the associated action. If the `<message>` argument is given, it is shown in the appropriate PBS daemon log, and in the `stderr` of the PBS command that caused this event to take place.

By default, `pbs.event().reject()` returns 255. To return an error code other than 255, specify a value between 2 and 255 in the optional `<error code>`.

6.3.5 Event Object Method Caveats

`pbs.event().accept()` terminates hook execution by throwing a `SystemExit` exception. So if hook content appears in a `try...except` clause that has no arguments to the `except` clause, always add the following to treat `SystemExit` as a normal occurrence:

```
except SystemExit:
    pass
```

See [section 5.3.7.1, “Treat SystemExit as a Normal Occurrence”, on page 70](#).

6.3.6 Examples of Using Event Objects

Example 6-3: Inside a hook script, create a PBS event object:

```
e = pbs.event()
```

Example 6-4: Get the event type:

```
type = e.type
```

Example 6-5: Get the user who requested the event action:

```
who = e.requestor
```

Example 6-6: Get the host where the request came from:

```
host = e.requestor_host
```

Example 6-7: The event type is `pbs.QUEUEJOB`. Get the number of CPUs requested for the job being queued:

```
j = e.job
res = j.Resource_List["ncpus"]
```

Example 6-8: Reset the number of CPUs requested by the job:

```
j.Resource_List["ncpus"] = 1
```

Example 6-9: The event type is `pbs.MOVEJOB`. Get the request parameters:

```
j = e.job
q = j.queue
```

Example 6-10: Accept an event request:

```
e.accept()
```

Example 6-11: Reject an event request:

```
e.reject("Can't set interactive attribute")
```

Example 6-12: Put a job into a wait state and requeue the job in 3600 seconds (1 hour):

```
import time
...
j.Execution_Time = time.time() + 3600
```

Example 6-13: Put a hold on a job:

```
j = pbs.event().job
j.Hold_Types = pbs.hold_types("u")
j.Hold_Types = pbs.hold_types("uo")
j.Hold_Types += pbs.hold_types("s")
or
j.Hold_Types = pbs.hold_types("<hold_list>")
```

Example 6-14: Release a hold on a job:

```
j.Hold_Types -= pbs.hold_types("un")
j.Hold_Types -= pbs.hold_types("sp")
j.Hold_Types -= pbs.hold_types("o")
```

```
or
j.Hold_Types -= pbs.hold_types("<hold_list>")
```

6.4 Server Objects

pbs.server

This object represents a PBS server. This object can either represent the local server, or be just a coding construct, not representing an actual server. If it represents the local server, you can read but cannot set its attributes. If it is just a coding construct that does not represent an actual server, you can set its attributes. **You cannot alter the PBS server.** If this server object represents the PBS server, it is the server at which the triggering event is taking place, and at which the hook is executing. The only PBS server available to hooks is the local server.

```
s = pbs.server(["<name>"])
```

Creates an instance of a PBS server object. If *<name>* is not specified, the object represents the default server.

You can use `pbs.server()` to retrieve server, queue, job, vnode, and reservation information, and pass it to a hook script. You **cannot** set attributes or resources for objects that are retrieved through the server via `pbs.server()`.

6.4.1 Server Object Members

Some server object members are server attributes, and some are not. A `pbs.server` has the following members:

6.4.1.1 Server Name Member

pbs.server().name

The server hostname.

Example: myhost.mydomain.com

This member is read-only.

Python type: *str*

6.4.1.2 Server Attribute Members

pbs.server().<attribute name>

The PBS server attribute named *<attribute name>*. The `pbs.server` object has a member to represent each server attribute, spelled exactly like the attribute. For information about using attributes, see [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44](#).

Server attributes are listed in [“Server Attributes” on page 281 of the PBS Professional Reference Guide](#). Attribute creation methods are described in [section 6.13.3, “PBS Types and Their Methods”, on page 143](#).

6.4.1.3 Server State Member

`pbs.server().server_state`

The `server_state` server attribute. It can take one of the following values, represented by constant objects:

Table 6-4: Server State Constant Objects

Object	State
<code>pbs.SV_STATE_IDLE</code>	<i>Idle</i>
<code>pbs.SV_STATE_ACTIVE</code>	<i>Scheduling</i>
<code>pbs.SV_STATE_HOT</code>	<i>Hot_Start</i>
<code>pbs.SV_STATE_SHUTDEL</code>	<i>Terminating, Delayed</i>
<code>pbs.SV_STATE_SHUTIMM</code>	<i>Terminating</i>
<code>pbs.SV_STATE_SHUTSIG</code>	<i>Terminating</i>

6.4.2 Setting Server Object Members

If the server object does not represent the PBS server, you can set, but not unset, server object members. If a server object does represent the PBS server, you cannot set values for object members. To set the value for the server attribute named `<attribute name>` to `<attribute value>`, where `s` is an instance of `pbs.server`:

```
s.<attribute name> = <attribute value>
```

6.4.3 Examples of Using Server Object Members

```
s = pbs.server()
```

Example 6-15: Get server name:

```
name = s.name
```

Example 6-16: Get the value of the server attribute `pbs_license_min`:

```
min = s.pbs_license_min
```

6.4.4 Server Object Methods

6.4.4.1 Method to Return Job

`pbs.server().job('<job ID>')`

Returns a `pbs.job` object for the job with ID `<id>`, residing on the local server. Returns `None` if the job with ID `<id>` does not exist at the server. See [section 6.6, “Job Objects”, on page 122](#).

6.4.4.2 Method to Return Job Iterator

`pbs.server().jobs()`

Returns a Python iterator that iterates over a list of `pbs.job` objects residing on the local server. Returns an empty iterator if no jobs exist on the local server. See [section 6.6, “Job Objects”, on page 122](#).

Example:

```
for j in s.jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "found job %s" % (j.id))
```

6.4.4.3 Method to Return Queue

pbs.server().queue(<queue_name>)

Returns a `pbs.queue` object representing the queue named `<queue name>` that is managed by the local server. See [section 6.5, “Queue Objects”, on page 121](#).

A value of `None` is returned if the queue named `<queue_name>` does not exist at the local server.

6.4.4.4 Method to Return Queue Iterator

pbs.server().queues()

Returns a Python iterator that iterates over a list of queue objects managed by the the local server. Returns an empty iterator if no queues exist at the local server. See [section 6.5, “Queue Objects”, on page 121](#).

6.4.4.5 Method to Return Reservation

pbs.server().resv(<reservation ID>)

Returns a `pbs.resv` object for `<reservation ID>` on the local server. Returns `None` if `<reservation ID>` does not exist. See [section 6.9, “Reservation Objects”, on page 131](#).

6.4.4.6 Method to Return Reservation Iterator

pbs.server().resvs()

Returns a Python iterator that iterates over a list of `pbs.resv` objects residing on the local server. Returns an empty iterator if no reservations exist at the local server. See [section 6.9, “Reservation Objects”, on page 131](#).

6.4.4.7 Method to Restart Scheduler Cycle

pbs.server().scheduler_restart_cycle()

This directs the current PBS server to tell the scheduler to restart its scheduling cycle.

A hook with its `user` attribute set to `pbsuser` cannot successfully invoke `pbs.scheduler_restart_cycle()`, unless the hook’s executing user is a PBS Manager or Operator. If this is attempted, the scheduler is not restarted, and the following message appears at log event class `PBSEVENT_DEBUG2` in the MoM logs:

```
"<node_host_name>;Not allowed to update vnodes or to request scheduler_restart_cycle, if run as a
non-manager/operator user"
```

6.4.4.8 Method to Return Named Vnode

pbs.server().vnode(<vnode name>)

Returns a `pbs.vnode` object representing the vnode with name `<vnode name>` that is managed by the current server.

Returns `None` if `<vnode name>` does not exist.

6.4.4.9 Method to Return Vnode List

pbs.server().vnodes()

Returns a list of `pbs.vnode` objects managed by current server.

Returns an empty iterator if no vnodes exist at the local server.

Example:

```
for vn in s.vnodes():
    pbs.logmsg(pbs.LOG_DEBUG, "found vn %s" % (vn.name))
```

6.5 Queue Objects

pbs.queue

This object represents a PBS queue. This object can either represent an actual PBS queue, or be just a coding construct, not representing an actual queue. If it is just a coding construct, you can set its attributes. If it represents an actual queue, you can read but cannot set its attributes. **You cannot set the attributes of any actual queue in any hook.**

To get information about a particular queue with name *<name>*, you must go through the associated server. Use:

```
q = pbs.server().queue("<name>")
```

To get a list of queues from the server:

```
pbs.server().queues()
```

6.5.1 Queue Object Members

Some queue object members are queue attributes, and some are not.

6.5.1.1 Queue Object Name Member

queue.name

The queue name.

This member is read-only.

Python type: *str*

6.5.1.2 Queue Object Attribute Members

A *pbs.queue* has a member representing each of its attributes. Each member that is not a *string*, *int*, *bool*, *long*, or *float* has a corresponding creation method; see [section 6.13.3, “PBS Types and Their Methods”, on page 143](#). See [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44](#).

queue.<attribute name>

The queue attribute named *<attribute name>*. Queue attributes are listed in [“Queue Attributes” on page 311 of the PBS Professional Reference Guide](#).

Example 6-17: Get the queue object representing the queue *workq*, and its Priority value:

```
q = s.queue("workq")
prio = q.Priority
```

6.5.1.3 Setting Queue Object Attributes

You can set or unset queue object attributes for queue objects that **don't** represent an actual queue. To set the value of a queue object attribute named *<attribute name>*:

```
pbs.queue.<attribute name> = <attribute value>
```

You cannot set or unset attributes for an actual queue.

6.5.2 Queue Object Methods

6.5.2.1 Method to Return Job

queue.job()

pbs.queue.job("<job ID>")

Returns a `pbs.job` object representing PBS job with ID `<job ID>`. This job must be residing on the queue. Returns `None` if the job with the specified job ID does not exist, or if the job is not in the queue. See [section 6.6, “Job Objects”, on page 122](#).

6.5.2.2 Method to Return Job Iterator

queue.jobs()

Returns a Python iterator that iterates over a list of `pbs.job` objects representing the jobs on the queue. Returns an empty iterator if no jobs exist on the queue. See [section 6.6, “Job Objects”, on page 122](#).

Example:

```
for j in pbs.server().queue("workq").jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "found job %s" % (j.id))
```

6.5.3 Queue Type Constant Objects

Queue types are represented by constant objects. The `pbs.queue.queue_type` member represents the type of the queue. It can take on the following values:

Table 6-5: Queue Type Constant Objects

Object	Queue Type
<code>pbs.QTYPE_EXECUTION</code>	<i>Execution</i>
<code>pbs.QTYPE_ROUTE</code>	<i>Route</i>

6.6 Job Objects

pbs.job

A job object represents a PBS job.

You can retrieve the job object either through an associated event or through the server. The job object represents one of the following, depending on how it is retrieved:

- The PBS job associated with the event that triggers the hook. To get the job associated with the current event, go through the event that triggered the hook:

pbs.event().job

A call to `pbs.event().job` can return only the job associated with the current event.

When you get a job using `pbs.event().job`, the hook can read and set the job attributes and resources listed in [Table 5-6, “Job Attributes Readable & Settable via Events,” on page 55](#) and [Table 5-9, “Built-in Job Resources Readable & Settable by Hooks via Events,” on page 60](#).

- A job at the server at which the hook is executing. To get a particular job with ID `<id>`, go through the server:

```
pbs.server().job("<job ID>")
```

When you get a job using `pbs.server().job(<job ID>)`, the hook can read all job attributes and resources, but can set none.

- To get a list of jobs at the server:

```
pbs.server().jobs()
```

For information about a list of jobs visible through events, see [section 6.3.2.11, “Job List Event Member”, on page 111](#) and [Table 6-3, “Using Event Object Members in Events,” on page 108](#) for the events that can use this list.

All job objects have the same members and methods. Each hook can read or set different attributes and resources. We describe what each type of hook can do in [section 6.3, “Event Objects”, on page 87](#).

If you use a hook to make a change to a job, that change is visible to all PBS daemons.

6.6.1 Job Object Members

A `pbs.job` object has a member to represent each job attribute. Each one is spelled exactly like the corresponding attribute. We list job object members here that require creation methods, require special treatment, or that are not job attributes. All job attribute members that are not listed here are defined this way:

job.<attribute name>

The type of the attribute is given in the attribute description, in [“Job Attributes” on page 328 of the PBS Professional Reference Guide](#).

For information about using job attributes in hooks, see [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44](#).

To see which hooks can set which job attributes and resources, see [Table 5-6, “Job Attributes Readable & Settable via Events,” on page 55](#) and [Table 5-9, “Built-in Job Resources Readable & Settable by Hooks via Events,” on page 60](#).

A `pbs.job` object also has the `id` member, which is not a job attribute.

6.6.1.1 Job ID Member

job.id

The PBS job ID.

Read-only.

Python type: *str*

6.6.1.2 Job `array_indices_submitted` Attribute Member

job.array_indices_submitted

Job attribute. Python type: *range*

See [section 6.13.3.21, “Method to Create or Set range Object”, on page 147](#).

6.6.1.3 Job Checkpoint Attribute Member

job.Checkpoint

Job attribute. Python type: *pbs.checkpoint*

See [section 6.13.3.3, “Method to Create or Set Checkpoint String”, on page 143.](#)

6.6.1.4 Job depend Attribute Member

job.depend

Job attribute. Python type: *pbs.depend*

See [section 6.13.3.4, “Method to Create or Set Dependency Object”, on page 143.](#)

6.6.1.5 Job Execution_Time Attribute Member

job.Execution_Time

Job attribute. Time when the current job is eligible to run. Syntax:

```
job.Execution_Time = time.mktime([ <YY>, <MM>, <DD>, <HH>, <MM>, <SS>, <WEEKDAY>, <YEARDAY>
<ISDST>])
```

For example, the following sets a job's Execution_Time to: *March 1, 2012 at 09:00 am:*

```
job.Execution_Time = time.mktime([2012, 3, 1, 12, 9, 0, -1, -1, -1])
```

Python type: *int*

6.6.1.6 Job exec_host Attribute Member

job.exec_host

Job attribute. Python type: *pbs.exec_host*

See [section 6.13.3.7, “Method to Create or Set exec_host Object”, on page 144.](#)

6.6.1.7 Job exec_vnode Attribute Member

job.exec_vnode

Job attribute. Python type: *pbs.exec_vnode*

This complex object is described in [section 6.7, “The exec_vnode Object”, on page 129.](#)

See also [section 6.13.3.8, “Method to Create or Set exec_vnode Object”, on page 144.](#)

6.6.1.8 Job group_list Attribute Member

job.group_list

Job attribute. Python type: *pbs.group_list*

See [section 6.13.3.9, “Method to Create or Set group_list Object”, on page 144.](#)

6.6.1.9 Job Hold_Types Attribute Member

job.Hold_Types

Job attribute. Python type: *pbs.hold_types*

See [section 6.13.3.10, “Method to Create or Set hold_types Object”, on page 145.](#)

6.6.1.10 Job `job_state` Attribute Member

job.job_state

Job attribute. Represents the job's state. Can be compared to the constants representing job states.

Use job state constant objects to test the state of a job. For example:

```
e = pbs.event()
if e.job.job_state == pbs.JOB_STATE_RUNNING :
    e.accept()
```

The `job_state` member can take on any of the values listed here:

Table 6-6: Job State Objects

Object	State	Description
<code>pbs.JOB_STATE_BEGUN</code>	<i>B</i>	Job arrays only: job array has started
<code>pbs.JOB_STATE_EXITING</code>	<i>E</i>	Job is exiting after having run
<code>pbs.JOB_STATE_EXPIRED</code>	<i>X</i>	Subjobs only; subjob is finished (expired.)
<code>pbs.JOB_STATE_FINISHED</code>	<i>F</i>	Job is finished: job executed successfully, job was terminated while running, job execution failed, or job was deleted before execution
<code>pbs.JOB_STATE_HELD</code>	<i>H</i>	Job is held.
<code>pbs.JOB_STATE_MOVED</code>	<i>M</i>	Job has been moved to another server
<code>pbs.JOB_STATE_QUEUED</code>	<i>Q</i>	Job is queued, eligible to run or be routed
<code>pbs.JOB_STATE_RUNNING</code>	<i>R</i>	Job is running
<code>pbs.JOB_STATE_SUSPEND</code>	<i>S</i>	Job is suspended by PBS so that a higher-priority job can run.
<code>pbs.JOB_STATE_SUSPEND_USERACTIVE</code>	<i>U</i>	Job is suspended due to workstation becoming busy
<code>pbs.JOB_STATE_TRANSIT</code>	<i>T</i>	Job is in transition (being moved to a new location)
<code>pbs.JOB_STATE_WAITING</code>	<i>W</i>	Job is waiting for its requested execution time to be reached, or the job's specified stagein request has failed for some reason.

6.6.1.11 Job `Join_Path` Attribute Member

job.Join_Path

Job attribute. Python type: `pbs.join_path`

See [section 6.13.3.12, "Method to Create or Set join_path Object"](#), on page 145.

6.6.1.12 Job `Keep_Files` Attribute Member

job.Keep_Files

Job attribute. Python type: `pbs.keep_files`

See [section 6.13.3.13, "Method to Create or Set keep_files Object"](#), on page 145.

6.6.1.13 Job Mail_Points Attribute Member

job.Mail_Points

Job attribute. Python type: *pbs.mail_points*

See [section 6.13.3.15, “Method to Create or Set mail_points Object”, on page 145.](#)

6.6.1.14 Job Mail_Users Attribute Member

job.Mail_Users

Job attribute. Python type: *pbs.email_list*

See [section 6.13.3.6, “Method to Create or Set Email List”, on page 144.](#)

6.6.1.15 Job Queue Attribute Member

job.queue

Job attribute. Python type: *pbs.queue*

6.6.1.16 Job Resource_List Attribute Member

job.Resource_List[]

job.Resource_List[“<resource name>”]

Job attribute. The job’s Resource_List attribute.

Python type: dictionary: *Resource_List[“<resource name>”]=<value>* where *<resource name>* is any built-in or custom resource

6.6.1.17 Job resources_used Attribute Member

job.resources_used[<resource name>]

Job attribute. The job’s resources_used attribute, which lists the resources used by the job. See [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44.](#)

Python type: dictionary: *resources_used[“<resource name>”]=<value>* where *<resource name>* is any built-in or custom resource

6.6.1.18 Job run_count Attribute Member

job.run_count

Job attribute. Execution hooks must run with *user = pbsadmin* to reduce the value of this member. Execution hooks running with *user = pbsuser* cannot reduce the value of this member.

Python type: *int*

6.6.1.19 Job stagein and stageout Attribute Members

job.stagein

job.stageout

Job attribute. Python type: *pbs.staging_list*

See [section 6.13.3.27, “Method to Create or Set staging_list Object”, on page 150.](#)

6.6.1.20 Job User_List Attribute Member

job.User_List

Job attribute. Python type: *pbs.user_list*

See [section 6.13.3.29, “Method to Create or Set user_list Object”, on page 151.](#)

6.6.1.21 Job Variable_List Attribute Member

job.Variable_List[<variable>]

Job attribute. Holds the job’s environment variables. Syntax:

job.Variable_List[<variable>] = <value>

Python type: dictionary: *Variable_List["<variable name>"]=<value>*

6.6.2 Setting Job Attributes

How you set a job attribute depends on the type of the attribute; those of type *str*, *int*, *bool*, *long*, and *float* can be set directly. Job attributes of other types require creation methods. Job attribute creation methods are listed in [section 6.13.3, “PBS Types and Their Methods”, on page 143.](#)

To set job attributes and resources directly:

pbs.event().job.<attribute> = <value>

pbs.event().job.Resource_List["<resource name>"] = <value>

See [section 5.2.4.3, “Determining Whether to Use Creation Method to Set Attribute or Resource”, on page 45.](#)

See [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44.](#)

6.6.3 Examples of Using Job Object Members

Get the job’s Priority value:

```
prio = job.Priority
```

Reset the Priority value of job *j*:

```
job.Priority = 5
```

Get the job’s PBS_O_WORKDIR environment variable:

```
workdir = job.Variable_List["PBS_O_WORKDIR"]
```

6.6.4 Job Object Methods for Execution Hooks

Job objects have the following methods. Most methods are available in *execjob_hooks* except for the *execjob_launch* hook, and in the *execestost_periodic* hook.

6.6.4.1 Job Object Method to Report Checkpoint

job.is_checkpointed()

Returns a Python bool value which is *True* if the job was checkpointed under the control of the PBS MoM.

For example, you could use this in an `execjob_epilogue` hook, where the hook writer directs the job to be requeued if the job was checkpointed under the control of PBS:

```
# cat epi.py
import pbs
if pbs.event().job.is_checkpointed():
    pbs.event().job.rerun()
    pbs.event().reject("job to be requeued")
# qmgr -c "create hook epi event=execjob_epilogue"
# qmgr -c "import hook epi application/x-python default epi.py"
```

6.6.4.2 Job Object Method to Report Execution Host Role

job.in_ms_mom()

Returns a Python bool value. Returns *True* if this job object is running on the primary execution host.

6.6.4.3 Job Object Method to Delete Job

job.delete()

When this method is used in an execution hook, the job is flagged at the server for deletion after its processes have terminated and any epilogue or `execjob_epilogue` hook has run.

When this method is used in a non-execution hook script, it raises a Python “`NotImplementedError`” exception.

If the `job.delete()` method is used in an `execjob_end` hook, it has no effect, because in this case the server has already performed end-of-job processing before the execution hook runs.

The `job.delete()` method overrides the `job.rerun()` method. If both are used, `job.delete()` takes precedence.

6.6.4.4 Job Object Method to Release Vnodes

job.release_nodes()

job.release_nodes(keep_select=<select specification>)

Automatically selects vnodes that satisfy the new request and are healthy, keeps them in the job’s vnode request, and releases all others. The method automatically trims out any vnodes in the `pbs.event().vnode_list_fail[]` list.

You can call `pbs.event().job.release_nodes(keep_select = <desired vnodes>)` in an `execjob_launch` or `execjob_prologue` hook. Note that despite the method being named “`release_nodes`”, it **keeps** the specified vnodes and **releases** all other vnodes. You can specify the job’s original vnode request as the vnodes to keep.

The `pbs.event().job.release_nodes()` method returns a PBS job object which has the updated values for the job’s `exec_vnode` and `Resource_List` attributes.

This method is only effective when it runs at the primary MoM.

This method can be used only when it’s used for a job whose `tolerate_node_failures` attribute is set to *job_start* or *all*.

6.6.4.4.i Advice and Recommendations for Using `release_nodes` Method

- Put the call to this method in an `'if pbs.event().job.in_ms_mom()'` clause
- Request vnodes that are a subset of the existing vnode request
- Because an `execjob_launch` hook is also called when spawning tasks via `pbsdsh` and `tm_spawn`, ensure that any `execjob_launch` hook invoking `release_nodes()` has `'PBS_NODEFILE'` in the `pbs.event().env` list. The presence of `'PBS_NODEFILE'` in the environment ensures that the primary MoM is executing on behalf of starting the top level job, and not spawning a sister task. You can add the following at the top of the hook:

```
if 'PBS_NODEFILE' not in pbs.event().env:
    pbs.event().accept()
...
pbs.release_nodes(keep_select=...)
```

- On Windows, where `PBS_NODEFILE` always appears in `pbs.event().env`, put the following at the top of any `execjob_launch` hook:

```
if any("mom_open_demux.exe") in s for s in e.argv:
    e.accept()
```

6.6.4.4.ii Side Effects of Using `release_nodes()` Method

When `release_nodes()` is successfully executed from `execjob_prologue` or `execjob_launch` hooks, the following happen:

- PBS generates the `s` accounting record.
- The primary MoM notifies the sister MoMs to update their internal nodes tables, so that the task manager API (e.g. `tm_spawn`, `pbsdsh`) will be aware of the change in the future.
- If the `pbs_cgrouops` hook is enabled, the `cgroup` already created for the job is updated to match the job's new resources. If the kernel rejects the update to the job's `cgroup` resources, the job is aborted at the execution host, and `queued/rerun` at the server.

6.6.4.5 Job Object Method to Re-run Job

job.rerun()

When this method is used in an execution hook, the job is flagged at the server for requeueing after its processes have terminated and any `epilogue` or `execjob_epilogue` hook has run.

When this method is used in a non-execution hook script, it raises a Python “`NotImplementedError`” exception.

If the `job.rerun()` method is used in an `execjob_end` hook, it has no effect, because in this case the server has already performed end-of-job processing before the execution hook runs.

The `job.delete()` method overrides the `job.rerun()` method. If both are used, `job.delete()` takes precedence.

6.7 The `exec_vnode` Object

pbs.exec_vnode

The `exec_vnode` object represents the job's `exec_vnode` attribute.

6.7.1 The `exec_vnode` Object Members

A `pbs.exec_vnode` object has the following member:

6.7.1.1 The `exec_vnode` Chunks Member

`pbs.exec_vnode.chunks[]`

List of `pbs.vchunk` objects. These objects represent the chunks assigned to a job. See [section 6.8, “Chunk Objects”, on page 131](#).

6.7.2 Using `pbs.vchunk` Objects in `exec_vnode`

- To get a list of `pbs.vchunks` in `pbs.event().job.exec_vnode`:

```
pbs.event().job.exec_vnode.chunks
```

For example, to log the name of the `vnode` containing each `vchunk`:

```
chunklist = pbs.event().job.exec_vnode.chunks
```

```
for chunk in chunklist:
```

```
    pbs.logmsg(pbs.LOG_DEBUG, "chunk.vnode_name=%s " % (chunk.vnode_name))
```

- To get a `pbs.vchunk` with a specific index:

```
pbs.event().job.exec_vnode.chunks[<index>]
```

- For example, to get the `vchunk` in `pbs.event().job.exec_vnode` with index number 2:

```
pbs.event().job.exec_vnode.chunks[2]
```

Example 6-18: List the job ID, `vnode` name, and resources in `exec_vnode`:

```
j = pbs.event().job
```

```
pbs.logmsg(pbs.LOG_DEBUG, "job %s exec_vnode = %s" % (j.id, j.exec_vnode))
```

```
chunklist = j.exec_vnode.chunks
```

```
for c in chunklist:
```

```
    pbs.logmsg(pbs.LOG_DEBUG, "c.vnode_name=%s " % (c.vnode_name))
```

```
    for r in c.chunk_resources.keys():
```

```
        pbs.logmsg(pbs.LOG_DEBUG, "c.chunk_resources[%s]=%s" % (r,
```

```
            c.chunk_resources[r]))
```

Sample output:

```
10:16:53;0006;Server@jobim;Hook;Server@jobim;job 153.jobim exec_vnode =
  (jobim[2]:ncpus=2:mem=10240kb)+ (jobim[1]:ncpus=2:mem=10240kb) +
  (jobim[3]:ncpus=2:mem=2048kb)
10:16:53;0006;Server@jobim;Hook;Server@jobim;c.vnode_name= jobim[2]
  10:16:53;0006;Server@jobim;Hook;Server@jobim; c.chunk_resources[ncpus]=2
10:16:53;0006;Server@jobim;Hook;Server@jobim; c.chunk_resources[mem]=10240kb
10:16:53;0006;Server@jobim;Hook;Server@jobim; c.vnode_name=jobim[1]
10:16:53;0006;Server@jobim;Hook;Server@jobim; c.chunk_resources[ncpus]=2
10:16:53;0006;Server@jobim;Hook;Server@jobim; c.chunk_resources[mem]=10240kb
10:16:53;0006;Server@jobim;Hook;Server@jobim; c.vnode_name=jobim[3]
10:16:53;0006;Server@jobim;Hook;Server@jobim; c.chunk_resources[ncpus]=2
  10:16:53;0006;Server@jobim;Hook;Server@jobim; c.chunk_resources[mem]=2048kb
```

6.7.3 Restrictions on `exec_vnode` Objects

A job's `exec_vnode` attribute is read-only. You cannot set its value, and you cannot build an `exec_vnode` object using `pbs.vchunk` objects.

6.8 Chunk Objects

pbs.vchunk

The `pbs.vchunk` object represents a chunk specification. It is used in a job's `exec_vnode` attribute or `select` statement.

6.8.1 Chunk Object Members and Methods

A `pbs.vchunk` object has the following members:

6.8.1.1 Chunk Object Vnode Name Member

vchunk.vnode_name

Name of the vnode from which the chunk is taken.

Python type: *str*

6.8.1.2 Chunk Object Chunk Resources Member

vchunk.chunk_resources[]

Resources assigned to the chunk.

Python type: Dictionary containing `<resource name>=<value>` pairs.

Syntax: `chunk_resources['<resource name>'] = <resource value>` where `<resource name>` is any custom or built-in resource.

6.8.1.3 Chunk Object Method to Return `chunk_resources` Keys

vchunk.chunk_resources.keys()

Returns list of `<resource name>` keys of `chunk_resources[]`. This list makes it convenient to list all the values of `chunk_resources[]`.

6.9 Reservation Objects

pbs.resv

This represents a PBS reservation. If the reservation is associated with the triggering event, you can read and set reservation attributes and resources in a `resvsub` hook, and read them in a `resv_end` hook. See [Table 5-8, “Reservation Attributes Readable & Settable in `resvsub` and `resv_end` Hooks,” on page 59](#) for a complete list of the reservation attributes and resources that can be set in the `resvsub` and `resv_end` hooks. If the reservation is retrieved through the server, and is not associated with the triggering event, you can read all its attributes and resources, but set none.

If you are working with the reservation being created using `pbs_rsub`, you must use `pbs.event().resv`. The server cannot return information about the reservation, because it has not yet been created.

In order to retrieve information about the reservation associated with the triggering action, you must use a reference to the reservation object represented by:

```
pbs.event().resv
```

To get a copy of a particular reservation, use:

```
pbs.server().resv("<reservation name>")
```

To get a list of the reservations at a server:

```
pbs.server().resvs()
```

6.9.1 Reservation Object Members

A `pbs.resv` object has members that represent reservation attributes, and the `resvid` member which exists for the job object but is not an attribute of a reservation.

6.9.1.1 Reservation ID Member

resv.resvid

The reservation ID.

Example: "R221.myhost".

This member is read-only.

Python type: *str*

6.9.1.2 Reservation Attribute Members

resv.<attribute name>

The reservation attribute named *<attribute name>*. Each member is spelled exactly like the corresponding attribute.

6.9.1.3 Setting Reservation Object Attribute Values

You can set, but not unset, reservation object attributes.

To see a list of which reservation attributes can be read and set by each hook, see [Table 5-8, "Reservation Attributes Readable & Settable in resvsub and resv_end Hooks," on page 59](#).

Some attributes require creation methods when setting them. See [section 5.2.4.3, "Determining Whether to Use Creation Method to Set Attribute or Resource", on page 45](#). To set a simple reservation object attribute:

```
pbs.resv.<attribute name> = <attribute value>
```

Reservation attribute creation methods are listed in [section 6.13.3, "PBS Types and Their Methods", on page 143](#).

See [section 5.2.4, "Using Attributes and Resources in Hooks", on page 44](#).

6.9.1.4 Examples of Using Reservation Object Attributes

Example 6-19: Get the reservation's owner:

```
owner = pbs.server().resv(<reservation ID>).Reserve_Owner
```

Example 6-20: Reset the reservation's name:

```
pbs.event().resv(<reservation ID>).Reserve_Name = "Resv2008"
```

6.9.2 Reservation State Constant Objects

The `pbs.resv.reserve_state` member represents the state of the reservation. It can take on the following values, which are represented by constant objects:

Table 6-7: Reservation State Objects

Object	State
<code>pbs.RESV_STATE_NONE</code>	<code>RESV_NONE</code>
<code>pbs.RESV_STATE_UNCONFIRMED</code>	<code>RESV_UNCONFIRMED</code>
<code>pbs.RESV_STATE_CONFIRMED</code>	<code>RESV_CONFIRMED</code>
<code>pbs.RESV_STATE_WAIT</code>	<code>RESV_WAIT</code>
<code>pbs.RESV_STATE_TIME_TO_RUN</code>	<code>RESV_TIME_TO_RUN</code>
<code>pbs.RESV_STATE_RUNNING</code>	<code>RESV_RUNNING</code>
<code>pbs.RESV_STATE_FINISHED</code>	<code>RESV_FINISHED</code>
<code>pbs.RESV_STATE_BEING_ALTERED</code>	<code>RESV_BEING_ALTERED</code>
<code>pbs.RESV_STATE_BEING_DELETED</code>	<code>RESV_BEING_DELETED</code>
<code>pbs.RESV_STATE_DELETED</code>	<code>RESV_DELETED</code>
<code>pbs.RESV_STATE_DELETING_JOBS</code>	<code>RESV_DELETING_JOBS</code>
<code>pbs.RESV_STATE_DEGRADED</code>	<code>RESV_DEGRADED</code>
<code>pbs.RESV_STATE_IN_CONFLICT</code>	<code>RESV_IN_CONFLICT</code>

6.10 Vnode Objects

pbs.vnode

Represents a PBS vnode.

The way in which you retrieve a vnode controls what you can do with the vnode. If a vnode is retrieved through an event, using `pbs.event().vnode_list[]`, and is managed by the same MoM where the event hook runs, you can set the vnode attributes and resources listed in [Table 5-7, “Vnode Attributes Readable & Settable via Events,” on page 57](#) and [Table 5-10, “Vnode Resources Readable & Settable by Hooks via Events,” on page 61](#). However, if a vnode is not retrieved through an event, or is not managed by the same MoM where the hook runs, you can read all vnode attributes and resources, but set none.

Execution events have access to the list of vnodes associated with the job. Periodic events have access to the list of vnodes managed by the local MoM. See [section 6.3.2.22, “The Vnode List Event Member”, on page 114](#).

- To retrieve the list of vnodes associated with an execution event or a periodic event:

```
pbs.event().vnode_list[]
```

- To retrieve a specific vnode that is associated with an execution or periodic event, use the list of vnodes associated with the event, and specify the vnode name:

```
pbs.event().vnode_list[“<vnode name>”]
```

- To retrieve the vnodes associated with a pre-execution event, get the job’s `exec_vnode` attribute:

```
pbs.event().job.exec_vnode
```

- To retrieve the server’s list of vnodes:

```
pbs.server().vnodes()
```

- To retrieve a named vnode through the server:

```
pbs.server().vnode("<vnode name>")
```

6.10.1 Vnode Object Members

vnode.<attribute name>

A `pbs.vnode` object has a member representing each attribute, and each member is spelled exactly like the corresponding attribute. [Table 5-7, “Vnode Attributes Readable & Settable via Events,” on page 57](#) lists which vnode attributes can be set by each hook. See [section 5.2.4.3, “Determining Whether to Use Creation Method to Set Attribute or Resource”, on page 45](#). Attribute creation methods are listed in [section 6.13.3, “PBS Types and Their Methods”, on page 143](#). See [section 5.2.4, “Using Attributes and Resources in Hooks”, on page 44](#).

6.10.1.1 The `topology_info` Attribute Member

vnode.topology_info

Vnode attribute. The `topology_info` vnode attribute shows topology information. This attribute is visible only in hooks, and can be used only in hooks.

