



# NightSim RT User's Guide

(Version 3.5)

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## Scope of Manual

This guide is designed to assist you in getting started with the use of NightSim™. NightSim is a real-time NightStar RT™ 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, four 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 RedHawk Linux.
- 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 NightStar License Manager (NSLM) and how to obtain and install licenses. It also discusses approaches for dealing with a firewall either on the system acting as the license server or on a system hosting the NightStar RT tools.
- 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 C presents the configurable X resources, NightStar resources, and widget hierarchy for 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> .
<b>list bold</b>	User input appears in <b>list bold</b> type and must be entered exactly as shown. Names of directories, files, commands, options and system manual page references also appear in <b>list bold</b> 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:

0890514	<i>NightBench™ User's Guide</i>
0891082	<i>Real-Time Clock and Interrupt Module User's Guide</i>
0898004	<i>RedHawk Linux™ User's Guide</i>
0898395	<i>NightView™ RT User's Guide</i>
0898398	<i>NightTrace™ RT User's Guide</i>
0898458	<i>NightSim™ RT User's Guide</i>
0898515	<i>NightTune™ RT User's Guide</i>
0898537	<i>MAXAda for RedHawk Linux Reference Manual</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 supports the use of timing sources, including Distributed Interrupts devices on the RCIM (Real-Time Clock and Interface Module) board. 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 **TOOLS** menu of any NightStar RT tool, and NightSim provides access to every other NightStar RT tool in the same way. 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 breakpoints or monitorpoints early on in the execution of the program, before it attaches to the frequency based scheduler.

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

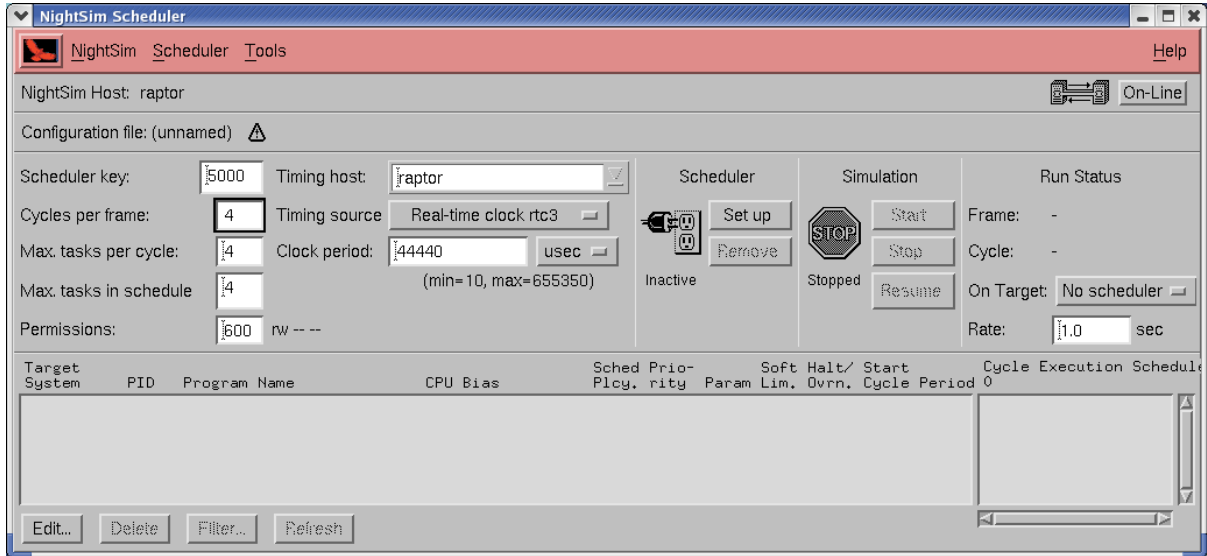
The performance monitor is a mechanism that allows you to monitor use of the CPU by processes that are scheduled on a frequency-based scheduler. The values obtained can help in determining whether processes need to be redistributed among processors for improved load balancing and processing efficiency. 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 time*. By examining the amount of idle 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.



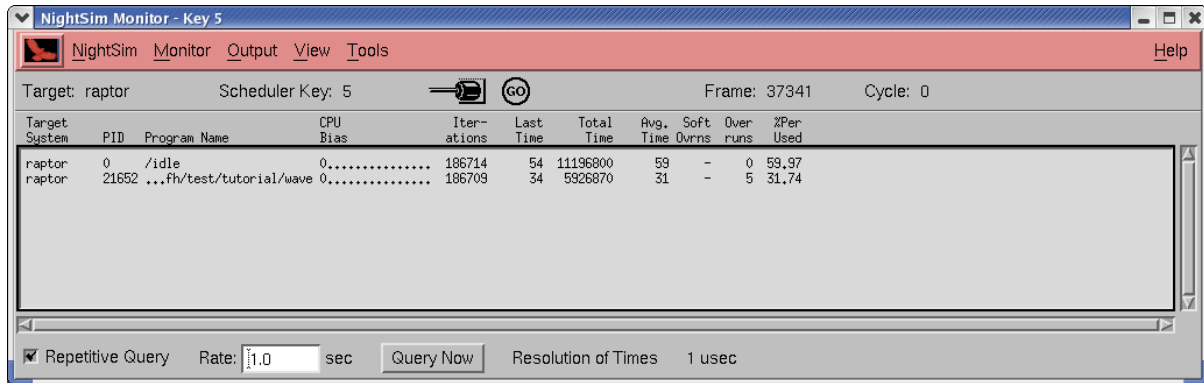
**Figure 1-1. Scheduler Window**

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 RCIM Support

NightSim supports the Real-Time Clock and Interrupt Module (RCIM). An RCIM is an 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.

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.

For more information see the *Real-Time Clock and Interrupt Module (RCIM) PCI Form Factor User's Guide (0898007)*.



# Establishing the NightSim Environment

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

## Configuration Requirements

NightSim requires the Frequency Based Scheduler to be installed on the target system. The FBS comes with the RedHawk distribution.

Typically, the default installation of the FBS is sufficient for NightSim activities. Refer to the *RedHawk Frequency-Based Scheduler (FBS) User's Guide (0898005)* for more information on FBS configuration.

NightSim schedulers that are driven by an interrupt source require an RCIM device; a real-time clock, an edge-triggered interrupt, or a distributed interrupt source.

If you do not have an RCIM device, you can still use NightSim's end-of-process scheduling capability to drive your simulation. See End of Processing Cycle scheduling on page 4-2 for more information.

## User Requirements

To use NightSim, you must also ensure that certain user requirements related to remote shell access, environment variables, and capabilities 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 4-6), 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.

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.

## 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 either root access or user registration in the `fbscheduser` capabilities role. Either execute the commands shown in the tutorial as the `root` user, or have your system administrator register you as an FBS user according to the following instructions:

1. Add the following line to the `/etc/pam.d/rsh` and `/etc/pam.d/login` files:

```
session required pam_capability.so
```

### NOTE

For those users that log into their system directly from the Gnome or KDE graphical desktop environment, it is necessary to add the above line to `/etc/pam.d/gdm` or `/etc/pam.d/kde`, respectively. In addition, you must restart your X server or reboot your system before these changes will take effect.

For those user that log into their system using **ssh**, it is necessary to add the above line to `/etc/pam.d/sshd`. Additionally, edit the `/etc/ssh/sshd_config` file and ensure the *UsePrivilegeSeparation* option is set to *no*. Restart the **sshd** service by executing the following command:

```
service sshd restart
```

2. Add the following line to the bottom of the `/etc/security/capability.conf` file:



```
user username fbscheduser
```

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

3. Log off and log back onto the system for these changes to take effect.
4. You may verify your capabilities by issuing the following command:

```
/usr/sbin/getpcaps $$
```

which lists the current capabilities.

This list should include the following capability:

```
cap_sys_nice
```

which is necessary for the proper execution of this tutorial.

For additional information on capabilities, refer to the **capability.conf(5)** and **pam\_capability(8)** system manual pages.



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` is as follows:

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

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.
- offline**        Create Scheduler windows initially in Off-Line mode. See “On-Line/Off-Line Operation” on page 4-6 for more information.
- s** *hostname*[, *key*]

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. The *hostname* must denote a host running the Concurrent Frequency Based Scheduler and a NightSim server installed. If the *hostname* parameter is not specified, the system defaults to the local host (where NightSim is running).

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*]

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. The *hostname* must denote a host running the Concurrent Frequency Based Scheduler and a NightSim server installed. If the *hostname* parameter is not specified, the system defaults to the local host (where NightSim is running).

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.

**[-f]** *file*

This option allows you to specify the name of a file that contains configuration and scheduling data for a selected *frequency-based scheduler*. 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 B-1.

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**.

