

NightSim User's Guide



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Scope of Manual

This guide is designed to assist you in getting started with use of NightSim™ on PowerMAX OS™ and Linux™. NightSim is a real-time tool that provides a graphical user interface to the frequency-based scheduler and performance monitor services.

Structure of Manual

This manual consists of five chapters, three appendixes, a glossary, and an index. A brief description of the chapters and appendixes is presented as follows.

- Chapter 1 introduces you to the concepts and components of NightSim, a real-time tool that is part of the NightStar™ development environment.
- Chapter 2 provides an overview of the primary factors that need to be taken into account prior to running NightSim on PowerMAX OS.
- Chapter 3 explains the procedures for beginning and ending a NightSim session and explains how to get help.
- Chapter 4 describes the frequency-based scheduler and introduces the components of NightSim's Scheduler window.
- Chapter 5 describes the performance monitor and introduces the components of NightSim's Monitor window.
- Appendix A discusses the format of configuration files used by NightSim as well as the automatic conversion of configuration files created by NightSim 2.4 and earlier versions.
- Appendix B presents the configurable X resources, NightStar resources, and widget hierarchy for NightSim.
- Appendix C details the procedures for reporting bugs found in NightSim.

The glossary contains definitions of technical terms that are important to understanding the concepts presented in this book.

The index contains an alphabetical reference to key terms and concepts and numbers of pages where they occur in the text.

Syntax Notation

The following notation is used throughout this manual:

| | |
|------------------|--|
| <i>italic</i> | Books, reference cards, and items that the user must specify appear in <i>italic</i> type. Special terms may also appear in <i>italics</i> . |
| list bold | User input appears in list bold type and must be entered exactly as shown. Names of directories, files, commands, options and system manual page references also appear in list bold type. |
| list | Operating system and program output such as prompts and messages and listings of files and programs appear in list type. |
| [] | Brackets enclose command options and arguments that are optional. You do not type the brackets if you choose to specify such options or arguments |

Referenced Publications

The following publications are referenced in this document:

| | |
|---------|--|
| 0890300 | <i>X Window System User's Guide</i> |
| 0890380 | <i>OSF/Motif Documentation Set</i> |
| 0890423 | <i>PowerMAX OS Programming Guide</i> |
| 0890430 | <i>System Administration Volume 2</i> |
| 0890466 | <i>Real-Time Guide</i> |
| 0890479 | <i>PowerMAX OS Guide to Real-Time Services</i> |
| 0891080 | <i>Diskless Systems Administrator's Guide</i> |
| 0891082 | <i>Real-Time Clock and Interrupt Module User's Guide</i> |

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This chapter introduces you to the concepts and components of NightSim, a real-time tool that is part of the NightStar development environment. NightSim provides a graphical user interface to the major functions associated with the *frequency-based scheduler* and the *performance monitor*.

Overview of NightSim

NightSim allows you to perform the entire range of functions associated with frequency-based scheduling. You can perform the major functions of configuring a scheduler, setting up a timing source, scheduling programs, saving and restoring a scheduler configuration, running a simulation, and viewing scheduling data. The principal features of the *frequency-based scheduler* are described in the section that follows.

NightSim also allows you to perform the entire range of functions associated with the *performance monitor*. You can perform the major functions of selecting a scheduler, clearing existing performance monitor values, enabling and disabling performance monitoring, including and excluding interrupt time, and viewing performance monitor values. The principal features of the performance monitor are described in “Overview of the Performance Monitor” (see p. 1-2).

In addition, NightSim fully supports frequency-based scheduling in a distributed environment, using *closely-coupled* and/or *loosely-coupled* systems, providing the ability for a single invocation of NightSim to schedule and monitor processes distributed across multiple single-board computers (SBCs), or multiple systems loosely-coupled using an RCIM (Real-Time Clock and Interface Module) board. (In this manual, loosely-coupled systems using an RCIM chain are referred to as *RCIM-coupled systems*.) An additional capability is NightSim’s ability to configure a frequency-based scheduler on any system in your network, not just the *NightSim host*.

NightSim is also integrated with other NightStar tools. NightSim may be invoked directly from the NightBench Program Development Environment. NightSim also provides the ability to schedule your programs under the control of the NightView Source-Level Debugger, making it easy to gain control of scheduled programs in order to set break-points or monitorpoints early on in the execution of the program, before it attaches to the FBS.

NightSim’s graphical user interface is based on the X Window System™ and OSF/Motif.™

Overview of the Frequency-Based Scheduler

The *frequency-based scheduler*, or FBS, is a task synchronization mechanism that allows you to run processes at specified frequencies. Frequencies can be based on high-resolution clocks, an external interrupt source, or completion of a cycle. The frequency-based scheduler provides a mechanism for initiating processes at the specified frequency. The processes are then scheduled via the standard priority-based scheduler.

When used in conjunction with the performance monitor, the FBS can be used to determine the best way of allocating processors to various tasks for a particular application. Chapter 4, "Using the Scheduler Window," fully describes the features and capabilities of the frequency-based scheduler.

Overview of the Performance Monitor

The performance monitor is a mechanism that allows you to monitor use of the CPU by processes that are scheduled on a frequency-based scheduler. The values obtained can help in determining whether processes need to be redistributed among processors for improved load balancing and processing efficiency. You can obtain performance monitor values by process or processor and can specify whether time spent servicing interrupts should be included or excluded from the values. The performance monitor also makes it possible to monitor a processor's *idle* and *spare time*. By examining the amount of idle and spare time on each processor, you can identify the processors that have the lightest load and determine the additional amount of CPU time that can be used for scheduling real-time processes. Chapter 5, "Using the Monitor Window," fully describes the features and capabilities of the performance monitor.

Overview of the Graphical User Interface

NightSim's graphical user interface has two major windows: the Scheduler window and the Monitor window. The Scheduler window provides access to the key operations associated with frequency-based scheduling. The Monitor window provides access to the key operations associated with performance monitoring. An overview of each window is provided in the sections that follow.

The Scheduler Window

Figure 1-1 presents the Scheduler window. This window allows you to configure a frequency-based scheduler; set up a timing source for it; schedule programs on it; start, stop, and resume a simulation; and view scheduling data.

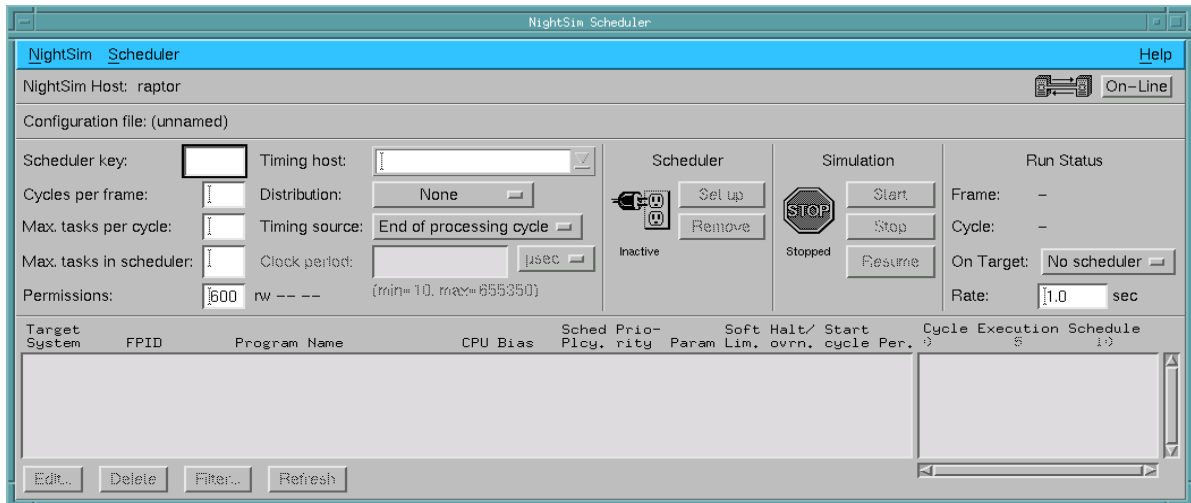


Figure 1-1. Scheduler Window

The Scheduler window also allows you to save a scheduler configuration to a file and to open and save a configuration file that you have previously created. It shows whether the window is active (associated with a scheduler that exists on the system) or inactive (not associated with a scheduler that exists on the system) and whether the selected scheduler is running or stopped. It displays the current *minor cycle* and current *major frame* for the simulation, and it graphically shows the execution cycle for each process that is scheduled on the scheduler.

Chapter 4, “Using the Scheduler Window,” provides a detailed explanation of each area of the Scheduler window and provides reference information for all of the fields and controls in each area.

The Monitor Window

Figure 1-2 presents the Monitor window. This window allows you to monitor the performance of selected FBS-scheduled processes scheduled on one or more processors on a selected scheduler. It allows you to display performance monitor values for selected FBS-scheduled processes, clear performance monitor values for all FBS-scheduled processes scheduled on one or more CPUs, and specify whether or not time spent servicing interrupts is to be included in performance monitor timing values.

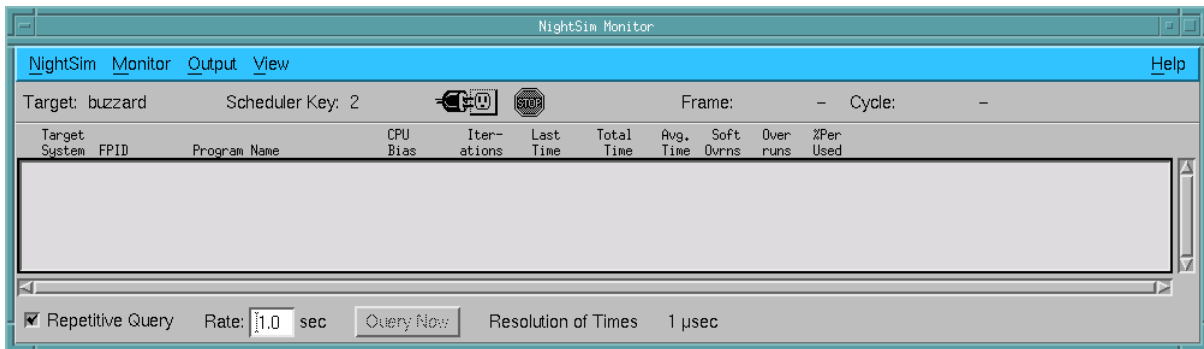


Figure 1-2. Monitor Window

The Monitor window also allows you to specify whether performance monitoring information is to be displayed in the Monitor window or written to a selected file. In either case, you may specify the types of information that are to be reported, the resolution with which performance monitor timing values are displayed (for example, microseconds, tens of microseconds, milliseconds), and the rate at which values are to be updated.

The Monitor window allows you to specify a frequency-based scheduler with which the window is to be associated. It shows whether the scheduler is active or inactive, and it shows whether the simulation is running or stopped. If the scheduler is active, it displays the current *major frame* and current *minor cycle* for the simulation. The Monitor window also shows performance monitor values for selected processes.

Chapter 5, “Using the Monitor Window,” provides a detailed explanation of each area of the Monitor window and provides reference information for all of the fields and controls in each area.

Overview of Closely-Coupled Support

NightSim presents an interface that makes it appear as though there is one frequency-based scheduler distributed across all the *SBCs* in a *cluster*. The user must still assign each process to a specific target computer, but NightSim presents all the processes triggered from a single timing source in a single window, making it appear as if there is one *FBS* controlling all the processes. In reality, NightSim creates an *FBS* and configures the chosen timing source as a *distributed timing device* on each target system where the user has scheduled processes (using the same scheduler key for each).

All frequency-based schedulers that are attached to the same remote timing device are stopped, started and resumed together, thus maintaining the same number of frame/cycle interrupts delivered to each scheduler residing on different *SBC* boards.

If the timing device is a real-time clock or an edge-triggered interrupt, the operating system ensures synchronization by starting the timing device **after** all target *FBS*'s have been started. However, if the timing device is an external device, NightSim has no control over when that source “fires,” opening the possibility that the target *FBS*'s will not start out synchronized.

Refer to the *Diskless Systems Administrator's Guide* (0891080) for information on configuring a *closely-coupled system*.

Overview of RCIM Support

NightSim supports the Real-Time Clock and Interrupt Module (RCIM). An RCIM is an optional hardware module attached to a *target system* which contains the following interrupt-generating devices:

- real-time clocks (RTCs)
- edge triggered interrupts (ETIs)
- programmable interrupt generators (PIGs)

Any of these devices may be used as the timing source for an FBS.

RCIMs may be connected via RCIM cables such that interrupts from one RCIM may be distributed to other systems in the RCIM chain.

Each interrupt device on an RCIM may be configured as an *RCIM-distributed* or normal device. By default, each interrupt device is available for use on the attached target system, or within an attached *cluster of closely-coupled* systems. If the interrupt device is configured as an RCIM-distributed device, interrupts are also distributed between target systems using the RCIM cable.

NightSim provides full support for the creation, control, and performance monitoring of schedulers distributed across multiple SBC's and/or target computers in an RCIM chain utilizing an RCIM-distributed device. NightSim provides an interface to the RCIM-coupled scheduler in much the same way that it does for a closely-coupled scheduler, creating the individual target schedulers on target systems. In addition, NightSim handles registration of the distributed interrupt source, providing control of all target schedulers as if they were a single scheduler.

An RCIM-coupled scheduler provides synchronized control for starting, stopping, and debugging of programs scheduled across loosely-coupled target systems.

Establishing the NightSim Environment

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Establishing the NightSim Environment

This chapter provides an overview of the primary factors that need to be taken into account prior to running NightSim. These include software requirements, system configuration requirements, user requirements, and performance considerations.

Software Requirements

Each of the NightSim *target systems* must have the following packages installed:

- **nsimserver** - the *NightSim server*
- **x11ipc** - the X Window System package containing libraries for inter-process communication
- **fb**s - the PowerMAX OS operating system package providing kernel support for the *frequency-based scheduler*, the *performance monitor*, and **rtcp(1)**.

NOTE

For an explanation of the procedures for installing software packages, refer to the **pkgadd(1M)** system manual page.

Configuration Requirements

There are certain system tunables on the target systems associated with the frequency-based scheduler as well as system tunables on the target systems associated with the performance monitor that may need to be set. There may also be additional considerations when running NightSim on a *closely-coupled* system or across *loosely-coupled* systems.

After changing a tunable parameter, you must rebuild the kernel using **idbuild(1M)** and then reboot your system. For additional information on tunable parameters, refer to the “Tunable Parameters” chapter of *System Administration Volume 2*.

It is necessary to add the **fb**s kernel module when you are configuring the target.

It should also be noted that if you want to use the real-time clocks on any of the target systems, you need to add the **rtc** kernel module when you configure the target.

If you want to use RCIM devices, you also need to add the **rcim** and **eti** kernel modules when you configure the target. See “RCIM-Coupled System Configuration” on page 2-4

for other considerations when using NightSim on an *RCIM-coupled* configuration. Also, see the *Real-Time Clock and Interrupt Module User's Guide* (0891082) for more information.

NOTE

System tunables can be examined and modified using the kernel configuration utility **config(1M)**.

Frequency-Based Scheduler System Tunables

The *frequency-based scheduler* has associated with it the following system tunable parameters:

| | |
|---|--|
| FBSMNI | The maximum number of frequency-based schedulers that can be configured at one time system-wide. The default value for this quantity is 10. You cannot specify a value greater than 100. |
| FBSUNSCHEDMAX | The maximum number of unscheduled processes that is permitted on a frequency-based scheduler. The default value for this quantity is -1, which indicates that the maximum number of unscheduled processes permitted per scheduler is equal to the maximum number of scheduled processes permitted on the scheduler. This number is specified when the scheduler is configured (see "Using the Scheduler Configuration Area", p. 4-21). A value other than -1 may be specified. This new value will be the maximum number of unscheduled processes permitted for all schedulers. |
| FBSCCSENABLED | Specifies whether the <code>CCS_FBS</code> subsystem is enabled. See "Closely-Coupled System Configuration" on page 2-3 for more information. |
| RCIM_MASTER_NAME RCIM_DISTRIB_INTR0 ... RCIM_DISTRIB_INTR7 | These tunables are required when RCIM-distributed frequency-based schedulers are created. See "RCIM-Coupled System Configuration" on page 2-4 for more information. |

To determine whether the values of these parameters have been modified for your system, examine the `/etc/conf/mtune.d/fbs` file. You can change the value of either of these parameters by using the **idtune(1M)** command.

Performance Monitor System Tunables

The *performance monitor* services to which NightSim provides access require that the high-resolution timing facility be configured into the kernel of the *target systems*. The high-resolution timing facility provides a means of measuring the execution time of each process or LWP (lightweight process). It is fully described in the *PowerMAX OS Real-Time Guide* (0890466). The performance monitor facility uses the times that are gathered for each process by the high-resolution timing facility to obtain its timing values. As specified by the user, these values may include or exclude time spent servicing interrupts.

By default, the high-resolution timing facility is not configured into the kernel. To determine whether it is configured into your kernel, examine the value of the HIGHRESTIMING system tunable parameter in the `/etc/conf/mtune.d/svc` file. To configure the high-resolution timing facility, you must change the value of this tunable parameter from 0 to 1 by using the `idtune(1M)` command. This must be turned on for each system (server or client) where performance monitoring is desired.

Closely-Coupled System Configuration

There are some additional considerations when using NightSim on a *closely-coupled* configuration.

The `rdevfs` file system provides local access to timing devices that exist on some other system. You may wish to refer to the section “The Remote Device File System” in the *PowerMAX OS Guide to Real-Time Services* (0890479) for more information.

The CCS_FBS subsystem (support for the frequency-based scheduler in a closely-coupled configuration) must be added to each potential NightSim *target system* within the cluster. This subsystem primarily checks kernel configuration options at system boot. See “Subsystem Support” and “Modifying the Kernel Configuration” in the *Diskless System Administrator’s Guide* (0891080) for more information.

Also, the FBSCCSENABLED system tunable should be properly set. See “Frequency-Based Scheduler System Tunables” on page 2-2 for more information. This will be automatically configured on targets that have added the CCS_FBS subsystem.

NOTE

If the file server SBC is also going to be part of a closely-coupled *FBS* simulation, then the user must manually configure the `rdevfs` and `fbs` kernel modules, and also enable the FBSCCSENABLED tunable into the server’s kernel. See “Modifying the Kernel Configuration” in the *Diskless System Administrator’s Guide* (0891080) for more information.

Note that when you configure your closely-coupled system, the `/etc/dtables/nodes.vmeboot` file specifies information about how each client is connected and how it boots. NightSim uses this file to map board IDs to a hostname that NightSim can use to communicate via networking with each *SBC*. It is important that you

specify an Ethernet hostname for a client only if it does, in fact, have an Ethernet interface. If you specify an Ethernet hostname, but the client cannot communicate via Ethernet, NightSim may give you an error, saying it cannot start up a *server* on that client.

RCIM-Coupled System Configuration

There are some additional considerations when using NightSim on an *RCIM-coupled* configuration.

If a frequency-based scheduler is to be distributed across multiple *target systems*, then RCIM modules are required for each of the target systems (unless all the target systems are contained solely within a *cluster*).

The following kernel modules must be enabled on all target systems involved in the distributed scheduler:

- **rdevfs**
- **fbs**
- **rcim**
- **eti** (if ETI devices are to be used)

The following subsystems must be enabled on all target systems involved in the distributed scheduler if they are part of a cluster:

RC_FBS

Each RCIM module must be configured with tunables similar to those mentioned below for appropriate distribution of interrupts on each target system:

```
RCIM_MASTER_NAME
RCIM_DISTRIB_INTR_0
...
RCIM_DISTRIB_INTR_7
```

These tunables define the topology of the RCIM chain and the distribution of interrupts along that chain.

NightSim cannot automatically determine which targets in an RCIM-distributed scheduler are actually connected via RCIM cables; however, NightSim remembers system interconnections as you configure RCIM-distributed schedulers.

Use of RCIM modules as timing devices for distributed schedulers requires that the RCIM interrupt device be registered on the host and target systems. This registration is dynamic in nature and is handled by NightSim as schedulers are configured, created, and removed.

User Requirements

To use NightSim, you must also ensure that certain user requirements related to remote shell access, environment variables, and privileges are met. These requirements are described in the sections that follow.

Remote Shell Access

NightSim uses the **rsh(1)** command on the *NightSim host* to execute programs on remote systems, only if necessary. When the Scheduler is in On-Line mode (see “On-Line/Off-Line Operation” on page 4-5), if your timing host or any target system is not the same as the NightSim host, the **rsh(1)** command will be used to start a *NightSim server* process on each remote system.

The NightSim user must be able to use the **rsh(1)** command to access each remote system involved and execute commands on those systems.

Ensure that for each remote system, there exists a login with the same username as on the NightSim host. In addition, the **.rhosts** file in the home directory for that username on each remote system must contain an entry for that username and the NightSim host, or else the **/etc/hosts.equiv** file on the remote system must contain the name of the NightSim host.

If you use NightSim Scheduler only in Off-Line mode, it is not necessary to configure systems for **rsh(1)** use.

See the **rsh(1)** man page for more details.

Environment Variables

You must ensure that the value of your **DISPLAY** variable is set to the name of your X server. You may determine whether the value of this variable is already set by typing the following at the system command prompt.

```
echo $DISPLAY
```

If the value of the variable has been set, output similar to the following is displayed:

```
pubtek7:0.0
```

If the value has not been set, you may set it from the command line. The format for specifying the name of your X server is as follows:

```
[host]:server[.screen]
```

Host specifies the name of your X server; *server* specifies the server number; and *screen* specifies the screen number. In most cases, the server number and screen number are zero.

Table 2-1 shows how to set the **DISPLAY** variable from the command line by using different versions of the shell.

Table 2-1. Setting the DISPLAY Variable

| Type of Shell | Command Line Entry |
|---------------|---|
| Bourne Shell | DISPLAY=pubtek7:0.0 export DISPLAY |
| C Shell | setenv DISPLAY pubtek7:0.0 |
| Korn Shell | export DISPLAY=pubtek7:0.0 |

In addition, you may use the **-display** X command-line option when invoking NightSim. This option has the following format:

```
-display [host] :server[.screen]
```

See the *X Window System User's Guide* for more information about this option and "Invoking NightSim" on page 3-1 for related information.