Python type: *str*

6.10.1.2 Vnode Attribute Restrictions

- The only vnode attribute that can be changed by a pre-execution hook is the `state` attribute
- The only pre-execution hook that can change the vnode `state` attribute is the `runjob` hook
- Execution and periodic hooks can change all settable vnode attributes

6.10.2 Vnode Type Constant Objects

The `pbs.vnode.ntyep` member represents the type of the vnode. It can take on the following values:

Table 6-8: Vnode Type Objects

Object	Type
<code>pbs.ND_PBS</code>	Represents <i>pbs</i> value for vnode <code>ntyep</code> attribute

6.10.3 Vnode Sharing Constant Objects

The `pbs.vnode.sharing` member represents the vnode's sharing attribute. It can take on the following values:

Table 6-9: Vnode Sharing Objects

Object	Sharing Value
<code>pbs.ND_DEFAULT_EXCL</code>	Represents <i>default_excl</i> vnode sharing attribute value
<code>pbs.ND_DEFAULT_EXCLHOST</code>	Represents <i>default_exclhost</i> vnode sharing attribute value
<code>pbs.ND_DEFAULT_SHARED</code>	Represents <i>default_shared</i> vnode sharing attribute value
<code>pbs.ND_FORCE_EXCL</code>	Represents <i>force_excl</i> vnode sharing attribute value
<code>pbs.ND_FORCE_EXCLHOST</code>	Represents <i>force_exclhost</i> vnode sharing attribute value
<code>pbs.ND_IGNORE_EXCL</code>	Represents <i>ignore_excl</i> vnode sharing attribute value

6.10.4 Vnode State Constant Objects

The `pbs.vnode.state` member represents the state of the vnode. It can take on the following values:

Table 6-10: Vnode State Constant Objects

Object	State
<code>pbs.ND_BUSY</code>	Represents <i>busy</i> vnode state
<code>pbs.ND_DOWN</code>	Represents <i>down</i> vnode state
<code>pbs.ND_FREE</code>	Represents <i>free</i> vnode state
<code>pbs.ND_JOBBUSY</code>	Represents <i>job-busy</i> vnode state
<code>pbs.ND_JOB_EXCLUSIVE</code>	Represents <i>job-exclusive</i> vnode state
<code>pbs.ND_OFFLINE</code>	Represents <i>offline</i> vnode state
<code>pbs.ND_PROV</code>	Represents <i>provisioning</i> vnode state
<code>pbs.ND_RESV_EXCLUSIVE</code>	Represents <i>resv-exclusive</i> vnode state
<code>pbs.ND_STALE</code>	Represents <i>stale</i> vnode state
<code>pbs.ND_STATE_UNKNOWN</code>	Represents <i>state-unknown, down</i> vnode state
<code>pbs.ND_UNRESOLVABLE</code>	Represents <i>unresolvable</i> vnode state
<code>pbs.ND_WAIT_PROV</code>	Represents <i>wait-provisioning</i> vnode state

6.11 Configuration File Objects

6.11.1 Variable Containing Hook Configuration File Path

pbs.hook_config_filename

Contains the path to the hook's configuration file, or *None* if there is no configuration file.

6.11.2 Dictionary of PBS Configuration File Entries

pbs.pbs_conf[]

This is a dictionary of values which represent entries in the `pbs.conf` file.

This reflects the contents of `/etc/pbs.conf` on the host where a hook runs, so pre-execution event (server) hooks get the entries on the server host, and execution event (MoM) hooks get the entries on the execution host where the hook runs.

Example of using `pbs.pbs_conf[]`:

```
pbs.logmsg(pbs.LOG_DEBUG, "pbs home is %s" % (pbs.pbs_conf['PBS_HOME']))
```

If you change `/etc/pbs.conf`, HUP `pbs_mom` (Linux) and/or restart `pbs_server` to rebuild the dictionary with the new contents of `pbs.conf`.

Each parameter in the `pbs.conf` file is the key to its dictionary entry. The `pbs.conf` file can contain the following parameters:

Table 6-11: Parameters in `pbs.conf`

Parameter	Description
PBS_AUTH_METHOD	Specifies default authentication method and library to be used by PBS. Used only at authenticating client. Case-insensitive. Default value: <i>resvport</i> To use MUNGE, set to <i>munge</i>
PBS_BATCH_SERVICE_PORT	Port on which server listens. Default: 15001
PBS_BATCH_SERVICE_PORT_DIS	DIS port on which server listens.
PBS_COMM_LOG_EVENTS	Communication daemon log mask. Default: <i>511</i>
PBS_COMM_ROUTERS	Tells a <code>pbs_comm</code> the location of the other <code>pbs_comms</code> .
PBS_COMM_THREADS	Number of threads for communication daemon.
PBS_CONF_REMOTE_VIEWER	Specifies remote viewer client. If not specified, PBS uses native Remote Desktop client for remote viewer. Set on submission host(s). Supported on Windows only.
PBS_CORE_LIMIT	Limit on corefile size for PBS daemons. Can be set to an integer number of bytes or to the string "unlimited". If unset, core file size limit is inherited from the shell environment.
PBS_DATA_SERVICE_PORT	Used to specify non-default port for connecting to data service. Default: 15007
PBS_ENCRYPT_METHOD	Specifies method and library for encrypting and decrypting data in client-server communication. Used only at authentication client side. Case-insensitive. To use TLS encryption in client-server communication, set this parameter to <i>tls</i> . No default; if this is not set, PBS does not encrypt or decrypt data.
PBS_ENVIRONMENT	Location of <code>pbs_environment</code> file.

Table 6-11: Parameters in `pbs.conf`

Parameter	Description
PBS_EXEC	Location of PBS <code>bin</code> and <code>sbin</code> directories.
PBS_HOME	Location of PBS working directories.
PBS_LEAF_NAME	<p>Tells endpoint what hostname to use for network.</p> <p>The value does not include a port, since that is usually set by the daemon.</p> <p>By default, the name of the endpoint's host is the hostname of the machine. You can set the name where an endpoint runs. This is useful when you have multiple networks configured, and you want PBS to use a particular network.</p> <p>The server only queries for the canonicalized address of the MoM host, unless you let it know via the <code>Mom</code> attribute; if you have set <code>PBS_LEAF_NAME</code> in <code>/etc/pbs.conf</code> to something else, make sure you set the <code>Mom</code> attribute at vnode creation.</p> <p>TPP internally resolves the name to a set of IP addresses, so you do not affect how <code>pbs_comm</code> works.</p>
PBS_LEAF_ROUTERS	Location of endpoint's <code>pbs_comm</code> daemon(s).
PBS_LOCALLOG=<value>	<p>Enables logging to local PBS log files. Valid values:</p> <p>0: no local logging</p> <p>1: local logging enabled</p> <p>Only available when using <code>syslog</code>.</p>
PBS_LR_SAVE_PATH	<p>Path where Undo Live Recorder stores daemon execution recordings. Default: <code>\$PBS_HOME/spool</code>. See "Sending Daemon Execution Recordings to Altair" on page 639 in the PBS Professional Administrator's Guide</p>
PBS_MAIL_HOST_NAME	<p>Used in addressing mail regarding jobs and reservations that is sent to users specified in a job or reservation's <code>Mail_Users</code> attribute.</p> <p>Optional. If specified, must be a fully qualified domain name. Cannot contain a colon (":"). For how this is used in email address, see section 2.2.2, "Specifying Mail Delivery Domain", on page 20.</p>
PBS_MANAGER_SERVICE_PORT	Port on which MoM listens. Default: 15003
PBS_MOM_HOME	Location of MoM working directories.
PBS_MOM_NODE_NAME	<p>Name that MoM should use for parent vnode, and if they exist, child vnodes. If this is not set, MoM defaults to using the non-canonicalized hostname returned by <code>gethostname()</code>.</p> <p>If you use the IP address for a vnode name, set <code>PBS_MOM_NODE_NAME=<IP address></code> in <code>pbs.conf</code> on the execution host.</p> <p>Dots are not allowed in this parameter unless they are part of an IP address.</p>
PBS_MOM_SERVICE_PORT	Port on which MoM listens. Default: 15002

Table 6-11: Parameters in `pbs.conf`

Parameter	Description
PBS_OUTPUT_HOST_NAME	<p>Host to which all job standard output and standard error are delivered. If specified in <code>pbs.conf</code> on a job submission host, the value of <code>PBS_OUTPUT_HOST_NAME</code> is used in the host portion of the job's <code>Output_Path</code> and <code>Error_Path</code> attributes. If the job submitter does not specify paths for standard output and standard error, the current working directory for the <code>qsub</code> command is used, and the value of <code>PBS_OUTPUT_HOST_NAME</code> is appended after an at sign (“@”). If the job submitter specifies only a file path for standard output and standard error, the value of <code>PBS_OUTPUT_HOST_NAME</code> is appended after an at sign (“@”). If the job submitter specifies paths for standard output and standard error that include host names, the specified paths are used.</p> <p>Optional. If specified, must be a fully qualified domain name. Cannot contain a colon (“:”). See "Delivering Output and Error Files" on page 62 in the PBS Professional Administrator's Guide.</p>
PBS_PRIMARY	<p>Hostname of primary server. Used only for failover configuration. Overrides <code>PBS_SERVER_HOST_NAME</code>.</p> <p>If you set <code>PBS_LEAF_NAME</code> on the primary server host, make sure that <code>PBS_PRIMARY</code> matches <code>PBS_LEAF_NAME</code> on the corresponding host. If you do not set <code>PBS_LEAF_NAME</code> on the server host, make sure that <code>PBS_PRIMARY</code> matches the hostname of the server host.</p>
PBS_RCP	Location of <code>rcp</code> command if <code>rcp</code> is used.
PBS_SCHEDULER_SERVICE_PORT	Port on which default scheduler listens. Default value: 15004
PBS_SCHED_THREADS	<p>Maximum number of scheduler threads. By default, scheduler starts a number of threads that is half the number of cores (or hyperthreads, if applicable) on its host. Scheduler automatically caps number of threads at the number of cores (or hyperthreads if applicable), regardless of value of this variable.</p> <p>Overridden by <code>pbs_sched -t</code> option and <code>PBS_SCHED_THREADS</code> environment variable.</p>
PBS_SCP	Location of <code>scp</code> command if <code>scp</code> is used; setting this parameter causes PBS to first try <code>scp</code> rather than <code>rcp</code> for file transport.
PBS_SECONDARY	<p>Hostname of secondary server. Used only for failover configuration. Overrides <code>PBS_SERVER_HOST_NAME</code>.</p> <p>If you set <code>PBS_LEAF_NAME</code> on the secondary server host, make sure that <code>PBS_SECONDARY</code> matches <code>PBS_LEAF_NAME</code> on the corresponding host. If you do not set <code>PBS_LEAF_NAME</code> on the server host, make sure that <code>PBS_SECONDARY</code> matches the hostname of the server host.</p>

Table 6-11: Parameters in `pbs.conf`

Parameter	Description
PBS_SERVER	Hostname of host running the server. Cannot be longer than 255 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 <code>pbs.conf</code> . 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. Overridden by PBS_SERVER_HOST_NAME and PBS_PRIMARY.
PBS_SERVER_HOST_NAME	The FQDN of the server host. Used by clients to contact server. Overridden by PBS_PRIMARY and PBS_SECONDARY failover parameters. Overrides PBS_SERVER parameter. Optional. If specified, must be a fully qualified domain name. Cannot contain a colon (“:”). See "Contacting the Server" on page 62 in the PBS Professional Administrator's Guide .
PBS_START_COMM	Set this to <code>1</code> if a communication daemon is to run on this host.
PBS_START_MOM	Default is <code>0</code> . Set this to <code>1</code> if a MoM is to run on this host.
PBS_START_SCHED	Deprecated. Set this to <code>1</code> if default scheduler is to run on this host. Overridden by scheduler's <code>scheduling</code> attribute.
PBS_START_SERVER	Set this to <code>1</code> if server is to run on this host.
PBS_SUPPORTED_AUTH_METHODS	Specifies supported authentication methods for client-server communication. Used by authenticating server (PBS server, scheduler, MoM, or comm); ignored at client. Case-insensitive. If this parameter is set, PBS accepts only the methods listed. Format: comma-separated list of authentication methods. Default value: <code>resvport</code> Example: <code>munge,GSS</code>
PBS_SYSLOG=<value>	Controls use of <code>syslog</code> facility under which the entries are logged. Valid values: 0: no syslogging 1: logged via LOG_DAEMON facility 2: logged via LOG_LOCAL0 facility 3: logged via LOG_LOCAL1 facility ... 9: logged via LOG_LOCAL7 facility
PBS_SYSLOGSEVR=<value>	Filters <code>syslog</code> messages by severity. Valid values: 0: only LOG_EMERG messages are logged 1: messages up to LOG_ALERT are logged ... 7: messages up to LOG_DEBUG are logged
PBS_TMPDIR	Location of temporary files/directories used by PBS components.

6.12 Constant Objects

Constant objects are used to represent PBS elements such as event types, job, server, reservation, and vnode states, log event classes, queue and vnode types, and exceptions. These objects cannot be modified. When the PBS module is imported, the constant objects are imported. PBS uses the following constant objects:

Table 6-12: Constant Objects

Category	Description
Event type objects	The <code>pbs.event().type</code> event member represents the type of the event, for example, <code>pbs.QUEUEJOB</code> or <code>pbs.MOVEJOB</code> . See section 6-2, “Event Types and Objects”, on page 87
Message log event class objects	You can use these objects to indicate log event class when placing messages in the server logs. See section 6-16, “Message Log Level Objects”, on page 152 .
Queue type objects	The <code>queue(<queue name>).queue_type</code> member represents the type of the queue. See section 6-5, “Queue Type Constant Objects”, on page 122 .
PBS server state objects	The <code>pbs.server().server_state</code> member represents the state of the server. See section 6.4.1.3, “Server State Member”, on page 119 .
Job state objects	The <code>job.job_state</code> member represents the job’s state. Use these constant objects to test the state of a job. See section 6-6, “Job State Objects”, on page 125 .
Reservation state objects	The <code>resv.reserve_state</code> member represents the state of the reservation. See section 6-7, “Reservation State Objects”, on page 133 .
Vnode state objects	The <code>vnode.state</code> member represents the state of the vnode. See section 6-10, “Vnode State Constant Objects”, on page 135 .
Vnode sharing objects	The <code>vnode.sharing</code> member represents the vnode’s sharing attribute. See section 6-9, “Vnode Sharing Objects”, on page 135 .
Vnode type objects	The <code>vnode.ntype</code> member represents the type of the vnode. See section 6-8, “Vnode Type Objects”, on page 134 .

6.13 Object Members and Methods

The relationships between objects and methods are shown in [Figure 6-1](#) and [Figure 6-2](#).

Event object members are listed in [Table 6-3, “Using Event Object Members in Events,” on page 108](#).

Non-event objects and object members are listed in [Table 6-13, “PBS Objects and Object Members,” on page 141](#).

[Table 6-14, “Methods Available in Events,” on page 141](#) shows the methods available for each kind of event.

Each global method is described in [section 6.13.3, “PBS Types and Their Methods”, on page 143](#).

Each event-only method is described in [section 6.3.4, “Event-only Methods”, on page 116](#).

Each object-only method is described in the section for its object.

6.13.1 PBS Objects and Object Members

The following table lists PBS objects and their members, such as the server or jobs:

Table 6-13: PBS Objects and Object Members

Object	Object Member	Object Sub-member
pbs.hook_config_filename		
pbs.job	job.id	
	job.<attribute name>	
	pbs.exec_vnode (job attribute)	pbs.exec_vnode.chunks[]
pbs.pbs_conf[]		
pbs.queue	queue.<attribute name>	
	queue.name	
pbs.resv	resv.<attribute name>	
	resv.resvid	
pbs.server	pbs.server().<attribute name>	
	pbs.server().name	
pbs.vnode	vnode.<attribute name>	
	pbs.vchunk	vchunk.chunk_resources[]
		vchunk.vnode_name

6.13.2 Methods Available in Events

The following table lists all methods, and shows which event can use each method. A “y” means that the hook can use the method, an “n” means it cannot, and an “o” means that it can but will have no effect:

Table 6-14: Methods Available in Events

Method	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
job.delete()	y	y	y	y	y	n	o	o	y	o	y	o	o	o	o	y	y	o	y	n
job.in_ms_mom()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
job.is_checkpointed()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
job.release_nodes()	n	n	n	n	n	n	n	o	n	n	y	y	n	n	n	n	n	n	n	n
job.rerun()	y	y	y	y	y	n	o	o	y	o	y	o	o	o	o	y	y	o	y	n
pbs.acl()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
pbs.args()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	y	n
pbs.checkpoint()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
pbs.depend()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
pbs.depend()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
pbs.duration()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
pbs.email_list()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n
pbs.event().accept()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	y	n
pbs.event().reject()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	y	n
pbs.exec_host()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	y	o	y	n

Table 6-14: Methods Available in Events

Method	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_attach	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
pbs.exec_vnode()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.get_local_nodename()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.group_list()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.hold_types()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.job_sort_formula()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.join_path()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.keep_files()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.license_count()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.logjobmsg()	y	y	y	y	y	y	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.logmsg()	y	y	y	y	y	y	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.mail_points()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.node_group_key()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.path_list()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.pbs_env()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.place()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.range()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.reboot()	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
pbs.route_destinations()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.select()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.select.increment_chunks()	y	y	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	
pbs.server().job('<job ID>')	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().jobs()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().queue(<queue name>)	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().queues()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().resv(<reservation ID>)	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().resvs()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().scheduler_restart_cycle()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().vnode(<vnode name>)	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.server().vnodes()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
pbs.size()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.software()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.staging_list()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.state_count()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.user_list()	y	y	y	y	y	n	o	o	y	o	y	o	y	y	y	y	o	y	n	
pbs.version()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
queue.job()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
queue.jobs()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	
vchunk.chunk_resources.keys()	y	y	y	y	y	n	y	o	y	y	y	y	y	y	y	y	y	y	n	

6.13.3 PBS Types and Their Methods

6.13.3.1 Method to Create or Set ACL

pbs.acl()

```
pbs.acl("[+|-]<entity>][,...]")
```

Creates an object representing a PBS ACL, from the specified formatted input string.

6.13.3.2 Method to Create or Set Command Argument List

pbs.args()

```
pbs.args("<args>")
```

where *<args>* are space-separated arguments to a command.

Creates an object representing the arguments to the command from the specified formatted input string *<args>*.

Example of setting a command argument list:

```
pbs.args("-Wsuppress_email=N -r y")
```

6.13.3.3 Method to Create or Set Checkpoint String

pbs.checkpoint()

```
pbs.checkpoint("<checkpoint_string>")
```

where *<checkpoint_string>* must be one of "n", "s", "c", "c=mmm", "w", or "w=mmm"

Creates an object representing the job Checkpoint attribute, using the specified formatted input string *<checkpoint_string>*.

6.13.3.4 Method to Create or Set Dependency Object

pbs.depend()

```
pbs.depend("<depend_string>")
```

<depend_string> must be of format "*<type>:<jobid>[,<jobid>...]*", or "*on:<count>*".

where *<type>* is one of "after", "afterok", "afterany", "afternotok", "before", "beforeok", "beforeany", and "beforenotok".

Creates a PBS dependency specification object representing the job depend attribute, using the given *<depend_string>*.

Usage:

```
pbs.event().job.depend = pbs.depend("<depend_string>")
```

6.13.3.5 Method to Create or Set Duration from Time String or Integer

pbs.duration()

```
pbs.duration("[[hours:]minutes:]seconds[.milliseconds]")
```

Creates a time specification *duration* instance, returning the equivalent number of seconds from the given time string.

Represents an interval or elapsed time in number of seconds. Duration objects can be specified using either a time or an integer. See "[Method to Create or Set Duration from Time String or Integer](#)".

```
pbs.duration(<integer>)
```


Creates an integer `duration` instance using the specified number of seconds.

A `pbs.duration` instance can be operated on by any of the Python `int` functions. When performing arithmetic operations on a `pbs.duration` type, ensure the resulting value is a `pbs.duration()` type, before assigning to a job member that expects such a type.

Example:

```
pbs.event().job.Resource_List["cput"] = pbs.duration(300 + d1) # safe
```

The following will **not** work, since Python evaluates from left to right, and returns result as the type at left (`int`):

```
d1 = pbs.duration(30)
pbs.event().job.Resource_List["cput"] = 300 + d1
```

6.13.3.6 Method to Create or Set Email List

pbs.email_list()

```
pbs.email_list("<email_address1>[, <email address2>...]" )
```

Creates an object representing a mail list from the specified formatted input string.

6.13.3.7 Method to Create or Set `exec_host` Object

pbs.exec_host()

```
pbs.exec_host("host/N[*C][+...]" )
```

Create an object representing the `exec_host` job attribute, using the specified input string containing host and resource specification.

6.13.3.8 Method to Create or Set `exec_vnode` Object

pbs.exec_vnode()

```
pbs.exec_vnode("<vchunk>[+<vchunk> ...]" )
```

```
<vchunk> is (<vnodename:ncpus=N:mem=M>)
```

Creates an object representing the `exec_vnode` job attribute, using the input string containing the vnode and resource specification. When the `qrun -H` command is used, or when the scheduler runs a job, the `job.exec_vnode` object contains the vnode specification for the job.

Example:

```
pbs.exec_vnode(" (vnodeA:ncpus=N:mem=X)+(nodeB:ncpus=P:mem=Y+nodeC:mem=Z) ")
```

This object is managed and accessed via the `str()` or `repr()` functions. Example:

```
Python> ev = pbs.server().job("10").exec_vnode
Python> str(ev)                "(vnodeA:ncpus=2:mem=200m)+(vnodeB:ncpus=5:mem=1g) "
```

6.13.3.9 Method to Create or Set `group_list` Object

pbs.group_list()

```
pbs.group_list("<group_name>[@<host>][,<group_name>[@<host>]...]" )
```

Creates an object representing a PBS group list from the specified formatted input string.

To use a group list object:

```
job.group_list = pbs.group_list(...)
```


6.13.3.10 Method to Create or Set hold_types Object

pbs.hold_types()

pbs.hold_types("<hold_type_str>")

where *<hold_type_str>* is one of "u", "o", "s", or "n".

Creates an object representing the Hold_Types job attribute from the specified formatted input string.

6.13.3.11 Method to Create or Set job_sort_formula Object

pbs.job_sort_formula()

pbs.job_sort_formula("<formula string>")

where *<formula string>* is a string containing a math formula. See [section 4.9.21, “Using a Formula for Computing Job Execution Priority”, on page 149](#).

Creates an object representing the job_sort_formula server attribute from the specified formatted input string.

6.13.3.12 Method to Create or Set join_path Object

pbs.join_path()

pbs.join_path({"oe"|"eo"|"n"})

Creates an object representing the Join_Path job attribute from the specified formatted input string.

6.13.3.13 Method to Create or Set keep_files Object

pbs.keep_files()

pbs.keep_files("<Keep_Files option>")

where *<Keep_Files option>* is one of "n", "d", "o", "e", "oe", "eo".

Creates an object representing the Keep_Files job attribute from the specified formatted input string.

6.13.3.14 Method to Create or Set license_count Object

pbs.license_count()

pbs.license_count("Avail_Global:<value> Avail_Local:<value> Used:<value> High_Use:<value>")

Instantiates an object representing a license_count attribute from the specified formatted input string.

6.13.3.15 Method to Create or Set mail_points Object

pbs.mail_points()

pbs.mail_points("<mail points string>")

where *mail points string* is "a", "b", and/or "e", optionally with *j*, or "n".

Creates a pbs.mail_points object representing a Mail_Points attribute from the specified formatted input string.

6.13.3.16 Method to Create or Set node_group_key Object

pbs.node_group_key()

pbs.node_group_key("<resource(s)>")

Creates a `pbs.node_group_key` object representing the resource(s) to be used for node grouping, using the specified resource(s). The input string is a comma-separated, quoted list of resources.

6.13.3.17 Method to Create or Set `path_list` Object

pbs.path_list()

```
pbs.path_list("<path>[@<host>][,<path>@<host> ...]" )
```

Creates an object representing a PBS pathname list from the specified formatted input string.

To use a path list object:

```
job.Shell_Path_List = pbs.path_list(...)
```

6.13.3.18 Method to Create or Set Job Environment Object

pbs.pbs_env()

Creates an empty environment variable list.

For example, to clear an environment variable list:

```
pbs.event().env = pbs.pbs_env()
```

6.13.3.19 Method to Create or Set Resource List

pbs.pbs_resource()

```
pbs.pbs_resource(<resource list name>)
```

Creates a `pbs.pbs_resource` object with the specified name.

To set values for a `pbs.pbs_resource` object:

```
<resource list name>['<resource name>']=<resource value>
```

For example:

```
Resource_List['ncpus']=8
Resource_List['mem']=pbs.size("10gb")
Resource_List['walltime']=pbs.duration('00:45:00')
```

A `pbs.pbs_resource` is similar to a dictionary, but you cannot use direct traversal. To loop through entries:

```
for r in <list name>.keys():
```

...

For example:

```
for r in <Resource_List>.keys():
    pbs.logmsg(pbs.LOG_DEBUG, "Resource_List[%s]=%s" % (r, Resource_List[r]))
```

which produces the following log message:

```
03/08/2018 18:47:16;0006;pbs_python;Hook;pbs_python;Resource_List[walltime]=00:45:00
03/08/2018 18:47:16;0006;pbs_python;Hook;pbs_python;Resource_List[mem]=10gb
03/08/2018 18:47:16;0006;pbs_python;Hook;pbs_python;Resource_List[ncpus]=7
```

A `str(<object of type pbs.pbs_resource>)` produces output of the form:

```
<resource name>=<value>,<resource name>=<value>, ...
```

To do the equivalent of `str()`:

```
pbs.logmsg(pbs.LOG_DEBUG, "Resource_List is %s (%s)" % (Resource_List, type(Resource_List)))
```

This produces the following log message:

```
03/08/2018 18:47:16;0006;pbs_python;Hook;pbs_python;Resource_List is
    mem=10gb,ncpus=7,walltime=00:45:00 (<class 'pbs.v1._base_types.pbs_resource'>)
```

6.13.3.20 Method to Create or Set place Object

pbs.place()

```
pbs.place("[arrangement]:[sharing]:[group]")
```

arrangement can be “*pack*”, “*scatter*”, “*free*”, “*vscatter*”

sharing can be “*shared*”, “*excl*”, “*exclhost*”

group can be of the form “*group=<resource>*”

[arrangement], *[sharing]*, and *[group]* can be given in any order or combination.

Creates a *place* object representing the job’s *place* specification from the specified formatted input string.

Example:

```
pl = pbs.place("pack:excl")
s = repr(pl)          (or s = `pl`)
letter = pl[0]        (assigns 'p' to letter)
s = s + ":group=host" (append to string)
pl = pbs.place(s)     (update original pl)
```

6.13.3.21 Method to Create or Set range Object

pbs.range()

```
pbs.range("<start>-<stop>:<step>")
```

Creates a PBS object representing a range of values from the specified formatted input string. Can be used to create a *job.array_indices_submitted* object. See [section 6.6.1.2, “Job array indices submitted Attribute Member”, on page 123](#).

Example:

```
pbs.range("1-30:3")
```

6.13.3.22 Method to Create or Set route_destinations Object

pbs.route_destinations()

```
pbs.route_destinations("<queue_spec>[,<queue_spec>,...]")
```

where *<queue_spec>* is *queue_name[@server_host[:port]]*

Creates an object that represents a *route_destinations* routing queue attribute from the specified formatted input string.

6.13.3.23 Method to Create or Set select Object

pbs.select()

```
pbs.select("[N:]res=val[:res=val]...[+ [N:]res=val[:res=val] ... ]")
```

Creates a *select* object representing the job’s *select* specification from the specified formatted input string.

Example:

```
sel = pbs.select("2:ncpus=1:mem=5gb+3:ncpus=2:mem=5gb")
s = repr(sel)           (or s = `sel`)
letter = s[3]          (assigns 'c' to letter)
s = s + "+5:scratch=10gb" (append to string)
sel = pbs.select(s)    (reset the value of sel)
```

6.13.3.24 Method to Increment select Object Chunks

pbs.select.increment_chunks()

pbs.select.increment_chunks(<increment specification>)

Creates a `select` object representing the job's new `select` specification, which has been padded from the original according to the *increment specification*.

You can pad all chunks, but you do not pad the primary vnode request itself; the job can only request one primary vnode. So when a job requests `3:ncpus=8+4:ncpus=1`, the non-paddable primary vnode is considered to be a separate request of `1:ncpus=8`, and the paddable part is the remaining `2:ncpus=8+4:ncpus=1`.

Table 6-15: Behavior for increment specification

Value of increment specification	Behavior
<p>Integer amount</p> <p>Format: can be with or without quotes (a number or a numeric string), e.g. 5 or "5"</p>	<p>Adds specified number of vnodes to each chunk in the job's vnode request. Examples:</p> <p>Given this initial select statement:</p> <pre>my_select=pbs.select("ncpus=3:mem=1gb+1:ncpus=2:mem=2gb+2:ncpus=1:mem=3gb")</pre> <p>Calling <code>my_select.increment_chunks(2)</code> returns:</p> <pre>"1:ncpus=3:mem=1gb+3:ncpus=2:mem=2gb+4:ncpus=1:mem=3gb"</pre> <p>Calling <code>my_select.increment_chunks("3")</code> returns:</p> <pre>"1:ncpus=3:mem=1gb+4:ncpus=2:mem=2gb+5:ncpus=1:mem=3gb"</pre>
<p>Percentage amount</p> <p>Format: a quoted numeric string ending in a percent sign, e.g. "10%"</p>	<p>Adds specified percent of vnodes to each chunk in the job's vnode request. Resulting amounts are rounded up. Example:</p> <p>Given this initial select statement:</p> <pre>my_select=pbs.select("ncpus=3:mem=1gb+1:ncpus=2:mem=2gb+2:ncpus=1:mem=3gb")</pre> <p>Calling <code>my_select.increment_chunks("23.5%")</code> returns:</p> <pre>"1:ncpus=3:mem=1gb+2:ncpus=2:mem=2gb+3:ncpus=1:mem=3gb"</pre> <p>The first chunk, which is a single chunk, is left as is, and the second and third chunks are increased by 23.5 %. 1.24 is rounded up to 2, and 2.47 is rounded up to 3.</p>
<p>Per-chunk specification</p> <p>Format: <code>{<chunk index> : <increment>, ...}</code> where the increment can be an integer or a percentage</p>	<p>Adds specified amount or percent to specified chunk(s). Chunk index starts at 0. Examples:</p> <p>Given this initial select statement:</p> <pre>my_select=pbs.select("ncpus=3:mem=1gb+1:ncpus=2:mem=2gb+2:ncpus=1:mem=3gb")</pre> <p>Calling <code>my_select.increment_chunks({0: 0, 1: 4, 2: "50%"})</code> returns:</p> <pre>"1:ncpus=3:mem=1gb+5:ncpus=2:mem=2gb+3:ncpus=1:mem=3gb"</pre> <p>There is no increase (0) for chunk 1, we give 4 additional chunks to chunk 2, and we increase chunk 3 by 50%, resulting in 3.</p> <p>Given this initial select statement:</p> <pre>my_select=pbs.select("5:ncpus=3:mem=1gb+4:ncpus=2:mem=2gb+2:ncpus=1:mem=3gb")</pre> <p>Calling <code>my_select.increment_chunks("50%")</code> or <code>my_select.increment_chunks({0: "50%", 1: "50%", 2: "50%"})</code> returns:</p> <pre>"7:ncpus=3:mem=1gb+6:ncpus=2:mem=2gb+3:ncpus=1:mem=3gb"</pre> <p>The primary vnode is broken out as <code>"1:ncpus=3:mem=1gb"</code> and is left as is. The <code>"50%"</code> increase is applied to the remaining portion, <code>"4:ncpus=3:mem=1gb"</code>. After the increase is applied, the original first chunk is re-created from the primary vnode and the padded remains of the first chunk to make 7. Chunk 2 gets 6 and chunk 3 gets 3.</p>

6.13.3.24.i Example of Padding Chunks

The following code snippet illustrates padding a job's vnode request by one extra vnode per chunk:

```
import pbs
e=pbs.event()
j = e.job
new_select = e.job.Resource_List["select"].increment_chunks(1)
e.job.Resource_List["select"] = new_select
```

6.13.3.25 Method to Create or Set size Object

pbs.size()

You can create a `pbs.size` object using either a byte count or a suffix:

```
pbs.size(<integer>)
```

Creates a PBS size object using integer byte count, storing the value as the number of bytes. Size objects can be specified using either an integer or a string. See the ["`pbs.size\(<integer><suffix>\)`"](#) creation method.

```
pbs.size("<integer><suffix>")
```

Creates a PBS size object using the specified suffix. The suffix must be a multiplier defined in the table shown in ["`Size`" on page 360 of the PBS Professional Reference Guide](#). The size of a word is the word size on the execution host. Size objects can be specified using either an integer or a string.

To operate on `pbs.size` instances, use the "+" and "-" operators.

To compare `pbs.size` instances, use the "==" , "!=" , ">" , "<" , ">=" , and "<=" operators.

Example: the sizes are normalized to the smaller of the 2 suffixes. In this case, "10gb" becomes "10240mb" and is added to "10mb":

```
sz = pbs.size("10gb")
sz = sz + 10mb
10250mb
```

Example: the following returns `True` because `sz` is greater than 100 bytes:

```
if sz > 100:
    gt100 = True
```

6.13.3.26 Method to Create or Set Software Resource Object

pbs.software()

```
pbs.software("<software info string>")
```

Creates an object representing a site-dependent software resource from the specified formatted input string.

6.13.3.27 Method to Create or Set staging_list Object

pbs.staging_list()

```
pbs.staging_list("<filespec>[,<filespec>,...]")
```

where `<filespec>` is `<execution_path>@<storage_host>:<storage_path>`

Creates an object representing a job file staging parameters list from the specified formatted input string.

To use a staging list object:

```
job.stagein = pbs.staging_list(...)
```

6.13.3.28 Method to Create or Set state_count Object

pbs.state_count()

pbs.state_count("Transit:<U> Queued:<V> Held:<W> Running:<X> Exiting:<Y> Begun:<Z>")

Instantiates an object representing a `state_count` attribute from the specified formatted input string.

6.13.3.29 Method to Create or Set user_list Object

pbs.user_list()

pbs.user_list("<user>[@<host>][,<user>@<host>...]")

Creates an object representing a PBS user list from the specified formatted input string.

To use a user list object:

```
job.User_List = pbs.user_list(...)
```

6.13.3.30 Method to Create or Set PBS Version Object

pbs.version()

pbs.version("<pbs version string>")

Creates an object representing the PBS version string from the specified formatted input string.

6.13.4 Global Methods

6.13.4.1 Method to Get Local Vnode Name

pbs.get_local_nodename()

This returns a Python `str` whose value is the name of the local parent vnode.

If you want to refer to the vnode object representing the current host, you can pass this vnode name as the key to `pbs.event().vnode_list[]`. For example:

```
Vn = pbs.event().vnode_list[pbs.get_local_nodename()]
```

6.13.4.2 Method to Log Job-related String

pbs.logjobmsg()

pbs.logjobmsg(job ID, message)

where *job ID* must be an existing or previously existing job ID and where *message* is an arbitrary string.

This puts a custom string in the log of the PBS daemon running the hook, so if the method is being run by a server hook such as `queuejob`, it prints to the server log, but if the method is being run at an execution host hook such as `execjob_prologue`, it prints to the MoM log.

The `tracejob` command can be used to print out the job-related messages logged by a hook script.

Messages are logged at log event class `pbs.LOG_DEBUG`. See [Table 6.13.4.4, "Message Log Level Objects," on page 152](#).

6.13.4.3 Method to Log String

pbs.logmsg()

pbs.logmsg(log event class, message)

where *message* is an arbitrary string, and where *log event class* can be one of the message log event class constants shown in [Table 6-16, “Message Log Level Objects,” on page 152](#).

This puts a custom string in the log of the PBS daemon running the hook, so if the method is being run by a server hook such as `queuejob`, it prints to the server log, but if the method is being run at an execution host hook such as `execjob_prologue`, it prints to the MoM log.

Example:

```
for j in pbs.server().jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "found job %s" % (j.id))
```

6.13.4.4 Message Log Level Objects

You can use the following objects to indicate log level when placing messages in the server logs.

