Fujitsu Software
PRIMECLUSTER

Reliant Monitor Services (RMS) with Wizard Tools Configuration and Administration Guide 4.7

Oracle Solaris / Linux

J2UL-2824-02ENZ0(00)
July 2023

Preface

Reliant Monitor Services (RMS) is a software monitor designed to guarantee the high availability of applications in a cluster of nodes. This manual describes how to configure RMS using the RMS Wizards and how to administer RMS using the Cluster Admin GUI.

Target Readers

This manual is intended for all users who use PRIMECLUSTER 4.7 and perform cluster system installation and operation management.

Organization

This manual consists as follows:

Chapter title	Description
Chapter 1 Introduction	Introduces the overview of RMS and PRIMECLUSTER products.
Chapter 2 Advanced RMS concepts	Provides background details about RMS operation including state detection and transition processing.
Chapter 3 Using the Wizard Tools interface (hvw)	Describes how to configure RMS using the RMS Wizard Tools.
Chapter 4 Example of configuration change	Illustrates the procedure on how to change the configuration of cluster application using RMS Wizard Tools.
Chapter 5 Using the Cluster Admin GUI	Describes how to start Cluster Admin and how to display the attributes and states of RMS which uses Cluster Admin.
Chapter 6 Additional administrative tools	Describes the RMS clusterwide table, RMS graphs, and the RMS log viewer which use Cluster Admin.
Chapter 7 Controlling RMS operation	Describes common RMS administrative functions available through the Cluster Admin GUI, including the equivalent CLI procedures.
Appendix A Preparation	Describes network and file settings required for RMS operation.
Appendix B States	Lists the object states that are supported by RMS.
Appendix C Object types	Lists the object types that are supplied with RMS.
Appendix D Attributes	Lists the attributes that are supported by RMS object types.
Appendix E Environment variables	Describes the RMS environment variables.
Appendix F Troubleshooting	Describes how to troubleshoot RMS using graphical user interface (GUI) and command line interface (CLI) tools.
Appendix G RMS command line interface	Lists the RMS administrative CLI commands.
Appendix H Release information	Lists the main changes in this manual.

Related documentation

Refer to the following manuals as necessary when setting up the cluster:

- PRIMECLUSTER Concepts Guide
- PRIMECLUSTER Installation and Administration Guide
- PRIMECLUSTER Installation and Administration Guide Cloud Services
- PRIMECLUSTER Web-Based Admin View Operation Guide
- PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide
- PRIMECLUSTER Global Disk Services Configuration and Administration Guide
- PRIMECLUSTER Global File Services Configuration and Administration Guide
- PRIMECLUSTER Global Link Services Configuration and Administration Guide: Redundant Line Control Function

- PRIMECLUSTER Global Link Services Configuration and Administration Guide: Redundant Line Control Function for Virtual NIC Mode
- PRIMECLUSTER Global Link Services Configuration and Administration Guide: Multipath Function
- PRIMECLUSTER DR/PCI Hot Plug User's Guide
- PRIMECLUSTER Messages
- FJQSS (Information Collection Tool) User's Guide
- PRIMECLUSTER Wizard for Oracle Configuration and Administration Guide
- PRIMECLUSTER Wizard for NAS Configuration and Administration Guide
- PRIMECLUSTER Wizard for NetWorker Configuration and Administration Guide

Note

The PRIMECLUSTER documentation includes the following documentation in addition to those listed above:

- PRIMECLUSTER Software Release Guide and Installation Guide

This Software Release Guide and Installation Guide are provided with each PRIMECLUSTER product package.

The data is stored on "DVD" of each package. For details on the file names, see the documentation.

Conventions

Notation

This manual uses the following notational conventions.

Prompts

Command line examples that require system administrator (or root) rights to execute are preceded by the system administrator prompt, the hash sign (#). Entries that do not require system administrator rights are preceded by a dollar sign ($).
In some examples, the notation <*nodename*># indicates a root prompt on the specified node. For example, a command preceded by shasta1# would mean that the command was run as user root on the node named shasta1.

Manual page section numbers

In manuals, helps, and messages of PRIMECLUSTER, a section number in a manual page is shown in parentheses after a command name or a file name. Example: cp(1)

For Linux, or Oracle Solaris 11.4 or later, replace the section numbers as follows:
- "(1M)" to "(8)"
- "(4)" to "(5)"
- "(5)" to "(7)"
- "(7)" to "(4)"

The keyboard

Keystrokes that represent nonprintable characters are displayed as key icons such as [Enter] or [F1]. For example, [Enter] means press the key labeled Enter; [Ctrl-b] means hold down the key labeled Ctrl or Control and then press the [B] key.

Typefaces

The following typefaces highlight specific elements in this manual.

Typeface	Usage
Constant Width	Computer output and program listings; commands, file names, manual page names and other literal programming elements in the main body of text.
Italic	Variables that you must replace with an actual value.
Bold	Items in a command line that you must type exactly as shown.

Typeface conventions are shown in the following examples.

Example 1

Several entries from an /etc/passwd file are shown below:

```
root:x:0:1:0000-Admin(0000):/:/sbin/ksh
sysadm:x:0:0:System Admin.:/usr/admin:/usr/sbin/sysadm
setup:x:0:0:System Setup:/usr/admin:/usr/sbin/setup
daemon:x:1:1:0000-Admin(0000):/:
```

Example 2

To use the cat(1) command to display the contents of a file, enter the following command line:

```
$ cat <file>
```

Command line syntax

The command line syntax observes the following conventions.

Symbol	Name	Meaning
[ ]	Brackets	Enclose an optional item
{ }	Braces	Enclose two or more items of which only one is used. The items are separated from each other by a vertical bar (|).
|	Vertical bar	When enclosed in braces, it separates items of which only one is used. When not enclosed in braces, it is a literal element indicating that the output of one program is piped to the input of another.
( )	Parentheses	Enclose items that must be grouped together when repeated.
...	Ellipsis	Signifies an item that may be repeated. If a group of items can be repeated, the group is enclosed in parentheses.

Notation symbols

Material of particular interest is preceded by the following symbols in this manual:

Point

Contains important information about the subject at hand.

Note

Describes an item to be noted.

Example

Describes operation using an example.

Information

Describes reference information.

See

Provides the names of manuals to be referenced.

Abbreviations

Oracle Solaris might be described as Solaris, Solaris Operating System, or Solaris OS.

If "Solaris X" is indicated in the reference manual name of the Oracle Solaris manual, replace "Solaris X" with "Oracle Solaris 10 (Solaris 10)," or "Oracle Solaris 11 (Solaris 11).

Red Hat Enterprise Linux is abbreviated as RHEL.

RHEL is abbreviated as Linux.

PRIMEQUEST 3000 Series are abbreviated as PRIMEQUEST.

Export Controls

Exportation/release of this document may require necessary procedures in accordance with the regulations of your resident country and/or US export control laws.

Trademarks

UNIX is a registered trademark of The Open Group in the United States and other countries.

Red Hat and Red Hat Enterprise Linux are registered trademarks of Red Hat, Inc. in the U.S. and other countries.

Linux(R) is the registered trademark of Linus Torvalds in the U.S. and other countries.

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners. All other hardware and software names used are trademarks of their respective companies.

VMware is a registered trademark or trademark of VMware, Inc. in the United States and/or other jurisdictions.

Other product names are product names, trademarks, or registered trademarks of these companies.

Requests

- No part of this documentation may be reproduced or copied without permission of FUJITSU LIMITED.
- The contents of this documentation may be revised without prior notice.

Date of publication and edition

February 2023, First edition
July 2023, Second edition

Copyright notice

Copyright Fujitsu Limited 2023.

Contents

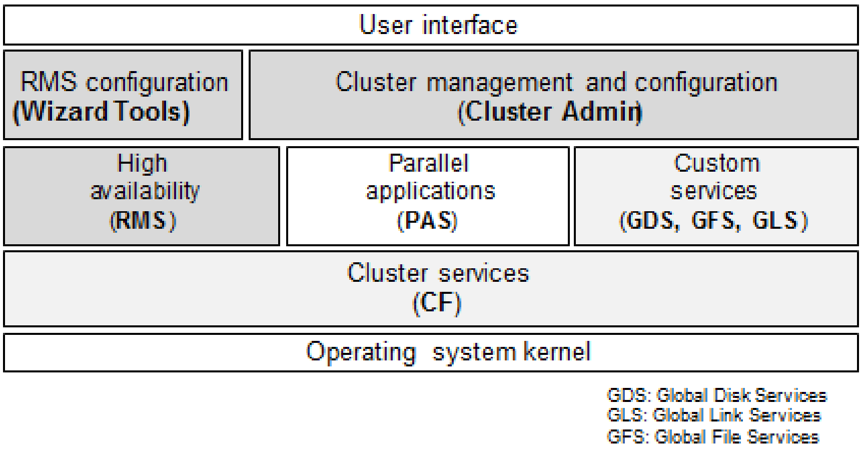
Chapter 1 Introduction

This chapter contains general information on Reliant Monitor Services (RMS), introduces the PRIMECLUSTER of products, details how RMS, RMS Wizard Tools, and the RMS Wizard Kit work together to produce high-availability configurations, and introduces Cluster Admin.

1.1 PRIMECLUSTER overview

The PRIMECLUSTER of products is an integrated set of cluster services, including configuration and administration services, high availability, scalability, parallel application support, cluster file system, and cluster volume management. The figure below illustrates the relationship of PRIMECLUSTER services to each other and to the operating system environment.

Figure 1.1 Overview of PRIMECLUSTER products


User interface
RMS configuration (Wizard Tools)
Cluster management and configuration (Cluster Admin)
High availability (RMS)
Parallel applications (PAS)
Custom services (GDS, GFS, GLS)
Cluster services (CF)
Operating system kernel
GDS: Global Disk Services
GLS: Global Link Services
GFS: Global File Services

This manual focuses on PRIMECLUSTER products and services that relate to high availability operation (shown with a solid gray background in the figure above). They are as follows:

- RMS

  This high availability manager is a software monitor that provides high availability (HA) for customer applications in a cluster of nodes. Its task is to monitor systems and application resources, to identify any failures, and to provide application availability virtually without interruption in the event of any such failures.

  RMS also provides integrated services for market-specific applications. Contact field engineers for availability and details.

- RMS Wizard Tools

  This configuration tool provides a character-based interface to create RMS configurations. It includes templates for generic applications and commonly used resources.

  The RMS Wizard Kit works with the Wizard Tools to configure popular enterprise products for operation with RMS.

- Cluster Admin

  The Cluster Admin GUI is the primary administrative tool for RMS.

- Cluster Foundation (CF)

  This comprehensive suite provides cluster administration and communication services for user applications and other PRIMECLUSTER services.

PRIMECLUSTER products shown with a dotted background in the figure above are described in their respective manuals. See the section "Related documentation" in the Preface.

1.2 How RMS provides high availability

RMS provides high availability of a customer's application by controlling and monitoring the state of all resources in use by a given application. Resources include items such as network interfaces, local and remote file systems, and SAN (Storage Area Networks). RMS monitors the state of each node in the cluster.

1.2.1 Applications, resources, and objects

RMS relies on a virtual representation of the cluster called a configuration. The configuration represents each machine, application, and system resource as an object, and the objects are logically arranged in a tree structure according to their dependencies. For instance, suppose a user application depends on a network interface and a file system in order to operate properly. In the tree structure, the corresponding application object would appear as a parent and the network and file system objects would appear as its children. The tree structure is commonly known as a graph.

Each object in the graph contains the state of the corresponding item along with any other parameters that may be required. An object is typically in the online (enabled, available) state or the offline (disabled, unavailable) state, but other states are possible according to the type of object. For the complete list of states supported by RMS, see "Appendix B States".

At runtime, the configuration is managed by the RMS base monitor, which initiates actions when an object's state changes, or, in the case of a timeout, when an object has remained in the same state for some specified time interval even though a change was expected. This design is known as a state machine.

Nodes and heartbeats

Machines that are members of a cluster are called nodes. When RMS monitors the health of a node, its highest priority is to detect a complete failure of the node or its base monitor. Its second priority is to detect slow response times that may be caused by system overloads. RMS uses two mechanisms, heartbeat and ELM to detect these problems.

Refer to the "2.2 RMS heartbeat operation".

Detectors

RMS monitors each resource by using detectors, which are processes that deliver status reports to the RMS base monitor process. RMS interprets the status reports to determine the state of the corresponding virtual object. When an object's state changes, RMS takes action according to the parameters set in the object. Each object may be associated with a detector.

Detectors are persistent: when RMS starts on a cluster node it starts the detectors for its configuration, which normally continue to run on that node until RMS is shut down. RMS has the ability to restart a detector if it terminates prematurely.

A complete list of the states that can be reported by detectors or displayed in the user interface is presented later in this chapter.

Scripts

Each object is linked with multiple scripts. These scripts are shell scripts. Normally, each script is described to interact with items in the operating system such as user applications or physical resources.

Some scripts are reactive: they define the actions that RMS should take in response to state changes. Other scripts are proactive: they define the actions that RMS should use to take control of individual objects. For instance, RMS would process one script when a resource reports a transition from the online state to the offline state; however, RMS would process a different script when it must force the resource to the offline state.

After performing their programmed tasks, the scripts exit and return an exit code to the base monitor.

A complete list of the scripts that may be specified for RMS objects is presented later in this chapter.

Object types

Most high-availability applications rely on a set of physical resources such as network interfaces, files systems, or virtual disks. RMS represents these as gResource objects. Most gResource objects have scripts that allow them to be brought online or taken offline.

Internally, RMS represents an actual application that runs in the operating system environment as a userApplication object. The set of gResource objects that represent the actual application's resource requirements are called its dependent resources. Bringing a userApplication object to the online state, along with all of its dependent resources, is called online processing. Taking a userApplication object to the offline state, along with all of its dependent resources, is called offline processing.

Each node that may run one or more applications in the high availability configuration is represented by a SysNode object. Like gResource objects and userApplication objects, SysNode objects can be brought online or taken offline, and they have an associated set of scripts. However, booting up or shutting down the corresponding physical machine requires more than simple script processing.

For the complete list of the RMS object types supported by the Wizard Tools, see "Appendix C Object types".

Shutdown Facility

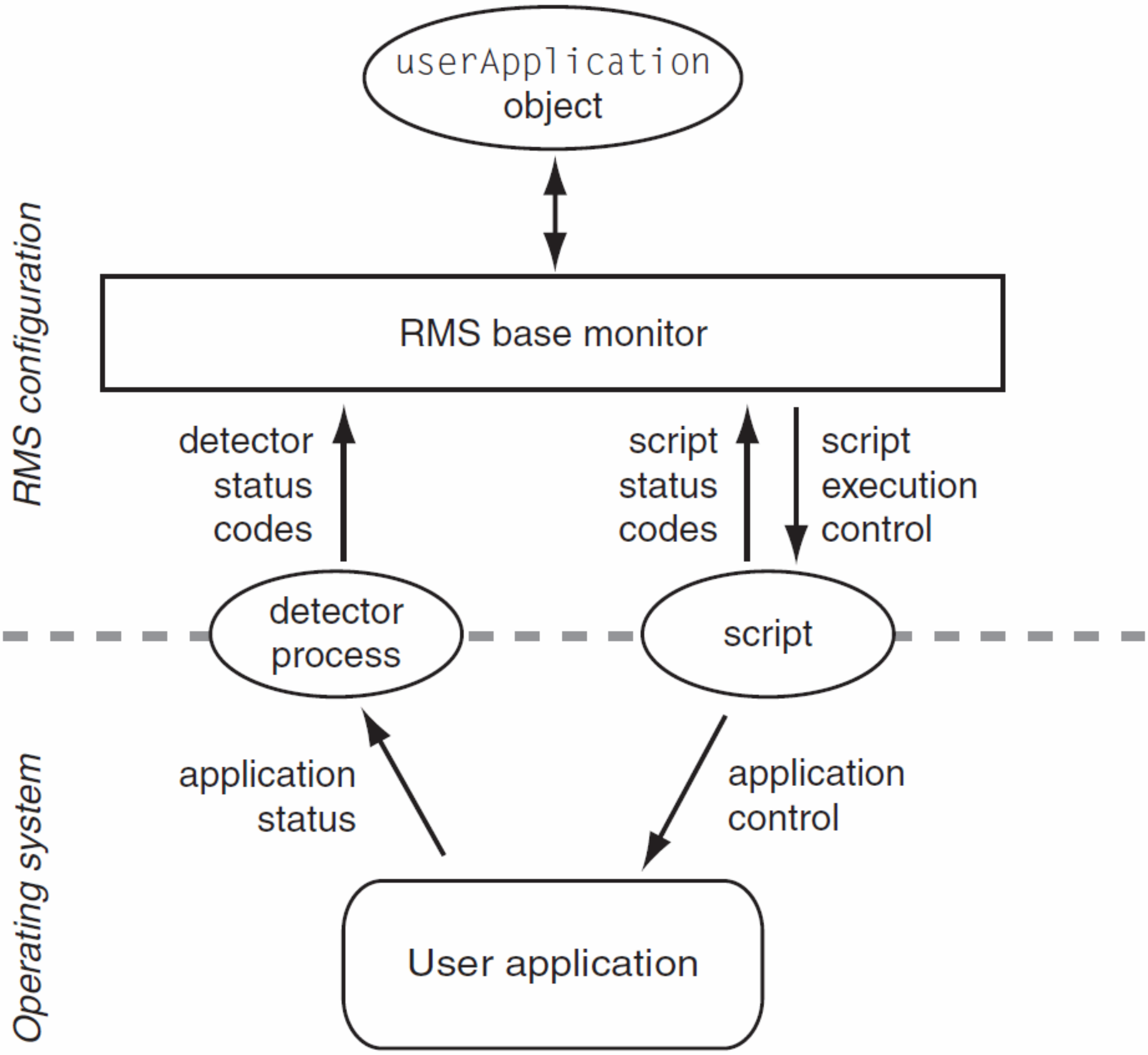
The shutdown facility issues a forcible shutdown instruction to each node in the cluster. When it is necessary to take a SysNode object offline, RMS instructs the forcible shutdown of the target node by using the shutdown facility. RMS waits for successful completion of the node kill before switching any userApplication to another SysNode. This prevents any user application from running on two machines at the same time, which could lead to data corruption.

For more information about the Shutdown Facility, see "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide" for your operating system.

1.2.2 Relationship of RMS configurations to the real world

It is important to understand that RMS does not interact directly with "real-world" items such as machines, users' applications, or system resources - it interacts only with the objects in its virtual representation. The following figure illustrates the relationship between an actual user application in the operating system environment and the corresponding userApplication object in an RMS configuration.

Figure 1.2 Interface between RMS and the operating system



Note that the interface between the RMS virtual representation and the actual operating system depends entirely on the scripts and detectors provided by the configuration tools. The script in the figure represents any of the standard scripts discussed later in this chapter: it reports whether or not it completed its tasks successfully by returning a status code, and RMS combines this with the status code from the object's detector to determine the object's state. RMS has no other way to determine what actually happened to the user application in the operating system environment (the part of the figure below the dashed line).

For instance, if a userApplication object's Online script reports success, its detector reports that it is online, and all of its resources are online, then RMS considers that object to be online, regardless of the state of the actual user application. Similarly, if a resource object's detector reports an Offline state, it does not necessarily mean that the physical resource is unavailable.

Point

For reliable high availability operation, RMS requires scripts that properly control the corresponding real world items, and detectors that accurately reflect the items' states.

Configuration terminology

This manual discusses configuration procedures within the RMS context (represented by the part of figure above the dashed line). Strictly speaking, our principle concern is with SysNode objects, userApplication objects, and other RMS entities, and not the real-world items they represent.

However, it is intuitive to use terms such as "node" instead of "SysNode object" and "application" instead of "userApplication object," because the relationships are so close, and because it is always understood we are working from the RMS perspective. This also helps to simplify many of the technical discussions. Therefore, unless there is a need to distinguish between an RMS object and the actual item it represents, this manual and the configuration tools it describes use the following terms interchangeably:

- "node" and "SysNode object" and "SysNode"
- "application" and "userApplication object" and "userApplication"
- "resource" and "gResource object" and "gResource"

The descriptions of object states and attributes are abbreviated similarly. For instance, instead of "the gResource object that monitors the mount point xyz is in the Offline state," it is customary to say, "the xyz file system is offline." It is also common to refer to a script by its attribute name, so "the script specified by the PreOnlineScript attribute" becomes simply "the PreOnlineScript."

All the objects that are managed by RMS are collectively described as "RMS resource."

1.2.3 Node and application failover

During normal operation, one instance of RMS runs on each node in the cluster. Every instance communicates with the others to coordinate the actions configured for each userApplication. If a node crashes or loses contact with the rest of the cluster, then RMS can switch all userApplication objects from the failed node to a surviving node in the cluster. This operation is known as failover.

Failover can also operate with individual applications. Normally, a userApplication object is allowed to be online on only one node at a time. (Exceptions to this rule are shared objects like Oracle RAC vdisk.) If a fault occurs within a resource used by a userApplication object, then only that userApplication can be switched to another node in the cluster. userApplication failover involves offline processing for the object on the first node, followed by online processing for the object on a second node.

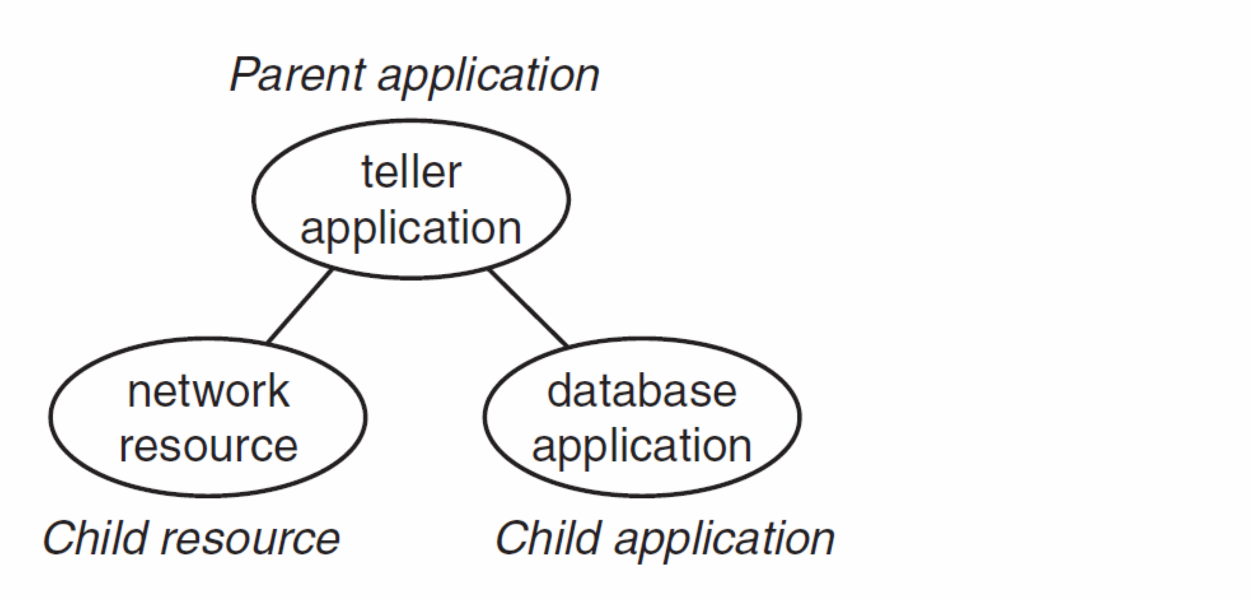
There are also situations in which RMS requires a node to be shut down, or killed. In any case, before switching applications to a new node, RMS works together with the PRIMECLUSTER Shutdown Facility to guarantee that the original node is completely shut down. This helps to protect data integrity.

RMS also has the ability to recover a resource locally; that is, a faulted resource can be brought back to the online state without switching the entire userApplication to another cluster node.

1.2.4 Controlled applications and controller objects

In some situations, it is desirable for one application to control another in a parent/child relationship. Consider a scenario in which a bank teller application depends on the local network (represented by a network resource object) and a database application. This can be represented by the graph in the following figure.

Figure 1.3 Parent application with two dependencies

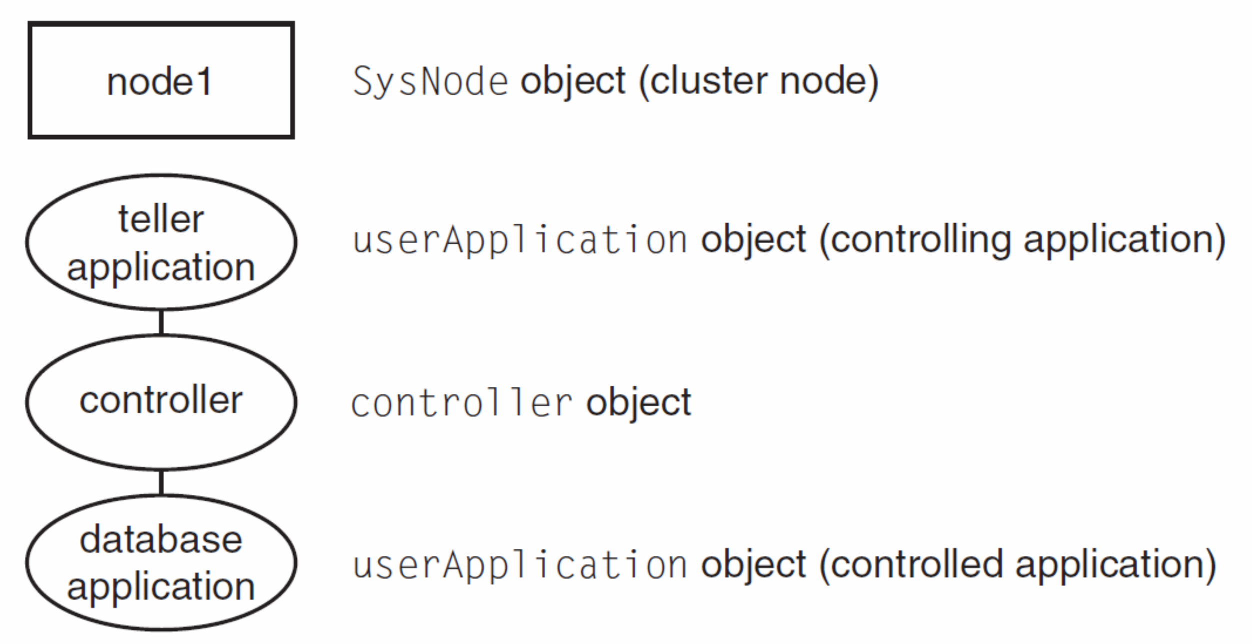


Assume that if the network fails in some way, or if the database fails in some way, then the parent teller application cannot complete any transactions. The lines joining the objects in the figure indicate these dependencies. From the RMS perspective, then, we would like both the network resource and the database application to be configured in similar ways: they should both act as dependent resources that must be online if the teller application is to function properly.

However, RMS does not allow any application to be directly configured as the child of another application. Instead, RMS accommodates parent/child relationships between applications by providing an intermediate controller object, which is often simply called a controller. Unlike other resource objects, a controller has no scripts or detectors. Instead, it propagates online and offline requests from the parent to the child application, and it determines its status from that of the child application.

The following figure demonstrates how RMS would represent the banking scenario with the teller application, the controller, and the database application all running on node1. For the purposes of this example and the discussions that follow, only the applications and the controller are included in the illustration; the resource object representing the network interface is not shown.

Figure 1.4 RMS representation of controlled application


node1
SysNode object (cluster node)
teller application
userApplication object (controlling application)
controller
controller object
database application
userApplication object (controlled application)

Note

- In accordance with the manual of the PRIMECLUSTER Products that support the operation mode of the controller objects, use the control of the applications by the controller objects.

- Each controlled application requires a separate controller as a child of the parent application. Also, controllers exist only for internal RMS management purposes. There is no equivalent in the context of the real-world operating system.