Privileges

PowerMAX OS supports a privilege mechanism through which processes are allowed to perform sensitive system operations or override system restrictions. Some of the operations associated with the *frequency-based scheduler* and the *performance monitor* require special privileges. These operations are related to configuration and removal of a scheduler, scheduling and rescheduling of programs, and selection of the timing mode under which the performance monitor runs. One or a combination of the following privileges is required to perform these types of operations:

P_RTIME

P_CPUBIAS

P_TSHAR

Normally, NightSim automatically grants the above privileges to target processes. However, when scheduling a process under the NightView debugger (see "Debug" on page 4-30), the user must ensure that appropriate privileges are granted to the NightView session. Typically this is done by putting a **tfadmin(1)** command at the end of the user's **.profile** or **.login** script:

```
exec tfadmin [role: cmd]
```

When a NightView session is initiated from NightSim, a telnet session is launched to execute the NightView dialogue. The dialogue runs the user's default shell, thereby executing the user's **.profile** or **.login** script during initialization. The **exec tfadmin** command above causes the login shell to obtain the privileges associated with the optionally specified (or default) role for the user. NightSim then takes control of the

dialogue shell and executes commands on the user's behalf to schedule the user's processes on an FBS.

Additionally, users may use the **Edit Process** window (see "Privileges" on page 4-32) to specify other privileges needed by their target processes as long as the user or target process is entitled to them.

Allowable privileges are determined by:

- the combined set of all privileges specified by the roles assigned to the user on the target system (see **adminuser(1)** and **adminrole(1)** for more information)
- the fixed privileges associated with the executable process on the target system (see **filepriv(1)** for more information)

For additional information on privileges, refer to the *PowerMAX OS Programming Guide* (0890423) and the **intro(2)** system manual page.

Capabilities

RedHawk Linux provides a means to grant otherwise unprivileged users the authority to perform certain privileged operations. In this manner, processes are allowed to perform sensitive system operations or override system restrictions. The **pam_capability(8)** (Pluggable Authentication Module) is used to manage sets of capabilities, called roles, required for various activities.

Some of the operations associated with the *frequency-based scheduler* and the *performance monitor* require the **CAP_SYS_ADMIN** capability. These operations are related to the configuration and removal of a scheduler, scheduling and rescheduling of programs, and selection of the timing mode under which the performance monitor runs.

RedHawk systems are configured with an **fbscheduser** role which provides this capability. In order to use the NightSim server on a RedHawk target, each NightSim user must be configured to use (at a minimum) the capabilities provided by the **fbscheduser** role. In addition, the **/etc/pam.d** configuration files associated with the **rsh** and **login** services must be modified.

To configure user capabilities, you must be **root** or have system administrator level capabilities. Edit the **/etc/pam.d/rsh** and **/etc/pam.d/login** files, adding the following line to each, if it is not already present:

```
session    required /lib/security/pam_capability.so
```

In addition, for each NightSim user on the target system, add the following line to the end of **/etc/security/capability.conf**

```
user  username    fbscheduser
```

where *username* is the login name of the user.

In order for the above changes to take effect, the user should log off and log back onto the target system.

Proper configuration may be verified by running:

```
cat /proc/self/status
```

and ensuring that the capability-related values `CapInh`, `CapPerm`, and `CapEff` are non-zero. Furthermore, all NightSim servers on the target must be restarted to take advantage of the newly configured capabilities.

For additional information on capabilities, refer to the `capability.conf(5)` and `pam_capability(8)` system manual pages.

Performance Considerations

To prevent the execution of NightSim from interfering with the execution of the real-time application, it is recommended that you assign NightSim to the boot processor or any other processor on which real-time tasks are not running. You can assign NightSim to a particular processor by invoking the `run(1)` command from the shell and specifying the `-b bias` option. Prior to using the `run` command for this purpose, you may wish to determine which processor on your system is the boot processor. You can do so by invoking the `run` command without specifying any arguments. On Series 6000 systems, the boot CPU is always 0. Note that this may not be the case for future architectures.

For more information on use of the `run(1)` command for these purposes, refer to the corresponding system manual page.

In addition, NightSim has the ability to configure an FBS on any system in the network, not just the *NightSim host*. This capability allows the user interface to operate on a system other than the ones on which processes are scheduled, freeing the resources of those *target systems* for the scheduled processes.

Getting Started



| | |
|--------------------------|-----|
| Invoking NightSim | 3-1 |
| Getting Help | 3-4 |
| Using Accelerators | 3-5 |
| Exiting NightSim..... | 3-5 |

This chapter explains the procedures for beginning and ending a NightSim session. It also explains how to get help and how to use accelerators.

Invoking NightSim

The NightSim tool is available on your system as `/usr/bin/nsim`.

The format for executing `nsim` on *PowerMAX OS* is as follows:

```
nsim [-help] [-version] [-f file] [-offline] [-s [[hostname,]key]]
      [-m [[hostname,]key]] [-Xoption ...]
```

The format for executing `nsim` on *Linux* is as follows:

```
nsim [-help] [-version] [-f file] [-offline] [-s hostname,[key]]
      [-m hostname,[key]] [-Xoption ...]
```

Options are described as follows:

- | | |
|-----------------|---|
| -help | This option allows you to display the usage information for NightSim and then exit. |
| -version | This option allows you to display the version and copyright information for NightSim and then exit. |
| -f file | This option allows you to specify the name of a file that contains configuration and scheduling data for a selected <i>frequency-based scheduler</i> . You may specify a full or relative pathname for the file. To save the configuration and scheduling data entered in a particular Scheduler window to a file, select the Scheduler->Save Config File As menu item from that Scheduler window. Procedures are fully explained in “Save Config File As . . .” on page 4-17. You may also use a text editor to create or modify a configuration file, following the format as described in “Configuration File Format” on page A-1. |
| -offline | Create Scheduler windows initially in Off-Line mode. See “On-Line/Off-Line Operation” on page 4-5 for more information. |

-s [[*hostname*,]*key*] (**PowerMAX OS**)

-s *hostname*[,*key*] (**Linux**)

This option allows you to create a **Scheduler** window.

The *key* parameter allows you to specify the key for a *frequency-based scheduler* that is active on your system. *Key* specifies an integer value that identifies the scheduler. If the optional *key* parameter is not specified, the new **Scheduler** window is inactive—that is, it is not associated with a scheduler that exists on your system.

The *hostname* parameter causes the window to be associated with an FBS that is active on that particular system. If the optional *hostname* parameter is not specified, the system defaults to the local host (where NightSim is running).

NOTE

On Linux, the *hostname* is required, and must denote a host running PowerMAX OS with a NightSim server installed.

If an active scheduler associated with the specified key is found and you have read permission for it, an active **Scheduler** window associated with the key is created. See Chapter 4, “Using the Scheduler Window,” for information about the **Scheduler->Select Active Scheduler** menu item.

If a scheduler with the specified key does not exist, NightSim reports an error.

This option may be used more than once; a **Scheduler** window will be created for each occurrence of the option.

-m [[*hostname*,]*key*] (**PowerMAX OS**)

-m *hostname*[,*key*] (**Linux**)

This option allows you to create a **Monitor** window.

The *key* parameter allows you to create a **Monitor** window that is associated with a particular *frequency-based scheduler*. *Key* specifies an integer value that identifies the scheduler with which you wish the **Monitor** window to be associated. If you do not specify the optional *key* parameter and you have opened a **Scheduler** window, the new **Monitor** window will display the same key as that displayed in the **Scheduler** window.

The *hostname* parameter causes the window to be associated with an FBS with the specified *key* on that particular system. If the optional *hostname* parameter is not specified, the system defaults to the local host (where NightSim is running).

NOTE

On Linux, the *hostname* is required, and must denote a host running PowerMAX OS with a NightSim server installed.

You must have read permission for the specified scheduler. You must also have write permission for the scheduler if you wish to be able to enable or disable performance monitoring for processes that are scheduled on it.

This option may be used more than once; a **Monitor** window will be created for each occurrence of the option.

-Xoption

You may also specify any standard X Toolkit command-line option. Such options include **-bg** *color* to set the color for the window background; **-fg** *color* to set the color to use for text or graphics; and **-xrm** *resourcestring* to set selected resources. For a complete list of these options, refer to the **X(1)** system manual page.

When invoking NightSim, you may specify options in any order; you may specify the **-f**, **-s**, and **-m** options one or more times as illustrated by the following example:

```
nsim -s buzzard,4 -s papio,5 -m papio,5 -f config_file
```

In this case, NightSim opens two *active scheduler windows*—one associated with the scheduler identified by key 4 on target **buzzard** and one associated with the scheduler identified by key 5 on target **papio** — a monitor window associated with the scheduler identified by key 5 on target **papio**, and an *inactive scheduler window* associated with the scheduler identified in **config_file**.

You may also invoke NightSim without specifying any options. Doing so allows you to display an inactive Scheduler window. An inactive Scheduler window is one that is not associated with a scheduler that exists on the system.

NOTE

On Linux, invoking NightSim without any options will open a NightSim Main Window. It may be used to specify a host on which to open an inactive Scheduler or Monitor window.

The steps for invoking NightSim are as follows:

1. Log in to your system.
2. Ensure that the value of your **DISPLAY** variable is set to the name of your X server (or use the **-display** command-line option to the NightSim command). Refer to “Environment Variables” on page 2-5 for more information.
3. Type **nsim** and any desired options after the system command prompt, and press the **Enter** key.

Getting Help

NightSim provides on-line help information through the **Help** menu which is accessible via the menu bars in the **Scheduler** (see “Introduction to the Scheduler Window” on page 4-8) and **Monitor** (see “Introduction to the Monitor Window” on page 5-7) windows. Figure 3-1 presents this menu:

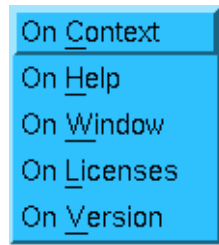


Figure 3-1. Help Menu

Descriptions of the options on the **Help** menu follow.

On Context

Gives context-sensitive help on the various menu options, dialogs, or other parts of the user interface.

Help for a particular item is obtained by first choosing this menu option, then clicking the mouse pointer on the object for which help is desired (the mouse pointer will become a floating question mark when the **On Context** menu item is selected).

In addition, context-sensitive help may be obtained for the currently highlighted option by pressing the **F1** key. The HyperHelp viewer will open with the appropriate topic displayed.

On Help

Explains the various ways of obtaining help in NightSim and describes each of the items in the **Help** menu

On Window

Displays help information for the current window

On Licenses

Displays status information about licenses and the license manager

On Version

Displays version and copyright information for NightSim

NightSim also provides help information through the **Help** buttons that appear in other windows. When you click on the **Help** button in one of these windows, NightSim displays the help information for that window.

Using Accelerators

A set of keyboard accelerators is defined for use within NightSim to provide quick access to certain functions and menu items. Accelerators associated with menu items allow you to access those items whether or not the menu is posted. Table 3-1 contains a list of the accelerators and the resulting actions; where applicable, it indicates the menu items for which the accelerators provide shortcuts. Note that you can define additional accelerators through the use of X resources (refer to the **X(1)** system manual page and “Widget Hierarchy” on page B-4 for the information needed to do so).

Table 3-1. Accelerators

| Accelerator | Menu Item | Action |
|---------------|-----------------------------|--|
| <Control> <W> | NightSim->Close Window | Closes the current Scheduler or Monitor window |
| <Control> <Q> | NightSim->Exit | Exits NightSim |
| <Control> <N> | Scheduler->New | Clears all information from the current Scheduler window; resets the various areas to blank or default values; and places the window in the inactive state |
| <Control> <O> | Scheduler->Open Config File | In the current Scheduler window, opens a scheduler configuration file that you have previously saved |
| <Control> <S> | Scheduler->Save Config File | Saves the configuration and scheduling data entered in the current Scheduler window in the file that is associated with the window |
| F1 | | Displays context help for the component that currently has the focus |

Exiting NightSim

You may exit NightSim from the Scheduler or Monitor window by using one of the following techniques:

- Select the NightSim->Exit menu item.
- Press <Control> <Q>.

If you have not saved the changes that you have made in any window, you will be asked to confirm that you wish to exit.

Using the Scheduler Window

| | |
|---|------|
| Understanding the Frequency-Based Scheduler | 4-1 |
| How Is Scheduler Frequency Defined? | 4-2 |
| How Are Processes Scheduled? | 4-2 |
| On-Line/Off-Line Operation | 4-5 |
| Verify Scheduler | 4-5 |
| Introduction to the Scheduler Window | 4-8 |
| Using the Scheduler Window Menu Bar | 4-9 |
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| Using the On-Line/Off-Line Status Area | 4-20 |
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| Using the Run Status Area | 4-45 |

Using the Scheduler Window

This chapter describes the *frequency-based scheduler* and explains how scheduler frequency is defined and how processes are scheduled. It introduces the components of NightSim's Scheduler window and describes the use of each component.

Understanding the Frequency-Based Scheduler

The *frequency-based scheduler* is a task synchronization mechanism that allows you to run processes at frequencies that you specify. Frequencies can be based on high-resolution clocks, an external interrupt source, or completion of a cycle. The frequency-based scheduler provides a mechanism for initiating processes at the specified frequency. The processes are then scheduled via the standard PowerMAX OS priority-based scheduler.

The frequency-based scheduler provides you with the ability to:

- Define *FBS* frequency in terms of the duration of a *minor cycle* and the number of minor cycles per *major frame*
- Specify the scheduling parameters with which processes are scheduled
- Detect *frame overruns* for all FBS-scheduled processes
- View the status of FBS-scheduled processes
- Remove one or all FBS-scheduled processes from a scheduler
- Reschedule an FBS-scheduled process
- Start, stop, and resume scheduling on a frequency-based scheduler
- Connect a timing source to and disconnect it from a frequency-based scheduler
- Control use of the real-time clock device as the timing source for a frequency-based scheduler
- Configure up to 100 frequency-based schedulers system-wide in a single processor or multiprocessor environment
- Use both frequency-based scheduling and static priority scheduling simultaneously

In addition, NightSim provides the following additional capabilities for your convenience:

- Specify input and output files for scheduled processes
- Specify a working directory for scheduled processes.

- Schedule processes under **xterm(1)** terminal windows, providing the option of interactive behavior
- Schedule processes under the NightView debugger
- Configure working privileges for scheduled processes.

NOTE

Some of these additional features are not available for schedulers started via a saved script.

How Is Scheduler Frequency Defined?

You configure a *frequency-based scheduler*, in part, by defining the number of *minor cycles* that compose a *major frame*. Minor cycles and major frames have associated with them a duration of time that you can define by using a timing source for the scheduler. The timing source can be the end of a minor cycle, a real-time clock, an edge-triggered interrupt, or a user-supplied device. Procedures for using each of the devices as a timing source are explained in detail in the *PowerMAX OS Guide to Real-Time Services*.

If you use *end-of-cycle scheduling*, scheduling is triggered when the last process that is scheduled during the current minor cycle of the current major frame completes its processing.

If you use a real-time clock as the timing source, you can specify the period in microseconds or the frequency in hertz.

How Are Processes Scheduled?

You schedule processes to run at a certain frequency by specifying the first *minor cycle* in which the process is to be wakened in each *major frame* (called the *starting base cycle*) and the frequency with which it is to be wakened (called the period). If, for example, you schedule "Process 1" with a starting base cycle of zero and a *period* of two, the process will be wakened once every two minor cycles, starting with the first minor cycle in the frame. If you schedule "Process 2" with a starting base cycle of one and a period of four, that process will be wakened once every four minor cycles, starting with the second minor cycle in the frame. If you then schedule "Process 3" with a starting base cycle of two and a period of two, that process will be wakened once every two minor cycles, starting with the

third minor cycle in the frame. On a *frequency-based scheduler* configured with 100 minor cycles per major frame, these processes will be wakened as illustrated in Table 4-1.

Table 4-1. Process Scheduling

| Minor Cycle | Processes Wakened |
|-------------|----------------------|
| 0 | Process 1 |
| 1 | Process 2 |
| 2 | Process 1, Process 3 |
| 3 | |
| 4 | Process 1, Process 3 |
| 5 | Process 2 |
| ... | |
| 97 | Process 2 |
| 98 | Process 1, Process 3 |
| 99 | |

The maximum frequency with which you can schedule a process is once per minor cycle (a period of one); the minimum frequency is once per major frame (in the case of the example, a period of 100).

A process runs until it calls an *FBS* library routine that causes it to sleep until the frequency-based scheduler wakes it again. The frequency-based scheduler wakes those sleeping processes that are scheduled to be wakened in the current minor cycle of the current major frame and repeats the process for each minor cycle in the current frame. It continues to repeat the entire process on every major frame until the scheduler is disabled. A scheduler configured with 100 minor cycles per major frame, a minor cycle duration of 10,000 microseconds (0.01 second), and a major frame duration of one second wakes processes as illustrated in Table 4-2.

Table 4-2. Scheduler Operation

| Major Frame | Time (sec.) | Minor Cycle | Processes Wakened |
|-------------|----------------|-------------|----------------------|
| 0 | 0 | 0 | Process 1 |
| | 0.01 | 1 | Process 2 |
| | 0.02 | 2 | Process 1, Process 3 |
| | ... | | |
| | 0.97 | 97 | Process 2 |
| | 0.98 | 98 | Process 1, Process 3 |
| | 0.99 | 99 | |

Table 4-2. Scheduler Operation (Cont.)

| Major Frame | Time (sec.) | Minor Cycle | Processes Wakened |
|-------------|----------------|-------------|----------------------|
| 1 | 1.00 | 0 | Process 1 |
| | 1.01 | 1 | Process 2 |
| | 1.02 | 2 | Process 1, Process 3 |
| | ... | | |
| | 1.97 | 97 | Process 2 |
| | 1.98 | 98 | Process 1, Process 3 |
| | 1.99 | 99 | |
| | ... | | |
| n | n.00 | 0 | Process 1 |
| | n.01 | 1 | Process 2 |
| | n.02 | 2 | Process 1, Process 3 |
| | .. | | |
| | n.97 | 97 | Process 2 |
| | n.98 | 98 | Process 1, Process 3 |
| | n.99 | 99 | |
| | | | |

As illustrated in Table 4-2, when the current major frame is zero and the current minor cycle is zero, the scheduler wakes “Process 1.” After 0.01 second, it wakes “Process 2”; after 0.02 second, it wakes “Process 1” and “Process 3”; and so on. At one second, when the current major frame becomes one, the current minor cycle becomes zero again, and the scheduler wakes “Process 1.” After .01 second, it wakes “Process 2”; after .02 second, it wakes “Process 1” and “Process 3”; and so on. The scheduler continues repeating this process for as long as it is enabled.

It is important to note that a process may not always run at the frequency that you have specified. A *frame overrun* occurs when a scheduled process does not finish its processing before it is scheduled to run again. Overrun counts are maintained for each process and for each scheduler. You can obtain information on overruns by querying a process in the Monitor window (see Chapter 5, “Using the Monitor Window”). When you schedule a process on a selected scheduler, you have the option of ensuring that the scheduler is stopped when that process causes a frame overrun.

For additional information on the *frequency-based scheduler*, refer to the *PowerMAX OS Guide to Real-Time Services*.

On-Line/Off-Line Operation

NightSim provides two modes of operation for a Scheduler, **On-Line** and **Off-Line**. You can toggle the current state by pressing the **On-Line/Off-Line** button on either the NightSim Scheduler window (see “**On-Line/Off-Line**” on page 4-20) or the **Edit Process** window associated with it (see “**On-Line/Off-Line**” on page 4-29).

By placing a NightSim Scheduler into an **Off-Line** state, immediate checking of the information entered in either the NightSim Scheduler window or its associated **Edit Process** window can be avoided. When in **Off-Line** mode, the NightSim Scheduler will not communicate with any servers on any timing host or target system of the Scheduler.

This is useful when creating a configuration for future use that deals with target systems which may not currently exist or may not be currently accessible. The values entered in a Scheduler while it is **Off-Line** will be checked when the mode is changed to **On-Line**.

There are two ways to request a transition to **On-Line** mode:

1. Press the **On-Line/Off-Line** button on either the NightSim Scheduler or its associated **Edit Process** window. This toggles the value on the face of the button.
2. Press the **Set Up** button on the Scheduler window.

In each of these cases, when going from **Off-Line** to **On-Line**, the information entered in the Scheduler window and its associated **Edit Process** window is examined for correctness given the current state of the timing host and target systems. NightSim servers are started if necessary, and all scheduled process attributes are checked for correctness.

If errors are found in the configuration, the user will be guided through the list of issues discovered in the examination via the **Verify Scheduler** dialog.

Verify Scheduler

NightSim provides two modes of operation for a Scheduler, **On-Line** and **Off-Line** (see “**On-Line/Off-Line Operation**” on page 4-5). When going from **Off-Line** to **On-Line**, the information entered in the Scheduler window and its associated **Edit Process** window is examined for correctness given the current state of the timing host and target systems.

If errors are found in the configuration, the user will be guided through the list of issues discovered in the examination via the **Verify Scheduler** dialog. An example of such an error is shown below.

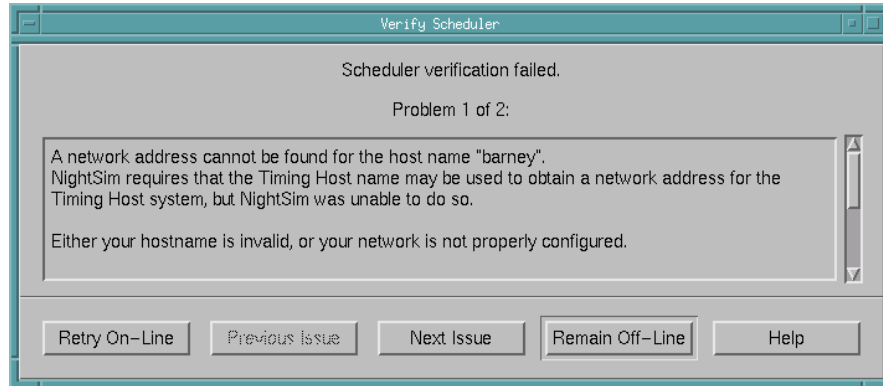


Figure 4-1. Verify Scheduler Dialog

The operation of the buttons in the Verify Scheduler dialog is as follows:

Retry On-Line

If all problems found during the current verification process have been attended to, the user may press this button to re-attempt the transition to **On-Line**.