Table 6-16: Message Log Level Objects

Object	Decimal	Hex	PBS Log Event Filter	Name and Event Category
<code>pbs. EVENT_ERROR</code>	1	0x0001	error	PBSEVENT_ERROR Internal errors
<code>pbs. EVENT_SYSTEM</code>	2	0x0002	system	PBSEVENT_SYSTEM system errors
<code>pbs. EVENT_ADMIN</code>	4	0x0004	admin	PBSEVENT_ADMIN Administrative events
<code>pbs.LOG_WARNING</code>	4	0x0004	admin	PBSEVENT_ADMIN Administrative events
<code>pbs.LOG_ERROR</code>	4	0x0004	admin	PBSEVENT_ADMIN Administrative events
<code>pbs.LOG_DEBUG</code>	4	0x0004	admin	PBSEVENT_ADMIN Administrative events
<code>pbs. EVENT_JOB</code>	8	0x0008	job	PBSEVENT_JOB Job-related events
<code>pbs. EVENT_JOB_USAGE</code>	16	0x0010	job_usage	PBSEVENT_JOB_USAGE Job accounting info
<code>pbs. EVENT_SECURITY</code>	32	0x0020	Security	PBSEVENT_SECURITY Security violations
<code>pbs. EVENT_SCHED</code>	64	0x0040	sched	PBSEVENT_SCHED Scheduler events

Table 6-16: Message Log Level Objects

Object	Decimal	Hex	PBS Log Event Filter	Name and Event Category
pbs. EVENT_DEBUG	128	0x0080	debug	PBSEVENT_DEBUG Common debug messages
pbs. EVENT_DEBUG2	256	0x0100	debug2	PBSEVENT_DEBUG2 Uncommon debug messages
pbs. EVENT_RESV	512	0x0200	resv	PBSEVENT_RESV Reservation-related events
pbs. EVENT_DEBUG3	1024	0x0400	debug3	PBSEVENT_DEBUG3 Less common than PBSEVENT_DEBUG2
pbs. EVENT_DEBUG4	2048	0x0800	debug4	PBSEVENT_DEBUG4 Less common than debug3
pbs. EVENT_FORCE	4096	0x8000	(No filter applies)	PBSEVENT_FORCE Forces a message to be logged

6.13.4.5 Method to Reboot Host

pbs.reboot()

pbs.reboot([<command>])

This stops hook execution, so that remaining lines in the hook script are not executed, and starts the tasks that would normally begin after the hook is finished, such as flagging the current host to be rebooted. The MoM logs show the following:

```
<hook name> requested for host to be rebooted
```

We recommend that before calling `pbs.reboot()`, you set any vnodes managed by this MoM offline, and requeue the current job, if this hook is not an `execchost_periodic` hook. For example:

```
for v in pbs.event().vnode_list.keys():
    pbs.event().vnode_list[v].state = pbs.ND_OFFLINE
    pbs.event().vnode_list[v].comment = "Rebooting host"
pbs.event().job.rerun()
pbs.reboot()
```

The effect of the call to `pbs.reboot()` is not instantaneous. The reboot happens after the hook executes, and after any of the other actions such as `pbs.event().job.rerun()`, `pbs.event().delete()`, and `pbs.event().vnode_list[]` take effect.

A hook with its `user` attribute set to `pbsuser` cannot successfully invoke `pbs.reboot()`, even if the owner is a PBS Manager or Operator. If this is attempted, the host is not rebooted, and the following message appears at log event class `PBSEVENT_DEBUG2` in the MoM logs:

```
<hook name>; Not allowed to issue reboot if run as user.
```

The `<command>` is an optional argument. It is a Python `str` which is executed instead of the `reboot` command that is the default for the system. For example:

```
pbs.reboot("/usr/local/bin/my_reboot -s 10 -c 'going down in 10'")
```

The specified `<command>` is executed in a shell on Linux/UNIX or via `cmd` on Windows.

Built-in Hooks

7.1 Managing Built-in Hooks

PBS comes shipped with built-in hooks that implement features or patch bugs. You can operate on these hooks via `qmgr`. The `qmgr` keyword for built-in hooks is “*pbshook*”. These hooks are named with the “*PBS*” prefix.

7.2 Prerequisites

You can operate on built-in hooks only from an account that has root access to the PBS server host.

When operating on a built-in hook, use the keyword “*pbshook*”, not “*hook*”.

7.3 Allowed Operations

You can perform a limited set of operations on built-in hooks. You can do the following:

- View attributes
- Set all attributes except for type
- Edit configuration files
- Replace with your own hook

7.4 Viewing Built-in Hooks

You can view attributes of built-in hooks:

```
# qmgr -c "list pbshook"
Hook PBS_example_hook
  type = pbs
  enabled = false
  event = queuejob, resvsub
  user = pbsadmin
  alarm = 90
  order = 1000
```

7.5 Setting Attributes of Built-in Hooks

You can set all attributes except for the type attribute for a built-in hook. For example, you can enable and disable built-in hooks:

```
# qmgr -c "set pbshook <built-in hook name> enabled=true"
# qmgr -c "set pbshook <built-in hook name> enabled=false"
```

If you disable a built-in hook, the following message is printed to qmgr's STDERR:

```
"WARNING: Disabling a PBS hook results in an unsupported configuration!"
```

7.6 Editing and Importing Configuration Files for Built-in Hooks

You can edit and re-import a configuration file for a built-in hook. Get the contents of the configuration file by exporting the file:

```
#qmgr -c "export pbshook <hook name> application/x-config default" > config_file_save
```

Edit the file (here, config_file.save), then re-import it:

```
# qmgr -c "import pbshook <hook name> application/x-config <content-encoding> default
config_file.save"
```

7.7 Restrictions

- You cannot create or delete a built-in hook. Attempting to do so results in the following error being printed to qmgr's STDERR:
Invalid request
- You cannot import or export content of a built-in hook. Attempting to do so results in the following error being printed to qmgr's STDERR:
<content-type> must be application/x-config
- You cannot display the commands to re-create a built-in hook: using qmgr -c "print pbshook" won't work.

7.8 Replacing a Built-in Hook with Your Own Hook

You can replace a built-in hook with your own hook. For example, to replace a built-in exechost_startup hook:

1. Disable the built-in hook:

```
# qmgr -c "set pbshook <built-in startup hook> enabled=false"
```

2. Create your own site-defined hook instead:

```
# qmgr -c "create hook <your startup hook> event=exechost_startup"
# qmgr -c "import hook <your startup hook> application/x-python default <your startup script>"
```

7.9 Errors and Logging when Operating on Built-in Hooks

- If you try to operate on a built-in hook from an account that does not have root or Admin access, the following error message is issued to `STDERR`:

```
"unable to generate a hook_tempfile from <filepath> - Permission denied"  
<user>@<host> is unauthorized to access hooks data from server <hostname>"
```

- If you try to import or export a built-in hook, you will see one of the following messages on `STDERR`:

```
# qmgr -c "import pbshook <hook name> application/x-python default my_hook.py"  
<content-type> must be application/x-config
```

or

```
#qmgr -c "export pbshook <hook name> application/x-python default"  
<content-type> must be application/x-config
```


Debugging Hooks

8.1 The `pbs_python` Hook Debugging Tool

You can use the `pbs_python` wrapper that is shipped with PBS to debug hooks. Either:

- Use the `--hook` option to `pbs_python` to run `pbs_python` as a wrapper to Python, employing the `pbs_python` options. With the `--hook` option, you cannot use the standard Python options. The rest of this section covers how to use `pbs_python` with the `--hook` option.
- Do not use the `--hook` option, so `pbs_python` runs the Python interpreter, with the standard Python options, and without access to the `pbs_python` options.

Usage for `pbs_python`:

```
pbs_python --hook [-e <log event mask>] [-i <event input file>] [-L <log dir>] [-l <log file>] [-o <hook execution record>] [-r <resourcedef file>] [-s <site data file>] [<python script>]
```

For a complete description of `pbs_python`, see [“`pbs_python`” on page 83 of the PBS Professional Reference Guide](#).

8.2 Files for Debugging

You can get each hook to write out debugging files, and then modify the files and use them as debugging input to `pbs_python`. Alternatively, you can write the files yourself.

Debugging files can contain information about the event, about the site, and about what the hook changed. You can use these as inputs to a hook when debugging.

8.2.1 Producing Files for Debugging

To get a hook to write out event and site debugging files, and a hook execution record, set its `debug` attribute to `True` (the default is `False`). The files are named `hook_<event type>_<hook name>_<random integer>.in`, `.data`, and `.out`. The `<random integer>` is the same for all output files for one run of a hook. The `<random integer>` is different for each run.

The hook writes these files:

- *Event file*, containing the values that populate the `pbs.event()` objects in the hook and any other top level `pbs` objects like `pbs.get_local_nodename()`, and job and job list information. This file always contains the event type. The file is named `hook_<event type>_<hook name>_<random integer>.in`. Can be passed to `pbs_python` using `-i <event file>` option. See [section 8.2.5, “Event File”, on page 160](#).
- *Site data file*, containing the values that populate the `pbs.server()` objects: server, queue, vnode, etc. information. The site data file is named `hook_<event type>_<hook name>_<random integer>.data`. Can be passed to `pbs_python` using `-s <site data file>` option. This file is populated only when the hook calls `pbs.server()`. See [section 8.2.6, “Site Data File”, on page 164](#).
- *Hook execution record*, listing whether the hook accepted or rejected the event, and whatever was changed by the hook, named `hook_<event type>_<hook name>_<random integer>.out`. See [section 8.2.7, “Hook Execution Record File”, on page 164](#).

So for example an `execjob_begin` hook named *BeginHook* will produce files, if PBS chooses “15223” as its random integer, named `hook_execjob_begin_BeginHook_15223.in`, `hook_execjob_begin_BeginHook_15223.data`, and `hook_execjob_begin_BeginHook_15223.out`.

8.2.2 Locations for Debugging Files

These files are written to these locations:

- Pre-execution hooks: `PBS_HOME/server_priv/hooks/tmp`
- All `execest_*` and `execjob_*` hooks: `PBS_HOME/mom_priv/hooks/tmp`

8.2.3 Format for Debugging Files

File format for debugging files is text. For example:

```
pbs.event().job.Hold_Types=u
pbs.event().job.Job_Name=STDIN
pbs.event().job.Checkpoint=u
pbs.event().job.Join_Path=n
pbs.event().job.Keep_Files=n
pbs.event().job.Mail_Points=a
pbs.event().job.Priority=0
pbs.event().job.Rerunable=TRUE
pbs.event().job.Resource_List[ncpus]=5
pbs.event().job.Resource_List[mem]=2gb
pbs.get_local_nodename()=mars.example.com
pbs.event().type=queuejob
pbs.event().hook_name=qjob
pbs.event().hook_type=site
pbs.event().requestor=TestUser
pbs.event().requestor_host=mars.example.com
pbs.event().user=pbsadmin
pbs.event().alarm=30
```

8.2.4 Time Limit for Debugging Files

PBS deletes hook `.in`, `.data`, and `.out` files in `PBS_HOME/*/hooks/tmp` that are older than 20 minutes. If you need to keep any of these files, copy them to another location.

8.2.5 Event File

The event file must contain the event type, and can contain any relevant information about the triggering event, the current job, or list of jobs.

When the hook writes it, this file contains the values that populate the `pbs.event()` objects in the hook and any other top level `pbs` objects such as the local `vnode`, the `job`, and the list of jobs. When a hook writes this file, it includes `pbs.event().type` and the result of `get_local_nodename()`. Each kind of hook writes different additional `pbs.event()` information.

The file is named `hook_<event type>_<hook name>_<random integer>.in`. It can be passed to `pbs_python` using the `-i <event file>` option.

The following table shows which information is written to the event file by each kind of hook:

Table 8-1: Event File by Hook

Event Information Written by Hooks: pbs.event.<list item>	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	exechost_startup	exechost_periodic	provision
pbs.get_local_nodename()	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
alarm	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
argv[]											y								
env											y								
freq																		y	
hook_name	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
hook_type	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
job.Checkpoint									y	y	y	y	y	y	y				
job.egroup									y	y	y	y	y	y	y				
job.Error_Path									y	y	y	y	y	y	y				
job.euser									y	y	y	y	y	y	y				
job.exec_vnode									y	y	y	y	y	y	y				
job.Exit_Status												y	y	y					
job.id									y	y	y	y	y	y	y				
job.jobdir												y	y	y	y				
job.job_kill_delay									y	y	y	y	y	y	y				
job.Job_Name									y	y	y	y	y	y	y				
job.Job_Owner									y	y	y	y	y	y	y				
job.job_state										y	y	y	y	y	y				
job.Join_Path									y	y	y	y	y	y	y				
job.Keep_Files									y	y	y	y	y	y	y				
job.mtime									y	y	y	y	y	y	y				
job.Output_Path									y	y	y	y	y	y	y				
job.Priority										y	y	y	y	y	y				
job.project									y	y	y	y	y	y	y				
job.queue									y	y	y	y	y	y	y				
job.resources_used[cpupercent]												y	y	y	y				
job.resources_used[cpu]												y	y	y	y				
job.resources_used[mem]												y	y	y	y				
job.resources_used[ncpus]												y	y	y	y				
job.resources_used[vmem]												y	y	y		y			
job.resources_used[walltime]												y	y	y	y				
job.Resource_List[file]									y	y	y	y	y	y	y				
job.Resource_List[ncpus]									y	y	y	y	y	y	y				
job.Resource_List[place]									y	y	y	y	y	y	y				
job.run_count									y	y	y	y	y	y	y				
job.run_version									y	y	y	y	y	y	y				
job.schedselect									y	y	y	y	y	y	y				

Table 8-1: Event File by Hook

Event Information Written by Hooks: pbs.event.<list item>	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
job.server								y	y	y	y	y	y	y	y				
job.session_id												y	y	y	y				
job.substate									y	y	y	y	y	y	y				
job.Variable_List								y	y	y	y	y	y	y	y				
job_list[<job ID>].Checkpoint																		y	
job_list[<job ID>].egroup																		y	
job_list[<job ID>].Error_Path																		y	
job_list[<job ID>].euser																		y	
job_list[<job ID>].exec_vnode																		y	
job_list[<job ID>].hashname																		y	
job_list[<job ID>].jobdir																		y	
job_list[<job ID>].job_kill_delay																		y	
job_list[<job ID>].Job_Name																		y	
job_list[<job ID>].Job_Owner																		y	
job_list[<job ID>].job_state																		y	
job_list[<job ID>].Join_Path																		y	
job_list[<job ID>].Keep_Files																		y	
job_list[<job ID>].mtime																		y	
job_list[<job ID>].Output_Path																		y	
job_list[<job ID>].project																		y	
job_list[<job ID>].queue																		y	
job_list[<job ID>].resources_used[cpu-percent]																		y	
job_list[<job ID>].resources_used[cput]																		y	
job_list[<job ID>].resources_used[mem]																		y	
job_list[<job ID>].resources_used[ncpus]																		y	
job_list[<job ID>].resources_used[wall-time]																		y	
job_list[<job ID>].Resource_List[file]																		y	
job_list[<job ID>].Resource_List[ncpus]																		y	
job_list[<job ID>].Resource_List[place]																		y	
job_list[<job ID>].run_count																		y	
job_list[<job ID>].run_version																		y	
job_list[<job ID>].schedselect																		y	
job_list[<job ID>].server																		y	
job_list[<job ID>].session_id																		y	
job_list[<job ID>].substate																		y	
job_list[<job ID>].Variable_List																		y	
job_list[<job ID>]._msmom																		y	
job_list[<job ID>]._stderr_file																		y	
job_list[<job ID>]._stdout_file																		y	
progname											y								

Table 8-1: Event File by Hook

Event Information Written by Hooks: pbs.event.<list item>	queuejob	modifyjob (before run)	movejob	runjob (on reject)	runjob (on accept)	periodic	resvsub	resv_end	execjob_begin	execjob_prologue	execjob_launch	execjob_postsuspend	execjob_preresume	execjob_end	execjob_epilogue	execjob_preterm	execjob_startup	execjob_periodic	provision
requestor	y	y	y	y	y		y	y	y	y	y	y	y	y	y	y	y	y	
requestor_host	y	y	y	y	y		y	y	y	y	y	y	y	y	y	y	y	y	
resv.reserve_end							y	y											
resv.reserve_start							y	y											
resv.Variable_List							y	y											
type	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
user	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
vnode_list[<local vnode name>] .pbs_version									y	y	y	y	y	y	y	y		y	
vnode_list[<local vnode name>] .pcpus									y	y	y	y	y	y	y	y		y	
vnode_list[<local vnode name>] .resources_assigned[mem]									y	y	y	y	y	y	y	y			
vnode_list[<local vnode name>] .resources_assigned[ncpus]									y	y	y	y	y	y	y	y			
vnode_list[<local vnode name>] .resources_available[arch]									y	y	y	y	y	y	y	y		y	
vnode_list[<local vnode name>] .resources_available[file]																		y	
vnode_list[<local vnode name>] .resources_available[mem]									y	y	y	y	y	y	y	y	y	y	
vnode_list[<local vnode name>] .resources_available[ncpus]									y		y	y	y	y	y	y	y	y	

For example, an event file created by a queuejob hook contains this data:

```
pbs.get_local_nodename()=jupiter.example.com
pbs.event().type=queuejob
pbs.event().hook_name=qjob
pbs.event().hook_type=site
pbs.event().requestor=TestUser
pbs.event().requestor_host=jupiter.example.com
pbs.event().user=pbsadmin
pbs.event().alarm=30
```

The equivalent command is:

```
Qmgr: list hook
```

8.2.5.1 Caveats

When the execjob_epilogue or execjob_end hook writes resources such as resources_used to the event file, it is writing about only the resources on the local host.

8.2.6 Site Data File

The site data file can contain any relevant information about the server, queues, vnodes, and jobs at the server.

This file is populated only when the hook calls `pbs.server()`.

When the hook writes it, this file contains the values that populate the server, queues, vnodes, reservations, and jobs, with all attributes and resources for which there are values.

The site data file is named `hook_<event type>_<hook name>_<random integer>.data`. It can be passed to `pbs_python` using the `-s <site data file>` option.

The following commands give equivalent information:

```
qstat -Bf
qstat -Qf
qstat -f
pbsnodes -av
```

For example, here are some representative parts of a site data file:

```
pbs.server().scheduling=True
pbs.server().total_jobs=2
pbs.server().state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:0 Exiting:0 Begun:0
...
ppbs.server().default_chunk[ncpus]=1
pbs.server().resources_assigned[mem]=0mb
pbs.server().resources_assigned[ncpus]=0
...
pbs.server().job(501.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(501.jupiter.example.com).job_state=H
pbs.server().job(501.jupiter.example.com).queue=workq
...
pbs.server().job(501.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(501.jupiter.example.com).Resource_List[place]=pack
...
pbs.server().queue(workq).queue_type=Execution
pbs.server().queue(workq).total_jobs=2
pbs.server().queue(workq).resources_assigned[mem]=0mb
pbs.server().queue(workq).resources_assigned[ncpus]=0
```

8.2.7 Hook Execution Record File

The hook execution record file is produced when the hook runs. This file lists the following:

- Whether the event was accepted or rejected
- Any job values that were changed by the hook, showing the new values

This file is named `hook_<event type>_<hook name>_<random integer>.out`.

8.3 Steps to Debug a Hook Using `pbs_python`

When you debug a hook using `pbs_python`, give it the following information:

- Use the `--hook` option to `pbs_python` so that you can use the other `pbs_python` options
- Specify event information by using `-i <event file>`. At a minimum, include the type of the event, but you can also include job and job list information. Information about the event can be one of these:
 - An event information file (`.in`) written by the hook
 - A file written by you
 - Interactive input

See [section 8.2.5, “Event File”, on page 160](#).

- Optionally, provide site data. Site data includes data about the server, queues, vnodes, etc. You specify site data in a file by using `-s <site data file name>`. If you do not specify the `-s` option, `pbs_python` connects to the server and obtains live data about the site. See [section 8.2.6, “Site Data File”, on page 164](#). Site data can come from one of these sources:
 - A site data file (`.data`) written by the hook
 - A file written by you
 - Interactive input
 - Live data from the server
- If you have added any custom resources, specify the `PBS_HOME/server_priv/resourcedef` file with the `-r` option to `pbs_python`. Make sure you specify the whole path to the file. For example:

```
pbs_python --hook -r $PBS_HOME/server_priv/resourcedef -i <input_file> <hook.py>
```
- If your hook uses a configuration file, set the environment variable `PBS_HOOK_CONFIG_FILE` to the file's path-name before calling `pbs_python`. See [section 5.1.6, “Using Hook Configuration Files”, on page 32](#).
- Run `pbs_python` on the hook:

```
pbs_python --hook -s <site data> -i <event file> <hook script>
```

8.4 Caveats and Restrictions for `pbs_python`

- When you run a hook inside `pbs_python`, it has access to the extended set of `PBS_EXEC/python` modules listed in [section 4.5, “Python Modules and PBS”, on page 24](#). When you run `pbs_python` at the command line (without `--hook`), the hook does not have access to the `PBS_EXEC/lib` set of modules.
- If PBS has attempted to run a job multiple times in the 20 minute window, you may need to check the timestamp of hook debugging files (e.g. `ls -lt`) to figure out which files were produced during a particular hook run.
- The site data file is populated only when the hook calls `pbs.server()`.

8.5 Examples of Using `pbs_python` to Debug Hooks

Example 8-1: Basic periodic hook, with updates to vnodes:

- Input file:


```
% cat hook.input
pbs.event().type=exechoost_periodic
pbs.event().vnode_list["host1"].state=free
pbs.get_local_nodename()=host1
```
- Hook file:


```
$ cat test.py
import pbs

e = pbs.event()

pbs.event().vnode_list[pbs.get_local_nodename()].resources_available["ncpus"]=7
pbs.event().vnode_list[pbs.get_local_nodename()].resources_available["mem"]=pbs.size("7gb")
```
- Run:


```
$ pbs_python --hook -i hook.input test.py
pbs.event().accept=True
pbs.event().reject=False
pbs.event().vnode_list["host1"].resources_available[ncpus]=7
pbs.event().vnode_list["host1"].resources_available[mem]=7gb
```

Example 8-2: A queuejob hook:

- Input file:


```
$ cat qjob.input
pbs.event().hook_name=qjob
pbs.event().hook_type=site
pbs.event().type=queuejob
pbs.event().requestor=user1
pbs.event().requestor_host=host1
pbs.event().alarm=40
pbs.event().job.Job_Name=pact
pbs.event().job.Resource_List[ncpus]=1
pbs.event().job.Resource_List[mem]=1mb
```
- Hook file:


```
$ cat qjob.py
import pbs

e = pbs.event()

e.job.Priority = 7
e.job.Account_Name = "mammoth"
e.job.Resource_List["ncpus"] = 5
```

```
e.job.Resource_List["mem"] = pbs.size("5gb")
```

- Run:

```
% pbs_python --hook -i qjob.input qjob.py
pbs.event().accept=True
pbs.event().reject=False
pbs.event().job.Priority=7
pbs.event().job.Resource_List[ncpus]=5
pbs.event().job.Resource_List[mem]=5gb
pbs.event().job.Account_Name=mammoth
```

Example 8-3: Reservation hook:

- Input file:

```
% cat rsub.input
pbs.event().hook_name=qjob
pbs.event().hook_type=site
pbs.event().type=resvsub
pbs.event().requestor=user1
pbs.event().requestor_host=host1
pbs.event().alarm=40
pbs.event().resv.Reserve_Name=my_resv
pbs.event().resv.Resource_List[ncpus]=1
pbs.event().resv.Resource_List[mem]=1mb
```

- Hook file:

```
% cat rsub.py
import pbs

def print_attribs(pbs_obj):
    for a in pbs_obj.attributes:
        v = getattr(pbs_obj, a)
        if v and str(v) != "":
            pbs.logmsg(pbs.LOG_DEBUG, "%s = %s" % (a,v))

e = pbs.event()
r = e.resv

print_attribs(r)

r.Resource_List["select"] = pbs.select("1:ncpus=1:mem=5mb")
r.Resource_List["place"] = pbs.place("pack:shared")

# group_list = pbs.group_list
r.group_list = pbs.group_list("Everyone,Everyone@host2,group1@jobim")

# Mail_Points= pbs.mail_points
r.Mail_Points = pbs.mail_points("a")
```

```
# User_List = pbs.user_list
r.User_List = pbs.user_list("pbstest,pbstest@host2")

# Authorized_Users = pbs.acl
r.Authorized_Users = pbs.acl("pbstest,user1,Administrator")

# Authorized_Groups = pbs.acl
r.Authorized_Groups = pbs.acl("Everyone,group1,group2")
```

- Run:

```
% pbs_python --hook -i rsub.input rsub.py
pbs.event().accept=True
pbs.event().reject=False
pbs.event().resv.group_list=Everyone,Everyone@host2,group1@jobim
pbs.event().resv.User_List=pbstest,pbstest@host2
pbs.event().resv.Resource_List[select]=1:ncpus=1:mem=5mb
pbs.event().resv.Resource_List[place]=pack:shared
pbs.event().resv.Mail_Points=a
pbs.event().resv.Authorized_Users=pbstest,user1,Administrator
pbs.event().resv.Authorized_Groups=Everyone,group1,group2
```

Example 8-4: A modifyjob hook:

- Hook script:

```
$ cat modifyjob.py
```

```
import pbs

def print_attribs(pbs_obj):
    for a in pbs_obj.attributes:
        v = getattr(pbs_obj, a)
        if v and str(v) != "":
            pbs.logmsg(pbs.LOG_DEBUG, "%s = %s" % (a,v))

e = pbs.event()

pbs.logmsg(pbs.LOG_DEBUG, "-----> printing job %s" % (e.job_o.id))
print_attribs(e.job_o)
e.job.Priority = 5
e.job.Resource_List["file"] = pbs.size("7gb")
e.job.Variable_List["FILE"] = "7gb"
```

- Use the `pbs_python` debugging tool.

Ensure you have the following input file:

```
% cat hook.input
pbs.event().type=modifyjob
pbs.event().job.id=0.host1
pbs.event().job.Variable_List=A=b
```

- Run the hook:

```
% pbs_python --hook -i hook.input modifyjob.py
```

- The following are printed:

```
pbs.event().accept=True
pbs.event().reject=False
```

```
pbs.event().job.Variable_List=A=b,FILE=7gb
pbs.event().job.Priority=5
pbs.event().job.Resource_List[file]=7gb
```

- The pbs_python log file shows this:

```
% cat <yyyymmdd>
```

```
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;-----> printing job 0.host1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;qtime = 1357387083
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Error_Path =
host1.example.com:/home/user1/STDIN.e0
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;job_state = 1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;schedselect =1:ncpus=1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;ctime = 1357387083
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Rerunable = 1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;server = host1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;egroup = pbs
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Variable_List =A=b,FILE=7gb
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Checkpoint = u
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;etime = 1357387083
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;queue = workq
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Job_Name = STDIN
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;comment = Not Running:
Could not run job - nodes are not licensed or unable to obtain 1 cpu licenses. avail_licenses=0
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;substate = 10
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;queue_rank = 1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;euser = user1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Mail_Points = a
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Priority = 0
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;project = _pbs_project_default
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;queue_type = 1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Output_Path =
host1.example.com:/home/user1/STDIN.o0
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Hold_Types = n
```

```

01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Join_Path = n
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;mtime = 1357387083
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;id = 0.host1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Resource_List =
    select=1;ncpus=1,nodect=1,ncpus=1,place=free
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Keep_Files = n
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;_connect_server = host1
01/05/2013 07:50:41;0006;pbs_python;Hook;pbs_python;Job_Owner = user1@host1.example.com

```

Example 8-5: A movejob hook which prints job ID, src_queue, and movejob event parameters, and sets src_queue:

- Hook script:

```
$ cat movejob.py
```

```

import pbs

def print_attribs(pbs_obj):
    for a in pbs_obj.attributes:
        v = getattr(pbs_obj, a)
        if v and str(v) != "":
            pbs.logmsg(pbs.LOG_DEBUG, "%s = %s" % (a,v))

e = pbs.event()

pbs.logmsg(pbs.LOG_DEBUG, "-----> printing src_queue %s" % (e.src_queue.name))
print_attribs(e.src_queue)
pbs.logmsg(pbs.LOG_DEBUG, "-----> printing job %s" % (e.job.id))
print_attribs(e.job)
e.job.queue = pbs.server().queue("workq2")

```

- Use the pbs_python debugging tool:

Use the following input file:

```

% cat hook.input2
pbs.event().type=movejob
pbs.event().job.id=<existing-job-id>

```

where <existing-job-id> must be some arbitrary job currently existing in the queue *workq*. Submit one (`qsub -h`) if it doesn't exist.

- Run the hook:

```
% pbs_python --hook -i hook.input2 movejob.py
```

- The following is printed:

```
pbs.event().accept=True
pbs.event().reject=False
pbs.event().src_queue=workq2
```

- The `pbs_python` log file shows this:

```
% cat <yyyymmdd>
```

```
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;-----> printing
src_queue workq
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;name = workq
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;-----> printing
job 0.host1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;qtime = 1357387083
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Error_Path = host1.example.com:/home/user1/
STDIN.e0
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;job_state = 1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;ctime = 1357387083
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Rerunable = 1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;server = host1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Variable_List =
PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/
user1,PBS_O_HOST=host1.example.com,PBS_O_LOGNAME=user1,PBS_O_WORKDIR=/home/
user1,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/opt/pbs/bin:/opt/pbs/python/bin:/opt/pbs/tcltk/
bin:/home/user1/bin:/opt/pbs/bin:/opt/pbs/python/bin:/opt/pbs/tcltk/bin:/home/user1/bin:/
usr/local/bin:/bin:/usr/bin:/usr/X11R6/bin:/home/user1/bin:/usr/local/rational/releases/
purify.i386_linux2.2003a.06.15.FixPack.0194:/usr/local/purify/base/cots/flexlm.10.8.0.1/
i386_linux2:/home/user1/PbsTestLab/bin:/home/user1/bin:/home/user1/bin:/usr/local/rational/
releases/purify.i386_linux2.2003a.06.15.FixPack.0194:/usr/local/purify/base/cots/
flexlm.10.8.0.1/i386_linux2:/home/user1/PbsTestLab/bin,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/
spool/mail/user1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Checkpoint = u
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;etime = 1357387083
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Job_Name = STDIN
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;comment = Not Running:
Could not run job - nodes are not licensed or unable to obtain 1 cpu licenses. avail_licenses=0
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;substate = 10
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Mail_Points = a
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Priority = 0
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;project = _pbs_project_default
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Output_Path =
host1.example.com:/home/user1/STDIN.o0
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Hold_Types = n
```

```

01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Join_Path = n
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;mtime = 1357387083
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;id = 0.host1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Resource_List =
select=1;ncpus=1,nodect=1,ncpus=1,place=free
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Keep_Files = n
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;_connect_server = host1
01/05/2013 11:23:36;0006;pbs_python;Hook;pbs_python;Job_Owner =
user1@host1.example.com

```

Example 8-6: A runjob hook to print attributes:

- Hook script:

```
$ cat runjob.py
```

```

import pbs
import time

def print_attribs(pbs_obj):
    for a in pbs_obj.attributes:
        v = getattr(pbs_obj, a)
        if v and str(v) != "":
            pbs.logmsg(pbs.LOG_DEBUG, "%s = %s" % (a,v))

e = pbs.event()

pbs.logmsg(pbs.LOG_DEBUG, "-----> printing job %s" % (e.job.id))
print_attribs(e.job)
e.job.Hold_Types = pbs.hold_types("us")
e.job.Execution_Time = time.mktime([15, 11, 28, 14, 10, 15, -1, -1, 01])
e.job.project="looper"

pbs.event().reject("not allowed to run at this time!")

```

- Use the following input file:

```

% cat hook.input3
pbs.event().type=runjob
pbs.event().job.id=<existing-job-id>

```

where *<existing-job-id>* must be some arbitrary job currently existing in the server. Submit one (`qsub -h`) if it doesn't exist.

- Run the hook:

```
# pbs_python --hook -i hook.input3 runjob.py
```

- The execution record contains the following:

```
pbs.event().reject=True
pbs.event().accept=False
pbs.event().reject_msg=not allowed to run at this time!
pbs.event().job.Execution_Time=1448745015
pbs.event().job.Hold_Types=us
pbs.event().job.project=looper
```

- The `pbs_python` log file shows:

```
% cat <yyyyymmdd>
```

```
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;-----> printing
job 5.host1
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;qtime = 1357424154
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Error_Path =
host1.example.com:/home/user1/bugs/sp260361/STDIN.e5
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;job_state = 2
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;ctime = 1357424154
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Rerunable = 1
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;server = host1
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Variable_List =
PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/
user1,PBS_O_HOST=host1.example.com,PBS_O_LOGNAME=user1,PBS_O_WORKDIR=/home/user1/bugs/
sp260361,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/opt/pbs/bin:/opt/pbs/python/bin:/opt/pbs/tcltk/
bin:/home/user1/bin:/opt/pbs/bin:/opt/pbs/python/bin:/opt/pbs/tcltk/bin:/home/user1/bin:/
usr/local/bin:/bin:/usr/bin:/usr/X11R6/bin:/home/user1/bin:/usr/local/rational/releases/
purify.i386_linux2.2003a.06.15.FixPack.0194:/usr/local/purify/base/cots/flexlm.10.8.0.1/
i386_linux2:/home/user1/PbsTestLab/bin:/home/user1/bin:/home/user1/bin:/usr/local/rational/
releases/purify.i386_linux2.2003a.06.15.FixPack.0194:/usr/local/purify/base/cots/
flexlm.10.8.0.1/i386_linux2:/home/user1/PbsTestLab/bin,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/
spool/mail/user1
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Checkpoint = u
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Submit_arguments =
<jsdl-hpcpa:Argument>-h</jsdl-hpcpa:Argument>
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;queue = workq
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Job_Name = STDIN
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;substate = 20
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Mail_Points = a
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Priority = 0
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;project = _pbs_project_default
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Output_Path =
host1.example.com:/home/user1/bugs/sp260361/STDIN.o5
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Hold_Types = u
```

```

01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Join_Path = n
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;mtime = 1357424154
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;id = 5.host1
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Resource_List =
select=1;ncpus=1,nodect=1,ncpus=1,place=pack
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Keep_Files = n
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;_connect_server = host1
01/05/2013 14:49:39;0006;pbs_python;Hook;pbs_python;Job_Owner =
user1@host1.example.com

```

8.6 Using Log Messages to Debug Hook Scripts

The following steps may help you avoid errors in hook scripts:

1. Create a hook, and import its content.
2. Temporarily set the server's `log_events` to a higher value such as `2047` to see plenty of logging.
3. Do a test run of the hook script, by causing events (e.g. `qsub`, `qalter`, `qmove`, `pbs_rsub`) that invoke the hook script. Check for error messages in the server logs.
4. Correct the hook script, re-import the fixed code, and rerun the test.
5. Once the hook script is running fine, then set the server's `log_events` back to the default (i.e. `511`).

8.7 Checking Hook Syntax using Python

You can check hook syntax using Python. If you run Python on the hook, the hook cannot import the `pbs` module. If the first error you see is a failure to import the `pbs` module, Python did not find any syntax errors.

8.8 Examples of Debugging Files

Example 8-7: We show several hooks and their debugging files. Our example hooks are `queuejob`, `exechost_startup`, `exechost_periodic`, `execjob_begin`, and `execjob_launch`.