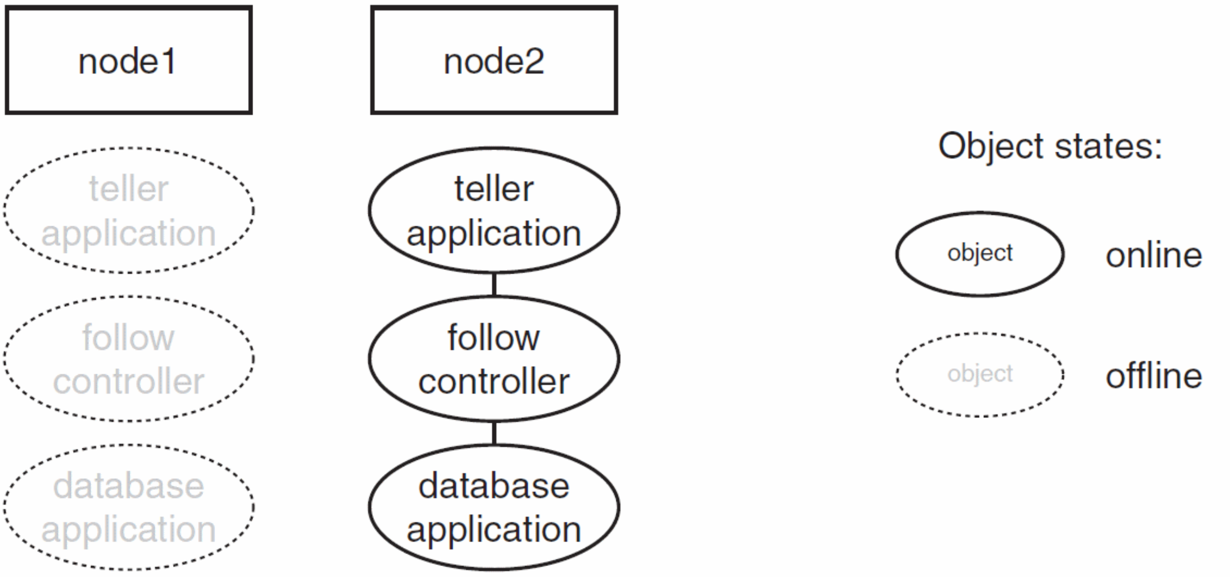
Failover of controlled applications

If a child application (controlled application) becomes Offline or Faulted state, RMS switches a parent, a child, or all the dependent resources to another cluster node. The exact action depends on the controller mode (Follow or Scalable mode).
The Follow and Scalable modes are described below.

1.2.4.1 Follow controllers

If a parent application (to control) and a child application (to be controlled) must operate in the same cluster node, set the controller to Follow mode. If the parent is switched to another node, the application set in Follow mode and all its dependent resources will be switched there too. Likewise, if the child application fails in a way that requires it to be switched to another node, then the parent application must be switched as well. The node1 in Figure 1.4 RMS representation of controlled application shows the example when the teller application tree is Online at the beginning and the controller is configured to operate in Follow mode. If either the parent or child application needs to be switched to node2 for any reason, the rest of the tree follows. The following figure illustrates the result.

Figure 1.5 Result of follow-mode switchover



Note the state of the local controller in the figure above. Like the child application, it is brought online only on the same node as the parent. Follow Local controllers can guarantee that a group of applications and their resources remain closely coupled, so they always run together on the same machine.

Note

When RMS switches an application from node1 to node2, no objects are moved within the corresponding graph. Instead, the objects in the part of the graph corresponding to node1 are first taken offline, and then the objects in the part of the graph corresponding to node2 are brought online. The sequence used by RMS in an actual configuration is crucial to high availability operation. For a more detailed discussion, see "Appendix A Preparation."

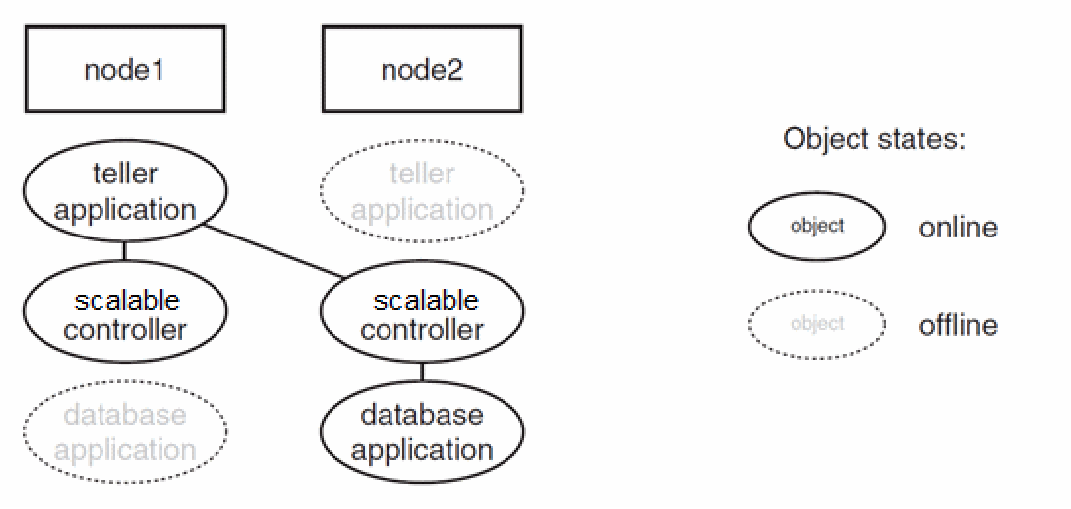
1.2.4.2 Scalable controllers

Generally speaking, scalability is the ability of the overall system to adapt to changes in resources or workload. One of the main features of RMS scalable controllers is that they allow the parent and child applications to run on separate machines. This not only provides more flexibility but it may also prevent delays or outages when resources fail in certain combinations.

In our banking scenario, for example, the teller application depends on a network and a database application. Suppose the file system on node1 fails and the database goes offline. If the database controller is operating in follow mode, RMS will attempt to switch the teller and database to node2. However, if the network on node2 is offline or faulted, the teller can't be brought online there either. This is an extreme example, but it illustrates how high loads or resource outages could severely impact a configuration that relies only on a follow controller.

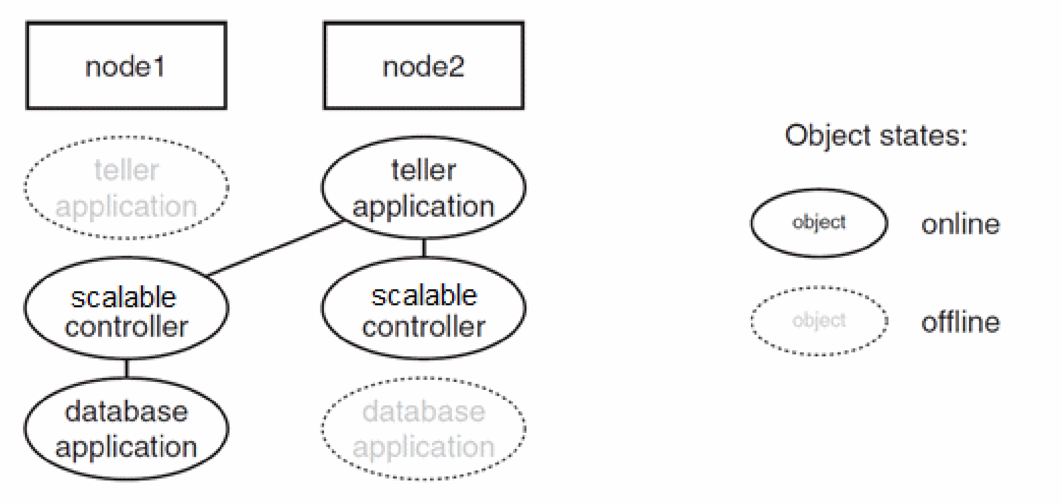
Using a scalable controller can help the configuration adjust dynamically in such situations. If the network is online on node1, while the file system is online on node2, then the database can be switched independently as shown in the following figure.

Figure 1.6 Scalable mode child (controlled) application switchover



Conversely, a network outage could cause RMS to switch the teller to node2 while leaving the database online on node1, as shown in the following figure.

Figure 1.7 Scalable mode parent (controlling) application switchover



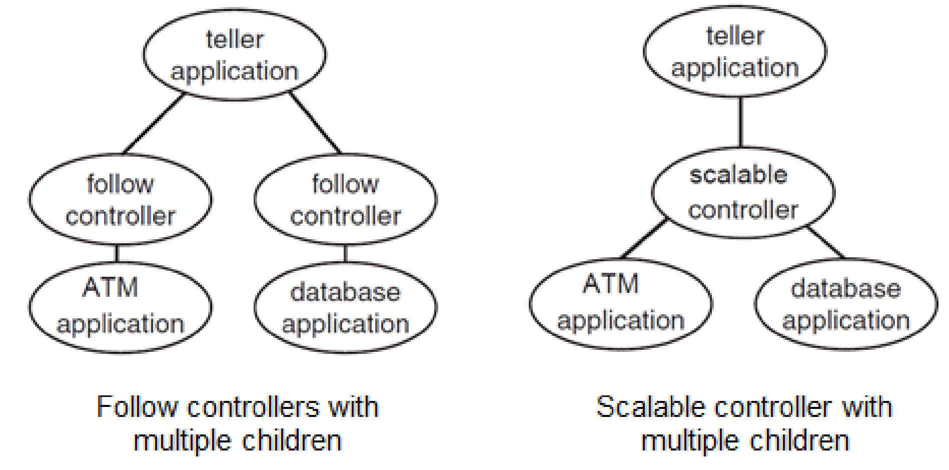
If an application can run on more than one node, RMS allows only one instance of that application to be online in the cluster. That is, an application can run on only one node at a time. However, controller objects do not have the same restriction. Note the state of the controller objects in "Figure 1.6 Scalable mode child (controlled) application switchover" and "Figure 1.7 Scalable mode parent (controlling) application switchover." For each scalable child application, an instance of its controller is online on every node where that application can run.

1.2.4.3 Further notes about controllers

The follow and scalable modes are mutually exclusive: a controller for a child application can operate in either follow mode or scalable mode, but not both. The Wizard Tools ensure that each controller's configuration is self-consistent.

A parent application can have more than one child application, but the Wizard Tools require the controller type to be the same for all children. If follow mode is used, then there will be one distinct follow controller for each child. If scalable mode is used, there will be one scalable controller with multiple children. For example, suppose the teller application in the banking scenario also has an automated teller machine (ATM) controlled application. The difference between the follow graph and the scalable graph is shown in the following figure.

Figure 1.8 Controller structure with multiple children



For a more detailed discussion, see the section "2.3 Scalable controllers".

1.3 How the Wizard Tools provide easy configuration

RMS is a mature product with many features and options. Experts who develop, debug, and fine tune complete RMS configurations must know how RMS works and what RMS needs in order to function properly. For each application in the configuration, the expert must do the following:

- Define the set of resources used by the application, including:
  - Disks
  - Volume managers
  - File systems
  - processes to be monitored
  - IP addresses
- Define the relationship between each resource and its dependent resources, e.g., which file system depends on which virtual or physical disk, which processes depend on which file systems, and so forth.
- Define the relationship between the applications being controlled; for example, which applications must be up and running before others are allowed to start.
- Provide scripts to bring each resource online and offline.
- Provide a detector to determine the state of each resource.

Configuring the above set of requirements by hand can be quite time consuming and prone to errors. This is why the RMS Wizard Tools were developed.

The PRIMECLUSTER RMS Wizard Tools allow the creation of flexible and quality-tested RMS configurations while minimizing your involvement. A simple user interface prompts you for details regarding your applications and resources. Using these details, the Wizard Tools automatically select the proper scripts and detectors and combine them in a pre-defined structure to produce a complete RMS configuration.

Specialists skilled in popular applications and in RMS worked together to create the RMS wizards. The wizards are designed to easily configure RMS for certain popular applications such as Oracle and they are flexible enough to create custom RMS configurations that can control any other type of application.

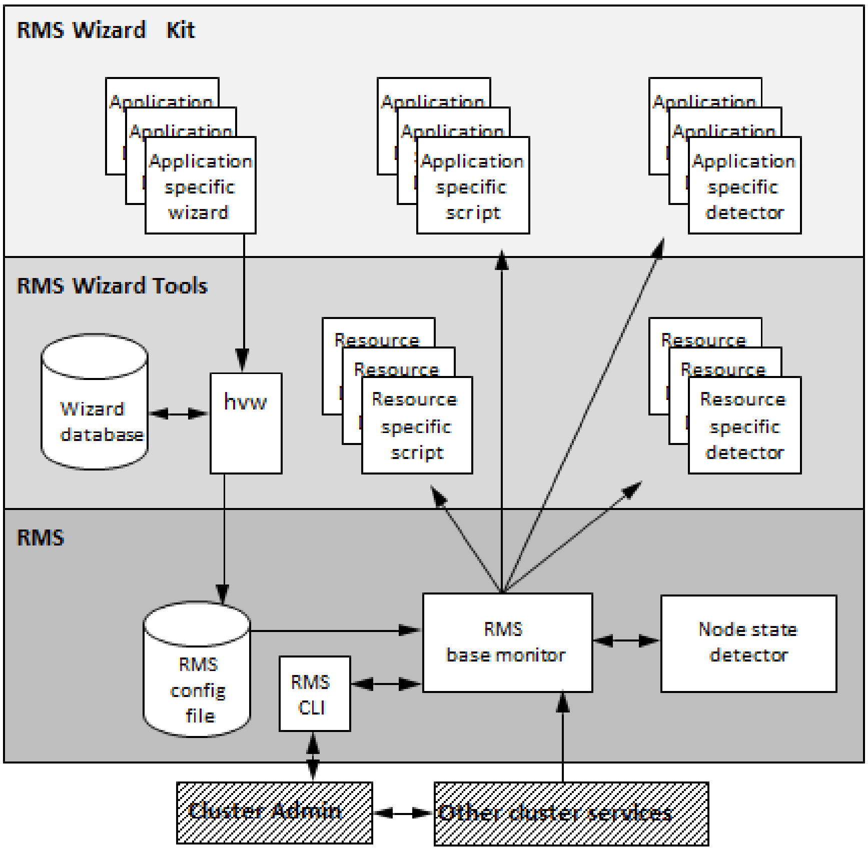
1.4 RMS wizard products

The RMS wizards are divided into the following separate products:

- RMS Wizard Tools - user interface, general-purpose application wizards, and basic set of subapplication wizards. Provided as a standard component of RMS
- RMS Wizard Kit - set of custom wizards designed to configure specific applications. Available as additional product.

The following figure depicts the relationship between RMS, the Wizard Tools, and the RMS Wizard Kit.

Figure 1.9 Relationship between RMS and RMS Wizards



For Solaris, as a means of setting the RMS configuration, the userApplication Configuration Wizard, which is a GUI utilizing Web-Based Admin View, is provided. The RMS configuration can be set on a graphical screen.

1.4.1 RMS Wizard Tools

The RMS Wizard Tools provides the following for basic resource types (such as file systems and IP addresses):

- Online scripts
- Offline scripts
- Detectors

The RMS Wizard Tools package contains the hvw command. The hvw interface provides a simple menu driven interface to allow a user to enter information specific to applications placed under the control of RMS. hvw also provides an interface through which application-specific knowledge can be dynamically added to provide turnkey solutions for those applications typically found in the data center. These application-specific modules are provided by the RMS Wizard Kit such as Wizard for Oracle, etc.

1.4.2 RMS Wizard Kit

The RMS Wizard Kit provides application knowledge modules which can be used by the hvw command. The knowledge modules provide hvw with information specific to popular applications, which greatly eases the configuration task. The following are also provided for specific applications:

- Online scripts
- Offline scripts
- Detectors

See

For information on the availability of the RMS Wizard Kit, contact your local customer support service.

1.5 Cluster Admin administration tool

The Cluster Admin GUI is the primary administrative tool for RMS. It allows users full access to the application control functions of RMS, including the following:

- Cluster application startup
- Cluster application shutdown
- Manual switchover of cluster application
- Visual cues for resource and application fault isolation
- Fault clearing capability
- RMS startup
- RMS shutdown
- Graphs of application and resources

1.6 RMS components

The RMS product is made up of the following software components that run on each node in the cluster:

- Base monitor
- Detectors
- Scripts
- RMS CLI

1.6.1 Base monitor

The base monitor process is the decision-making segment of the RMS process group. It has the following functions:

- Stores the current configuration of resources as represented by objects, their attributes, and their interdependent relationships
- Receives user requests for specific actions from the Cluster Admin graphical user interface (GUI) or the RMS command line interface (CLI)
- Receives input from detectors and monitors state changes
- Launches scripts to bring applications and their dependent resources online or offline
- Dictates the sequencing of the resource state changes to ensure resources and applications are brought online or offline in the correct order
- Initiates and controls automatic application switchover in case of a resource or node failure, or when directed by a user request

- Performs various administrative functions

1.6.2 Detectors and states

Detectors monitor each object status and return these object statuses to the base monitor.

The detectors that monitor the functions provided by OS are provided by RMS Wizard Tools. Additional application-specific detectors are provided by RMS Wizard Tools and RMS Wizard Kit.

Some objects provided by RMS, such as the controller object, have no detector. Instead, RMS calculates the state of the object based on factors such as transitory processes and the states of its dependent resources.

1.6.3 Scripts

RMS uses scripts to perform actions such as moving a resource from one state to another (for example, from Offline to Online). The two types of scripts are as follows:

- Request-triggered scripts initiate a state change to a resource.

  The request-triggered scripts are as follows:

  - InitScript - It is executed only once when RMS is started.
  - PreCheckScript - It is executed to determine if Online or Standby processing is needed or possible.
  - PreOfflineScript - It is executed before a transition to the Offline state.
  - OfflineScript - It is executed to set a resource to the Offline state.
  - PreOnlineScript - It is executed before a transition to the Online or Standby state.
  - OnlineScript - It is executed to set a resource to the Online state.

- State-triggered scripts react to specific events.

  The state-triggered scripts are as follows:

  - PostOnlineScript - It is executed after a transition to the Online or Standby state.
  - PostOfflineScript - It is executed after a transition to the Offline state.
  - OfflineDoneScript - It is executed after Offline processing is completed.
  - FaultScript - It is executed when a transition is made to the Faulted state.
  - WarningScript - It is executed when a transition is made to the Warning state.
  - StateChangeScript - It is executed when the state of the controlled child application and the state of the node where the child application is running transition.

Scripts that control the functions provided by OS are provided with RMS Wizard Tools.

1.6.4 RMS CLI

The primary interface for configuring RMS is the RMS Wizard Tools, and the primary interface for administering RMS is the Cluster Admin GUI. Both the RMS Wizard Tools and Cluster Admin call the RMS CLI. For example, use the following CLI command to manually switch the userApplication object to another node (SysNode) in the cluster.

```
# hvswitch userApplication SysNode
```

The following table lists the RMS CLI commands available to administrators. For a complete description of any command's usage, see its online man page. For a list of all commands related to RMS, see "Appendix B Manual Pages" in "PRIMECLUSTER Installation and Administration Guide."

Note

- With few exceptions, RMS CLI commands require root privilege. The exceptions are noted in the following table.

Table 1.1 Available CLI commands

Command	Function
hvassert	Tests an RMS resource for a specified resource state. It can be used in scripts when a resource must achieve a specified state before the script can issue the next command. Does not require root privilege.
hvcm	Starts the base monitor and the detectors for all monitored resources. In most cases, it is not necessary to specify options to the hvcm command. The base monitor is the decision-making module of RMS. It controls the configuration and access to all RMS resources. If a resource fails, the base monitor analyzes the failure and initiates the appropriate action according to the specifications for the resource in the configuration file.
hvconfig	Either displays the current RMS configuration or sends the current configuration to an output file. The output of the hvconfig command is equivalent to the running RMS configuration file, but does not include any comments that are in the original file. Also, the order in which the resources are listed in the output might vary from the actual configuration file.
hvdisp	Displays information about the current configuration for RMS resources. Does not require root privilege.
hvdispall	Displays the resource information of all the nodes in RMS.
hvdump	Gets debugging information about RMS on the local node.
hvlogclean	Either saves old log files into a subdirectory whose name is the time RMS was last started, or, if invoked with the -d option, deletes old log files. In either case, hvlogclean creates a clean set of log files even while RMS is running.
hvsetenv	Provides an interface for changing the following RMS environment variables on the local node: - HV_RCSTART controls the automatic startup of RMS. - HV_AUTOSTARTUP controls the automatic startup of all applications. Changes made by this command apply only to the command execution node. For more information about these environment variables, see "Appendix E Environment variables".
hvshut	Shuts down RMS on one node or all the nodes in the configuration. The base monitor on the local node sends a message to other online nodes indicating which node or nodes will be shut down.
hvswitch	Manually switches control of a userApplication or a gResource between SysNodes in the RMS configuration.
hvutil	Provides general administration interface to RMS. This command performs the following management operations:

Command	Function
	- Dynamically setting logging levels - Sending the userApplication Offline - Sending the gResource Offline - Clearing faulted resources - Stopping cluster nodes in the Wait state - Setting detector time periods - Setting Maintenance Mode, and so forth

- Excluding some commands (such as hvshut), hv_* commands of RMS only send requests to the base monitor then return immediately. They do not wait for the requests to be processed. The status code 0 (success) at the end of command execution means that the requests have been successfully sent to the base monitor. However, this does not secure that the requests have been processed successfully.

1.7 Object types

An object type represents a group of similar resources that are monitored by the same detector (for example, all disk drives). Using the Wizard Tools, you can create configuration files that contain objects of various types, each representing resources or groups of resources to be monitored by RMS. The supported types are as follows:

- SysNode
  Object indicating the node.
- userApplication
  Object indicating the cluster application.
- gResource
  General object.
- andOp
  Object indicating logical AND operator.
- orOp
  Object indicating logical OR operator.
- Controller
  Object controlling multiple userApplication objects.

Refer to the "Appendix C Object types" for the supported types, their required attributes, and a brief description of each object.

Point

These objects are created by the Wizard Tools during the generation phase of the configuration process. The type of an object may be listed in diagnostic messages for use by RMS experts.

1.8 Object attributes

An attribute is the part of an object definition that specifies how the base monitor acts and reacts for a particular resource during normal operation. An attribute can include a device name and configuration scripts. Users can specify attributes in any order in the object definition.

Refer to the "Appendix D Attributes" for the supported types, their associated values, and a description of each attribute.

Point

The values are determined by the Wizard Tools during the generation phase of the configuration process. Refer to the "Chapter 3 Using the Wizard Tools interface (hvw)".

1.9 Environment variables

RMS uses global and local environment variables:

- Global environment variables must have the same setting on all the nodes in the cluster. RMS maintains global environment variables in the ENV object.
- Local environment variables have priority over the global environment variables and can vary from node to node. RMS maintains local environment variables in the ENVL object.

RMS creates the ENV and ENVL objects dynamically from the contents of hvenv and hvenv.local when the base monitor starts up. The ENVL object values have priority over the ENV object values. Refer to the chapter "E.1 Setting environment variables" for more information.

Note

- Global variable settings (ENV) are included in the configurations checksum that is common to the cluster. The checksum is verified on each node during startup of the base monitor. RMS will fail to start if it detects a checksum difference between the values on any two nodes.
- Local variable settings (ENVL) are not included in the configurations checksum that is common to the cluster.

While RMS is running, you can display the environment variables with the hvdisp command which does not require root privilege. Use hvdisp ENV for global list and hvdisp ENVL for local list.

Refer to the "Appendix E Environment variables" for a complete description of each of these variables.

1.9.1 Setting environment variables

When RMS starts, it reads the values of environment variables from hvenv and hvenv.local and initializes the ENV and ENVL objects respectively. To change the values of environment variables before RMS starts up, you need to specify them in the hvenv.local file. RMS provides an extended set of environment variables when it executes a script for a controlled application. Like the general set of script execution variables, this extended set exists only while the script is being processed, but the context is even more specialized.

These settings will be overridden at installation.

Note

The RMS error may occur if the /tmp directory is nearly full because hvenv uses it to sort the RMS environment variables.

To change the global environment variables, you must make the same adjustment to hvenv.local on all the nodes in the cluster. After stopping RMS on all the nodes, you will have to restart RMS for the change to take effect.

Note

Do not explicitly set RMS environment variables in the user environment. Doing so can cause RMS to lose environment variables settings.

The values of environment variables are specified as export directives in each file. A typical export directive would appear as follows:

```
export SCRIPTS_TIME_OUT=200
```

Therefore, any changes you make to hvenv.local file will not take effect until the next time RMS starts up. While RMS is running, you can display the environment variables with the following commands:

- hvdisp ENV
- hvdisp ENVL

1.9.2 Script execution environment variables

When the RMS invokes a script on behalf of an object, it provides a set of variables in the script's environment that can be used for decision processing at runtime. Since these variables exist only within the context of the script while it is carrying out its tasks, they are not usually visible in the RMS user or administrator environment. In rare cases, they could appear in a diagnostic message in the system log or on the console.

The section "E.4 Script execution environment variables" provides a complete description of each of these variables.

1.10 RMS Directory structure

RMS software consists of a number of executables, scripts, files, and commands, all located relative to the directory specified in the RELIANT_PATH environment variable. The following table illustrates the directory structure of the RMS software after it has been correctly installed.

Table 1.2 RMS base directory structure

Name	Contents
RELIANT_PATH	Base directory. Default: /opt/SMAW/SMAWRrms
<*RELIANT_PATH*>/bin	Executables, including detectors, commands, and scripts.
<*RELIANT_PATH*>/build	Work and storage area for configuration files.
<*RELIANT_PATH*>/etc	Miscellaneous files used by RMS and the configuration tools.
<*RELIANT_PATH*>/include	RMS include files (header files) used by detectors and configuration files.
<*RELIANT_PATH*>/lib	RMS runtime libraries.
<*RELIANT_PATH*>/us	RMS source files. The names of the files in this directory are reserved and should not be used to name any configuration files that the user may create.

As summarized in the following table, RMS log files are located in the directory specified in the RELIANT_LOG_PATH environment variable.

Table 1.3 Log directory structure

Name	Contents
RELIANT_LOG_PATH	Log directory (default: /var/opt/SMAWRrms/log) Use the log files in this directory for debugging. The same directory has subdirectories that contain backup copies of the RMS log files. Each backup subdirectory has a name of the form *yyyy-mm-dd_HH:MM:SS* to indicate the date and time when the backup was created.

Chapter 2 Advanced RMS concepts

This chapter describes details of RMS.

2.1 State transition

This chapter deals with the RMS state engine. In particular, it describes how states are determined, and how RMS causes state changes and reacts to state changes.

In this chapter, nodes (nodes/vertices) in the graph theory are called graph nodes to distinguish them from the cluster nodes.

2.1.1 Internal organization

A brief description of the object-oriented internal aspects of the base monitor is useful in understanding RMS.

Every object is an independent instance that carries out actions (typically implemented by shell scripts) according to rules based on its state and messages received from detectors or other objects. States, detectors, and scripts are briefly described in the section "Chapter 1 Introduction". The following sections provide more details about RMS internal structure and inter-object communication.

2.1.1.1 Application and resource description

The configuration wizards generate a description for all applications that will be monitored by RMS. The description, which is maintained in an RMS-specific meta-language, represents every application with a logical graph that has the following characteristics:

- Resources required by the applications are represented by objects in this graph.
- Parent/child relationships between objects represent interdependencies between resources.
- Object attributes represent the properties of the resources and the actions that are required for specific resources.

The proactive procedures that bring a particular object online or take it offline are specified by referring to shell scripts that are configured as attributes of the object. Other script attributes specify actions to be taken in reaction to state changes of the object as a result of messages from other objects.

A userApplication object has no detector, and if it has been configured by the RMS Wizard Tools or the RMS Wizard Kit, it has no scripts specified. Instead, a child Cmdline resource is configured with the appropriate scripts, and it is this object that interacts with the actual user application in the operating system environment. In this case, the userApplication becomes a logical container that represents the combined states of the resources in its graph.

2.1.1.2 Messages

RMS objects exchange messages for the following purposes:

- To send requests
- To communicate changes in the object states

In general, objects communicate only with their direct parents and children.

RMS sends incoming external requests to the parent userApplication object before it forwards the requests to the children. A userApplication object can also generate its own requests on the basis of changes to its state (such as a change over to the Faulted state). Requests originating from the userApplication are forwarded from the parent to the child (top-down).

2.1.2 Initializing

After RMS starts, the initial state of all objects is Unknown. RMS changes this state after the object has the necessary information for identifying the actual state.

The following is necessary information for identifying the state:

- For objects with a detector - First report of the detector
- For objects with children - Messages of the children concerning their state

Two conclusions can be drawn from the above:

- Leaf objects without a detector are illegal in an RMS configuration, because they cannot generate a detector report and they are not able to logically derive their state from the state of their children. Their state always remains Unknown.
- All transitions from the Unknown state are always bottom-up, such as from the leaf object to the userApplication. Every object above the leaf object first requires the state of its children before it is able to determine its own state.

Point

SysNode objects and userApplication objects have no detectors for their physical counterparts. SysNode objects receive a detector report directly from the base monitor. userApplication objects determine their status from their children.

After the userApplication object exits the Unknown state, the initializing process of the application ends. From this point, RMS controls the application.

The initializing processes of userApplication objects are independent of each other. Therefore, one userApplication object may be initialized to an Online, Offline, or Standby state while a second userApplication object is still in the Unknown state.

The initializing process of SysNode objects is also independent. A SysNode object exits its initial Unknown state after receiving its detector report.

The Unknown state is a pure initial state. Once an object exits the Unknown state, it does not return to that state.