Previous Issue

Pressing this button will cycle to the previous issue found during the current verification process. The text describing the problem will be displayed in the Verify Scheduler dialog.

Next Issue

Pressing this button will cycle to the next issue found during the current verification process. The text describing the problem will be displayed in the Verify Scheduler dialog.

Remain Off-Line

This button allows the user to continue to work off-line in lieu of the problems found and attempt to transition to **On-Line** at a later time.

Help

This button displays appropriate information related to the problem currently displayed in the Verify Scheduler dialog.

For each issue, NightSim will highlight the label associated with the field most likely to be of use in correcting the problem. If that field is on a window that is not visible, NightSim will raise the appropriate window to the top of the display. Below is a portion of the NightSim Scheduler window corresponding to the error listed in Figure 4-1. Note that the Timing host field is highlighted since the host name entered was invalid.

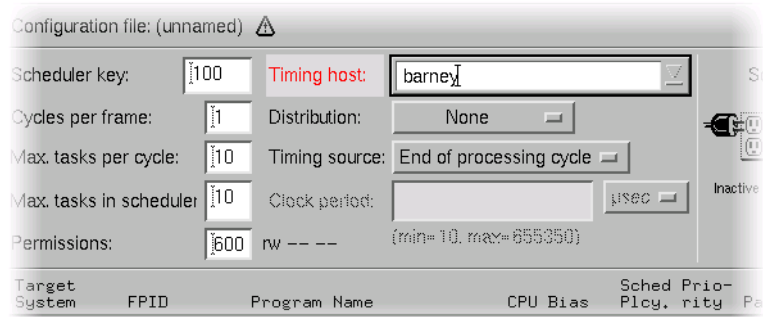


Figure 4-2. Errors found during transition to on-line

After making the appropriate changes, the user may retry the transition to On-Line mode or may choose to remain in Off-Line mode. If new problems are discovered when transitioning to On-Line mode, the Verify Scheduler window will re-appear.

Introduction to the Scheduler Window

The Scheduler window allows you to configure a *frequency-based scheduler*; select a timing source for it; schedule programs on it; start, stop, and resume a simulation; and view scheduling data.

The Scheduler window consists of the following components:

- Menu Bar
- On-Line/Off-Line Status Area
- Configuration File Name Area
- Scheduler Configuration Area
- Process Scheduling Area
- Scheduler Control Area
- Simulation Control Area
- Run Status Area

Figure 4-3 identifies the location of each of these components in the Scheduler window. Note that this window contains sample data associated with a scheduler that exists on the system.

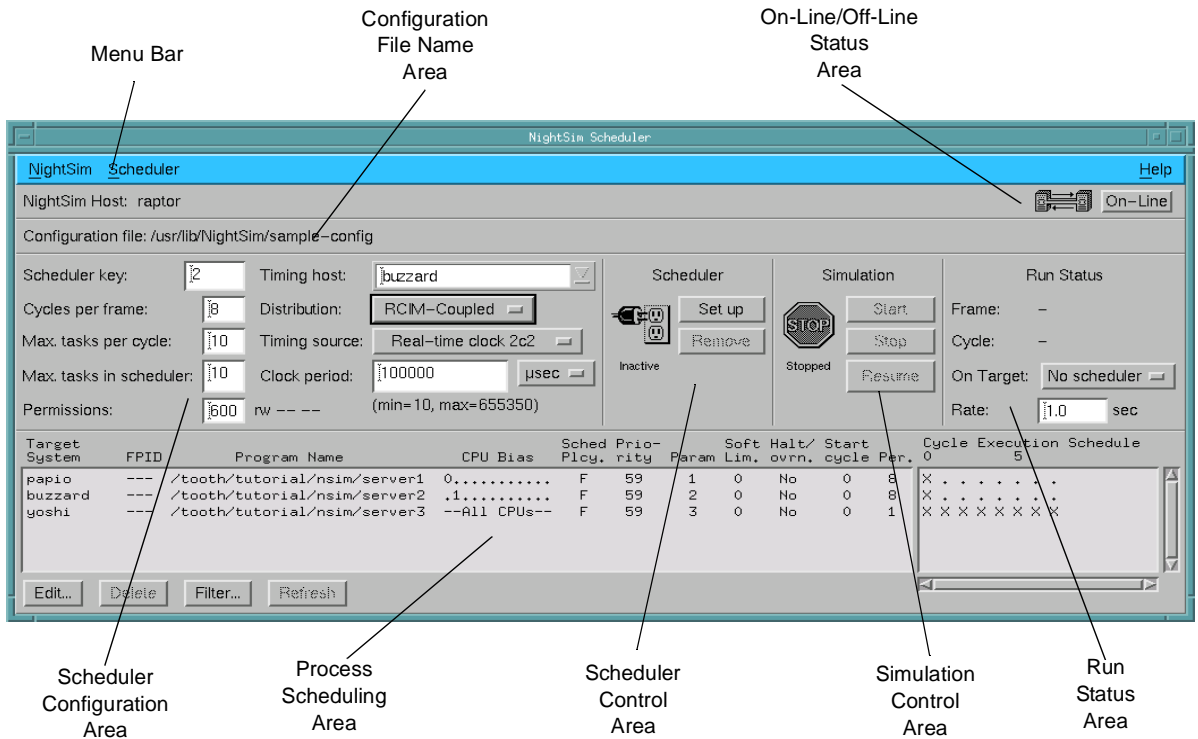


Figure 4-3. Sample Scheduler Window

Procedures for using each component of the Scheduler window are described in the sections that follow.

Using the Scheduler Window Menu Bar

The Scheduler Window menu bar is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Scheduler Window menu bar provides access to the following menus:

- NightSim
- Scheduler
- Help

Each menu is described in the sections that follow.

The NightSim Menu

The NightSim menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-9).

The NightSim menu on the Scheduler Window contains commands related to the global operation of NightSim. Figure 4-4 presents this menu.

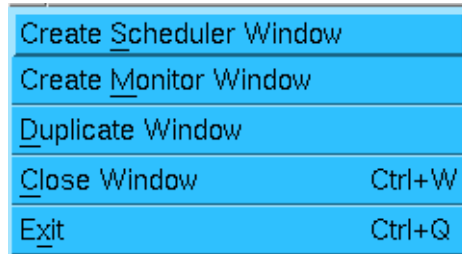


Figure 4-4. NightSim Menu

Descriptions of the options on the NightSim menu follow.

Create Scheduler Window

This option allows you to create a new Scheduler window. The new window is *inactive*—that is, it is not associated with a scheduler that exists on your system. Its text fields contain blanks or default values. You may create any number of Scheduler windows.

Create Monitor Window

This option allows you to create a new Monitor window. If the Scheduler window from which you create the window is associated with an existing scheduler, the *key* and *target* for that scheduler will be displayed in the Status Area of the new Monitor window. In addition, if the scheduler is active, scheduled processes will be listed in the Output Area of the new Monitor window. Use of the Monitor window is fully explained in Chapter 5, “Using the Monitor Window.”

Duplicate Window

This option allows you to create a new Scheduler window with the same configuration as that of the Scheduler window from which this option was selected.

Close Window

This option allows you to close the current Scheduler window. If the window is untitled and contains unsaved changes, NightSim displays the warning dialog that Figure 4-5 presents.

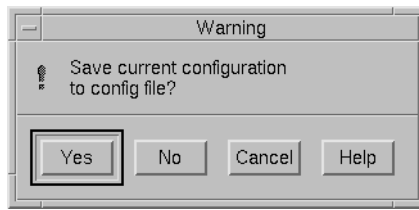


Figure 4-5. Save Changes Dialog: Untitled Window

If you proceed with the current action without saving, these changes will be lost. If you click on the **Yes** button to save the changes, NightSim displays the file selection dialog that Figure 4-6 presents. If you click on the **No** button, the changes will be discarded. If you click on the **Cancel** button, the action is aborted.

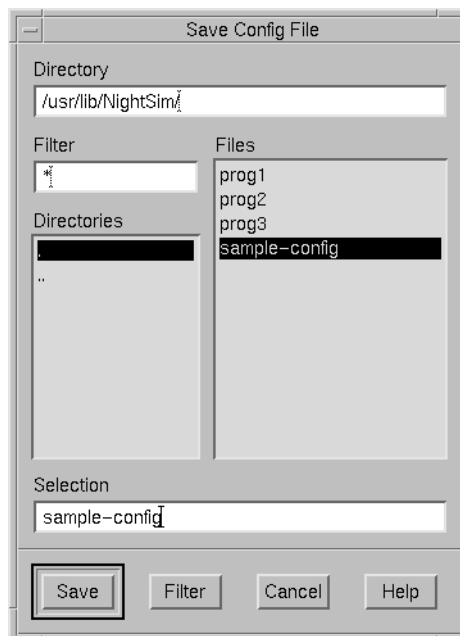


Figure 4-6. Save Configuration File Dialog

To select the file in which to save the changes, use the directory text area, file mask area, list of directories, list of files, and file selection text area as appropriate. After making a selection, you may save the changes to the selected file, search for another file, cancel the operation, or display help related to the dialog.

If the **Scheduler** window is associated with a configuration file name and contains unsaved changes, NightSim displays the warning dialog that Figure 4-7 presents.

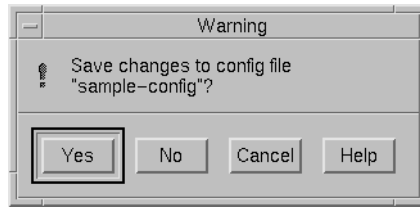


Figure 4-7. Save Changes Dialog: Titled Window

If you proceed with the current action without saving, these changes will be lost. If you click on the **Yes** button, the changes are saved in the file associated with the window. If you click on the **No** button, the changes will be discarded. If you click on the **Cancel** button, the action is aborted.

If the window from which you select **Close Window** is the only window that you have open, NightSim displays the question dialog that Figure 4-8 presents.

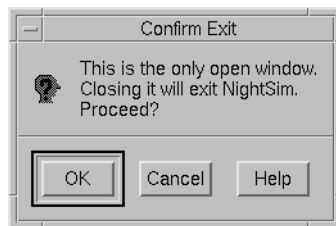


Figure 4-8. Confirm Exit Dialog

You may confirm that you wish to exit, continue to keep the window open, or display help related to the dialog.

Exit

This option allows you to exit NightSim. If you have open **Scheduler** windows that are untitled and contain unsaved changes or if you have an active scheduler, NightSim displays the warning dialog that Figure 4-5 presents (see p. 4-11). In each case, you may save the changes, close the window without saving the changes, cancel the close operation, or display help related to the dialog. If you click on the **Yes** button to save the changes, NightSim displays the file selection dialog that Figure 4-6 presents (see p. 4-11).

If you have open a **Scheduler** window that is associated with a configuration file name and contains unsaved changes, NightSim displays the warning dialog that Figure 4-7 presents. If you click on the **Yes** button, the changes are saved in the file associated with the window.

The warning dialogs are displayed for each window that contains unsaved changes.

The Scheduler Menu

The Scheduler menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-9).

The Scheduler menu contains commands that affect the current Scheduler window. Figure 4-9 presents this menu.

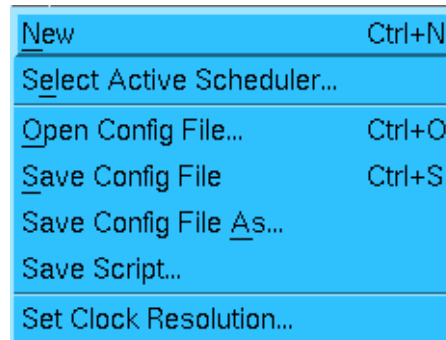


Figure 4-9. Scheduler Menu

Descriptions of the options on the Scheduler menu follow.

New

This option allows you to clear all information from the current Scheduler window; reset the various areas to blank or default values; and place the window in the *inactive* state. The *timing host* is preserved, however.

If the window is untitled and contains unsaved changes, NightSim displays the warning dialog that Figure 4-5 presents (see p. 4-11). You may save the changes, clear the window without saving the changes, cancel the operation, or display help related to the dialog. If you click on the **Yes** button to save the changes, NightSim displays the file selection dialog that Figure 4-6 presents (see p. 4-11).

If the window is associated with a configuration file name and contains unsaved changes, NightSim displays the warning dialog that Figure 4-7 presents. You may save the changes, clear the window without saving the changes, cancel the operation, or display help related to the dialog. If you click on the **Yes** button, the changes are saved in the file associated with the window.

NOTE

If the window containing the unsaved changes is associated with an active scheduler, the scheduler will continue to run although the window is no longer associated with it.

Select Active Scheduler . . .

This option allows you to associate the current **Scheduler** window with a *frequency-based scheduler* active on a given *target system*. When you select this option, NightSim displays Figure 4-10.

If the window from which you select this option is untitled and contains unsaved changes, NightSim displays the warning dialog that Figure 4-5 presents (see p. 4-11). You may save the changes, close the window without saving the changes, cancel the operation, or display help related to the dialog. If you click on the **Yes** button to save the changes, NightSim displays the file selection dialog that Figure 4-6 presents (see p. 4-11).

If the window is associated with a configuration file name and contains unsaved changes, NightSim displays the warning dialog that Figure 4-7 presents. You may save the changes, close the window without saving the changes, cancel the operation, or display help related to the dialog. If you click on the **Yes** button, the changes are saved in the file associated with the window.

To assist you in selecting a scheduler, NightSim displays the selection dialog that Figure 4-10 presents.

NOTE

NightSim needs to communicate with a target system in order to determine which schedulers are active. This will occur even if the existing Scheduler window is **Off-Line**. This is to be expected since the existing scheduler will be abandoned when an active scheduler is selected, and because an active scheduler is necessarily **On-Line** (see “On-Line/Off-Line Operation” on page 4-5).

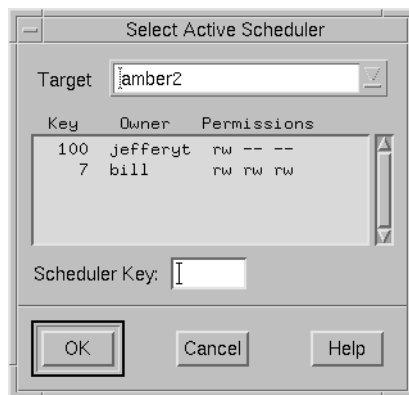


Figure 4-10. Select Active Scheduler Dialog

This dialog provides a list of the *active schedulers* for the system designated by the **Target** field. The **Target** defaults to your local host and the list contains the active schedulers running on that particular system. For instance, Figure 4-10 lists the two schedulers currently running on the host `amber2`.

You may change the **Target** either by using the drop-down list (which lists the hosts in your *cluster* or RCIM chain) or by typing the name of the *target system* into the text field provided. Entering an item in this field will populate the list with the *active schedulers* on the specified target.

You may select a scheduler from the list that the dialog displays, or you may use the **Scheduler Key** text field to enter the numeric *key* that is associated with the desired scheduler. The key can be any positive integer value. Whether you select from the list or enter a key, the selected scheduler must previously have been configured, and you must have at least read permission for it; otherwise, NightSim reports an error.

Once you select a scheduler, NightSim will determine whether that scheduler is attached to a *distributed timing device*. If so, NightSim will try to locate schedulers on any other targets that have the same key and are attached to the same distributed timing device using the **fbsinfo_rdev(3rt)** service. All such schedulers found will be treated as one “virtual” *FBS* and the combined information displayed to the user.

If you successfully select an existing scheduler, the **Scheduler** window becomes an active window associated with that scheduler. Information related to the selected scheduler replaces information that the window contained prior to the operation.

Open Config File

This option allows you to open a scheduler configuration file that you have previously saved. The file is opened in the current **Scheduler** window.

If the window from which you select this option is untitled and contains unsaved changes, NightSim displays the warning dialog that Figure 4-5 presents (see p. 4-11). You may save the changes, close the window without saving the changes, cancel the operation, or display help related to the dialog. If you click on the **Yes** button to save the changes, NightSim displays the file selection dialog that Figure 4-6 presents (see p. 4-11).

If the window is associated with a configuration file name and contains unsaved changes, NightSim displays the warning dialog that Figure 4-7 presents. You may save the changes, close the window without saving the changes, cancel the operation, or display help related to the dialog. If you click on the **Yes** button, the changes are saved in the file associated with the window.

To assist you in specifying a configuration file to be opened, NightSim displays the file selection dialog that Figure 4-11 presents.

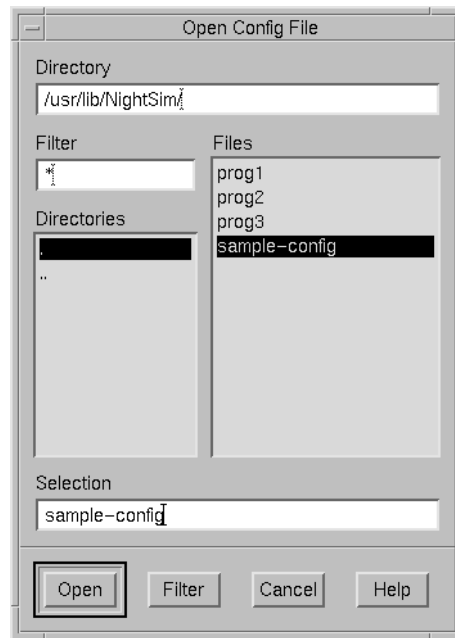


Figure 4-11. Open Config File Dialog

To select the file to be opened, use the directory text area, file mask area, list of directories, list of files, and file selection text area as appropriate. After making a selection, you may open the selected file, search for another file, cancel the operation, or display help related to the dialog. When you open the selected file, the Scheduler window is associated with that file and displays the configuration and scheduling data contained in the file.

NightSim will open the configuration file in **Off-Line** mode. Once the file has been read in, NightSim will make a transition to **On-Line** mode unless the **-offline** option was used on the command line, or the ***offline X** resource was set to **True** (see “X Resources” on page B-1). When this transition occurs, the new scheduler will be verified. See “On-Line/Off-Line Operation” on page 4-5 for more information.

NOTE

NightSim 2.4 and earlier versions use a different format for this configuration file. NightSim 3.2 and later versions will automatically convert these configuration files from the older format to the newer format. You will be prompted to save the converted configuration when you close the Scheduler window.

Save Config File

This option allows you to save the configuration and scheduling data entered in the current Scheduler window in the file that is associated with the window. If the configuration file name has not yet been specified, this option is disabled; you

should use the **Save Config File As...** option. See “Configuration File Format” on page A-1 for a description of the format of this file as well as “Configuration File Example” on page A-2 for the actual configuration file associated with Figure 4-3, “Sample Scheduler Window,” on page 4-8.

NOTE

NightSim 2.4 and earlier versions use a different format for this configuration file. NightSim 3.2 and later versions will automatically convert these configuration files from the older format to the newer format. You will be prompted to save the converted configuration when you close the **Scheduler** window.

Save Config File As . . .

This option allows you to specify the name of the file in which you wish the configuration and scheduling data entered in the current **Scheduler** window to be saved.

When you select this option, NightSim displays the file selection dialog that Figure 4-6 presents (see p. 4-11). After making a selection, you may save the current configuration and scheduling data in the selected file, search for another file, cancel the operation, or display help related to the dialog.

See “Configuration File Format” on page A-1 for a description of the format of this file as well as “Configuration File Example” on page A-2 for the actual configuration file associated with Figure 4-3, “Sample Scheduler Window,” on page 4-8.

NOTE

NightSim 2.4 and earlier versions use a different format for this configuration file. NightSim 3.2 and later versions will automatically convert these configuration files from the older format to the newer format. You will be prompted to save the converted configuration when you close the **Scheduler** window.

Save Script . . .

This option allows you to save the current configuration as a shell script containing **rtcp** commands. The script may be run from any host in your network as long as it has **rsh(1)** access to all the targets, as well as the timing host (see “Remote Shell Access” on page 2-5). This script can then be used to recreate your scheduler configuration without the added overhead of NightSim, allowing your application to start up and run more quickly. This can be extremely useful when dealing with time-critical applications.

The main disadvantage of using this script instead of using NightSim is that you do not get any monitoring capabilities. This may be less important for systems that are typically used in production environments but can be critical to those systems used in a testing/development environment where the monitoring feedback that NightSim provides can be invaluable.

Another disadvantage is that the script does not support starting your processes under NightView or `xterm(1)`. Neither is there support for starting your scheduled processes with privileges. For these features, you must use the NightSim scheduler to start your scheduler.

If a scheduler which makes use of `xterm` or NightView is saved as a script, NightSim will ignore these points and schedule the processes directly. If File input or output is used, NightSim will honor those filenames, but if the scheduler uses Standard Input Stream or Standard Output Stream, NightSim will forcibly redirect from or to `/dev/null` in order to prevent `rsh` from hanging while waiting for input or output.

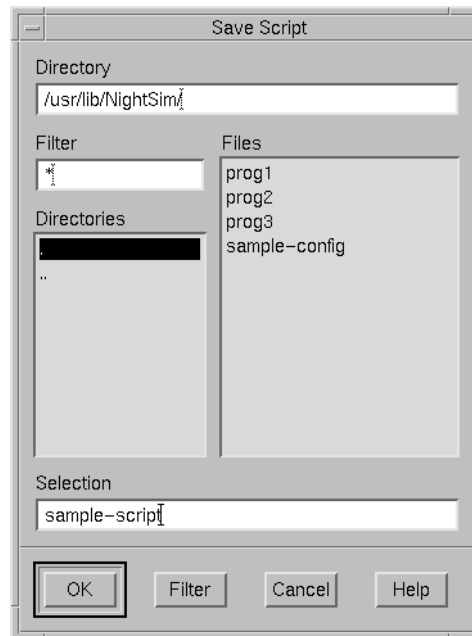


Figure 4-12. Save Script Dialog

Note that this script is different from the `rtcp`-style configuration files found in NightSim 2.4 and earlier versions. See “Configuration File Format” on page A-1 for details on this new format.