Given the following two jobs in the system:

```

TestUser@jupiter:~/jobs> qstat
Job id          Name          User          Time Use S Queue
-----
501.jupiter    STDIN         TestUser      0 H workq
502.jupiter    STDIN         TestUser      0 H workq

```

Given the following reservations:

```

TestUser@jupiter:~/jobs> pbs_rstat
Resv ID  Queue  User      State          Start / Duration / End
-----
R503.jupiter. R503  TestUser@ CO  Today 08:00 / 1800 / Today 08:30
R504.jupiter. R504  TestUser@ CO  Today 09:00 / 1800 / Today 09:30

```

Given the following set of vnodes:

```
TestUser@jupiter:~/jobs> pbsnodes -av
jupiter
  Mom = jupiter.example.com
  Port = 15002
  pbs_version = PBSPro_10.0
  ntype = PBS
  state = free
  pcpus = 1
  resv = R504.jupiter.example.com, R503.jupiter.example.com
  resources_available.arch = linux
  resources_available.host = jupiter
  resources_available.mem = 8gb
  resources_available.ncpus = 8
  resources_available.vnode = jupiter
  resources_assigned.accelerator_memory = 0kb
  resources_assigned.mem = 0kb
  resources_assigned.naccelerators = 0
  resources_assigned.ncpus = 0
  resources_assigned.vmem = 0kb
  resv_enable = True
  sharing = default_shared
mars
  Mom = mars.example.com
  Port = 15002
  pbs_version = PBSPro_10.0
  ntype = PBS
  state = free
  pcpus = 1
  resources_available.arch = linux
  resources_available.host = mars
  resources_available.mem = 8gb
  resources_available.ncpus = 8
  resources_available.vnode = mars
  resources_assigned.accelerator_memory = 0kb
  resources_assigned.mem = 0kb
  resources_assigned.naccelerators = 0
  resources_assigned.ncpus = 0
  resources_assigned.vmem = 0kb
  resv_enable = True
  sharing = default_shared
```

queuejob hook attributes:

```
Hook qjob
  type = site
  enabled = true
  event = queuejob
  user = pbsadmin
  alarm = 30
  order = 1
  debug = true
  fail_action = none
```

queuejob hook contents:

```
import pbs
e=pbs.event()

e.job.Priority=7
e.job.Resource_List["file"] = pbs.size("7gb")

s=pbs.server()
for j in s.jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "got j %s" % (j.id,))

for q in s.queues():
    pbs.logmsg(pbs.LOG_DEBUG, "got q %s" % (q.name,))

for v in s.vnodes():
    pbs.logmsg(pbs.LOG_DEBUG, "got vnode %s" % (v.name,))

for r in s.resvs():
    pbs.logmsg(pbs.LOG_DEBUG, "got resv %s" % (r.resvid))
```

Submit the job:

```
% qsub job.scr
```

Here are the resulting *.in, *.data, and *.out files:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # ls -ltr /var/spool/PBS/server_priv/hooks/tmp
-rw-r--r-- 1 root root 241 Sep 17 03:54 hook_queuejob_qjob_1410940476.in
-rw-r--r-- 1 root root 18619 Sep 17 03:54 hook_queuejob_qjob_1410940476.data
-rw-r--r-- 1 root root 805 Sep 17 03:54 hook_queuejob_qjob_1410940476.out
```

List the queuejob hook event file:

```
jupiter:/var/spool/PBS/server_priv/hooks/tmp # cat hook_queuejob_qjob_1410940476.in
pbs.get_local_nodename()=jupiter.example.com
pbs.event().type=queuejob
pbs.event().hook_name=qjob
pbs.event().hook_type=site
pbs.event().requestor=TestUser
pbs.event().requestor_host=jupiter.example.com
pbs.event().user=pbsadmin
pbs.event().alarm=30
```

List the queuejob hook site data file:

```
jupiter:/var/spool/PBS/server_priv/hooks/tmp # cat hook_queuejob_qjob_1410940476.data
pbs.server().server_state=Active
pbs.server().server_host=jupiter.example.com
pbs.server().scheduling=True
pbs.server().total_jobs=2
pbs.server().state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:0 Exiting:0 Begun:0
pbs.server().managers=TestUser@*
pbs.server().default_queue=workq
pbs.server().log_events=511
pbs.server().mail_from=adm
pbs.server().query_other_jobs=True
pbs.server().resources_default[ncpus]=1
pbs.server().default_chunk[ncpus]=1
pbs.server().resources_assigned[mem]=0mb
pbs.server().resources_assigned[ncpus]=0
pbs.server().resources_assigned[nodect]=0
pbs.server().scheduler_iteration=600
pbs.server().flatuid=True
pbs.server().FLlicenses=32
pbs.server().resv_enable=True
pbs.server().node_fail_requeue=310
pbs.server().max_array_size=10000
pbs.server().pbs_license_min=1
pbs.server().pbs_license_max=2147483647
pbs.server().pbs_license_linger_time=3600
pbs.server().license_count=Avail_Global:0 Avail_Local:32 Used:0 High_Use:2
pbs.server().pbs_version=PBSPro_10.0
pbs.server().eligible_time_enable=False
pbs.server().max_concurrent_provision=5
pbs.server().job(501.jupiter.example.com).Job_Name=STDIN
pbs.server().job(501.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(501.jupiter.example.com).job_state=H
pbs.server().job(501.jupiter.example.com).queue=workq
pbs.server().job(501.jupiter.example.com).server=jupiter.example.com
pbs.server().job(501.jupiter.example.com).Checkpoint=u
pbs.server().job(501.jupiter.example.com).ctime=1410940219
pbs.server().job(501.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e501
pbs.server().job(501.jupiter.example.com).Hold_Types=u
pbs.server().job(501.jupiter.example.com).Join_Path=n
pbs.server().job(501.jupiter.example.com).Keep_Files=n
pbs.server().job(501.jupiter.example.com).Mail_Points=a
pbs.server().job(501.jupiter.example.com).mtime=1410940219
pbs.server().job(501.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o501
```

```

pbs.server().job(501.jupiter.example.com).Priority=7
pbs.server().job(501.jupiter.example.com).qtime=1410940219
pbs.server().job(501.jupiter.example.com).Rerunable=True
pbs.server().job(501.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(501.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(501.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(501.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(501.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(501.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(501.jupiter.example.com).substate=20
pbs.server().job(501.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(501.jupiter.example.com).euser=TestUser
pbs.server().job(501.jupiter.example.com).egroup=users
pbs.server().job(501.jupiter.example.com).hop_count=1
pbs.server().job(501.jupiter.example.com).queue_rank=185
pbs.server().job(501.jupiter.example.com).queue_type=E
pbs.server().job(501.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(501.jupiter.example.com).project=_pbs_project_default
pbs.server().queue(workq).queue_type=Execution
pbs.server().queue(workq).total_jobs=2
pbs.server().queue(workq).state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(workq).resources_assigned[mem]=0mb
pbs.server().queue(workq).resources_assigned[ncpus]=0
pbs.server().queue(workq).resources_assigned[nodect]=0
pbs.server().queue(workq).enabled=True
pbs.server().queue(workq).started=True
pbs.server().job(502.jupiter.example.com).Job_Name=STDIN
pbs.server().job(502.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(502.jupiter.example.com).job_state=H
pbs.server().job(502.jupiter.example.com).queue=workq
pbs.server().job(502.jupiter.example.com).server=jupiter.example.com
pbs.server().job(502.jupiter.example.com).Checkpoint=u
pbs.server().job(502.jupiter.example.com).ctime=1410940221
pbs.server().job(502.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.e502
pbs.server().job(502.jupiter.example.com).Hold_Types=u
pbs.server().job(502.jupiter.example.com).Join_Path=n
pbs.server().job(502.jupiter.example.com).Keep_Files=n
pbs.server().job(502.jupiter.example.com).Mail_Points=a
pbs.server().job(502.jupiter.example.com).mtime=1410940221

```

```

pbs.server().job(502.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o502
pbs.server().job(502.jupiter.example.com).Priority=7
pbs.server().job(502.jupiter.example.com).qtime=1410940223
pbs.server().job(502.jupiter.example.com).Rerunable=True
pbs.server().job(502.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(502.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(502.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(502.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(502.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(502.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(502.jupiter.example.com).substate=20
pbs.server().job(502.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(502.jupiter.example.com).euser=TestUser
pbs.server().job(502.jupiter.example.com).egroup=users
pbs.server().job(502.jupiter.example.com).hop_count=1
pbs.server().job(502.jupiter.example.com).queue_rank=186
pbs.server().job(502.jupiter.example.com).queue_type=E
pbs.server().job(502.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
hpcpa:Argument>
pbs.server().job(502.jupiter.example.com).project=_pbs_project_default
pbs.server().queue(R503).queue_type=Execution
pbs.server().queue(R503).total_jobs=0
pbs.server().queue(R503).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
Begun:0
pbs.server().queue(R503).acl_user_enable=True
pbs.server().queue(R503).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R503).resources_max[ncpus]=1
pbs.server().queue(R503).resources_max[walltime]=00:30:00
pbs.server().queue(R503).resources_available[ncpus]=1
pbs.server().queue(R503).resources_available[walltime]=00:30:00
pbs.server().queue(R503).enabled=True
pbs.server().queue(R503).started=False
pbs.server().queue(R504).queue_type=Execution
pbs.server().queue(R504).total_jobs=0
pbs.server().queue(R504).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
Begun:0
pbs.server().queue(R504).acl_user_enable=True
pbs.server().queue(R504).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R504).resources_max[ncpus]=1
pbs.server().queue(R504).resources_max[walltime]=00:30:00
pbs.server().queue(R504).resources_available[ncpus]=1

```

```

pbs.server().queue(R504).resources_available[walltime]=00:30:00
pbs.server().queue(R504).enabled=True
pbs.server().queue(R504).started=False
pbs.server().vnode(jupiter).Mom=jupiter.example.com
pbs.server().vnode(jupiter).Port=15002
pbs.server().vnode(jupiter).pbs_version=PBSPPro_10.0
pbs.server().vnode(jupiter).pcpus=1
pbs.server().vnode(jupiter).resv=R504.jupiter.example.com, R503.jupiter.example.com
pbs.server().vnode(jupiter).resources_available[arch]=linux
pbs.server().vnode(jupiter).resources_available[host]=jupiter
pbs.server().vnode(jupiter).resources_available[mem]=8gb
pbs.server().vnode(jupiter).resources_available[ncpus]=8
pbs.server().vnode(jupiter).resources_available[vnode]=jupiter
pbs.server().vnode(jupiter).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(jupiter).resources_assigned[mem]=0kb
pbs.server().vnode(jupiter).resources_assigned[naccelerators]=0
pbs.server().vnode(jupiter).resources_assigned[ncpus]=0
pbs.server().vnode(jupiter).resources_assigned[vmem]=0kb
pbs.server().vnode(jupiter).resv_enable=True
pbs.server().vnode(jupiter).sharing=1
pbs.server().resv(R503.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R503.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).reserve_type=2
pbs.server().resv(R503.jupiter.example.com).reserve_state=2
pbs.server().resv(R503.jupiter.example.com).reserve_substate=2
pbs.server().resv(R503.jupiter.example.com).reserve_start=1410955200
pbs.server().resv(R503.jupiter.example.com).reserve_end=1410957000
pbs.server().resv(R503.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R503.jupiter.example.com).queue=R503
pbs.server().resv(R503.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R503.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R503.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R503.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).ctime=1410940237
pbs.server().resv(R503.jupiter.example.com).mtime=1410940237
pbs.server().resv(R503.jupiter.example.com).hop_count=1
pbs.server().resv(R503.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R503.jupiter.example.com).euser=TestUser
pbs.server().resv(R503.jupiter.example.com).egroup=users
pbs.server().resv(R504.jupiter.example.com).Reserve_Name=NULL

```

```

pbs.server().resv(R504.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).reserve_type=2
pbs.server().resv(R504.jupiter.example.com).reserve_state=2
pbs.server().resv(R504.jupiter.example.com).reserve_substate=2
pbs.server().resv(R504.jupiter.example.com).reserve_start=1410958800
pbs.server().resv(R504.jupiter.example.com).reserve_end=1410960600
pbs.server().resv(R504.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R504.jupiter.example.com).queue=R504
pbs.server().resv(R504.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R504.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R504.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R504.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).ctime=1410940250
pbs.server().resv(R504.jupiter.example.com).mtime=1410940250
pbs.server().resv(R504.jupiter.example.com).hop_count=1
pbs.server().resv(R504.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R504.jupiter.example.com).euser=TestUser
pbs.server().resv(R504.jupiter.example.com).egroup=users

```

List the queuejob hook execution record file:

```

jupiter:/var/spool/PBS/server_priv/hooks/tmp # cat hook_queuejob_qjob_1410940476.out
pbs.event().job.Rerunnable=1
pbs.event().job.Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.event().job.Checkpoint=u
pbs.event().job.Submit_arguments=<jSDL-hpcpa:Argument>job.scr</jSDL-hpcpa:Argument>
pbs.event().job.Job_Name=job.scr
pbs.event().job.Mail_Points=a
pbs.event().job.Priority=7
pbs.event().job.Hold_Types=n
pbs.event().job.Join_Path=n
pbs.event().job.Resource_List[file]=7gb
pbs.event().job.Keep_Files=n

```

The `exechoost_startup` hook attributes:

```
Hook start
  type = site
  enabled = true
  event = exechoost_startup
  user = pbsadmin
  alarm = 30
  order = 1
  debug = true
  fail_action = none
```

The `exechoost_startup` hook contents:

```
import pbs
e=pbs.event()

e.vnode_list[pbs.get_local_nodename()].resources_available["file"] = pbs.size("7gb")

s=pbs.server()
for j in s.jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "got j %s" % (j.id,))

for q in s.queues():
    pbs.logmsg(pbs.LOG_DEBUG, "got q %s" % (q.name,))

for v in s.vnodes():
    pbs.logmsg(pbs.LOG_DEBUG, "got vnode %s" % (v.name,))

for r in s.resvs():
    pbs.logmsg(pbs.LOG_DEBUG, "got resv %s" % (r.resvid))
```

Restart `pbs_mom`. Upon startup, the `exechoost_startup` hook writes the following files:

```
jupiter:/home/TestUser/jobs # cd /var/spool/PBS/mom_priv/hooks/tmp
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # ls -ltr
total 24
-rw-r--r-- 1 root root 455 Sep 17 04:02 hook_exechoost_startup_start_11607.in
-rw-r--r-- 1 root root 115 Sep 17 04:02 hook_exechoost_startup_start_11607.out
-rw-r--r-- 1 root root 12389 Sep 17 04:02 hook_exechoost_startup_start_11607.data
```

List the `exehost_startup` hook event file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_exehost_startup_start_11607.in
pbs.event().vnode_list["jupiter"].resources_available[mem]=757388kb
pbs.event().vnode_list["jupiter"].resources_available[ncpus]=1
pbs.get_local_nodename()=jupiter
pbs.event().type=exehost_startup
pbs.event().hook_name=start
pbs.event().hook_type=site
pbs.event().requestor=pbs_mom
pbs.event().requestor_host=jupiter.example.com
pbs.event().user=pbsadmin
pbs.event().alarm=30
```


List the `exechost_startup` hook site data file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_exechost_startup_start_11607.data
pbs.server().server_state=Active
pbs.server().server_host=jupiter.example.com
pbs.server().scheduling=True
pbs.server().total_jobs=2
pbs.server().state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:0 Exiting:0 Begun:0
pbs.server().managers=TestUser@*
pbs.server().default_queue=workq
pbs.server().log_events=511
pbs.server().mail_from=adm
pbs.server().query_other_jobs=True
pbs.server().resources_default[ncpus]=1
pbs.server().default_chunk[ncpus]=1
pbs.server().resources_assigned[mem]=0mb
pbs.server().resources_assigned[ncpus]=0
pbs.server().resources_assigned[nodect]=0
pbs.server().scheduler_iteration=600
pbs.server().flatuid=True
pbs.server().FLlicenses=32
pbs.server().resv_enable=True
pbs.server().node_fail_requeue=310
pbs.server().max_array_size=10000
pbs.server().pbs_license_min=1
pbs.server().pbs_license_max=2147483647
pbs.server().pbs_license_linger_time=3600
pbs.server().license_count=Avail_Global:0 Avail_Local:32 Used:0 High_Use:2
pbs.server().pbs_version=PBSPRO_10.0
pbs.server().eligible_time_enable=False
pbs.server().max_concurrent_provision=5
pbs.server().job(501.jupiter.example.com).Job_Name=STDIN
pbs.server().job(501.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(501.jupiter.example.com).job_state=H
pbs.server().job(501.jupiter.example.com).queue=workq
pbs.server().job(501.jupiter.example.com).server=jupiter.example.com
pbs.server().job(501.jupiter.example.com).Checkpoint=u
pbs.server().job(501.jupiter.example.com).ctime=1410940219
pbs.server().job(501.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e501
pbs.server().job(501.jupiter.example.com).Hold_Types=u
pbs.server().job(501.jupiter.example.com).Join_Path=n
pbs.server().job(501.jupiter.example.com).Keep_Files=n
pbs.server().job(501.jupiter.example.com).Mail_Points=a
pbs.server().job(501.jupiter.example.com).mtime=1410940219
pbs.server().job(501.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o501
```

```

pbs.server().job(501.jupiter.example.com).Priority=7
pbs.server().job(501.jupiter.example.com).qtime=1410940219
pbs.server().job(501.jupiter.example.com).Rerunable=True
pbs.server().job(501.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(501.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(501.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(501.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(501.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(501.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(501.jupiter.example.com).substate=20
pbs.server().job(501.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(501.jupiter.example.com).euser=TestUser
pbs.server().job(501.jupiter.example.com).egroup=users
pbs.server().job(501.jupiter.example.com).queue_rank=185
pbs.server().job(501.jupiter.example.com).queue_type=E
pbs.server().job(501.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(501.jupiter.example.com).project=_pbs_project_default
pbs.server().job(502.jupiter.example.com).Job_Name=STDIN
pbs.server().job(502.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(502.jupiter.example.com).job_state=H
pbs.server().job(502.jupiter.example.com).queue=workq
pbs.server().job(502.jupiter.example.com).server=jupiter.example.com
pbs.server().job(502.jupiter.example.com).Checkpoint=u
pbs.server().job(502.jupiter.example.com).ctime=1410940221
pbs.server().job(502.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.e502
pbs.server().job(502.jupiter.example.com).Hold_Types=u
pbs.server().job(502.jupiter.example.com).Join_Path=n
pbs.server().job(502.jupiter.example.com).Keep_Files=n
pbs.server().job(502.jupiter.example.com).Mail_Points=a
pbs.server().job(502.jupiter.example.com).mtime=1410940221
pbs.server().job(502.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.o502
pbs.server().job(502.jupiter.example.com).Priority=7
pbs.server().job(502.jupiter.example.com).qtime=1410940223
pbs.server().job(502.jupiter.example.com).Rerunable=True
pbs.server().job(502.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(502.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(502.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(502.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(502.jupiter.example.com).Resource_List[select]=1:ncpus=1

```

```

pbs.server().job(502.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(502.jupiter.example.com).substate=20
pbs.server().job(502.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(502.jupiter.example.com).euser=TestUser
pbs.server().job(502.jupiter.example.com).egroup=users
pbs.server().job(502.jupiter.example.com).queue_rank=186
pbs.server().job(502.jupiter.example.com).queue_type=E
pbs.server().job(502.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(502.jupiter.example.com).project=_pbs_project_default
pbs.server().queue(workq).queue_type=Execution
pbs.server().queue(workq).total_jobs=2
pbs.server().queue(workq).state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(workq).resources_assigned[mem]=0mb
pbs.server().queue(workq).resources_assigned[ncpus]=0
pbs.server().queue(workq).resources_assigned[nodect]=0
pbs.server().queue(workq).enabled=True
pbs.server().queue(workq).started=True
pbs.server().queue(R503).queue_type=Execution
pbs.server().queue(R503).total_jobs=0
pbs.server().queue(R503).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(R503).acl_user_enable=True
pbs.server().queue(R503).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R503).resources_max[ncpus]=1
pbs.server().queue(R503).resources_max[walltime]=00:30:00
pbs.server().queue(R503).resources_available[ncpus]=1
pbs.server().queue(R503).resources_available[walltime]=00:30:00
pbs.server().queue(R503).enabled=True
pbs.server().queue(R503).started=False
pbs.server().queue(R504).queue_type=Execution
pbs.server().queue(R504).total_jobs=0
pbs.server().queue(R504).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(R504).acl_user_enable=True
pbs.server().queue(R504).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R504).resources_max[ncpus]=1
pbs.server().queue(R504).resources_max[walltime]=00:30:00
pbs.server().queue(R504).resources_available[ncpus]=1
pbs.server().queue(R504).resources_available[walltime]=00:30:00
pbs.server().queue(R504).enabled=True

```

```
pbs.server().queue(R504).started=False
pbs.server().vnode(jupiter).Mom=jupiter.example.com
pbs.server().vnode(jupiter).Port=15002
pbs.server().vnode(jupiter).pbs_version=PBSPPro_10.0
pbs.server().vnode(jupiter).ntype=0
pbs.server().vnode(jupiter).state=0
pbs.server().vnode(jupiter).pcpus=1
pbs.server().vnode(jupiter).resv=R504.jupiter.example.com, R503.jupiter.example.com
pbs.server().vnode(jupiter).resources_available[arch]=linux
pbs.server().vnode(jupiter).resources_available[host]=jupiter
pbs.server().vnode(jupiter).resources_available[mem]=8gb
pbs.server().vnode(jupiter).resources_available[ncpus]=8
pbs.server().vnode(jupiter).resources_available[vnode]=jupiter
pbs.server().vnode(jupiter).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(jupiter).resources_assigned[mem]=0kb
pbs.server().vnode(jupiter).resources_assigned[naccelerators]=0
pbs.server().vnode(jupiter).resources_assigned[ncpus]=0
pbs.server().vnode(jupiter).resources_assigned[vmem]=0kb
pbs.server().vnode(jupiter).resv_enable=True
pbs.server().vnode(jupiter).sharing=1
pbs.server().vnode(mars).Mom=mars.example.com
pbs.server().vnode(mars).Port=15002
pbs.server().vnode(mars).pbs_version=PBSPPro_10.0
pbs.server().vnode(mars).ntype=0
pbs.server().vnode(mars).state=0
pbs.server().vnode(mars).pcpus=1
pbs.server().vnode(mars).resources_available[arch]=linux
pbs.server().vnode(mars).resources_available[host]=mars
pbs.server().vnode(mars).resources_available[mem]=8gb
pbs.server().vnode(mars).resources_available[ncpus]=8
pbs.server().vnode(mars).resources_available[vnode]=mars
pbs.server().vnode(mars).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(mars).resources_assigned[mem]=0kb
pbs.server().vnode(mars).resources_assigned[naccelerators]=0
pbs.server().vnode(mars).resources_assigned[ncpus]=0
pbs.server().vnode(mars).resources_assigned[vmem]=0kb
pbs.server().vnode(mars).resv_enable=True
pbs.server().vnode(mars).sharing=1
pbs.server().resv(R503.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R503.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).reserve_type=2
pbs.server().resv(R503.jupiter.example.com).reserve_state=2
pbs.server().resv(R503.jupiter.example.com).reserve_substate=2
pbs.server().resv(R503.jupiter.example.com).reserve_start=1410955200
pbs.server().resv(R503.jupiter.example.com).reserve_end=1410957000
pbs.server().resv(R503.jupiter.example.com).reserve_duration=1800
```

```

pbs.server().resv(R503.jupiter.example.com).queue=R503
pbs.server().resv(R503.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R503.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R503.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R503.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).ctime=1410940237
pbs.server().resv(R503.jupiter.example.com).mtime=1410940237
pbs.server().resv(R503.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R503.jupiter.example.com).euser=TestUser
pbs.server().resv(R503.jupiter.example.com).egroup=users
pbs.server().resv(R504.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R504.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).reserve_type=2
pbs.server().resv(R504.jupiter.example.com).reserve_state=2
pbs.server().resv(R504.jupiter.example.com).reserve_substate=2
pbs.server().resv(R504.jupiter.example.com).reserve_start=1410958800
pbs.server().resv(R504.jupiter.example.com).reserve_end=1410960600
pbs.server().resv(R504.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R504.jupiter.example.com).queue=R504
pbs.server().resv(R504.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R504.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R504.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R504.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).ctime=1410940250
pbs.server().resv(R504.jupiter.example.com).mtime=1410940250
pbs.server().resv(R504.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R504.jupiter.example.com).euser=TestUser
pbs.server().resv(R504.jupiter.example.com).egroup=users

```

List the `execheap_start` hook execution record file:

```

jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_execheap_start_11607.out
pbs.event().accept=True
pbs.event().reject=False
pbs.event().vnode_list["jupiter"].resources_available[file,size]=7gb

```

The `exechoost_periodic` hook attributes:

```
Hook period
  type = site
  enabled = true
  event = exechoost_periodic
  user = pbsadmin
  alarm = 30
  freq = 30
  order = 1
  debug = true
  fail_action = none
```

The contents of the `exechoost_periodic` hook:

```
jupiter:/home/TestUser/jobs # qmgr -c "e h period application/x-python default"
import pbs
e=pbs.event()

e.vnode_list[pbs.get_local_nodename()].resources_available["file"] = pbs.size("7gb")

s=pbs.server()
for j in s.jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "got j %s" % (j.id,))

for q in s.queues():
    pbs.logmsg(pbs.LOG_DEBUG, "got q %s" % (q.name,))

for v in s.vnodes():
    pbs.logmsg(pbs.LOG_DEBUG, "got vnode %s" % (v.name,))

for r in s.resvs():
    pbs.logmsg(pbs.LOG_DEBUG, "got resv %s" % (r.resvid))
```

In our example, we have two jobs running on the execution host:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # qstat
Job id      Name      User      Time Use  S Queue
-----
501.jupiter  STDIN    TestUser  0         H workq
502.jupiter  STDIN    TestUser  0         H workq
506.jupiter  STDIN    TestUser  00:00:00 R workq
507.jupiter  STDIN    TestUser  00:00:00 R workq
```

The `*.in`, `*.out`, and `*.data` files end up here:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # ls -ltr
-rw-r--r-- 1 root root 6885 Sep 17 04:09 hook_exechoost_periodic_period_11753.in
-rw-r--r-- 1 root root 1387 Sep 17 04:09 hook_exechoost_periodic_period_11753.out
-rw-r--r-- 1 root root 19039 Sep 17 04:09 hook_exechoost_periodic_period_11753.data
```


List the `exechost_periodic` event file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_exechost_periodic_period_11753.in
pbs.event().freq=30
pbs.event().vnode_list["jupiter"].pcpus=1
pbs.event().vnode_list["jupiter"].resources_available[ncpus]=1
pbs.event().vnode_list["jupiter"].resources_available[mem]=757388kb
pbs.event().vnode_list["jupiter"].resources_available[arch]=linux
pbs.event().vnode_list["jupiter"].pbs_version=PBSPro_10.0
pbs.event().vnode_list["jupiter"].resources_available[file]=7gb
pbs.event().job_list["506.jupiter.example.com"].Job_Name=STDIN
pbs.event().job_list["506.jupiter.example.com"].Job_Owner=TestUser@jupiter.example.com
pbs.event().job_list["506.jupiter.example.com"].resources_used[cpupercent]=0
pbs.event().job_list["506.jupiter.example.com"].resources_used[cput]=00:00:00
pbs.event().job_list["506.jupiter.example.com"].resources_used[mem]=3880kb
pbs.event().job_list["506.jupiter.example.com"].resources_used[ncpus]=1
pbs.event().job_list["506.jupiter.example.com"].resources_used[vmem]=32192kb
pbs.event().job_list["506.jupiter.example.com"].resources_used[walltime]=00:00:13
pbs.event().job_list["506.jupiter.example.com"].job_state=T
pbs.event().job_list["506.jupiter.example.com"].queue=workq
pbs.event().job_list["506.jupiter.example.com"].server=jupiter.example.com
pbs.event().job_list["506.jupiter.example.com"].Checkpoint=u
pbs.event().job_list["506.jupiter.example.com"].Error_Path=jupiter.example.com:/home/TestUser/
    jobs/STDIN.e506
pbs.event().job_list["506.jupiter.example.com"].exec_host2=jupiter.example.com:15002/0
pbs.event().job_list["506.jupiter.example.com"].exec_vnode=(jupiter:ncpus=1)
pbs.event().job_list["506.jupiter.example.com"].Join_Path=n
pbs.event().job_list["506.jupiter.example.com"].Keep_Files=n
pbs.event().job_list["506.jupiter.example.com"].mtime=1410941347
pbs.event().job_list["506.jupiter.example.com"].Output_Path=jupiter.example.com:/home/TestUser/
    jobs/STDIN.o506
pbs.event().job_list["506.jupiter.example.com"].Resource_List[file]=7gb
pbs.event().job_list["506.jupiter.example.com"].Resource_List[ncpus]=1
pbs.event().job_list["506.jupiter.example.com"].Resource_List[place]=pack
pbs.event().job_list["506.jupiter.example.com"].schedselect=1:ncpus=1
pbs.event().job_list["506.jupiter.example.com"].session_id=11683
pbs.event().job_list["506.jupiter.example.com"].jobdir=/home/TestUser
pbs.event().job_list["506.jupiter.example.com"].substate=0
pbs.event().job_list["506.jupiter.example.com"].Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/
    bin/bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
    jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
    lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
    X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
    TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.event().job_list["506.jupiter.example.com"].euser=TestUser
pbs.event().job_list["506.jupiter.example.com"].egroup=users
pbs.event().job_list["506.jupiter.example.com"].hashname=506.jupiter.example.com
pbs.event().job_list["506.jupiter.example.com"].cookie=000000002CEAFC4E0000000043354104
```

```

pbs.event().job_list["506.jupiter.example.com"].run_count=1
pbs.event().job_list["506.jupiter.example.com"].job_kill_delay=10
pbs.event().job_list["506.jupiter.example.com"].project=_pbs_project_default
pbs.event().job_list["506.jupiter.example.com"].run_version=1
pbs.event().job_list["506.jupiter.example.com"]._msmom=True
pbs.event().job_list["506.jupiter.example.com"]._stdout_file=/var/spool/PBS/spool/
    506.jupiter.example.com.OU
pbs.event().job_list["506.jupiter.example.com"]._stderr_file=/var/spool/PBS/spool/
    506.jupiter.example.com.ER
pbs.event().job_list["507.jupiter.example.com"].Job_Name=STDIN
pbs.event().job_list["507.jupiter.example.com"].Job_Owner=TestUser@jupiter.example.com
pbs.event().job_list["507.jupiter.example.com"].resources_used[cpupercent]=0
pbs.event().job_list["507.jupiter.example.com"].resources_used[cput]=00:00:00
pbs.event().job_list["507.jupiter.example.com"].resources_used[mem]=3892kb
pbs.event().job_list["507.jupiter.example.com"].resources_used[ncpus]=1
pbs.event().job_list["507.jupiter.example.com"].resources_used[vmem]=32192kb
pbs.event().job_list["507.jupiter.example.com"].resources_used[walltime]=00:00:10
pbs.event().job_list["507.jupiter.example.com"].job_state=T
pbs.event().job_list["507.jupiter.example.com"].queue=workq
pbs.event().job_list["507.jupiter.example.com"].server=jupiter.example.com
pbs.event().job_list["507.jupiter.example.com"].Checkpoint=u
pbs.event().job_list["507.jupiter.example.com"].Error_Path=jupiter.example.com:/home/TestUser/
    jobs/STDIN.e507
pbs.event().job_list["507.jupiter.example.com"].exec_host2=jupiter.example.com:15002/1
pbs.event().job_list["507.jupiter.example.com"].exec_vnode=(jupiter:ncpus=1)
pbs.event().job_list["507.jupiter.example.com"].Join_Path=n
pbs.event().job_list["507.jupiter.example.com"].Keep_Files=n
pbs.event().job_list["507.jupiter.example.com"].mtime=1410941350
pbs.event().job_list["507.jupiter.example.com"].Output_Path=jupiter.example.com:/home/TestUser/
    jobs/STDIN.o507
pbs.event().job_list["507.jupiter.example.com"].Resource_List[file]=7gb
pbs.event().job_list["507.jupiter.example.com"].Resource_List[ncpus]=1
pbs.event().job_list["507.jupiter.example.com"].Resource_List[place]=pack
pbs.event().job_list["507.jupiter.example.com"].schedselect=1:ncpus=1
pbs.event().job_list["507.jupiter.example.com"].session_id=11716
pbs.event().job_list["507.jupiter.example.com"].jobdir=/home/TestUser
pbs.event().job_list["507.jupiter.example.com"].substate=0
pbs.event().job_list["507.jupiter.example.com"].Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/
    bin/bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
    jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
    lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
    X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
    TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.event().job_list["507.jupiter.example.com"].euser=TestUser
pbs.event().job_list["507.jupiter.example.com"].egroup=users
pbs.event().job_list["507.jupiter.example.com"].hashname=507.jupiter.example.com
pbs.event().job_list["507.jupiter.example.com"].cookie=000000003C3AB5AC000000007A31CFD4

```

```
pbs.event().job_list["507.jupiter.example.com"].run_count=1
pbs.event().job_list["507.jupiter.example.com"].job_kill_delay=10
pbs.event().job_list["507.jupiter.example.com"].project=_pbs_project_default
pbs.event().job_list["507.jupiter.example.com"].run_version=1
pbs.event().job_list["507.jupiter.example.com"].msmom=True
pbs.event().job_list["507.jupiter.example.com"]._stdout_file=/var/spool/PBS/spool/
    507.jupiter.example.com.OU
pbs.event().job_list["507.jupiter.example.com"]._stderr_file=/var/spool/PBS/spool/
    507.jupiter.example.com.ER
pbs.get_local_nodename()=jupiter
pbs.event().type=exechost_periodic
pbs.event().hook_name=period
pbs.event().hook_type=site
pbs.event().requestor=pbs_mom
pbs.event().requestor_host=jupiter.example.com
pbs.event().user=pbsadmin
pbs.event().alarm=30
```

List the `exechost_periodic` site data file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_exechost_periodic_period_11753.data
pbs.server().server_state=Active
pbs.server().server_host=jupiter.example.com
pbs.server().scheduling=True
pbs.server().total_jobs=4
pbs.server().state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:2 Exiting:0 Begun:0
pbs.server().managers=TestUser@*
pbs.server().default_queue=workq
pbs.server().log_events=511
pbs.server().mail_from=adm
pbs.server().query_other_jobs=True
pbs.server().resources_default[ncpus]=1
pbs.server().default_chunk[ncpus]=1
pbs.server().resources_assigned[mem]=0mb
pbs.server().resources_assigned[ncpus]=2
pbs.server().resources_assigned[nodect]=2
pbs.server().scheduler_iteration=600
pbs.server().flatuid=True
pbs.server().FLlicenses=30
pbs.server().resv_enable=True
pbs.server().node_fail_requeue=310
pbs.server().max_array_size=10000
pbs.server().pbs_license_min=1
pbs.server().pbs_license_max=2147483647
pbs.server().pbs_license_linger_time=3600
pbs.server().license_count=Avail_Global:0 Avail_Local:30 Used:2 High_Use:2
pbs.server().pbs_version=PBSPRO_10.0
pbs.server().eligible_time_enable=False
pbs.server().max_concurrent_provision=5
pbs.server().job(501.jupiter.example.com).Job_Name=STDIN
pbs.server().job(501.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(501.jupiter.example.com).job_state=H
pbs.server().job(501.jupiter.example.com).queue=workq
pbs.server().job(501.jupiter.example.com).server=jupiter.example.com
pbs.server().job(501.jupiter.example.com).Checkpoint=u
pbs.server().job(501.jupiter.example.com).ctime=1410940219
pbs.server().job(501.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e501
pbs.server().job(501.jupiter.example.com).Hold_Types=u
pbs.server().job(501.jupiter.example.com).Join_Path=n
pbs.server().job(501.jupiter.example.com).Keep_Files=n
pbs.server().job(501.jupiter.example.com).Mail_Points=a
pbs.server().job(501.jupiter.example.com).mtime=1410940219
pbs.server().job(501.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o501
```

```
pbs.server().job(501.jupiter.example.com).Priority=7
pbs.server().job(501.jupiter.example.com).qtime=1410940219
pbs.server().job(501.jupiter.example.com).Rerunable=True
pbs.server().job(501.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(501.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(501.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(501.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(501.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(501.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(501.jupiter.example.com).substate=20
pbs.server().job(501.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(501.jupiter.example.com).euser=TestUser
pbs.server().job(501.jupiter.example.com).egroup=users
pbs.server().job(501.jupiter.example.com).queue_rank=185
pbs.server().job(501.jupiter.example.com).queue_type=E
pbs.server().job(501.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(501.jupiter.example.com).project=_pbs_project_default
pbs.server().job(502.jupiter.example.com).Job_Name=STDIN
pbs.server().job(502.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(502.jupiter.example.com).job_state=H
pbs.server().job(502.jupiter.example.com).queue=workq
pbs.server().job(502.jupiter.example.com).server=jupiter.example.com
pbs.server().job(502.jupiter.example.com).Checkpoint=u
pbs.server().job(502.jupiter.example.com).ctime=1410940221
pbs.server().job(502.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.e502
pbs.server().job(502.jupiter.example.com).Hold_Types=u
pbs.server().job(502.jupiter.example.com).Join_Path=n
pbs.server().job(502.jupiter.example.com).Keep_Files=n
pbs.server().job(502.jupiter.example.com).Mail_Points=a
pbs.server().job(502.jupiter.example.com).mtime=1410940221
pbs.server().job(502.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.o502
pbs.server().job(502.jupiter.example.com).Priority=7
pbs.server().job(502.jupiter.example.com).qtime=1410940223
pbs.server().job(502.jupiter.example.com).Rerunable=True
pbs.server().job(502.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(502.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(502.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(502.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(502.jupiter.example.com).Resource_List[select]=1:ncpus=1
```