Example configuration

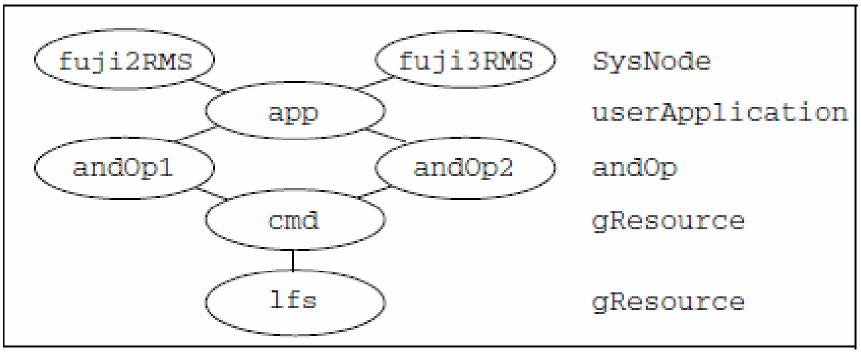
The examples of RMS processing in the following sections are based on an application app configured to run on fuji2RMS and fuji3RMS as follows:

- For each node, fuji2RMS and fuji3RMS, there is one SysNode object bearing the name of the node.
- For each SysNode where a particular user application may run, the corresponding userApplication object has one child of type andOp, which bears the name of this SysNode as the HostName attribute. The order in which the nodes were defined in the userApplication object determines the priority of the nodes for this application.

  The base monitor identifies each andOp object at this level as a **local** object if the value of the HostName attribute corresponds to the local node's name, and as a **remote** object if not. The base monitor ignores all remote objects, so that only the local objects and its children are processed.
- As children of this logical AND object, the other resources (a command line subapplication and a local file system) are configured according to their internal dependencies.

A diagram of the object hierarchy is shown in the following figure.

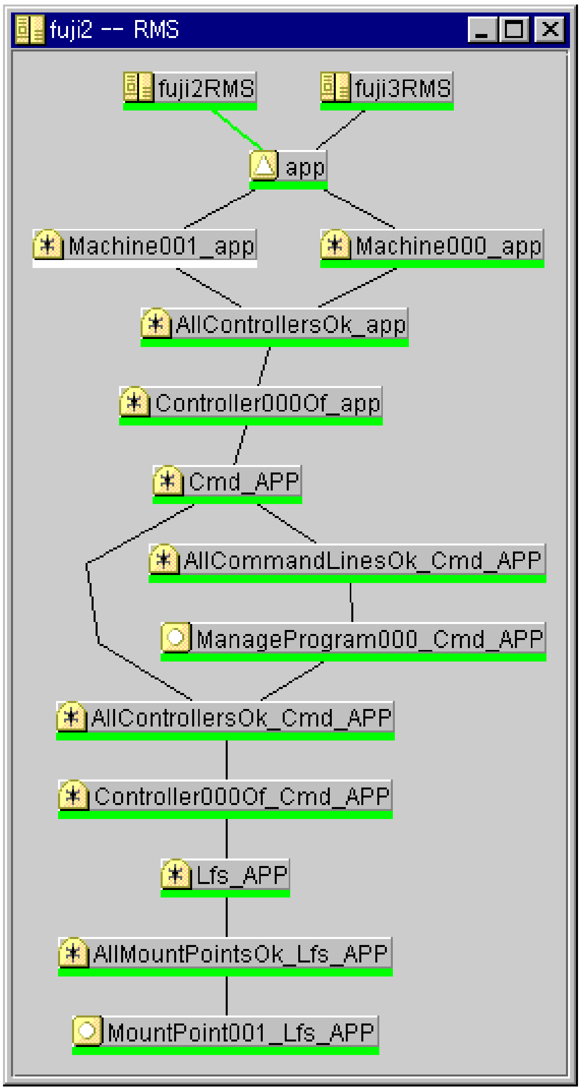
Figure 2.1 Object hierarchy for initializing examples



Note that the hierarchy in the figure includes the SysNode objects as parents of the application. While this is often done by convention, these SysNode objects are not dependent on the application objects in any way; however, their presence serves as a reminder of which nodes are represented by the application's child andOp objects. They also appear in the graph generated by the GUI, but in this case their major purpose is to indicate the node where the application is currently running.

The actual RMS graph for this configuration as produced by RMS Wizard Tools is shown in the following figure.

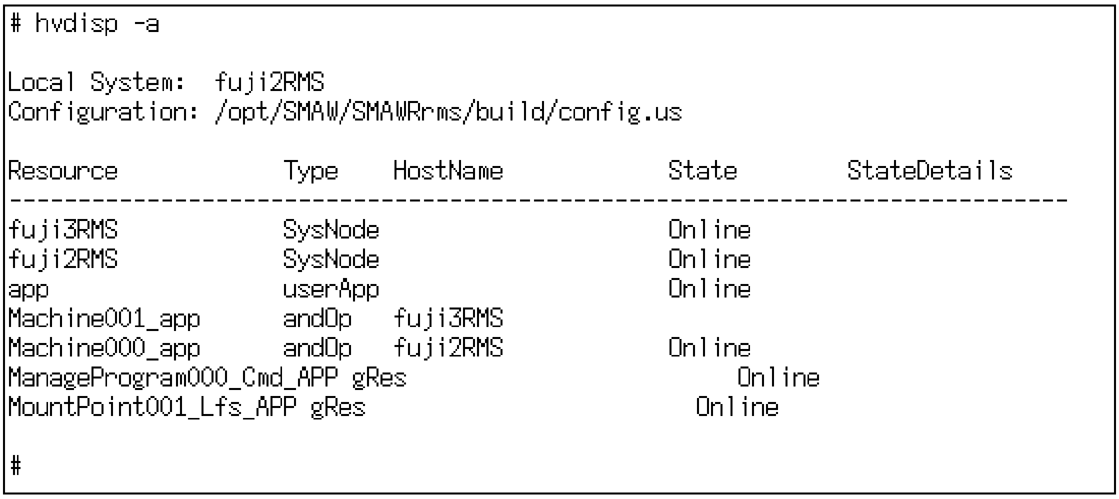
Figure 2.2 System graph for initializing examples - RMS Wizard Tools



The title bar contains the name of the node on which the graph was drawn, which is fuji2RMS. The line connecting fuji2RMS to app is green, indicating the node where the application is online.

The corresponding output from 'hvdisp -a' is shown in the following figure.

Figure 2.3 hvdisp output for initializing examples - RMS Wizard Tools



```
# hvdisp -a

Local System:  fuji2RMS
Configuration: /opt/SMAW/SMAWRrms/build/config.us

Resource            Type    HostName            State        StateDetails
-----------------------------------------------------------------------------
fuji3RMS            SysNode                     Online
fuji2RMS            SysNode                     Online
app                 userApp                     Online
Machine001_app      andOp   fuji3RMS
Machine000_app      andOp   fuji2RMS            Online
ManageProgram000_Cmd_APP gRes                        Online
MountPoint001_Lfs_APP gRes                        Online

#
```

To match the hvdisp output, the actual graph includes resource names, which can be displayed by selecting Preferences -> Show Resource Names in Graph in the Cluster Admin rms tab view.

Note that some of the actual object names generated by the RMS Wizard Tools are more complex than the simplified, generic names shown in the abstract graph of Figure 2.1 Object hierarchy for initializing examples. Also, Figure 2.1 Object hierarchy for initializing examples contains additional dependencies that are automatically inserted to ensure proper operation. Selecting other items from the Cluster Admin Preferences menu will display further detail and reveal additional objects and dependencies.

Neither the additional objects nor the complex names in the actual graph are required for a basic understanding of RMS operation. Therefore, to simplify the discussion, the examples in this chapter will focus on the abstract graph and use the generic names.

Example 1

The following process for the configuration illustrated in Figure 2.1 Object hierarchy for initializing examples is applicable for a monitor running on fuji2RMS:

1. RMS starts.
2. The base monitor determines the state of the SysNode objects.
3. The detectors of the cmd and lfs resources report their respective states as Offline.
4. Since it is a leaf object, lfs changes immediately to Offline and reports this change to its parent.
5. After receiving the detector report and the report of its child, cmd possesses the necessary information for determining its own state. It then goes offline and notifies this change of state to its parent andOp1.

   Point

   andOp2 is a remote object which is ignored by the base monitor on fuji2RMS.

6. andOp1 is a logical object which has no detector. It uses the message of the child to determine its own state as Offline and notifies this change of state to app.
7. app is also an object without a detector. When the child andOp that corresponds to the local node goes offline, app also goes offline.
8. All local child objects of app have exited the Unknown state and the initializing procedure is complete.

2.1.3 Online processing

The online processing for a userApplication object normally results in the userApplication transitioning to the Online state. Online processing of one userApplication object is independent of the online processing of any other userApplication objects.

The following situations can prevent successful online processing of a userApplication:

- The PreCheckScript determines that the userApplication should not come online.
- A fault occurs during online processing.

These situations are discussed in detail in later sections.

2.1.3.1 Online request

Generating the online request is referred to as switching the userApplication; that is, switching the userApplication online or switching the userApplication to another cluster node (refer also to the "2.1.6 Switch processing").

The following actions can generate an online request:

- Manual request using the GUI or CLI (hvswitch)
- Automatic request when RMS is started using the GUI or CLI (hvcm)
- Automatic requests controlled by the application's AutoSwitchOver attribute:
  - AutoSwitchOver includes ResourceFailure and a fault occurs
  - AutoSwitchOver includes ShutDown and a node is shut down

- AutoSwitchOver includes HostFailure and a node is killed

Manual methods

Manual methods have two modes for switching the userApplication. These modes are as follows:

- Priority switch - RMS selects the SysNode. The userApplication is switched to the highest priority SysNode. The SysNode objects' priority is determined by their order in the PriorityList attribute of the userApplication object.
- Directed switch - The user selects the SysNode. The userApplication is switched to a specific SysNode.

In both priority and directed switches, only SysNode objects that are in the Online state may be selected.

Manual request using the GUI

To manually generate an online request, perform the following steps:

1. Using the graph, right-click on an application to display its context menu.
2. Click on a switch or online item in the context menu.

Manual request using the CLI

To generate an online request for each userApplication, use the hvswitch command. Refer to the hvswitch manual page for details on usage and options.

Automatic methods

All automatic methods can only invoke a priority switch.

Automatic request at RMS startup

When RMS first starts on a cluster, it switches the userApplication online on the highest priority node if all of the following conditions are true:

- All SysNode objects associated with a specific application are online.
- The userApplication is neither online nor inconsistent on any other cluster node.
- The AutoStartUp attribute of the userApplication is enabled.
- No object in the graph of the userApplication is in the faulted state.

These limitations ensure that the userApplication is not started on more than one cluster node at a time.

If the userApplication is already online after startup, an automated startup request for the userApplication is immediately created, even if AutoStartUp is not set or not all SysNodes are online. This is intended to ensure a consistent graph of an online userApplication. Otherwise objects could still be offline in an graph of an online application.

Automatic request when a fault occurs

RMS initiates a priority switchover when it detects either a fault of a userApplication, or a fault of a SysNode where a userApplication was online. This automatic switchover is controlled by the application's AutoSwitchOver attribute as follows:

- AutoSwitchOver includes ResourceFailure and a fault occurs
- AutoSwitchOver includes ShutDown and a node is shut down
- AutoSwitchOver includes HostFailure and a node is killed

No automatic switchover occurs if AutoSwitchOver is set to No.

2.1.3.2 PreCheckScript

The PreCheckScript is intended to verify in advance that certain prerequisites for successful online processing are fulfilled. It avoids useless attempts when those prerequisites are not (yet) met. The PreCheckScript is also invoked during policy-based switching.

The PreCheckScript will be forked before the original online processing begins. If the script is successful and returns with an exit code of 0, online processing proceeds as usual. If the script fails and returns with an exit code other than 0, online processing is discarded and a warning is written into the switchlog.

Resulting state

When the PreCheckScript is running, the userApplication object transits into the Wait state. If the PreCheckScript fails, the userApplication object transits back into its previous state, usually Offline or Faulted.

AutoSwitchOver

If the PreCheckScript fails and the AutoSwitchOver attribute includes ResourceFailure, then RMS automatically forwards the online request to the next priority node (except in cases of directed-switch requests).

2.1.3.3 Online processing in a logical graph of a userApplication

If the PreCheckScript is successful, the base monitor generates a pre-online request. Relative to the resource graph, the pre-online request process is as follows:

1. Request is sent from the parent to the child.
2. Parent object changes to the Wait state, but no script is initiated.
3. Child receives the request. The pre-online script is initiated in the leaf objects.
4. When the script terminates, confirmation is sent to the parent.
5. As soon as all children of the parent have sent their confirmation, the pre-online script is executed on the parent.

In relation to the resource graph, the above steps illustrate the bottom-up procedure for executing the scripts in online processing.

The userApplication object is the final object to execute its pre-online script; it then generates an online request that is passed to the leaf objects. However, there is a difference between online processing and pre-online processing.

Relative to the resource graph, the online script process is as follows:

1. RMS executes the online script.
2. The system waits until the object detector reports the Online state. If a object does not have a detector, the post-online script executes after the OnlineScript is completed successfully.
3. The post-online script executes immediately.
4. Confirmation of the success of online processing is forwarded to the parent.
5. The object exits the Wait state and changes to the Online state.

In the context of RMS, "the userApplication is online" means that all the graph nodes configuring userApplication are Online. In this case, the term online does not pertain to the state of the actual application. The actual application is not controlled by RMS, or it is started by OnlineScript (or PostOnlineScript) configured for the userApplication object (more generally a Cmdline child object). When the userApplication object is Online, it only means that the script execution ended normally.

Note

How a script influences the state of the actual application depends on the application itself. RMS has no direct control over any user application. For a more complete discussion, see the section "1.2.2 Relationship of RMS configurations to the real world."

Example 2

The scenario for this example is as follows:

- AutoStartUp attribute is set to "yes."
- None of the resource objects have PreOnlineScript definitions.
- All objects are in the Offline state at startup time.

Online processing is as follows:

1. RMS starts.
2. userApplication object app on node fuji2RMS generates a pre-online request because the AutoStartUp attribute is set to "yes."

3. This request is passed through to the lfs leaf object. As no PreOnlineScript has been configured for any of the objects in this example, lfs forwards a message to app indicating that pre-online processing has completed successfully.
4. When the pre-online success message arrives, app generates the online request, which is also passed through to the lfs leaf object.
5. The lfs object executes the online script and brings the disk online.
6. As soon as the detector of lfs reports Online, successful completion of online processing is notified upwards to the cmd object. (If the object had a post-online script, this would have been executed before the success message was forwarded.)
7. The cmd object starts its online script.
8. As soon as the cmd detector reports a success completion, the success message is forwarded to andOp1.
9. The andOp1 object is a object without a detector; it does not have an online script in this example. As soon as its local child reports the Online state, it forwards the success message to its parent object app.
10. Upon receipt of the success message at app, RMS executes the online script and the application starts. Because app does not have a detector and also because no post-online script is configured, app changes immediately to the Online state after the online script has completed successfully.

2.1.3.4 Unexpected reports during online processing

Unexpected reports during online processing mean reports which are reported during the online processing but not in the Online state ignored by the base monitor.

Reports other than in the Online state ignored by the base monitor may be reported from the point where the online processing of the user application which an object belongs to starts until the object's online processing succeeds or fails.

For cases where the object's online processing fails, see the "2.1.3.5 Fault situations during online processing".

2.1.3.5 Fault situations during online processing

If an error situation occurs during online processing, the affected object commences fault processing and notifies its parent of the error (see also the "2.1.5 Fault processing"). The following can cause faults during online processing:

a. When the last reported state from a detector of a resource object is in the Offline or Faulted state at the point where Online processing finishes.

b. Script fails with an exit status other than 0.

c. Script fails with a timeout.

d. An object's OnlineScript finishes and the detector does not notify the Online state within a specific period.

For case a, fault processing is initiated after online processing of userApplication finishes in direct contrast to cases b, c, and d where fault processing is initiated immediately once that condition is satisfied.

2.1.3.6 Initialization when an application is already online

A situation can occur in which the entire logical graph of a userApplication is already online when RMS is initialized. In this case, the PreCheckScript does not execute and the affected objects switch directly from the Unknown state to the Online state without executing any scripts.

Request while online

If a userApplication receives an online request when it is already online, it is forwarded to the other objects as usual. The only difference from the description in the "2.1.3 Online processing" is that any objects that are already online forward the request or the responses without executing their scripts and without changing to the Wait state. In particular, the PreCheckScript is not run.

A typical example of an object which is always online when RMS is initialized is a gResource object for a physical disk, since physical disks cannot in general be disabled through a software interface.

No request while online

If a userApplication does not receive an online request when it is already online and RMS is initialized, the userApplication carries out online processing of its graph as if it had received an explicit online request. The resulting state of the local graph is exactly the same as in the previous case.

Guarding against data loss when the application is already online

A primary objective of RMS is to ensure that no data loss occurs as a result of simultaneous activity of the same application on more than one node in the cluster. Therefore, after the online processing of the application's graph in either of the two cases described above, the base monitor on the local node reports the userApplication object's Online state to the base monitors on the other nodes to ensure that no corresponding application goes online elsewhere in the cluster.

Note

- It can be extremely damaging if a userApplication is online on more than one node immediately after RMS has initialized. In this case, RMS generates a FATAL ERROR message and blocks any further requests for the userApplication. This minimizes the possibility of damage caused by inconsistency in the cluster.
- The situations described in this section are a result of manual intervention. If the manual intervention allowed competing instances of an application or a disk resource to run on multiple nodes, data corruption may have already occurred before RMS was initialized.

2.1.4 Offline processing

Normally, offline processing results in the userApplication object transitioning to the Offline state.

2.1.4.1 Offline request

An offline request can be generated for any of the following reasons:

- Manual offline request using the GUI or CLI (hvutil -f)
- Manual switch request using the GUI or CLI (hvswitch)
- Offline processing after a fault, either automatically or using the GUI or CLI (hvutil -c)
- RMS shutdown using the GUI or CLI (hvshut)

In normal operating mode, only the RMS command interface can generate an Offline request. In the case of a fault, the userApplication generates its own Offline request to prevent an application that is no longer operating correctly from continuing to operate in an uncontrolled manner (see also the "2.1.5 Fault processing"). This offline request is also a primary precondition for any subsequent switchover.

Note

Offline processing of userApplication objects does not occur if RMS is shut down with 'hvshut -L' or 'hvshut -A'.

2.1.4.2 Offline processing in a logical graph of a userApplication

Unlike online processing, the direction of offline processing is from the userApplication to the leaf object (top-down). Nodes without a detector execute the post-offline script immediately after the offline script. The offline process is as follows:

1. The userApplication changes to the Wait state.
2. The userApplication executes its pre-offline script, and sends a corresponding request to its children after the pre-offline script terminates.
3. After receiving the pre-offline request, each child object changes to the Wait state, executes its pre-offline script, and forwards the request.
4. As soon as the leaf objects have completed their pre-offline script, they send a corresponding message (confirmation of successful pre-offline processing) to their parents.

5. The message is forwarded without any further activity from the children to the parent until it arrives at the userApplication.
6. After pre-offline processing has been completed, the userApplication executes its offline script, immediately followed by the post-offline script (userApplication is a object without a detector).
7. The userApplication then generates the actual offline request.

Processing of the offline request in the individual objects is similar to online processing, as follows:

- The offline script is executed first.
- The post-offline script is started after the object's detector Offline report has arrived.
- After the post-offline script has completed, the offline request is forwarded to each of the object's children.
- When all children have returned a PostOfflineDone message, the object returns a PostOfflineDone message to its parent.

As illustrated, the userApplication is the final object to go offline. After the last child returns a PostOfflineDone message, the offline processing is complete; the OfflineDoneScript, if present, is fired; and the base monitor notifies the corresponding userApplication objects on the other nodes that the application has gone offline.

Example 3

The following further explains the offline process:

1. As none of the objects in the example has a pre-offline script, the corresponding pre-offline request is forwarded from app down to the leaf object.
2. The leaf object returns a success message to the userApplication.
3. The userApplication executes its offline script; in our example, this means that the application app is stopped. As the object app does not monitor the application, RMS considers the successful completion of the offline script to be a successful completion of offline processing.
4. A post-offline script is not configured, and an offline request is accordingly sent to andOp1 immediately after the offline script has completed.
5. The andOp1 object has no detectors and no scripts. The offline request is simply permitted to pass through.
6. The cmd object executes its offline script and forwards the request as soon as its own detector signals that offline processing has completed successfully.
7. The lfs leaf object also executes its offline script and forwards the success message after the corresponding report of its detector.
8. Offline processing completes successfully when app receives the success message.
9. Upon successful completion of offline processing, the OfflineDoneScript is fired. This script is intended for cleanup or for sending information. Its return code has no impact on the state of the userApplication.

2.1.4.3 Unexpected reports during offline processing

Unexpected reports during offline processing mean reports which are reported during the offline processing but not in the Offline state ignored by the base monitor.

Reports other than in the Offline state ignored by the base monitor may be reported from the point where the offline processing of the user application which an object belongs to starts until the object's offline processing succeeds or fails.

For cases where the object's offline processing fails, see the "2.1.4.4 Fault situations during offline processing".

2.1.4.4 Fault situations during offline processing

If an error situation occurs during offline processing, the affected object commences fault processing and notifies its parent of the error (see also the "2.1.5 Fault processing"). The following can cause faults during offline processing:

- When the last reported state from a detector of a resource object is in the Online, Standby, or Faulted state at the point where Offline processing finishes.
- Script fails with an exit status other than 0.

- Script fails with a timeout.
- An object's OfflineScript finishes and the detector does not notify the Offline state within a specific period.

2.1.4.5 Object is already in Offline state

An object may already be offline at the start of offline processing. This typically occurs if an offline request originates from a host where the parent userApplication is offline. (If the parent userApplication is online, then the offline object must be in the tree below an OR object.) When an offline object receives an offline request, the request is merely passed through, similar to the situation in online processing. Scripts are not executed, and the Wait state is not entered.

2.1.4.6 Object cannot be sent to Offline state

RMS covers an extremely wide range of system conditions, including monitoring resources that cannot be taken to the Offline state by a script. Physical disks are an example of such objects because they are monitored but cannot in general be physically shut down. For this purpose, RMS provides the attribute LieOffline to indicate that the resource has no true Offline state. The Wizard Tools subapplications set this attribute by default for gResource objects that represent physical disks, so it does not have to be explicitly specified.

During offline processing, an object whose LieOffline attribute is set reacts in the same way as any other object when its preoffline, offline, and postoffline scripts are run. The reaction of the object with respect to its parent is also the same as if the object had been successfully taken offline; that is, it "lies." An object with LieOffline set does not wait for an offline report of the detector after the offline script has executed; instead, it automatically executes the post-offline script. An unexpected online report of the detector (which arrives after the offline script has executed) is not a fault condition in this case.

2.1.5 Fault processing

The handling of fault situations is a central aspect of RMS. How RMS reacts to faults differs depending on the state of an application at any particular time. For instance, the reaction to faults that occur in the resource graph of an ongoing application differs from the reaction to faults in the graph of an application that is locally offline.

2.1.5.1 Faults in the online state or request processing

When a detector indicates a fault for an online object whose corresponding userApplication is also online, RMS executes the fault script of the object. An equivalent fault condition occurs if the detector indicates that a previously online object is offline although no request is present.

After the fault script completes, RMS notifies the parents of the fault. The parents also execute their fault scripts and forward the fault message.

A special case is represented by orOp objects, which report a logical OR of their children's states. These react to the fault message only if no child is online. If any child of the parent orOp is online, RMS terminates the fault processing at this point.

If there is no intermediate orOp object that intercepts the fault message, it reaches the userApplication. The userApplication then executes its fault script. There are three possible cases during processing according to the following combinations of the AutoSwitchOver and PreserveState attributes:

- AutoSwitchOver includes ResourceFailure
- AutoSwitchOver does not include ResourceFailure and PreserveState=1
- AutoSwitchOver does not include ResourceFailure and PreserveState=0 or is not set

AutoSwitchOver includes ResourceFailure

When the AutoSwitchOver attribute includes ResourceFailure, RMS ignores the PreserveState attribute and responds as if only the AutoSwitchOver attribute were set. In this case, the process is as follows:

1. The userApplication attempts to initiate the switchover procedure. For this purpose, the application on the local node must be set to a defined Offline state. The procedure is the same as that described under offline processing.
2. When offline processing is successfully completed, an online request is sent to the corresponding userApplication of a remote node (see the "2.1.6 Switch processing"). However, the userApplication is now in the Faulted state - unlike the situation with a normal offline request. This prevents the possibility of an application returning to the node in the event of another switchover.

If a further fault occurs during offline processing; for example, if RMS cannot deconfigure the resource of an object that was notified of a Faulted state, then it does not execute a switchover procedure. RMS does not execute a switchover because it views the resources as being in an undefined state. The userApplication does not initiate any further actions and blocks all external, non-forced requests.

Point

A failure during offline processing that was initiated by a previous fault is called a double fault.
This situation cannot be resolved by RMS and requires the intervention of the system administrator. The following principle is applicable for RMS in this case: Preventing the possible destruction of data is more important than maintaining the availability of the application.
If the application is important, the HaltFlag attribute can be set in the userApplication during the configuration procedure. This attribute ensures that the local node is shut down immediately if RMS cannot resolve a double fault state, provided there is another node available for the application. The other nodes detect this as a system failure, and RMS transfers the applications running on the failed node to the available node.

AutoSwitchOver does not include ResourceFailure and PreserveState=1

In this case, the process is as follows:

1. The userApplication does not initiate any further activity after the fault script executes.
2. All objects remain in their current state.

Use the PreserveState attribute if an application can remedy faults in required resources.

AutoSwitchOver does not include ResourceFailure and PreserveState=0 or is not set

In this case, RMS carries out offline processing as a result of the fault, but it does not initiate a switchover after offline processing is complete (successful or not).

Fault during pending switch request

A special case occurs when a switch request causes a fault during offline processing. In this case, RMS carries out a switchover after completing the offline processing that the fault caused (provided that offline processing is successful), even if the AutoSwitchOver attribute is set to No. Switchover had evidently been requested at this time by the system administrator who sent the switch request online. If the ongoing switch request is a direct switch request, the target node of the switchover procedure may not be the node with the highest priority; it is the node explicitly specified in the directed switch request.

See

For more information about the AutoSwitchOver and PreserveState attributes, see the "Appendix D Attributes".

2.1.5.2 Offline faults

Even if an application is not online on a node, RMS still monitors the objects configured in the application's graph. If a detector indicates a fault in one of these objects, the fault is displayed. However, no processing takes place, the fault script is not executed, and no message is sent to the parent.

In this case, it is possible that an andOp object could be offline, even though one of its children is Faulted.

This design was chosen on the principle that mandatory dependencies between the objects in a userApplication graph exist only if the userApplication is to run.

2.1.5.3 AutoRecover attribute

An object of the type gResource that represents a local file system is one example of an object that can enter a Faulted state due to reasons that are easily and automatically remedied. A fault that occurs in the object itself (and not as a result of an input/output fault on an underlying disk) is most likely from a umount command that was erroneously executed. In this case, causing the entire application to be switched over probably would not be the best remedy. Therefore, fault processing would not be the best solution.

For such cases, administrators can configure an object's AutoRecover attribute. If a fault then occurs when the object is online, the online script is invoked before the fault script. If the object enters the Online state again within a specific period after the online script has been executed, fault processing does not take place.

RMS only evaluates the AutoRecover attribute when the object is the cause of the fault, that is, when the cause of the fault is not the fault of a child. Accordingly, RMS only evaluates AutoRecover for objects with a detector. The AutoRecover attribute is not relevant if a fault occurs during request processing or if the object is in the Offline state.

2.1.5.4 Fault during offline processing

A fault occurrence during offline processing does not result in an immediate halt of offline processing at that object. Instead, the fault condition at that point in the tree is stored, and offline processing continues in the normal manner down to the leaf objects. However, the fault is recalled and handled when the success/failure message is propagated to the object on the way upstream to the userApplication. This design avoids race conditions that could occur if the fault were processed immediately.

2.1.5.5 Examples of fault processing

The following are examples of fault processing.

Example 4

The scenario for this example is as follows:

- The application app has its AutoSwitchOver attribute set to No and is online on node fuji2RMS.
- There is no request.
- The lfs object does not have its AutoRecover attribute set.
- An error by the system administrator unmounts the lfs file system.

Fault processing is as follows:

1. The lfs object's gResource detector indicates that its object is offline. Because the corresponding userApplication is online and because there is no offline request, RMS interprets this offline report as a fault and notifies the parent cmd.

   Point

   Reminder: An unexpected Offline state results in a fault.