Set Clock Resolution . . .

This option allows you to select the resolution for a real-time clock that you have selected as the timing source for a scheduler. The resolution indicates the duration in microseconds of one clock count.

The duration of a *minor cycle* is defined by specifying the number of clock counts per minor cycle (1 to 65,535) and the number of microseconds per clock count (1, 10, 100, 1000, or 10,000). You determine the duration of a *major frame* by multiplying the duration of a minor cycle by the number of minor cycles per major frame. If, for example, you configure a scheduler with 100 minor cycles per major frame and you use as the timing source a real-time clock with a clock count of 10,000 and a clock count duration of one microsecond, each minor cycle has a duration of 10,000 microseconds, or 0.01 second, and each frame a duration of one second.

When you select this option, NightSim displays the selection dialog that Figure 4-13 presents.



Figure 4-13. Set Clock Resolution Dialog

You select the resolution by clicking on the toggle button and choosing one of the following options: 1, 10, 100, 1000, or 10000. You may apply your selection, cancel the operation, or display help related to the dialog.

The resolution of the clock affects the valid range of the clock period. See “Clock period” on page 4-24.

Detailed Scheduler Info . . . (*expert mode only*)

The dialog associated with this option provides more information about the current *FBS* which may be of interest to some users.

This option appears on the **Scheduler** menu (see “The Scheduler Menu” on page 4-13) only when the user is running in *expert mode*. See the *expert* resource under “X Resources” on page B-1 for more details.

The Help Menu

The Help menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-9).

The Help menu provides access to the on-line help system. See “Getting Help” on page 3-4 for detailed information about this menu and each of its items.

Using the On-Line/Off-Line Status Area

The On-Line/Off-Line Status Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The On-Line/Off-Line Status Area shows the name of the NightSim host as well as an On-Line/Off-Line toggle button indicating the current state of operation of the Scheduler (see “On-Line/Off-Line Operation” on page 4-5).

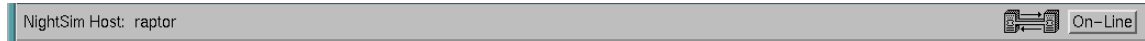


Figure 4-14. Scheduler Window - On-Line/Off-Line Status Area

On-Line/Off-Line

NightSim provides two modes of operation for a Scheduler, **On-Line** and **Off-Line** (see “On-Line/Off-Line Operation” on page 4-5). You can toggle the current state by pressing the **On-Line/Off-Line** button on either the NightSim Scheduler window or its associated **Edit Process** window (see “The Edit Button” on page 4-26).

By placing a NightSim Scheduler into an **Off-Line** state, immediate checking of the information entered in either the NightSim Scheduler window or its associated **Edit Process** window can be avoided. When in **Off-Line** mode, the NightSim Scheduler will not communicate with any servers on any timing host or target system of the Scheduler.

This is useful when creating a configuration for future use that deals with target systems which may not currently exist or may not be currently accessible. The values entered while **Off-Line** will be checked when the mode is changed to **On-Line**.

Using the Configuration File Name Area

The Configuration File Name Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Configuration File Name Area shows the name of the configuration file with which the current Scheduler window is associated.



Figure 4-15. Scheduler Window - Configuration File Name Area

If the window contains unsaved changes, the name is followed by a warning icon as illustrated by Figure 4-15. When the Scheduler window is not associated with a configura-

tion file name, the Configuration File Name Area displays (unnamed) as illustrated by Figure 1-1 (see p. 1-3).

Using the Scheduler Configuration Area

The Scheduler Configuration Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Scheduler Configuration Area allows you to configure a *frequency-based scheduler*, select the timing source that is to be used for it, and specify the permissions that are to be associated with it.

The screenshot shows the Scheduler Configuration Area with the following settings:

| | | | |
|--------------------------|-----|----------------|-----------------------------|
| Scheduler key: | 100 | Timing host: | buzzard |
| Cycles per frame: | 50 | Distribution: | None |
| Max. tasks per cycle: | 8 | Timing source: | Real-time clock 0c3 |
| Max. tasks in scheduler: | 32 | Clock period: | 1000 μ sec |
| Permissions: | 600 | | rw --- (min=10, max=655350) |

Figure 4-16. Scheduler Window - Configuration Area

Descriptions of the text fields and controls contained in the Configuration Area follow:

Scheduler key

This field allows you to specify a *key* for the frequency-based scheduler that you wish to create. The key is a user-chosen numeric identifier with which the scheduler will be associated. It can be any positive integer value. Note that the number of schedulers that can be configured at one time cannot exceed the value of FBSMNI, which is the maximum number of frequency-based schedulers permitted on your system (see Chapter 2, “Establishing the NightSim Environment,” for a description of system tunable parameters).

Cycles per frame

This field allows you to specify the number of cycles that compose a frame on the specified scheduler.

Max. tasks per cycle

This field allows you to specify the maximum number of processes that can be scheduled to execute during one cycle.

Max. tasks in scheduler

This field allows you to specify the maximum number of processes that can be scheduled on the specified scheduler at one time. The number must be less than or equal to the *product* that is obtained by multiplying the values specified in the

Cycles per frame and the Max. tasks per cycle text fields. Enter a number ranging from one to the product of these values.

Permissions

This field allows you to specify the permissions required for operations related to the specified scheduler (see the system manual page for **intro(2)** for information on permissions associated with the *frequency-based scheduler*). Enter three octal digits—the first indicating permissions granted to the owner, the second indicating those granted to the group, and the third indicating those granted to other users. The octal method for setting permissions associated with a scheduler is the same as that used for specifying *mode* with the **chmod** command (for assistance in using this method, see the system manual page for **chmod(1)**). The default, **600**, grants read and alter (write) permission to the owner only.

Timing host

This field allows you to select the *host* of the timing source for the scheduler. You may enter the name of the host directly in the entry field or choose from the supplied list.

This list contains a list of possible timing hosts. NightSim maintains a list in `~/NightSimHosts` of all hosts you ever used as a timing host. In addition, if any possible host is part of a *cluster*, this list includes all of the hosts in that cluster. It also includes all the hosts in all the clusters that share a common file server with a timing host. Once selected, the **Timing source** menu is repopulated with the set of devices available on that host.

On PowerMAX OS, this field defaults to the NightSim host. On Linux, this field is empty by default. The user must provide a Timing host name.

NOTE

The timing host cannot be changed while the scheduler is active; you must first remove the scheduler.

Distribution

This option menu allows you to select the type of distribution for your scheduler.

| | |
|-----------------|---|
| None | Target processes will be scheduled only on the <i>timing host</i> . Interrupts will be delivered by the <i>FBS</i> on the timing host directly. |
| Closely-Coupled | Target processes will be scheduled on <i>SBCs</i> within the <i>closely-coupled cluster</i> in which the timing host resides. Interrupts will be distributed to the <i>FBS</i> on each <i>SBC</i> in the cluster via VME message passing. |
| RCIM-Coupled | Target processes will be scheduled on <i>target systems</i> which are connected via a chain of <i>RCIMs</i> . Interrupts will be distributed to the <i>FBS</i> on each target via the <i>RCIM</i> cable. |

Timing source

This option menu allows you to select the timing source for the scheduler. The timing source can be the end of a *minor cycle*, a real-time clock, an edge-triggered interrupt, or a user-supplied device. Figure 4-17 presents an example of the option menu.

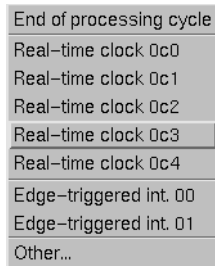


Figure 4-17. Timing Source Option Menu

This list contains the set of devices available on the *timing host*. Note that the options that NightSim displays vary according to the devices that are configured in the system designated as the timing host and may change if the timing host is changed. This list will be initially populated with the devices on the default timing host.

NOTE

If the frequency-based scheduler will be distributed across multiple *target systems*, the timing device must support the `IOCTLVECNUM ioctl` operation or be an RCIM-distributed device.

If you select the **End of processing cycle** option from the **Timing source** option menu, scheduling is triggered when the last process that is scheduled during the current *minor cycle* of the current *major frame* completes its processing.

NOTE

End of processing cycle is not valid for a distributed scheduler (i.e. you cannot assign processes to multiple targets and use *end-of cycle scheduling*). This is true for both **Closely-Coupled** and **RCIM-Coupled** distributions (see “**Distribution**” on page 4-23).

If you select a real-time clock, the **Clock period** text field is enabled so that you can specify the information needed to set the clock.

If you select the **Other . . .** option, NightSim displays the dialog shown in Figure 4-18. The text input area in this dialog allows you to specify the name of a user-supplied device that you wish to use as the timing source. The **Device Pathname** must be the name of a device file on the currently selected timing host.

NOTE

The user is responsible for ensuring that the **Timing source** is appropriate for the selected **Distribution**. If it is determined to be inappropriate at the time that the scheduler is **Set up**, an error message will be issued by NightSim.

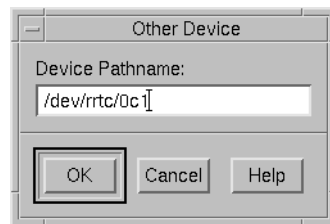


Figure 4-18. Other Device Prompt Dialog

Clock period

If you select a real-time clock as the timing source for the scheduler, this field allows you to specify a value to be used in setting the clock. Otherwise, this field is disabled.

You may specify the period in microseconds, milliseconds, hertz, or kilohertz by clicking on the toggle button and choosing the desired option. Below the field is a label that shows the minimum and maximum values that are permitted. The label changes according to the option you choose. Figure 4-19 presents the options from which you may choose.

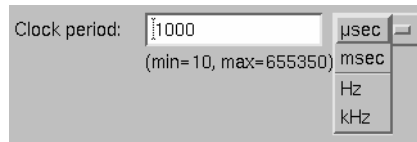


Figure 4-19. Clock Period Options

The valid range of the clock period is determined by multiplying the minimum and maximum clock counts, 1 and 65535, by the clock resolution, which defaults to 10 microseconds. By changing the clock resolution, you can increase or decrease the valid range of the clock period. See “Set Clock Resolution . . .” on page 4-18 to adjust the number of microseconds per clock count.

Using the Process Scheduling Area

The Process Scheduling Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Process Scheduling Area allows you to (1) add programs to a *frequency-based scheduler*, (2) remove *FBS*-scheduled processes from a scheduler, (3) reschedule *FBS*-scheduled processes, (4) view scheduling data for current *FBS*-scheduled processes, and (5) select the processes for which scheduling data are to be displayed.

| Target System | FPID | Program Name | CPU Bias | Sched Polcy | Prio, rity | Param | Soft Lim. | Halt/ovrn. | Start cycle | Per. | Cycle Execution Schedule |
|---------------|------|-------------------------|--------------|-------------|------------|-------|-----------|------------|-------------|------|-----------------------------------|
| amber2 | 9 | /usr/lib/NightSim/prog1 | --All CPUs-- | F | 50 | 0 | 0 | No | 0 | 2 | X . X . X . X . X . X . X . > |
| amber2 | 1 | /usr/lib/NightSim/prog2 | --All CPUs-- | F | 45 | 0 | 0 | No | 1 | 50 | . X |

Figure 4-20. Scheduler Window - Process Scheduling Area

The Process Scheduling Area contains a scrolling list of the processes that are currently scheduled on a *frequency-based scheduler* and the parameters with which they have been scheduled (CPU mask, scheduling policy and priority, starting *minor cycle*, and so on). You can select the process or processes that you wish to reschedule or delete by clicking on the respective item(s) in this list.

In addition, the Process Scheduling Area includes a grid that graphically shows the execution cycle for each process in the list. The labels at the top of the grid show the number of the *minor cycle*. The minor cycles in which each process is scheduled to run are denoted by the appearance of the letter X in the appropriate column. You can use the horizontal and vertical scroll bars to scroll the visible contents of the grid.

The Process Scheduling Area provides a row of process controls below the list of *FBS*-scheduled processes. Each of these controls is described in the following sections.

The Edit Button

Edit . . .

This push button allows you to add a program to a *frequency-based scheduler* or reschedule an *FBS*-scheduled process. When you click on this button, NightSim displays the **Edit Process** dialog that Figure 4-21 presents. Note that if you have selected a process from the list of scheduled processes and then click on this button, the dialog contains the scheduling parameters for the selected process. NightSim also displays the **Edit Process** dialog if you double click on a line in the list of scheduled processes.

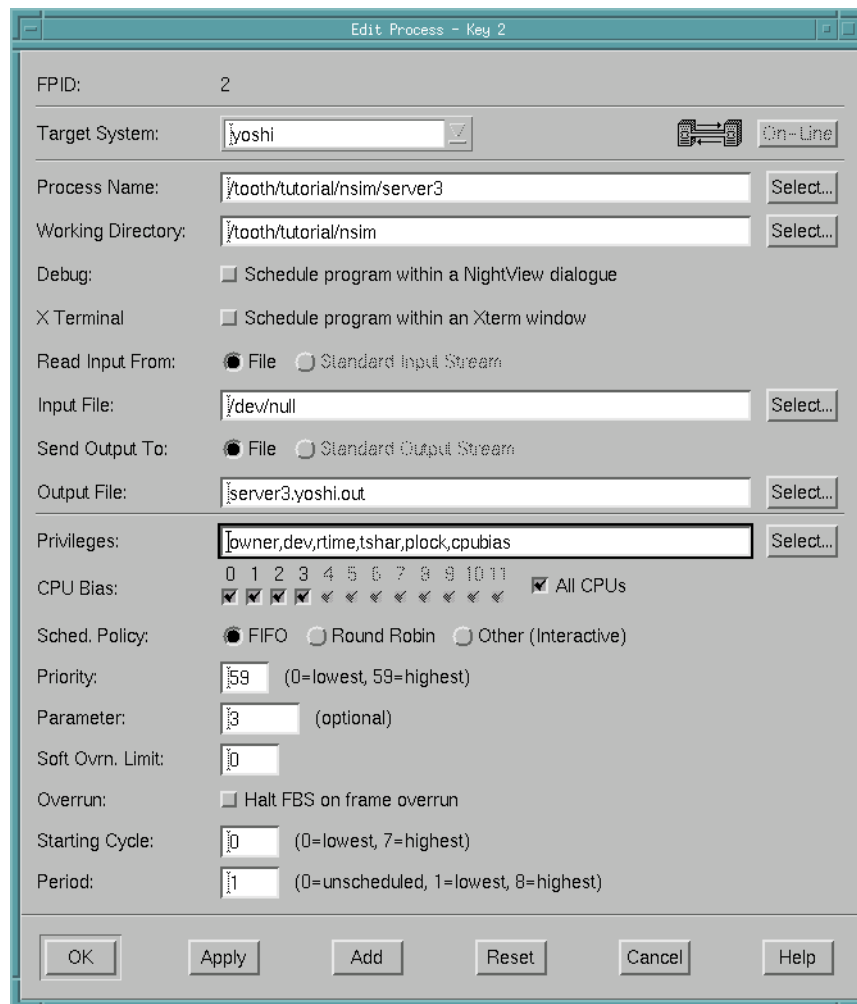


Figure 4-21. Edit Process Dialog

Descriptions of the text fields and controls contained in the **Edit Process** dialog follow:

FPID

This field specifies the unique *frequency-based scheduler* process identifier that is obtained when a program is scheduled on a scheduler. When a program has not yet been scheduled on the scheduler, this field displays “(Scheduler is inactive)”.

Target System

This item specifies the *target system* on which this process is to be scheduled.

The list associated with this field is populated with appropriate target names for the selected **Distribution** from the associated Scheduler Window.

- If the selected **Distribution** is **None**, this list will contain only the name of the *timing host*, which is the default value.
- If **Closely-Coupled** distribution is selected, the list will contain the target names of all the members of the *cluster* to which the timing host belongs.
- When **RCIM-Coupled** distribution is selected, this list contains the names of all targets known to be connected to the timing host via the RCIM chain.

If the desired target is not available in the list, and the selected **Distribution** is **RCIM-Coupled**, then you may enter the name of the desired target in the combo-box. NightSim will ask for confirmation before adding the new target to the list of known targets connected via the RCIM chain.

If the new target is already part of an RCIM chain, NightSim will also ask how to add the target to the new chain. You may either merge the two subchains together, if appropriate, or remove the target first from the chain to which it was believed to be connected before adding it to the new chain.

If the target name you enter is not in the list of expected systems, then NightSim is not aware that the target is connected to the same RCIM chain as the timing host. NightSim will display the dialog in Figure 4-22.

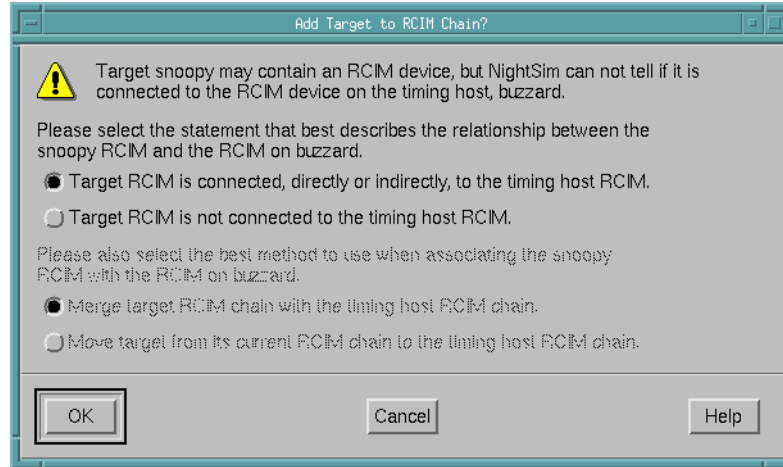


Figure 4-22. Add Target to RCIM Chain Dialog

This dialog is made up of two questions. The second question will be grayed out unless it is relevant.

The first question asks if the new target you entered is in the same RCIM chain as the timing host. The new target will be remembered in the `~/ .KnownTargetsFile` as being in the same RCIM chain as the selected timing host. Otherwise, NightSim will issue an error, and the target name will be restored to its previous value.

If you check the radiobutton indicating that the new target is connected to the timing host via an RCIM cable, and the new target is already known be part of another RCIM chain, then the second portion of the dialog will be activated. You will be asked if the new target should be removed from its old RCIM chain and then inserted into the timing host's RCIM chain, or whether the two RCIM chains should be merged.

NightSim keeps a persistent list in `~/ .NightSimTargets` of targets on which you have scheduled processes, including information regarding which of those targets belong to the same RCIM chain. NightSim uses this information to provide a meaningful selection of RCIM-distributed targets.

If the Edit Process dialog is used to modify the attributes of an existing process and the Target System is changed after the process has been created, NightSim will pop up a warning dialog informing the user that the process will be killed and recreated on the new target. Processes cannot be moved between hosts intact.

NOTE

NightSim does not allow you to assign processes to the same target system using two different names. You must either assign all the processes to the system using one name, or delete the processes you assigned to one of the names (see “The Delete Button” on page 4-36).

On-Line/Off-Line

NightSim provides two modes of operation for a Scheduler, **On-Line** and **Off-Line** (see “On-Line/Off-Line Operation” on page 4-5). You can toggle the current state by pressing the **On-Line/Off-Line** button on either the the NightSim Scheduler window or the **Edit Process** window associated with it (see “Using the On-Line/Off-Line Status Area” on page 4-20).

By placing a NightSim Scheduler into an **Off-Line** state, immediate checking of the information entered in either the NightSim Scheduler window or its associated **Edit Process** window can be avoided. When in **Off-Line** mode, the NightSim Scheduler will not communicate with any servers on any timing host or target system of the Scheduler.

This is useful when creating a configuration for future use that deals with target systems which may not currently exist or may not be currently accessible. The values entered while **Off-Line** will be checked when the mode is changed to **On-Line**.

Program Name

This field specifies the name of the process that you wish to schedule. Enter a full or relative pathname (see “Pathname Expansion” on page 4-36). The pathname must be valid on the *target system* to which this process is assigned. If you have selected a process from the list of *FBS*-scheduled processes prior to clicking on the **Edit** button, this field contains the name of the *FBS*-scheduled process.

NOTE

You cannot change the name of a process while the process is running. You must either stop the scheduler first or add a new process with the desired name.

Select...

You may use the **Select** button to bring up the following file selection dialog to choose the program you want to configure under the *FBS*. Note that NightSim displays files on the selected target system if it is reachable via the network. If the target system is unavailable, NightSim will disable file browsing on the target system. In addition, the Scheduler must be operating in an **On-Line** state in order to browse on the target file system (see “On-Line/Off-Line Operation” on page 4-5).

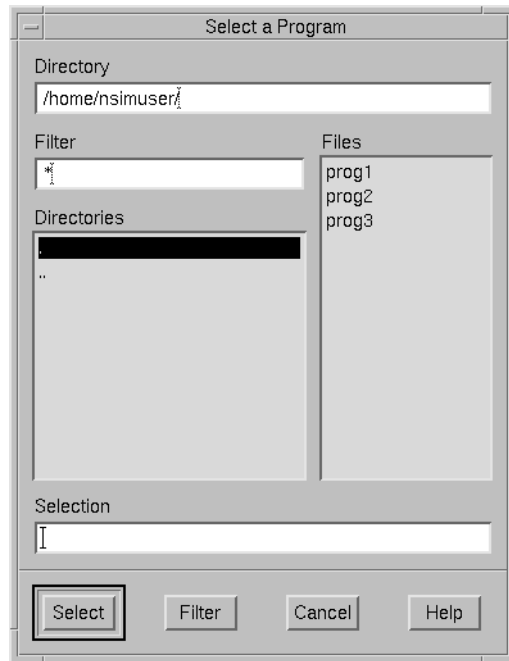


Figure 4-23. Select a Program Dialog

NOTE

If the Program Name is /idle or /spare, then all of the following fields which are inappropriate for the /idle and /spare pseudo-processes are desensitized. Only the CPU Bias field is valid for /idle or /spare.

Working Directory

You may specify the path to the working directory in which the scheduled process will run. This path must be a valid directory name on the *target system*. If the target system is not available, or if the Scheduler is Off-Line (see “On-Line/Off-Line Operation” on page 4-5), the path must be a valid directory on the target system at the time the program scheduler is created (i.e. when the Set up button is pressed on the Scheduler window).