```

pbs.server().job(502.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(502.jupiter.example.com).substate=20
pbs.server().job(502.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(502.jupiter.example.com).euser=TestUser
pbs.server().job(502.jupiter.example.com).egroup=users
pbs.server().job(502.jupiter.example.com).queue_rank=186
pbs.server().job(502.jupiter.example.com).queue_type=E
pbs.server().job(502.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(502.jupiter.example.com).project=_pbs_project_default
pbs.server().job(506.jupiter.example.com).Job_Name=STDIN
pbs.server().job(506.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(506.jupiter.example.com).resources_used[cpupercent]=0
pbs.server().job(506.jupiter.example.com).resources_used[cput]=00:00:00
pbs.server().job(506.jupiter.example.com).resources_used[mem]=3880kb
pbs.server().job(506.jupiter.example.com).resources_used[ncpus]=1
pbs.server().job(506.jupiter.example.com).resources_used[vmem]=32192kb
pbs.server().job(506.jupiter.example.com).resources_used[walltime]=00:00:13
pbs.server().job(506.jupiter.example.com).job_state=R
pbs.server().job(506.jupiter.example.com).queue=workq
pbs.server().job(506.jupiter.example.com).server=jupiter.example.com
pbs.server().job(506.jupiter.example.com).Checkpoint=u
pbs.server().job(506.jupiter.example.com).ctime=1410941347
pbs.server().job(506.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.e506
pbs.server().job(506.jupiter.example.com).exec_host=jupiter/0
pbs.server().job(506.jupiter.example.com).exec_vnode=(jupiter:ncpus=1)
pbs.server().job(506.jupiter.example.com).Hold_Types=n
pbs.server().job(506.jupiter.example.com).Join_Path=n
pbs.server().job(506.jupiter.example.com).Keep_Files=n
pbs.server().job(506.jupiter.example.com).Mail_Points=a
pbs.server().job(506.jupiter.example.com).mtime=1410941347
pbs.server().job(506.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.o506
pbs.server().job(506.jupiter.example.com).Priority=7
pbs.server().job(506.jupiter.example.com).qtime=1410941347
pbs.server().job(506.jupiter.example.com).Rerunable=True
pbs.server().job(506.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(506.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(506.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(506.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(506.jupiter.example.com).Resource_List[select]=1:ncpus=1

```

```
pbs.server().job(506.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(506.jupiter.example.com).stime=1410941347
pbs.server().job(506.jupiter.example.com).session_id=11683
pbs.server().job(506.jupiter.example.com).jobdir=/home/TestUser
pbs.server().job(506.jupiter.example.com).substate=42
pbs.server().job(506.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(506.jupiter.example.com).euser=TestUser
pbs.server().job(506.jupiter.example.com).egroup=users
pbs.server().job(506.jupiter.example.com).hashname=506.jupiter.example.com
pbs.server().job(506.jupiter.example.com).queue_rank=188
pbs.server().job(506.jupiter.example.com).queue_type=E
pbs.server().job(506.jupiter.example.com).comment=Job run at Wed Sep 17 at 04:09 on
(jupiter:ncpus=1)
pbs.server().job(506.jupiter.example.com).etime=1410941347
pbs.server().job(506.jupiter.example.com).run_count=1
pbs.server().job(506.jupiter.example.com).project=_pbs_project_default
pbs.server().job(506.jupiter.example.com).run_version=1
pbs.server().job(507.jupiter.example.com).Job_Name=STDIN
pbs.server().job(507.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(507.jupiter.example.com).resources_used[cpupercent]=0
pbs.server().job(507.jupiter.example.com).resources_used[cpu]=00:00:00
pbs.server().job(507.jupiter.example.com).resources_used[mem]=3892kb
pbs.server().job(507.jupiter.example.com).resources_used[ncpus]=1
pbs.server().job(507.jupiter.example.com).resources_used[vmem]=32192kb
pbs.server().job(507.jupiter.example.com).resources_used[walltime]=00:00:10
pbs.server().job(507.jupiter.example.com).job_state=R
pbs.server().job(507.jupiter.example.com).queue=workq
pbs.server().job(507.jupiter.example.com).server=jupiter.example.com
pbs.server().job(507.jupiter.example.com).Checkpoint=u
pbs.server().job(507.jupiter.example.com).ctime=1410941350
pbs.server().job(507.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e507
pbs.server().job(507.jupiter.example.com).exec_host=jupiter/1
pbs.server().job(507.jupiter.example.com).exec_vnode=(jupiter:ncpus=1)
pbs.server().job(507.jupiter.example.com).Hold_Types=n
pbs.server().job(507.jupiter.example.com).Join_Path=n
pbs.server().job(507.jupiter.example.com).Keep_Files=n
pbs.server().job(507.jupiter.example.com).Mail_Points=a
pbs.server().job(507.jupiter.example.com).mtime=1410941350
pbs.server().job(507.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o507
pbs.server().job(507.jupiter.example.com).Priority=7
```

```

pbs.server().job(507.jupiter.example.com).qtime=1410941350
pbs.server().job(507.jupiter.example.com).Rerunable=True
pbs.server().job(507.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(507.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(507.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(507.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(507.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(507.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(507.jupiter.example.com).stime=1410941350
pbs.server().job(507.jupiter.example.com).session_id=11716
pbs.server().job(507.jupiter.example.com).jobdir=/home/TestUser
pbs.server().job(507.jupiter.example.com).substate=42
pbs.server().job(507.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(507.jupiter.example.com).euser=TestUser
pbs.server().job(507.jupiter.example.com).egroup=users
pbs.server().job(507.jupiter.example.com).hashname=507.jupiter.example.com
pbs.server().job(507.jupiter.example.com).queue_rank=189
pbs.server().job(507.jupiter.example.com).queue_type=E
pbs.server().job(507.jupiter.example.com).comment=Job run at Wed Sep 17 at 04:09 on
  (jupiter:ncpus=1)
pbs.server().job(507.jupiter.example.com).etime=1410941350
pbs.server().job(507.jupiter.example.com).run_count=1
pbs.server().job(507.jupiter.example.com).project=_pbs_project_default
pbs.server().job(507.jupiter.example.com).run_version=1
pbs.server().queue(workq).queue_type=Execution
pbs.server().queue(workq).total_jobs=4
pbs.server().queue(workq).state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:2 Exiting:0
  Begun:0
pbs.server().queue(workq).resources_assigned[mem]=0mb
pbs.server().queue(workq).resources_assigned[ncpus]=2
pbs.server().queue(workq).resources_assigned[nodect]=2
pbs.server().queue(workq).enabled=True
pbs.server().queue(workq).started=True
pbs.server().queue(R503).queue_type=Execution
pbs.server().queue(R503).total_jobs=0
pbs.server().queue(R503).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(R503).acl_user_enable=True
pbs.server().queue(R503).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R503).resources_max[ncpus]=1
pbs.server().queue(R503).resources_max[walltime]=00:30:00
pbs.server().queue(R503).resources_available[ncpus]=1

```



```
pbs.server().queue(R503).resources_available[walltime]=00:30:00
pbs.server().queue(R503).enabled=True
pbs.server().queue(R503).started=False
pbs.server().queue(R504).queue_type=Execution
pbs.server().queue(R504).total_jobs=0
pbs.server().queue(R504).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(R504).acl_user_enable=True
pbs.server().queue(R504).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R504).resources_max[ncpus]=1
pbs.server().queue(R504).resources_max[walltime]=00:30:00
pbs.server().queue(R504).resources_available[ncpus]=1
pbs.server().queue(R504).resources_available[walltime]=00:30:00
pbs.server().queue(R504).enabled=True
pbs.server().queue(R504).started=False
pbs.server().vnode(jupiter).Mom=jupiter.example.com
pbs.server().vnode(jupiter).Port=15002
pbs.server().vnode(jupiter).pbs_version=PBSPPro_10.0
pbs.server().vnode(jupiter).ntype=0
pbs.server().vnode(jupiter).state=0
pbs.server().vnode(jupiter).pcpus=1
pbs.server().vnode(jupiter).jobs=506.jupiter.example.com/0, 507.jupiter.example.com/1
pbs.server().vnode(jupiter).resv=R504.jupiter.example.com, R503.jupiter.example.com
pbs.server().vnode(jupiter).resources_available[arch]=linux
pbs.server().vnode(jupiter).resources_available[file]=7gb
pbs.server().vnode(jupiter).resources_available[host]=jupiter
pbs.server().vnode(jupiter).resources_available[mem]=8gb
pbs.server().vnode(jupiter).resources_available[ncpus]=8
pbs.server().vnode(jupiter).resources_available[vnode]=jupiter
pbs.server().vnode(jupiter).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(jupiter).resources_assigned[mem]=0kb
pbs.server().vnode(jupiter).resources_assigned[naccelerators]=0
pbs.server().vnode(jupiter).resources_assigned[ncpus]=2
pbs.server().vnode(jupiter).resources_assigned[vmem]=0kb
pbs.server().vnode(jupiter).resv_enable=True
pbs.server().vnode(jupiter).sharing=1
pbs.server().vnode(mars).Mom=mars.example.com
pbs.server().vnode(mars).Port=15002
pbs.server().vnode(mars).pbs_version=PBSPPro_10.0
pbs.server().vnode(mars).ntype=0
pbs.server().vnode(mars).state=0
pbs.server().vnode(mars).pcpus=1
pbs.server().vnode(mars).resources_available[arch]=linux
pbs.server().vnode(mars).resources_available[file]=7gb
pbs.server().vnode(mars).resources_available[host]=mars
pbs.server().vnode(mars).resources_available[mem]=8gb
```

```

pbs.server().vnode(mars).resources_available[ncpus]=8
pbs.server().vnode(mars).resources_available[vnode]=mars
pbs.server().vnode(mars).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(mars).resources_assigned[mem]=0kb
pbs.server().vnode(mars).resources_assigned[naccelerators]=0
pbs.server().vnode(mars).resources_assigned[ncpus]=0
pbs.server().vnode(mars).resources_assigned[vmem]=0kb
pbs.server().vnode(mars).resv_enable=True
pbs.server().vnode(mars).sharing=1
pbs.server().resv(R503.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R503.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).reserve_type=2
pbs.server().resv(R503.jupiter.example.com).reserve_state=2
pbs.server().resv(R503.jupiter.example.com).reserve_substate=2
pbs.server().resv(R503.jupiter.example.com).reserve_start=1410955200
pbs.server().resv(R503.jupiter.example.com).reserve_end=1410957000
pbs.server().resv(R503.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R503.jupiter.example.com).queue=R503
pbs.server().resv(R503.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R503.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R503.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R503.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).ctime=1410940237
pbs.server().resv(R503.jupiter.example.com).mtime=1410940237
pbs.server().resv(R503.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R503.jupiter.example.com).euser=TestUser
pbs.server().resv(R503.jupiter.example.com).egroup=users
pbs.server().resv(R504.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R504.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).reserve_type=2
pbs.server().resv(R504.jupiter.example.com).reserve_state=2
pbs.server().resv(R504.jupiter.example.com).reserve_substate=2
pbs.server().resv(R504.jupiter.example.com).reserve_start=1410958800
pbs.server().resv(R504.jupiter.example.com).reserve_end=1410960600
pbs.server().resv(R504.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R504.jupiter.example.com).queue=R504
pbs.server().resv(R504.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R504.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[select]=1:ncpus=1

```



```

pbs.server().resv(R504.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R504.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R504.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).ctime=1410940250
pbs.server().resv(R504.jupiter.example.com).mtime=1410940250
pbs.server().resv(R504.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R504.jupiter.example.com).euser=TestUser
pbs.server().resv(R504.jupiter.example.com).egroup=users

```

List the `exechost_periodic` hook execution record file:

```

jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_exechost_periodic_period_11753.out
pbs.event().accept=True
pbs.event().reject=False
pbs.event().vnode_list["jupiter"].resources_available[file,size]=7gb
pbs.event().job_list["506.jupiter.example.com"].Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/TestUser,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin
pbs.event().job_list["506.jupiter.example.com"]._delete=False
pbs.event().job_list["506.jupiter.example.com"]._rerun=False
pbs.event().job_list["507.jupiter.example.com"].Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/TestUser,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin
pbs.event().job_list["507.jupiter.example.com"]._delete=False
pbs.event().job_list["507.jupiter.example.com"]._rerun=False

```

Attributes of the `execjob_begin` hook:

```

Hook begin
  type = site
  enabled = true
  event = execjob_begin
  user = pbsadmin
  alarm = 30
  order = 1
  debug = true
  fail_action = none

```

Contents of the `execjob_begin` hook:

```
import pbs
e=pbs.event()

e.job.Priority=7
e.job.Variable_List["Monsieur"] = "Shlomi"

s=pbs.server()
for j in s.jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "got j %s" % (j.id,))

for q in s.queues():
    pbs.logmsg(pbs.LOG_DEBUG, "got q %s" % (q.name,))

for v in s.vnodes():
    pbs.logmsg(pbs.LOG_DEBUG, "got vnode %s" % (v.name,))

for r in s.resvs():
    pbs.logmsg(pbs.LOG_DEBUG, "got resv %s" % (r.resvid))
```

We submit a job:

```
% qsub job.scr
```

The resulting `execjob_begin` debug files are here:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # ls -ltr
-rw-r--r-- 1 root root 2263 Sep 17 04:15 hook_execjob_begin_begin_11883.in
-rw-r--r-- 1 root root 585 Sep 17 04:15 hook_execjob_begin_begin_11883.out
-rw-r--r-- 1 root root 15327 Sep 17 04:15 hook_execjob_begin_begin_11883.data
```

List the `execjob_begin` event file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_execjob_begin_begin_11883.in
pbs.event().job.id=509.jupiter.example.com
pbs.event().job.Job_Name=job.scr
pbs.event().job.Job_Owner=TestUser@jupiter.example.com
pbs.event().job.queue=workq
pbs.event().job.server=jupiter.example.com
pbs.event().job.Checkpoint=u
pbs.event().job.Error_Path=jupiter.example.com:/home/TestUser/jobs/job.scr.e509
pbs.event().job.exec_host2=jupiter.example.com:15002/0
pbs.event().job.exec_vnode=(jupiter:ncpus=1)
pbs.event().job.Join_Path=n
pbs.event().job.Keep_Files=n
pbs.event().job.mtime=1410941704
pbs.event().job.Output_Path=jupiter.example.com:/home/TestUser/jobs/job.scr.o509
pbs.event().job.Resource_List[file]=7gb
pbs.event().job.Resource_List[ncpus]=1
pbs.event().job.Resource_List[place]=pack
pbs.event().job.schedselect=1:ncpus=1
pbs.event().job.Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/
TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/jobs,PBS_O_LANG=en_US.UTF-
8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/bin:/
home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/opt/
pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.event().job.euser=TestUser
pbs.event().job.egroup=users
pbs.event().job.hashname=509.jupiter.example.com
pbs.event().job.run_count=1
pbs.event().job.job_kill_delay=10
pbs.event().job.project=_pbs_project_default
pbs.event().job.run_version=1
pbs.event().job._msmom=True
pbs.event().job._stdout_file=
pbs.event().job._stderr_file=
pbs.event().vnode_list["jupiter"].resources_assigned[ncpus]=1
pbs.event().vnode_list["jupiter"].resources_assigned[mem]=0kb
pbs.event().vnode_list["jupiter"].pcpus=1
pbs.event().vnode_list["jupiter"].resources_available[ncpus]=1
pbs.event().vnode_list["jupiter"].resources_available[mem]=757388kb
pbs.event().vnode_list["jupiter"].resources_available[arch]=linux
pbs.event().vnode_list["jupiter"].pbs_version=PBSPro_10.0
pbs.get_local_nodename()=jupiter
pbs.event().type=execjob_begin
pbs.event().hook_name=begin
pbs.event().hook_type=site
pbs.event().requestor=pbs_mom
```

```
pbs.event().requestor_host=jupiter.example.com  
pbs.event().user=pbsadmin  
pbs.event().alarm=30
```

List the `execjob_begin` site data file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_execjob_begin_begin_11883.data
pbs.server().server_state=Active
pbs.server().server_host=jupiter.example.com
pbs.server().scheduling=True
pbs.server().total_jobs=3
pbs.server().state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:1 Exiting:0 Begun:0
pbs.server().managers=TestUser@*
pbs.server().default_queue=workq
pbs.server().log_events=511
pbs.server().mail_from=adm
pbs.server().query_other_jobs=True
pbs.server().resources_default[ncpus]=1
pbs.server().default_chunk[ncpus]=1
pbs.server().resources_assigned[mem]=0mb
pbs.server().resources_assigned[ncpus]=1
pbs.server().resources_assigned[nodect]=1
pbs.server().scheduler_iteration=600
pbs.server().flatuid=True
pbs.server().FLlicenses=31
pbs.server().resv_enable=True
pbs.server().node_fail_requeue=310
pbs.server().max_array_size=10000
pbs.server().pbs_license_min=1
pbs.server().pbs_license_max=2147483647
pbs.server().pbs_license_linger_time=3600
pbs.server().license_count=Avail_Global:0 Avail_Local:31 Used:1 High_Use:2
pbs.server().pbs_version=PBSPRO_10.0
pbs.server().eligible_time_enable=False
pbs.server().max_concurrent_provision=5
pbs.server().job(501.jupiter.example.com).Job_Name=STDIN
pbs.server().job(501.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(501.jupiter.example.com).job_state=H
pbs.server().job(501.jupiter.example.com).queue=workq
pbs.server().job(501.jupiter.example.com).server=jupiter.example.com
pbs.server().job(501.jupiter.example.com).Checkpoint=u
pbs.server().job(501.jupiter.example.com).ctime=1410940219
pbs.server().job(501.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e501
pbs.server().job(501.jupiter.example.com).Hold_Types=u
pbs.server().job(501.jupiter.example.com).Join_Path=n
pbs.server().job(501.jupiter.example.com).Keep_Files=n
pbs.server().job(501.jupiter.example.com).Mail_Points=a
pbs.server().job(501.jupiter.example.com).mtime=1410940219
pbs.server().job(501.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o501
```

```

pbs.server().job(501.jupiter.example.com).Priority=7
pbs.server().job(501.jupiter.example.com).qtime=1410940219
pbs.server().job(501.jupiter.example.com).Rerunable=True
pbs.server().job(501.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(501.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(501.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(501.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(501.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(501.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(501.jupiter.example.com).substate=20
pbs.server().job(501.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(501.jupiter.example.com).euser=TestUser
pbs.server().job(501.jupiter.example.com).egroup=users
pbs.server().job(501.jupiter.example.com).queue_rank=185
pbs.server().job(501.jupiter.example.com).queue_type=E
pbs.server().job(501.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(501.jupiter.example.com).project=_pbs_project_default
pbs.server().job(502.jupiter.example.com).Job_Name=STDIN
pbs.server().job(502.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(502.jupiter.example.com).job_state=H
pbs.server().job(502.jupiter.example.com).queue=workq
pbs.server().job(502.jupiter.example.com).server=jupiter.example.com
pbs.server().job(502.jupiter.example.com).Checkpoint=u
pbs.server().job(502.jupiter.example.com).ctime=1410940221
pbs.server().job(502.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.e502
pbs.server().job(502.jupiter.example.com).Hold_Types=u
pbs.server().job(502.jupiter.example.com).Join_Path=n
pbs.server().job(502.jupiter.example.com).Keep_Files=n
pbs.server().job(502.jupiter.example.com).Mail_Points=a
pbs.server().job(502.jupiter.example.com).mtime=1410940221
pbs.server().job(502.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
  STDIN.o502
pbs.server().job(502.jupiter.example.com).Priority=7
pbs.server().job(502.jupiter.example.com).qtime=1410940223
pbs.server().job(502.jupiter.example.com).Rerunable=True
pbs.server().job(502.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(502.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(502.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(502.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(502.jupiter.example.com).Resource_List[select]=1:ncpus=1

```

```

pbs.server().job(502.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(502.jupiter.example.com).substate=20
pbs.server().job(502.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(502.jupiter.example.com).euser=TestUser
pbs.server().job(502.jupiter.example.com).egroup=users
pbs.server().job(502.jupiter.example.com).queue_rank=186
pbs.server().job(502.jupiter.example.com).queue_type=E
pbs.server().job(502.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
  hpcpa:Argument>
pbs.server().job(502.jupiter.example.com).project=_pbs_project_default
pbs.server().job(509.jupiter.example.com).Job_Name=job.scr
pbs.server().job(509.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(509.jupiter.example.com).job_state=R
pbs.server().job(509.jupiter.example.com).queue=workq
pbs.server().job(509.jupiter.example.com).server=jupiter.example.com
pbs.server().job(509.jupiter.example.com).Checkpoint=u
pbs.server().job(509.jupiter.example.com).ctime=1410941704
pbs.server().job(509.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
  job.scr.e509
pbs.server().job(509.jupiter.example.com).exec_host=jupiter/0
pbs.server().job(509.jupiter.example.com).exec_vnode=(jupiter:ncpus=1)
pbs.server().job(509.jupiter.example.com).Hold_Types=n
pbs.server().job(509.jupiter.example.com).Join_Path=n
pbs.server().job(509.jupiter.example.com).Keep_Files=n
pbs.server().job(509.jupiter.example.com).Mail_Points=a
pbs.server().job(509.jupiter.example.com).mtime=1410941704
pbs.server().job(509.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
  job.scr.o509
pbs.server().job(509.jupiter.example.com).Priority=7
pbs.server().job(509.jupiter.example.com).qtime=1410941704
pbs.server().job(509.jupiter.example.com).Rerunable=True
pbs.server().job(509.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(509.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(509.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(509.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(509.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(509.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(509.jupiter.example.com).substate=41
pbs.server().job(509.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
  lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
  X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/

```



```

TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(509.jupiter.example.com).euser=TestUser
pbs.server().job(509.jupiter.example.com).egroup=users
pbs.server().job(509.jupiter.example.com).hashname=509.jupiter.example.com
pbs.server().job(509.jupiter.example.com).queue_rank=190
pbs.server().job(509.jupiter.example.com).queue_type=E
pbs.server().job(509.jupiter.example.com).comment=Job run at Wed Sep 17 at 04:15 on
(jupiter:ncpus=1)
pbs.server().job(509.jupiter.example.com).etime=1410941704
pbs.server().job(509.jupiter.example.com).run_count=1
pbs.server().job(509.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>job.scr</jsdl-
hpcpa:Argument>
pbs.server().job(509.jupiter.example.com).project=_pbs_project_default
pbs.server().job(509.jupiter.example.com).run_version=1
pbs.server().queue(workq).queue_type=Execution
pbs.server().queue(workq).total_jobs=3
pbs.server().queue(workq).state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:1 Exiting:0
Begun:0
pbs.server().queue(workq).resources_assigned[mem]=0mb
pbs.server().queue(workq).resources_assigned[ncpus]=1
pbs.server().queue(workq).resources_assigned[nodect]=1
pbs.server().queue(workq).enabled=True
pbs.server().queue(workq).started=True
pbs.server().queue(R503).queue_type=Execution
pbs.server().queue(R503).total_jobs=0
pbs.server().queue(R503).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
Begun:0
pbs.server().queue(R503).acl_user_enable=True
pbs.server().queue(R503).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R503).resources_max[ncpus]=1
pbs.server().queue(R503).resources_max[walltime]=00:30:00
pbs.server().queue(R503).resources_available[ncpus]=1
pbs.server().queue(R503).resources_available[walltime]=00:30:00
pbs.server().queue(R503).enabled=True
pbs.server().queue(R503).started=False
pbs.server().queue(R504).queue_type=Execution
pbs.server().queue(R504).total_jobs=0
pbs.server().queue(R504).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
Begun:0
pbs.server().queue(R504).acl_user_enable=True
pbs.server().queue(R504).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R504).resources_max[ncpus]=1
pbs.server().queue(R504).resources_max[walltime]=00:30:00
pbs.server().queue(R504).resources_available[ncpus]=1
pbs.server().queue(R504).resources_available[walltime]=00:30:00
pbs.server().queue(R504).enabled=True
pbs.server().queue(R504).started=False

```



```
pbs.server().vnode(jupiter).Mom=jupiter.example.com
pbs.server().vnode(jupiter).Port=15002
pbs.server().vnode(jupiter).pbs_version=PBSPPro_10.0
pbs.server().vnode(jupiter).ntype=0
pbs.server().vnode(jupiter).state=0
pbs.server().vnode(jupiter).pcpus=1
pbs.server().vnode(jupiter).jobs=509.jupiter.example.com/0
pbs.server().vnode(jupiter).resv=R504.jupiter.example.com, R503.jupiter.example.com
pbs.server().vnode(jupiter).resources_available[arch]=linux
pbs.server().vnode(jupiter).resources_available[file]=7gb
pbs.server().vnode(jupiter).resources_available[host]=jupiter
pbs.server().vnode(jupiter).resources_available[mem]=8gb
pbs.server().vnode(jupiter).resources_available[ncpus]=8
pbs.server().vnode(jupiter).resources_available[vnode]=jupiter
pbs.server().vnode(jupiter).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(jupiter).resources_assigned[mem]=0kb
pbs.server().vnode(jupiter).resources_assigned[naccelerators]=0
pbs.server().vnode(jupiter).resources_assigned[ncpus]=1
pbs.server().vnode(jupiter).resources_assigned[vmem]=0kb
pbs.server().vnode(jupiter).resv_enable=True
pbs.server().vnode(jupiter).sharing=1
pbs.server().vnode(mars).Mom=mars.example.com
pbs.server().vnode(mars).Port=15002
pbs.server().vnode(mars).pbs_version=PBSPPro_10.0
pbs.server().vnode(mars).ntype=0
pbs.server().vnode(mars).state=0
pbs.server().vnode(mars).pcpus=1
pbs.server().vnode(mars).resources_available[arch]=linux
pbs.server().vnode(mars).resources_available[file]=7gb
pbs.server().vnode(mars).resources_available[host]=mars
pbs.server().vnode(mars).resources_available[mem]=8gb
pbs.server().vnode(mars).resources_available[ncpus]=8
pbs.server().vnode(mars).resources_available[vnode]=mars
pbs.server().vnode(mars).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(mars).resources_assigned[mem]=0kb
pbs.server().vnode(mars).resources_assigned[naccelerators]=0
pbs.server().vnode(mars).resources_assigned[ncpus]=0
pbs.server().vnode(mars).resources_assigned[vmem]=0kb
pbs.server().vnode(mars).resv_enable=True
pbs.server().vnode(mars).sharing=1
pbs.server().resv(R503.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R503.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).reserve_type=2
pbs.server().resv(R503.jupiter.example.com).reserve_state=2
pbs.server().resv(R503.jupiter.example.com).reserve_substate=2
pbs.server().resv(R503.jupiter.example.com).reserve_start=1410955200
```

```
pbs.server().resv(R503.jupiter.example.com).reserve_end=1410957000
pbs.server().resv(R503.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R503.jupiter.example.com).queue=R503
pbs.server().resv(R503.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R503.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R503.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R503.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).ctime=1410940237
pbs.server().resv(R503.jupiter.example.com).mtime=1410940237
pbs.server().resv(R503.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R503.jupiter.example.com).euser=TestUser
pbs.server().resv(R503.jupiter.example.com).egroup=users
pbs.server().resv(R504.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R504.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).reserve_type=2
pbs.server().resv(R504.jupiter.example.com).reserve_state=2
pbs.server().resv(R504.jupiter.example.com).reserve_substate=2
pbs.server().resv(R504.jupiter.example.com).reserve_start=1410958800
pbs.server().resv(R504.jupiter.example.com).reserve_end=1410960600
pbs.server().resv(R504.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R504.jupiter.example.com).queue=R504
pbs.server().resv(R504.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R504.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R504.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R504.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).ctime=1410940250
pbs.server().resv(R504.jupiter.example.com).mtime=1410940250
pbs.server().resv(R504.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R504.jupiter.example.com).euser=TestUser
pbs.server().resv(R504.jupiter.example.com).egroup=users
```

List the `execjob_begin` hook execution record file:

```
jupiter:/var/spool/PBS/mom_priv/hooks/tmp # cat hook_execjob_begin_begin_11883.out
pbs.event().accept=True
pbs.event().reject=False
pbs.event().job.Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,Monsieur=Shlomi,PBS_O_HOME=/home/
  TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/
  bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/
  opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin
pbs.event().job.Priority=7
```

Attributes of the `execjob_launch` hook:

```
Hook launch
  type = site
  enabled = true
  event = execjob_launch
  user = pbsadmin
  alarm = 30
  order = 1
  debug = true
  fail_action = none
```

Contents of the `execjob_launch` hook:

```
import pbs
e=pbs.event()

e.progname = "/bin/sleep"
e.argv[1] = "30"

s=pbs.server()
for j in s.jobs():
    pbs.logmsg(pbs.LOG_DEBUG, "got j %s" % (j.id,))

for q in s.queues():
    pbs.logmsg(pbs.LOG_DEBUG, "got q %s" % (q.name,))

for v in s.vnodes():
    pbs.logmsg(pbs.LOG_DEBUG, "got vnode %s" % (v.name,))

for r in s.resvs():
    pbs.logmsg(pbs.LOG_DEBUG, "got resv %s" % (r.resvid))
```

Submit a job:

```
% qsub job.scr
```

The `execjob_launch` hook writes the `*.in`, `*.data`, and `*.out` files in `/var/spool/PBS/spool`:

```
jupiter:/var/spool/PBS/spool # ls -ltr /var/spool/PBS/spool
-rw----- 1 TestUser users  3489 Sep 17 04:24 hook_execjob_launch_launch_12135.in
-rw----- 1 TestUser users  1045 Sep 17 04:24 hook_execjob_launch_launch_12135.out
-rw----- 1 TestUser users 15906 Sep 17 04:24 hook_execjob_launch_launch_12135.data
```

List the `execjob_launch` hook event file:

```
cat hook_execjob_launch_launch_12135.in
pbs.event().programe=/bin/bash
pbs.event().argv[0]=--bash
pbs.event().env=TZ=US/Eastern,PATH=/bin:/usr/bin,PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
bash,Monsieur=Shlomi,PBS_O_HOME=/home/
TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/
bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/
opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,HOME=/home/
```

```

TestUser,LOGNAME=TestUser,PBS_JOBNAME=job.scr,PBS_JOBID=511.jupiter.example.com,PBS_QUEUE=workq,SHELL=/bin/
bash,USER=TestUser,PBS_JOBCOOKIE=00000000434AB4BA00000000BDC62D3,PBS_NODENUM=0,PBS_TASKNUM=
1,PBS_MOMPORT=15003,OMP_NUM_THREADS=1,NCPUS=1,PBS_NODEFILE=/var/spool/PBS/aux/
511.jupiter.example.com,PBS_TMPDIR=/var/tmp/pbs.511.jupiter.example.com,PBS_JOBDIR=/home/
TestUser,PBS_ENVIRONMENT=PBS_BATCH,ENVIRONMENT=BATCH
pbs.event().job.id=511.jupiter.example.com
pbs.event().job.Job_Name=job.scr
pbs.event().job.Job_Owner=TestUser@jupiter.example.com
pbs.event().job.job_state=T
pbs.event().job.queue=workq
pbs.event().job.server=jupiter.example.com
pbs.event().job.Checkpoint=u
pbs.event().job.Error_Path=jupiter.example.com:/home/TestUser/jobs/job.scr.e511
pbs.event().job.exec_host2=jupiter.example.com:15002/0
pbs.event().job.exec_vnode=(jupiter:ncpus=1)
pbs.event().job.Join_Path=n
pbs.event().job.Keep_Files=n
pbs.event().job.mtime=1410942248
pbs.event().job.Output_Path=jupiter.example.com:/home/TestUser/jobs/job.scr.o511
pbs.event().job.Priority=7
pbs.event().job.Resource_List[file]=7gb
pbs.event().job.Resource_List[ncpus]=1
pbs.event().job.Resource_List[place]=pack
pbs.event().job.schedselect=1:ncpus=1
pbs.event().job.substate=0
pbs.event().job.Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
bash,Monsieur=Shlomi,PBS_O_HOME=/home/
TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/
bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/
opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin
pbs.event().job.euser=TestUser
pbs.event().job.egroup=users
pbs.event().job.hashname=511.jupiter.example.com
pbs.event().job.cookie=00000000434AB4BA00000000BDC62D3
pbs.event().job.run_count=1
pbs.event().job.job_kill_delay=10
pbs.event().job.project=_pbs_project_default
pbs.event().job.run_version=1
pbs.event().job._msmom=True
pbs.event().job._stdout_file=/var/spool/PBS/spool/511.jupiter.example.com.OU
pbs.event().job._stderr_file=/var/spool/PBS/spool/511.jupiter.example.com.ER
pbs.event().vnode_list["jupiter"].resources_assigned[ncpus]=1
pbs.event().vnode_list["jupiter"].resources_assigned[mem]=0kb
pbs.event().vnode_list["jupiter"].pcpus=1
pbs.event().vnode_list["jupiter"].resources_available[ncpus]=1

```

```
pbs.event().vnode_list["jupiter"].resources_available[mem]=757388kb
pbs.event().vnode_list["jupiter"].resources_available[arch]=linux
pbs.event().vnode_list["jupiter"].pbs_version=PBSPPro_10.0
pbs.get_local_nodename()=jupiter
pbs.event().type=execjob_launch
pbs.event().hook_name=launch
pbs.event().hook_type=site
pbs.event().requestor=pbs_mom
pbs.event().requestor_host=jupiter.example.com
pbs.event().user=pbsadmin
pbs.event().alarm=30
```