2. The cmd object in this example does not have a fault script. The cmd object goes directly to the Faulted state and reports the fault to its parent andOp1.
3. andOp1 does not have a fault script either, so it also goes directly to the Faulted state, and reports the fault to the parent app object.
4. The app object then changes to the Faulted state and starts offline processing in preparation for switchover, since its AutoSwitchOver attribute is set to a value other than No.
5. In this example, assume that the local file system lfs uses the mount point /mnt, and the offline script of lfs consists of the simple instruction umount/mnt. Because /mnt is no longer mounted, this offline script terminates with an exit status other than 0.
6. Accordingly, offline processing for RMS fails after a fault. A switchover is not possible because the local state remains unclear. RMS waits for the intervention of the system administrator.

A more complex offline script for lfs could check whether the object is still mounted and terminate with an exit status of 0. In this case, RMS could successfully complete offline processing after the fault and switch over to fuji3RMS; all local objects on fuji2RMS would then be offline following successful online processing, and only app would remain in the Faulted state.

Example 5

The scenario is the same as in the previous example, except the AutoRecover attribute is set for the lfs object.

Fault processing is as follows:

1. The lfs object's gResource detector indicates that its object is offline. Since the corresponding userApplication is online and because there is no offline request, RMS interprets this offline report as a fault (see above).
2. Since the AutoRecover attribute is set, RMS does not immediately report the fault to the parent cmd object. Instead, RMS starts the lfs object's online script to reverse the unmount procedure.
3. A few seconds later, the lfs object's gResource detector reports that the object is once again online. RMS returns the object to the Online state, and no further fault processing takes place.

Example 6

In this scenario, app receives an online request, but the file system represented by lfs has been corrupted.

Fault processing is as follows:

1. Online processing starts as a result of the request.
2. The lfs object starts its online script, which terminates with an exit status other than 0.
3. The lfs object then initiates fault processing: it starts its fault script (if one is configured), changes to the Faulted state, and notifies RMS of the fault.
4. The rest of the process proceeds in the same manner as described as above.

Point

Fault processing in this case would be the same even if the AutoRecover attribute were set. This attribute is only significant if the application is in a stable Online state, that is, the application is online and there is no pending request.

2.1.5.6 Fault clearing

After successful offline processing due to a fault occurrence, the resource objects will be offline, and the userApplication object will be faulted. If offline processing fails as a result of the fault, or if the application's PreserveState attribute is set, at least part of the graph may remain in a state other than Offline, i.e., Online, Standby, or Faulted.

In all of the above states, the userApplication prevents switch requests to this host, because the base monitor assumes that at least some of the resources are not available. After the system administrator has remedied the cause of the fault, one of the following procedures can be used to notify the base monitor so that RMS can resume normal operation:

1. The following command may be used to clear the faulted state of the userApplication object and the objects in its graph:

   ```
   hvutil -c userApplication
   ```

   This command attempts to clear the fault by switching the parent application and its graph into a self-consistent state: if the application object is online, then online processing will be initiated; if the application object is offline, then offline processing will be initiated. (The user is notified about which type of processing will occur and given a chance to abandon the operation.) The fault clears successfully when every branch leading to the application reaches the same online or offline state. If the final state is offline, the system administrator can set the userApplication to the online state with a switch request.

   If the userApplication object is initially online, invoking 'hvutil -c' may not affect every object in the tree. To initiate offline processing for the entire tree, use 'hvutil -f' as described below.

2. The following command initiates an offline request to the userApplication object:

   ```
   hvutil -f userApplication
   ```

   This starts offline processing for the application. If the command completes successfully, the application and every object in its graph are switched to the offline state, and the fault is cleared. If required, the system administrator can set the userApplication to the online state with a switch request.

2.1.5.7 SysNode faults

RMS handles a fault that occurs in a SysNode in a different manner than faults in any other type of object. A SysNode fault occurs under the following conditions:

- The local base monitor loses the heartbeat of the base monitor on a remote host.
- A CF LEFTCLUSTER event occurs

When either of these events happen, RMS must first ensure that the remote node is actually down before automatic switchover occurs. To accomplish this, RMS uses the Shutdown Facility (SF). For more information about the Shutdown Facility and shutdown agents, see "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide."

Once the shutdown of the cluster node is verified by the SF, all userApplication objects that were Online on the affected cluster node, and whose AutoSwitchOver attribute includes HostFailure, are priority switched to surviving cluster nodes.

Example 7

The scenario for this example is as follows:

- RMS is running on a cluster consisting of nodes fuji2 and fuji3, which are represented by the SysNode objects fuji2RMS and fuji3RMS, respectively.
- app is online on fuji2RMS and its AutoSwitchOver attribute includes the HostFailure setting.
- A system fault on fuji2 generates a panic message.

The reaction of RMS is as follows:

1. CF determines that a node failure has occurred and generates a LEFTCLUSTER event.
2. RMS puts the SysNode in a Wait state. RMS receives the LEFTCLUSTER event and sends a kill request to SF.
3. After SF successfully kills the node, a DOWN event is sent.
4. RMS receives the DOWN event and marks the SysNode as Faulted
5. The fuji2RMS object executes its fault script (assuming that such a script has been configured).
6. The fuji2RMS object notifies the userApplication objects that fuji2RMS has failed. Since app was online on fuji2RMS when fuji2RMS failed, and since its AutoSwitchOver attribute includes the HostFailure setting, the object app on fuji2RMS starts online processing.

Operator intervention

If the Shutdown Facility is engaged to kill a node, but the duration of the SysNode object's Wait state exceeds the object's ScriptTimeout limit, RMS records an ERROR message in the switchlog to this effect.

At this point, one cluster node is now in an undefined state, so RMS blocks all further action on all other nodes. This situation is usually resolved only by operator intervention as described in "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide." Upon successful completion of the procedure, CF sends a DOWN event, RMS resolves the blocked state, and normal operation resumes.

For more information about the ScriptTimeout attribute, see the "Appendix D Attributes".

2.1.6 Switch processing

The switch processing procedure ensures that an application switches over to another node in the cluster.

2.1.6.1 Switch request

Switch requests are divided as follows:

- Priority switch request

  RMS identifies the target node according to the node priority list defined during the configuration process.

- Directed switch request

  The user specifies the target node.

The types of switches are divided as follows:

- Switchover

  The application running on a node is to be switched over to another node.

- Switch-online

  An application that is not running on any node is started; or the node on which it has previously been running has failed.

Point

During switch processing, RMS notifies all the nodes in the cluster of the procedure. This prevents competing requests.

Example 8

The scenario for this example is as follows:

- app is online on fuji2RMS.
- The system administrator sends a directed switch request on fuji3RMS with the aim of switching app to fuji3RMS.

Switch processing is as follows:

1. RMS forwards the switch request to fuji2RMS because fuji2RMS is the online node of the userApplication object.
2. app on fuji2RMS notifies the corresponding nodes in the cluster (in this case, app on fuji3RMS) that switchover processing is active. This means that competing activities are blocked.
3. app on fuji2RMS sends a request to app on fuji3RMS to establish whether any faults are known in the local graph on fuji3RMS. In this example, there are no known faults in the local graph on fuji3RMS.
4. app on fuji2RMS commences offline processing.
5. As soon as RMS has successfully deconfigured app on fuji2RMS, app on fuji2RMS notifies all corresponding nodes in the cluster that the application will now be running on fuji3RMS. Blocking of competing requests is simultaneously cancelled.
6. app on fuji2RMS terminates its activity by sending an explicit online request to app on fuji3RMS.
7. app on fuji3RMS commences online processing.

2.1.7 Special states

2.1.7.1 Restrictions during maintenance mode

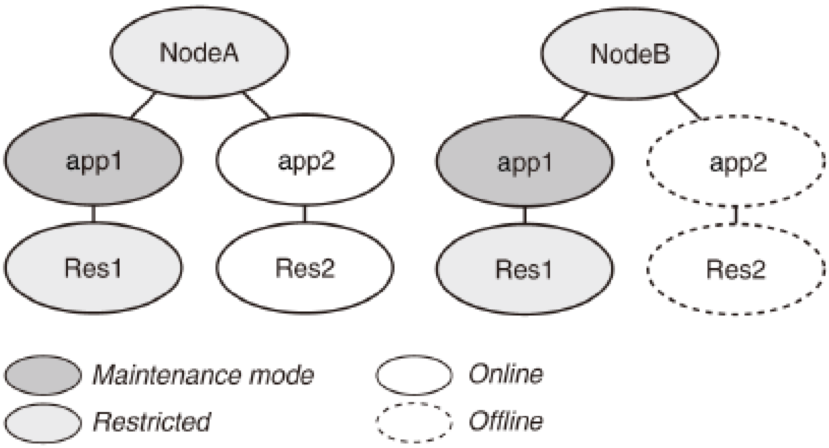
An application in maintenance mode imposes processing restrictions on other objects that appear in the same graph. These restrictions prevent all processing described in earlier sections of this chapter, and they affect the following objects:

- All child objects of the application in maintenance mode
- All ancestors up to and including the node where the application in maintenance mode resides

The restrictions may generate either an error or a timeout, depending on the type of processing request.

To illustrate how the restrictions apply, consider the situation in which two applications (app1 and app2) each have a single dependent resource (Res1 and Res2, respectively) and are configured to run on either of two nodes (NodeA and NodeB). The following figure shows the states of these objects if app1 is put into maintenance mode.

Figure 2.4 Example of maintenance mode restrictions



This simple example illustrates the following features:

- Maintenance mode for an application applies on every node where the application could be brought online, i.e., on every node in its PriorityList attribute. Therefore, app1 is in the Maintenance state on every node where it could run, regardless of its previous state on any of those nodes.

  Note that app1 also has an intended status on each of its nodes. This is the status just before the start of maintenance mode. The intended status is available in the application's *StateDetails* parameter in the GUI and in the CLI hvdisp output.

- Since Res1 is a child of app1, it is restricted everywhere.

- Since app1 appears in the graph of both NodeA and NodeB, they are also restricted. (You can initiate RMS shutdown of either node, but you will be prompted to let RMS take app1 out of maintenance mode first.)

- app1 does not appear in the graph of app2. Therefore, normal processing of app2 and its resource is allowed, including switching app2 offline, online, or to a different node.

- Do not stop RMS or the system while the application is in the maintenance mode. You must exit the maintenance mode of all applications before stopping them.

  If you stop RMS by using a force option before exiting the maintenance mode of all applications, the OS will shut down without the offline process being performed.
  Therefore, this could sometimes result in some resources like volume manager being in an incorrect state when RMS comes back up.

This behavior is typical if an application is put into maintenance mode with 'hvutil -m on', or if the equivalent GUI operation begins by right-clicking on the individual application. However, if 'hvutil -M on' is used, or if the GUI operation begins by right-clicking on the cluster name, then maintenance mode is clusterwide and processing is suspended everywhere.

2.1.7.2 The Inconsistent state

There are situations in which a userApplication and one or more of the resources in its graph are Offline or Faulted, while other resources in its graph are Online or Faulted. This could be the result of manual intervention by an administrator, or it could occur when a fault clearing operation fails and leaves some objects in Online or Faulted states.

It may be that some of these Online or Faulted resource objects have their ClusterExclusive attribute set, which indicates that they should not be brought Online on two or more hosts at the same time. If the userApplication were marked simply as Offline or Faulted, it could be switched Online on another node along with all its resources. This would be in direct conflict with the intention of the ClusterExclusive attribute, and the resulting resource conflict might cause data corruption. To avoid problems in these cases, RMS prevents any switch of the userApplication by marking it as Inconsistent rather than Offline or Faulted. The exact definition is as follows:

- A userApplication is marked with the Inconsistent state if its actual state is either Offline, Standby, or Faulted, and one or more resource objects in its graph are either Online or Faulted and have their ClusterExclusive attribute set to 1.

Note that while the userApplication is displayed or reported as Inconsistent, the actual state is either Offline, Standby, or Faulted. For most operations, the behavior of an Inconsistent userApplication is determined by the underlying actual state. For instance, if the actual state is Offline, and an Offline request is issued, no Offline script will be fired (see the "2.1.4.5 Object is already in Offline state").

The exception to this behavior occurs when there is a request to switch an Inconsistent userApplication to a remote node: in this case, the request is denied. This avoids possible damage by ensuring that the ClusterExclusive resources are Online only on one host at a time.

If a userApplication is Inconsistent on only one node, then it is possible to switch it Online on that node. However, if it is Inconsistent on two or more nodes, then it cannot be switched at all; in this case, the inconsistency must be resolved first, e.g., by bringing all resources into an Offline state via 'hvutil-f' or 'hvutil-c'.

If a userApplication is Inconsistent on multiple nodes, one of its ClusterExclusive resources may be Online on multiple nodes as well. If this is the case, take appropriate action to shut down the resource gracefully on each node before you issue an 'hvutil' command for the userApplication. Depending on the resource type, you may also need to determine if there has been any data corruption.

2.2 RMS heartbeat operation

RMS transmits a UDP heartbeat signal at regular intervals. If the elapsed time since the last heartbeat from a node exceeds an adjustable connection timeout, RMS assumes the node has lost connectivity (see "HV_CONNECT_TIMEOUT"). RMS then begins a recovery period for the node. If the node heartbeat is detected during the recovery period, RMS assumes the node is functional and returns it to normal status. However, if RMS receives no heartbeats from the node before the recovery period expires, it assumes the node is down, even if other communication with the node is possible.

Once RMS marks a node as down, it takes a series of steps to ensure application and cluster integrity. First, it is necessary to ensure that the node is truly shut down. Otherwise, the node and its applications could unexpectedly recover later, causing conflicts and data corruption. To avoid these problems, RMS directs the Shutdown Facility (described later) to eliminate the node. This is often done by rebooting the node or turning off its power, but the exact action depends on which shutdown agents have been configured for the node. Only after the node has been eliminated is it safe for RMS to restart the node's applications elsewhere in the cluster. The process of automatically switching applications from a failed node to a healthy node is called application failover.

Application switchover impacts cluster performance, so it is important to choose a recovery timeout that avoids false detection of node outages. The optimum UDP recovery time depends on the conditions in the cluster. A short recovery period is the best choice to deal with failures of nodes or base monitors. However, a long recovery period allows time for overloaded nodes to respond, which avoids unnecessary shutdowns. If the UDP method is used by itself, these opposing requirements make it difficult to tune the recovery time in large or busy clusters.

Note that the UDP method can be unreliable, because it has three potential points of failure: first, an outgoing request for a response may not get through to the remote node, so it has no reason to respond; second, the remote node may be so busy that it cannot respond within the recovery period, especially if the recovery timeout is set to a low value; third, a response packet may be sent from the remote node, but it may not get through to the local node. In all three cases, the local node cannot take action until the recovery period expires.

To improve cluster response, RMS uses its Enhanced Lock Manager (ELM) as the primary method to determine machine states and connectivity. ELM is not a polling method. Instead, it relies on locks that are managed at the kernel level by the Cluster Foundation. When a node joins the cluster, it creates a lock and holds it as long as its base monitor is running. The lock is released when the node or its base monitor goes down. The state of the locks is available locally on each node, because the Cluster Foundation maintains them in the background.

ELM is designed to address the high priority issue of node or base monitor failures. The UDP heartbeat can therefore be optimized to detect slow node response, with the recovery time set to a relatively large value. This provides an important complement to ELM. A node with an overloaded CPU or network interface may respond so slowly that the underlying Cluster Foundation cannot determine the state of the node's lock. If this condition persists, the UDP heartbeat recovery period eventually expires, and RMS proceeds to shut down the node. ELM's efficiency and reliability make this a very infrequent occurrence.

Experts can manually disable ELM for rolling upgrade or debugging operations (see "HV_USE_ELM"). In this case, when RMS starts up, the expert must also manually adjust the UDP heartbeat recovery timeout to a smaller value with 'hvcm -h <timeout>'. This is necessary to efficiently detect remote base monitor and node outages in the absence of ELM.

2.2.1 Operational details

The ELM mechanism is best illustrated with a few simple examples. The following discussion assumes the cluster consists of two or more nodes named A, B, C, etc.

2.2.1.1 ELM lock management

The lock name for each node has the format "RMS<*nnnnnn*>", where <*nnnnnn*> is the 6-digit CF node ID. Therefore, the correspondence of every node's name, CF node ID, and lock name is easily determined. The locks are maintained clusterwide by CF, and any node can request access to any lock.

When a node first requests access to a lock, the request is granted immediately, because the node will initially receive it in the NULL state. This is a special, neutral state that does not conflict with that lock's state on any other node. The local node can then issue a request to ELM to convert the lock to another state. Once the request is granted, the node can hold it in that state, or it can convert it to another state. Those are the only possible operations.

Besides the NULL state, ELM supports only two other states:

- concurrent read (CR)

  Multiple nodes can hold the lock in this state. This will prevent other nodes from converting the lock to the exclusive state.

- exclusive (EX)

  Only one node in the cluster can hold the lock in this state. This will prevent other nodes from converting the lock to the concurrent read or exclusive states.

The conversion operation is the central control mechanism for ELM. Requesting a conversion that would conflict with other nodes does not cause an error condition. Instead, the request is put into a queue until ELM can grant the request. The requesting process is put in a wait state, and when it reawakens, it knows its request has been granted.

When a node converts a lock back to the NULL state, it effectively releases the lock, and allows other nodes to convert the lock to their desired state. The requests will be granted in the order they were queued.

For example, suppose A has converted its lock to the EX state. B can request access to A's lock and receive it immediately in the NULL state. If B then issues a request to convert it to the CR state, the request will wait until A (or ELM itself) converts the lock to the NULL or CR state, because neither of these conflict with B's request. Therefore, when B successfully converts A's lock, it knows that A is no longer holding the lock in the EX state.

Since a request to access another node's lock is granted immediately and does not affect the ELM lock mechanism, that step is omitted in the following discussions.

2.2.1.2 First node startup

Assume that A is the first node to start RMS. The following sequence occurs:

1. A converts its own lock to EX mode. This happens immediately, since no other nodes have completed their startup at this point.
2. A initiates its UDP heartbeat and waits for responses from other nodes. It does not yet attempt to convert the locks of any other node at this point.

2.2.1.3 Second node startup

Assume that B is the second node to start RMS. The following sequence occurs:

1. B converts its own lock to EX mode. This happens immediately, since A has not requested access to B's lock at this point.
2. B initiates its UDP heartbeat and waits for responses from other nodes. It does not attempt to convert the locks of any other nodes at this point.
3. A detects the first heartbeat from B. A issues a request to convert B's lock to the CR state. Since B holds its lock in the EX state, A's request goes to sleep while it waits in the ELM queue.
4. Since A's request is sleeping, B must be holding its own lock. Therefore, B must be online, and A marks it accordingly. A continues to mark B as online as long as its request remains asleep.
5. B detects the heartbeat from A and executes a similar sequence. B tries to convert A's lock to CR mode. But A holds its lock in the EX state, so B's request goes to sleep while it waits in the ELM queue.
6. As long as B's request remains asleep, B continues to mark A as online.

At this point, both nodes hold their own locks in the EX state, and each has issued a request to convert the other's lock to the CR state. Both requests are sleeping, but that has no effect on anything else either node is doing. However, the unfulfilled request on each node indicates the other base monitor is online.

2.2.1.4 Third and subsequent nodes

Assume C is the third node to start RMS. The sequence of operations with each of A and B are similar to the second node startup above:

1. C converts its own lock in the EX state, initiates its heartbeat, and then waits for the heartbeats from the other nodes.
2. When it first receives the heartbeat from one of the other nodes, it tries to convert that node's lock to the CR state, and the request goes to sleep.
3. As long as the request remains asleep, C marks the other node as online.

C performs steps 2 and 3 whenever it receives a heartbeat from a node for the first time.

At the same time, the other online nodes receive C's heartbeat for the first time, and they execute steps 2 and 3 with C's lock.

When the entire cluster is online, the states of the locks on each node are as follows:

- The node hold its own lock in the EX state.
- The node has issued requests to convert every other node's lock to the CR state, and all of these requests are sleeping.

2.2.1.5 Node or RMS down scenario

When CF has issued a LEFTCLUSTER event for a remote node, or when the base monitor on a remote node goes down, ELM converts that node's lock to the NULL state on every node in the cluster.

For example, suppose node B has just gone down. The sequence of events on node A is typical of every other online node:

1. A's pending request to convert B's lock to the CR state wakes up. A now holds that lock in the CR state.
2. A immediately converts the lock to the NULL state and marks B as being offline.
3. A continues to mark B as offline until it receives a heartbeat from B. At that point, A restarts the lock cycle by requesting to convert B's lock to the CR state.

The same sequence would have occurred if node B's base monitor went down first. The major difference would be that, if the node goes down, the LEFTCLUSTER event would precede the ELM lock release; if the base monitor went down, the ELM lock release would precede the LEFTCLUSTER event. Either condition would cause RMS to initiate a node elimination.

The ELM method proactively alerts the other base monitors when an outage occurs somewhere in the cluster. They do not have to wait for heartbeat timeouts to expire.

Note that ELM handles a graceful shutdown in much the same way, but in this case, the node itself releases the lock. Also, at the RMS level, no node elimination is necessary.

2.2.1.6 Slow response scenario

When a remote node is busy, its base monitor may respond very slowly. ELM is a state-based method and cannot detect this condition. Therefore, RMS depends on the time-based UDP heartbeat to decide when the remote response has become unacceptably slow.

For example, suppose node B is not down, but its base monitor is responding very slowly. The following sequence will occur on one of the nodes in the cluster, which we will be supposed to node A for this discussion:

1. A's request to convert B's lock to the CR state continues to sleep, because B is still up.
2. B's heartbeat period expires (default: 30 seconds), and then its heartbeat recovery period expires (default: 600 seconds).
3. Based on the heartbeat loss, A directs SF to eliminate B. (Note that ELM still detects no problem.)
4. When B is eliminated, ELM releases its lock on every node.
5. A's request to convert B's lock is granted. A immediately releases the lock and marks B as offline.
6. A waits for B's heartbeat, and the lock cycle starts again.

Other nodes may detect the loss of B's heartbeat before their lock request wakes up, in which case they will also initiate a node elimination of B.

This illustrates why ELM needs the UDP heartbeat as a backup. Without UDP, the ELM lock requests could remain in the queue well beyond the point where the remote node provides no useful services.

2.2.2 Default initialization in hvenv

The HV_USE_ELM environment variable in hvenv is automatically initialized to enable or disable ELM according to the status of CF:

- If CF is not installed, HV_USE_ELM is set to 0 and the default UDP heartbeat recovery timeout is 45 seconds.
- If CF is installed, HV_USE_ELM is set to 1 and the default UDP heartbeat recovery timeout is 600 seconds.

You can override the default recovery timeout with 'hvcm -h'.

Point

If the heartbeat recovery timeout is too short, premature node kills may occur even though ELM is operational.

2.2.3 Manually controlling ELM in hvenv.local

ELM may be manually disabled, but this should be done only by experts or consultants. Reasons for disabling ELM include:

- rolling upgrades
- testing or debugging

When you disable ELM, you must change the HV_USE_ELM variable and then start RMS with a suitable timeout:

1. In hvenv.local, set HV_USE_ELM=0

   See "HV_USE_ELM".

2. Start RMS with 'hvcm -h <timeout> ...'

   The recommended timeout when ELM is disabled is 45 seconds. See the hvcm man page. There is no way to specify the heartbeat timeout when you start RMS from the Cluster Admin GUI.

Point

You can also set HV_USE_ELM=1 in hvenv.local. However, if this setting is in effect when CF is not installed, you will not be able to start RMS. RMS indicates this with a message in the switchlog.

2.3 Scalable controllers

This chapter describes operational details of scalable controllers and scalable applications.

2.3.1 Controller overview

Controllers enable an application to monitor and control other applications. The application that includes the controller subapplication is referred to as the controlling or parent application; the application(s) specified in the controller description are referred to as the controlled or child application(s). The child application(s) act like resources of the parent application. The controlling application can be thought of as the master application and the controlled applications can be thought of as slave applications.

2.3.2 Scalable controllers and applications

The scalable controller provides a single point of administration, control, and display of information for multiple applications. Applications controlled by a scalable controller are called scalable applications.

For example, by switching online a controlling application with a scalable controller, scalable applications come online in the order prescribed by the controller's ApplicationSequence attribute; by switching the controlling application offline its scalable applications come offline in the opposite order. At the same time, the state of the scalable controller reflects a combined state of the scalable applications - this state can be readily viewed via GUI or hvdisp.

Scalable controllers and scalable applications are useful for configurations that require complex control and administration for multiple configuration resources. Some such configurations have already been implemented in the past using multiple follow-type controllers. However, the scalable controller permits the construction of very complex high availability configurations that are treated as a single entity.

2.3.2.1 Scalable applications

A scalable application is any application controlled by a scalable controller. Different scalable applications can be online at the same time on the same or on different hosts. For example, parallel databases like Oracle RAC, Fujitsu Symfoware(Native) and IBM DB2 PE (Parallel Edition) are all database servers that may have separate instances running at the same time on different nodes in the cluster. A separate application is configured for each database instance. A top-level application monitors and controls all applications (or database instances). The top-level application is referred to as the "controlling" application. The "database instance" applications are referred to as "controlled" applications. By organizing such components into scalable applications controlled by a scalable controller, one can use this controller as a single point of access to the whole server across the cluster. Of course, these are the most commonly encountered scalable applications in commercial data processing. However, any application that has similar requirements can be configured similarly.

2.3.2.2 Benefits of scalable controllers

A primary benefit of the scalable controller is that it makes it allows configurations in which child applications can (or must) run on different nodes than the parent. It also simplifies administrative operations for multiple applications such as parallel databases.

For example, one method used to configure Oracle RAC is to provide a separate user application on each node. Each user application is managed independently on each node. This configuration works fine for Oracle RAC because it is a shared access database so that when a node on any instance of the cluster is available, the whole database is accessible.

However, in a non-shared database such as IBM DB2 PE, all of the instances of the database must be on-line before the entire database can be accessed. Building a configuration to support DB2 PE can be complicated using traditional follow-mode controllers because of the multiplicity of applications and relationships. However, with the scalable controller these configurations are much simpler to construct.

Various configuration options are available to the user to support multiple applications or parent-child application dependencies that span multiple hosts. The following sections describe the scalable controller in more detail.

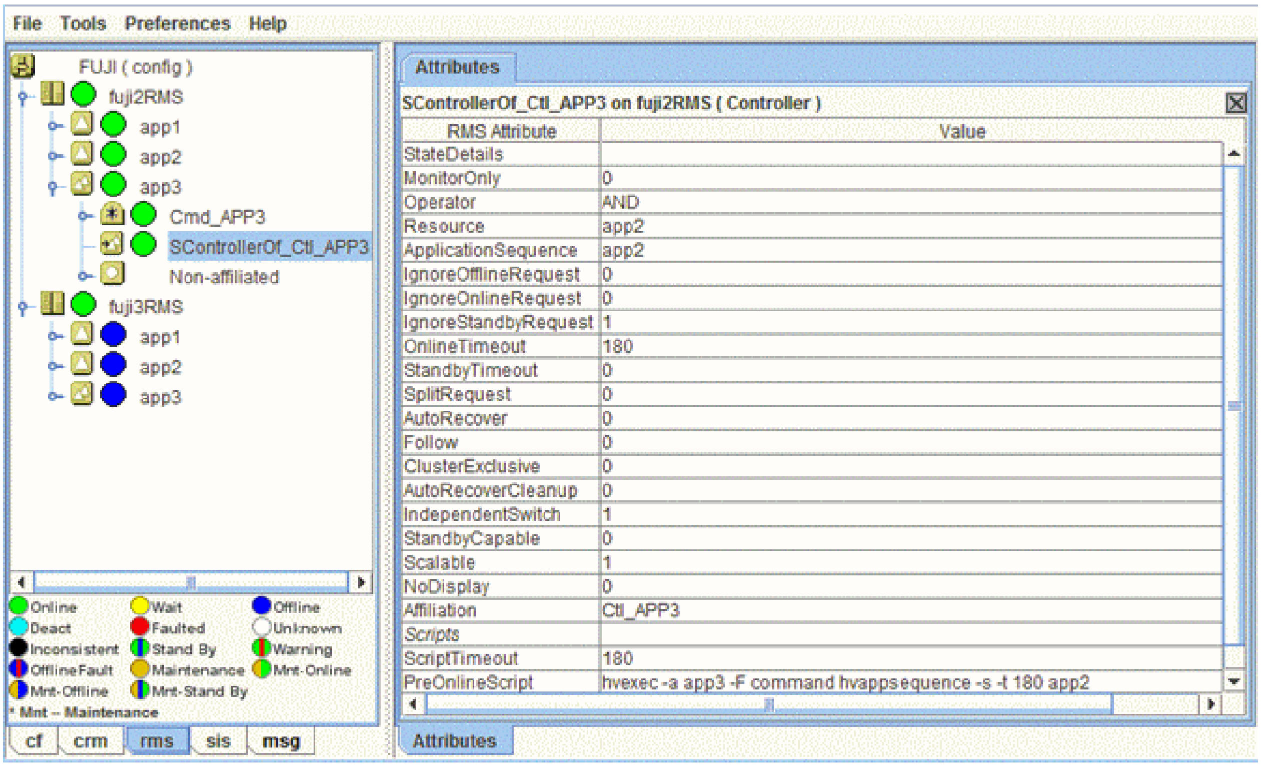
2.3.2.3 Attributes for scalable controllers

The Scalable controller attribute controls support for scalable child applications: if the controller's Scalable attribute is set to 1, then all applications listed in its Resource attribute are considered to be scalable applications.