Debug

Schedule this process under the NightView debugger. When the Schedule program within a NightView dialogue checkbox is checked, the process will be stopped at the point it begins execution, allowing early intervention for the purpose of setting breakpoints, watchpoints, etc. A **continue** command to NightView is required to resume the execution of the scheduled process.

NOTE

Scheduling processes under the FBS requires certain privileges (see “User Requirements” on page 2-5). In addition, the user may configure additional privileges if permitted by the target system (see “Privileges” on page 4-32).

It is the responsibility of the user to ensure that appropriate privileges are granted to the NightView session (see “Privileges” on page 2-6 for details). Most notably, the `P_RTIME` privilege is required. Attempts to schedule a process under the NightView debugger without the `P_RTIME` privilege will fail.

X Terminal

Schedule the process in an `xterm(1)` window. An `xterm` window may be used in conjunction with scheduling the process under NightView as well, if so desired (see **Debug** above). This permits the scheduled process to interact with the terminal services provided by the `xterm`.

Read Input From

Select the input source, if any, for the scheduled process. By default, as in previous versions of NightSim, input is taken from the file, `/dev/null`. When either the **Debug** or **X Terminal** checkboxes are selected, the default is to permit input to come from the **Standard Input Stream**, but you may choose **File** input in either case if your scheduled program needs a fixed input stream (see **Input File** below).

Input File

If **File** is selected for **Read Input From**, this field specifies the name of the input file which the scheduled process will use. By default, the file is `/dev/null`. See “Pathname Expansion” on page 4-36.

If the NightSim Scheduler is **On-Line** (see “On-Line/Off-Line Operation” on page 4-5), the pathname given must be a valid file on the target system with sufficient read permissions.

If the NightSim Scheduler is **Off-Line**, the path must represent a valid readable file at the time the program scheduler is created (i.e. when the NightSim Scheduler transitions to an **On-Line** mode of operation).

Send Output To

Select the way to manage output from your scheduled process. If neither the **Debug** and **X Terminal** checkboxes are selected, you may select **File** output, where the default file is `/dev/null`. Output may be sent to an actual file specified in the **Output File** field, if desired. By default, output is sent to the **Standard Output Stream** of the scheduled process.

Output File

If **File** is selected for **Send Output To**, this field specifies the name of the output file to generate. The output file name may be a full pathname or may be a pathname

relative to the **Working Directory** specified for the scheduled process. See “Path-name Expansion” on page 4-36.

Privileges

NightSim grants the `P_RTIME`, `P_CPUBIAS`, and `P_TSHAR` privileges to target processors automatically, except when scheduling a process under the NightView debugger (see “**Debug**” on page 4-30). Additionally, users may specify other privileges needed by their target processes as long as the user or target process is entitled to them (see “Privileges” on page 2-6 for more details).

NightSim queries the target system to determine the set of privileges to which the user or target process is entitled.

Select...

Brings up the **Select Process Privileges** dialog to allow the user to specify desired privileges.

See “Select Process Privileges” on page 4-35 for more information.

CPU Bias

This panel of check buttons allows you to select the processor or processors on which the program can be scheduled. Click on one or more buttons, where the label 0 represents the first logical CPU, 1 represents the second, and so on. To select all CPUs on your system, click on the **All CPUs** button.

NOTE

If the **CPU Bias** of a process is changed while the scheduler is running, the **Monitor** window will not reflect the updated value until the next **Monitor** window update after the process runs again.

NOTE

You cannot change the CPU bias of **/idle** or **/spare** while the scheduler is active because they are not real processes. You must either add a new process with the desired CPU bias, or make the change while the scheduler is inactive. See “How Is Idle Time Monitored?” on page 5-4 and “How Is Spare Time Monitored?” on page 5-4 for more information.

Sched Policy

This panel of radio buttons allows you to select the POSIX scheduling policy for the specified program. The options are as follows: the FIFO (first-in-first-out) scheduling policy, the round-robin scheduling policy, and the other (time-sharing) scheduling policy.

For a full description of the behavior of processes that are scheduled under the respective policies, refer to the “Process Scheduling and Management” chapter of the *PowerMAX OS Programming Guide*.

Priority

The range of priority values that you can enter is governed by the scheduling policy specified. You can determine the allowable range of priorities associated with each policy (FIFO, Round-Robin, or Other) by invoking the **run(1)** command from the shell and not specifying any options or arguments (see the corresponding system manual page for an explanation of this command). Higher numerical values correspond to more favorable scheduling priorities.

NightSim displays the range of priority values that you can enter next to the Priority field.

For complete information on scheduling policies and priorities, refer to the “Process Scheduling and Management” chapter of the *PowerMAX OS Programming Guide*.

NOTE

If the Priority of a process is changed while the scheduler is running, the Monitor window will not reflect the updated value until the next Monitor window update after the process runs again.

Parameter

This field allows you to pass an integer value to a process that is scheduled on a frequency-based scheduler. The value must be a 32-bit decimal value. The default is no value. The process can retrieve this value by using the **sched_fbsqry(3rt)** library routine.

Soft Ovrn. Limit

This field allows you to specify a consecutive overrun limit count that this process will tolerate and have processed as soft overruns by the kernel. *Soft overruns* are catastrophic failures only if the process reaches its limit on the number of soft overruns tolerated. This soft overrun limit defaults to 0 for each process.

Overrun

This check button allows you to indicate whether or not the selected scheduler should be stopped in the event that the specified program causes a *frame overrun*. Turn this button on if you wish the scheduler to be stopped.

NOTE

This may be useful in conjunction with scheduling a process under the NightView debugger, making it easier to stop a scheduled process at the source of an overrun and determine the activity which caused the overrun to occur.

Starting cycle

This field allows you to specify the first *minor cycle* in which the specified program is to be wakened in each *major frame*. Enter a number ranging from zero to the total number of minor cycles per frame minus one. (The total number of minor cycles per frame is defined when you use the Scheduler Configuration Area to configure a scheduler. See “Using the Scheduler Configuration Area” on page 4-21 for details.)

NightSim displays the range of starting cycle values that you can enter next to the Starting cycle field.

NOTE

You must enter a starting cycle of zero for unscheduled processes (for an explanation of unscheduled processes, see Chapter 5, “Using the Monitor Window,” and the section entitled “Monitoring Unscheduled Processes”).

Period

This field allows you to establish the frequency with which the specified program is to be wakened in each *major frame*. A period of one indicates that the specified program is to be wakened every *minor cycle*; a period of two indicates that it is to be wakened once every two minor cycles, a period of three once every three minor cycles, and so on. Enter the number of minor cycles representing the frequency with which you wish the program to be wakened. This number can range from zero to the number of minor cycles that compose a frame on the scheduler. (The total number of minor cycles per frame is defined when you use the Scheduler Configuration Area to configure a scheduler. See “Using the Scheduler Configuration Area” on page 4-21 for details.)

NightSim displays the range of period values that you can enter next to the Period field.

NOTE

You must enter a period of zero for unscheduled processes (for an explanation of unscheduled processes, see Chapter 5, “Using the Monitor Window,” and the section entitled “Monitoring Unscheduled Processes”).

After you have entered the scheduling parameters for a specified program, you may apply the changes and close the **Edit Process** dialog, apply the changes without closing the dialog, add another program to the scheduler, reset the contents of the dialog to its initial state, cancel the changes and close the dialog, or display help for the dialog.

NOTE

If the **Period** of a process is changed while the scheduler is running, the **Monitor** window will not reflect the updated value until the next **Monitor** window update after the process runs again.

Select Process Privileges

The **Select Process Privileges** dialog allows the user to specify **Privileges** (see “Privileges” on page 4-32) needed by the target process as long as the user or target process is entitled to them (see “Privileges” on page 2-6 for more details).

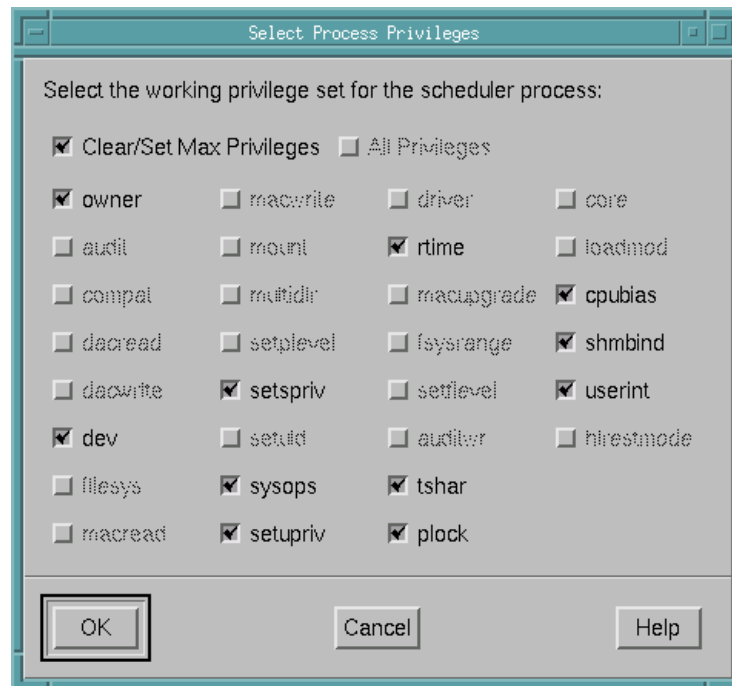


Figure 4-24. Select Process Privileges Dialog

The user may select the **Clear/Set Max Privileges** checkbox to select all or none of the privileges to which the user or target process is entitled. These include:

- the combined set of all privileges specified by the roles assigned to the user on the target system (see **adminuser(1)** and **adminrole(1)** for more information)
- the fixed privileges associated with the executable process on the target system (see **filepriv(1)** for more information)

The user may select the **All Privileges** checkbox only if the user is entitled to all privileges on the target system.

If the Scheduler is **On-Line** (see “On-Line/Off-Line Operation” on page 4-5), the user may select from the set of privileges to which the user or target process is entitled.

If the Scheduler is **Off-Line**, the user may select from all privileges listed in the **Select Process Privileges** dialog. Verification of the allowable privileges will occur when the Scheduler transitions to an **On-Line** mode of operation.

NOTE

If the user has selected to run the process under NightView (see “**Debug**” on page 4-30), it is the responsibility of the user to ensure that appropriate privileges are granted to the NightView session (see “**Privileges**” on page 2-6 for details). Most notably, the `P_RTIME` privilege is required. Attempts to schedule a process under the NightView debugger without the `P_RTIME` privilege will fail.

Pathname Expansion

When entering the **Program Name**, **Input File**, or **Output File** in the **Edit Process** window (see “**The Edit Button**” on page 4-26), the user can make use of the following conventions:

- if the pathname begins with `/`, it is assumed to be fully rooted
- if the pathname begins with `.`, `..`, or a simple file or directory name, it is assumed to be relative to the path in the **Working Directory** field
- if the pathname begins with `~`, it is interpreted according to the values of the following environment variables *on the NightSim host*:
 - `~`, `~/`, or `~user` (where *user* is the username of the user running NightSim), the login directory of the user is substituted
 - `~otheruser` (where *othername* is a user other than the user running NightSim), the login directory of *otheruser* is substituted
 - `~+`, the value of `$PWD` on the NightSim host is substituted.
 - `~-`, the value of `$OLDPWD` on the NightSim host is substituted
- if any part of the pathname contains an environment variable reference of the form `$name`, the value of `$name` on the NightSim host is substituted

The pathnames will be expanded and substitutions made at the time the **Apply** or **Add** button is pressed.

The Delete Button

Delete . . .

This button allows you to delete *FBS*-scheduled processes from a scheduler. If you select more than one process in the list, all of them are deleted when you click on this button. If the scheduler is active when you click on this button, NightSim displays the warning dialog in Figure 4-25.

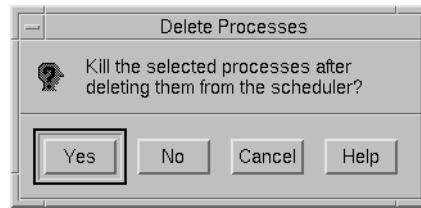


Figure 4-25. Delete Process Dialog: Active Scheduler

You may press the **Yes** button to kill the selected processes after deleting them from the *frequency-based scheduler*. You may also press the **NO** button to delete the processes from the scheduler but allow them to continue executing or press **Cancel** to abort the action.

If the scheduler is inactive when you click on this button, NightSim displays the dialog that Figure 4-26 presents.

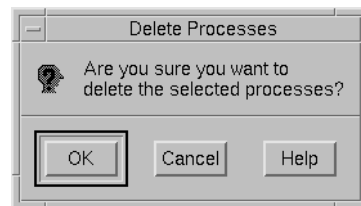


Figure 4-26. Delete Process Dialog: Inactive Scheduler

You may press **OK** to delete the processes from the scheduler or **Cancel** to cancel the operation.

The Filter Button

Filter . . .

This button allows you to specify the *FBS*-scheduled processes that you wish to be displayed in the the Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-25) of the Scheduler window. When you click on this button, NightSim displays the dialog that Figure 4-27 presents.

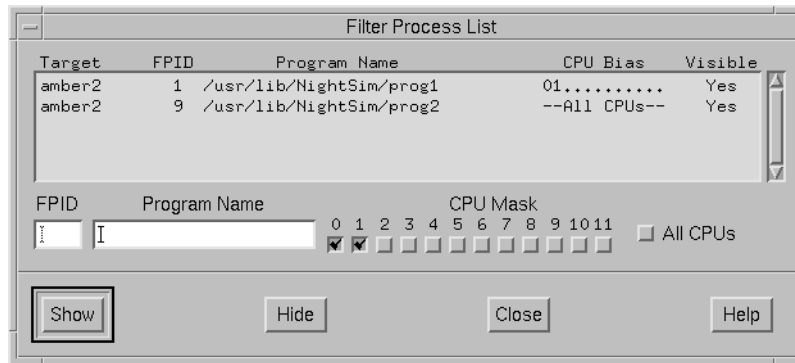


Figure 4-27. Filter Process List Dialog

Filter Process List

This list contains all of the processes that are scheduled on the scheduler and indicates whether or not they are visible in the list presented in the Process Scheduling Area of the Scheduler window (see “Using the Process Scheduling Area” on page 4-25 for details). You may use the mouse to select the process or processes that you wish to show or hide and then click on the Show or Hide button as desired.

You may also use a combination of the following items to specify which processes you wish to Show or Hide:

FPID

You may specify the unique *frequency-based scheduler* process identifier for a process that you wish to Show or Hide.

Program Name

You may specify the name of the process that you wish to Show or Hide. Enter a full or relative pathname. The pathname must be valid on the *target system* to which this process is assigned.

CPU Mask

This panel of check buttons allows you to Show or Hide processes which are scheduled on the specified processor or processors. Click on one or more buttons, where the label 0 represents the first logical CPU, 1 represents the second, and so on. To select all CPUs on your system, click on the All button.

If an FBS-scheduled process with the specified identifier(s) does not exist, NightSim reports an error. If more than one FBS-scheduled process with the specified identifier(s) exists, all such processes are shown or hidden.

Show

Lists in the Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-25) of the Scheduler window those processes either selected in the Filter Process List or specified using FPID, Program Name, or CPU Mask .

Hide

Removes from the Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-25) of the Scheduler window those processes either selected in the Filter Process List or specified using FPID, Program Name, or CPU Mask .

The Refresh Button

Refresh

This button is enabled only when the Scheduler window is active. Clicking on this button updates the scheduler and process information in the window. If a process terminates, for example, it will remain in the process list until the Refresh button is clicked, at which time it will be removed.

Using the Scheduler Control Area

The Scheduler Control Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Scheduler Control Area allows you to create and remove a *frequency-based scheduler*. It contains two push buttons that you use to perform these functions: the Set up button and the Remove button.

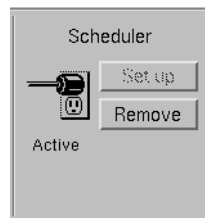


Figure 4-28. Scheduler Window - Scheduler Control Area

The Scheduler Control Area also contains an icon that indicates the current state of the Scheduler window.



When the window is inactive, NightSim shows an unplugged connection.



When the window is active, it shows a plugged connection.

Figure 4-3 illustrates a Scheduler window that is in the active state.

The **Set up** button is enabled only when the window is in the *inactive* state. When you click on the **Set up** button, NightSim carries out the following actions:

- Transitions the NightSim Scheduler to an **On-Line** mode of operation, if the NightSim Scheduler is operating in an **Off-Line** mode (see “On-Line/Off-Line Operation” on page 4-5). The state of each target on which processes are scheduled, the existence and execute permissions of each scheduled program, and the existence and read permissions for any input files required on each target is verified.
- Determines whether there is an existing scheduler that is associated with the same *key* as that entered in the current window.

If an active scheduler with the same scheduler key as the key you selected already exists on one or more target systems to which you assigned processes, NightSim displays the dialog that Figure 4-29 presents.

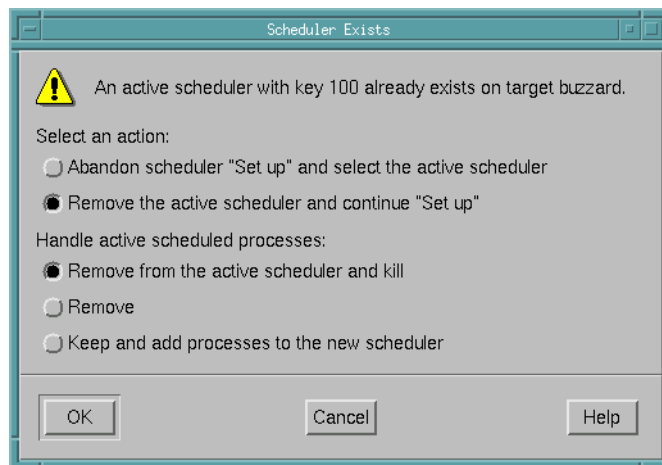


Figure 4-29. Scheduler Exists Dialog

You have two main choices:

- Work with the existing FBS, in which case the active FBS's configuration will appear in the Scheduler window in place of the current configuration.

or

- Replace the existing FBS with a new scheduler based on the configuration in the window.

If you decide to replace the existing FBS, you then need to decide what to do with the processes running under the old FBS. Figure 4-25 is presented in this case.

You may also press the **Cancel** button to abort this action.

- Creates a scheduler that is configured according to the parameters specified in the Scheduler Configuration Area of the window (see "Using the Scheduler Configuration Area" on page 4-21 for details)
- Schedules the processes that are listed in the Process Scheduling Area of the window and starts them running (see "Using the Process Scheduling Area" on page 4-25 for details). Programs will run up to the first **fbwait** system call.
- If a distributed timing source is selected but not already in use, and is found to be already registered, NightSim automatically re-registers the device for the current scheduler.
- Attaches the timing source to the scheduler
- Enables the **Start** button in the Simulation Control Area

Initially, the simulation is stopped. For an explanation of the Simulation Control Area, see "Using the Simulation Control Area" on page 4-43.

- Disables the **Set up** button and enables the **Remove** button
- Places the window in the *active* state and changes the state icon and title bar accordingly

The **Remove** button is enabled only when the window is in the *active* state. When you click on the **Remove** button, NightSim carries out the following actions:

- Displays the dialog that Figure 4-30 presents.

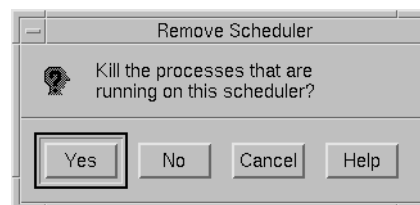


Figure 4-30. Remove Scheduler Dialog

You may press **Yes** to kill the processes that are currently scheduled on the scheduler, **No** to remove the processes from the scheduler but allow them to continue executing, or **Cancel** to abort the action.

- Stops the simulation if it is running
- If a real-time clock is being used as the timing source, and the scheduler is running, stops the clock.
- Detaches the timing source from the scheduler or disables *end-of-cycle scheduling*
- Removes all processes that are currently scheduled on the scheduler from it and either terminates them or allows them to continue executing in accordance with the selections made in response to the dialog presented in Figure 4-30
- Removes the scheduler from the system
- Disables the **Start**, **Stop**, and **Resume** buttons in the Simulation Control Area

For an explanation of the Simulation Control Area, see “Using the Simulation Control Area” on page 4-43

- Enables the **Set up** button and disables the **Remove** button
- Places the window in the *inactive* state and changes the state icon and title bar accordingly

Using the Simulation Control Area

The Simulation Control Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Simulation Control Area allows you to start, stop, and resume a simulation. It contains three push buttons that you use to perform these functions: the **Start** button, the **Stop** button, and the **Resume** button.

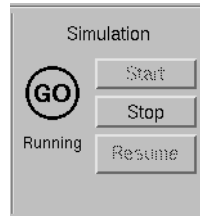


Figure 4-31. Scheduler Window - Simulation Control Area

The Simulation Control Area also contains an icon that indicates whether the simulation is stopped or running.



When the simulation is stopped, NightSim displays a stop sign.



When the simulation is running, NightSim displays a circle containing the word **GO**.

Figure 4-3 illustrates a Scheduler window in which the simulation is running.

The **Start** button is enabled only when the simulation is stopped. When you click on the **Start** button, NightSim carries out the following actions:

- Attaches the timing source to the scheduler if not already attached or if the timing source has been changed
- If a real-time clock is being used as the timing source, sets the clock period in accordance with the value entered in the **Clock period** field in the Scheduler Configuration Area (see p. 4-24 for information on this field)
- Starts the simulation with the values of the *minor cycle*, *major frame*, and *overrun* counts set to zero

The **Stop** button is enabled when the simulation is running. When you click on the **Stop** button, NightSim stops the simulation. When the simulation is stopped, the timing source

is not detached from the scheduler, but the **Timing source** and **Clock period** fields in the Scheduler Configuration Area of the **Scheduler** window are enabled (see pp. 4-23 and 4-24, respectively, for information on these fields). You may wish to change the timing source, and, if the timing source is a real-time clock, you may wish to change the clock *period*.

NOTE

If you change the timing source, the previously specified timing source is detached from the scheduler when you click on the **Start** or **Resume** button to start or resume the simulation.