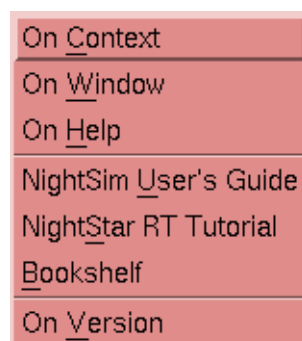
You may also invoke NightSim without specifying any options. Doing so allows you to display an *inactive Scheduler window*. An inactive Scheduler window is one that is not associated with a scheduler that exists on the system.

The steps for invoking NightSim are as follows:

5. Log in to your system.
6. 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).
7. 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 window (see “Introduction to the Scheduler Window” on page 4-9) and Monitor window (see “Introduction to the Monitor Window” on page 5-6). Figure 3-1 presents this menu:



**Figure 3-1. Help Menu**

The following describe the options on the **Help** menu:

### **On Context**

Mnemonic: C

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. HyperHelp™, NightProbe's online help system, will open with the appropriate topic displayed.

### **On Window**

Mnemonic: W

Displays help information for the current window.

### **On Help**

Mnemonic: H

Displays help information about how to use HyperHelp™, NightSim's online help system.

### **NightSim User's Guide**

Mnemonic: U

Opens the online version of the *NightSim RT User's Guide* in the HyperHelp viewer.

### **NightStar RT Tutorial**

Mnemonic: S

Opens a HyperHelp window containing a tutorial which demonstrates the features of NightSim, NightProbe, NightView, NightTrace, and NightTune in one cohesive example.

### **Bookshelf**

Mnemonic: B

Opens a HyperHelp window that lists all of the currently available HyperHelp publications.

### **On Version**

Mnemonic: V

Displays a short description of the current version of NightSim.

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.

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.

**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

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 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

#### 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 *RedHawk Linux 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 *RedHawk Frequency-Based Scheduler (FBS) User's Guide (0898005)*.

## 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 4-22) or the **Edit Process** dialog associated with it (see “On-Line/Off-Line” on page 4-31).

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** dialog 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** dialog. This toggles the value on the face of the button.
2. Press the **Set Up** button on the Scheduler window.

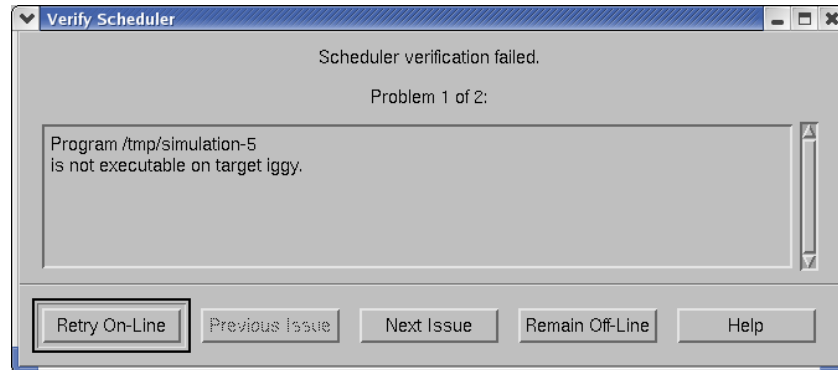
In each of these cases, when going from **Off-Line** to **On-Line**, the information entered in the Scheduler window and its associated **Edit Process** dialog is examined for correctness given the current state of the timing host and target systems. NightSim servers are started if necessary, and all 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 4-6). When going from **Off-Line** to **On-Line**, the information entered in the Scheduler window and its associated **Edit Process** dialog 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.

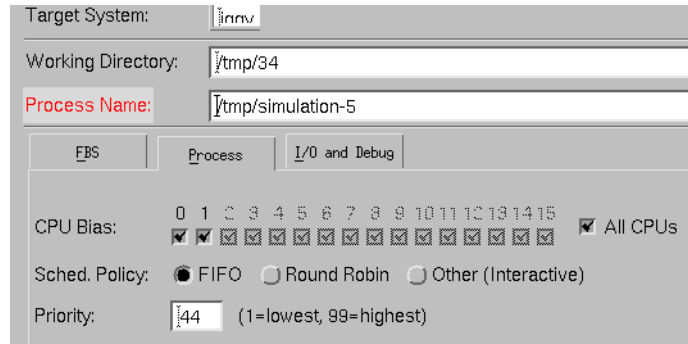
### **Remain Off-Line**

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.



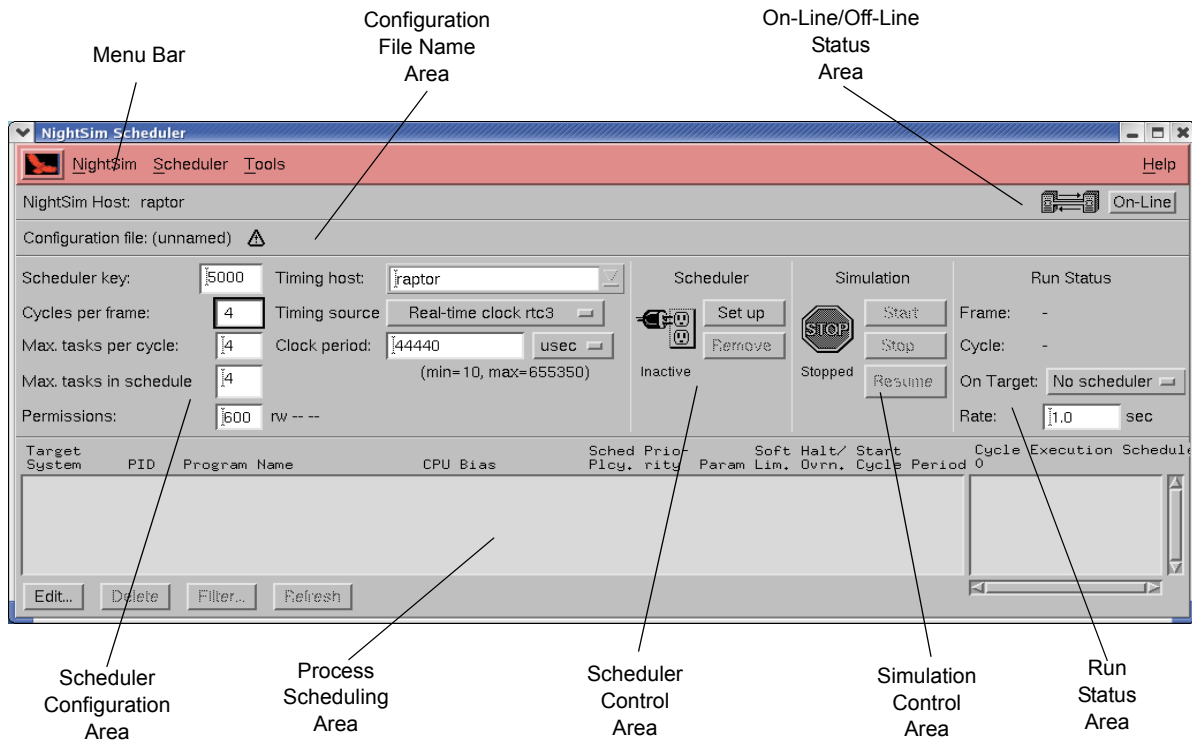
## Introduction to the Scheduler Window

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 (see “Using the Scheduler Window Menu Bar” on page 4-11)
- On-Line/Off-Line Status Area (see “Using the On-Line/Off-Line Status Area” on page 4-22)
- Configuration File Name Area (see “Using the Configuration File Name Area” on page 4-23)
- Scheduler Configuration Area (see “Using the Scheduler Configuration Area” on page 4-24)
- Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-28)
- Scheduler Control Area (see “Using the Scheduler Control Area” on page 4-43)
- Simulation Control Area (see “Using the Simulation Control Area” on page 4-47)
- Run Status Area (see “Using the Run Status Area” on page 4-49)

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 4-9).

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

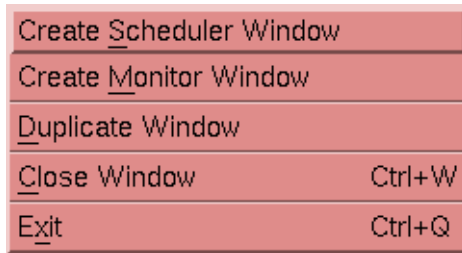
- **NightSim** (see “NightSim” on page 4-12)
- **Scheduler** (see “Scheduler” on page 4-14)
- **Tools** (see “Tools” on page 4-20)
- **Help** (see “Help” on page 4-21)

Each menu is described in the sections that follow.

## NightSim

The NightSim menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-11).

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 a warning dialog. 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 a file selection dialog. If you click on the **No** button, the changes will be discarded. If you click on the **Cancel** button, the action is aborted.

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 a warning dialog about saving changes. 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 a confirmation 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 a warning dialog. 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 a file selection dialog.