List the `execjob_launch` hook site data file:

```
jupiter:/var/spool/PBS/spool # cat hook_execjob_launch_launch_12135.data
pbs.server().server_state=Active
pbs.server().server_host=jupiter.example.com
pbs.server().scheduling=True
pbs.server().total_jobs=3
pbs.server().state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:1 Exiting:0 Begun:0
pbs.server().managers=TestUser@*
pbs.server().default_queue=workq
pbs.server().log_events=511
pbs.server().mail_from=adm
pbs.server().query_other_jobs=True
pbs.server().resources_default[ncpus]=1
pbs.server().default_chunk[ncpus]=1
pbs.server().resources_assigned[mem]=0mb
pbs.server().resources_assigned[ncpus]=1
pbs.server().resources_assigned[nodect]=1
pbs.server().scheduler_iteration=600
pbs.server().flatuid=True
pbs.server().FLlicenses=31
pbs.server().resv_enable=True
pbs.server().node_fail_requeue=310
pbs.server().max_array_size=10000
pbs.server().pbs_license_min=1
pbs.server().pbs_license_max=2147483647
pbs.server().pbs_license_linger_time=3600
pbs.server().license_count=Avail_Global:0 Avail_Local:31 Used:1 High_Use:2
pbs.server().pbs_version=PBSPro_10.0
pbs.server().eligible_time_enable=False
pbs.server().max_concurrent_provision=5
pbs.server().job(501.jupiter.example.com).Job_Name=STDIN
pbs.server().job(501.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(501.jupiter.example.com).job_state=H
pbs.server().job(501.jupiter.example.com).queue=workq
pbs.server().job(501.jupiter.example.com).server=jupiter.example.com
pbs.server().job(501.jupiter.example.com).Checkpoint=u
pbs.server().job(501.jupiter.example.com).ctime=1410940219
pbs.server().job(501.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e501
pbs.server().job(501.jupiter.example.com).Hold_Types=u
pbs.server().job(501.jupiter.example.com).Join_Path=n
pbs.server().job(501.jupiter.example.com).Keep_Files=n
pbs.server().job(501.jupiter.example.com).Mail_Points=a
pbs.server().job(501.jupiter.example.com).mtime=1410940219
pbs.server().job(501.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o501
```

```
pbs.server().job(501.jupiter.example.com).Priority=7
pbs.server().job(501.jupiter.example.com).qtime=1410940219
pbs.server().job(501.jupiter.example.com).Rerunable=True
pbs.server().job(501.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(501.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(501.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(501.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(501.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().job(501.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(501.jupiter.example.com).substate=20
pbs.server().job(501.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(501.jupiter.example.com).euser=TestUser
pbs.server().job(501.jupiter.example.com).egroup=users
pbs.server().job(501.jupiter.example.com).queue_rank=185
pbs.server().job(501.jupiter.example.com).queue_type=E
pbs.server().job(501.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
hpcpa:Argument>
pbs.server().job(501.jupiter.example.com).project=_pbs_project_default
pbs.server().job(502.jupiter.example.com).Job_Name=STDIN
pbs.server().job(502.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(502.jupiter.example.com).job_state=H
pbs.server().job(502.jupiter.example.com).queue=workq
pbs.server().job(502.jupiter.example.com).server=jupiter.example.com
pbs.server().job(502.jupiter.example.com).Checkpoint=u
pbs.server().job(502.jupiter.example.com).ctime=1410940221
pbs.server().job(502.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.e502
pbs.server().job(502.jupiter.example.com).Hold_Types=u
pbs.server().job(502.jupiter.example.com).Join_Path=n
pbs.server().job(502.jupiter.example.com).Keep_Files=n
pbs.server().job(502.jupiter.example.com).Mail_Points=a
pbs.server().job(502.jupiter.example.com).mtime=1410940221
pbs.server().job(502.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
STDIN.o502
pbs.server().job(502.jupiter.example.com).Priority=7
pbs.server().job(502.jupiter.example.com).qtime=1410940223
pbs.server().job(502.jupiter.example.com).Rerunable=True
pbs.server().job(502.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(502.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(502.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(502.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(502.jupiter.example.com).Resource_List[select]=1:ncpus=1
```



```
pbs.server().job(502.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(502.jupiter.example.com).substate=20
pbs.server().job(502.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
bash,PBS_O_HOME=/home/TestUser,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/
lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/
X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,PBS_O_MAIL=/var/spool/mail/
TestUser,PBS_O_QUEUE=workq,PBS_O_HOST=jupiter.example.com
pbs.server().job(502.jupiter.example.com).euser=TestUser
pbs.server().job(502.jupiter.example.com).egroup=users
pbs.server().job(502.jupiter.example.com).queue_rank=186
pbs.server().job(502.jupiter.example.com).queue_type=E
pbs.server().job(502.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>-h</jsdl-
hpcpa:Argument>
pbs.server().job(502.jupiter.example.com).project=_pbs_project_default
pbs.server().job(511.jupiter.example.com).Job_Name=job.scr
pbs.server().job(511.jupiter.example.com).Job_Owner=TestUser@jupiter.example.com
pbs.server().job(511.jupiter.example.com).resources_used[cpupercent]=0
pbs.server().job(511.jupiter.example.com).resources_used[cput]=00:00:00
pbs.server().job(511.jupiter.example.com).resources_used[mem]=0kb
pbs.server().job(511.jupiter.example.com).resources_used[ncpus]=1
pbs.server().job(511.jupiter.example.com).resources_used[vmem]=0kb
pbs.server().job(511.jupiter.example.com).resources_used[walltime]=00:00:00
pbs.server().job(511.jupiter.example.com).job_state=R
pbs.server().job(511.jupiter.example.com).queue=workq
pbs.server().job(511.jupiter.example.com).server=jupiter.example.com
pbs.server().job(511.jupiter.example.com).Checkpoint=u
pbs.server().job(511.jupiter.example.com).ctime=1410942249
pbs.server().job(511.jupiter.example.com).Error_Path=jupiter.example.com:/home/TestUser/jobs/
job.scr.e511
pbs.server().job(511.jupiter.example.com).exec_host=jupiter/0
pbs.server().job(511.jupiter.example.com).exec_vnode=(jupiter:ncpus=1)
pbs.server().job(511.jupiter.example.com).Hold_Types=n
pbs.server().job(511.jupiter.example.com).Join_Path=n
pbs.server().job(511.jupiter.example.com).Keep_Files=n
pbs.server().job(511.jupiter.example.com).Mail_Points=a
pbs.server().job(511.jupiter.example.com).mtime=1410942250
pbs.server().job(511.jupiter.example.com).Output_Path=jupiter.example.com:/home/TestUser/jobs/
job.scr.o511
pbs.server().job(511.jupiter.example.com).Priority=7
pbs.server().job(511.jupiter.example.com).qtime=1410942249
pbs.server().job(511.jupiter.example.com).Rerunable=True
pbs.server().job(511.jupiter.example.com).Resource_List[file]=7gb
pbs.server().job(511.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().job(511.jupiter.example.com).Resource_List[nodect]=1
pbs.server().job(511.jupiter.example.com).Resource_List[place]=pack
pbs.server().job(511.jupiter.example.com).Resource_List[select]=1:ncpus=1
```

```

pbs.server().job(511.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().job(511.jupiter.example.com).stime=1410942250
pbs.server().job(511.jupiter.example.com).session_id=12134
pbs.server().job(511.jupiter.example.com).jobdir=/home/TestUser
pbs.server().job(511.jupiter.example.com).substate=42
pbs.server().job(511.jupiter.example.com).Variable_List=PBS_O_SYSTEM=Linux,PBS_O_SHELL=/bin/
  bash,Monsieur=Shlomi,PBS_O_HOME=/home/
  TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_LOGNAME=TestUser,PBS_O_WORKDIR=/home/TestUser/
  jobs,PBS_O_LANG=en_US.UTF-8,PBS_O_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/
  TestUser,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/
  bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/
  opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin
pbs.server().job(511.jupiter.example.com).euser=TestUser
pbs.server().job(511.jupiter.example.com).egroup=users
pbs.server().job(511.jupiter.example.com).hashname=511.jupiter.example.com
pbs.server().job(511.jupiter.example.com).queue_rank=192
pbs.server().job(511.jupiter.example.com).queue_type=E
pbs.server().job(511.jupiter.example.com).comment=Job run at Wed Sep 17 at 04:24 on
  (jupiter:ncpus=1)
pbs.server().job(511.jupiter.example.com).etime=1410942249
pbs.server().job(511.jupiter.example.com).run_count=1
pbs.server().job(511.jupiter.example.com).Submit_arguments=<jsdl-hpcpa:Argument>job.scr</jsdl-
  hpcpa:Argument>
pbs.server().job(511.jupiter.example.com).project=_pbs_project_default
pbs.server().job(511.jupiter.example.com).run_version=1
pbs.server().queue(workq).queue_type=Execution
pbs.server().queue(workq).total_jobs=3
pbs.server().queue(workq).state_count=Transit:0 Queued:0 Held:2 Waiting:0 Running:1 Exiting:0
  Begun:0
pbs.server().queue(workq).resources_assigned[mem]=0mb
pbs.server().queue(workq).resources_assigned[ncpus]=1
pbs.server().queue(workq).resources_assigned[nodect]=1
pbs.server().queue(workq).enabled=True
pbs.server().queue(workq).started=True
pbs.server().queue(R503).queue_type=Execution
pbs.server().queue(R503).total_jobs=0
pbs.server().queue(R503).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(R503).acl_user_enable=True
pbs.server().queue(R503).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R503).resources_max[ncpus]=1
pbs.server().queue(R503).resources_max[walltime]=00:30:00
pbs.server().queue(R503).resources_available[ncpus]=1
pbs.server().queue(R503).resources_available[walltime]=00:30:00
pbs.server().queue(R503).enabled=True
pbs.server().queue(R503).started=False
pbs.server().queue(R504).queue_type=Execution
pbs.server().queue(R504).total_jobs=0

```

```
pbs.server().queue(R504).state_count=Transit:0 Queued:0 Held:0 Waiting:0 Running:0 Exiting:0
  Begun:0
pbs.server().queue(R504).acl_user_enable=True
pbs.server().queue(R504).acl_users=TestUser@jupiter.example.com
pbs.server().queue(R504).resources_max[ncpus]=1
pbs.server().queue(R504).resources_max[walltime]=00:30:00
pbs.server().queue(R504).resources_available[ncpus]=1
pbs.server().queue(R504).resources_available[walltime]=00:30:00
pbs.server().queue(R504).enabled=True
pbs.server().queue(R504).started=False
pbs.server().vnode(jupiter).Mom=jupiter.example.com
pbs.server().vnode(jupiter).Port=15002
pbs.server().vnode(jupiter).pbs_version=PBSPPro_10.0
pbs.server().vnode(jupiter).ntype=0
pbs.server().vnode(jupiter).state=0
pbs.server().vnode(jupiter).pcpus=1
pbs.server().vnode(jupiter).jobs=511.jupiter.example.com/0
pbs.server().vnode(jupiter).resv=R504.jupiter.example.com, R503.jupiter.example.com
pbs.server().vnode(jupiter).resources_available[arch]=linux
pbs.server().vnode(jupiter).resources_available[file]=7gb
pbs.server().vnode(jupiter).resources_available[host]=jupiter
pbs.server().vnode(jupiter).resources_available[mem]=8gb
pbs.server().vnode(jupiter).resources_available[ncpus]=8
pbs.server().vnode(jupiter).resources_available[vnode]=jupiter
pbs.server().vnode(jupiter).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(jupiter).resources_assigned[mem]=0kb
pbs.server().vnode(jupiter).resources_assigned[naccelerators]=0
pbs.server().vnode(jupiter).resources_assigned[ncpus]=1
pbs.server().vnode(jupiter).resources_assigned[vmem]=0kb
pbs.server().vnode(jupiter).resv_enable=True
pbs.server().vnode(jupiter).sharing=1
pbs.server().vnode(mars).Mom=mars.example.com
pbs.server().vnode(mars).Port=15002
pbs.server().vnode(mars).pbs_version=PBSPPro_10.0
pbs.server().vnode(mars).ntype=0
pbs.server().vnode(mars).state=0
pbs.server().vnode(mars).pcpus=1
pbs.server().vnode(mars).resources_available[arch]=linux
pbs.server().vnode(mars).resources_available[file]=7gb
pbs.server().vnode(mars).resources_available[host]=mars
pbs.server().vnode(mars).resources_available[mem]=8gb
pbs.server().vnode(mars).resources_available[ncpus]=8
pbs.server().vnode(mars).resources_available[vnode]=mars
pbs.server().vnode(mars).resources_assigned[accelerator_memory]=0kb
pbs.server().vnode(mars).resources_assigned[mem]=0kb
pbs.server().vnode(mars).resources_assigned[naccelerators]=0
```

```
pbs.server().vnode(mars).resources_assigned[ncpus]=0
pbs.server().vnode(mars).resources_assigned[vmem]=0kb
pbs.server().vnode(mars).resv_enable=True
pbs.server().vnode(mars).sharing=1
pbs.server().resv(R503.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R503.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).reserve_type=2
pbs.server().resv(R503.jupiter.example.com).reserve_state=2
pbs.server().resv(R503.jupiter.example.com).reserve_substate=2
pbs.server().resv(R503.jupiter.example.com).reserve_start=1410955200
pbs.server().resv(R503.jupiter.example.com).reserve_end=1410957000
pbs.server().resv(R503.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R503.jupiter.example.com).queue=R503
pbs.server().resv(R503.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R503.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R503.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R503.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R503.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).server=jupiter.example.com
pbs.server().resv(R503.jupiter.example.com).ctime=1410940237
pbs.server().resv(R503.jupiter.example.com).mtime=1410940237
pbs.server().resv(R503.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R503.jupiter.example.com).euser=TestUser
pbs.server().resv(R503.jupiter.example.com).egroup=users
pbs.server().resv(R504.jupiter.example.com).Reserve_Name=NULL
pbs.server().resv(R504.jupiter.example.com).Reserve_Owner=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).reserve_type=2
pbs.server().resv(R504.jupiter.example.com).reserve_state=2
pbs.server().resv(R504.jupiter.example.com).reserve_substate=2
pbs.server().resv(R504.jupiter.example.com).reserve_start=1410958800
pbs.server().resv(R504.jupiter.example.com).reserve_end=1410960600
pbs.server().resv(R504.jupiter.example.com).reserve_duration=1800
pbs.server().resv(R504.jupiter.example.com).queue=R504
pbs.server().resv(R504.jupiter.example.com).Resource_List[ncpus]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[walltime]=00:30:00
pbs.server().resv(R504.jupiter.example.com).Resource_List[nodect]=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[select]=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).Resource_List[place]=free
pbs.server().resv(R504.jupiter.example.com).schedselect=1:ncpus=1
pbs.server().resv(R504.jupiter.example.com).resv_nodes=(jupiter:ncpus=1)
pbs.server().resv(R504.jupiter.example.com).Authorized_Users=TestUser@jupiter.example.com
pbs.server().resv(R504.jupiter.example.com).server=jupiter.example.com
```

```
pbs.server().resv(R504.jupiter.example.com).ctime=1410940250
pbs.server().resv(R504.jupiter.example.com).mtime=1410940250
pbs.server().resv(R504.jupiter.example.com).Variable_List=PBS_O_LOGNAME=TestUser,PBS_O_HOST=jupiter.example.com,PBS_O_MAIL=/var/spool/mail/TestUser
pbs.server().resv(R504.jupiter.example.com).euser=TestUser
pbs.server().resv(R504.jupiter.example.com).egroup=users
```

List the `execjob_launch` hook execution record file:

```
jupiter:/var/spool/PBS/spool # cat hook_execjob_launch_launch_12135.out
pbs.event().accept=True
pbs.event().reject=False
pbs.event().progname=/bin/sleep
pbs.event().argv[0]=sleep
pbs.event().env=PBS_O_SYSTEM=Linux,PBS_JOBCOOKIE=00000000434AB4BA00000000BDC62D3,PBS_O_SHELL=/bin/bash,PBS_O_HOME=/home/TestUser,PBS_O_HOST=jupiter.example.com,PBS_NODENUM=0,PBS_O_LOGNAME=TestUser,PBS_JOBID=511.jupiter.example.com,PBS_JOBNAME=job.scr,PBS_O_LANG=en_US.UTF-8,USER=TestUser,PATH=/bin:/usr/bin,HOME=/home/TestUser,PBS_QUEUE=workq,PBS_O_MAIL=/var/spool/mail/TestUser,PBS_TMPDIR=/var/tmp/pbs.511.jupiter.example.com,ENVIRONMENT=BATCH,PBS_NODEFILE=/var/spool/PBS/aux/511.jupiter.example.com,SHELL=/bin/bash,PBS_ENVIRONMENT=PBS_BATCH,Monsieur=Shlomi,OMP_NUM_THREADS=1,NCPUS=1,PBS_JOBDIR=/home/TestUser,PBS_O_QUEUE=workq,PBS_MOMPORT=15003,PBS_O_WORKDIR=/home/TestUser/jobs,PBS_O_PATH=/usr/local/bin:/usr/local/bin:/usr/local/bin:/usr/lib64/mpi/gcc/openmpi/bin:/home/TestUser/bin:/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/X11R6/bin:/usr/games:/opt/pbs/bin:/opt/pbs/bin:/opt/pbs/bin,LOGNAME=TestUser,PBS_TASKNUM=1,TZ=US/Eastern
```

8.9 Interactive Debugging using `pbs_python`

You can perform interactive debugging by leaving out the hook name and supplying event input information and/or site data information. For example, to interactively debug with event input and site data information:

```
pbs_python --hook -i MyEventInputFile -s MySiteData
```

You get a `pbs_python` prompt, and in order to end the session, issue a `pbs.event().accept()` or `pbs.event().reject()`:

```
>>import pbs
>>print pbs.event().job.id
1234.examplehost
>>pbs.event().accept()
```

8.10 Error Reporting and Logging

Hook errors are printed to `stderr` for the command (`qsub`, `qalter`, `pbs_rsub`, or `qmove`) that triggered the hook. If the hook provides a custom error message, that message is treated the same way.

Hooks can log custom strings to the log file of the daemon from which the hook is executing. When logging a message, a hook uses message logging methods to specify the message, and constant objects to specify the log event class. See ["pbs.logmsg\(\)" on page 152](#), and [section 6.13.4.4, "Message Log Level Objects", on page 152](#).

When the PBS server starts, it prints to the server logs both the Python version integrated with the server, and a list of all the hook names registered with the server.

To see only hook-related 0x0400 messages in the MoM logs, such as “<hook name>;started”, “<hook_name>;finished”, set the \$logevent MoM parameter to *0x400* in the MoM configuration file.

To see all the different types of MoM log messages, set \$logevent to *0xffff*.

The default value for the \$logevent MoM parameter is *975*, so that the following log events are captured. See [“Log Levels” on page 375 of the PBS Professional Reference Guide](#) for more about log levels.

```
PBSEVENT_ERROR
PBSEVENT_SYSTEM
PBSEVENT_ADMIN
PBSEVENT_JOB
PBSEVENT_JOB_USAGE
PBSEVENT_SECURITY
PBSEVENT_DEBUG
PBSEVENT_DEBUG2
PBSEVENT_RESV
```

8.10.1 Errors During Creation and Deployment

8.10.1.1 Hook Name Matches Existing Hook

Creating a hook whose name matches that of an existing hook: the following error message is printed in stderr and in the server logs:

```
"hook error: hook name <hook_name> already registered, try another name"
```

8.10.1.2 Using a Hook Name that Starts with *PBS*

Using a hook name that starts with “*PBS*”: the hook name is rejected with the following error in qmgr's stderr, as well as in the server logs:

```
"hook error: cannot use PBS as a prefix - it is reserved for PBS hooks"
```

8.10.1.3 Deleting a Non-Existent Hook

Deleting a non-existent hook: the following is returned in qmgr's stderr and server logs:

```
"qmgr: hook error: <non-existent hook name> does not exist"
```

8.10.1.4 Specifying a Non-Existent Event Type

Specifying a non-existent event type: an error message is printed to qmgr's stderr and also to the server logs:

Example:

```
Qmgr: set hook hook1 event="mom_checkpoint"
```

```
"hook error: invalid argument to event. Should be one of: queuejob, modifyjob, resvsub, movejob,
runjob, provision, execjob_begin, execjob_prologue, execjob_epilogue, execjob_preterm,
execjob_end, exechost_periodic, execjob_launch, exechost_startup, execjob_attach or "" for no
event."
```

```
"qmgr: hook error returned from server"
```


8.10.1.5 Using a Bad Hook Value

Putting in a bad hook value: an error is printed to `qmgr`'s `stderr` and also to the server logs:

Example:

```
Qmgr: set hook hook2 order=1025
"qmgr obj=hookA svr=default: order given (1025) is outside the acceptable range of [1, 1000] for
  type 'site'."
"qmgr: hook error returned from server"
```

8.10.1.6 Unauthorized User

If `qmgr` is invoked, and the object being operated on is "`hook`", and the executing user at some host does not have access to the target server's private location for hooks data, then the following error is issued to `stderr` and server logs:

```
"<user>@<host> is unauthorized to access hooks data from server <hostname>"
```

8.10.1.7 Setting a Bad Hook Type

Setting a bad type to a hook produces the following error message in `qmgr`'s `stderr` and also in the server logs:

```
"hook error: invalid argument to type. Must be site"
```

8.10.1.8 Setting a Bad Alarm Value

Setting a bad alarm value to a hook produces the following error message in `qmgr`'s `stderr` and also in the server logs:

```
"hook error: alarm value of a hook must be > 0"
```

8.10.1.9 Exporting To Non-Writable File

Exporting a hook's content to a file that is not writable due to ownership or permission problems results in the following error message being printed to `stderr`:

```
"qmgr: hook error: <output_file> permission denied"
```

8.10.1.10 Setting Bad Hook user Attribute

Setting a value for the `user` attribute of a hook to something other than "`pbsadmin`" produces the following error message in `qmgr`'s `stderr` and also in the server logs:

```
"hook error: user value of a hook must be pbsadmin, pbsuser"
```

This attribute does not need to be set to the actual name of the PBS service account.

8.10.1.11 Importing From Non-Readable File

Importing a hook where the PBS server is unable to open the input file because the file is non-existent, has a permission problem, or any other system-related error causes the following error message to be printed in `stderr` and in the server logs:

```
"qmgr: hook error: unable to open <filename> by server run by <user>@<host>: <error message>"
```

Examples:

```
"qmgr: hook error: unable to open hook1.py by server run by pbsadmin@hostX: permission denied"
"qmgr: hook error: unable to open hook1.py by server run by pbsadmin@hostY: No such file or
  directory"
```

8.10.1.12 Importing or Exporting with Wrong Content Type

Importing or exporting a hook where the *<content-type>* is something other than “*application/x-python*” causes the following error message to be printed in `stderr` and in the server logs:

```
"qmgr: hook error: <content_type> must be 'application/x-python'"
```

Importing/exporting a hook where the *<content-encoding>* is something other than “*default*” or “*base64*” causes the following error message to be printed in `stderr` and on the server logs:

```
"qmgr: hook error: <content_encoding> must be 'default' or 'base64'"
```

An import call on a hook that already has a content script results in the following informational message being printed in `stdout` and server logs:

```
"qmgr: hook <hook_name> contents overwritten by file <hook input file>
```

8.10.1.13 Setting Vnode State to Invalid Value

Setting a vnode’s `state` attribute to an invalid value causes the `pbs.BadAttributeValueError` exception to be raised.

8.10.1.14 Creating a Hook with Same Name as Existing Hook

You may find that when you remove a hook, it may take some time for the hook to be completely purged. If you run `"qmgr -c 'create hook <hook_name>'"` where a previous hook of the same *<hook_name>* still exists, you will see the following message:

```
"hook name <hook_name> is pending delete, try another name"
```

Either specify another name for the hook, or retry the `qmgr` request again later, after the previous hook is completely purged.

8.10.2 Errors And Messages During Hook Execution

8.10.2.1 Successful Operation of runjob Hook

When a hook successfully sets an attribute, one of the following is written to the server’s log:

```
<job ID>; '<hook name>' hook set job's <attribute name> = <value>
```

or

```
Job held by '<hook name>' hook on <timedate>
```

8.10.2.2 Unsuccessful Operation for runjob Hook

When a hook fails to set an attribute, the following is written to the server’s log:

```
<job ID>; '<hook name>' hook failed to set job's <attribute name> = <value>
```

8.10.2.3 Rejecting an Action

If a hook rejects an action by calling the `pbs.event().reject()` function:

- The following messages are printed to `stderr` of the command that triggered the hook:

```
"<command_name>: Request rejected by filter hook <hook_name>" "<command_name>:<'msg' value passed to pbs.event().reject()>"
```


where 'msg' is the message passed (if any) as input to `pbs.event().reject()`.

- The following messages are printed in the appropriate PBS daemon log, logged at event class 0x0400:

```
"<user>@<host>...<request type> request rejected by <hook name> "<user>@<host> ...<request type>
<'msg' value passed to pbs.event().reject()>"
```

8.10.2.4 Triggering an Alarm

If the alarm was triggered while executing a hook:

- The command that initiated the request gets the following messages in its `stderr`:

```
"<command_name>: Request rejected by filter hook <hook_name>" "<command_name>: alarm call while
running hook <hook_name>"
```
- The following entry appears in the appropriate PBS daemon log, logged under event class PBSEVENT_DEBUG2:

```
"<user>@<host>...<request type> alarm call while running hook <hook_name>, request rejected"
```

8.10.2.5 Encountering an Unhandled Exception

If a hook encounters an unhandled exception:

- PBS rejects the corresponding action. The command that triggered the hook gets the following message in `stderr`:

```
"<command_name>: request rejected as filter hook <hook_name> encountered an exception. Inform
admin."
```
- The following message appears on the appropriate PBS daemon log, logged under PBSEVENT_DEBUG2 event class:

```
"<request type> hook <hook_name> encountered an exception, request rejected"
```

See [section 5.2.3, "Hook Alarm Calls and Unhandled Exceptions", on page 43](#).

8.10.2.6 Starting and Finishing Hook Execution

Whenever hook execution starts or finishes, timestamped 0x0400 event class log messages appear in the appropriate PBS daemon log:

```
"11/13/2007 00:00:42 ...<user>@<host>...<request type> running hook named <hook name>"
"11/13/2007 00:01:42<user@><host>...<request type> <hook_name> finished"
```

8.10.2.7 Hook Timeout

When a hook timeout is triggered, the hook script gets a Python `KeyboardInterrupt` from the PBS server. The server logs show the following:

```
06/17/2008 17:57:16;0001;Server@host2;Svr;Server@host2;PBS server internal error (15011) in
Python script received a KeyboardInterrupt, <type 'exceptions.KeyboardInterrupt'>
```

8.10.2.8 Hooks Attempting I/O

When the PBS server is running, `stdout`, `stderr`, and `stdin` are closed, so that a hook script containing calls to print to standard output or standard error, or to read input from standard input, gets the following exception:

```
02/24/2008 08:03:34;0086;Server@a-centauri;Svr;Server@a-centauri;Compiling script file: </var/
spool/pbs/server_priv/hooks/hook_test.PY>
02/24/2008 08:03:34;0001;Server@a-centauri;Svr;Server@a-centauri;PBS server internal error
(15011) in Error evaluating Python script, <type 'exceptions.IOError'>
```

8.10.2.9 Bad Value for debug Attribute

If you specify an invalid value for a hook's debug attribute, the following error message appears in `qmgr`'s `STDERR`:

```
"unexpected value '<bad_val>' must be (not case sensitive) true|t|y|1|false|f|n|0"
```

8.10.2.10 Commands Fail Inside Hooks

When a command fails inside a hook, but succeeds outside the hook, the problem may be a difference in the environments.

8.10.2.11 runjob Hook Errors

8.10.2.11.i Modifying Hold, Execution Time, Dependency, or Project of Accepted Job

If a `runjob` hook accepts an event request, using `pbs.event().accept()`, but attempts to set a disallowed attribute, the hook request is rejected.

If the hook is triggered by a `qrun` command, the following message is sent to `stderr` where the `qrun` command was run. If the hook is triggered when the scheduler tries to run the job, the following message is written to the job's `comment` attribute:

```
request rejected by filter hook <hook_name>: cannot modify job after runjob request has been
accepted.
```

The following message is written to the PBS server log, at log event class `PBSEVENT_DEBUG2`:

```
<hook name>; Found job <attribute name> attribute flagged to be set
runjob request rejected by <hook name>: cannot modify job after runjob request has been accepted.
```

8.10.2.11.ii Modifying Disallowed Attributes of Rejected Job

If a `runjob` hook rejects an event request, using `pbs.event().reject()`, but attempts to do any of the above, the following message is written to the PBS server log, at log event class `0x0100`:

```
runjob request rejected by <hook name>: cannot modify job attribute
<attribute name> after runjob request has been rejected.
```

8.10.2.11.iii Modifying Vnode

If a `runjob` hook event is accepted via a `pbs.event().accept()` call, and yet an attempt is made to modify a `vnode`'s state, then the hook request is rejected. The following message is sent to the `stderr` of `qrun`, and becomes the job's `comment`:

```
request rejected by filter hook <hook_name>: cannot modify vnode after runjob request has been
accepted.
```

The following message appears in the PBS server log, logged at event class `PBSEVENT_DEBUG2`:

```
runjob request rejected by <hook name>: cannot modify a vnode after runjob request has been
accepted.
```

8.10.2.11.iv runjob Hook Referencing Wrong Parameter

If a `runjob` hook attempts to reference a `pbs.event()` parameter other than `pbs.event().job`, the exception `pbs.EventIncompatibleError` is raised.

8.10.2.11.v Attempting to Set Restricted Resource

A `runjob` hook cannot set the value of a `Resource_List` member other than those listed in [Table 5-9, "Built-in Job Resources Readable & Settable by Hooks via Events," on page 60](#).

Setting any of the wrong resources results in the following:

- The hook request is rejected
- The following message is sent to the `STDERR` of `qrun`, or after the failed `pbs_runjob()`:
`" request rejected by filter hook: '<hook name>' hook failed to set job's Resource_List.<resc_name> = <resc_value> (not allowed)"`
- The scheduler updates the affected job's comment attribute with the above message.
- The following message appears in the server's log, logged at level `PBSEVENT_DEBUG2`:
`"runjob request rejected: '<hook name>' hook failed to set job's Resource_list.<resc_name> = <resc_value> (not allowed)"`

8.10.2.12 Special Errors Requiring Support

If you encounter any of the following log messages, an internal failure has occurred during hook setup. Please contact PBS Professional support:

```
04/15/2011 17:55:23;0100;Server@jobim;Hook;<hook_name>t3;Encountered an error while setting event
04/15/2011 17:55:23;0001;Server@jobim;Svr;Server@jobim;PBS server internal error (15011) in
  _get_job, partially populated python job object
04/15/2011 17:55:23;0001;Server@jobim;Svr;Server@jobim;PBS server internal error (15011) in
  _get_server, partially populated python server object
04/15/2011 17:55:26;0001;Server@jobim;Svr;Server@jobim;PBS server internal error (15011) in
  _get_queue, partially populated python queue object
04/15/2011 17:55:26;0001;Server@jobim;Svr;Server@jobim;PBS server internal error (15011) in
  _get_vnode, partially populated python vnode object
04/15/2011 17:55:26;0001;Server@jobim;Svr;Server@jobim;PBS server internal error (15011) in
  _get_resv, warning: partially populated python resv object
```

8.10.3 Errors During Startup

If the server starts up and encounters a hook that has no content (no script was imported into the hook), PBS displays the following warning:

```
"failed to stat <path_server_priv_hooks>/<hook_name>.PY"
"failed to allocate storage for python script
<path_server_priv_hooks>/<hook_name>.PY"
```

8.10.4 Errors in Hook Updates

Updates to hooks are asynchronous with respect to jobs. During an update, some jobs may run on updated MoMs while others run on MoMs that are not yet updated. A multi-host job that started running before the update may find itself running on some MoMs that are updated and some that are not. In addition, a multi-host job that starts during the update may start on updated and non-updated MoMs. When a job triggers a hook, the hook that runs is the current hook, not the hook that was there when the job started. If you change, delete, or add a hook while a job is running, and the job subsequently triggers the hook, that job will encounter whatever changes have propagated to the MoM.

- If a job runs where a hook update is incomplete, PBS prints the following to the server's log file:
`"vnode <node_name>'s parent mom <mom_host>:<mom_port> has a pending copy hook or delete hook request"`

Bear in mind that hooks are updated asynchronously with respect to jobs, so a multi-host job that started before the update may encounter an incompletely updated hook.

- As PBS copies or deletes execution or periodic hooks to the MoMs, the following messages are printed in the server's log file at 2047:

```
"successfully sent hook file <filename> to <mom_hostname>"
"successfully sent rescdef file <filename> to <mom host name>"
"successfully deleted hook file <filename> from <mom host name>"
"successfully deleted rescdef file <filename> from <mom host name>"
"failed to copy hook file <filename> to <mom host name>"
"failed to copy rescdef file <filename> to <mom host name>"
"failed to delete hook file <filename> from <mom host name>"
"failed to delete rescdef file <filename> from <mom host name>"
```

- You may find that when you remove a hook, it takes some time for the hook to be completely purged. If you run `qmgr -c 'create hook <hook_name>'` where a previous hook of the same `<hook_name>` still exists, you will see the following message:

```
"hook name <hook_name> is pending delete, try another name"
```

Either specify another name for the hook, or retry the `qmgr` request again later, after the previous hook is completely purged.

- If a hook tries to use a resource that is not yet propagated, this will cause an exception, which if unhandled, may delete the job. Write your hooks so that they trap exceptions and deal gracefully with the job. For example, you can use `pbs.event().job.rerun()`. Custom resources are propagated to MoMs under the following circumstances:
 - When you install PBS on a multi-vnoded machine
 - When you add MoMs, resources are propagated to those MoMs
 - When you create a custom resource inside a hook

8.10.5 Hook-related Error Codes

The following are hook-related error codes:

Table 8-2: Hook-related Error Codes

Error Name	Code	Description
<i>PBSE_MOM_INCOMPLETE_HOOK</i>	15167	Execution hook not fully transferred to a particular MoM
<i>PBSE_MOM_REJECT_ROOT_SCRIPTS</i>	15168	A MoM has rejected a request to copy a hook-related file, or a job script to be executed by root
<i>PBSE_HOOK_REJECT</i>	15169	A MoM received a reject result from an execution or periodic hook
<i>PBSE_HOOK_REJECT_RERUNJOB</i>	15170	Hook rejection requiring a job to be rerun
<i>PBSE_HOOK_REJECT_DELETEJOB</i>	15171	Hook rejection requiring a job to be deleted

8.10.6 Troubleshooting

8.10.6.1 Bad Interpreter Path

If you see the following error:

```
/opt/pbs/bin/pbs_python: bad interpreter: No such file or directory
```

You should check to see whether this is a valid path on this host. Try to `cd` to the job execution directory and execute any command using this interpreter path.

8.10.6.2 Viewing Hook Propagation

You don't need to restart `pbs_mom` for a MoM hook to take effect. If you use `qmgr`, PBS takes care of copying the new hook over to the MoM, in the background. It's possible a job may have seen the old MoM hook before the new hook arrives. After the new hook arrives, you'll see a message in the `server_logs` with the following:

```
vnode <name>'s parent mom <mom_name> has a pending copy hook or delete hook request
```


9

Hook Examples

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9.1 resvsub Hook Examples

Example 9-1: Restrict ability to submit reservations to PBS administrators

Hook type: resvsub

Script NoSub.py on Windows:

```
import pbs
import os
e = pbs.event()
r = e.resv
who = e.requestor
pbs.logmsg(pbs.LOG_DEBUG, "requestor=%s" % (who,))
isadmin=0

admin_ulist = ["PBS_Server", "Scheduler", "pbs_mom", "Administrator"]
if who in admin_ulist:
    isadmin=1
else:
    cmd = "net user " + who + "/domain"
    admin_glist = ['Administrators', 'Domain Admins', 'Enterprise
        Admins']
    for line in os.popen(cmd).readlines():
        if line.find("Group") >= 0:
            for li in line.split("*"):
                if li.strip() in admin_glist:
                    isadmin=1
                    break
if e.type == pbs.RESVSUB and not isadmin:
    e.reject("Only admins allowed to create reservations!")
```


Script NoSub.py on Linux:

```
import pbs
import os
e = pbs.event()
r = e.resv
who = e.requestor
pbs.logmsg(pbs.LOG_DEBUG, "requestor=%s" % (who,))

admin_ulist = ["PBS_Server", "Scheduler", "pbs_mom", "root"]

if e.type == pbs.RESVSUB and who not in admin_ulist:
    e.reject("Only admins allowed to create reservations!")
```

Create hook and import script:

```
qmgr -c 'create hook NoSub event="resvsub"'
qmgr -c 'import hook NoSub application/x-python default NoSub.py'
```

9.2 queuejob Hook Examples

Example 9-2: Reject jobs which do not specify walltime

Hook type: queuejob

Script RequireWalltime.py:

```
import pbs
import sys

try:
    e = pbs.event()
    j = e.job
    if j.Resource_List["walltime"] == None :
        e.reject("Job has no walltime requested")

except SystemExit:
    pass

except pbs.UnsetResourceNameError:
    e.reject("Job has no walltime requested")
```

Create hook and import script:

```
qmgr -c 'create hook RequireWalltime event="queuejob"'
qmgr -c 'import hook RequireWalltime application/x-python default RequireWalltime.py'
```

Example 9-3: *Reject jobs with CPU requests that are not multiples of 8*

Hook type: queuejob

Script Multiple8.py:

```
import pbs
import sys

e = pbs.event()
j = e.job

mult_limit = 8

if j.Resource_List["ncpus"] != None:
    try:
        e = pbs.event()
        j = e.job
        R = j.Resource_List["ncpus"] % mult_limit
        if R != 0:
            e.reject("Ncpus resource is not a multiple of %s." % (mult_limit,))
    except SystemExit:
        pass
    except (pbs.UnsetResourceNameError, TypeError):
        e.reject("Bad ncpus resource value.")

else:
    R = pbs.event().job.Resource_List
    sel = repr(R["select"])
    tot_ncpus = 0
    for chunk in sel.split("+"):
        nchunks = 1
        for c in chunk.split(":"):
            kv = c.split("=")
            if len(kv) == 1:
                nchunks = kv[0]
            elif len(kv) == 2:
                if kv[0] == "ncpus":
                    tot_ncpus += (int(nchunks) * int(kv[1]))

    try:
        mod = tot_ncpus % mult_limit
        if mod != 0:
            e.reject("Ncpus resource is not a multiple of %s." % \
                (mult_limit,))
    except SystemExit:
        pass
    except (pbs.UnsetResourceNameError, TypeError):
```

```
e.reject("Bad Ncpus resource value.")
```

Create hook and import script:

```
qmgr -c 'create hook Multiple8 event="queuejob"
qmgr -c 'import hook Multiple8 application/x-python default Multiple8.py'
```

Example 9-4: *If a user asks for `-l ncpus=8:ppn=24`, change `ncpus` to 24*

Hook type: `queuejob`

Script `ChangeNcpus.py`:

```
import pbs
import sys

try:
    e = pbs.event()
    j = e.job
    j.Resource_List["ncpus"] = max(j.Resource_List["ncpus"], j.Resource_List["ppn"])

except SystemExit:
    pass

except (pbs.UnsetResourceNameError, pbs.BadResourceValError):
    e.reject("Failed to reset ncpus value")
```

Create hook and import script:

```
qmgr -c 'create hook ChangeNcpus event="queuejob"'
qmgr -c 'import hook ChangeNcpus application/x-python default ChangeNcpus.py'
```

Example 9-5: Calculate and set custom resource

Hook type: queuejob

Custom resource `cph` == total `ncpus` * `walltime` (in hours). Calculate it and set its value.