Only a single scalable controller can control a given child application - the child cannot have multiple parent controllers. A given application may contain one or more scalable controllers, and no limitations are imposed on the structure of the application that contains one or more scalable controllers. However, RMS Wizard Tools may restrict the choices available during configuration according to the template application wizard used.

The following figure shows the Cluster Admin view of a typical scalable controller's attributes.

Figure 2.5 Scalable controller attributes



SControllerOf_Ctl_APP3 on fuji2RMS (Controller)

RMS Attribute	Value
StateDetails	
MonitorOnly	0
Operator	AND
Resource	app2
ApplicationSequence	app2
IgnoreOfflineRequest	0
IgnoreOnlineRequest	0
IgnoreStandbyRequest	1
OnlineTimeout	180
StandbyTimeout	0
SplitRequest	0
AutoRecover	0
Follow	0
ClusterExclusive	0
AutoRecoverCleanup	0
IndependentSwitch	1
StandbyCapable	0
Scalable	1
NoDisplay	0
Affiliation	Ctl_APP3
Scripts	
ScriptTimeout	180
PreOnlineScript	hvexec -a app3 -F command hvappsequence -s -t 180 app2

Some of the scalable controller attributes shown in the figure above can be adjusted in the RMS Wizard Tools interface. These attributes in this example are set as follows (reading top-to-bottom in the figure):

- MonitorOnly=0
- Resource=<*a list of applications*>
- ApplicationSequence=<*the sequence of applications in the Resource list*>
- ScriptTimeout=180
- FaultScript=<*script definition*>
- StateChangeScript=<*script definition*>

Other attributes that affect scalable operation are set automatically by the RMS Wizard Tools when the user configures a scalable controller.

The effect of some of these attributes on switchover processing and state transitions is discussed in the following sections.

2.3.3 Online/offline processing and state transitions

2.3.3.1 How controller states depend on controlled application states

The following table summarizes scalable controller states according to the states of its controlled applications:

Table 2.1 Dependence of scalable controller states on child applications

Controller state	Child application states
Online	At least one online on any machine
Offline	All offline on all machines
Faulted	At least one faulted on any machine, all others offline on all machines
Standby	At least one standby on any machine, none online on any machine
Warning	At least one online on any machine, others offline on all machines

Note: Although two or more different scalable applications can be online at the same time on the same or on different hosts, each scalable application can still be online only on a single host. For example, when creating an RMS configuration for Oracle RAC, the Oracle daemon processes that must be online on multiple hosts should be represented not by a single RMS application, but by a number of separate, controlled RMS applications - one child application per daemon. The parent scalable controller for Oracle RAC becomes a single point of control, administration, and display for all these child applications.

2.3.3.2 About nodes of which application become the online state

Controlling applications and controlled applications may become the online state on different nodes. However, monitoring and controlling for applications can work normally and no action is needed.

Note

When you restart a node after it stopped abnormally because of a node failure, an application which is controlled from multiple nodes may become the online state. However, it has no problem operating the system and no action is needed.

2.3.3.3 Request propagation to controlled applications

Priority Online requests from the controller are propagated to all controlled applications, each of which will attempt to come Online according to the sequence of hosts in their PriorityList attribute. Offline and Standby requests are propagated to all controlled applications on all the hosts.

The attribute IndependentSwitch, which must be set to 1 for a scalable controller object, assures that a parent application can be switched from host to host without affecting controlled child applications. However, the IndependentSwitch setting is ignored when the parent application is switched via a forced request such as 'hvswitch -f'; in this case the controller will propagate Offline request to each child application as a part of its switchover processing.

When a parent application and child applications are switched over simultaneously by shutting down RMS or the operating system and restarting RMS is completed before the child applications status changed to Online on the secondary prior node, the child applications statuses will attempt to come Online according to the sequence of nodes in their PriorityList attributes. Therefore the child applications statuses will be Online again on the previous node that has not switched over.

2.3.3.4 Controller warning state

Scalable controller displays Warning state in GUI and hvdisp command if one of the following conditions is met. This is to warn administrators that some scalable applications are not running.

- When at least one application, which is controlled by an Online controller, was transited to an Offline, Standby, or Faulted state from an Online state

- When at least one application, which is controlled by an Standby controller, was transited to an Offline or Faulted state from a Standby state

Note

When RMS has been stopped on all the nodes where some applications (among all applications controlled by an Online controller) can run, the controller will remain in the Online state because it cannot detect a failure.

2.3.3.5 Application warning state

An application that contains one or more scalable controllers will acquire a posted Warning state if at least one of its scalable controllers appears in the posted Warning state. It will revert to its respective posted state when all its scalable controllers go out of the posted Warning state. As was the case for the controller, the GUI and hvdisp will display this application posted Warning state to alert the administrator that the scalable parent application is not running in its full capacity.

The posted Warning state will be changed to a respective posted state when the controller transitions to offline of faulted, or when all controlled applications transition either to online or standby.

2.3.3.6 Controller state change script

The controller's StateChangeScript attribute specifies a script to be executed for a scalable controller whenever a controlled child application transitions into an online, offline, faulted, or standby state. The script is executed on every host where the controlling parent application can run, even if it is done on behalf of a request originated from the controller itself. The state change script will also be executed if a host where a child application is running changes its state to offline or faulted. This script has no impact on state transitions - its abnormal exit code is merely recorded in the switchlog.

If more than one state transition event is delivered at the same time, then a state change script will be executed for each one of them. The state change script is scheduled immediately upon receiving an event, without any delay. For multiple events arriving from the same host, it is guaranteed that the order of state change script invocation will follow the order of the received events.

Script execution environment variables

The state change script's environment contains a set of variables that can be used for decision processing at runtime. Their names and purposes are summarized below. For a complete description of their content and format, see the "E.2 Global environment variables", the "E.4 Script execution environment variables".

RMS provides two complementary variables that are set according to whether the state change script was invoked due to an application state change or a host state change:

- HV_APPLICATION_STATE_CHANGE_INFO

  Set when a state change script is invoked because a controlled application changed its state. The colon-delimited substrings are:

  - Previous state of the application on its node, as recorded on the local node
  - Current state of the application on its node, as recorded on the local node
  - Name of the node where the application has changed its state
  - Name of the application that has changed its state

  HV_APPLICATION_STATE_CHANGE_INFO will be empty if the state change script is invoked because a node changed its state.

- HV_HOST_STATE_CHANGE_INFO

  Set when a state change script is invoked for a scalable controller because a SysNode that can run a controlled child application changes its state to Offline or Faulted. The colon-delimited substrings are:

  - Previous node state
  - Current node state
  - Name of the node
  - Reason for the node state change: Shutdown Facility, hvshut command, or unknown.

  HV_HOST_STATE_CHANGE_INFO will be empty if the state change script is invoked because a controlled child application changed its state.

Like other scripts invoked by RMS on behalf of an object, the state change script environment includes the following standard set of script variables:

- HV_APPLICATION

  Name of userApplication object at the top of the current sub-tree that contains the current object.

- HV_AUTORECOVER

  If set to 1, the script was initiated due to an AutoRecover attempt.

- HV_FORCED_REQUEST

  If set to 1, the script is currently processing a forced request.

- HV_LAST_DET_REPORT

  Last detector report for the current object.

- HV_OFFLINE_REASON

  Reason for ongoing offline processing: detect request, manual switchover, follow-up processing after a previous resource failure, or stopped application.

- HV_NODENAME

  Name of current object.

- HV_SCRIPT_TYPE

  Script type.

- NODE_SCRIPTS_TIME_OUT

  Timeout value for the current object and script type.

Script execution sequence

The state change script is executed immediately upon an event. As a result, it can run in parallel with other RMS scripts, including state change scripts for other objects or even for the current object. Since several events may be delivered nearly at the same time, the user's script is responsible to work in proper sequence. The writer of the script must assure proper access to shared resources from this and other scripts by using locks or other OS means.

2.3.3.7 Sequenced online/standby/offline and application groups

The controller's ApplicationSequence attribute controls how online, offline, and standby requests are propagated to child applications. The attribute lists all the controller's child applications that are specified in the controller Resource attribute, but arranged in groups that are processed in parallel or sequentially:

A space-separated group of applications is called a request group. All the applications in a request group are processed in parallel.

Request groups separated by colons (:) are processed sequentially. Online or standby requests are processed left-to-right. Offline requests are processed right-to-left.

For example, suppose the ApplicationSequence attribute for a controller contains the following specification:

```
A1 A2:B:C1 C2
```

The controller would issue online requests as follow:

1. A1 and A2 (the first request group) would be processed in parallel - neither would wait for the other. However, both A1 and A2 must post their respective online state before the controller proceeds to the next group.
2. B (the second request group) would be processed next. It must post its online state before the controller proceeds to the next group.
3. C1 and C2 (the third request group) would finally be processed in parallel.

Offline requests would be processed in the reverse order; that is, C1 and C2 first, then B, and finally A1 and A2.

The order is only important during a request propagated to controlled applications from the scalable controller. Applications state changes due to any other reason, including manual or automatic switchover, disregard ApplicationSequence.

The order of offline processing is also maintained for local hvshut requests such as 'hvshut -l'. However, the order is disregarded for clusterwide requests such as 'hvshut -a': each host will take its applications offline independently.

Like other subapplications, scalable request groups are not processed during 'hvshut -L' and 'hvshut -A' operations.

Note that the propagation of requests from the scalable controller is also affected by the state of the hosts where the child applications may run. If no hosts are available for the applications from the same request group, then the request is not propagated. Instead, it is delayed until such a host becomes available, or until ScriptTimeOut expires.

2.3.3.8 Auto Startup on a sub-cluster

A controlling application must be able to auto-startup even when some cluster hosts are offline. This is required to allow for some controlled child applications to come online on the partial cluster, in the order defined in their parent controller's ApplicationSequence attribute.

For example, if initially all cluster hosts are down, and some of them come up while others are in maintenance, controlled applications that are supposed to run only on the up sub-cluster must be brought online following a request from their scalable controller, regardless of the fact that other cluster hosts are currently offline or faulted. It is impossible to use 'hvswitch -f' in this case because a consultant may not be present, so the configuration must come up on its own.

The above is achieved by the attribute PartialCluster of the userApplication object. If set to 1, then the application can negotiate its online request within the currently online hosts, even if some other hosts, including the application's primary host, are offline or faulted. If set to 0, then application can negotiate its online request only when all hosts where it can possibly run are online (current behavior). The default value is 0.

For an application that contains a scalable controller (i.e. for a controlling application), PartialCluster can be set to 1 if the application graph has no cluster-exclusive resources; otherwise, PartialCluster must be set to 0. Each of its controlled applications must have its PartialCluster attribute set to 0, and its AutoStartUp attribute set to 0.

If controlling applications do not contain any objects other than the controller objects, having their PartialCluster attribute set to 1 is safe. Indeed, if two or more controlling applications auto-startup on different sub-clusters, they will not share any exclusive resources. As a part of their auto-startup, they will propagate online requests to their controlled applications that, in turn, may come online if they only require the hosts from the current sub-cluster.

However, if some controlled applications require hosts from several sub-clusters, then these applications will not come online, which is actually the desired effect. Note that their PartialCluster is 0, so the controlled applications that span subclusters refuse online processing.

Because scalable controllers delay propagation of the online request until hosts for the controlled applications from each application group come online, the order imposed by ApplicationSequence will be preserved even if two or more hosts simultaneously initiate online requests for the same scalable controller.

2.3.3.9 Switchover on a sub-cluster

When a controlling application has its PartialCluster set, it can be switched online, automatically or manually (with or without the '-f' forced option) between the hosts of a sub-cluster. Again, this is safe for the controlling application itself because it has no real resources other than controllers. Also, this is safe for the controlled applications because their PartialCluster is set to 0 - they will not come online if they cross the subcluster boundary.

2.3.3.10 Manual switching of child applications

Attempting to manually take the last online child application offline with the 'hvutil -f' command would cause the parent controller to go into the faulted state. To prevent the user from creating a faulted scenario, RMS rejects taking the last controlled online application offline with the 'hvutil -f' command and generates the following message:

```
ERROR: Application controlled from another online application - <application>.
```

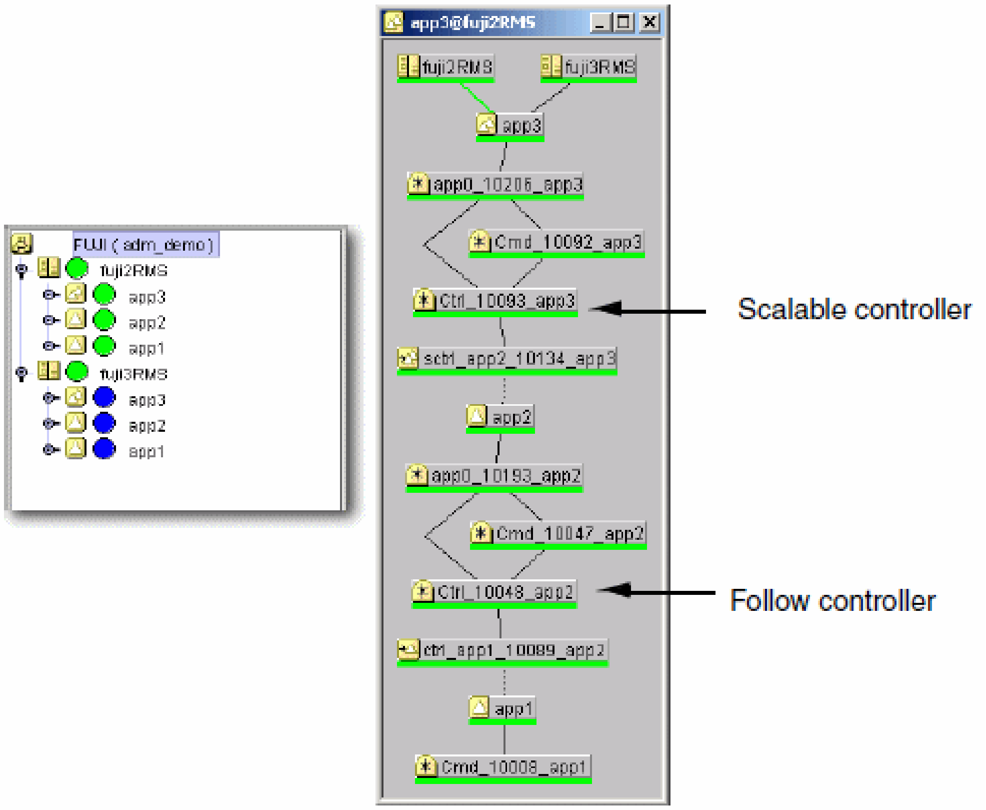
2.3.3.11 Operation during maintenance mode

To illustrate controller behavior in maintenance mode, consider the following example:

- The configuration consists of applications app1, app2, and app3 on nodes shasta1 and shasta2.
- app2 controls app1 with a follow mode controller.
- app3 controls app2 with a scalable mode controller.

The following figure shows the RMS configuration tree and the corresponding graph for this scenario.

Figure 2.6 Maintenance mode controller example

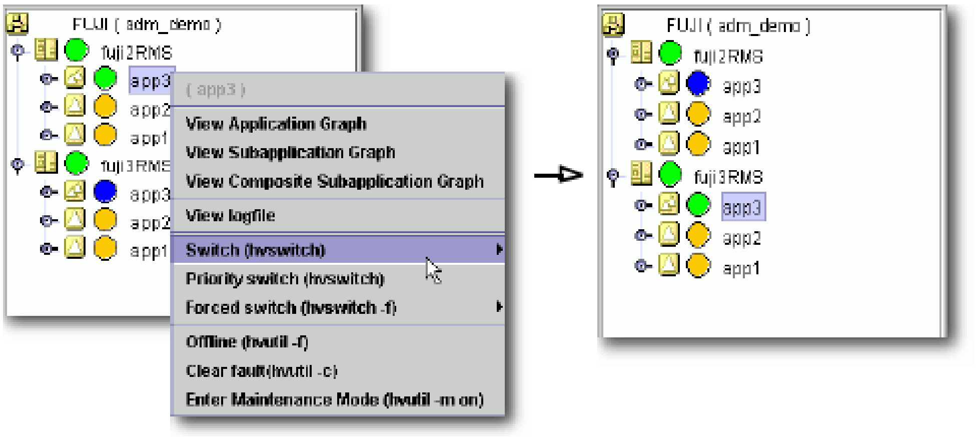


Switching applications between nodes

From the perspective of the graph, these may be thought of as "horizontal" switching operations.

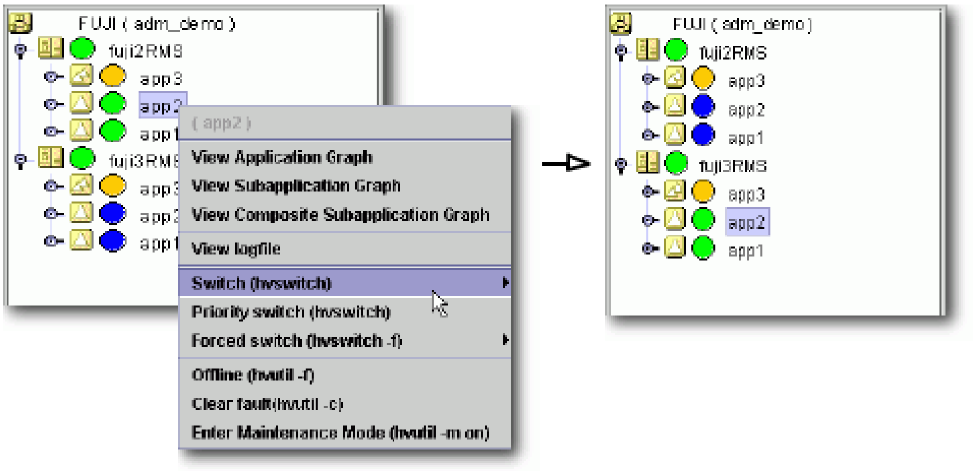
If a scalable-mode child application is put into maintenance mode, the parent can still be switched between nodes with hvswitch, either manually or automatically as shown in the following figure. Note that putting app2 into maintenance mode automatically puts its follow-mode child application, app1, into maintenance mode as well.

Figure 2.7 Switching scalable parent with child in maintenance mode



Likewise, if a scalable-mode parent application is put into maintenance mode, the child can still be switched between nodes with hvswitch as shown in the following figure. However, in actual practice, this would only occur via manual commands because the parent issues no processing requests while in maintenance mode. Note that switching app2 to a different node automatically switches its follow-mode child application, app1, as well.

Figure 2.8 Switching scalable child with parent in maintenance mode



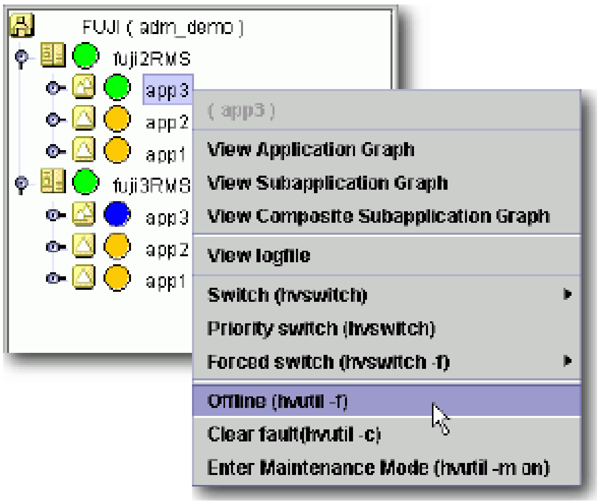
In summary, these "horizontal" hvswitch operations proceed normally.

Online, offline, and fault processing restrictions

From the perspective of the graph, these may be thought of as "vertical" switching operations.

Consider what happens if you attempt to take app3 offline with hvutil while app2 is in maintenance mode.

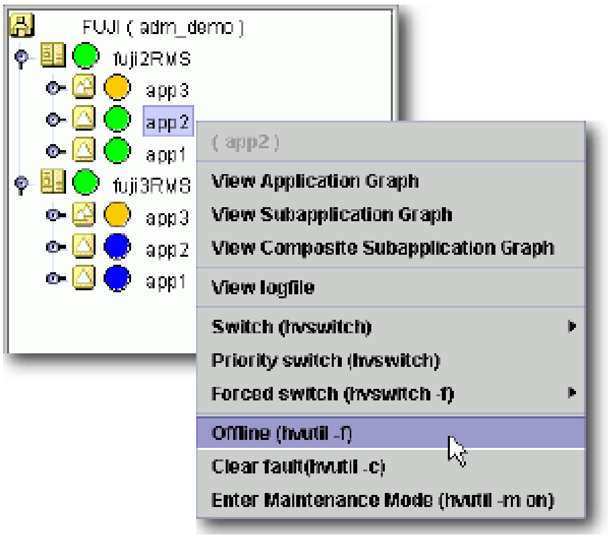
Figure 2.9 Attempting to take a parent offline with the child in maintenance mode



Unlike the hvswitch operations described previously, this 'hvutil -f' operation requires a response from its child application before it can proceed. Since maintenance mode prevents app2 from responding to normal processing requests from its parent, the offline request will eventually time out. The same situation occurs when fault processing via 'hvutil -c' is attempted.

Attempting to take a child offline while the parent is in maintenance mode as shown in the following figure also fails, but there is no long delay as in the previous case: RMS immediately generates an error because only the parent can initiate offline processing.

Figure 2.10 Attempting to take a child offline with the parent in maintenance mode



However, you can issue a fault processing 'hvutil -c' request to the child because that does not require a response from the parent.

In summary, these "vertical" hvutil operations will fail if the application requires a response from a child or parent application that is in maintenance mode.

Recommended approach for scalable controllers

It is highly recommended that maintenance mode requests be issued to the top-level application of a controlled hierarchy. This will help to avoid unexpected behavior:

- Child applications will receive no automatic requests from the parent to switch to other nodes. Also, no automatic online, offline, or fault processing requests will propagate from the parent.
- In case of a resource failure, a switch request from lower-level objects will fail immediately, so RMS can initiate fault processing without waiting for a timeout delay.

Chapter 3 Using the Wizard Tools interface (hvw)

This chapter describes how to configure high availability for customer applications using the RMS Wizards.

Note

For Solaris, as a means of setting the RMS configuration, the userApplication Configuration Wizard, which is a GUI utilizing Web-Based Admin View, is provided. For this reason, use hvw only when instructed.

For details on the userApplication Configuration Wizard, see "4.4.4 userApplication Configuration Wizard Functions" in "PRIMECLUSTER Installation and Administration Guide (Oracle Solaris)."

All the following procedures assume the Cluster Foundation (CF) software has been properly installed, configured, and started. See "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide" for details.

3.1 Overview

The "Chapter 1 Introduction" describes the components necessary for configuring applications for high availability. It is extremely important that you define applications and the resources that are used by them. Resources are entities like disks, file systems, processes, IP addresses, and so forth.

This definition also needs to include the following information:

- How the applications and their resources are related to each other
- What scripts bring resources online and offline
- Which detectors monitor the state of which resources

For example, if a node should fail to be available, the node that is to take its place must have been defined beforehand so that the applications depending on this node are able to continue operating with minimal interruption. Once the necessary information is defined, you can then set up an RMS configuration. A configuration of this magnitude, however, requires a great deal of expert knowledge.

The RMS Wizards are tools that allow you to set up an RMS configuration in a way that is simple, flexible, and quality-tested. Furthermore, these tools conform to a well-documented, standard design. To configure RMS with the wizards, you supply information about the applications using a menu-driven interface. The wizards use this information to set up a complete RMS configuration.

The following sections describe these wizards and the way they are used to configure high availability from a general point of view.

3.1.1 RMS Wizard types

The RMS Wizards are divided into two categories:

- RMS Wizard Tools

  This is a general-purpose package that includes the following components:

  - The hvw menu-based configuration interface
  - SCALABLE application wizard, which allows configuration of scalable application.
  - STANDBY application wizard, which allows configuration of standby application.
  - The basic set of resource-oriented wizards, which provide scripts and detectors for basic resources such as file systems, volume managers, and IP addresses. They are used by the SCALABLE and STANDBY wizards as well as components in the Wizard Kit.

- RMS Wizard Kit

  These application-oriented wizards are designed to cover complete applications and perform their tasks on the basis of the turnkey concept. The ORACLE wizard is this type of wizard.

See

For information on the availability of the RMS Wizard Kit, refer to the manual of each wizard product such as Wizard for Oracle or Wizard for Networker.

3.1.1.1 Turnkey wizards

Turnkey wizards provide predefined structures of resources to monitor almost every basic operating system object. This relieves the user of the tedious task of linking system resources according to their dependencies.

Many turnkey wizards, SCALABLE turnkey wizard, STANDBY turnkey wizard, ORACLE wizard, and so on are designed to configure a specific type of application. All characters of the turnkey wizards are in uppercase.

3.1.1.2 Resource wizards

Resource wizards (sometimes called subapplication wizards) configure resources, such as file systems or IP addresses, required to run upper-level applications. Resource wizards are invoked by turnkey wizards. The following are some of the more important resource wizards:

- Cmdline

  Configures any generic resource type by specifying StartScript (to bring the resource online), StopScript (to bring the resource offline) and CheckScript (to check the state of a resource).

- Controller

  Configures the settings to associate other applications with each other and use them.

- Gds

  Configures disk classes administrated by GDS.

- Gls

  Configures the resource class of GLS by using an RMS environment.

- Fsystem

  Configures local or remote file systems.

- Ipaddress

  Configures the LAN and IP addresses that are needed for a switchover network to be used on a cluster system.

3.2 General configuration procedure

RMS configuration always involves these four steps:

1. Stop RMS.

   Refer to the "7.1.3 Stopping RMS". You can use the Cluster Admin GUI or the command line interface from any node in the cluster.

2. Create or edit the configuration.

   Refer to "3.3 Creating and editing a configuration"

3. Activate the configuration.

   Activation includes generation and distribution. See the "3.4 Activating a configuration".

4. Start RMS.

   Refer to the "7.1.1 Starting RMS". You can use the Cluster Admin GUI or the command line interface from any node in the cluster.

3.3 Creating and editing a configuration

You can bring up an existing Wizard Tools configuration that is currently activated on the host systems of a cluster. In this case, you might call up the configuration because it is to be modified using the wizards while RMS is stopped. On the other hand, you might want to use the wizards to set up a new configuration. The commands for starting the wizards are as follows:

- hvw

  Runs RMS Wizard Tools using the last activated configuration stored in the <RELIANT_PATH>/etc/CONFIG.rms startup file. If this file does not exist or activation is being done for the first time, RMS creates the default configuration, config.

- hvw -n configname

  Edits an existing configuration or creates a new configuration using the specified name. The configuration will be stored in the <RELIANT_PATH>/build/configname.us startup file.

  The sample configuration used for demonstration purposes in this chapter shows how to set up a new configuration called myconfig using the STANDBY turnkey wizard. This example would be called up as follows:

  ```
  hvw -n myconfig
  ```

  For details on the hvw command, see the manual pages of the hvw command.

3.3.1 Using the wizard menus

The hvw command produces character-driven menus that guide you in a way designed to be self-explanatory. The following are some of the most frequently used menu operations and items:

- Selecting items

  This is normally done by typing the number of the item followed by the [Enter] or [Return] key. Within the menu, a prompting line indicates the kind of input that is required. A >> prompt indicates that a string of text should be entered.

- Responding to messages

  Within the menus, several kinds of messages are displayed. One type of message might be to inform the user about the activities that the wizard has performed; for example, a consistency check that ended in a positive result. Other messages may prompt the user to continue the configuration procedure with a certain activity; for example, choosing an application name.

- HELP

  This item provides user assistance and is available at the top of every wizard menu.

- QUIT

  This quits the wizard menu system.

- RETURN

  This moves one level upward in the menu system; that is, from a subordinate menu to the menu it was called from.

- SAVE+EXIT and NOSAVE+EXIT

  These save or discard your input and then exit. SAVE+EXIT will be disabled in read-only mode, and it may be disabled if the configuration is inconsistent at that point.

- NEXT and PREVIOUS

  If all items cannot be listed in a single screen due to many items to be selected, some are displayed in the next screen. Press NEXT to go on to the next screen, and press PREVIOUS to go back to the previous screen.

3.3.2 Main configuration menu

The Main configuration menu appears immediately after a configuration has been called up. This top-level menu shows the state of the RMS cluster by indicating either one the following:

- RMS is inactive
- The list of nodes where RMS is up and running

The *Main configuration menu* changes dynamically at run time depending on whether RMS is running in the cluster and whether the configuration being edited is the current configuration.