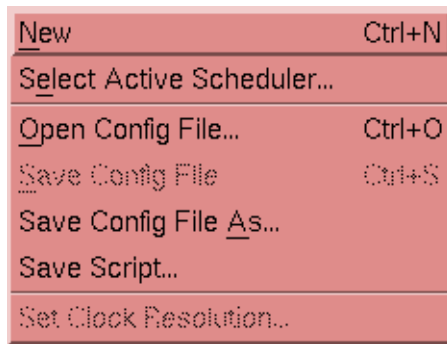
If you have open a Scheduler window that is associated with a configuration file name and contains unsaved changes, NightSim displays a warning dialog. If you click on the **Yes** button, the changes are saved in the file associated with the window.

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

## Scheduler

The **Scheduler** menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-11).

The **Scheduler** menu contains commands that affect the current Scheduler window. Figure 4-5 presents this menu.



**Figure 4-5. 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 a warning dialog. 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 a file selection dialog.

If the window is associated with a configuration file name and contains unsaved changes, NightSim displays a warning dialog. 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 4-6.

If the window from which you select this option is untitled and contains unsaved changes, NightSim displays a warning dialog. 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 a file selection dialog.

If the window is associated with a configuration file name and contains unsaved changes, NightSim displays a warning dialog. 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 4-6 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 4-6).



**Figure 4-6. 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 4-6 lists the two schedulers currently running on the host `amber2`.

You may change the **Target** either by using the drop-down list 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.

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 a warning dialog. 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 a file selection dialog.

If the window is associated with a configuration file name and contains unsaved changes, NightSim displays a warning dialog. 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 a file selection dialog. 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 C-1). When this transition occurs, the new scheduler will be verified. See "On-Line/Off-Line Operation" on page 4-6 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 B-1 for a description of the format of this file as well as “Configuration File Example” on page B-2 for the actual configuration file associated with Figure 4-3, “Sample Scheduler Window,” on page 4-10.

**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 a file selection dialog. 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 B-1 for a description of the format of this file as well as “Configuration File Example” on page B-2 for the actual configuration file associated with Figure 4-3, “Sample Scheduler Window,” on page 4-10.

**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 2-1). 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)**. For this 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.

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 B-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 4-7 presents.



**Figure 4-7. 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 4-27.

#### **Detailed Scheduler Info...**

*(Expert mode only)*

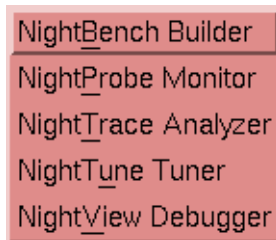
The dialog associated with this option provides more information about the current *FBS* which may be of interest to some users.

This option appears on the **Scheduler** menu (see “Scheduler” on page 4-14) only when the user is running in *expert mode*. See the `expert` resource under “X Resources” on page C-1 for more details.

## Tools

The **Tools** menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-11) as well as on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7).

The **Tools** menu contains a list of other NightStar tools that can be launched directly from NightSim.



**Figure 4-8. Tools Menu**

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

### **NightBench Builder**

Opens the NightBench Program Development Environment.

NightBench is a set of graphical user interface (GUI) tools for developing software with the Concurrent MAXAda™ compiler.

See the *NightBench User's Guide* (0890480) for more information.

### **NightProbe Monitor**

Opens the NightProbe Data Monitoring application.

NightProbe is a real-time graphical tool for monitoring, recording, and altering program data within one or more executing programs without significant intrusion. NightProbe can be used in a development environment as a tool for debugging, or in a production environment to create a “control panel” for program input and output.

See the *NightProbe RT User's Guide* (0898480) for more information.

### **NightTrace Analyzer**

Opens the NightTrace Analyzer.

The NightTrace Analyzer is a graphical tool for analyzing the dynamic behavior of multiprocess and/or multiprocessor user applications and operating system activity. NightTrace allows you to control user and kernel trace collection daemons and can

graphically display the interplay between many real-time programs and processes across multiple processors and systems.

See the *NightTrace RT User's Guide* (0898398) for more information.

### **NightTune Tuner**

Opens the NightTune Performance Tuner.

NightTune is a graphical tool for analyzing the status of the system in terms of processes, interrupts, context switches, interrupt CPU affinity, processor shielding and hyperthreading control as well as network and disk activity. NightTune can adjust the scheduling attributes of individual or groups of processes, including priority, policy, and CPU affinity.

See the *NightTune RT User's Guide* (0898515) for more information.

### **NightView Debugger**

Opens the NightView Source-Level Debugger.

NightView is a graphical source-level debugging and monitoring tool specifically designed for real-time applications. NightView can monitor, debug, and patch multiple real-time processes running on multiple processors with minimal intrusion.

See the *NightView RT User's Guide* (0898395) for more information.

## **Help**

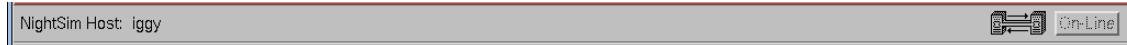
The **Help** menu appears on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-11) as well as on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7).

The **Help** menu provides access to the on-line help system. See “Getting Help” on page 3-3 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 4-9).

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 4-6).



**Figure 4-9. 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 4-6). 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** dialog (see “Edit Process” on page 4-30).

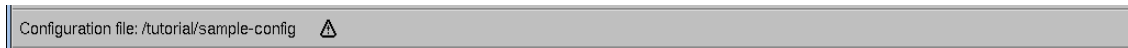
By placing a NightSim Scheduler into an **Off-Line** state, immediate checking of the information entered in either the NightSim Scheduler window or its associated **Edit Process** dialog can be avoided. When in **Off-Line** mode, the NightSim Scheduler will not communicate with any servers on any timing 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 4-9).

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



**Figure 4-10. Scheduler Window - Configuration File Name Area**

If the window contains unsaved changes, the name is followed by a warning icon as illustrated by Figure 4-10. When the Scheduler window is not associated with a configuration 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 4-9).

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:	1000	Timing host:	iggy
Cycles per frame:	5	Timing source:	Real-time clock rtc0
Max. tasks per cycle:	5	Clock period:	10000 usec
Max. tasks in schedule:	5		(min=10, max=655350)
Permissions:	600		rw -- --

**Figure 4-11. 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. 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. Once selected, the **Timing source** menu is repopulated with the set of devices available on that host.

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.

## 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 4-12 presents an example of the option menu.

End of processing cycle
Real-time clock rtc0
Real-time clock rtc1
Real-time clock rtc2
Real-time clock rtc3
Edge-triggered Int. eti0
Edge-triggered Int. eti1
Edge-triggered Int. eti2
Edge-triggered Int. eti3
Distributed Interrupt di0
Distributed Interrupt di1
Distributed Interrupt di2
Distributed Interrupt di3
Distributed Interrupt di4
Distributed Interrupt di5
Distributed Interrupt di6
Distributed Interrupt di7
Other...

**Figure 4-12. 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.

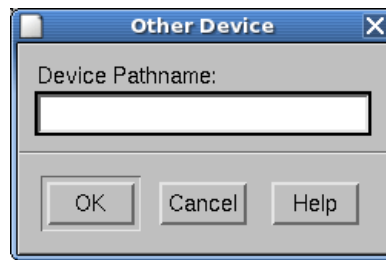
If you select the **End of processing cycle** option from the **Timing source** option menu, scheduling is triggered when the last process that is scheduled during the current *minor cycle* of the current *major frame* completes its processing.

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 4-13. 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 Path-name** must be the name of a device file on the currently selected timing host and that is supported by the RedHawk kernel as a FBS timing device. Currently, the only devices supported are those associated with an RCIM.

#### 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.

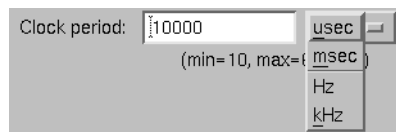


**Figure 4-13. Other Device Prompt Dialog**

### 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 4-14 presents the options from which you may choose.



**Figure 4-14. Clock Period Options**

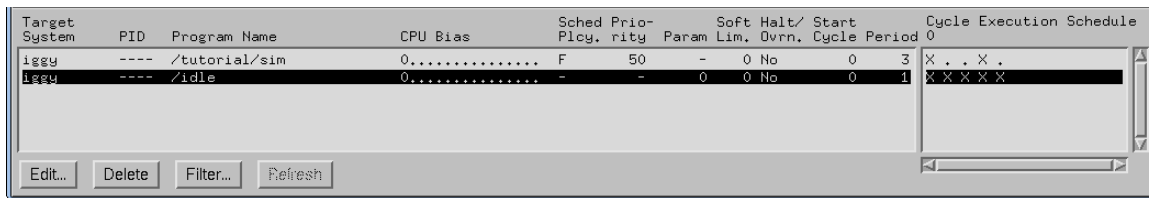
The valid range of the clock period is determined by multiplying the minimum and maximum clock counts, 1 and 65535, by the clock resolution, which defaults to 10 microseconds. By changing the clock resolution, you can increase or decrease the valid range of the clock period. See “Set Clock Resolution...” 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 4-9).