While the simulation is stopped, you may also wish to change one or more of the parameters with which you have scheduled a process on the scheduler.

Although you can also change the parameters with which a process has been scheduled while the scheduler is running, it is not recommended that you do so. Rescheduling requires processor time. As a result, other processes that are currently scheduled on the *frequency-based scheduler* may experience *frame overruns*. If you have indicated as such, the scheduler will halt on a frame overrun but can be resumed.

The **Resume** button is enabled when the simulation has been running but is currently stopped. When you click on the **Resume** button, NightSim restarts the simulation with the values of the *minor cycle*, *major frame*, and *overrun* counts the same as they were when you stopped the simulation.

Using the Run Status Area

The Run Status Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-8).

The Run Status Area shows the number of the current major **Frame** and the current minor **Cycle** for the simulation running on the scheduler.

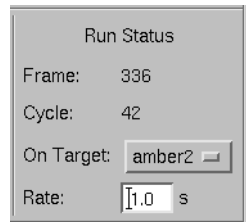


Figure 4-32. Scheduler Window - Run Status Area

This area also contains the following two configurable items:

On Target

This option menu allows you to select which *target system* supplies the frame number and *minor cycle* count. This allows you to see each target’s frame and cycle counts and determine if the schedulers are out of sync. It also allows you to assign the work of supplying this information to a target system that may not be as time-critical as other systems.

Rate

This field allows you to specify the frequency with which the frame and cycle counts in the Run Status Area are to be updated. Enter the number of seconds to occur between updates. The minimum value that you may specify is .01 second; the maximum is 100 seconds. The default value is 1.0 second.

Figure 4-3 and Figure 4-32 illustrate the Run Status Area for a Scheduler window that is in the *active state*.

Using the Monitor Window

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| How Is Idle Time Monitored? | 5-4 |
| How Is Spare Time Monitored? | 5-4 |
| Monitoring Unscheduled Processes | 5-5 |
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Using the Monitor Window

This chapter describes the *performance monitor* and explains how to monitor *FBS*-scheduled processes, a processor's *idle* and *spare time*, and unscheduled processes. It introduces the components of NightSim's Monitor window and describes the use of each component.

Understanding the Performance Monitor

The performance monitor is a mechanism that enables you to monitor *FBS*-scheduled processes' utilization of a CPU.

The performance monitor provides you with the ability to:

- Obtain performance monitor values by process or processor
- Start and stop performance monitoring by process
- Clear performance monitor values by processor

You also have the ability to set the *timing mode* under which the performance monitor is to run. You can select one of two modes: one that includes time spent servicing interrupts in performance monitor timing values and one that excludes time spent servicing interrupts from those values.

When the performance monitor timing mode is set to include interrupt time, a process's user and system times will total the elapsed time that accrues when the process is the currently running process. This elapsed time includes time spent servicing interrupts and performing context switches. Time spent servicing interrupts is added to the process's system time. Time spent switching to a new process is included in the new process's system time.

When the performance monitor timing mode is set to exclude interrupt time, a process's user and system times will total the time that accrues when the process is the currently running process. This time excludes time spent servicing interrupts, but it includes time spent performing context switches. Time spent switching to a new process is included in the new process's system time.

What Values Are Monitored?

The *performance monitor* keeps track of the time that a process spends running from the time that it is wakened by a frequency-based scheduler until it calls **fbwait**. Time is measured in microseconds. One instance of a process's being wakened by a scheduler is referred to as an iteration or a cycle. Performance monitor values for *FBS*-scheduled

processes are reported both in terms of cycles, or *iterations*, and in terms of *major frames*. They reflect what has happened since the last time that performance monitor values were cleared and performance monitoring was enabled.

When performance monitoring is enabled for an *FBS*-scheduled process, NightSim maintains the following values for each process:

Process Parameters

| | |
|--------------------------|---|
| Target | The system on which this process is running |
| FPID | The process's unique <i>frequency-based scheduler</i> identifier |
| PID | The process's process identification number |
| Name | The process's name |
| Priority | The process's scheduling priority |
| Starting Cycle | The number of the first <i>minor cycle</i> in which the process is to be wakened in each frame |
| Period | The frequency with which the process is to be wakened in each <i>major frame</i> |
| CPU Mask | The process's CPU mask |
| Interrupt Time Inclusion | Indicates whether time spent processing interrupts is included in performance monitor timing values |

General Statistics

| | |
|--------------------------|---|
| Total iterations, cycles | The number of times that the process has been wakened by the scheduler |
| Last time | The amount of time that the process has spent running from the last time that it has been wakened by the scheduler until it has called fbswait |
| Total time | The total amount of time that the process has spent running in all cycles |
| Average time | The average amount of time that the process has spent running in all cycles, or <i>iterations</i> . This value is obtained by dividing the value reported in the Total Time column by the value reported in the Iterations column. |
| Number of overruns | The number of times that the process has caused a <i>frame overrun</i> |
| Percent of period used | This value is maintained only if the timing source for the <i>frequency-based scheduler</i> on which the process is scheduled is a real-time clock. It is obtained by dividing the value reported in the Average Time column by the amount of time that is available to the process. The amount of time |

available to the process is calculated from its *period* and the length of a clock cycle.

Minimum Values

| | |
|---------------------|--|
| Minimum cycle time | The least amount of time that the process has spent running in a cycle |
| Minimum cycle frame | The number of the <i>major frame</i> in which the <i>minimum cycle time</i> has occurred |
| Minimum cycle cycle | The number of the <i>minor cycle</i> in which the <i>minimum cycle time</i> has occurred |
| Minimum frame time | The least amount of time that the process has spent running during a <i>major frame</i> |
| Minimum frame frame | The number of the <i>major frame</i> in which the <i>minimum frame time</i> has occurred |

Maximum Values

| | |
|---------------------|--|
| Maximum cycle time | The greatest amount of time that the process has spent running in a cycle |
| Maximum cycle frame | The number of the <i>major frame</i> in which the <i>maximum cycle time</i> has occurred |
| Maximum cycle cycle | The number of the <i>minor cycle</i> in which the <i>maximum cycle time</i> has occurred |
| Maximum frame time | The greatest amount of time that the process has spent running during a <i>major frame</i> |
| Maximum frame frame | The number of the <i>major frame</i> in which the <i>maximum frame time</i> has occurred |

Monitoring Idle and Spare Time

The *performance monitor* provides you with the capability of monitoring a processor's idle and spare time. Idle time refers to the time that the CPU is not busy. Spare time is composed of the following:

- Idle time
- CPU time of processes that are not scheduled on a frequency-based scheduler
- CPU time of *FBS*-scheduled processes for which performance monitoring has not been enabled

It is important to note that you may monitor a processor's spare time at the same time that you are monitoring its idle time. By monitoring a processor's idle time, you can determine

the amount of CPU time that is available to be allocated to additional processes. By subtracting the values obtained for idle time from those obtained for spare time, you can obtain an estimate of the amount of CPU time that is being allocated to processes that are not part of a simulation. You may be able to increase the number of tasks included in a simulation that you are running or run additional simulations.

Procedures for monitoring idle and spare time are described in “How Is Idle Time Monitored?” and “How Is Spare Time Monitored?”

How Is Idle Time Monitored?

You can monitor a particular processor's *idle time* if you add the process `/idle` to a frequency-based scheduler and schedule it on the desired processor for a particular *target system*. You can schedule `/idle` for any or all targets. You can also monitor idle time for a number of different processors by adding `/idle` to a selected *frequency-based scheduler* more than once and scheduling it on a different processor each time. Furthermore, you can add `/idle` to more than one frequency-based scheduler.

NOTE

It is important to note that you can schedule `/idle` on a particular processor for a particular target only once. This is a system-wide restriction. Only one user per processor per target may schedule `/idle` or `/spare`.

To add `/idle` to a frequency-based scheduler, use the Process Scheduling Area of the **Scheduler** window (see “Using the Process Scheduling Area” on page 4-25 for details). For an explanation of the procedures for adding a program to a scheduler, refer to Chapter 4, “Using the Scheduler Window.”

When you use NightSim to add `/idle` to a frequency-based scheduler, the only parameter that you may specify is the CPU mask. The CPU mask for `/idle` must specify only one CPU. The default scheduling priority is zero. The starting base cycle is zero, and the period is one. `/idle` will be scheduled every *minor cycle*, starting with the first minor cycle in each *major frame*.

You can view scheduling information for `/idle` in the same way that you view it for other *FBS*-scheduled processes—in the Process Scheduling Area of the **Scheduler** window (see “Using the Process Scheduling Area” on page 4-25 for details). For an illustration that shows this area, refer to Figure 4-3 in Chapter 4, “Using the Scheduler Window.”

How Is Spare Time Monitored?

You can monitor a processor's *spare time* by adding the process `/spare` to a selected *frequency-based scheduler* and scheduling it on the desired processor for a particular *target*. You can schedule `/spare` for any or all targets as well. As in the case of `/idle`, you can monitor spare time for a number of different processors by adding `/spare` to a selected frequency-based scheduler more than once and by scheduling it on a different

processor each time. You can also add **/spare** to more than one frequency-based scheduler.

NOTE

It is important to note that you can schedule **/spare** on a particular processor for a particular target only once. This is a system-wide restriction. Only one user per processor per target may schedule **/idle** or **/spare**.

When you add **/spare** to a frequency-based scheduler, the only parameter that you may specify is the CPU mask. The CPU mask for **/spare** must specify only one CPU. The default scheduling priority is zero. The starting base cycle is zero, and the period is one. **/spare** will be scheduled every *minor cycle*, starting with the first minor cycle in each *major frame*.

You can view scheduling information for **/spare** in the same way that you view it for other *FBS*-scheduled processes—in the Process Scheduling Area of the **Scheduler** window (see “Using the Process Scheduling Area” on page 4-25 for details). For an illustration that shows this area, refer to Figure 4-3 in Chapter 4, “Using the Scheduler Window.”.

Monitoring Unscheduled Processes

The *performance monitor* provides you with the additional capability of monitoring the performance of unscheduled processes. Unscheduled processes are those that are not wakened by the scheduler and do not call **fbswait**; they are not scheduled to run at a certain frequency. To be able to obtain *performance monitor* values for such processes, you must first add them to a *frequency-based scheduler* and specify a starting base cycle of zero and a *period* of zero. The other scheduling parameters that you must specify include the process’s scheduling priority and the CPU on which it is to be scheduled. You can optionally specify a decimal value to be passed to a process that is scheduled on a frequency-based scheduler. The Halt FBS on frame overrun flag does not apply to an unscheduled process (see “Overrun” on page 4-33).

You can add unscheduled processes to a frequency-based scheduler by using the Process Scheduling Area of the **Scheduler** window (see “Using the Process Scheduling Area” on page 4-25 for details). For an explanation of the procedures for adding a program to a scheduler, refer to Chapter 4, “Using the Scheduler Window.”

You can view scheduling information for unscheduled processes in the same way that you view it for other *FBS*-scheduled processes—in the Process Scheduling Area of the **Scheduler** window (see “Using the Process Scheduling Area” on page 4-25 for details). For an illustration that shows this area, refer to Figure 4-3 in Chapter 4, “Using the Scheduler Window.”.

The *performance monitor* values that are maintained for unscheduled processes include the following:

- Last time
- Total time
- *Minimum frame time* and the number of the frame in which it occurred
- *Maximum frame time* and the number of the frame in which it occurred

You can obtain these values if you enable performance monitoring for the processes. Procedures for enabling performance monitoring and retrieving *performance monitor* values are described in detail in “The Monitor Menu” on page 5-10.

Introduction to the Monitor Window

The Monitor window allows you to start and stop performance monitoring on *FBS*-scheduled processes scheduled on one or more processors, clear *performance monitor* values for all *FBS*-scheduled processes scheduled on one or more processors, and display *performance monitor* values for selected *FBS*-scheduled processes.

The Monitor window consists of the following components:

- Menu Bar
- Status Area
- Output Area
- Output Control Area

Figure 5-1 identifies the location of each of these components in the Monitor window. Note that this window contains sample data associated with a scheduler that exists on the system.

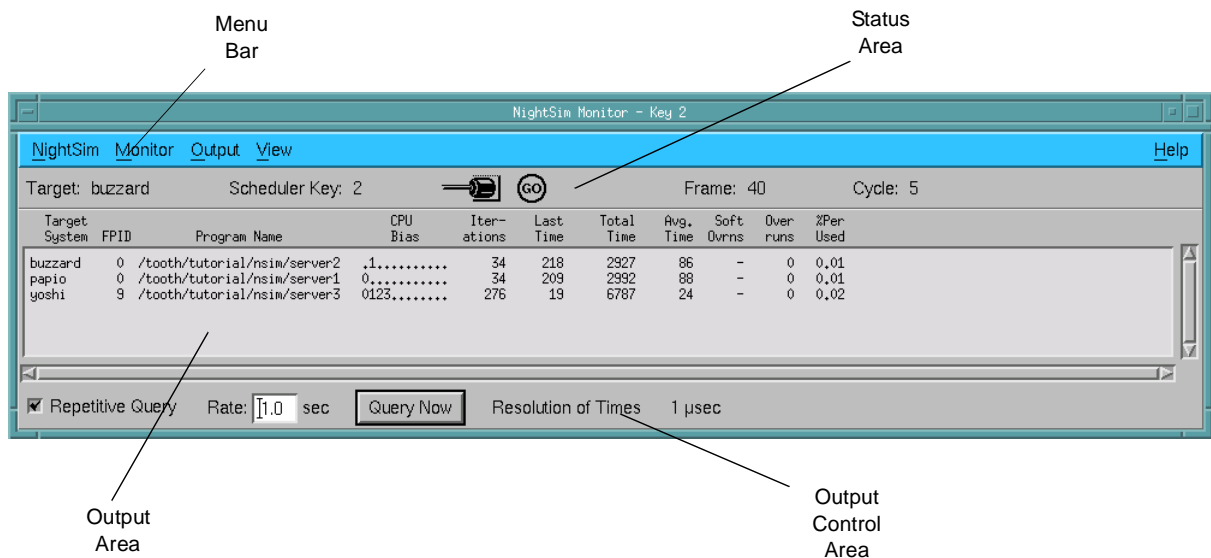


Figure 5-1. Sample Monitor Window

Procedures for using each component of the Monitor window are described in the sections that follow.

Using the Monitor Window Menu Bar

The Monitor Window menu bar is a part of the Monitor window (see “Introduction to the Monitor Window” on page 5-7).

The Monitor Window menu bar provides access to the following menus:

- NightSim
- Monitor
- Output
- View
- Help

Each menu is described in the sections that follow.

The NightSim Menu

The NightSim menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-8).

The NightSim menu on the Monitor Window contains commands related to the global operation of NightSim. Figure 5-2 presents this menu.



Figure 5-2. NightSim Menu

Descriptions of the options on the NightSim menu follow.

Create Scheduler Window

This option allows you to create a new Scheduler window. If this option is selected from a Monitor window which is associated with an existing scheduler, the new Scheduler window is created as an *active window* and all information associated with the Monitor window, including the *target* and *scheduler key*, is copied to this new Scheduler window.

Create Monitor Window

This option allows you to create a new Monitor window. The new window will not be associated with a particular *frequency-based scheduler*.

Duplicate Window

This option allows you to create a new **Monitor** window with the same configuration as that of the **Monitor** window from which this option was selected. Note that if *performance monitor* values are currently being logged to one or more files, the new **Monitor** window will not be associated with those files.

Close Window

This option allows you to close the current **Monitor** window.

If *performance monitor* values are being logged to a file, the dialog that appears in Figure 5-3 is presented. NightSim requires that you close this file before proceeding.



Figure 5-3. Stop Logging Dialog

Press **OK** to stop logging and close the file, **Cancel** to abort the requested action and continue logging, or display **Help** related to the dialog.

If the window from which you select **Close Window** is the only window that you have open, NightSim displays the warning dialog that Figure 4-8 presents.

Exit

This option allows you to exit NightSim. If you have open **Scheduler** windows that are untitled and contain unsaved changes, NightSim displays the warning dialog that Figure 4-5 presents (see p. 4-11). In each case, you may save the changes, close the window without saving the changes, cancel the close operation, or display help related to the dialog. If you click on the **Yes** button to save the changes, NightSim displays the file selection dialog that Figure 4-6 presents (see p. 4-11).

If you have open a **Scheduler** window that is associated with a configuration file name and contains unsaved changes, NightSim displays the warning dialog that Figure 4-7 presents. If you click on the **Yes** button, the changes are saved in the file associated with the window.

The warning dialogs are displayed for each window that contains unsaved changes.

If *performance monitor* values are being logged to one or more files, NightSim displays the warning dialog in Figure 5-3 (see p. 5-9). You may confirm that you wish to stop logging and close the file, continue to keep the window open, or display help related to the dialog.

The Monitor Menu

The Monitor menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-8).

The Monitor menu contains general commands related to performance monitoring. Figure 5-4 presents this menu.

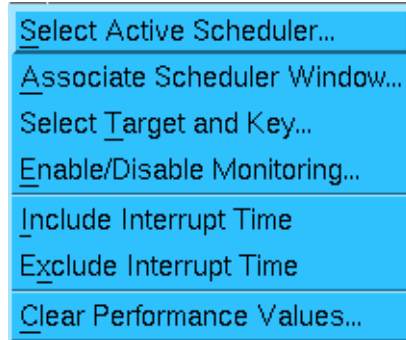


Figure 5-4. Monitor Menu

Descriptions of the options on the Monitor menu follow.

Select Active Scheduler . . .

This option allows you to associate the current Monitor window with a *frequency-based scheduler* active on a given *target system*. When you select this option, NightSim displays Figure 4-10, “Select Active Scheduler Dialog,” (see p. 4-14 of Chapter 4 for an explanation of this dialog).

This dialog provides a list of the active schedulers for the system designated by the Target field. The Target defaults to your local SBC and the list contains the active schedulers running on that particular system. For instance, Figure 4-10 lists the two schedulers currently running on the target `amber2`.

You may change the Target either by using the drop-down list (which lists the targets in your *cluster*) or by typing the name of the *target system* into the text field provided. Entering an item in this field will populate the list with the active schedulers on the specified target.

You may select a scheduler from the list that the dialog displays, or you may use the Scheduler Key text field to enter the numeric *key* that is associated with the desired scheduler. The key can be any positive integer value. Whether you select from the list or enter a key, the selected scheduler must previously have been configured, and you must have at least read permission for it; otherwise, NightSim reports an error.

Once you select a scheduler, NightSim will determine whether that scheduler is attached to a *distributed timing device*. If so, NightSim will try to locate schedulers on any other targets that have the same key and are attached to the same distributed timing device using the `fbsinfo_rdev(3rt)` service. All such schedulers

found will be treated as one “virtual” *FBS* and the combined information displayed to the user.

If you successfully select an existing scheduler, the **Monitor** window is associated with that scheduler.

If *performance monitor* values are being logged to one or more files, NightSim asks you if you wish to stop the logging and close the files using the dialog that appears in Figure 5-3. You may confirm that you wish to stop logging and close the file, continue to keep the window open, or display help related to the dialog. If the window from which you select **Select Active Scheduler . . .** is the only window that you have open, NightSim displays the warning dialog in Figure 4-8.

Associate Scheduler Window . . .

This dialog box allows you to associate a **Monitor** window with an existing scheduler. The dialog lists the *scheduler key* and the *target systems* to which processes are assigned for each **Scheduler** window in the current NightSim session. Select one of these schedulers by clicking on it and pressing **OK**, or press **Cancel** to close the dialog and leave the **Monitor** window unchanged.

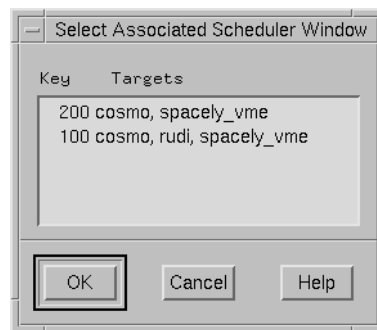


Figure 5-5. Select Associated Scheduler Window Dialog

Select Target and Key . . .

This dialog allows you to associate a **Monitor** window with a scheduler by specifying the **Target System** where the scheduler resides and its **Scheduler Key**. The scheduler need not already exist. If it does not exist but the scheduler is created in this session of NightSim, the **Monitor** window will automatically start monitoring that scheduler when the scheduler is created and started by NightSim.

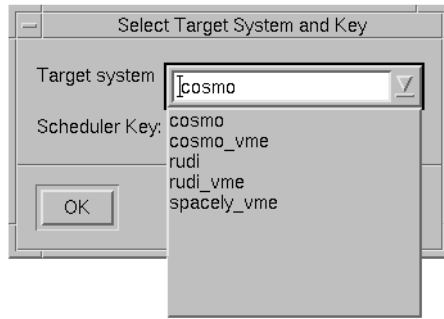


Figure 5-6. Select Target System and Key Dialog

Enable/Disable Monitoring . . .

This option allows you to enable or disable performance monitoring for one or more processes that are scheduled on the selected scheduler. By default, performance monitoring is enabled for all *FBS*-scheduled processes.

When you select this option, NightSim displays the selection dialog that Figure 5-7 presents.

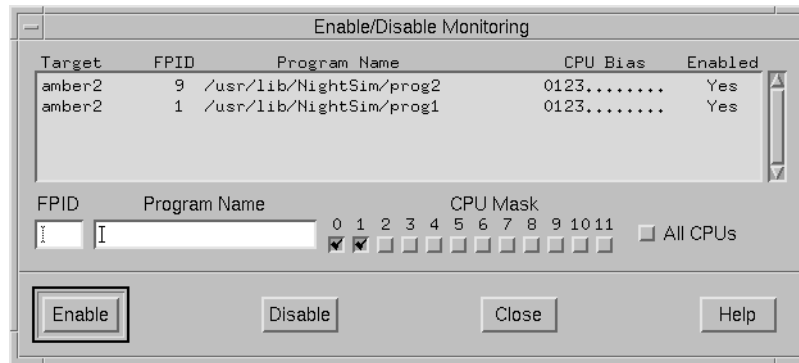


Figure 5-7. Enable/Disable Monitoring Dialog

Enable/Disable Monitoring List

This list contains all of the processes that are scheduled on the scheduler and indicates whether or not performance monitoring is currently enabled for each process. You may use the mouse to select the process or processes for which you wish to enable or disable performance monitoring and then click on the **Enable** or **Disable** button as desired.