You must create the `cph` resource before using it.

Script `CustCPH.py`:

```
import pbs

R = pbs.event().job.Resource_List
sel = repr(R["select"])
tot_ncpus = 0
for chunk in sel.split("+"):
    nchunks = 1
    for c in chunk.split(":"):
        kv = c.split("=")
        if len(kv) == 1:
            nchunks = kv[0]
        elif len(kv) == 2:
            if kv[0] == "ncpus":
                tot_ncpus += (int(nchunks) * int(kv[1]))
R["cph"] = tot_ncpus * R["walltime"]
```

Create hook and import script:

```
qmgr -c 'create hook CustCPH event="queuejob"
qmgr -c 'import hook CustCPH application/x-python default CustCPH.py'
```

Example 9-6: *Put interactive jobs in a particular queue*

Hook type: queuejob

Put job into “interQ” if the job was submitted interactively (using `qsub -I`).

Script IQueue.py:

```
# get the pbs module
import pbs
import sys
try:
    # Get the hook event information and parameters
    # This will be for the 'queuejob' event type.
    e = pbs.event()

    # Get the information for the job being queued
    j = e.job
    if j.interactive:
        # Get the "interQ" queue object
        q = pbs.server().queue("interQ")
        # Reset the job's destination queue
        # parameter for this event
        j.queue = q
        # accept the event
        e.accept()
except SystemExit:
    pass
except:
    e.reject("Failed to route job to queue interQ")
```

Create hook and import script:

```
qmgr -c 'create hook IQueue event="queuejob"'
qmgr -c 'import hook IQueue application/x-python default IQueue.py'
```

Example 9-7: *Set job project based on queue where job is submitted*

Hook type: queuejob

The following is a snippet of a queuejob hook:

```
import pbs
e = pbs.event()
If e.job.queue == None:
    # user did not specify a queue to submit to, so use default
    target_qname = pbs.server().default_queue
else:
    target_qname = e.job.queue.name
If (target_qname == "large") or (target_qname == "medium"):
    e.job.project = "some_large_medium_project"
```

Example 9-8: *Speed up throughput of interactive jobs*

Hook type: `queuejob`

Use a `queuejob` hook that determines whether a job entering the system is an interactive job. If so, it directs the job to the high priority queue specified in `'high_priority_queue'`, and tells the server to restart the scheduling cycle. You must first define a "high" queue as follows:

```
qmgr -c "create queue high queue_type=e,Priority=150"
qenable high
qstart high
```

The default priority for an express queue is `150`. If you do not want interactive jobs to go into an express queue, set the priority of the queue named "high" to a value greater than ordinary queues but lower than the value for an express queue. See [section 4.9.18, "Express Queues", on page 137](#).

Instantiate the hook as follows:

```
qmgr -c "create hook rapid_inter event=queuejob"
qmgr -c "import hook rapid_inter application/x-python default rapid_inter.py"
```

Hook script:

```
import pbs

high_priority_queue="high"

e = pbs.event()
if e.job.interactive:
    high = pbs.server().queue(high_priority_queue)
    if high != None:
        e.job.queue = high
        pbs.logmsg(pbs.LOG_DEBUG, "quick start interactive job")
        pbs.server().scheduler_restart_cycle()
```

Example 9-9: *Validate job account*

This hook reads valid accounts from a JSON file.

```
import os
import simplejson

try:
    import pbs

    pbs_conf = pbs.pbs_conf

except ImportError:
    pass

# Read in the configurations file
pbs_hook_cfg = pbs.hook_config_filename
if pbs_hook_cfg == None:
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s"%os.environ)
    pbs_hook_cfg = os.environ["PBS_HOOK_CONFIG_FILE"]
pbs.logmsg(pbs.EVENT_DEBUG3, "read config file: %s"%pbs.hook_config_filename)
config_file = open(pbs.hook_config_filename).read()

va_cfg = simplejson.loads(config_file)

#pbs.logmsg(pbs.EVENT_DEBUG2, "config file: %s"%va_cfg)

je = pbs.event()
j = pbs.event().job

user=je.requestor

account=j.Account_Name

#pbs.logmsg(pbs.EVENT_DEBUG2, "my Account_Name is: %s"%account)
#pbs.logmsg(pbs.EVENT_DEBUG2, "allowed users for this account are:
    %s"%va_cfg["accounts"][account])

if user in va_cfg["accounts"][account]:
    pbs.logmsg(pbs.EVENT_DEBUG2, "user is allowed to submit to account")
else:
    pbs.logmsg(pbs.EVENT_DEBUG2, "user is NOT allowed to submit to account")
    je.reject("user is unauthorized to submit to this account")
```

Here is an example JSON file with valid accounts:

```
{
  "accounts": {
    "account1":["user1"],
    "account11":["user11"],
    "account2":["user2"],
    "accountall":["user1","user2"]
  }
}
```

Example 9-10: Check job resource request and verify that job can run in this complex

```
#!/usr/bin/env python

# -*- coding: utf-8 -*-

#####
# Purpose: To check the request of the job and verify that it will be able to
#         run on this cluster
#
# Setup: Modify the config file. You will need to provide the correct
#        information for your complex
#####

import pbs
import sys
import os
from string import join
import simplejson as json
import traceback
import re
import string

pbs.logmsg(pbs.EVENT_DEBUG, "Entering the check limits hook")
e = pbs.event()

py_base_dir = pbs.pbs_conf['PBS_EXEC'] + "/python/lib/python2.5"
try:
    sys.path.index(py_base_dir + 'site-packages')
except ValueError:
    sys.path = [py_base_dir,
                py_base_dir + 'plat-linux2',
                py_base_dir + 'lib-tk',
                py_base_dir + 'lib-dynload',
                py_base_dir + 'site-packages'] \
                + sys.path

def caller_name():
    return str(sys._getframe(1).f_code.co_name)

# Define error codes

class AdminError(Exception):
    pass

class ConfigError(AdminError):
    pass
```

```
def e_reject(msg):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Message: %s" % (caller_name(), msg))
    pbs.event().reject(msg)

#
# FUNCTION decode_dict
#

def decode_dict(data):
    rv = {}
    for key, value in data.iteritems():
        if isinstance(key, unicode):
            key = key.encode('utf-8')
        if isinstance(value, unicode):
            value = value.encode('utf-8')
        elif isinstance(value, list):
            value = decode_list(value)
        elif isinstance(value, dict):
            value = decode_dict(value)
        rv[key] = value
    return rv

def decode_list(data):
    rv = []
    for item in data:
        if isinstance(item, unicode):
            item = item.encode('utf-8')
        elif isinstance(item, list):
            item = decode_list(item)
        elif isinstance(item, dict):
            item = decode_dict(item)
        rv.append(item)
    return rv

#
# FUNCTION convert_size
#
# Convert a string containing a size specification (e.g. "1m") to a
# string using different units (e.g. "1024k").
#
# This function only interprets a decimal number at the start of the string,
# stopping at any unrecognized character and ignoring the rest of the string.
#
# When down-converting (e.g. MB to KB), all calculations involve integers and
# the result returned is exact. When up-converting (e.g. KB to MB) floating
```

```

# point numbers are involved. The result is rounded up. For example:
#
# 1023MB -> GB yields 1g
# 1024MB -> GB yields 1g
# 1025MB -> GB yields 2g <-- This value was rounded up
#
# Pattern matching or conversion may result in exceptions.
#

def convert_size(value, units='b'):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    pbs.logmsg(pbs.EVENT_DEBUG3, "value: %s, units: %s" % (value, units))
    logs = {'b': 0, 'k': 10, 'm': 20, 'g': 30,
            't': 40, 'p': 50, 'e': 60, 'z': 70, 'y': 80}
    try:
        new = units[0].lower()
        if new not in logs:
            new = 'b'
        val, old = re.match('([-+]?\d+)([bkmgtpzey]?)',
                           str(value).lower()).groups()

        val = int(val)
        if val < 0:
            raise ValueError('Value may not be negative')
        if old not in logs.keys():
            old = 'b'
        factor = logs[old] - logs[new]
        val *= 2 ** factor
        slop = val - int(val)
        val = int(val)
        if slop > 0:
            val += 1
        # pbs.size() does not like units following zero
        if val <= 0:
            pbs.logmsg(pbs.EVENT_DEBUG3, "Return value: %s" % str(0))
            return '0'
        else:
            pbs.logmsg(pbs.EVENT_DEBUG3, "Return value: %s" % str(val) + new)
            return str(val) + new
    except:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Return value: None")
        return None

#
# FUNCTION size_as_int
#

```

```

# Convert a size string to an integer representation of size in bytes
#

def size_as_int(value):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    return int(convert_size(value).rstrip(string.ascii_lowercase))

#
# FUNCTION caller_name
#
# Return the name of the calling function or method.
#

# Read the config file in json format
def parse_config_file(e, s):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    config = {}

    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Server Name: %s" %
               (caller_name(), s.name))

# Identify the config file and read in the data
if pbs.hook_config_filename is not None:
    config_file = pbs.hook_config_filename
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Config file is %s" %
               (caller_name(), config_file))
    try:
        config = json.load(open(config_file, 'r'),
                           object_hook=decode_dict)
    except IOError:
        pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Encountered IOError:\n %s" %
                   (caller_name(), sys.exec_info()[0]))
        raise ConfigError("I/O error reading config file")
    except json.JSONDecodeError:
        pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Encountered DecodeError:\n %s" %
                   (caller_name(), sys.exec_info()[0]))
        raise ConfigError(
            "JSON parsing error reading config file")
    except Exception:
        pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Encountered error:\n %s" %
                   (caller_name(), sys.exec_info()[0]))
        raise
else:
    raise ConfigError("No configuration file present")

```

```

pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Config file:\n %s" %
           (caller_name(), config))
pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 0 " % (caller_name()))
# Set some defaults if they are not present
if 'clusters' not in config:
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 1 " % (caller_name()))
    e_reject("Please define the cluster inputs ")
pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 1.5 " % (caller_name()))
if s.name not in config['clusters']:
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 2 " % (caller_name()))
    e_reject("Cluster: %s needs to be " % s.name +
            "defined in the config file: %s" % config['clusters'].keys())
pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 2.5 " % (caller_name()))
pbs.logmsg(pbs.EVENT_DEBUG3, "%s: %s " % (caller_name(), s.name))
pbs.logmsg(pbs.EVENT_DEBUG3, "%s: %s " %
           (caller_name(), config["clusters"][s.name]))
if 'default_queue' not in config["clusters"][s.name]:
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 3 " % (caller_name()))
    # Find the default queue
    config["clusters"][s.name]['default_queue'] = s.default_queue
    # e_reject("Please define the default queue for the job")
else:
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 4 " % (caller_name()))
    try:
        s.queues(config["clusters"][s.name]['default_queue'])
        pbs.logmsg(pbs.EVENT_DEBUG3, "%s: I am here 5 " % (caller_name()))
    except:
        pbs.logmsg(pbs.EVENT_DEBUG3, "%s not found in pbs complex " %
                   config["clusters"][s.name]['default_queue'])
        config["clusters"][s.name]['default_queue'] = s.default_queue
        pbs.logmsg(pbs.EVENT_DEBUG3, "Changed default queue to %s" %
                   config["clusters"][s.name]['default_queue'])
if 'site_info' not in config["clusters"][s.name]:
    config["clusters"][s.name]['site_info'] = "not undefined"

pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Return Config file:\n %s" %
           (caller_name(), config))
return config

def chunk_resource_check(e, request, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    pbs.logmsg(pbs.EVENT_DEBUG3, "Request: %s" % (request))
    pbs.logmsg(pbs.EVENT_DEBUG3, "type: %s" % (type(request[0])))
    pbs.logmsg(pbs.EVENT_DEBUG3, "type: %s" % (type(request[1])))

```



```

resource = request[0]
if resource not in cluster:
    pbs.logmsg(pbs.EVENT_DEBUG3,
              "Resource %s is not defined in the cfg" %
              resource)

    try:
        pbs.logmsg(pbs.EVENT_DEBUG3,
                  "Trying to return an int for %s" % (request))
        return int(request[1])
    except:
        pbs.logmsg(pbs.EVENT_DEBUG3,
                  "Returning a string")
        return request[1]
elif resource == 'mem':
    value = pbs.size(request[1])
    clust_res = pbs.size(str(cluster[resource]))
elif isinstance(cluster[resource], int):
    value = int(request[1])
    clust_res = cluster[resource]
elif isinstance(cluster[resource], float):
    value = int(request[1])
    clust_res = cluster[resource]
else:
    pbs.logmsg(pbs.EVENT_DEBUG3, "Not checking resource: %s" % (resource))
    return True

pbs.logmsg(pbs.EVENT_DEBUG3, "Resource: %s" % (resource))
pbs.logmsg(pbs.EVENT_DEBUG3, "R:%s A:%s" %
          (str(request[1]), str(clust_res)))
if value > clust_res:
    pbs.logmsg(pbs.EVENT_DEBUG3, "I am here")
    line = "\nError: You requested %s=%s per " % (resource, value) + \
          "node. This exceeds the available %s " % resource + \
          "on a %s node (%s)\n" % (cluster['name'], clust_res)
    if resource == 'ncpus':
        clust_mem = pbs.size(str(cluster['mem']))
        line += "For example on %s use -l " % cluster['name'] + \
              "select=2:%s=%s:mem=%s" % \
              (resource, cluster[resource], clust_mem)
    else:
        line += "For example on %s use -l " % cluster['name'] + \
              "select=2:ncpus=%s:%s=%s" % \
              (cluster['ncpus'], resource, clust_res)
    line += "\nIf you still have questions, " + \
          "please refer to %s" % \

```

```

        cluster['site_info']
        pbs.logmsg(pbs.EVENT_DEBUG3, "line: %s" % (line))
        e_reject(line)
        return False
    pbs.logmsg(pbs.EVENT_DEBUG3, "Return %s value: %s" % (resource, value))
    return value

def job_ncpus_check(e, request, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    pbs.logmsg(pbs.EVENT_DEBUG3, "Request: %s" % (request))
    ncpus = int(request[1])
    if ncpus > int(cluster['ncpus']):
        line = "\nError: You requested ncpus=%d in a chunk. This " % ncpus + \
            "is more than is available on a %s " % cluster['name'] + \
            "compute node (%d).\n" % (int(cluster['ncpus']))
        line += "For example, on %s, use -l " % cluster['name'] + \
            "select=2:ncpus=%s:mpiprocs=%s " % \
            (cluster['ncpus'], cluster['ncpus']) + \
            "to use %d cores\n" % \
            (2 * int(cluster['ncpus']))
        line += "If you still have questions, refer to %s.\n" % \
            cluster['site_info']
        pbs.logmsg(pbs.EVENT_DEBUG3, "line: %s" % (line))
        e_reject(line)
    return ncpus

def job_mem_check(e, request, s, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    pbs.logmsg(pbs.EVENT_DEBUG3, "Request: %s" % (request))
    mem = pbs.size(request[1])

    clust_mem = pbs.size(str(cluster['mem']))
    pbs.logmsg(pbs.EVENT_DEBUG3, "Cluster mem: %s" % (clust_mem))
    if mem > clust_mem:
        pbs.logmsg(pbs.EVENT_DEBUG3, "I am here")
        line = "\nError: You requested %s of memory per " % mem + \
            "node. This exceeds the available memory " + \
            "on a %s node (%s)\n" % (cluster['name'], clust_mem)
        pbs.logmsg(pbs.EVENT_DEBUG3, "line: %s" % (line))
        line += "For example on %s use -l " % cluster['name'] + \
            "select=2:ncpus=%s:mpiprocs=%s:mem=%s" % \
            (cluster['ncpus'], cluster['ncpus'], clust_mem)
        pbs.logmsg(pbs.EVENT_DEBUG3, "line: %s" % (line))
        line += "\nIf you still have questions, " + \

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        "please refer to %s" % \
        cluster['site_info']
    e_reject(line)
    pbs.logmsg(pbs.EVENT_DEBUG3, "Return mem value: %s" % (mem))
    return mem

def job_size_mem(mem, ncpus, R, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "Check placement: %s" %
               (repr(R['place'])))
    if repr(R['place']).find('excl') == -1:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Set mem for non excl job")
        mem_line = 'mem=%s' % pbs.size(convert_size(ncpus * size_as_int(
            cluster['default_mem_per_core']), "mb"))
    else:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Set mem for excl job")
        mem_line = 'mem=%s' % pbs.size(convert_size(
            cluster['ncpus'] * size_as_int(
                cluster['default_mem_per_core']), "mb"))
    pbs.logmsg(pbs.EVENT_DEBUG3, "mem_line: %s" % mem_line)

    return mem_line

def job_requested_queue(j, s, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    # Check to see if the queue has been specified, if not specify the default
    # as defined in the config file.
    if hasattr(j.queue, 'name'):
        pbs.logmsg(pbs.EVENT_DEBUG3, "job queue: %s" %
                   j.queue.name)
    else:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Set job queue to : %s" %
                   cluster['default_queue'])
        j.queue = s.queue("%s" % cluster['default_queue'])
        pbs.logmsg(pbs.EVENT_DEBUG3, "job queue: %s" %
                   j.queue.name)
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Leaving" % (caller_name()))

def job_select_cores_only(sel, s, cluster):
    # Initialize local variables
    R = pbs.event().job.Resource_List
    tmp_select = list()

```

```

try:
    tot_ncpus = int(sel)
    tot_mpiprocs = int(sel)
    pbs.logmsg(pbs.EVENT_DEBUG3, "tot_ncpus: %s" % tot_ncpus)
    pbs.logmsg(pbs.EVENT_DEBUG3, "Mem/Core: %s" %
               cluster['default_mem_per_core'])
    tot_mem = pbs.size(convert_size(tot_ncpus *
                                    size_as_int(cluster['default_mem_per_core']), "mb"))

    pbs.logmsg(pbs.EVENT_DEBUG3, "tot_ncpus: %d\ttot_mem: %s" %
               (tot_ncpus, tot_mem))

# Check to see if tot_ncpus > total ncpus on cluster
if tot_ncpus > cluster['total_cpus']:
    reject_job("total", "ncpus", tot_ncpus, cluster['total_cpus'],
              s.name, cluster)

cores_per_node = int(cluster['ncpus'])
full_nodes = int(tot_ncpus / cores_per_node)
remaining_cores = tot_ncpus % cores_per_node

pbs.logmsg(pbs.EVENT_DEBUG3, "tot_ncpus: %d\tfull_nodes: %d\t" %
           (tot_ncpus, full_nodes) +
           "remaining_cores: %d\ttot_mem: %s" %
           (remaining_cores, tot_mem))

if 'resize_select' in cluster and cluster['resize_select']:
    pbs.logmsg(pbs.EVENT_DEBUG3, "Resizing select statement")
    if full_nodes == 0:
        tmp_select.append("1:ncpus=%d:mpiprocs=%d:mem=%s" %
                          (remaining_cores, remaining_cores, pbs.size(
                            convert_size(remaining_cores * size_as_int(
                                cluster['default_mem_per_core']), "mb"))))
    elif remaining_cores == 0:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Remaining cores: 0")
        pbs.logmsg(pbs.EVENT_DEBUG3, "Cluster: %s" % cluster)
        tmp_select.append("%d:ncpus=%d:mpiprocs=%d:mem=%s" %
                          (full_nodes, cores_per_node, cores_per_node,
                           pbs.size(convert_size(
                               int(cores_per_node) * size_as_int(
                                   cluster['default_mem_per_core']), "mb"))))
        pbs.logmsg(pbs.EVENT_DEBUG3, "tmp_select: %s" % tmp_select)
    else:
        tmp_select.append("%d:ncpus=%d:mpiprocs=%d:mem=%s" %
                          (full_nodes, cores_per_node, cores_per_node,
                           pbs.size(convert_size(

```

```

        cores_per_node * size_as_int(
            cluster['default_mem_per_core']), "mb"))))
    tmp_select.append("l:ncpus=%d:mpiprocs=%d:mem=%s" %
        (remaining_cores, remaining_cores,
        pbs.size(convert_size(
            remaining_cores * size_as_int(
                cluster['default_mem_per_core']), "mb"))))

    # Replace the old select statement with the new select statement
    R['select'] = pbs.select(join(tmp_select, '+'))
    pbs.logmsg(pbs.EVENT_DEBUG3, "New select Line: %s" % R['select'])
    pbs.logmsg(pbs.EVENT_DEBUG3, "Server: %s" % s.name)
    pbs.logmsg(pbs.EVENT_DEBUG3, "tot_ncpus: %d,\tcluster cores: %s" %
        (tot_ncpus, int(cluster['ncpus'])))
    return True
except ValueError:
    return False

def job_requested_resources(e, j, s, cluster, cfg):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))

    R = j.Resource_List
    sel = repr(R["select"])

    if R["select"] == None:
        sel = '1'
        pbs.logmsg(pbs.LOG_WARNING, "%s: Requested Resources: %s" %
            (caller_name(), R))
        if 'accept_empty_select' in cfg['clusters'][s.name]:
            if cfg['clusters'][s.name]['accept_empty_select']:
                return False

    # Calculate the ncpus and memory requested by this job
    tot_ncpus = 0
    tot_mpiprocs = 0
    tot_mem = pbs.size("0kb")
    tot_ngpus = 0
    tot_nmics = 0

    # Initialize a tmp select list
    tmp_select = list()

    pbs.logmsg(pbs.EVENT_DEBUG3, "Select Line: %s" % sel)

    # Check to see if the users just selected ncpus verses a chunk

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# i.e select=32 vs select=1:ncpus=32:mpiprocs=32:mem=32gb

status = job_select_cores_only(sel, s, cluster)
pbs.logmsg(pbs.EVENT_DEBUG3,
           "job_select_cores_only Status: %s" % status)

if not status:
    pbs.logmsg(pbs.EVENT_DEBUG3, "Eval select Line: %s" % R['select'])
    for chunk in sel.split("+"):
        nchunks = 1

        tmp_chunk = chunk.split(":")
        mpiprocs = -1
        ncpus = -1
        mem = 1900

        for c in tmp_chunk:
            pbs.logmsg(pbs.EVENT_DEBUG3, "Chunk: %s" % c)
            kv = c.split("=")
            if len(kv) == 1:
                nchunks = kv[0]
            elif kv[0] == "ncpus":
                pbs.logmsg(pbs.EVENT_DEBUG3, "ncpus: %s" % kv)
                ncpus = chunk_resource_check(e, kv, cluster)
                tot_ncpus += int(nchunks) * ncpus
            elif kv[0] == "ngpus":
                pbs.logmsg(pbs.EVENT_DEBUG3, "ngpus: %s" % kv)
                ngpus = chunk_resource_check(e, kv, cluster)
                tot_ngpus += int(nchunks) * ngpus

            elif kv[0] == "nmics":
                pbs.logmsg(pbs.EVENT_DEBUG3, "nmics: %s" % kv)
                nmics = chunk_resource_check(e, kv, cluster)
                tot_nmics += int(nchunks) * nmics

            elif kv[0] == "mpiprocs":
                pbs.logmsg(pbs.EVENT_DEBUG3, "mpiprocs: %s" % kv)
                mpiprocs = chunk_resource_check(e, kv, cluster)
                tot_mpiprocs += int(nchunks) * mpiprocs

            elif kv[0] == "mem":
                pbs.logmsg(pbs.EVENT_DEBUG3, "mem: %s" % kv)
                mem = chunk_resource_check(e, kv, cluster)
                pbs.logmsg(pbs.EVENT_DEBUG3, "mem: %s" % mem)
                pbs.logmsg(pbs.EVENT_DEBUG3, "nchunks: %d" % int(nchunks))
                pbs.logmsg(pbs.EVENT_DEBUG3, "mem (b): %d" %

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        size_as_int(str(mem)))
    mem = pbs.size(convert_size(
        int(nchunks) * size_as_int(mem), "mb"))
    pbs.logmsg(pbs.EVENT_DEBUG3, "mem: %s" % mem)
    tot_mem = tot_mem + mem
    pbs.logmsg(pbs.EVENT_DEBUG3, "Total mem: %s" % tot_mem)

# Set up the ncpus, mpiprocs, and mem if not set by the user
if ncpus == -1:
    ncpus = 1
    tmp_chunk.append('ncpus=%d' % ncpus)
if mpiprocs == -1:
    tmp_chunk.append('mpiprocs=%d' % ncpus)
if mpiprocs > ncpus:
    e_reject("You cannot specify more mpiprocs than ncpus\n" +
        "You specified: %s" % sel)
if mem == 1900 and cluster['assign_mem_per_core']:
    tmp_chunk.append(job_size_mem(mem, ncpus, R, cluster))

tmp_select.append(join(tmp_chunk, ':'))
R['select'] = pbs.select(join(tmp_select, '+'))

pbs.logmsg(pbs.EVENT_DEBUG3, "Check tot_ncpus: %d" %
    (tot_ncpus))

# Check to see if tot_ncpus > total ncpus on cluster
if tot_ncpus > cluster['total_cpus']:
    reject_job("total", "ncpus", tot_ncpus, cluster['total_cpus'],
        s.name, cluster)
if pbs.size(tot_mem) > pbs.size(cluster['total_mem']):
    tot_mem = pbs.size(convert_size(tot_mem, "gb"))
    reject_job("total", "mem", tot_mem, cluster['total_mem'],
        s.name, cluster)

pbs.logmsg(pbs.EVENT_DEBUG3, "Return resource totals")
return {'tncpus': tot_ncpus, 'tmem': tot_mem, 'tmpiprocs': tot_mpiprocs,
    'tnmics': tot_nmics, 'tngpus': tot_ngpus}

def reject_job(ltype, lres, lrequest, rlimit, lname, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))

    line = "\nInvalid job request.\n"
    if ltype == "total":
        line += "Job requested %s=%s and the total available for %s " % \
            (lres, lrequest, lname) + \

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        "is %s=%s\n" % (lres, rlimit)

elif (lres == "ncpus" or lres == "mem" or lres == "nmics" or
      lres == "ngpus"):
    if lname is not "":
        line += "Job requested %s=%s and the %s limit for the %s %s " % \
                (lres, lrequest, ltype, lname, ltype) + \
                "is %s=%s\n" % (lres, rlimit)
    else:
        line += "Job requested %s=%s and the limit for the %s is " % \
                (lres, lrequest, ltype) + "%s=%s\n" % (lres, rlimit)
elif lres == "walltime":
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: resource limit %s" %
              (caller_name(), lres))
    if ltype == "None" or ltype is None:
        line += "Job has not requested a walltime \nPlease add a " + \
                "walltime and resubmit.\n"
        line += "For example: To request 24 hours add this to the " + \
                "submission line -lwalltime=24:00:00\n"
    if ltype == "max":
        if lname is not "":
            line += "Job has requested %s walltime which " % lrequest + \
                    "exceeds the %s %s walltime limit of %s\n" % \
                    (lname, ltype, rlimit)
        else:
            line += "Job has requested %s walltime which " % lrequest + \
                    "exceeds the %s walltime limit of %s\n" % \
                    (ltype, rlimit)
        line += "Please change the walltime or queue (depending on " + \
                "the violated walltime limits) and resubmit.\n"
    if ltype == "min":
        if lname is not "":
            line += "Job requested %s walltime which is " % lrequest + \
                    "less than the %s %s walltime limit of %s\n" % \
                    (lname, ltype, rlimit)
        else:
            line += "Job requested %s walltime which is " % lrequest + \
                    "less than the %s walltime limit of %s\n" % \
                    (ltype, rlimit)
        line += "Please change the walltime or queue (depending on " + \
                "the violated walltime limits) and resubmit.\n"
    else:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Unknown resource: %s" % (lres))

pbs.logmsg(pbs.EVENT_DEBUG3, "%s: line %s" %
          (caller_name(), line))

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line += "If you believe that this is a valid " + \
        "job request, please contact the HPC staff\n"
line += "For more information, please refer to %s\n" % \
        cluster['site_info']
pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Ready to reject job" % (caller_name()))
e_reject(line)

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def check_ncpus_limits(job_res, j, s, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    ncpus_max_qlim = s.queue(j.queue.name).resources_max['ncpus']
    ncpus_min_qlim = s.queue(j.queue.name).resources_min['ncpus']
    ncpus_max_slim = s.resources_max['ncpus']

    pbs.logmsg(pbs.EVENT_DEBUG3, "ncpus_max_qlim: %s" %
               (ncpus_max_qlim))
    pbs.logmsg(pbs.EVENT_DEBUG3, "ncpus_max_slim: %s" %
               (ncpus_max_slim))

    R = j.Resource_List
    pbs.logmsg(pbs.EVENT_DEBUG3, "Job Resource List: %s" % (R))
    if R["ncpus"] != None:
        ncpus_req = R["ncpus"]
    else:
        ncpus_req = job_res['tncpus']
    pbs.logmsg(pbs.EVENT_DEBUG3, "Required ncpus: %s" % (ncpus_req))

    pbs.logmsg(pbs.EVENT_DEBUG3,
               "Above Find the PBS_GENERIC ncpus limit")

    # Find the PBS_GENERIC ncpus limit
    pbs.logmsg(pbs.EVENT_DEBUG3, "Above ncpus checks:")
    # Check to see if requested ncpus does not violate the limits
    if ((ncpus_max_qlim is not None) and
        (int(ncpus_req) > int(ncpus_max_qlim))):
        pbs.logmsg(pbs.EVENT_DEBUG3, "ncpus_max_qlim:")
        reject_job("queue", "ncpus", ncpus_req, ncpus_max_qlim,
                  j.queue.name, cluster)
    elif ((ncpus_min_qlim is not None) and
          (int(ncpus_req) < int(ncpus_min_qlim))):
        pbs.logmsg(pbs.EVENT_DEBUG3, "ncpus_min_qlim:")
        reject_job("queue", "ncpus", ncpus_req, ncpus_min_qlim,
                  j.queue.name, cluster)
    elif ((ncpus_max_slim is not None) and
          (int(ncpus_req) > int(ncpus_max_slim))):
        pbs.logmsg(pbs.EVENT_DEBUG3, "ncpus_max_slim:")

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    reject_job("server", "ncpus", ncpus_req, ncpus_max_slim,
              "", cluster)

pbs.logmsg(pbs.EVENT_DEBUG3, "Done with ncpus checks")

def check_mem_limits(job_res, j, s, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))

    # Mem limit checking section
    pbs.logmsg(pbs.EVENT_DEBUG3, "Looking at mem limits")
    mem_lim = s.queue(j.queue.name).max_run_res['mem']
    pbs.logmsg(pbs.EVENT_DEBUG3,
              "PBS_GENERIC mem limit: %s" % (mem_lim))
    mem_max_qlim = s.queue(j.queue.name).resources_max['mem']
    pbs.logmsg(pbs.EVENT_DEBUG3, "mem_max_qlim: %s" % (mem_max_qlim))

    # Get the requested memory
    R = j.Resource_List
    if R["mem"] != None:
        mem_req = R["mem"]
    else:
        mem_req = job_res['tmem']

    pbs.logmsg(pbs.EVENT_DEBUG3, "Required mem: %s" % (mem_req))

    # Find the PBS_GENERIC mem limit
    if mem_lim is not None:
        tmp_mem_lim = mem_lim.split(',')
        pbs.logmsg(pbs.EVENT_DEBUG3, "Above tmp_mem_lim: %s" %
                  (tmp_mem_lim))
        mem_lim = -1
        for limit in tmp_mem_lim:
            if "PBS_GENERIC=" in limit:
                mem_lim = pbs.size(limit.split('=')[1].replace("'",
                                                                    ''))
        else:
            mem_lim = -1

    # Check to see if requested mem does not violate the limits
    pbs.logmsg(pbs.EVENT_DEBUG3, "mem_lim: %s" % (mem_lim))
    pbs.logmsg(pbs.EVENT_DEBUG3, "mem_req: %s" % (mem_req))
    if mem_lim != -1 and pbs.size(mem_req) > mem_lim:
        pbs.logmsg(pbs.EVENT_DEBUG3, "mem_req > mem_lim")
        reject_job("user", "mem", mem_req, mem_lim,
                  j.queue.name, cfg['clusters'][s.name])

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elif mem_max_qlim is not None and pbs.size(mem_req) > mem_max_qlim:
    pbs.logmsg(pbs.EVENT_DEBUG3, "mem_req > mem_max_lim")
    reject_job("queue", "mem", mem_req, mem_max_qlim,
              j.queue.name, cfg['clusters'][s.name])

def check_walltime(j, s, cluster):
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    R = j.Resource_List
    if R["walltime"] != None:
        wt_req = R["walltime"]
    else:
        wt_req = None
    pbs.logmsg(pbs.EVENT_DEBUG3, "Requested walltime: %s" %
              (wt_req))

    # Get the walltime limits
    limit_name = j.queue.name
    wt_max = s.queue(limit_name).resources_max['walltime']
    wt_min = s.queue(limit_name).resources_min['walltime']
    pbs.logmsg(pbs.EVENT_DEBUG3, "Wall Limit: %s" % (wt_max))
    pbs.logmsg(pbs.EVENT_DEBUG3, "Wall Requested: %s" % (wt_req))
    if wt_max is not None and wt_req > wt_max:
        pbs.logmsg(pbs.EVENT_DEBUG3, "This job should exit: %s" %
                  (wt_req))
    pbs.logmsg(pbs.EVENT_DEBUG3, "Check the walltimes")

    if wt_max is None:
        # Check to see if it is set at the server level
        wt_max = s.resources_max['walltime']
        if wt_max is not None:
            limit_name = "server"

    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: Method called" % (caller_name()))
    pbs.logmsg(pbs.EVENT_DEBUG3, "%s: req: %s, max: %s, min: %s, name: %s" %
              (caller_name(), wt_req, wt_max, wt_min, limit_name))
    if wt_req is None:
        if 'require_walltime' in cluster:
            if cluster['require_walltime']:
                reject_job("None", "walltime", "", "", limit_name, cluster)
    elif wt_max is not None and wt_req > wt_max:
        reject_job("max", "walltime", wt_req, wt_max,
                  limit_name, cluster)
    elif wt_min is not None and wt_req < wt_min:
        reject_job("min", "walltime", wt_req, wt_min,
                  limit_name, cluster)

```

```

else:
    return True

return False

def main():
    pbs.logmsg(pbs.EVENT_DEBUG3, "Entering check limits hook")

    e = pbs.event()
    j = e.job
    s = pbs.server()
    who = e.requestor

    # Read in the config file
    cfg = parse_config_file(e, s)
    cluster = cfg['clusters'][s.name]

    # Check to see if we are running in test mode
    if 'test_mode' in cfg['clusters'][s.name]:
        if cfg['clusters'][s.name]['test_mode']:
            pbs.logmsg(pbs.EVENT_DEBUG3, "Entering check user")
            pbs.logmsg(pbs.EVENT_DEBUG3, "cfg: %s" % cfg['clusters'][s.name])
            if 'test_users' in cfg['clusters'][s.name]:
                pbs.logmsg(pbs.EVENT_DEBUG3, "check user: %s" % who)
                if who not in cfg['clusters'][s.name]['test_users']:
                    pbs.logmsg(pbs.EVENT_DEBUG3,
                                "User %s not in test users %s" %
                                (who, cfg['clusters'][s.name]['test_users']))
                e.accept()
            else:
                pbs.logmsg(pbs.EVENT_DEBUG3,
                            "Running hook for User %s" % who)

    # Collect the job requested resources
    pbs.logmsg(pbs.EVENT_DEBUG3, "Ready to look at job requested resources")
    job_res = job_requested_resources(e, j, s, cluster, cfg)
    pbs.logmsg(pbs.EVENT_DEBUG3, "Returned totals: %s" % job_res)

    try:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Default Queue: %s" %
                    cluster['default_queue'])
        job_requested_queue(j, s, cluster)
        pbs.logmsg(pbs.EVENT_DEBUG3, "job queue %s" % j.queue.name)

    # Find the server limits

```

```

q = s.queue(j.queue.name)
pbs.logmsg(pbs.EVENT_DEBUG3, "queue %s" % q.name)
for key in q.attributes.keys():
    exec "a=q.%s" % key

# check server/queue limits section
pbs.logmsg(pbs.EVENT_DEBUG3, "Ready to check queue/server limits")
if job_res is not False:
    if cfg['clusters'][s.name]['check_ncpus']:
        check_ncpus_limits(job_res, j, s, cluster)

    if cfg['clusters'][s.name]['check_mem']:
        check_mem_limits(job_res, j, s, cluster)

    if cfg['clusters'][s.name]['check_walltime']:
        check_walltime(j, s, cluster)

except:
    err = sys.exc_info()[0]
    pbs.logmsg(pbs.EVENT_DEBUG3, "This job had an exception: %s" % err)
    pass

if __name__ == 'builtins':
    try:
        pbs.logmsg(pbs.EVENT_DEBUG, "Entering the main loop")
        main()

    except SystemExit:
        pass
    except AdminError, exc:
        pbs.logmsg(pbs.EVENT_DEBUG3, "Encountered Admin Error")
        # Something on the system is misconfigured
        pbs.logmsg(pbs.EVENT_DEBUG3,
            str(traceback.format_exc().strip().splitlines()))
        msg = ("Admin error in %s handling %s event" %
            (e.hook_name, "queuejob"))
        pbs.logmsg(pbs.EVENT_ERROR, msg)
        e_reject(msg)
    except:
        e_reject("%s hook failed with %s.\nPlease contact your sys admin " +
            "if this problem persists for more than 10 minutes" %
            (e.hook_name, sys.exc_info()[2]))

```

9.3 modifyjob Hook Examples

Example 9-11: Prevent users from using *qalter* to change their jobs

Hook type: `modifyjob`

Allow only administrators to change jobs.