The Process Scheduling Area allows you to:

- add programs to a *frequency-based scheduler*
- remove *FBS*-scheduled processes from a scheduler
- reschedule *FBS*-scheduled processes
- view scheduling data for current *FBS*-scheduled processes
- select the processes for which scheduling data are to be displayed.



**Figure 4-15. 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 contains a row of process controls below the list of *FBS*-scheduled processes. These controls are explained below:

### 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 (see “Edit Process” on page 4-30). Note that if you select 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.

### **Delete**

This button allows you to delete *FBS*-scheduled processes from a scheduler. All processes that are selected in the list will be deleted. When you click on this button, NightSim displays the **Delete Processes** dialog (see “Delete Processes” on page 4-41).

### **Filter...**

This button allows you to specify the *FBS*-scheduled processes that you wish to be displayed in the Process Scheduling Area of the Scheduler window (see “Using the Process Scheduling Area” on page 4-28). When you click on this button, NightSim displays the **Filter Process List** dialog (see “Filter Process List” on page 4-42).

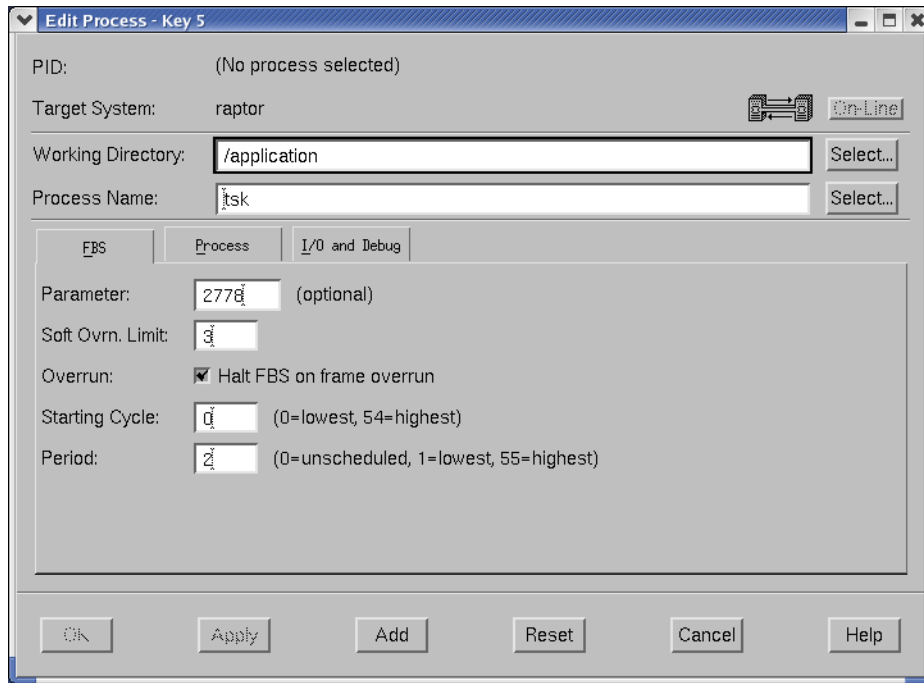
### **Refresh**

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.

## Edit Process

The **Edit Process** dialog allows you to add a program to a *frequency-based scheduler* or reschedule an *FBS*-scheduled process. Note that if you had selected a process from the list of scheduled processes in the Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-28) and then clicked on the **Edit** button, this dialog will contain 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.

The **Edit Process** dialog is shown in Figure 4-16:



**Figure 4-16. Edit Process Dialog**

The following fields appear at the top of the **Edit Process** dialog:

### PID

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 indicates the *target system* on which this process is to be scheduled.

## 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 4-6). 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** dialog associated with it (see “Using the On-Line/Off-Line Status Area” on page 4-22).

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** dialog 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**.

## 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 4-6), 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).

### Select...

You may use the **Select** button to bring up the **Select a Directory** dialog to specify the working directory for the program you want to configure under the *FBS*.

## Process 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 4-40). 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 **Select a Program** 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 4-6).

The bottom portion of the **Edit Process** dialog is divided into a number of pages that contain various parameters related to the given process. These pages are:

- **FBS** (see "FBS" on page 4-33)
- **Process** (see "Process" on page 4-36)
- **I/O and Debug** (see "I/O and Debug" on page 4-38)

#### **NOTE**

If the **Process Name** is `/idle`, then all of the fields which are inappropriate for the `/idle` pseudo-processes are desensitized. Only the **CPU Bias** field is valid for `/idle`.

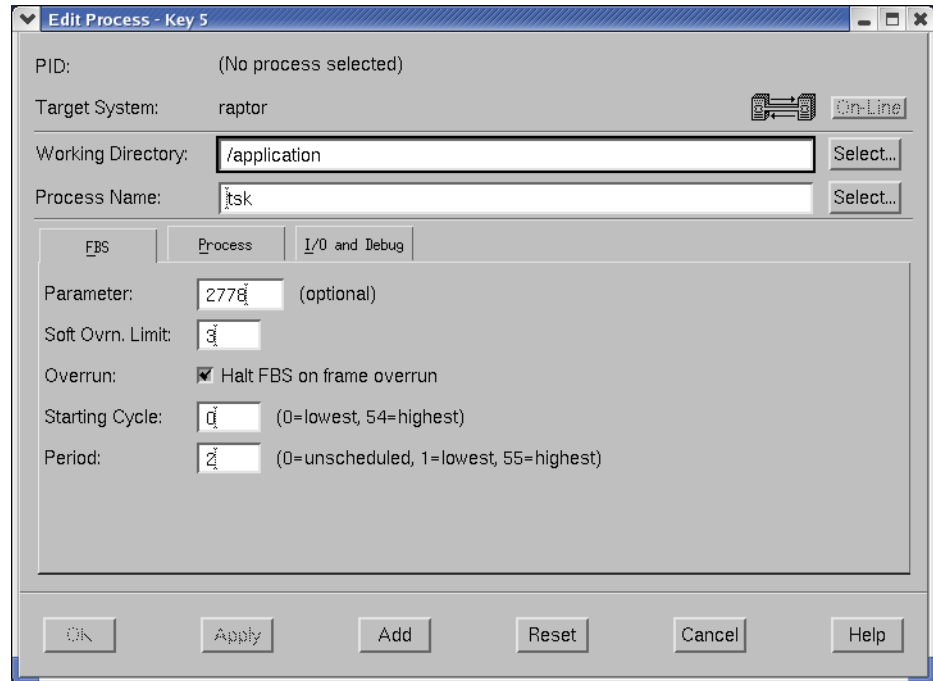
After you have entered the scheduling parameters for a specified program, you may apply the changes and close the **Edit Process** dialog, apply the changes without closing the dialog, add another program to the scheduler, reset the contents of the dialog to its initial state, cancel the changes and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



## FBS

The FBS tab of the Edit Process dialog (see “Edit Process” on page 4-30) allows the user to specify parameters such as the starting cycle, period, and overrun limits for the given process.

The FBS page of the Edit Process dialog is shown in Figure 4-17:



**Figure 4-17. Edit Process Dialog - FBS**

### 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(3)` 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 4-24 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 4-24 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”).

**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.

## Process

The Process tab of the Edit Process dialog (see “Edit Process” on page 4-30) allows the user to specify the CPU bias, scheduling policy, and priority of the given process.

The Process page of the Edit Process dialog is shown in Figure 4-18:

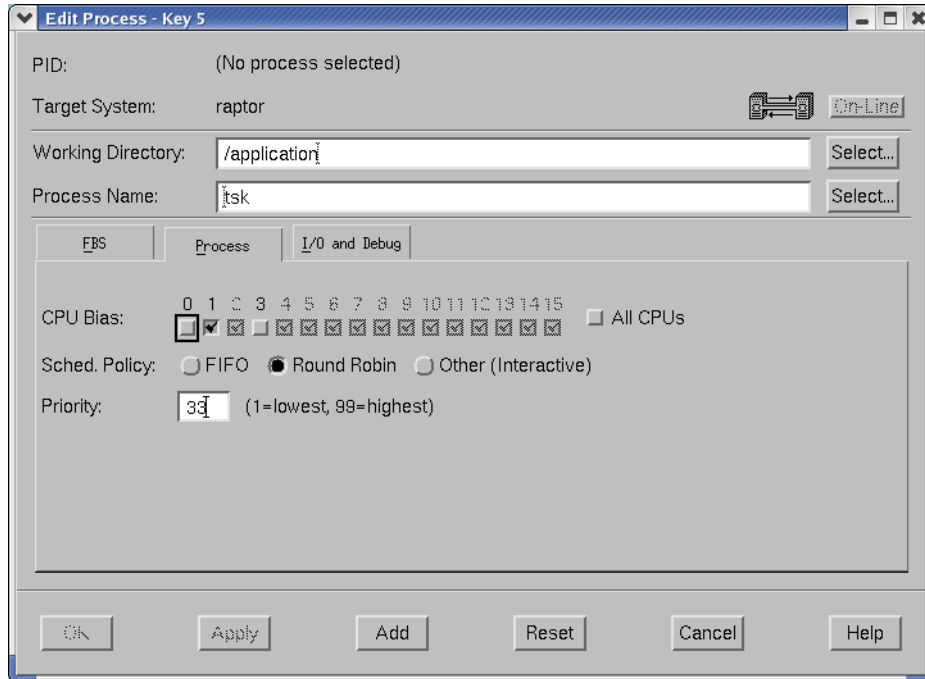


Figure 4-18. Edit Process Dialog - Process

### 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` while the scheduler is active because it is not a real process. 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 5-3 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** (interactive) 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 *RedHawk Linux 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 *RedHawk Linux 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.