You may also use a combination of the following items to specify those processes for which you wish performance monitoring enabled or disabled:

FPID:

You may specify the unique *frequency-based scheduler* process identifier of a process for which you wish performance monitoring enabled or disabled.

Program Name:

You may specify the name of the process for which you wish performance monitoring enabled or disabled. Enter a full or relative pathname. The pathname must be valid on the *target system* to which this process is assigned.

CPU Mask:

This panel of check buttons allows you to **Enable** or **Disable** performance monitoring for processes that are scheduled on the specified processor or processors. Click on one or more buttons, where the label 0 represents the first logical CPU, 1 represents the second, and so on. To select all CPUs on your system, click on the **All** button.

If an FBS-scheduled process with the specified identifier(s) does not exist, NightSim reports an error. If more than one FBS-scheduled process with the specified identifier(s) exists, all such processes are shown or hidden.

Enable

Enables performance monitoring for those processes either selected in the Enable/Disable Monitoring List or specified using FPID, Program Name, or CPU Mask.

Disable

Disables performance monitoring for those processes either selected in the Enable/Disable Monitoring List or specified using FPID, Program Name, or CPU Mask.

Include Interrupt Time

This item allows you set the *timing mode* under which the performance monitor is to run, indicating that time spent processing interrupts is to be **included** in *performance monitor* timing values. This is a system-wide setting that affects all processes on the *target systems* that have processes attached to the specified scheduler.

This status may be displayed by selecting the **Interrupt Time Inclusion** checkbox in the **Custom Display** dialog from the **View** menu (see Figure 5-12 on page 5-17). The **Output Area** in the **Monitor** window will then report this status for each process (see “Using the Output Area” on page 5-24 for related information).

Exclude Interrupt Time

This item allows you to set the *timing mode* under which the performance monitor is to run, indicating that time spent processing interrupts is to be **excluded** from *performance monitor* timing values. This is a system-wide setting that affects all processes on the *target systems* that have processes attached to the specified scheduler.

This status may be displayed by selecting the **Interrupt Time Inclusion** checkbox in the **Custom Display** dialog from the **View** menu (see Figure 5-12 on page

5-17). The Output Area in the Monitor window will then report this status for each process (see “Using the Output Area” on page 5-24 for related information).

Clear Performance Values . . .

This option allows you to clear *performance monitor* values for all *FBS*-scheduled processes on one or more processors. Note that values are cleared for selected CPUs on all *target systems* that have processes attached to the specified scheduler.

When you select this option, NightSim displays the dialog that Figure 5-8 presents.

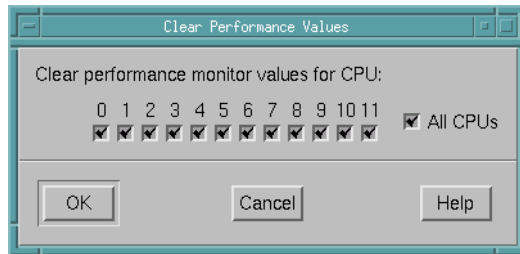


Figure 5-8. Clear Performance Monitor Values Dialog

By default, All CPUs is selected, so that you may conveniently clear all performance monitor values for all CPUs by simply pressing **Enter** or clicking **OK**.

You use the panel of check buttons to select the processor or processors for which you wish to clear *performance monitor* values. Click on one or more buttons, where the label 0 represents the first logical CPU, 1 represents the second, and so on. To select all CPUs on your system, click on the All CPUs button. After selecting the processor(s), you may apply your selection, cancel the operation, or display help related to the dialog.

The Output Menu

The Output menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-8).

The Output menu controls where performance data is to be sent. Figure 5-9 presents this menu.

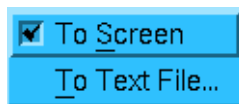


Figure 5-9. Output Menu

A checkmark appears next to an item if it is enabled. The two items can be enabled or disabled independently. Descriptions of these options follow.

To Screen

This toggle button allows you to indicate whether or not performance monitoring values are to be displayed in the Output Area of the Monitor window (see “Using the Output Area” on page 5-24 for related information).

To Text File . . .

This option allows you to (1) specify the name of a text file in which you wish *performance monitor* values to be saved and (2) specify the types of values to be saved. When you select this option, NightSim displays the selection dialog that Figure 5-10 presents.

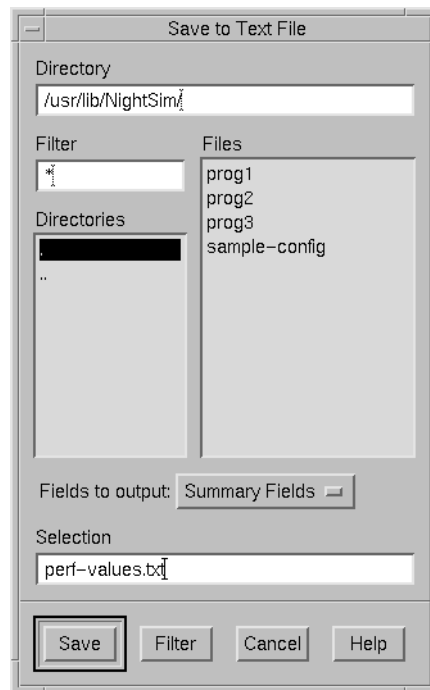


Figure 5-10. Save to Text File Dialog

To select the file in which values are to be saved, use the directory text area, file mask area, list of directories, list of files, and file selection text area as appropriate. To specify the types of values to be saved, use the Fields to output option menu that Figure 5-11 presents.

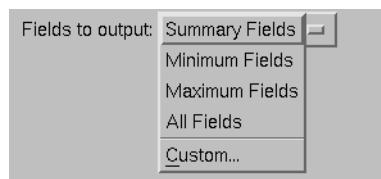


Figure 5-11. Fields to Output Option Menu

Descriptions of the options contained in the **Fields to output** option menu follow.

Summary Fields

This option specifies the following types of values: *target system*, process parameters (*FPID*, program name, and CPU mask) and general statistics. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

Minimum Fields

This option specifies the following types of values: *target system*, process parameters (*FPID*, program name, and CPU mask), general statistics (*iterations*), and minimum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

Maximum Fields

This option specifies the following types of values: *target system*, process parameters (*FPID*, program name, and CPU mask), general statistics (*iterations*), and maximum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

All Fields

This option specifies all types of values: *target system*, process scheduling parameters, general statistics, minimum values, and maximum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

Custom . . .

This option allows you to select any of the types of values that the *performance monitor* facility maintains.

When you select this option, NightSim displays the dialog that Figure 5-12 presents.

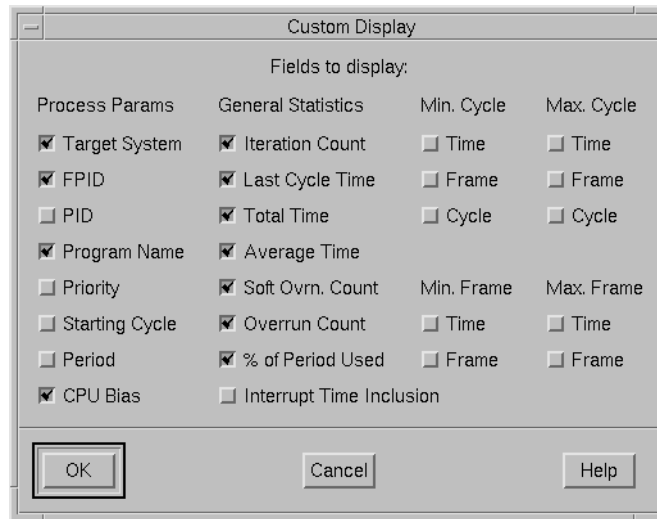


Figure 5-12. Custom Display Dialog Box

You use the panels of check buttons to select the types of *performance monitor* values that you wish to save. Click on one or more buttons as desired. After you have selected the types of values that you wish to save, you may apply the selections and close the **Custom Display** dialog box, cancel the selections, or display help related to the dialog.

After selecting the file in which values are to be saved and specifying the types of values to be saved, you may save the values in the selected file, search for another file, cancel the operation, or display help related to the dialog.

The View Menu

The **View** menu appears on the **Monitor** window menu bar (see “Using the Monitor Window Menu Bar” on page 5-8).

The **View** menu controls output to the **Monitor** window. Figure 5-13 presents this menu.



Figure 5-13. View Menu

Descriptions of the options on the **View** menu follow.

Select Processes. . .

This option allows you to specify the *FBS*-scheduled processes whose *performance monitor* values will be reported.

Depending on the selection under the Output menu (see “The Output Menu” on page 5-14), performance monitor values will be displayed in:

- the Output Area of the Monitor window if the “To Screen” option is selected (see “Using the Output Area” on page 5-24 for more information)
- a text file if the “To Text File...” option is selected

Note that performance monitoring must be enabled for a process in order for it to be shown in the Monitor window. Performance monitoring is enabled for all processes by default.

When you choose the Select Processes . . . option, NightSim displays the dialog in Figure 5-14:

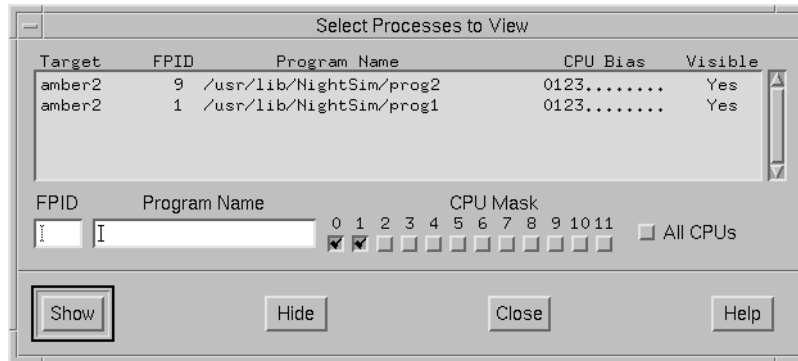


Figure 5-14. Select Processes to View Dialog

Select Processes List

This list contains all of the processes that are scheduled on the scheduler and indicates whether or not their performance values will be reported. You may use the mouse to select the process or processes whose performance values you wish to Show or Hide.

You may also use a combination of the following items to specify which processes you wish to Show or Hide:

FPID:

You may specify the unique *frequency-based scheduler* process identifier for a process whose performance values you wish to Show or Hide.

Program Name:

You may specify the name of the process that you wish to **Show** or **Hide**. Enter a full or relative pathname. The pathname must be valid on the *target system* to which this process is assigned.

CPU Mask:

This panel of check buttons allows you to **Show** or **Hide** processes which are scheduled on the specified processor or processors. Click on one or more buttons, where the label 0 represents the first logical CPU, 1 represents the second, and so on. To select all CPUs on your system, click on the All button.

If an FBS-scheduled process with the specified identifier(s) does not exist, NightSim reports an error. If more than one FBS-scheduled process with the specified identifier(s) exists, all such processes are shown or hidden.

Show

Reports the performance monitor values for those processes either selected in the **Select Processes List** or specified using **FPID**, **Program Name**, or **CPU Mask**.

Hide

Refrains from reporting the performance monitor values for those processes either selected in the **Select Processes List** or specified using **FPID**, **Program Name**, or **CPU Mask**.

Display Fields

This option allows you to specify the types of *performance monitor* values that are to be displayed in the **Output Area** of the **Monitor** window (see “Using the Output Area” on page 5-24 for related information). When you select this option, NightSim displays the tear-off menu that Figure 5-15 presents.



Figure 5-15. Display Fields Tear-Off Menu

Descriptions of the options contained in the **Display Fields** tear-off menu follow.

Summary Fields

This option specifies the following types of values: *target system*, process parameters (*FPID*, program name, and CPU mask) and general statistics.

Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

Minimum Fields

This option specifies the following types of values: *target system*, process parameters (*FPID*, program name, and CPU mask), general statistics (*iterations*) and minimum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

Maximum Fields

This option specifies the following types of values: *target system*, process parameters (*FPID*, program name, and CPU mask), general statistics (*iterations*) and maximum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

All Fields

This option specifies all types of values: *target system*, process scheduling parameters, general statistics, minimum values, and maximum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

Custom . . .

This option allows you to select any of the types of values that the *performance monitor* facility maintains.

When you select this option, NightSim displays the dialog that Figure 5-12 presents.

You use the panels of check buttons to select the types of *performance monitor* values that you wish to display. Click on one or more buttons as desired. After you have selected the types of values that you wish to display, you may apply the selections and close the **Custom Display** dialog box, apply the selections without closing the dialog box, cancel the selections, or display help related to the dialog.

Sort By

This option allows you to select the primary sort key used in ordering the *FBS*-scheduled processes and associated *performance monitor* values. (Refer to “The Output Menu” on page 5-14 for information on specifying where these values are reported.)

When you select this option, NightSim displays the tear-off menu that Figure 5-16 presents.

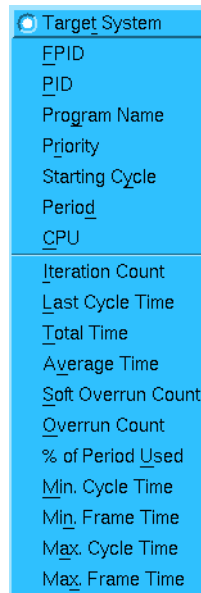


Figure 5-16. Sort By Tear-Off Menu

You specify the type of value to be used as the primary sort key by clicking on the desired radio button. It is important to note that the first seven options are separated from the others. The reason is that with the first seven options, the sort order must be calculated only once. With the other options, the sort order must be recalculated each time you query the values. As a result, the overhead associated with the first seven options is far less than that associated with the others.

The default is Target System.

Then Sort By

This option allows you to indicate the secondary sort key to be used in ordering the *FBS*-scheduled processes and associated *performance monitor* values. (Refer to “The Output Menu” on page 5-14 for information on specifying where these values are reported.) The Sort By and Then Sort By options allow you to sort first on a value such as priority and then sort again within that grouping by a value such as average time.

When you select this option, NightSim displays the tear-off menu that Figure 5-17 presents.

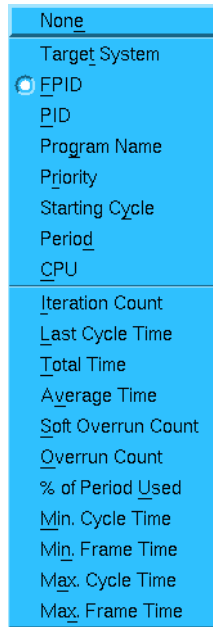


Figure 5-17. Then Sort By Tear-Off Menu

You specify the type of value to be used as the secondary sort key by clicking on the desired radio button or you may choose the first option, **NONE**, to have no secondary sort key. It is important to note that the next eight options are separated from the others. The reason is that with those eight options, the sort order must be calculated only once. With the other options, the sort order must be recalculated each time you query the values. As a result, the overhead associated with the eight options is far less than that associated with the other options.

The default is FPID.

Resolution

This option allows you to control the precision with which NightSim reports the *performance monitor* timing values. When you select this option, NightSim displays the tear-off menu that Figure 5-18 presents.

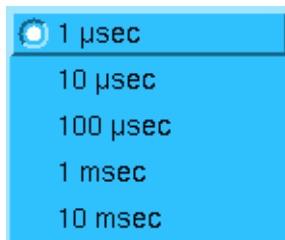


Figure 5-18. Resolution Options

You may specify the precision in microseconds, tens of microseconds, hundreds of microseconds, milliseconds, or tens of milliseconds by clicking on the toggle button and choosing the desired option.

NOTE

As the values of times increase in a long-running simulation, the resolution option value is automatically increased by NightSim in order to avoid overflowing the display.

The Help Menu

The Help menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-8).

The Help menu provides access to the on-line help system. See “Getting Help” on page 3-4 for detailed information about this menu and each of its items.

Using the Status Area

The Status Area is a part of the Monitor window (see “Introduction to the Monitor Window” on page 5-7).

The Status Area displays information about the *frequency-based scheduler* with which this Monitor window is associated.



Figure 5-19. Monitor Window - Status Area

It contains the following values:

Target

This field displays the *target system* on which the scheduler associated with this Monitor window resides. If this scheduler is distributed across multiple systems in a *cluster* configuration, this is just one of the target systems; it is the system that NightSim will query first to determine information about the scheduler.

Together with the Scheduler Key, this Target system serves to identify the scheduler to NightSim.

Scheduler Key

This field displays the numeric *key* for the scheduler with which this Monitor window is associated.

If the *frequency-based scheduler* with which the **Monitor** window is associated is an active scheduler, the Status Area also shows:

Frame

Current *major frame* of the associated *frequency-based scheduler*.

Cycle

Current *minor cycle* of the associated *frequency-based scheduler*.

The Status Area also contains two icons: one that indicates the current state of the scheduler and one that indicates the current state of the simulation.

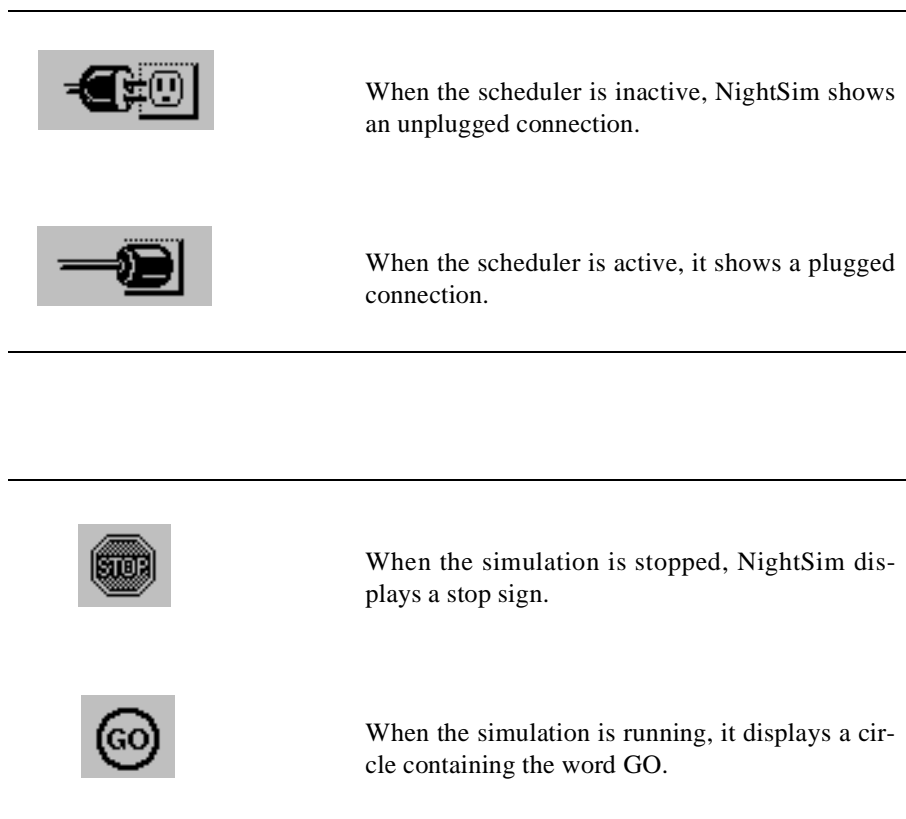


Figure 5-19 illustrates the Status Area for a **Monitor** window that is associated with an active scheduler and a running simulation.

Using the Output Area

The Output Area is a part of the **Monitor** window (see “Introduction to the Monitor Window” on page 5-7).

The Output Area contains a textual display of *performance monitor* information.

| Target System | FPID | Program Name | CPU Bias | Iterations | Last Time | Total Time | Avg. Time | Soft Ovrns | Over runs | %Per Used |
|---------------|------|-------------------------|-----------|------------|-----------|------------|-----------|------------|-----------|-----------|
| amber2 | 1 | /usr/lib/NightSim/prog1 | 0123..... | 14148 | 137 | 1866380 | 131 | - | 228 | 6.60 |
| amber2 | 9 | /usr/lib/NightSim/prog2 | 0123..... | 566 | 853 | 525412 | 928 | - | 0 | 1.86 |

Figure 5-20. Monitor Window - Output Area

The Output Area allows you to view *performance monitor* values for selected *FBS*-scheduled processes. It contains a scrolling list of the processes that are currently scheduled on the *frequency-based scheduler* with which the **Monitor** window is associated and that have been selected for performance monitoring. You can use the horizontal and vertical scroll bars to scroll the visible contents of the area. Although you cannot edit this area of the **Monitor** window, you can use the mouse to select text in the area and paste it in another window—one in which an editor is running, for example.

NOTE

If the **Priority**, **Period**, or **CPU Bias** mask of a process are changed while the scheduler is running, the **Monitor** window will not reflect the updated values until the next **Monitor** window update after the process runs again.

For information on the commands that allow you to control the operation of the *performance monitor*, refer to “The Monitor Menu” on page 5-10. For information on the commands that allow you to control the information that is displayed in the Output Area, refer to “The View Menu” on page 5-17.

Using the Output Control Area

The Output Control Area is a part of the **Monitor** window (see “Introduction to the Monitor Window” on page 5-7).

The Output Control Area allows you to specify the frequency and precision with which you wish *performance monitor* values to be updated. Note that the selections that you make in the Output Control Area apply both to the values displayed in the Output Area of the **Monitor** window (see “Using the Output Area” on page 5-24) and the values saved in a file. See “The Output Menu” on page 5-14 for related information.



Figure 5-21. Monitor Window - Output Control Area

The Output Control Area contains the following text field and controls:

Repetitive Query

This check button allows you to indicate that you wish NightSim to repeatedly query *performance monitor* values at a rate that you specify in the **Rate** text field in the Output Control Area. If this button is activated and the simulation on the *frequency-based scheduler* associated with the **Monitor** window has not been started, NightSim will query the *target system* (designated in the **Target** field of the **Monitor** window) at the specified **Rate** to detect when the scheduler gets started.

Note that once the scheduler is active, NightSim must query every target system to which processes have been assigned to obtain the complete set of performance data. This may affect the performance of those target systems to some degree.