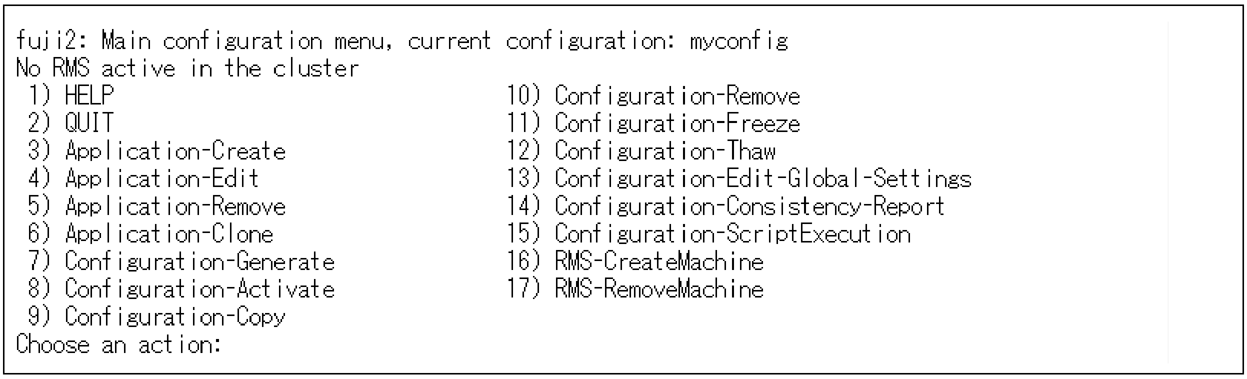
If RMS is running anywhere in the cluster, actions that could modify a running configuration are not available. Additionally, the menu items that are available are modified such that no changes can be made to the running configuration.

When RMS is running but the configuration being edited is not the same as the currently active one, the main menu is not restricted except that the Configuration-Activate menu option is not available.

3.3.2.1 Main configuration menu when RMS is not active

If RMS is not running anywhere, then the entire top level menu is presented without restrictions. The following figure shows the *Main configuration menu* window when RMS is inactive.

Figure 3.1 Main configuration menu when RMS is not active



```
fuji2: Main configuration menu, current configuration: myconfig
No RMS active in the cluster
 1) HELP                               10) Configuration-Remove
 2) QUIT                               11) Configuration-Freeze
 3) Application-Create                 12) Configuration-Thaw
 4) Application-Edit                   13) Configuration-Edit-Global-Settings
 5) Application-Remove                 14) Configuration-Consistency-Report
 6) Application-Clone                  15) Configuration-ScriptExecution
 7) Configuration-Generate             16) RMS-CreateMachine
 8) Configuration-Activate             17) RMS-RemoveMachine
 9) Configuration-Copy
Choose an action:
```

Menu items

The *Main configuration menu* can perform the following activities when RMS is not running anywhere in the cluster:

- Application-Create

  Specifies which application to configure for high availability. In addition, this operation specifies all the relevant settings for the application so that it can run in a high-availability configuration monitored by RMS. Among the most important of these settings is the name of the application and the list of nodes on which the application may run.

  The user application should be configured to run on multiple nodes for a high-availability configuration.

  The wizard assists you by supplying menus with basic and non-basic attributes, assigns values to the attributes, and prompts you if an attribute is mandatory.

  By choosing the appropriate turnkey wizard for an application, the wizard will then provide predefined elements, like scripts and detectors, for the application in question. These elements have been developed especially for the respective type of application.

  The wizard will also carry out consistency checks at certain stages of the configuration procedure in order to prevent inconsistent applications from running in a high-availability configuration.

- Application-Edit

  Modifies an existing application.

  An existing application can be modified using this menu item. The following modes are available for editing an application:

  - Turnkey mode (highly recommended)

    Turnkey mode is the default mode. Normally, use this mode because it allows you to easily configure the various settings required to create a cluster application.

  - Non-turnkey mode

    Do not use this mode for creating and editing a normal RMS configuration. Use it only when you are requested from field engineers.

- Application-Remove

  Removes an existing application from the high-availability configuration.

- Application-Clone

  Clones an application. This feature is provided for users who want to create a new application that differs only slightly from an existing one. To do this, clone an application and modify only the parts that are necessary to create a new one.

  Note

  Application-Clone is not available in this version.

- Configuration-Generate

  Performs the following:

  - Runs consistency checks on the configuration
  - Creates the RMS graph of the configuration and stores it in the configname.us file. The graph is a hierarchical description of objects that represent the nodes, applications, and resources used in the configuration.

  During the Configuration-Generate phase, the wizard indicates the progress with a series of dots on the screen. Each dot represents an application or resource that has been successfully generated.

  Normally, you would use Configuration-Activate (described below) to generate and distribute the configuration in one step. Configuration-Generate provides a way to generate and check a configuration without distributing it to the other nodes in the cluster. This may be useful for testing or debugging (see also the description for Configuration-ScriptExecution later in this list).

  Note

  Configuration-Generate is always available, whether RMS is running or not.

- Configuration-Activate

  Generates and distributes a configuration.

  Selecting this item performs both the generation and distribution phases in one step. The generation phase is described above.

  The distribution phase prepares the cluster for RMS, ensuring that all the required data is put into place. The wizard copies the configuration data to every reachable node specified in the configuration and installs all necessary files.

  Note

  - Configuration-Activate is not available if RMS is already running on one or more nodes.
  - Do not execute the Configuration-Activate menu simultaneously on multiple nodes which constitute the cluster.

- Configuration-Copy

  Produces a copy of an existing configuration. This is often used to make a backup before an existing, tested configuration is enhanced.

- Configuration-Remove

  Removes (deletes) any existing configuration.

- Configuration-Freeze

  Prevents further changes to a configuration. This marks the configuration as read-only so it can be viewed, but not modified.

  Point

  Configuration-Freeze is password protected: you will be prompted to create a password before the configuration is locked.

Note

Configuration-Freeze is not available in this version.

- Configuration-Thaw

  Releases the configuration from the frozen (read-only) state so it can be modified.

Point

Configuration-Thaw is password protected: you must enter the correct password before the configuration is unlocked.

Note

Configuration-Thaw is not available in this version.

- Configuration-Edit-Global-Settings

  Modifies settings that affect the entire configuration. This includes settings for the detectors and the operation mode of the hvw command.

- Configuration-Consistency-Report

  Provides a consistency check that verifies whether an application is running within a high-availability configuration and has actually been created using the configuration data provided by the respective wizard.

  The wizard compares the currently activated wizard checksum against the wizard database checksum. One checksum is called the *LiveInfo*, the other is called the *BuildInfo*. If both checksums match for an application, it is certified that its running version conforms to what was configured by the wizard.

Note

Configuration-Consistency-Report is not available in this version.

- Configuration-ScriptExecution

  Allows administrators to run any script independent of RMS.

  By selecting the resources configured for the application, the user can execute the scripts that are to bring the resources online or offline. To see the online scripts being executed, you can go through the resource list, which is displayed for this purpose, in ascending order. The return code indicates the proper functioning of the respective script.

Note

Configuration-ScriptExecution is not available in this version.

- RMS-CreateMachine

  Defines the list of machines which constitute the cluster. During the activation phase, the RMS configuration will be distributed to all the nodes in this list.

  Applications managed by RMS must each be configured to run on one or more machines in this pool. Therefore, complete this step before creating any application.

- RMS-RemoveMachine

  Removes machines from the list of cluster nodes.

3.3.2.2 Main configuration menu when RMS is running

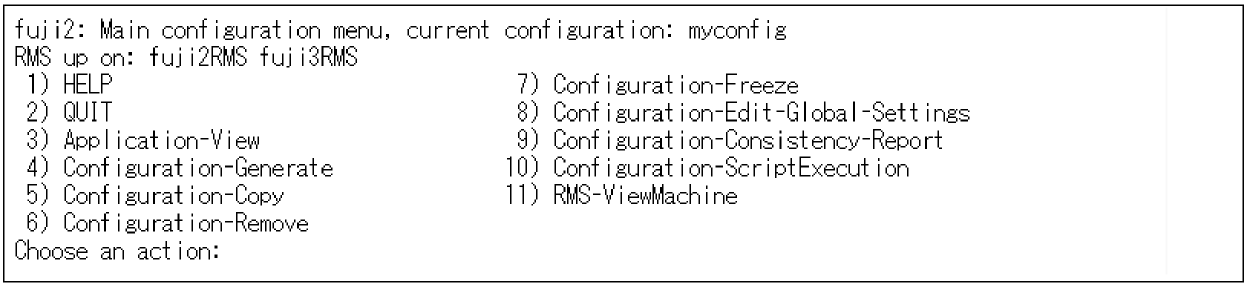
Wizard Tools menus change dynamically according to whether or not RMS is running in the following locations:

- anywhere in the cluster
- on the local node

If RMS is running on any of the cluster machines, any operation which could potentially modify the currently active configuration is not allowed.

In particular, when RMS is running on the local node, the *Main configuration menu* changes as shown in the following figure.

Figure 3.2 Main configuration menu when RMS is running



```
fuji2: Main configuration menu, current configuration: myconfig
RMS up on: fuji2RMS fuji3RMS
 1) HELP                                 7) Configuration-Freeze
 2) QUIT                                 8) Configuration-Edit-Global-Settings
 3) Application-View                     9) Configuration-Consistency-Report
 4) Configuration-Generate              10) Configuration-ScriptExecution
 5) Configuration-Copy                  11) RMS-ViewMachine
 6) Configuration-Remove
Choose an action:
```

When RMS is running, the following entries either appear or change their behavior:

- Application-View

  Views an existing application in read-only mode.

- Configuration-Generate

  Same functionality as when RMS is not running.

- Configuration-Copy

  Produces a copy of an existing configuration. This is often used to make a backup before an existing, tested configuration is enhanced.

  Note

  Configuration-Copy cannot overwrite the configuration that is currently running.

- Configuration-Remove

  Removes (deletes) any existing configuration except the one that is currently running.

- RMS-ViewMachine

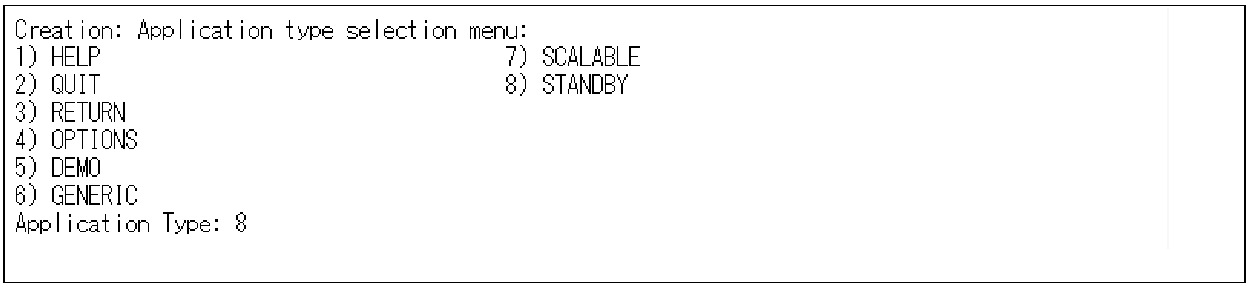
  Displays the list of nodes on which RMS is currently running.

3.3.3 Secondary menus

Each of the main menu items has a number of secondary menus. The secondary menus themselves can have sub-menus.

The Creation: Application type selection menu is an example of a secondary menu. You see this menu after selecting Application-Create from the main menu.

Figure 3.3 Application type selection



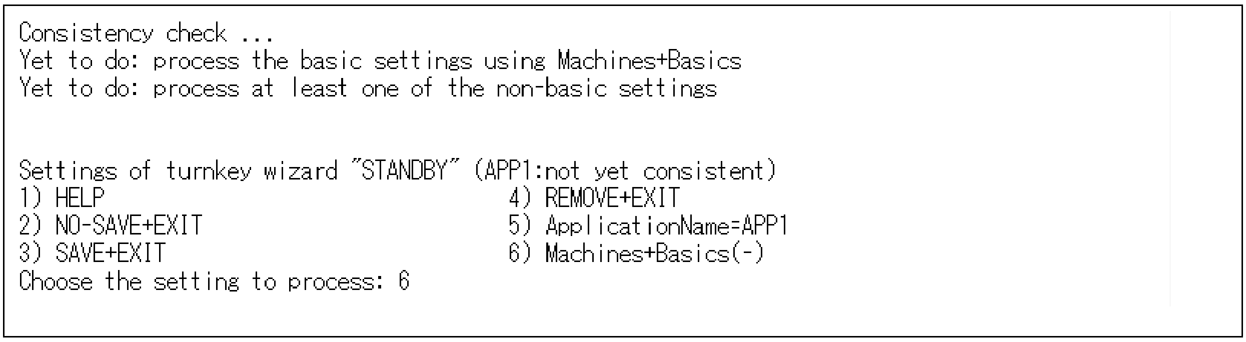
```
Creation: Application type selection menu:
1) HELP                                 7) SCALABLE
2) QUIT                                 8) STANDBY
3) RETURN
4) OPTIONS
5) DEMO
6) GENERIC
Application Type: 8
```

3.3.4 Basic and non-basic settings

Basic and non-basic settings are designed to guide you safely through the configuration process, ensuring that all mandatory settings are configured.

Among the basic settings are the application name and the names of the nodes where it can run. For example, at the application type selection menu shown in the previous section, selecting 8) STANDBY produces the menu in the following figure.

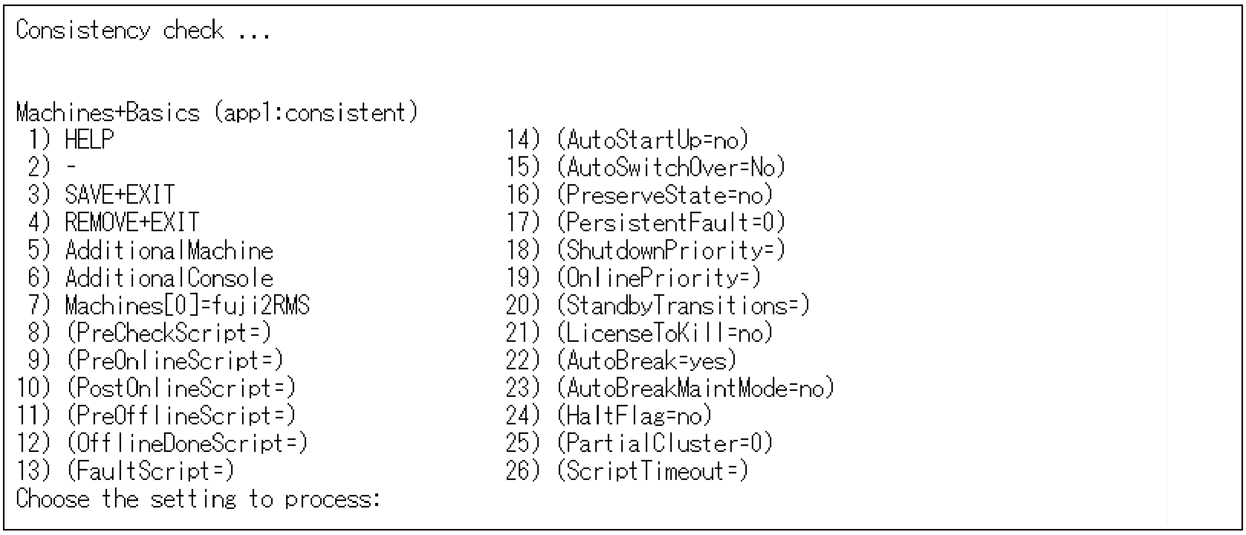
Figure 3.4 Menu leading to basic settings



```
Consistency check ...
Yet to do: process the basic settings using Machines+Basics
Yet to do: process at least one of the non-basic settings


Settings of turnkey wizard "STANDBY" (APP1:not yet consistent)
1) HELP                                 4) REMOVE+EXIT
2) NO-SAVE+EXIT                         5) ApplicationName=APP1
3) SAVE+EXIT                            6) Machines+Basics(-)
Choose the setting to process: 6
```

If you select 6) Machines+Basics, you can configure the basic settings using the menu in the following figure.

Figure 3.5 Menu to configure basic settings

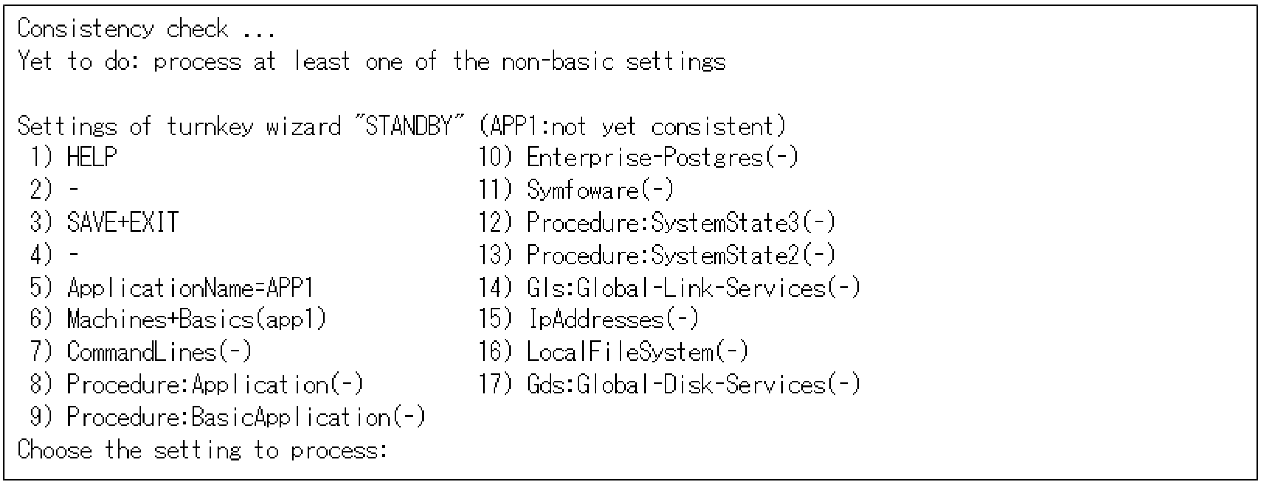


```
Consistency check ...


Machines+Basics (app1:consistent)
 1) HELP                                14) (AutoStartUp=no)
 2) -                                   15) (AutoSwitchOver=No)
 3) SAVE+EXIT                           16) (PreserveState=no)
 4) REMOVE+EXIT                         17) (PersistentFault=0)
 5) AdditionalMachine                   18) (ShutdownPriority=)
 6) AdditionalConsole                   19) (OnlinePriority=)
 7) Machines[0]=fuji2RMS                20) (StandbyTransitions=)
 8) (PreCheckScript=)                   21) (LicenseToKill=no)
 9) (PreOnlineScript=)                  22) (AutoBreak=yes)
10) (PostOnlineScript=)                 23) (AutoBreakMaintMode=no)
11) (PreOfflineScript=)                 24) (HaltFlag=no)
12) (OfflineDoneScript=)                25) (PartialCluster=0)
13) (FaultScript=)                      26) (ScriptTimeout=)
Choose the setting to process:
```

The menu displays the application's current attribute settings, some of which may be set automatically by the wizards. Attributes enclosed in parentheses are optional.

After you complete the configuration of the basic settings, the non-basic settings menu appears. Non-basic settings include specifications for resources such as file systems, IP addresses, disks, and so forth.

Figure 3.6 Menu to configure non-basic settings



```
Consistency check ...
Yet to do: process at least one of the non-basic settings

Settings of turnkey wizard "STANDBY" (APP1:not yet consistent)
 1) HELP                              10) Enterprise-Postgres(-)
 2) -                                 11) Symfoware(-)
 3) SAVE+EXIT                         12) Procedure:SystemState3(-)
 4) -                                 13) Procedure:SystemState2(-)
 5) ApplicationName=APP1              14) Gls:Global-Link-Services(-)
 6) Machines+Basics(app1)             15) IpAddresses(-)
 7) CommandLines(-)                   16) LocalFileSystem(-)
 8) Procedure:Application(-)          17) Gds:Global-Disk-Services(-)
 9) Procedure:BasicApplication(-)
Choose the setting to process:
```

Point

The list of available subapplications displayed in the menu depends on the packages installed on the local system. Some of the subapplications shown in this example may not be available in your market or for your platform.

3.4 Activating a configuration

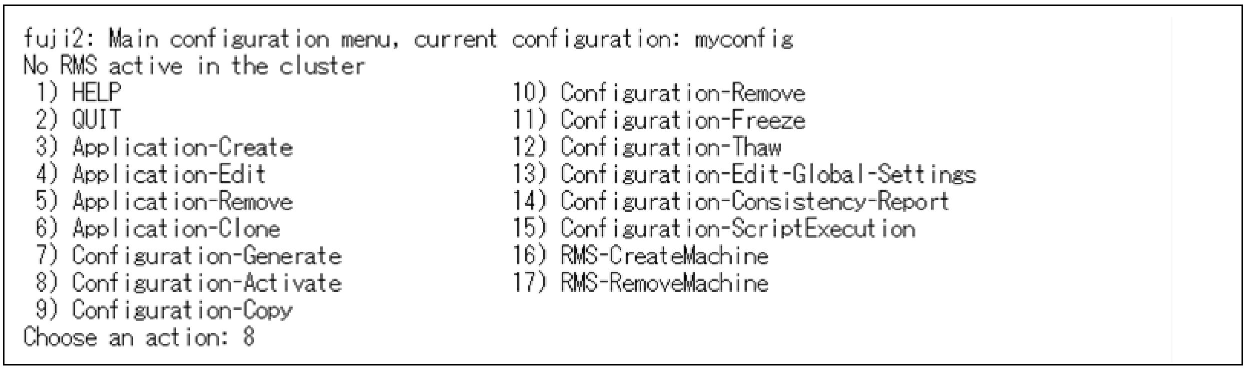
As described in "3.2 General configuration procedure", activating a configuration is the third of the four fundamental steps required to set up a high-availability configuration. The activation phase comprises a number of tasks, among which are generation and distribution of a configuration.

Point

You must stop RMS on all the nodes in the cluster before you activate a configuration.

The starting point for the activation phase is the Main configuration menu (see the following figure).

Figure 3.7 Main configuration menu



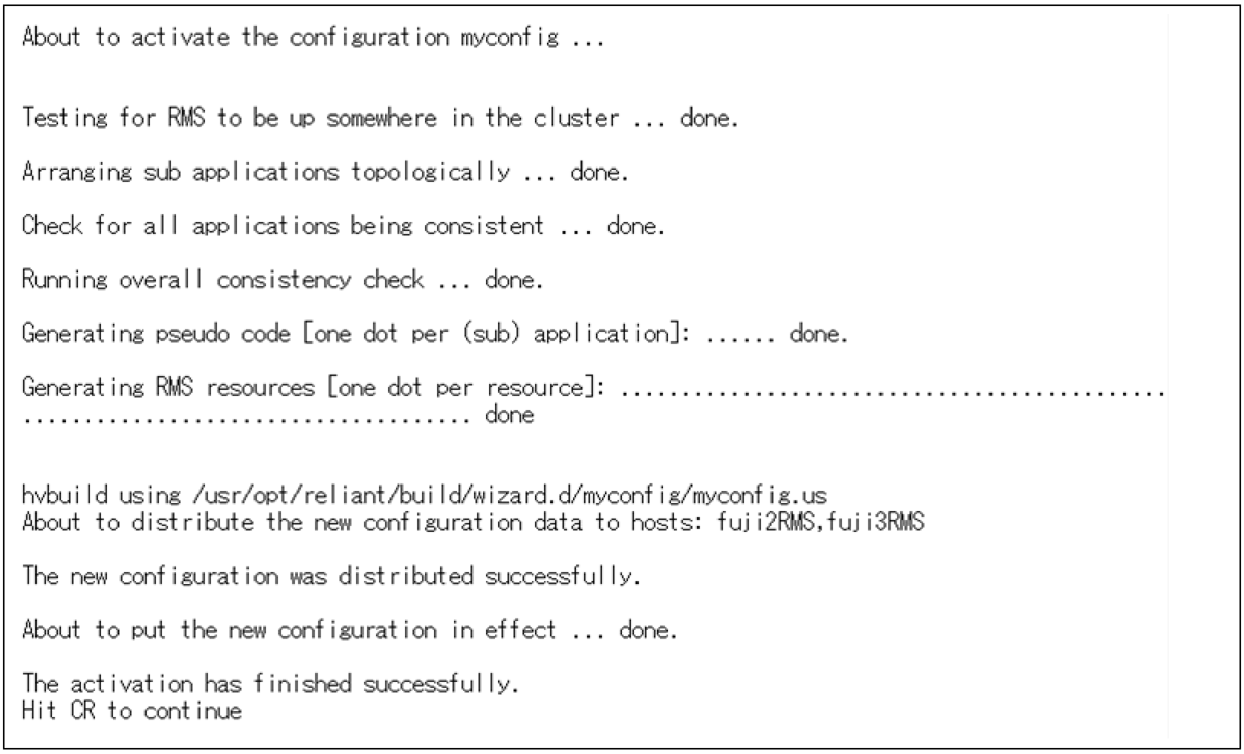
```
fuji2: Main configuration menu, current configuration: myconfig
No RMS active in the cluster
 1) HELP                                10) Configuration-Remove
 2) QUIT                                11) Configuration-Freeze
 3) Application-Create                  12) Configuration-Thaw
 4) Application-Edit                    13) Configuration-Edit-Global-Settings
 5) Application-Remove                  14) Configuration-Consistency-Report
 6) Application-Clone                   15) Configuration-ScriptExecution
 7) Configuration-Generate              16) RMS-CreateMachine
 8) Configuration-Activate              17) RMS-RemoveMachine
 9) Configuration-Copy
Choose an action: 8
```

1. Select the *Configuration-Activate* item by entering the number 8.

   The activation is performed by the wizard. No further input is required at this stage.

During the activation phase, the wizard executes a series of tasks and displays the status on the screen. The completion of a task is indicated by the word *done* or a similar expression (see the following figure).

Figure 3.8 Activating a configuration



```
About to activate the configuration myconfig ...


Testing for RMS to be up somewhere in the cluster ... done.

Arranging sub applications topologically ... done.

Check for all applications being consistent ... done.

Running overall consistency check ... done.

Generating pseudo code [one dot per (sub) application]: ...... done.

Generating RMS resources [one dot per resource]: ..............................................
.................................... done


hvbuild using /usr/opt/reliant/build/wizard.d/myconfig/myconfig.us
About to distribute the new configuration data to hosts: fuji2RMS,fuji3RMS

The new configuration was distributed successfully.

About to put the new configuration in effect ... done.

The activation has finished successfully.
Hit CR to continue
```

Among the tasks carried out by Configuration-Activate are generation and distribution of the configuration. The wizard performs a consistency check of the graph created in the generation of the configuration before distributing the configuration to all the nodes specified in the configuration.

The test to see whether RMS is up on one of the nodes in the cluster is required since activation cannot be performed if RMS is running. In this case, RMS would need to be shut down first.

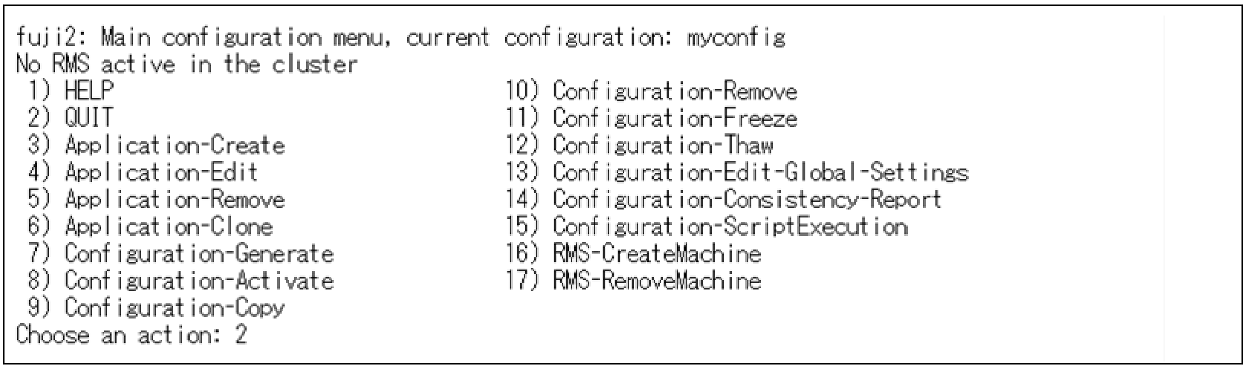
Point

The Configuration-Activate process removes persistent status information on all affected nodes.

After the configuration has been activated successfully, you can return to the Main configuration menu. From there, you can quit the configuration procedure.