## I/O and Debug

The I/O and Debug tab of the Edit Process dialog (see “Edit Process” on page 4-30) allows the user to specify where to read input from, where to send output, and if the process is to be scheduled within a NightView dialogue or within an **xterm(1)** window.

The I/O and Debug page of the Edit Process dialog is shown in Figure 4-19:

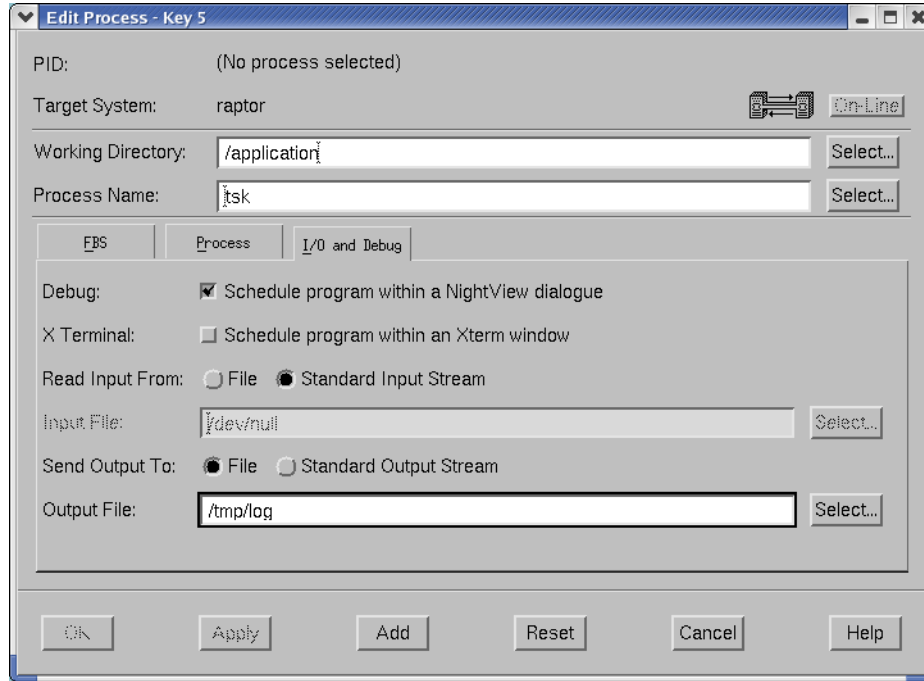


Figure 4-19. Edit Process Dialog - I/O and Debug

### 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 **resume** command to NightView is required to resume the execution of the scheduled process.

#### NOTE

Scheduling processes under the FBS requires certain capabilities (see “Capabilities” on page 2-2). It is the responsibility of the user to ensure that appropriate capabilities are granted to the NightView session.

## 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 4-40.

If the NightSim Scheduler is **On-Line** (see “On-Line/Off-Line Operation” on page 4-6), 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).

## Select...

You may use the **Select** button to bring up the **Select a File** dialog to specify the name of the input file which the scheduled process will use.

## 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 “Pathname Expansion” on page 4-40.

### Select...

You may use the **Select** button to bring up the **Select a File** dialog to specify the name of the output file that will be generated.

## Pathname Expansion

When entering the **Process Name**, **Input File**, or **Output File** in the **Edit Process** dialog (see “Edit Process” on page 4-30), 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.



## Delete Processes

The Delete Processes dialog is presented when deleting *FBS*-scheduled processes after pressing the **Delete** button in the Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-28).

If the scheduler is active when you click on this button, NightSim displays a dialog to confirm killing the selected processes. 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 a dialog to confirm deleting the processes. You may press **OK** to delete the processes from the scheduler or **Cancel** to cancel the operation.

## Filter Process List

The Filter Process List dialog 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 4-28) of the Scheduler window. When you click on this button, NightSim displays the dialog that Figure 4-20 presents.

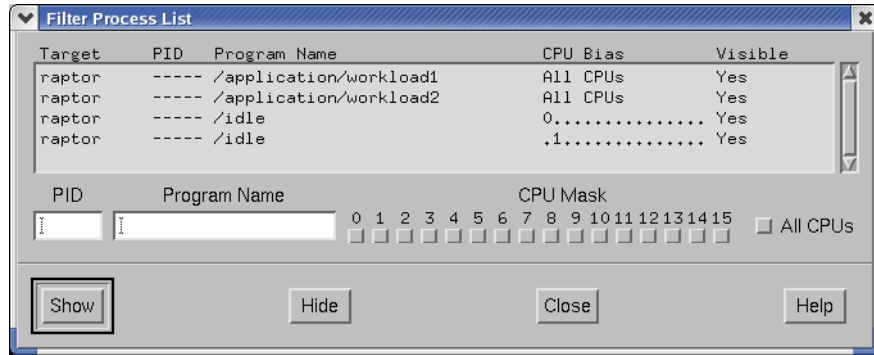


Figure 4-20. Filter Process List Dialog

### 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 4-28 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 4-28) of the Scheduler window those processes either selected in the Filter Process List or specified using FPID, Program Name, or CPU Mask .

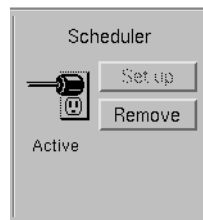
### Hide

Removes from the Process Scheduling Area (see “Using the Process Scheduling Area” on page 4-28) of the Scheduler window those processes either selected in the Filter Process List or specified using FPID, Program Name, or CPU Mask.

## Using the Scheduler Control Area

The Scheduler Control Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-9).

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 4-21. Scheduler Window - Scheduler Control Area**

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

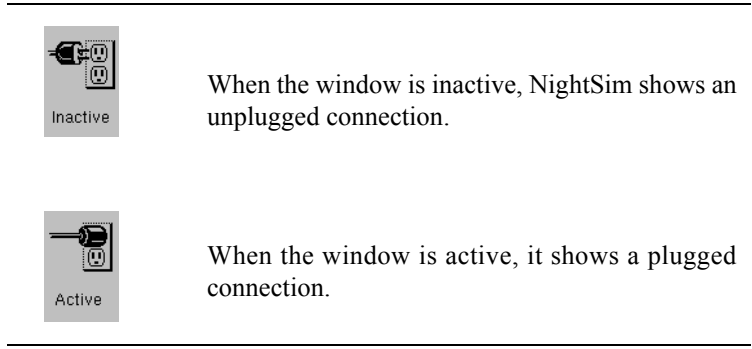
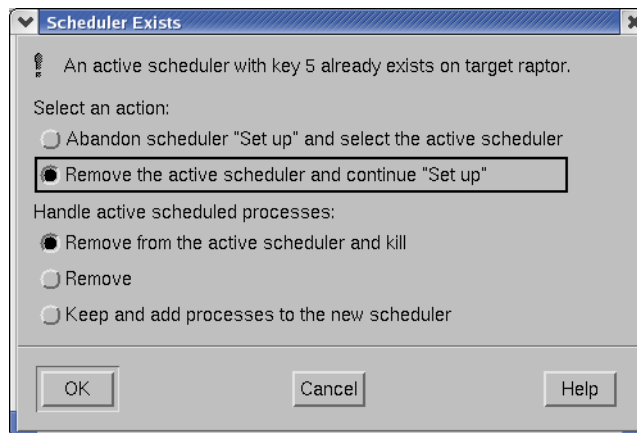


Figure 4-3 illustrates a Scheduler window that is in the active state.

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 4-6). The state of the 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.
- 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 the target system to which you assigned processes, NightSim displays the dialog that Figure 4-22 presents.



**Figure 4-22. 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.

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 4-24 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 4-28 for details). Programs will run up to the first **fbwait** system call.
- 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 4-47.