Rate

This field allows you to specify the frequency with which *performance monitor* values are to be updated. Enter the number of seconds to occur between updates. The minimum value that you may specify is 0.01 second and the maximum is 100 seconds. The default value is 1.0 second.

Query Now

This push button allows you to query *performance monitor* values immediately.

Resolution of Times

This displays the resolution of the times displayed by the *performance monitor*. This resolution is controlled by the **Resolution** item in the **View** menu. See “The View Menu” on page 5-17 for more information.

NOTE

For long-running simulations, as times become larger, the resolution of displayed times is automatically reduced (i.e. resolution value is increased) in order to avoid overflowing the display values.

A

Configuration Files

This appendix discusses the format of configuration files used by NightSim as well as the automatic conversion of configuration files created by NightSim 2.4 and earlier versions.

Configuration File Format

NightSim 2.4 and earlier versions allowed the user to save the configuration as a sequence of `rtcp` commands to a file that could be run as a script in place of using NightSim. The concept of a *distributed FBS* introduced in NightSim 3.2, allowing for processes to be scheduled in a synchronized manner on more than one target computer, makes this form less desirable, as well as less efficient. The configuration is now saved to a file with the following format:

```
Scheduler <key> {
  cycles <n>;                // cycles per frame
  tasks total <n>;           // total number of tasks allowed in scheduler
  tasks per cycle <n>;       // optional, defaults to total tasks
  permissions owner=<perms>; // permissions, see below
  distribution <dist_kind>;  // distribution kind, see below

  timing source {
    host "<name>";           // timing-host name
    EOC ;                     // if end-of-cycle timing
    clock "<name>";         // if rtc, simple name of clock
    eti "<name>";           // if eti, simple name of eti
    other "<name>";         // full pathname of device
    clock duration <n>;       // if rtc, clock duration in microseconds
    clock count <n>;         // if rtc, ticks per minor cycle.
  }

  process "<program_name>" on "<target_name>" {
    NightView <boolean> ;     // schedule under NightView, {True | False}
    xterm <boolean> ;         // run under an xterm(1), {True | False}
    dir "<name>";            // full pathname of working directory on target
    input <style> ;           // input source, {File | Standard}
    infile "name" ;          // full pathname of input file
    output <style> ;          // output destination, {File | Standard}
    outfile "<name>";       // full pathname of output file
    privilege "<privlist>" ; // working privileges, see below
    policy <p>;               // scheduling policy, p = {R | O | P}
    priority <n>;             // scheduling priority
    parameter <n>;           // program parameter. if absent, -1
    soft overruns <n>;       // soft overrun limit. if absent, no limit
    cpu <mask>;               // cpu bias mask, see below
    start cycle <n>;         // starting cycle
    period <n>;              // period
  } ...
}
```

NOTE

The values for `<name>`, `<program_name>`, `<target_name>`, and `<privlist>` must be enclosed in double quotes ("")

The <perms> specification is a sequence of one or more of the following:

```
owner=<permspec>
group=<permspec>
other=<permspec>
```

where <permspec> is either 'r', 'w', or 'rw'.

The <dist_kind> specification is one of the following values:

```
"None"           target names must match the timing-host name
"Closely Coupled" targets must be in the same cluster as timing-host
"RCIM Coupled"   targets are on the same RCIM chain as timing-host.
```

The <boolean> specifications should have a simple boolean keyword:

```
True           the feature is enabled
False          the feature is disabled
```

The <style> specifications should have one of the following values:

```
File           input/output should be redirected from/to a file on the
                target system. A name must be provided.
Standard       I/O should be performed to/from standard I/O streams,
                Standard Input, or Standard Error.
```

NOTE

If both `xterm` and `NightView` boolean parameters are `False`, then the <style> specifications for input and output must both be `File`.

The <privlist> specification should contain a comma-separated list of simple privilege names. For example:

```
"owner,dev,rtime"
```

See **intro(2)** for more information on privileges.

The <mask> specification can be a comma-separated list of mask specifiers. Each specifier can be a CPU number (specified as an integer), a range of CPU numbers in the form <n>-<m>, or the keyword `active`, indicating all active CPUs on the system.

Configuration File Example

The following is an example of the configuration file associated with the scheduler in Figure 4-3, "Sample Scheduler Window," on page 4-8.


```

Scheduler 2 {
  cycles 8;
  tasks total 10;
  tasks per cycle 10;
  permissions owner=rw;
  distribution RCIM coupled;

  timing source {
    host "buzzard";
    clock "2c2";
    clock duration 10;
    clock count 10000;
  }

  process "/tooth/tutorial/nsim/server1"
    on "papio" {
      NightView False ;
      xterm False ;
      dir "/tooth/tutorial/nsim/" ;
      input File ;
      infile "/dev/null" ;
      output File ;
      outfile "server1.papio.out" ;
      privilege "owner,dev,rtime,tshar,plock,cpubias" ;
      policy F;
      priority 59;
      parameter 1;
      soft overruns 0;
      cpu 0;
      start cycle 0;
      period 8;
    }

  process "/tooth/tutorial/nsim/server2"
    on "buzzard" {
      NightView False ;
      xterm False ;
      dir "/tooth/tutorial/nsim/" ;
      input File ;
      infile "/dev/null" ;
      output File ;
      outfile "server2.buzzard.out" ;
      privilege "owner,dev,rtime,tshar,plock,cpubias" ;
      policy F;
      priority 59;
      parameter 2;
      soft overruns 0;
      cpu 1;
      start cycle 0;
      period 8;
    }
}

```

```
process "/tooth/tutorial/nsim/server3"
  on "yoshi" {
    NightView False ;
    xterm False ;
    dir "/tooth/tutorial/nsim" ;
    input File ;
    infile "/dev/null" ;
    output File ;
    outfile "server3.yoshi.out" ;
    privilege "owner,dev,rtime,tshar,plock,cpubias" ;
    policy F;
    priority 59;
    parameter 3;
    soft overruns 0;
    cpu active;
    start cycle 0;
    period 1;
  }
}
```

Configuration File Conversion

NightSim 2.4 and earlier versions supported configuration files consisting of a sequence of **rtcp** commands. While NightSim still retains the ability to generate a script containing **rtcp** commands, the "configuration" is now saved to a file with an enhanced format that supports the concept of a *distributed FBS*, allowing for processes to be scheduled in a synchronized manner on more than one target computer (see "Configuration File Format" on page A-1).

Configuration files created by NightSim 2.4 and earlier versions will be converted to this new format automatically when opened by NightSim. Save your configuration file again after opening to complete the conversion.

NOTE

The conversion of configuration files will not occur on Linux systems.

This appendix details the X resources, NightStar resources, and widget hierarchy in NightSim.

X Resources

The following X resources are available for configuring the behavior of NightSim:

`*defaultClockRes`

Specifies the default resolution in microseconds that is to be used when configuring a real-time clock. Permissible values are 1, 10, 100, 1000, and 10000. The default value is 10.

`*defaultPermissions`

Specifies the default access permissions to be used when creating a new scheduler. The value is an octal number in the same format used by `chmod(1)`. The default value is 600.

`*defaultUpdateRate`

Specifies the default rate in seconds that is to be used for updating the run status fields in the **Scheduler** window and taking repetitive queries in the **Monitor** window. Minimum value is 0.01 second; maximum value is 100 seconds; default value is 1.0 second.

`*defaultMonitorRes`

Specifies the default resolution in microseconds of time-based fields in the **Monitor** window. Permissible values are 1, 10, 100, 1000, and 10000; the default value is 1.

`*displayTitle1` - `*displayTitle9`

`*displayFields1` - `*displayFields9`

These resources are used to specify the predefined sets of performance monitor fields. Up to 9 sets of fields can be defined. The `displayTitlen` resource is a string that defines a name for field set n , and the `displayFieldsn` resource is a

list of four-letter codes that specify the fields to be displayed. The codes are as follows:

| | |
|------|---------------------------------------|
| targ | Target system |
| fpid | FPID of the process |
| spid | system PID of the process |
| name | program name |
| prio | program priority |
| stcy | starting cycle |
| peri | period |
| cpum | CPU bias |
| itrc | iteration count |
| lcyt | last cycle time |
| tott | total time |
| avgt | average cycle time |
| sorc | soft overrun count |
| ovrc | overrun count |
| prcn | percent of period used |
| mnct | minimum cycle time |
| mncf | minimum cycle frame |
| mncc | minimum cycle cycle |
| mnft | minimum frame time |
| mnff | minimum frame frame |
| mxct | maximum cycle time |
| mxcf | maximum cycle frame |
| mxcc | maximum cycle cycle |
| mxft | maximum frame time |
| mxff | maximum frame frame |
| intr | inclusion/exclusion of interrupt time |

As an example, the following is the default for the first field set:

```
*displayTitle1: Summary Fields
*displayFields1: targ fpid name cpum itrc lcyt tott
avgt sorc ovrc prcn
```

***offline**

Specifies whether new Scheduler windows should be initially **Off-Line** (True) or **On-Line** (False). See “On-Line/Off-Line Operation” on page 4-5 for more information.

***expert**

Specifies whether the user is running in *expert mode* (True or False). The default value is False.

***serverStartTimeout**

Specifies the amount of time (in seconds) that NightSim should allow for the NightSim server to start up on a target system. If the server does not start successfully

within this time period, but no error is received, NightSim aborts the operation and displays an error message.

The default value is 15 seconds. You may need to specify a longer time for slow or heavily-loaded networks or target systems.

`*serverMessageTimeout`

Specifies the amount of time (in seconds) that NightSim should allow for the NightSim server to respond to a message. If the server does not respond within this period, NightSim will assume that the server has terminated or that the remote target is inoperative. NightSim will then abort the operation and display an error message.

The default value is 20 seconds. You may need to specify a longer time for slow or heavily-loaded networks or target systems.

`*extendedResponseTimeout`

Specifies the maximum length of time (in seconds) that NightSim should allow for the NightSim server to respond with a longer response to a message. For example, the length of time NightSim should wait for the NightSim server to read a remote directory and return the names of all the files contained within.

If the server does not respond within this time period, NightSim will assume that the server has terminated or that the remote target is inoperative. NightSim will then abort the operation and display an error message.

The default value is 90 seconds. You may need to specify a longer time for slow or heavily-loaded networks or target systems.

NightStar Resources

You may control NightSim's appearance using the NightStar Font Resources and NightStar Color Resources. In most cases, however, the default values for the following resources should be used.

NightStar Font Resources

This section describes the special font resources available for NightStar tools. In addition to these resources, NightStar tools specify an overall *default font* that is used for most of the textual display. NightStar tools use proportional-width fonts except in areas that depend on text alignment; in these instances a fixed-width font is important for readability. If you decide to change fonts, make sure that you choose another fixed-width font for the font resources that have *fixed* in their names.

NightStar font resources include:

`*smallFontList`

Used for areas that require a smaller font.

*infoFontList

Used for areas that display informational messages, warnings, errors.

*fixedFontList

Used for areas that depend on text alignment.

*smallFixedFontList

Used for areas that depend on text alignment but require a smaller font.

The `/usr/lib/X11/app-defaults/Nsim` resource file specifies the font values for NightSim.

NightStar Color Resources

This section describes the special color resources available for NightStar tools. In addition to these resources, NightStar tools specify an overall *default color* that is used for most of the window areas. NightStar tools use the same color scheme to indicate that they are part of the same tool set and to provide cues about the usage of different areas in the windows. Each NightStar tool uses a unique color for its menu bars.

The following NightStar color application resources are defined:

*outputBackground

*outputForeground

Used for the background and foreground colors in output-only areas.

*inputBackground

*inputForeground

Used for the background and foreground colors in areas that accept user input.

The `/usr/lib/X11/app-defaults/Nsim-color` resource file specifies the color values for NightSim.

Widget Hierarchy

Information about the widget hierarchy for the graphical user interface is useful for modifying the behavior of NightSim through the use of standard X11 or Motif resources. You can get this information by using `editres(1)`. See the `man` page for information about `editres`.

C

Reporting Bugs

This section describes how to report bugs in NightSim. It is important to report problems, otherwise we might never know about them. You can report a problem by calling the Concurrent Software Support Center or by submitting a Software Action Request (SAR). For details on these methods, see the section *Direct Software Support* in the Release Notes for the current release.

It is also important to report a problem in a way that helps us understand and reproduce the problem.

Here is a list of things you should tell us in a problem report.

- What version of NightSim are you using? You can get this by running `nsim -version` or by activating `On Version` in the `Help` menu in the GUI (see “Getting Help” on page 3-4).
- What type of machine are you running on, and what is the version of the operating system? Use the command `uname -a` to get this information.
- Try to be very explicit about what you see happen when the problem occurs. Do you get any error messages? Exactly what incorrect behavior do you see? How will we know when we have reproduced the problem?
- Try to isolate the problem to a minimal test case.
- Be explicit about exactly how to reproduce the problem. Try not to leave out any facts, even if you think you know the cause of the problem.

Glossary

active scheduler window

A Scheduler window that is associated with a scheduler that exists on the system.

closely-coupled distribution

A scheduler with a closely-coupled distribution must use a device which supports the `IOCTLVECNUM ioctl` command (See `rtc(7)` man page). The integral real-time clocks and the real-time clocks and edge-triggered interrupts on the RCIM support this feature.

closely-coupled system

A closely-coupled system is a set of single-board computers (*SBCs*) which share the same VMEbus. The first board must have an attached system disk and acts as the file server for the other boards in the VMEbus. The VMEbus can be used for various types of inter-board communication. A closely-coupled system is also known as a *cluster*.

cluster

A cluster is one or more single-board computers (*SBCs*) which reside on the same VMEbus. In general, a cluster may be viewed as a number of *SBCs* which reside in the same VME chassis. A cluster is also referred to as a *closely-coupled system*.

distributed FBS

An *FBS* configured by NightSim which allows for processes to be scheduled in a synchronized manner on more than one target computer. See *closely-coupled distribution*.

distributed timing device

A timing device may be registered as either a closely-coupled timing device or as an RCIM-coupled timing device for use with a distributed frequency-based scheduler. (See `fbs_register_rdev(3rt)` man page).

If registered as a closely-coupled timing-device on the *SBC* where it actually resides, the device is available for use on all other *SBC's* in the same *cluster*. If registers as an RCIM-coupled timing device on the *host* where the *RCIM* device actually resides, the remote timing device is available to all others targets in the RCIM chain.

end-of-cycle scheduling

A form of frequency-based scheduling in which scheduling is triggered when the last process that is scheduled to execute in the current *minor cycle* of the current *major frame* completes its processing.

expert mode

A mode specified by setting the `expert X` resource to `True`, allowing the user to see more detailed information about the current *FBS* in the Scheduler window.

FBS

Frequency-based scheduler.

FBSMNI

A system tunable parameter that is associated with the *frequency-based scheduler*. It specifies the maximum number of frequency-based schedulers that can be configured at one time system-wide.

FBSUNSCHEDMAX

A system tunable parameter that is associated with the *frequency-based scheduler*. It specifies the maximum number of unscheduled processes that is permitted on a frequency-based scheduler.

FPID

A unique *frequency-based scheduler* process identifier that is returned when a program is scheduled on a frequency-based scheduler.

frame overrun

The condition that occurs when an *FBS*-scheduled process does not finish its processing before it is scheduled to run again.

frequency-based scheduler

A high resolution task synchronization mechanism that enables processes to run at user-specified frequencies.

high-resolution timing facility

A feature that provides a means of measuring each process's or LWP's execution time.

host system

A system designated by a host name. A host may be an *SBC* in a cluster, a stand-alone computer system, or a node in a network of computer system connected by ethernet. See *NightSim host*, *timing host*, *target system*.

idle time

Time during which the CPU is not busy.

inactive scheduler window

A Scheduler window that is not associated with an existing scheduler.

iteration

One instance of a process's being wakened by a *frequency-based scheduler*.

KoalaTalk

The inter-tool communication mechanism used by NightSim to exchange messages among its components. It is provided with the X Window System.

last time

A value returned by the *performance monitor* indicating the amount of time that an *FBS*-scheduled process has spent running from the last time that it has been wakened by the scheduler until it has called **fbwait**.

loosely-coupled system

Two or more *target systems* connected via either Ethernet or *RCIMs* and RCIM cables.

major frame

One pass through all of the *minor cycles* with which a *frequency-based scheduler* is configured. A major frame has associated with it a duration, which is obtained by multiplying the duration of a minor cycle by the number of minor cycles per major frame.

maximum cycle cycle

A value returned by the *performance monitor* indicating the number of the *minor cycle* in which the *maximum cycle time* has occurred.

maximum cycle frame

A value returned by the *performance monitor* indicating the number of the *major frame* in which the *maximum cycle time* has occurred.

maximum cycle time

A value returned by the *performance monitor* indicating the greatest amount of time that an *FBS*-scheduled process has spent running in a cycle.

maximum frame frame

A value returned by the *performance monitor* indicating the number of the *major frame* in which the *maximum frame time* has occurred.

maximum frame time

A value returned by the *performance monitor* indicating the greatest amount of time that an *FBS*-scheduled process has spent running during a *major frame*.

minimum cycle cycle

A value returned by the *performance monitor* indicating the number of the *minor cycle* in which the *minimum cycle time* has occurred.

minimum cycle frame

A value returned by the *performance monitor* indicating the number of the *major frame* in which the *minimum cycle time* has occurred.

minimum cycle time

A value returned by the *performance monitor* indicating the least amount of time that an *FBS*-scheduled process has spent running in a cycle.

minimum frame frame

A value returned by the *performance monitor* indicating the number of the *major frame* in which the *minimum frame time* has occurred.

minimum frame time

A value returned by the *performance monitor* indicating the least amount of time that an *FBS*-scheduled process has spent running during a *major frame*.

minor cycle

The smallest unit of frequency maintained by a *frequency-based scheduler*. A minor cycle has associated with it a duration, which is the time that elapses between interrupts generated by the timing source that is attached to the scheduler. If the timing source is a real-time clock, the minor cycle duration is defined by specifying the number of clock counts per minor cycle and the number of microseconds per clock count.

NightSim host

The system from which NightSim was invoked.

NightSim server

The NightSim server is a program that executes on a *target system* and performs system-level actions on behalf of NightSim. Whenever NightSim needs to perform an operation on a target system, such as creating an *FBS*, scheduling a program on an *FBS*, or starting or stopping an *FBS*, NightSim makes a request of the NightSim server on that target system. NightSim automatically takes care of starting up a NightSim server on a target system when needed.

number of overruns

A value returned by the *performance monitor* indicating the number of times that an *FBS*-scheduled process has caused a *frame overrun*.

performance monitor

A mechanism that makes it possible to monitor use of the CPU by processes that are scheduled on a *frequency-based scheduler*.

period

A *frequency-based scheduler* scheduling parameter that specifies the frequency with which a specified program is to be wakened in each *major frame*. A period of one indicates that the program is to be wakened every *minor cycle*; a period of two indicates that it is to be wakened once every two minor cycles; and so on.

privilege

A mechanism through which processes are allowed to perform sensitive operations or override system restrictions.

process dispatch latency

The time that elapses from the occurrence of an external event, which is signified by an interrupt, until the process that is waiting for that external event executes its first instruction in user mode.

RCIM

Real-Time Clocks and Interrupt Module - an optional hardware module which provides both real-time clocks and edge-triggered interrupt pins for the *host* to which it is attached, allowing those devices to be used as timing and interrupt sources for that host. RCIMs may be connected, and therefore synchronized, via RCIM cables. RCIM real-time clocks and edge-triggered interrupts may be used locally or registered as distributed timing devices for use as either closely-coupled timing devices or as RCIM-coupled timing devices (See the `fbs_register_rdev(3rt)` man page).

RCIM-coupled distribution

Distribution of scheduling interrupts to targets on an *RCIM* chain. A scheduler with RCIM-coupled distribution requires the use of an *RCIM-distributed device* as a timing source.

RCIM-distributed device

An *RCIM* timing device whose interrupts are configured to be distributed via an RCIM cable between RCIMs on multiple *target systems*. When registered using `fbs_register_rdev(3rt)`, such a device may be used as either an RCIM-coupled timing device or a closely-coupled timing device.

SBC

Single-board computer.

scheduler key

A user-supplied numeric identifier for a *frequency-based scheduler*.

server

See *NightSim server*.

soft overrun

Soft overruns are a type of *frame overrun* which give the scheduled process a chance to recover and return to synchronization. When scheduling a process, you can specify a consecutive soft overrun limit count that this process will tolerate and have processed as soft overruns by the kernel. Soft overruns are catastrophic failures only if the process reaches its limit on the number of soft overruns tolerated. This soft overrun limit defaults to 0 for each process.

spare time

Processor time that is composed of the following: (1) *idle time*, (2) CPU time of processes that are not scheduled on a *frequency-based scheduler*, and (3) CPU time of *FBS*-scheduled processes for which performance monitoring has not been enabled.

starting base cycle

A *frequency-based scheduler* scheduling parameter that specifies the first *minor cycle* in which an *FBS*-scheduled process is to be wakened in each *major frame*.

target system

Any system on which processes will be scheduled.

timing host

The system on which the timing device physically resides.

timing mode

The mode under which the *performance monitor* runs. It specifies whether time spent servicing interrupts is to be included in or excluded from performance monitor timing values.

total iterations

A value returned by the *performance monitor* indicating the number of times that an *FBS*-scheduled process has been wakened by the scheduler.

total time

A value returned by the *performance monitor* indicating the total amount of time that an *FBS*-scheduled process has spent running in all cycles.

unscheduled process

A process that is not wakened by the *frequency-based scheduler* and does not call **fbwait**; it is not scheduled to run at a certain frequency.

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Spine for 1/2" Binder

**Product Name: 0.5" from
top of spine, Helvetica,
36 pt, Bold**

**Volume Number (if any):
Helvetica, 24 pt, Bold**

**Volume Name (if any):
Helvetica, 18 pt, Bold**

**Manual Title(s):
Helvetica, 10 pt, Bold,
centered vertically
within space above bar,
double space between
each title**

**Bar: 1" x 1/8" beginning
1/4" in from either side**

**Part Number: Helvetica,
6 pt, centered, 1/8" up**

NightSim

**User's
Guide**

0890480