2. Press [Enter] to return to the Main configuration menu (see the following figure).

Figure 3.9 Quitting the Main configuration menu



```
fuji2: Main configuration menu, current configuration: myconfig
No RMS active in the cluster
 1) HELP                               10) Configuration-Remove
 2) QUIT                               11) Configuration-Freeze
 3) Application-Create                 12) Configuration-Thaw
 4) Application-Edit                   13) Configuration-Edit-Global-Settings
 5) Application-Remove                 14) Configuration-Consistency-Report
 6) Application-Clone                  15) Configuration-ScriptExecution
 7) Configuration-Generate             16) RMS-CreateMachine
 8) Configuration-Activate             17) RMS-RemoveMachine
 9) Configuration-Copy
Choose an action: 2
```

3. Select QUIT by entering the number 2.

   This ends the activation phase of the configuration process. Usually, the next step is to start RMS to monitor the newly-configured application.

4. Start RMS with the GUI or with the following command:

   ```
   hvcm -a
   ```

3.5 Configuration elements

This section discusses some basic elements that are part of a high-availability configuration. Most of them have been mentioned in previous sections. Additional details are provided here to assist you in understanding how they are used by the wizards.

Note

Users do not have to deal with any of the items listed in this section directly. RMS Wizards manage all the basic elements for a high availability configuration. This section is provided only to help users better understand the configuration elements.

3.5.1 Scripts

Scripts are used in a high-availability configuration to perform several kinds of actions. Among the most important types of actions are the following:

- Bringing a resource to an Online state
- Bringing a resource to an Offline state

As an example of a script sending a resource Offline, you might think of a file system that has to be unmounted on a node where a fault occurs. An offline script would use the umount command to unmount the file system. Another script might use the mount command to mount it on a different node.

Besides such online and offline scripts, there are also pre-online and pre-offline scripts for preparing transition into the respective states, as well as a number of other scripts.

See

The hvexec command executes scripts for a high-availability configuration monitored by RMS. For more details on the command hvexec please refer to the primer.htm document. (See the "Related documentation".)

3.5.2 Detectors

Detectors are processes that have the task of monitoring resources. If there is a change in the state of a resource (for example, of a disk group) the detector in charge notifies the RMS base monitor. The base monitor may then decide to have a script executed as a reaction to this changed state.

3.5.3 RMS objects

A high-availability configuration can be seen as a set or group of objects with interdependencies. Any application or resource that is part of the configuration is then represented by one of the objects.

The interdependences of objects can be displayed as a graph called the RMS graph.

These are the most important object types used in RMS configurations:

- userApplication

  Represents an application to be configured for high-availability.

- SysNode

  Represents a machine that is running as a node in a cluster.

- gResource

  Represents a generic resource that is to be defined according to the needs of a customer application.

- Controller

  Manages the dependencies between child and parent applications so that the child application can act as a resource of the parent application.

In a typical configuration, one detector can be associated with all objects of the same type.

Chapter 4 Example of configuration change

This chapter provides an example procedure of configuration change to pre-built cluster applications using the RMS Wizard with Solaris version PRIMECLUSTER. The following below provides the example of configuration change.

Note

- When editing the RMS configuration, make sure to stop RMS. Use the Cluster Admin GUI (See "7.1.3 Stopping RMS") or enter the following command from any machine in the cluster:

  ```
  # hvshut -a
  ```

- When taking this procedure, note the following things:
  - Before taking this procedure, complete all the settings of the cluster application first on the userApplication Configuration Wizard.
  - Use the wgcnfclient command to check the RMS Configuration name specified by the -n option when executing the hvw command. For details on how to use the wgcnfclient command, see "6.7.6 Changing the RMS Configuration Name" in "PRIMECLUSTER Installation and Administration Guide (Oracle Solaris)."
  - Make sure to execute the hvw command with the -xj option.

4.1 Setting scripts in cluster application

See the procedure below to set scripts in the cluster application. The settable scripts are as follows.

- PreCheckScript
- PreOnlineScript
- PostOnlineScript
- PreOfflineScript
- PostOfflineScript
- OfflineDoneScript
- FaultScript

Note

When adding/deleting a resource or changing the setting of a resource in the cluster application, delete the userApplication once as a setting procedure. In this case, follow this procedure to set the scripts again.

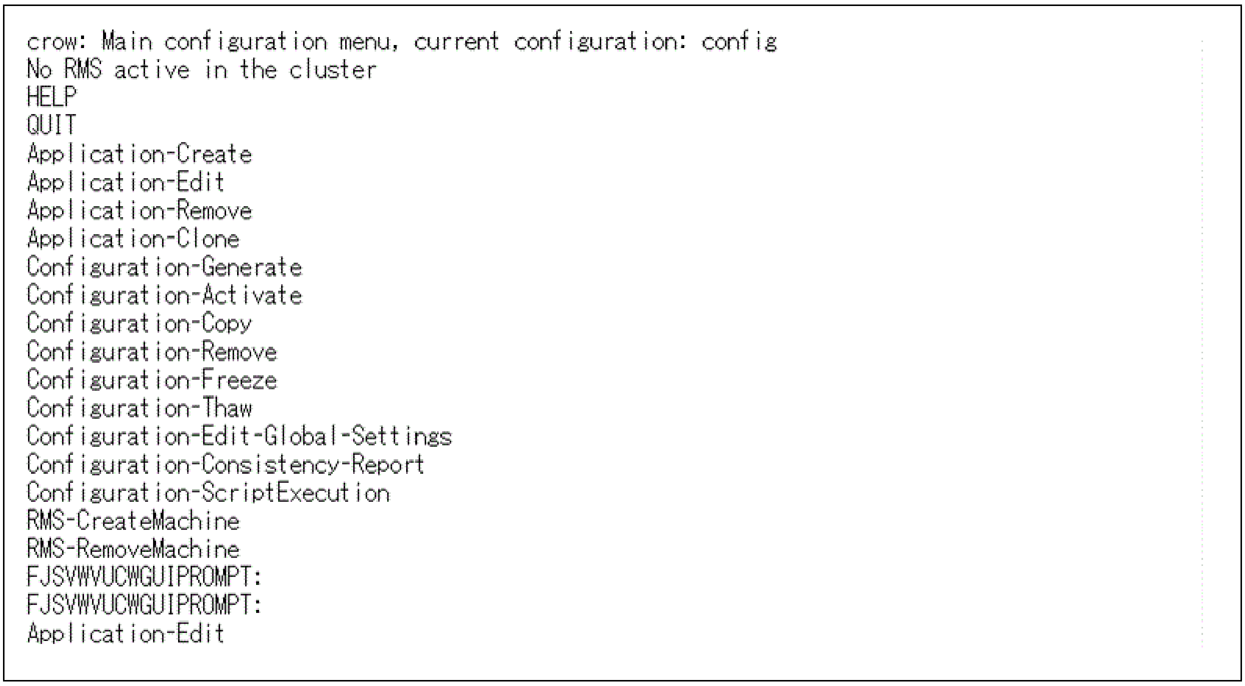
1. Enter the following command to display the wizard menu for configuring RMS.

   ```
   # hvw -xj -n configname
   ```

2. RMS Wizard is started and the Main configuration menu is displayed.

   Enter "Application-Edit" and then select [Application-Edit].

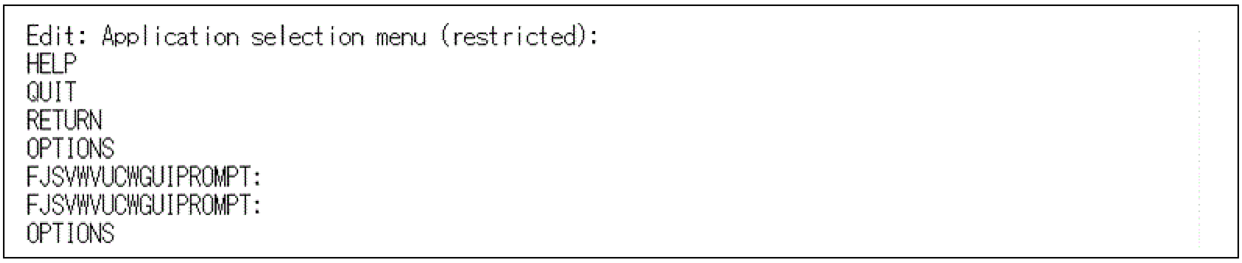
   Figure 4.1 Main configuration menu



```
crow: Main configuration menu, current configuration: config
No RMS active in the cluster
HELP
QUIT
Application-Create
Application-Edit
Application-Remove
Application-Clone
Configuration-Generate
Configuration-Activate
Configuration-Copy
Configuration-Remove
Configuration-Freeze
Configuration-Thaw
Configuration-Edit-Global-Settings
Configuration-Consistency-Report
Configuration-ScriptExecution
RMS-CreateMachine
RMS-RemoveMachine
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
Application-Edit
```

3. Enter "OPTIONS" and then select [OPTIONS].

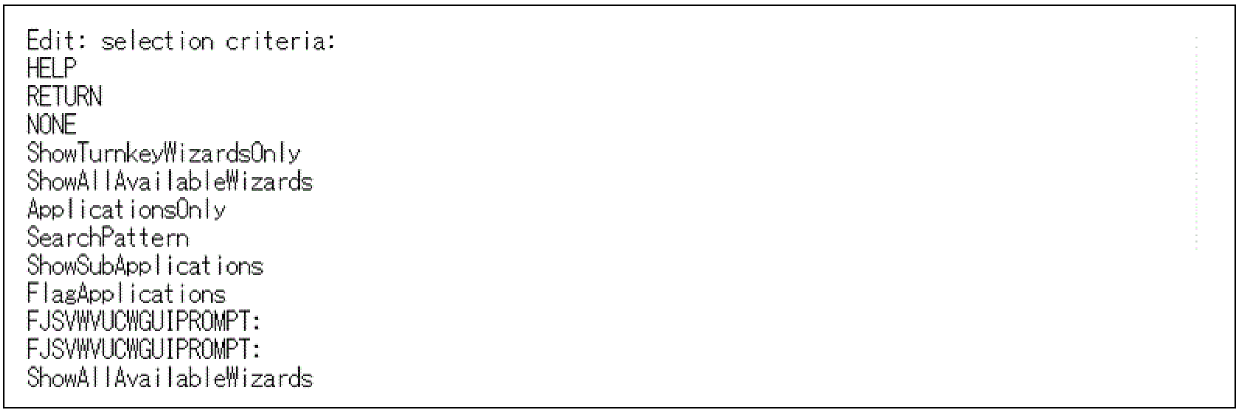
   Figure 4.2 [Application selection] menu



```
Edit: Application selection menu (restricted):
HELP
QUIT
RETURN
OPTIONS
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
OPTIONS
```

4. Enter "ShowAllAvailableWizards" and then select [ShowAllAvailableWizards].

Figure 4.3 Option menu of the application setting

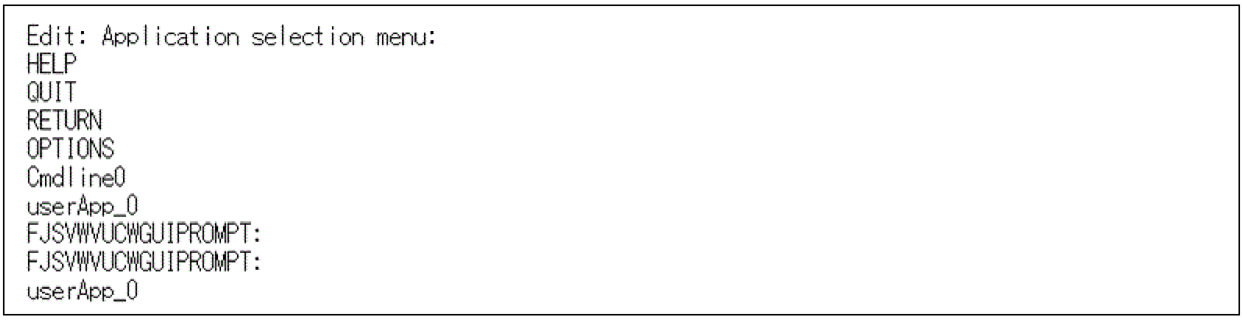


```
Edit: selection criteria:
HELP
RETURN
NONE
ShowTurnkeyWizardsOnly
ShowAllAvailableWizards
ApplicationsOnly
SearchPattern
ShowSubApplications
FlagApplications
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
ShowAllAvailableWizards
```

5. In the screen below, enter the application name that sets the script, and enter the return key.

In the example below, "userApp_0" is entered to set the PreCheckScript of userApp_0.

Figure 4.4 [Application selection] menu

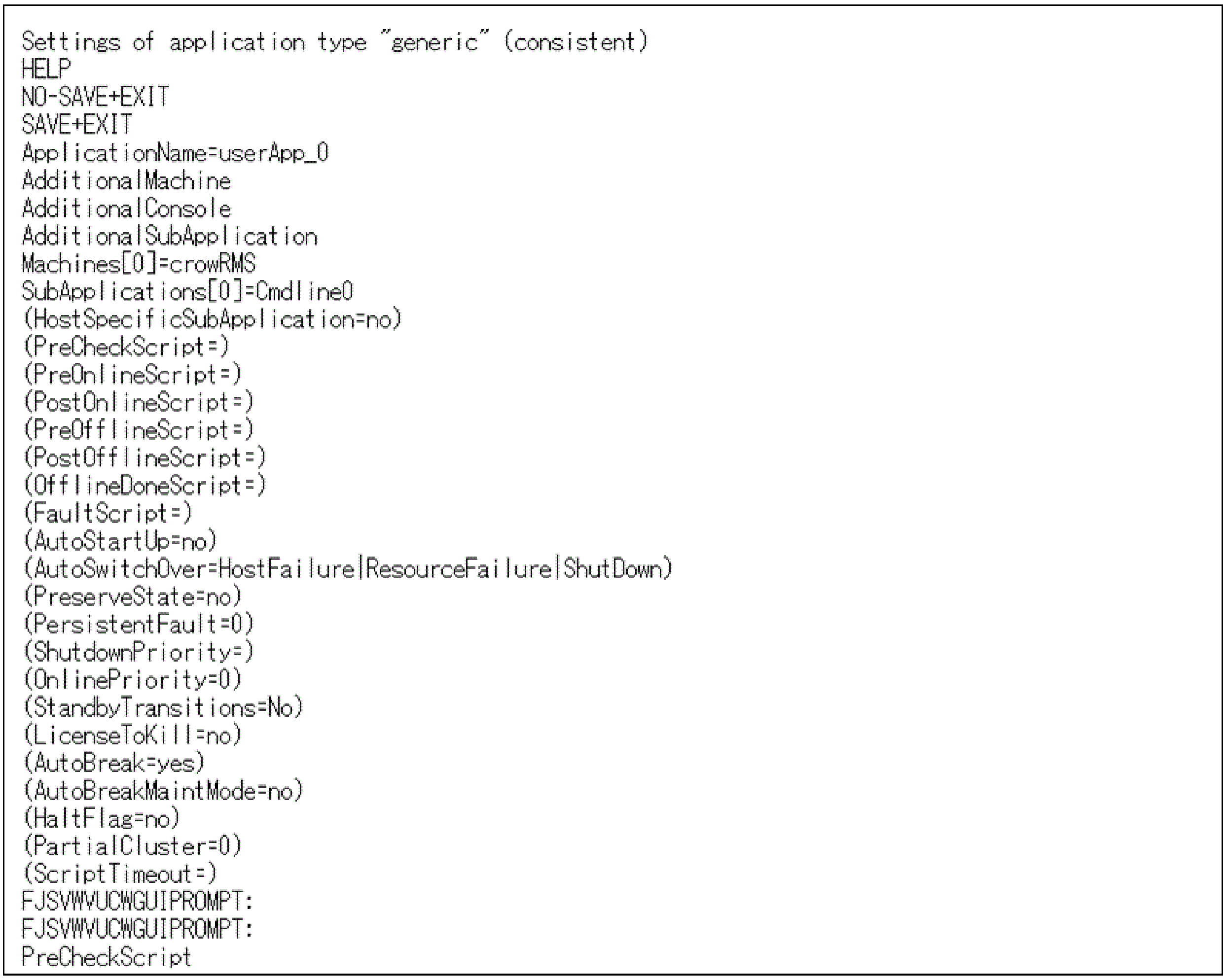


```
Edit: Application selection menu:
HELP
QUIT
RETURN
OPTIONS
Cmdline0
userApp_0
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
userApp_0
```

6. Enter the script name to be set, and press the return key.

   In the example below, "PreCheckScript" is entered to set the PreCheckScript.

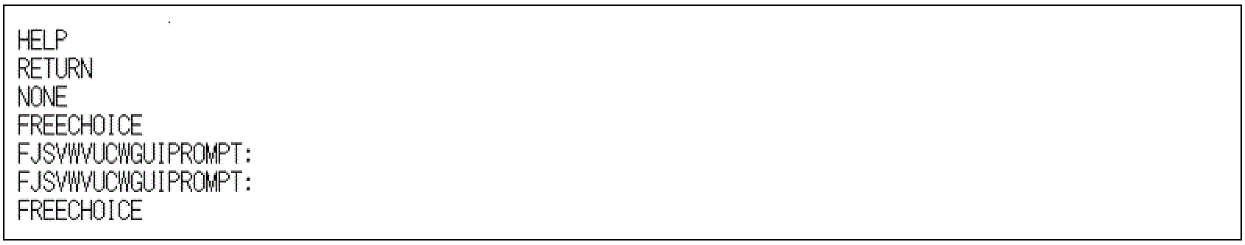
   Figure 4.5 Application setting menu



```
Settings of application type "generic" (consistent)
HELP
NO-SAVE+EXIT
SAVE+EXIT
ApplicationName=userApp_0
AdditionalMachine
AdditionalConsole
AdditionalSubApplication
Machines[0]=crowRMS
SubApplications[0]=Cmdline0
(HostSpecificSubApplication=no)
(PreCheckScript=)
(PreOnlineScript=)
(PostOnlineScript=)
(PreOfflineScript=)
(PostOfflineScript=)
(OfflineDoneScript=)
(FaultScript=)
(AutoStartUp=no)
(AutoSwitchOver=HostFailure|ResourceFailure|ShutDown)
(PreserveState=no)
(PersistentFault=0)
(ShutdownPriority=)
(OnlinePriority=0)
(StandbyTransitions=No)
(LicenseToKill=no)
(AutoBreak=yes)
(AutoBreakMaintMode=no)
(HaltFlag=no)
(PartialCluster=0)
(ScriptTimeout=)
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
PreCheckScript
```

7. Enter "FREECHOICE" and then select [FREECHOICE].

   Figure 4.6 Selection menu of the scripts

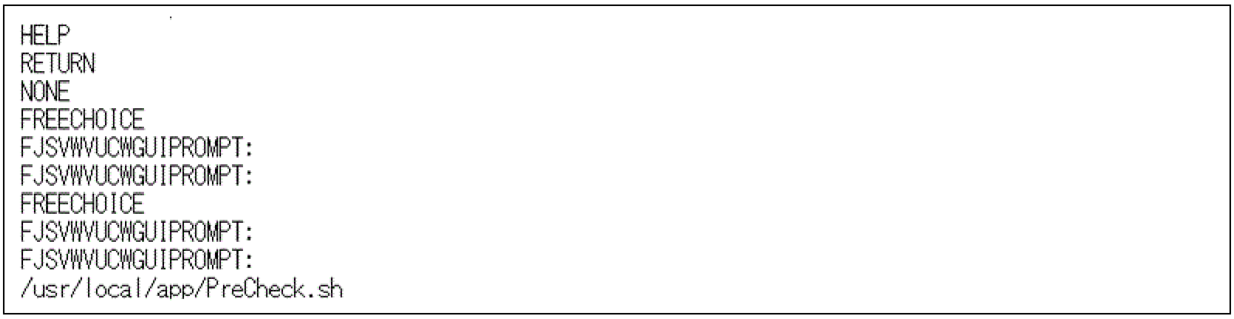


```
HELP
RETURN
NONE
FREECHOICE
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
FREECHOICE
```

8. Enter the file path of the script, and press the return key.

   In the example below, /usr/local/app/PreCheck.sh is specified for the PreCheckScript.

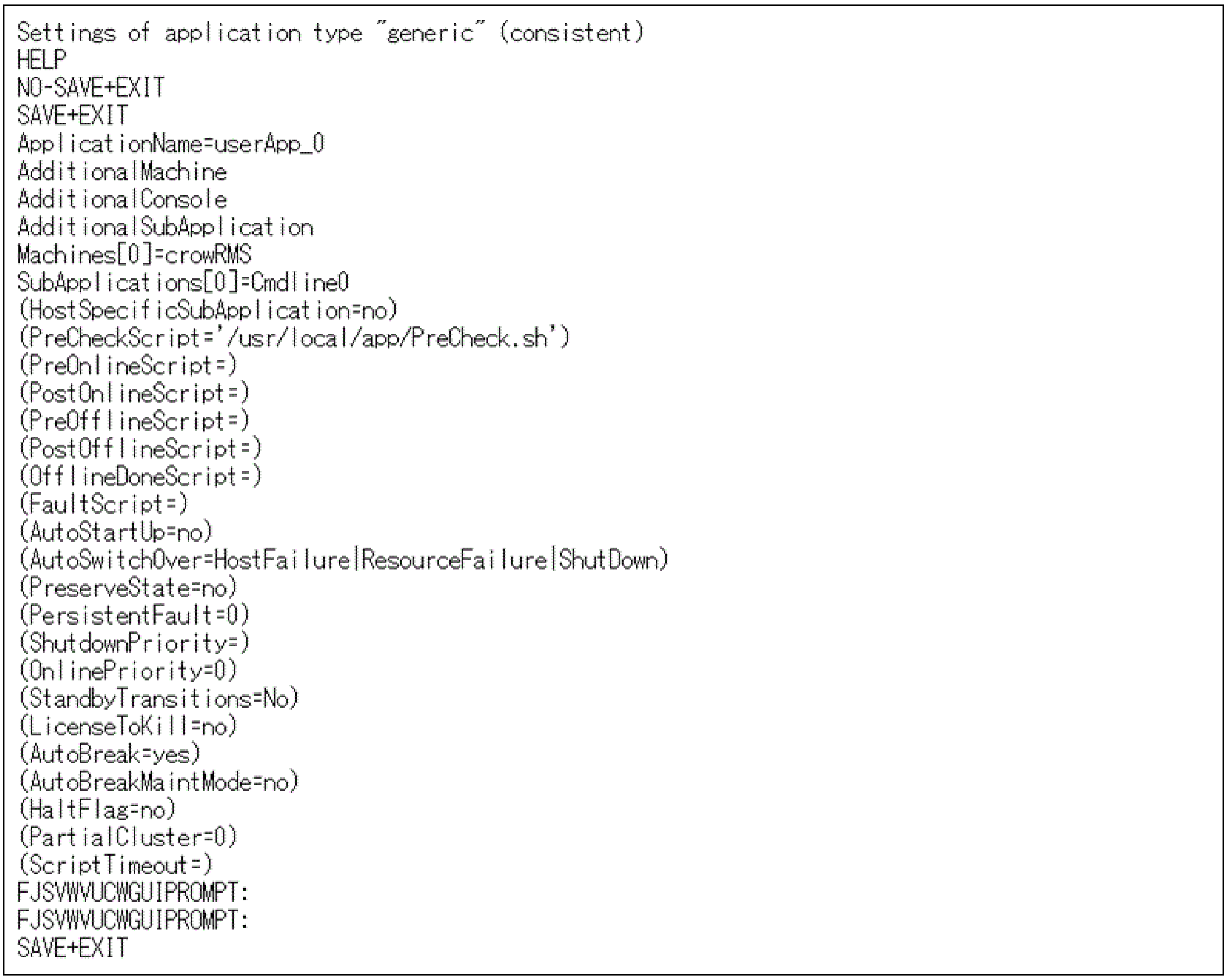
Figure 4.7 Entering the file path of the script



```
HELP
RETURN
NONE
FREECHOICE
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
FREECHOICE
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
/usr/local/app/PreCheck.sh
```

9. Enter "SAVE+EXIT" and then select [SAVE+EXIT].

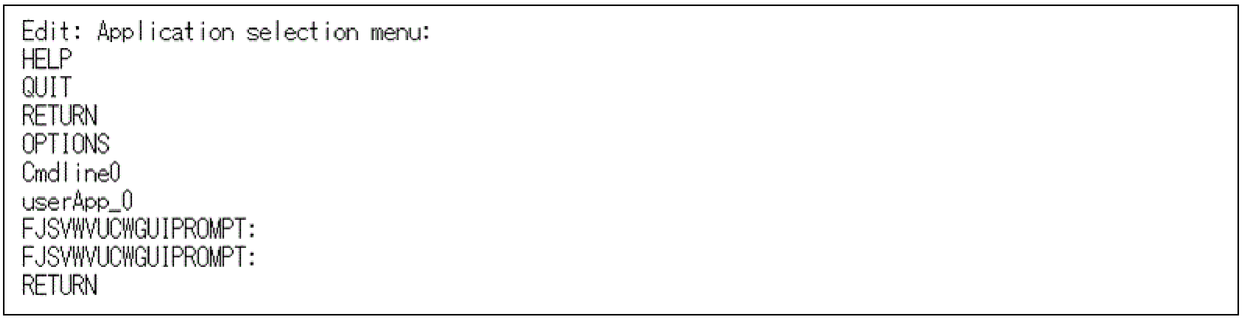
Figure 4.8 Application setting menu



```
Settings of application type "generic" (consistent)
HELP
NO-SAVE+EXIT
SAVE+EXIT
ApplicationName=userApp_0
AdditionalMachine
AdditionalConsole
AdditionalSubApplication
Machines[0]=crowRMS
SubApplications[0]=Cmdline0
(HostSpecificSubApplication=no)
(PreCheckScript='/usr/local/app/PreCheck.sh')
(PreOnlineScript=)
(PostOnlineScript=)
(PreOfflineScript=)
(PostOfflineScript=)
(OfflineDoneScript=)
(FaultScript=)
(AutoStartUp=no)
(AutoSwitchOver=HostFailure|ResourceFailure|ShutDown)
(PreserveState=no)
(PersistentFault=0)
(ShutdownPriority=)
(OnlinePriority=0)
(StandbyTransitions=No)
(LicenseToKill=no)
(AutoBreak=yes)
(AutoBreakMaintMode=no)
(HaltFlag=no)
(PartialCluster=0)
(ScriptTimeout=)
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
SAVE+EXIT
```

10. Enter "RETURN" and then select [RETURN].

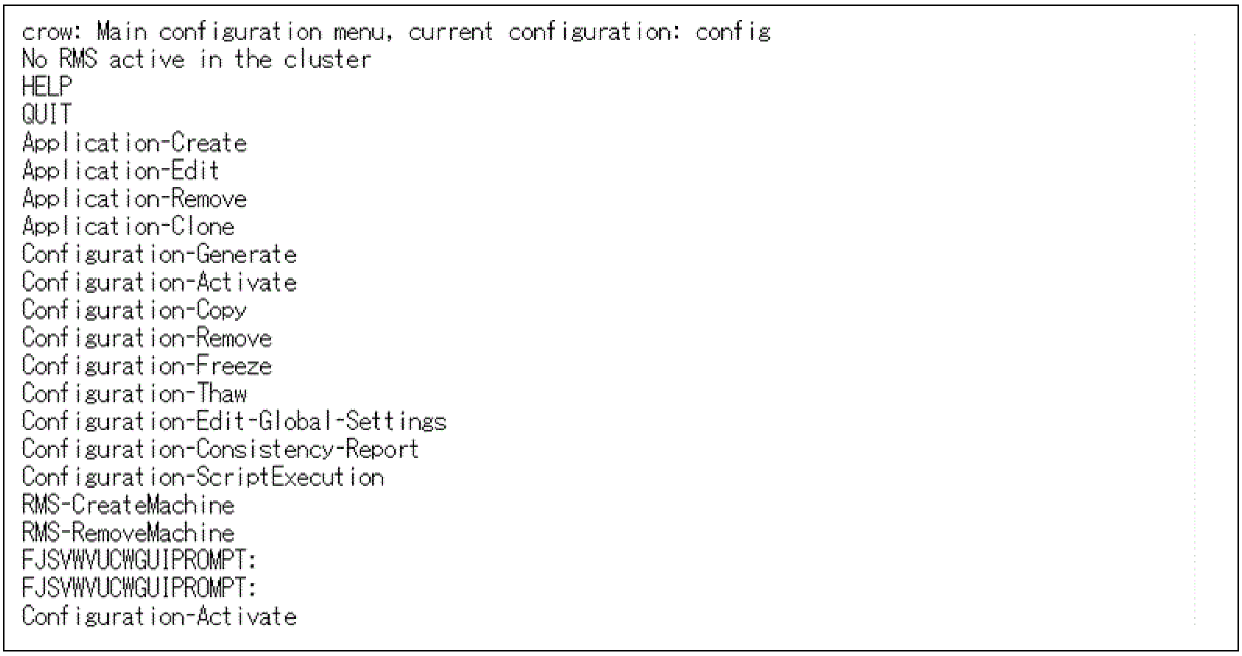
Figure 4.9 [Application selection] menu



```
Edit: Application selection menu:
HELP
QUIT
RETURN
OPTIONS
Cmdline0
userApp_0
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
RETURN
```