Script `NoAlter.py`, on Windows, in a domain:

```
import os
import pbs

e = pbs.event()
j = e.job
who = e.requestor
pbs.logmsg(pbs.LOG_DEBUG, "requestor=%s" % (who,))
isadmin=0
admin_ulist = ["PBS_Server", "Scheduler", "pbs_mom", "Administrator"]

if who in admin_ulist:
    isadmin=1
else:
    cmd = "net user " + who + " /domain"
    admin_glist = ['Administrators', 'Domain Admins', 'Enterprise
        Admins']
    for line in os.popen(cmd).readlines():
        if line.find("Group") >= 0:
            for li in line.split("*"):
                if li.strip() in admin_glist:
                    isadmin=1
                    break
    if e.type == pbs.MODIFYJOB and not isadmin:
        e.reject("Normal users are not allowed to modify their jobs")
```

Script `NoAlter.py`, on Linux:

```
import pbs
e = pbs.event()
j = e.job
who = e.requestor
pbs.logmsg(pbs.LOG_DEBUG, "requestor=%s" % (who,))
admin_ulist = ["PBS_Server", "Scheduler", "pbs_mom", "root"]
if who not in admin_ulist:
    e.reject("Normal users are not allowed to modify their jobs")
```

Create hook and import script:

```
qmgr -c 'create hook NoAlter event="modifyjob"
qmgr -c 'import hook NoAlter application/x-python default NoAlter.py'
```

Example 9-12: *Reject jobs requesting a specific queue that do not request mem*

Hook type: modifyjob

Reject jobs requesting workq2 if they don't also request memory.

Script queuespec.py:

```
import pbs
import sys
try:
    e = pbs.event()
    j = e.job
    if j.queue.name == "workq2" and not j.Resource_List["mem"]:
        e.reject("workq2 requires job to have mem specification")

except SystemExit:
    pass

except:
    e.reject("%s hook failed with %s. Please contact
            Admin" % (e.hook_name, sys.exc_info()[2]))
```

Create hook, import script:

```
qmgr -c 'create hook queuespec event="modifyjob"'
qmgr -c 'import hook queuespec application/x-python default queuespec.py'
```

9.4 periodic Hook Examples

Example 9-13: Run job start time estimator

Hook type: `periodic`

Run job start time estimator named `pbs_est`.

Script `run_pbs_est.py`:

```
import pbs
import time
import os
import subprocess

pbs_est_cmd = os.path.join(pbs.pbs_conf['PBS_EXEC'], 'sbin', 'pbs_est')

e = pbs.event()

pbs.logmsg(pbs.LOG_DEBUG, "Starting job start time estimation task")

exit_stat = subprocess.call([pbs_est_cmd], shell=True)
if exit_stat != 0:
    e.reject("%s exited abnormally with return code %d" % (pbs_est_cmd, exit_stat))
else:
    e.accept()
```

9.5 execjob_launch Hook Examples

Example 9-14: Modify arguments to job program

Hook type: `execjob_launch`

The `argv[]` entries can be modified to change the existing arguments to `progrname`.

Given the following hook:

```
# cat launch.py
import pbs
e = pbs.event()
e.argv[1] = "cool"

# qmgr -c "create hook launch event=execjob_launch"
# qmgr -c "import hook launch application/x-python default launch.py"
```

So if a job is submitted as follows:

```
% qsub -- /bin/echo uncool
```

When the job is submitted, `progrname = "/bin/echo"`, `argv[0] = "/bin/echo"`, `argv[1] = "uncool"`. However, when the job executes, the `execjob_launch` hook runs, causing `"/bin/echo cool"` to execute instead of `"/bin/echo uncool"`.

9.6 `execjob_prologue` and `execjob_epilogue` Hook Examples

Example 9-15: Run shell script prologue or epilogue.

You can use this hook when the `execjob_prologue` and `execjob_epilogue` events are used in other hooks, such as the `cgroups` hook, and you still want to run the classic prologue and epilogue scripts we describe in section [“Using Shell Scripts for Prologue and Epilogue”](#), on page 496 in the *PBS Professional Administrator’s Guide*. Additionally, the hook introduces parallel prologue and epilogue shell scripts.

See [“Using Hooks for Prologue and Epilogue”](#), on page 500 in the *PBS Professional Administrator’s Guide*, for configuration and installation instructions.

This hook is included in `$PBS_EXEC/unsupported.as` `run_pelog_shell.py`, along with its configuration file, `run_pelog_shell.ini`.

Configuration File

Here is the contents of `run_pelog_shell.ini`:

```
[run_pelog_shell]
# Enable parallel prologues/epilogues that run on sister moms. Note that all
# the normal requirements apply, except the scripts should be named pprologue
# and pepilogue.
ENABLE_PARALLEL=False

# Provide verbose hook output to the user's .o/.e file
VERBOSE_USER_OUTPUT=False

# DEFAULT_ACTION can be one of DELETE or RERUN
DEFAULT_ACTION=RERUN

# Enable Torque argument compatibility
TORQUE_COMPAT=False
```

Hook Script

Here is the hook script (the contents of `run_pellog_shell.py`):

```
import pbs
import os, sys
import time

# Set up a few variables
start_time=time.time()
pbs_event=pbs.event()
hook_name=pbs_event.hook_name
hook_alarm=30 # default, we'll read it from the .HK later
DEBUG=False # default, we'll read it from the .HK later
job=pbs_event.job

# The trace_hook function has been written to be portable between hooks.
def trace_hook(**kwargs):
    """Simple exception trace logger for PBS hooks
    loglevel=<int> (pbs.LOG_DEBUG): log level to pass to pbs.logmsg()
    reject=True: reject the job upon completion of logging trace
    trace_in_reject=<bool> (False): pass trace to pbs.event().reject()
    trace_in_reject=<str>: message to pass to pbs.event().reject() with trace
    Usage:
    try:
        your=code(here)
    except:
        trace_hook()
    """
    import sys

    if 'loglevel' in kwargs:
        loglevel=kwargs['loglevel']
    else:
        loglevel=pbs.LOG_ERROR
    if 'reject' in kwargs:
        reject=kwargs['reject']
    else:
        reject=True
    if 'trace_in_reject' in kwargs:
        trace_in_reject=kwargs['trace_in_reject']
    else:
        trace_in_reject=False

    # Associate hook events with the appropriate PBS constant. This is a list
    # of all hook events as of PBS Pro 13.0. If the event does not exist, it is
    # removed from the list.
    hook_events=['queuejob', 'modifyjob', 'movejob', 'runjob', 'execjob_begin',
```

```

        'execjob_prologue', 'execjob_launch', 'execjob_attach',
        'execjob_preterm', 'execjob_epilogue', 'execjob_end',
        'resvsub', 'resv_end', 'provision', 'exechost_periodic',
        'exechost_startup', 'periodic']

hook_event={}
for he in hook_events:
    # Only set available hooks for the current version of PBS.
    if hasattr(pbs, he.upper()):
        event_code=eval('pbs.'+he.upper())
        hook_event[event_code]=he
        hook_event[he]=event_code
        hook_event[he.upper()]=event_code
        del event_code
    else:
        del hook_events[hook_events.index(he)]

trace={
    'line':      sys.exc_info()[2].tb_lineno,
    'module':    sys.exc_info()[2].tb_frame.f_code.co_name,
    'exception': sys.exc_info()[0].__name__,
    'message':   sys.exc_info()[1].message,
}
}
tracemsg='%s hook %s encountered an exception: Line %s in %s %s: %s' %(
    hook_event[pbs.event().type], pbs.event().hook_name,
    trace['line'], trace['module'], trace['exception'], trace['message']
)
rejectmsg="Hook Error: request rejected as filter hook '%s' encountered " \
    "an exception. Please inform Admin" % pbs.event().hook_name
if not isinstance(loglevel, int):
    pbs.logmsg(pbs.LOG_ERROR, 'trace_hook() called with invalid argument' \
        ' (loglevel=%s), setting to pbs.LOG_ERROR. ' % repr(loglevel))
    loglevel=pbs.LOG_ERROR

pbs.logmsg(loglevel, tracemsg)

if reject:
    tracemsg+=", request rejected"
    if isinstance(trace_in_reject, bool):
        if trace_in_reject:
            pbs.event().reject(tracemsg)
        else:
            pbs.event().reject(rejectmsg)
    else:
        pbs.event().reject(str(trace_in_reject)+'Line %s in %s %s:\n%s' % (
            trace['line'], trace['module'], trace['exception'],

```

```

        trace['message'] ))

class JobLog:
    """ Class for managing output to job stdout and stderr."""

    def __init__(self):
        PBS_SPOOL=os.path.join(pbs_conf()['PBS_MOM_HOME'], 'spool')
        self.stdout_log=os.path.join(PBS_SPOOL,
                                     '%s.OU' % str(pbs.event().job.id))
        self.stderr_log=os.path.join(PBS_SPOOL,
                                     '%s.ER' % str(pbs.event().job.id))

        if str(pbs.event().job.Join_Path) == 'oe':
            self.stderr_log=self.stdout_log
        elif str(pbs.event().job.Join_Path) == 'eo':
            self.stdout_log=self.stderr_log

    def stdout(self, msg):
        """Write msg to appropriate file handle for stdout"""
        import sys

        try:
            if not pbs.event().job.interactive and pbs.event().job.in_ms_mom:
                logfile=open(self.stdout_log, 'ab+')
            else:
                logfile=sys.stdout

            if DEBUG:
                pbs.logmsg(pbs.EVENT_DEBUG3,
                          '%s;%s:[DEBUG3]: writing %s to %s' %
                          (pbs.event().hook_name,
                           pbs.event().job.id,
                           repr(msg),
                           logfile.name))

            logfile.write(msg)
            logfile.flush()
            logfile.close()
        except IOError:
            trace_hook()

    def stderr(self, msg):
        """Write msg to appropriate file handle for stdout"""
        import sys

        try:

```

```

        if not pbs.event().job.interactive and pbs.event().job.in_ms_mom():
            logfile=open(self.stderr_log, 'ab+')
        else:
            logfile=sys.stderr

        if DEBUG:
            pbs.logmsg(pbs.EVENT_DEBUG3,
                '%s;%s:[DEBUG3]: writing %s to %s' %
                (pbs.event().hook_name,
                 pbs.event().job.id,
                 repr(msg),
                 logfile.name))

            logfile.write(msg)
            logfile.flush()
            logfile.close()
    except IOError:
        trace_hook()

# Read in pbs.conf
def pbs_conf(pbs_key=None):
    """Function to return the values from /etc/pbs.conf
    If the PBS python interpreter hasn't been recycled, it is not necessary
    to re-read and re-parse /etc/pbs.conf. This function will simply return
    the variable that exists from the first time this function ran.
    Creates a dict containing the key/value pairs in pbs.conf, accounting for
    comments in lines and empty lines.
    Returns a string representing the pbs.conf setting for pbs_key if set, or
    the dict of all pbs.conf settings if pbs_key is not set.
    """
    import os

    if hasattr(pbs_conf, 'pbs_keys'):
        return pbs_conf.pbs_keys[pbs_key] if pbs_key else pbs_conf.pbs_keys

    if 'PBS_CONF_FILE' in os.environ.keys():
        pbs_conf_file=os.environ['PBS_CONF_FILE']
    elif sys.platform == 'win32':
        if 'ProgramFiles(x86)' in os.environ.keys():
            program_files=os.environ['ProgramFiles(x86)']
        else:
            program_files=os.environ['ProgramFiles']
        pbs_conf_file='%s\\PBS Pro\\pbs.conf' % program_files
    else:
        pbs_conf_file='/etc/pbs.conf'

```

```

pbs_conf.pbs_keys=dict([line.split('#')[0].strip().split('=') \
    for line in open(pbs_conf_file) \
    if not line.startswith('#') and '=' in line])

if 'PBS_MOM_HOME' not in pbs_conf.pbs_keys.keys():
    pbs_conf.pbs_keys['PBS_MOM_HOME'] = \
        pbs_conf.pbs_keys['PBS_HOME']

return pbs_conf.pbs_keys[pbs_key] if pbs_key else pbs_conf.pbs_keys

# Primary hook execution begins here
try:

def rejectjob(reason, action=DEFAULT_ACTION):
    """Log job rejection and then call pbs.event().reject()"""

    # Arguments to pbs.event().reject() do nothing in execjob events. Log a
    # warning instead, update the job comment, then reject the job.
    if action == RERUN:
        job.rerun()
        reason='Requeued - %s' % reason
    elif action == DELETE:
        job.delete()
        reason='Deleted - %s' % reason
    else:
        reason='Rejected - %s' % reason

    job.comment='%s: %s' % (hook_name, reason)
    pbs.logmsg(pbs.LOG_WARNING, ';' .join([hook_name, job.id, reason]))
    pbs.logjobmsg(job.id, reason) # Add a message that can be tracejob'd
    if VERBOSE_USER_OUTPUT:
        print reason
    pbs_event.reject()

# For the path to mom_priv, we use PBS_MOM_HOME in case that is set,
# pbs_conf() will return PBS_HOME if it is not.
mom_priv=os.path.abspath(os.path.join(
    pbs_conf()['PBS_MOM_HOME'], 'mom_priv'))

# Get the hook alarm time from the .HK file if it exists.
hk_file=os.path.join(mom_priv, 'hooks', '%s.HK' % hook_name)
if os.path.exists(hk_file):
    hook_settings=dict([l.strip().split('=') for l in
        open(hk_file, 'r').readlines()])
    if 'alarm' in hook_settings.keys():

```

```

hook_alarm=int(hook_settings['alarm'])
if 'debug' in hook_settings.keys():
    DEBUG=True if hook_settings['debug']=='true' else False

if DEBUG:
    pbs.logmsg(pbs.LOG_DEBUG, '%s;%s:[DEBUG] starting.' %
              (hook_name, job.id))

if 'PBS_HOOK_CONFIG_FILE' in os.environ:
    config_file = os.environ["PBS_HOOK_CONFIG_FILE"]
    config=dict([l.split('#')[0].strip().split('=')
                for l in open(config_file,'r').readlines() if '=' in l])

# Set the true/false configurations
if 'ENABLE_PARALLEL' in config.keys():
    ENABLE_PARALLEL=config['ENABLE_PARALLEL'].lower()[0] in ['t', '1']
if 'VERBOSE_USER_OUTPUT' in config.keys():
    VEROSE_USER_OUTPUT=config['VERBOSE_USER_OUTPUT'].lower()[0] in ['t', '1']
if 'DEFAULT_ACTION' in config.keys():
    if config['DEFAULT_ACTION'].upper() == 'DELETE':
        DEFAULT_ACTION=DELETE
    elif config['DEFAULT_ACTION'].upper() == 'RERUN':
        DEFAULT_ACTION=RERUN
    else:
        pbs.logmsg(pbs.LOG_WARN,
                  '%s;%s:[ERROR] ' % (hook_name, job.id) + \
                  'DEFAULT_ACTION in %s.ini must be one ' % (hook_name) + \
                  'of DELETE or RERUN.')
if 'TORQUE_COMPAT' in config.keys():
    TORQUE_COMPAT=config['TORQUE_COMPAT'].lower()[0] in ['t', '1']

# Skip sister mom if parallel pelogs aren't enabled.
if not ENABLE_PARALLEL and not job.in_ms_mom():
    pbs_event.accept()

# Prologues and epilogues have different arguments
if pbs_event.type == pbs.EXECJOB_PROLOGUE:
    event='prologue'
    args=[
        job.id,                # argv[1]
        job.euser,             # argv[2]
        job.egroup             # argv[3]
    ]
    if TORQUE_COMPAT:
        args.extend([
            job.Job_Name,      # argv[4]

```



```

        job.Resource_List,          # argv[5]
        job.queue.name,            # argv[6]
        job.Account_Name or ''    # argv[7]
    ])
elif pbs_event.type == pbs.EXECJOB_EPILOGUE:
    null='null' if not TORQUE_COMPAT else ''
    event='epilogue'
    args=[
        job.id,                    # argv[1]
        job.euser,                 # argv[2]
        job.egroup,               # argv[3]
        job.Job_Name,             # argv[4]
        job.session_id,           # argv[5]
        job.Resource_List,        # argv[6]
        job.resources_used,       # argv[7]
        job.queue.name,           # argv[8]
        job.Account_Name or null,  # argv[9]
        job.Exit_status           # argv[10]
    ]
else: # hook has wrong events added
    pbs.logmsg(pbs.LOG_WARNING,
        '%s;%s;[ERROR] PBS event type %s not supported in this hook.' %
        (hook_name, job.id, pbs_event.type))
    pbs_event.accept()

# Handle empty arguments
args=[str(a) if ( a or a == 0 ) else '' for a in args]

if DEBUG: pbs.logmsg(pbs.LOG_DEBUG,
    '%s;%s;[DEBUG] %s event triggered.' % \
    (hook_name, job.id, event))

if DEBUG:
    pbs.logmsg(pbs.LOG_DEBUG, '%s;%s;[DEBUG3] args=%s' % \
        (hook_name, job.id, repr(args)))

# execjob_prologue and execjob_epilogue hooks can run on all nodes, so use
# pprologue/pepilogue if available and not on primary execution node.
p='' if job.in_ms_mom() else 'p'

if DEBUG:
    pbs.logmsg(pbs.LOG_DEBUG, '%s;%s;[DEBUG] %s.' %
        (pbs_event.hook_name,
        job.id,
        'in sister mom' if p else 'in the primary execution host'))

```

```

script=os.path.join(mom_priv, p+event)

if sys.platform == 'win32':
    script=script + '.bat'

if DEBUG:
    pbs.logmsg(pbs.EVENT_DEBUG3, '%s;%s;[DEBUG3] script set to %s.' % (
        pbs_event.hook_name, job.id, script))

correct_permissions = False
if not script:
    pbs_event.accept()

if not os.path.exists(script):
    pbs_event.accept()

if sys.platform == 'win32':
    # Windows support is currently not implemented.
    pbs.logmsg(pbs.LOG_WARNING,
        '%s;%s;[ERROR] ' % (hook_name, job.id) + \
        'Classic prologues and epilogues on Windows are not ' + \
        'currently implemented in this hook.')
    pbs_event.accept()

else:
    try:
        struct_stat = os.stat(script)
    except OSError:
        rejectjob('Could not stat the %s script (%s).' %
            (event, script), RERUN)

    # We mask for read and execute on owner make sure no one else can write
    # with 0522 (?r?x?w??w?). With this, permissions such as 0777 masked by
    # 522 will return 522. Acceptable permissions will return 500.
    correct_permissions = bool(struct_stat.st_mode & 0522 == 0500 and
        struct_stat.st_uid == 0)

if correct_permissions:
    import signal
    import subprocess
    import shlex

    # Correction for subprocess SIGPIPE handling courtesy of Colin Watson:
    # http://www.chiark.greenend.org.uk/~cjwatson/blog/python-sigpipe.html
    def subprocess_setup():
        """subprocess_setup corrects a known bug where python installs a

```

```

SIGPIPE handler by default. This is usually not what non-Python
subprocesses expect"""
signal.signal(signal.SIGPIPE, signal.SIG_DFL)

if DEBUG:
    pbs.logmsg(pbs.EVENT_DEBUG2,
               '%s;%s;[DEBUG2] script %s has appropriate permissions.' %
               (hook_name, job.id, script))

# change to the correct working directory (PBS_HOME):
os.chdir(pbs_conf()['PBS_MOM_HOME'])

# add PBS_JOBDIR environment variable, accounting for empty job.jobdir
os.environ['PBS_JOBDIR'] = job.jobdir or ''

shell=""
if sys.platform == 'win32': #win32 is _always_ cmd
    shell="cmd /c"
else:
    # check the script for the interpreter line
    shebang=open(script, 'r').readline().strip().split('#!')
    if len(shebang)==2:
        shell=shebang[1].split()[0]
        if not os.path.exists(shell):
            rejectjob(
                'Interpreter specified in %s (%s) does not exist.' %
                (p+event, shell),
                RERUN)
        else:
            rejectjob('No interpreter specified in %s.' % (p+event), RERUN)

if DEBUG:
    pbs.logmsg(pbs.EVENT_DEBUG2,
               '%s;%s;[DEBUG2] interpreter set to "%s".' %
               (hook_name, job.id, shell))

pbs.logmsg(pbs.LOG_DEBUG, '%s;%s;running %s.' %
           (hook_name, job.id, p+event))

# We perform a shlex.split to make sure we capture any #! arguments
cmd=shlex.split('%s %s' % (shell, script))
cmd.extend(args)

if DEBUG:
    pbs.logmsg(pbs.EVENT_DEBUG3,
               '%s;%s;[DEBUG3] cmd=%s' % (hook_name, job.id, repr(cmd)))

```

```

if str(job.Join_Path) in ['oe', 'eo']:
    proc=subprocess.Popen(
        cmd,
        stdout=subprocess.PIPE,
        stderr=subprocess.STDOUT,
        preexec_fn=subprocess_setup)
else:
    proc=subprocess.Popen(
        cmd,
        stdout=subprocess.PIPE,
        stderr=subprocess.PIPE,
        preexec_fn=subprocess_setup)

# Wait for the script to gracefully exit.
while time.time() < start_time + hook_alarm - 5:
    if proc.poll() is not None:
        break
    time.sleep(1)

# If we reach the alarm time - 5 seconds, send a SIGTERM
if proc.poll() is None:
    pbs.logmsg(pbs.LOG_WARNING,
              '%s;%s;[WARNING] Terminating %s after %s seconds' % \
              (hook_name, job.id, event, int(time.time() - start_time)))
    os.kill(proc.pid, signal.SIGTERM)
    while time.time() < start_time + hook_alarm - 3:
        if proc.poll() is not None:
            break
        time.sleep(0.5)

# If we reach an alarm time - 3 seconds, send a SIGKILL
if proc.poll() is None:
    pbs.logmsg(pbs.LOG_WARNING,
              '%s;%s;[WARNING] Killing %s after %s seconds' % \
              (hook_name, job.id, event, int(time.time() - start_time)))
    os.kill(proc.pid, signal.SIGKILL)
    while time.time() < start_time + hook_alarm - 1:
        if proc.poll() is not None:
            break
        time.sleep(0.5)

# If we still can't kill the script, log a warning and let pbs kill it
if proc.poll() is None:
    pbs.logmsg(pbs.LOG_WARNING,
              '%s;%s;[WARNING] Unable to kill %s after %s seconds' % \

```

```

        (hook_name, job.id, event, start_time - time.time()))

# Get the stdout and stderr from the pelog
(o, e)=proc.communicate()

if DEBUG:
    pbs.logmsg(
        pbs.EVENT_DEBUG2,
        '%s;%s;[DEBUG2]: stdout=%s, stderr=%s.' %
        (hook_name, job.id, repr(o), repr(e)))

joblog=JobLog()
if o:
    joblog.stdout(o)
if e:
    joblog.stderr(e)

if proc.returncode:
    return_action=RERUN
    if event == 'prologue':
        return_action=RERUN
        if proc.returncode == 1:
            return_action=DELETE
    elif event == 'epilogue':
        return_action=DELETE
        if proc.returncode == 2:
            return_action=RERUN

    rejectjob(
        '%s exited with a status of %s.' % (p+event, proc.returncode),
        return_action)
else:
    if DEBUG:
        pbs.logmsg(pbs.LOG_DEBUG,
            '%s;%s;[DEBUG] %s exited with a status of 0.' %
            (hook_name, job.id, p+event))

    if pbs_event.type == pbs.EXECJOB_PROLOGUE and VERBOSE_USER_OUTPUT:
        print '%s: attached as primary execution host.' % \
            pbs.get_local_nodename()

    pbs_event.accept()
else:
    rejectjob("The %s does not have the correct " % (p+event) + \
        'permissions. See the section entitled, ' + \
        '"Prologue and Epilogue Requirements" in the PBS Pro ' + \

```

```
"Administrator's Guide.", RERUN)
```

```
except SystemExit:  
    pass  
except:  
    trace_hook()
```

9.7 exechost_startup Hook Examples

Example 9-16: Create vnode and set vnode resources

Hook type: exechost_startup

```
% cat startup.py
import pbs
e=pbs.event()
for v in e.vnode_list.keys():
    vn = e.vnode_list[v]
    vn.resources_available["file"] = pbs.size("7gb")
    vn.resources_available["fab_int"] = 9
    vn.resources_available["fab_str"] = "happy"
    vn.resources_available["fab_bool"] = False
    vn.resources_available["fab_size"] = pbs.size("7mb")
    vn.resources_available["fab_time"] = pbs.duration("00:30:00")
    vn.resources_available["fab_float"] = 7.0
```

```
e.vnode_list["mars[1]"] = pbs.vnode("mars[1]")
e.vnode_list["mars[1]"].resources_available["ncpus"] = 7
```

Create hook

```
# qmgr -c "create hook start event=exechost_startup"
# qmgr -c "import hook start application/x-python default startup.py"
```

Restart MoM

```
# kill <pbs_mom PID>
then
# systemctl start pbs
```

```
or
# /etc/init.d/pbs start (start MoM)
```

Output

```
# pbsnodes -av
mars
  Mom = mars.example.com
  Port = 15002
  pbs_version = PBSPro_12.3.0.140813
  ntype = PBS
  state = free
  pcpus = 4
  resources_available.arch = linux
  resources_available.fab_bool = False
  resources_available.fab_float = 7
  resources_available.fab_int = 9
  resources_available.fab_size = 7mb
  resources_available.fab_str = happy
  resources_available.fab_time = 1800
  resources_available.file = 7gb
  resources_available.host = mars
  resources_available.mem = 8gb
  resources_available.ncpus = 5
  resources_available.vmem = 16gb
  resources_available.vnode = mars
  ...

mars[1]
  Mom = mars.example.com
  Port = 15002
  pbs_version = PBSPro_12.3.0.140813
  ntype = PBS
  state = free
  resources_available.arch = linux
  resources_available.file = 7gb
  resources_available.host = mars
  resources_available.ncpus = 7 (set in hook)
  resources_available.vnode = mars[1]
```


9.8 exechost_periodic Hook Examples

Example 9-17: Monitor load; offline or free vnode depending on CPU load

Hook type: `exechost_periodic`

Monitor load average on the local host. Offline or free the vnode representing the host depending on the CPU load.

You can modify values for `ideal_load` and `max_load`. Your hook does the following:

If the system's CPU load average rises above `max_load`, the state of the vnode corresponding to the current host is set to *offline*. This prevents the scheduler from scheduling jobs on this vnode.

If the system's CPU load average falls below `ideal_load`, the state of the vnode representing the current host is set to *free*. This allows the scheduler to schedule jobs on this vnode.

To instantiate this hook, specify the following:

```
qmgr -c "create hook load_balance event=exechost_periodic,freq=10"
qmgr -c "import hook load_balance application/x-python default load_balance.py"
```

Hook script:

```
import pbs
import os
import re

ideal_load=1.5
max_load=2.0

# get_la: returns a list of load averages within the past 1-minute, 5-minute, 15-minutes range.
def get_la():
    line=os.popen("uptime").read()
    r = re.search(r'load average: (\S+), (\S+), (\S+)\$', line).groups()
    return map(float, r)

local_node = pbs.get_local_nodename()

vnl = pbs.event().vnode_list
current_state = pbs.server().vnode(local_node).state
m1a = get_la()[0]
if (m1a >= max_load) and ((current_state == pbs.ND_OFFLINE) == 0):
    vnl[local_node].state = pbs.ND_OFFLINE
    vnl[local_node].comment = "offlined node as it is heavily loaded"
elif (m1a < ideal_load) and ((current_state == pbs.ND_OFFLINE) != 0):
    vnl[local_node].state = pbs.ND_FREE
    vnl[local_node].comment = None
```

Example 9-18: *Periodically update resources on vnodes*

Hook type: `exechost_periodic`

Periodically update the values of a set of custom resources for the vnode where the current MoM runs.

The current set includes two size types, which are `scratch` and `home`

Prerequisites:

1. Create the following custom resources:

```
qmgr -c "create resource scratch type=size, flag=nh"
qmgr -c "create resource home type=size, flag=nh"
```

2. Add the new resources to the "resources:" line in the `sched_config` file and restart `pbs_sched`:

```
% cat PBS_HOME/sched_priv/sched_config resources
ncpus, mem, arch, [...], scratch, home
```

3. Install this hook as follows:

```
qmgr -c "create hook mom_dyn_res event=exechost_periodic,freq=30"
qmgr -c "import hook mom_dyn_res application/x-python default mom_dyn_res.py"
```

The `mom_dyn_res.py` script:

```
# NOTE:
# Update the dyn_res[] array below to include any other custom resources
# to be included in the updates. Ensure that each resource added has an
# entry in the scheduler's sched_config file.

import pbs
import os
import sys

# get_filesystem_avail_unprivileged: returns available size in kbytes
# (in pbs.size type) to unprivileged users, of the filesystem where
# 'dirname' resides.

def get_filesystem_avail_unprivileged( dirname ):
    o = os.statvfs(dirname)
    return pbs.size( "%skb" % ((o.f_bsize * o.f_bavail) / 1024) )

# get_filesystem_avail_privileged: returns available size in kbytes
# (in pbs.size type) to privileged users, of the filesystem where 'dirname'
# resides.

def get_filesystem_avail_privileged( dirname ):
    o = os.statvfs(dirname)
    return pbs.size( "%skb" % ((o.f_bsize * o.f_bfree) / 1024) )

try:
    # Define here the custom resources as key, and the function and its
    # argument for obtaining the value of the custom resource:
```

```
#   Format: dyn_res[<resource_name>] = [<function_name>,
#           <function_argument>]
# So "<function_name>(<function_argument>)" is called to return the
# value for custom <resource_name>.
dyn_res = {}
dyn_res["scratch"] = [get_filesystem_avail_unprivileged, "/tmp"]
dyn_res["home"]    = [get_filesystem_avail_unprivileged, "/home"]

vnl = pbs.event().vnode_list
local_node = pbs.get_local_nodename()

for k in dyn_res.keys():
    vnl[local_node].resources_available[k] = dyn_res[k][0](dyn_res[k][1])

except SystemExit:
    pass

except:
    e = pbs.event()
    e.reject("%s hook failed with %s. Please contact Admin" % \
            (e.hook_name, sys.exc_info()[2]))
```

Example 9-19: *Log loads on vnodes*Hook type: `exechost_periodic`You must create the custom resources `r1m`, `r5m`, and `r15m` on the vnodes.

```
#cat getload.py

import pbs
import sys
import os
load = os.getloadavg()
r1m = load[0]
r5m = load[1]
r15m = load[2]
e = pbs.event()
mynode = pbs.get_local_nodename()
v = e.vnode_list[mynode]
v.resources_available["r1m"] = r1m
v.resources_available["r5m"] = r5m
v.resources_available["r15m"] = r15m
pbs.logmsg(pbs.LOG_DEBUG,"getloadavg: vnode %s, r1m = %f, r5m = %f, r15m = %f" %
(repr(mynode), r1m, r5m, r15m))
```

Example 9-20: *Set job attributes and resources*

Hook type: `exechost_periodic`

```
% cat period.py
import pbs
E = pbs.event()
for k in e.job_list.keys():
    e.job_list[k].resources_used["mem"] = pbs.size("7gb")
    e.job_list[k].Variable_List["POLI"] = "negri"
    e.job_list[k].Hold_Types = pbs.hold_types("us")
```

Create the hook:

```
# qmgr -c "create hook period event=exechost_periodic,freq=30"
# qmgr -c "import hook period application/x-python default period.py"
```

Submit several jobs:

```
% qsub job.scr
<job-id1>
% qsub job.scr
<job-id2>
```

As the `exechost_periodic` hook executes, the jobs get the new values:

```
% qstat -f <job-id1>
...
Resources_used.mem = 7gb
Hold_Types = us
Variable_List = ...POLI=negri...
2
% qstat -f <job-id1>
...
Resources_used.mem = 7gb
Hold_Types = us
Variable_List = ...POLI=negri...
```

9.9 Multi-event Hooks

Example 9-21: Helper function for logging exceptions more completely and flexibly:

```
# The trace_hook function has been written to be portable between hooks.
def trace_hook(**kwargs):
    """Simple exception trace logger for PBS hooks
    loglevel=<int> (pbs.LOG_DEBUG): log level to pass to pbs.logmsg()
    reject=True: reject the job upon completion of logging trace
    trace_in_reject=<bool> (False): pass trace to pbs.event().reject()
    trace_in_reject=<str>: message to pass to pbs.event().reject() with trace
    Usage:
    try:
        your=code(here)
    except:
        trace_hook()
    """

    import pbs
    import sys

    if 'loglevel' in kwargs:
        loglevel=kwargs['loglevel']
    else:
        loglevel=pbs.LOG_ERROR
    if 'reject' in kwargs:
        reject=kwargs['reject']
    else:
        reject=True
    if 'trace_in_reject' in kwargs:
        trace_in_reject=kwargs['trace_in_reject']
    else:
        trace_in_reject=False

    # Associate hook events with the appropriate PBS constant. This is a list
    # of all hook events as of PBS Pro 13.0. If the event does not exist, it is
    # removed from the list.
    hook_events=['queuejob', 'modifyjob', 'movejob', 'runjob', 'execjob_begin',
                'execjob_prologue', 'execjob_launch', 'execjob_attach',
                'execjob_preterm', 'execjob_epilogue', 'execjob_end',
                'resvsub', 'provision', 'exechost_periodic',
                'exechost_startup']

    hook_event={}
    for he in hook_events:
        # Only set available hooks for the current version of PBS.
```

```

    if hasattr(pbs, he.upper()):
        event_code=eval('pbs.'+he.upper())
        hook_event[event_code]=he
        hook_event[he]=event_code
        hook_event[he.upper()]=event_code
        del event_code
    else:
        del hook_events[hook_events.index(he)]

trace={
    'line':      sys.exc_info()[2].tb_lineno,
    'module':    sys.exc_info()[2].tb_frame.f_code.co_name,
    'exception': sys.exc_info()[0].__name__,
    'message':   sys.exc_info()[1].message,
}
}
tracemsg='%s hook %s encountered an exception: Line %s in %s %s: %s' %(
    hook_event[pbs.event().type], pbs.event().hook_name,
    trace['line'], trace['module'], trace['exception'], trace['message']
)
rejectmsg="Hook Error: request rejected as filter hook '%s' encountered " \
    "an exception. Please inform Admin" % pbs.event().hook_name
if not isinstance(loglevel, int):
    pbs.logmsg(pbs.LOG_ERROR, 'trace_hook() called with invalid argument' \
        ' (loglevel=%s), setting to pbs.LOG_ERROR. ' % repr(loglevel))
    loglevel=pbs.LOG_ERROR

pbs.logmsg(loglevel, tracemsg)

if reject:
    tracemsg+=' , request rejected'
    if isinstance(trace_in_reject, bool):
        if trace_in_reject:
            pbs.event().reject(tracemsg)
        else:
            pbs.event().reject(rejectmsg)
    else:
        pbs.event().reject(str(trace_in_reject)+'Line %s in %s %s:\n%s' % (
            trace['line'], trace['module'], trace['exception'],
            trace['message'] ))

```


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