- 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 a dialog verifying that NightSim should kill the processes running on the scheduler. 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.

- 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 4-47

- 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 4-9).

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 4-23. 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 “Clock period” on page 4-27).
- 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. 4-25 and 4-27, 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.

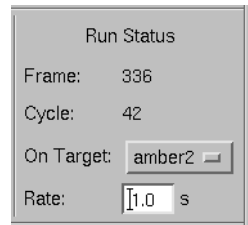
The **Resume** button is enabled when the simulation has been running but is currently stopped. When you click on the **Resume** button, NightSim restarts the simulation with the values of the *minor cycle*, *major frame*, and *overrun* counts the same as they were when you stopped the simulation.



## Using the Run Status Area

The Run Status Area is a part of the Scheduler window (see “Introduction to the Scheduler Window” on page 4-9).

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 4-24. 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 4-24 illustrate the Run Status Area for a Scheduler window that is in the *active state*.



## Using the Monitor Window

This chapter describes the *performance monitor* and explains how to monitor *FBS*-scheduled processes, a processor's *idle 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 <b>fbwait</b>
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 consecutive "soft" frame overruns, as well as the number of "hard" frame overruns that the process has caused.
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 Time

The *performance monitor* provides you with the capability of monitoring a processor's idle time. Idle time refers to the time that the CPU is not busy. By monitoring a processor's idle time, you can determine the amount of CPU time that is available to be allocated to additional processes.

Procedures for monitoring idle time is described in "How Is Idle 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. You can also monitor idle time for a number of different processors by adding `/idle` to a selected *fre-*

*quency-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**.

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 4-28 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 4-28 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 **fbwait**; 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 4-34).

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 4-28 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 4-28 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:

- Total time

You can obtain this value if you enable performance monitoring for the processes. Procedures for enabling performance monitoring and retrieving *performance monitor* values are described in detail in “Monitor” on page 5-8.

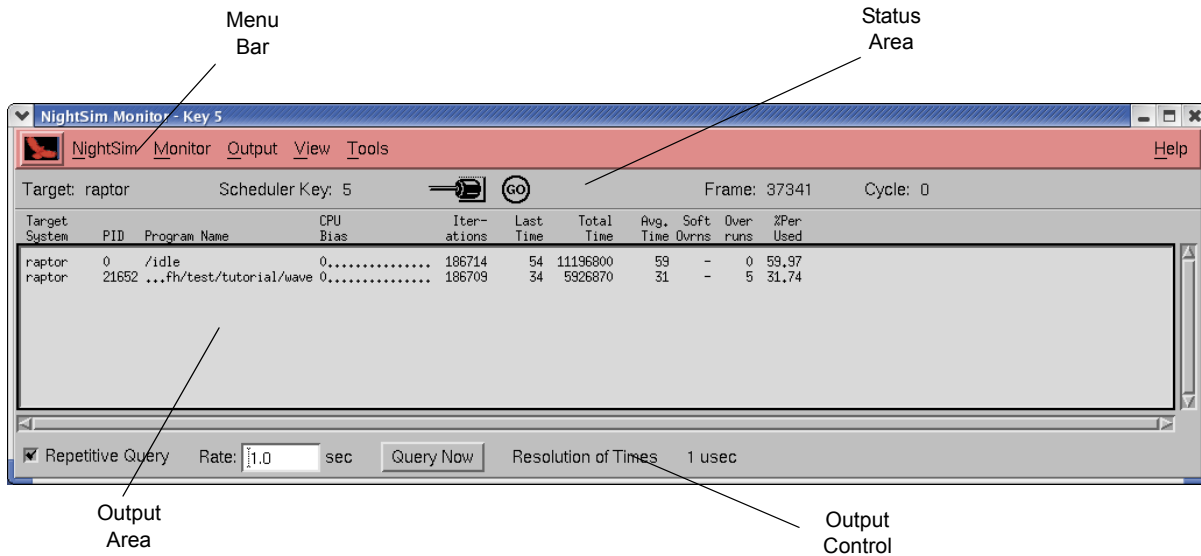
## Introduction to the Monitor Window

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 (see “Using the Monitor Window Menu Bar” on page 5-7)
- Status Area (see “Using the Status Area” on page 5-22)
- Output Area (see “Using the Output Area” on page 5-23)
- Output Control Area (see “Using the Output Control Area” on page 5-24)

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 5-6).

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

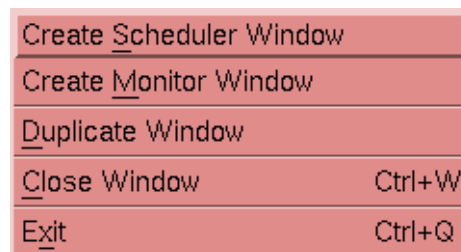
- NightSim (see “NightSim” on page 5-7)
- Monitor (see “Monitor” on page 5-8)
- Output (see “Output” on page 5-13)
- View (see “View” on page 5-15)
- Tools (see “Tools” on page 5-21)
- Help (see “Help” on page 5-21)

Each menu is described in the sections that follow.

### NightSim

The NightSim menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7).

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, NightSim requires that you close this file before proceeding.

### Exit

This option allows you to exit NightSim. If you have open Scheduler windows that are untitled and contain unsaved changes, NightSim displays a warning dialog. 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 a file selection dialog.

If you have open a Scheduler window that is associated with a configuration file name and contains unsaved changes, NightSim displays a warning dialog. 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.

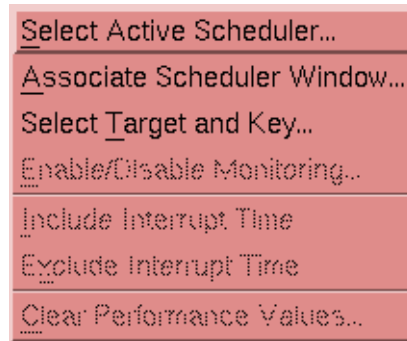
If *performance monitor* values are being logged to one or more files, NightSim displays a warning dialog. You may confirm that you wish to stop logging and close the file, continue to keep the window open, or display help related to the dialog.

If a scheduler is currently active, NightSim display a confirmation dialog that allows you to exit and leave the scheduler active, or to cancel the exit action.

## Monitor

The **Monitor** menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7).

The **Monitor** menu contains general commands related to performance monitoring. Figure 5-3 presents this menu.



**Figure 5-3. 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 4-6, “Select Active Scheduler Dialog,” (see p. 4-15 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 4-6 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.

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. 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 a warning dialog.

### 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 5-4. 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.

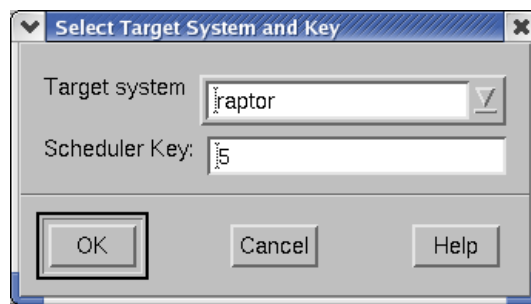
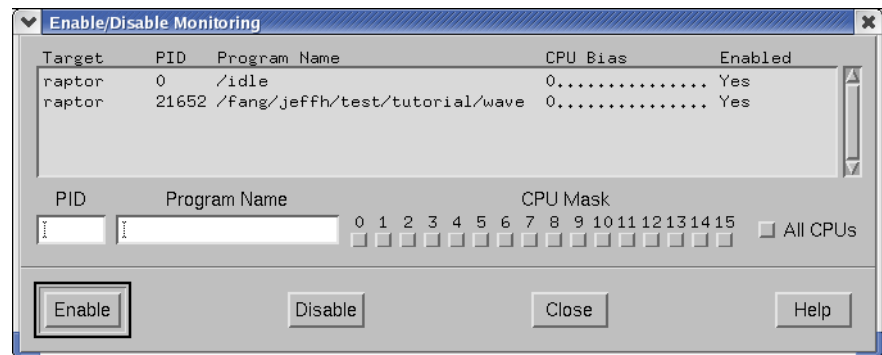


Figure 5-5. Select Target System and Key Dialog

## 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 5-6 presents.



**Figure 5-6. 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 5-10 on page 5-15). The Output Area in the Monitor window will then report this status for each process (see “Using the Output Area” on page 5-23 for related information).

### **Exclude Interrupt Time**

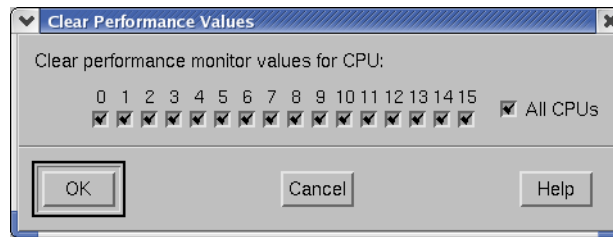
This item allows you to set the *timing mode* under which the performance monitor is to run, indicating that time spent processing interrupts is to be **excluded** from *performance monitor* timing values. This is a system-wide setting that affects all processes on the *target systems* that have processes 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 5-10 on page 5-15). The Output Area in the Monitor window will then report this status for each process (see “Using the Output Area” on page 5-23 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 5-7 presents.



**Figure 5-7. Clear Performance Monitor Values Dialog**

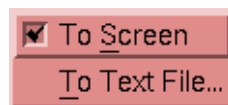
By default, All CPUs is selected, so that you may conveniently clear all performance monitor values for all CPUs by simply pressing **Enter** or clicking **OK**.

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.

## Output

The **Output** menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7).

The **Output** menu controls where performance data is to be sent. Figure 5-8 presents this menu.



**Figure 5-8. 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.

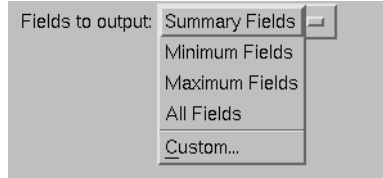
### To Screen

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 5-23 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 a file selection dialog to specify the

name of the text file. 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 5-9 presents.



**Figure 5-9. 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**

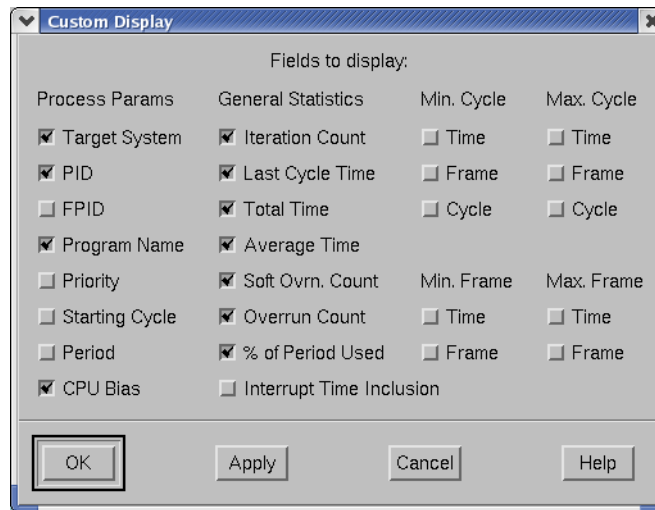
This option specifies all types of values: *target system*, process scheduling parameters, general statistics, minimum values, and maximum values. Refer to “What Values Are Monitored?” on page 5-1 for a complete description of all types of *performance monitor* values.

### **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 5-10 presents.



**Figure 5-10. 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.

## View

The View menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7).

The View menu controls output to the Monitor window. Figure 5-11 presents this menu.



**Figure 5-11. View Menu**

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

**Select Processes. . .**

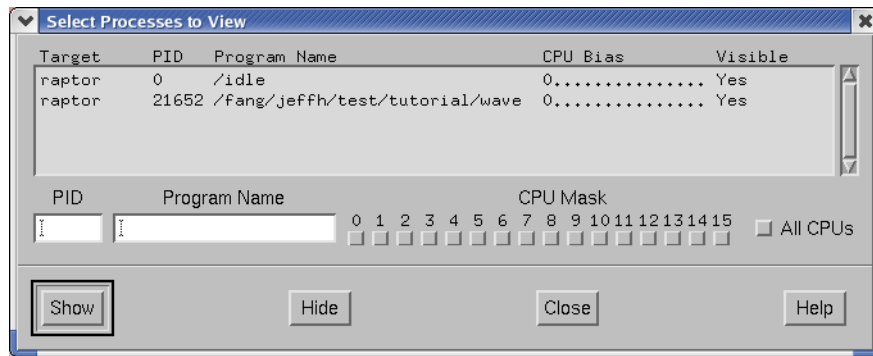
This option allows you to specify the *FBS*-scheduled processes whose *performance monitor* values will be reported.

Depending on the selection under the **Output** menu (see “Output” on page 5-13), 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 5-23 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 5-12:



**Figure 5-12. 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

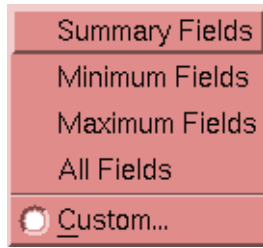
Reports the performance monitor values for those processes either selected in the **Select Processes List** or specified using **FPID**, **Program Name**, or **CPU Mask**.

#### 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 5-23 for related information). When you select this option, NightSim displays the tear-off menu that Figure 5-13 presents.



**Figure 5-13. 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 5-10 presents.

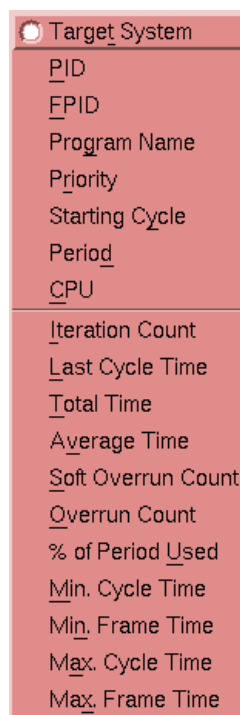
You use the panels of check buttons to select the types of *performance monitor* values that you wish to display. Click on one or more buttons as desired.

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 “Output” on page 5-13 for information on specifying where these values are reported.)

When you select this option, NightSim displays the tear-off menu that Figure 5-14 presents.



**Figure 5-14. Sort By Tear-Off Menu**

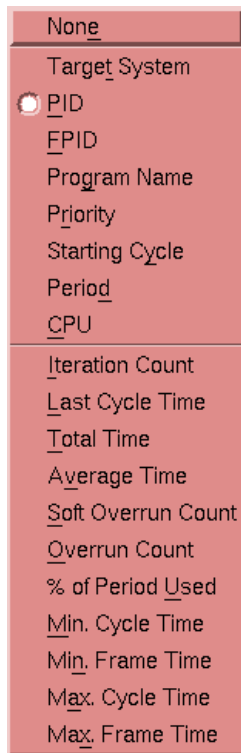
You specify the type of value to be used as the primary sort key by clicking on the desired radio button. It is important to note that the first seven options are separated from the others. The reason is that with the first seven options, the sort order must be calculated only once. With the other options, 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 “Output” on page 5-13 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 5-15 presents.



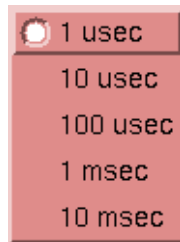
**Figure 5-15. Then Sort By Tear-Off Menu**

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 5-16 presents.



**Figure 5-16. 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.

## Tools

The **TOOLS** menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7) as well as on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-11).

The **TOOLS** menu contains a list of other NightStar tools that can be launched directly from NightSim.

See “Tools” on page 4-20 for detailed information about this menu and each of its items.

## Help

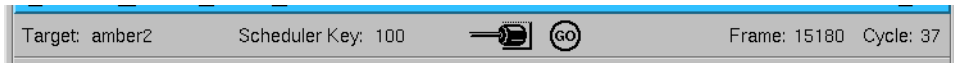
The **Help** menu appears on the Monitor window menu bar (see “Using the Monitor Window Menu Bar” on page 5-7) as well as on the Scheduler window menu bar (see “Using the Scheduler Window Menu Bar” on page 4-11).

The **Help** menu provides access to the on-line help system. See “Getting Help” on page 3-3 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 5-6).

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



**Figure 5-17. 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.

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.



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



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



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



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

Figure 5-17 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 5-6).

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 5-18. 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 “Monitor” on page 5-8. For information on the commands that allow you to control the information that is displayed in the Output Area, refer to “View” on page 5-15.

## Using the Output Control Area

The Output Control Area is a part of the Monitor window (see “Introduction to the Monitor Window” on page 5-6).

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 5-23) and the values saved in a file. See “Output” on page 5-13 for related information.



**Figure 5-19. 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 “View” on page 5-15 for more information.



# NightStar Licensing

---

NightStar RT uses the NightStar License Manager (NSLM) to control access to the NightStar RT tools.

License installation requires a licence key provided by Concurrent. The NightStar RT tools request a licence (see “License Requests” on page A-2) from a license server (see “License Server” on page A-2).

Two license modes are available, fixed and floating, depending on which product option you purchased. Fixed licenses can only be served to NightStar RT users from the local system. Floating licenses may be served to any NightStar RT user on any system on a network.

Tools are licensed per system, per concurrent user. A single license is shared among any or all of the NightStar RT tools for a particular user on a particular system. The intent is to allow  $n$  developers to fully utilize all the tools at the same time while only requiring  $n$  licenses. When operating the tools in remote mode, where a tool is launched on a local system but is interacting with a remote system, licenses are required only from the host system.

You can obtain a license report which lists all licenses installed on the local system, current usage, and expiration date for demo licenses (see “License Reports” on page A-3).

The default Red Hat Enterprise Linux configuration includes a strict firewall which interferes with floating licenses. See “Firewall Configuration for Floating Licenses” on page A-3 for information on handling such configurations.

## License Keys

Licenses are granted to specific systems to be served to either local or remote clients, depending on the license model, fixed or floating.

License installation requires a license key provided by Concurrent. To obtain a license key, you must provide your system identification code. The system identification code is generated by the `nslm_admin` utility:

```
nslm_admin --code
```

System identification codes are dependent on system configurations. Reinstalling Linux on a system or replacing network devices may require you to obtain new license keys.

To obtain a license key, use the following URL:

```
http://www.ccur.com/NightStarRTKeys
```

Provide the requested information, including the system identification code. Your license key will be immediately emailed to you.

Install the license key using the following command:

```
nslm_admin --install=xxxx-xxxx-xxxx-xxxx-xxxx
```

where `xxxx-xxxx-xxxx-xxxx-xxxx` is the key included in the license acknowledgment email.

## License Requests

By default, the NightStar RT tools request a license from the local system. If no licenses are available, they broadcast a license request on the local subnet associated with the system's hostname.

You can control the license requests for an entire system using the `/etc/nslm.config` configuration file.

By default, the `/etc/nslm.config` file contains a line similar to the following:

```
:server @default
```

The argument `@default` may be changed to a colon-separated list of system names, system IP addresses, or broadcast IP addresses. Licenses will be requested from each of the entities found in the list, until a license is granted or all entries in the list are exhausted.

For example, the following setting prevents broadcast requests for licenses, by only specifying the local system:

```
:server localhost
```

The following setting requests a license from `server1`, then `server2`, and then a broadcast request if those fail to serve a license:

```
:server server1:server2:192.168.1.0
```

Similarly, you can control the license requests for individual invocations of the tools using the `NSLM_SERVER` environment variable. If set, it must contain a colon-separated list of system names, system IP addresses, or broadcast IP addresses as described above. Use of the `NSLM_SERVER` environment variable takes precedence over settings defined in `/etc/nslm.config`.

## License Server

The NSLM license server is automatically installed and configured to run when you install NightStar RT.

The `nslm` service is automatically activated for run levels 2, 3, 4, and 5. You can check on these settings by issuing the following command:

```
/sbin/chkconfig --list nslm
```

In rare instances, you may need to restart the license server via the following command:

```
/sbin/service nslm restart
```

See **nslm(1)** for more information.

## License Reports

A license report can be obtained using the **nslm\_admin** utility.

```
nslm_admin --list
```

lists all licenses installed on the local system, current usage, and expiration date (for demo licenses). Use of the **--verbose** option also lists individual clients to which licenses are currently granted.

Adding the **--broadcast** option will list this information for all servers that respond to a broadcast request on the local subnet associated with the system's hostname.

See **nslm\_admin(1)** for more options and information.

## Firewall Configuration for Floating Licenses

The default Red Hat Enterprise Linux configuration includes a strict firewall which interferes with floating licenses.

If such a system is used to serve licenses, then at least one port must be opened in its firewall to allow server requests to pass. See “Serving Licenses with a Firewall” on page A-3 for more information.

Similarly, if such a system is host to the NightStar RT tools, then at least one port must be opened in its firewall so that it can receive licenses from the license server. If this is not done, a tool requesting a floating license will not receive it and will not function properly. See “Running NightStar RT Tools with a Firewall” on page A-5 for more information.

## Serving Licenses with a Firewall

Following are a few approaches for allowing the NSLM license server to serve floating licenses when the system on which it is running is configured with a firewall:

- disable the firewall on the system entirely
- allow NSLM license requests from a specific system (or one of several)

- allow NSLM license requests from any system on a particular subnet (or one of several)
- allow NSLM license requests from any system

### NOTE

You must be root in order to modify the firewall configuration.

To disable the firewall entirely, execute:

```
service iptables stop
```

and then remove the `/etc/sysconfig/iptables` file:

```
rm -f /etc/sysconfig/iptables
```

This option may not be as dangerous as it seems. Often, whole networks are protected with a firewall so it is not necessary for individual systems on the network to be protected further. If unsure, check with your network administrator.

For the remaining cases, a simple modification should be made to the `/etc/sysconfig/iptables` file. By default, that file should contain a line like the following:

```
-A RH-Firewall-1-INPUT -j REJECT --reject-with icmp-host-prohibited
```

To allow NSLM license requests from a specific system, insert the following lines before the REJECT line:

```
-A RH-Firewall-1-INPUT -p udp -m udp -s system --dport 25517 -j ACCEPT  
-A RH-Firewall-1-INPUT -p tcp -m tcp -s system --dport 25517 -j ACCEPT
```

Those lines can be repeated for multiple systems.

To allow NSLM license requests from any system on a particular subnet, insert the following lines before the REJECT line:

```
-A RH-Firewall-1-INPUT -p udp -m udp -s subnet/mask --dport 25517 -j ACCEPT  
-A RH-Firewall-1-INPUT -p tcp -m tcp -s subnet/mask --dport 25517 -j ACCEPT
```

The subnet might be of a form like `192.168.1.0` and the mask could be a traditional network mask like `255.255.255.0` or a single number like `24`, which indicates the number of bits from the left that are part of the mask. For example, `192.168.1.0/255.255.255.0` and `192.168.1.0/24` are equivalent.

Those lines can be repeated for multiple subnets.



To allow NSLM license requests from any system, insert the following lines before the REJECT line:

```
-A RH-Firewall-1-INPUT -p udp -m udp --dport 25517 -j ACCEPT
-A RH-Firewall-1-INPUT -p tcp -m tcp --dport 25517 -j ACCEPT
```

After modifying `/etc/sysconfig/iptables`, execute:

```
service iptables restart
```

## Running NightStar RT Tools with a Firewall

Following are a few approaches for allowing a NightStar RT tool to receive floating licenses from a license server, when the system running the NightStar RT tool is configured with a firewall:

- disable the firewall on the requesting system entirely
- allow NSLM licenses from a specific license server (or one of several)
- allow NSLM licenses from any system on a particular subnet (or one of several)
- allow NSLM licenses from any system

### NOTE

You must be root in order to modify the firewall configuration.

To disable the firewall entirely, execute:

```
service iptables stop
```

and then remove the `/etc/sysconfig/iptables` file:

```
rm -f /etc/sysconfig/iptables
```

This option may not be as dangerous as it seems. Often, whole networks are protected with a firewall so it is not necessary for individual systems on the network to be protected further. If unsure, check with your network administrator.

For the remaining cases, a simple modification should be made to the `/etc/sysconfig/iptables` file. By default, that file should contain a line like the following:

```
-A RH-Firewall-1-INPUT -j REJECT --reject-with icmp-host-prohibited
```

To allow NSLM licenses from a specific system running a license server, insert the following line before the REJECT line:

```
-A RH-Firewall-1-INPUT -p udp -m udp -s server --sport 25517 -j ACCEPT
```

That line can be repeated for multiple servers.

To allow NSLM licenses from any system running a license server on a particular subnet, insert the following before the REJECT line:

```
-A RH-Firewall-1-INPUT -p udp -m udp -s subnet/mask --sport 25517 -j ACCEPT
```

The subnet might be of a form like 192.168.1.0 and the mask could be a traditional network mask like 255.255.255.0 or a single number like 24, which indicates the number of bits from the left that are part of the mask. For example, 192.168.1.0/255.255.255.0 and 192.168.1.0/24 are equivalent.

That line can be repeated for multiple subnets.

To allow NSLM licenses from any system running a license server, insert the following line before the REJECT line:

```
-A RH-Firewall-1-INPUT -p udp -m udp --sport 25517 -j ACCEPT
```

After modifying **/etc/sysconfig/iptables**, execute:

```
service iptables restart
```

## License Support

For additional aid with licensing issues, contact the Concurrent Software Support Center at our toll free number 1-800-245-6453. For calls outside the continental United States, the number is 1-954-283-1822. The Software Support Center operates Monday through Friday from 8 a.m. to 5 p.m., Eastern Standard Time.

You may also submit a request for assistance at any time by using the Concurrent Computer Corporation web site at [http://www.ccur.com/isd\\_support\\_contact.asp](http://www.ccur.com/isd_support_contact.asp) or by sending an email to [support@ccur.com](mailto:support@ccur.com).

# 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 4-10.

```

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;
    }
}

```



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 4-6 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`.

# Glossary

---

## **active scheduler window**

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

## **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.*

## **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.

## **host system**

A system designated by a host name. A host may be 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**.

**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 soft or hard *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 as distributed timing devices.

**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.

**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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