11. Enter "Configuration-Activate" and then select [Configuration-Activate].

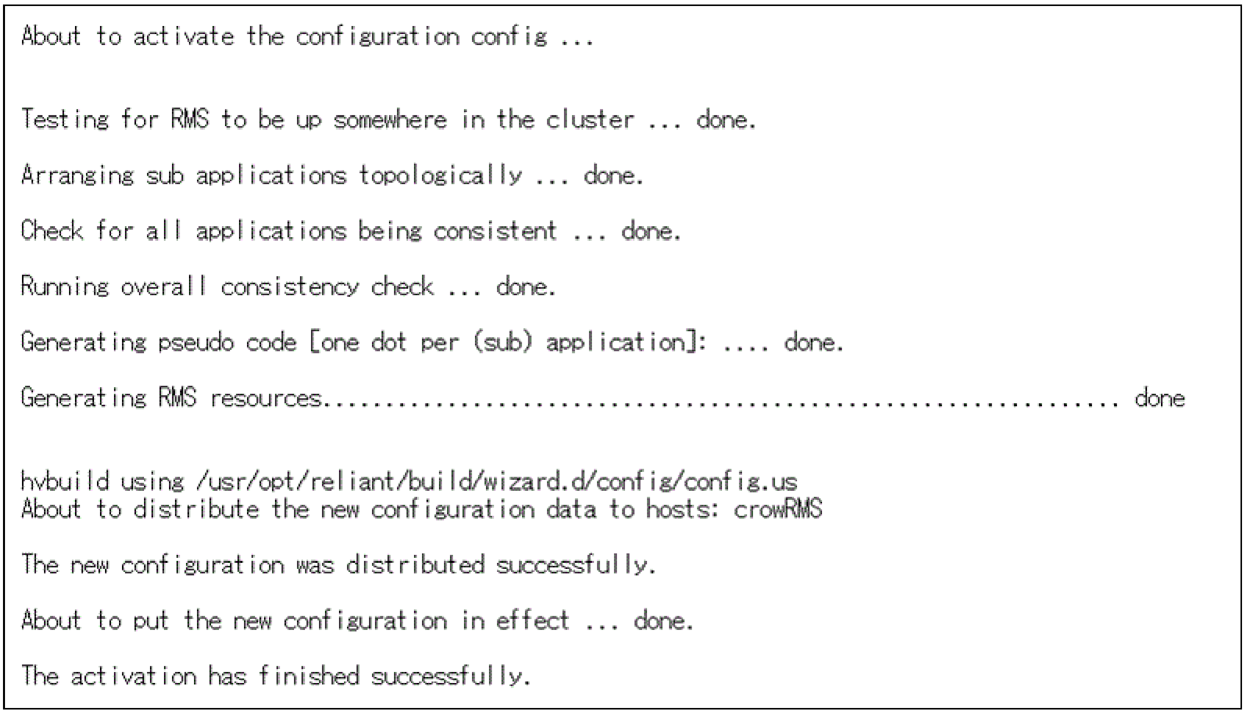
Figure 4.10 Main configuration menu



```
crow: Main configuration menu, current configuration: config
No RMS active in the cluster
HELP
QUIT
Application-Create
Application-Edit
Application-Remove
Application-Clone
Configuration-Generate
Configuration-Activate
Configuration-Copy
Configuration-Remove
Configuration-Freeze
Configuration-Thaw
Configuration-Edit-Global-Settings
Configuration-Consistency-Report
Configuration-ScriptExecution
RMS-CreateMachine
RMS-RemoveMachine
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
Configuration-Activate
```

12. RMS configuration is generated and distributed.

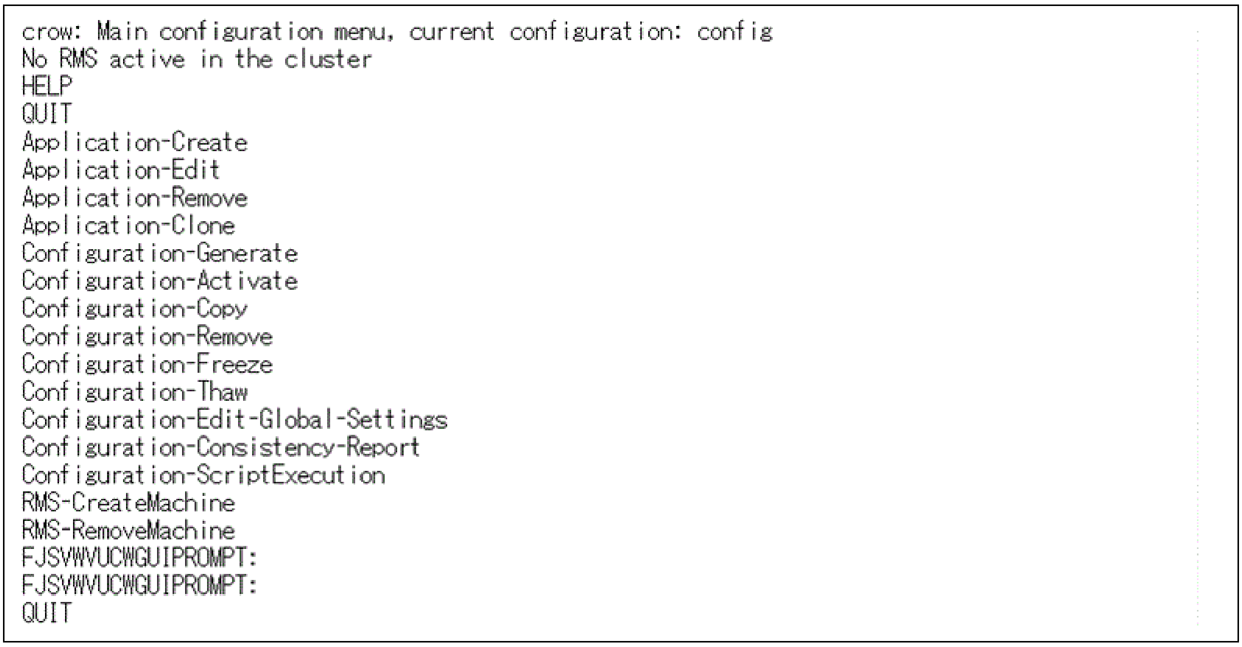
Figure 4.11 Generation and distribution of the RMS configuration file



```
About to activate the configuration config ...


Testing for RMS to be up somewhere in the cluster ... done.

Arranging sub applications topologically ... done.

Check for all applications being consistent ... done.

Running overall consistency check ... done.

Generating pseudo code [one dot per (sub) application]: .... done.

Generating RMS resources............................................................. done


hvbuild using /usr/opt/reliant/build/wizard.d/config/config.us
About to distribute the new configuration data to hosts: crowRMS

The new configuration was distributed successfully.

About to put the new configuration in effect ... done.

The activation has finished successfully.
```

13. Enter "QUIT" and then select [QUIT].

Figure 4.12 Quitting main configuration menu



```
crow: Main configuration menu, current configuration: config
No RMS active in the cluster
HELP
QUIT
Application-Create
Application-Edit
Application-Remove
Application-Clone
Configuration-Generate
Configuration-Activate
Configuration-Copy
Configuration-Remove
Configuration-Freeze
Configuration-Thaw
Configuration-Edit-Global-Settings
Configuration-Consistency-Report
Configuration-ScriptExecution
RMS-CreateMachine
RMS-RemoveMachine
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
QUIT
```

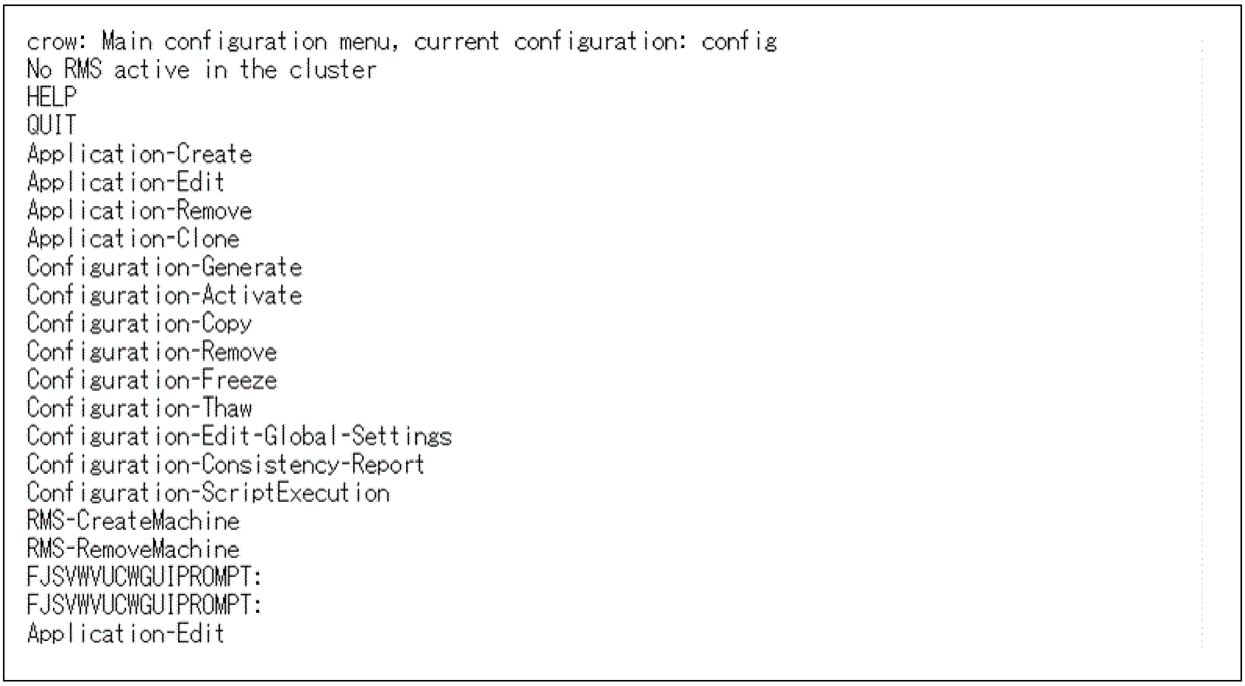
4.2 Changing timeout period of controller

1. Enter the following command to display the wizard menu for configuring RMS.

```
# hvw -xj -n configname
```

2. Enter "Application-Edit" and the select [Application-Edit].

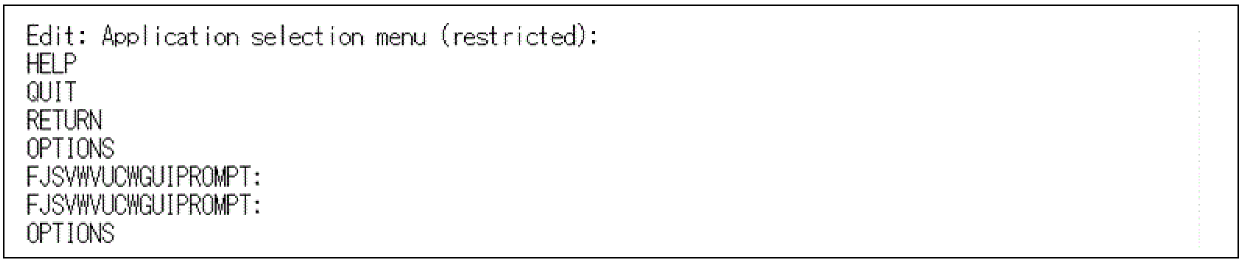
Figure 4.13 Main configuration menu



```
crow: Main configuration menu, current configuration: config
No RMS active in the cluster
HELP
QUIT
Application-Create
Application-Edit
Application-Remove
Application-Clone
Configuration-Generate
Configuration-Activate
Configuration-Copy
Configuration-Remove
Configuration-Freeze
Configuration-Thaw
Configuration-Edit-Global-Settings
Configuration-Consistency-Report
Configuration-ScriptExecution
RMS-CreateMachine
RMS-RemoveMachine
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
Application-Edit
```

3. Enter "OPTIONS" and then select [OPTIONS].

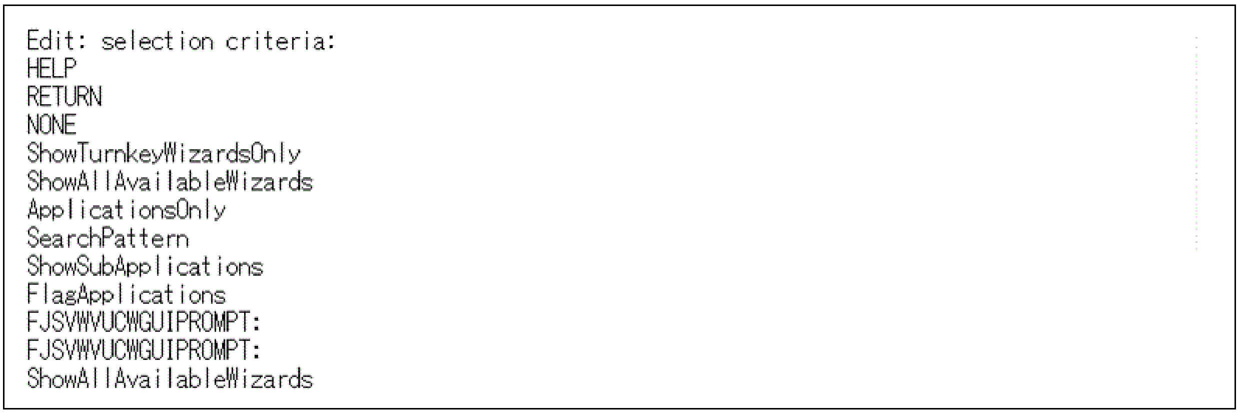
Figure 4.14 [Application selection] menu



```
Edit: Application selection menu (restricted):
HELP
QUIT
RETURN
OPTIONS
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
OPTIONS
```

4. Enter "ShowAllAvailableWizards" and then select [ShowAllAvailableWizards].

Figure 4.15 Option menu of application setting

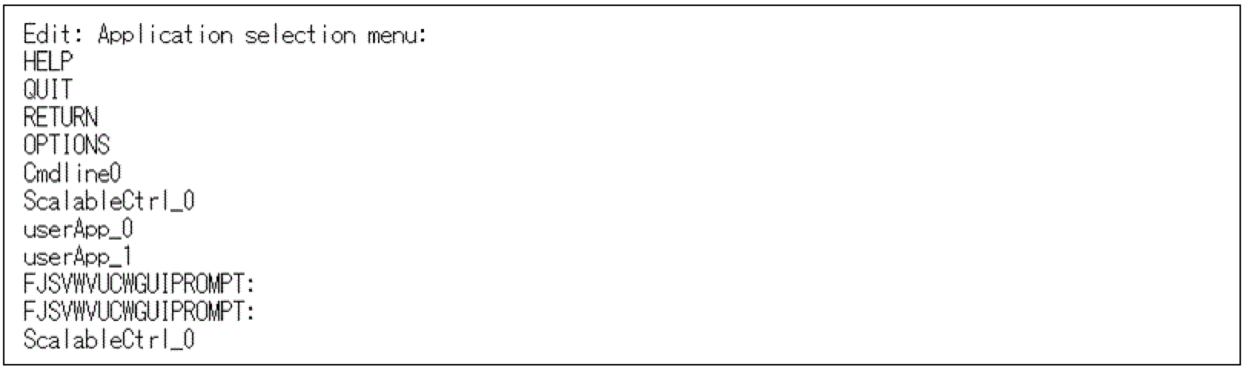


```
Edit: selection criteria:
HELP
RETURN
NONE
ShowTurnkeyWizardsOnly
ShowAllAvailableWizards
ApplicationsOnly
SearchPattern
ShowSubApplications
FlagApplications
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
ShowAllAvailableWizards
```

5. In the screen below, enter the resource name of the Controller resource that you want to change the timeout period and then press the return key.

   Enter "ScalableCtrl_0" to change the timeout period of ScalableCtrl_0.

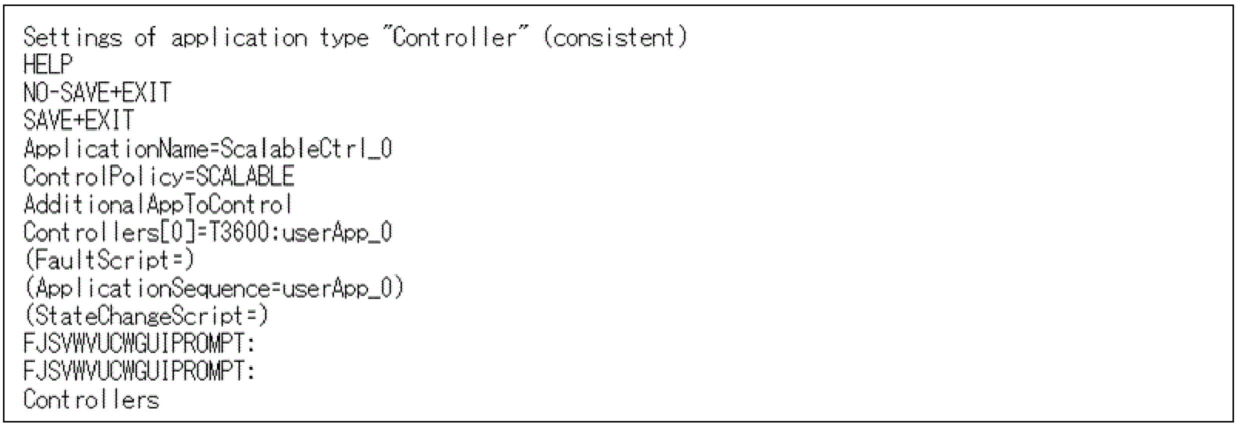
   Figure 4.16 [Application selection] menu



```
Edit: Application selection menu:
HELP
QUIT
RETURN
OPTIONS
Cmdline0
ScalableCtrl_0
userApp_0
userApp_1
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
ScalableCtrl_0
```

6. Enter "Controllers" and then select [Controllers].

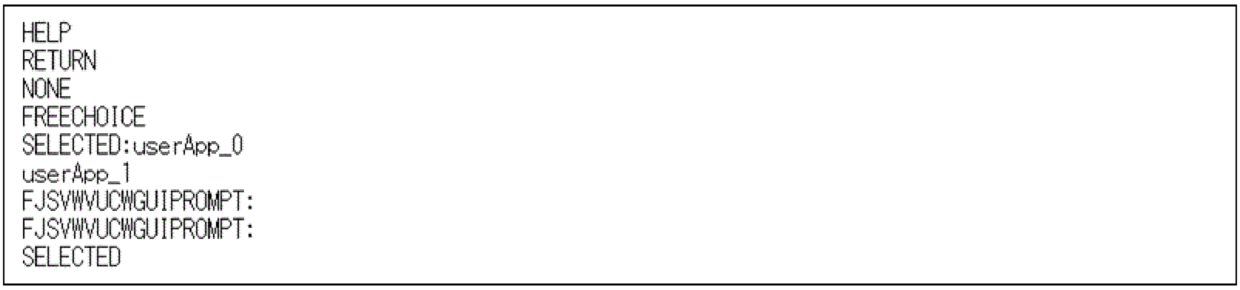
   Figure 4.17 Settings menu of controller



```
Settings of application type "Controller" (consistent)
HELP
NO-SAVE+EXIT
SAVE+EXIT
ApplicationName=ScalableCtrl_0
ControlPolicy=SCALABLE
AdditionalAppToControl
Controllers[0]=T3600:userApp_0
(FaultScript=)
(ApplicationSequence=userApp_0)
(StateChangeScript=)
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
Controllers
```

7. Enter "SELECTED:<*userApplication name*> and then select [SELECTED].

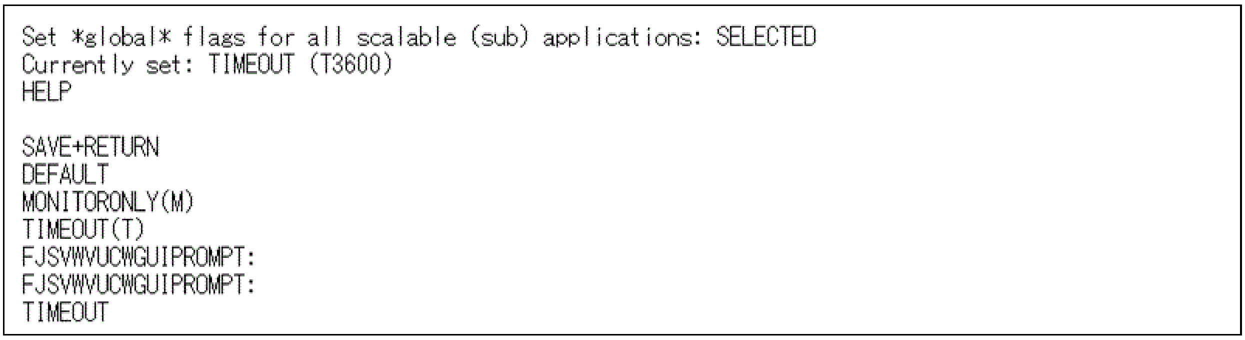
   Figure 4.18 Selection menu of controlled target application



```
HELP
RETURN
NONE
FREECHOICE
SELECTED:userApp_0
userApp_1
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
SELECTED
```

8. Enter "TIMEOUT" and then select [TIMEOUT(T)].

Figure 4.19 Attribution setting menu of the controller

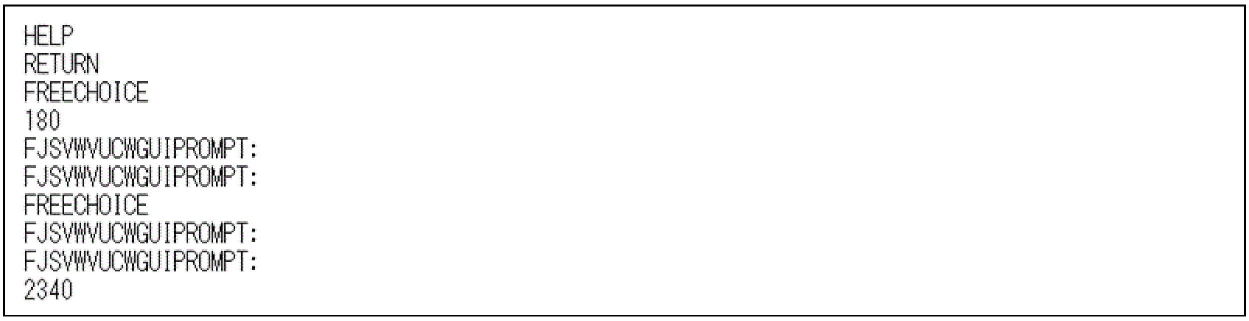


```
Set *global* flags for all scalable (sub) applications: SELECTED
Currently set: TIMEOUT (T3600)
HELP

SAVE+RETURN
DEFAULT
MONITORONLY(M)
TIMEOUT(T)
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
TIMEOUT
```

9. Enter "FREECHOICE" then select [FREECHOICE] and then enter the timeout period.

Here, enter "2340" to set the timeout period to 2340 seconds.

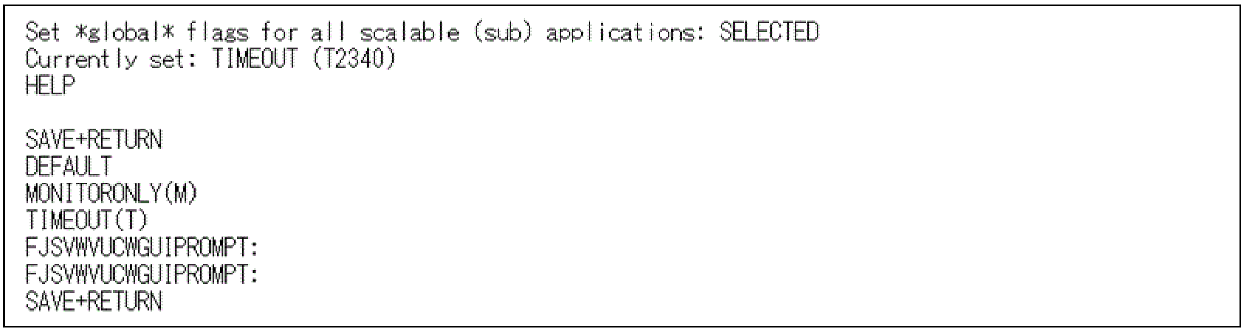
Figure 4.20 TIMEOUT input



```
HELP
RETURN
FREECHOICE
180
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
FREECHOICE
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
2340
```

10. Enter "SAVE+RETURN" and then select [SAVE+RETURN].

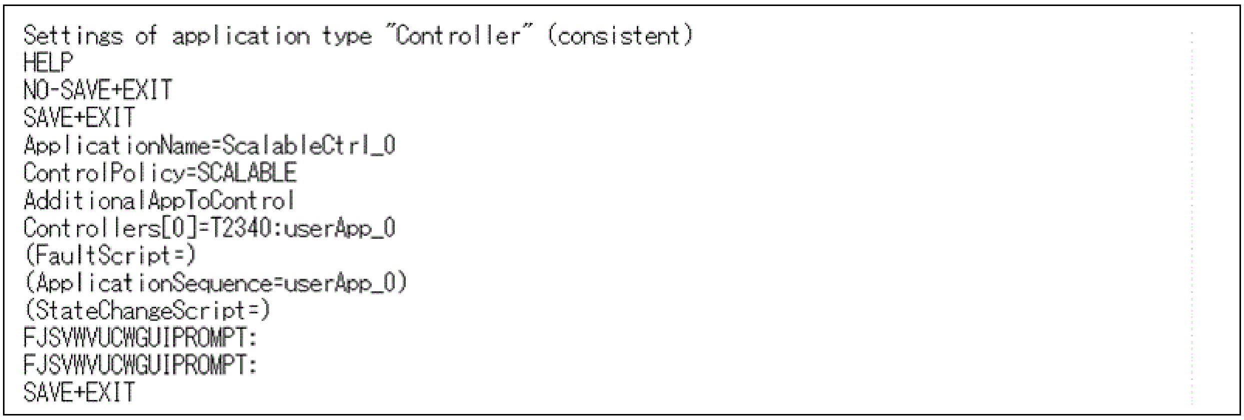
Figure 4.21 Attribution setting menu of the controller



```
Set *global* flags for all scalable (sub) applications: SELECTED
Currently set: TIMEOUT (T2340)
HELP

SAVE+RETURN
DEFAULT
MONITORONLY(M)
TIMEOUT(T)
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
SAVE+RETURN
```

11. Enter "SAVE+EXIT" and then select [SAVE+EXIT].

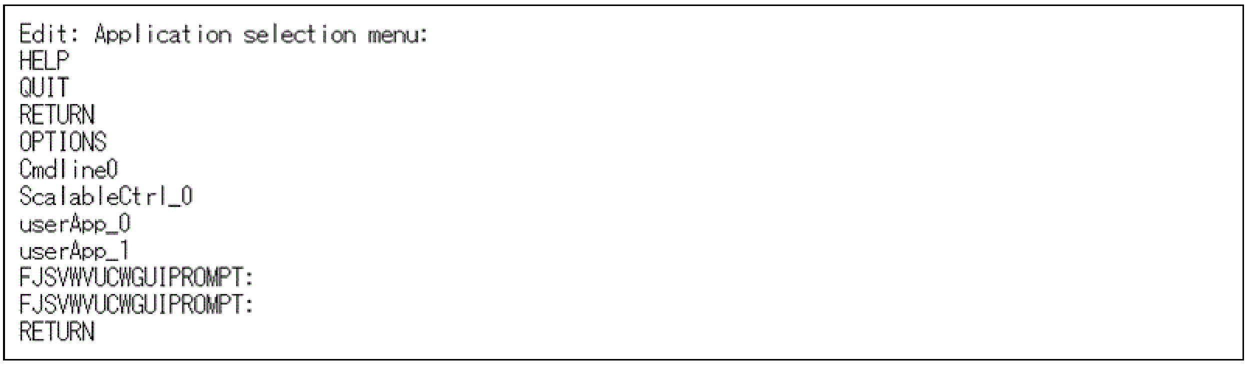
Figure 4.22 Menu settings of the controller



```
Settings of application type "Controller" (consistent)
HELP
NO-SAVE+EXIT
SAVE+EXIT
ApplicationName=ScalableCtrl_0
ControlPolicy=SCALABLE
AdditionalAppToControl
Controllers[0]=T2340:userApp_0
(FaultScript=)
(ApplicationSequence=userApp_0)
(StateChangeScript=)
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
SAVE+EXIT
```

12. Enter "RETURN" and then select [RETURN].

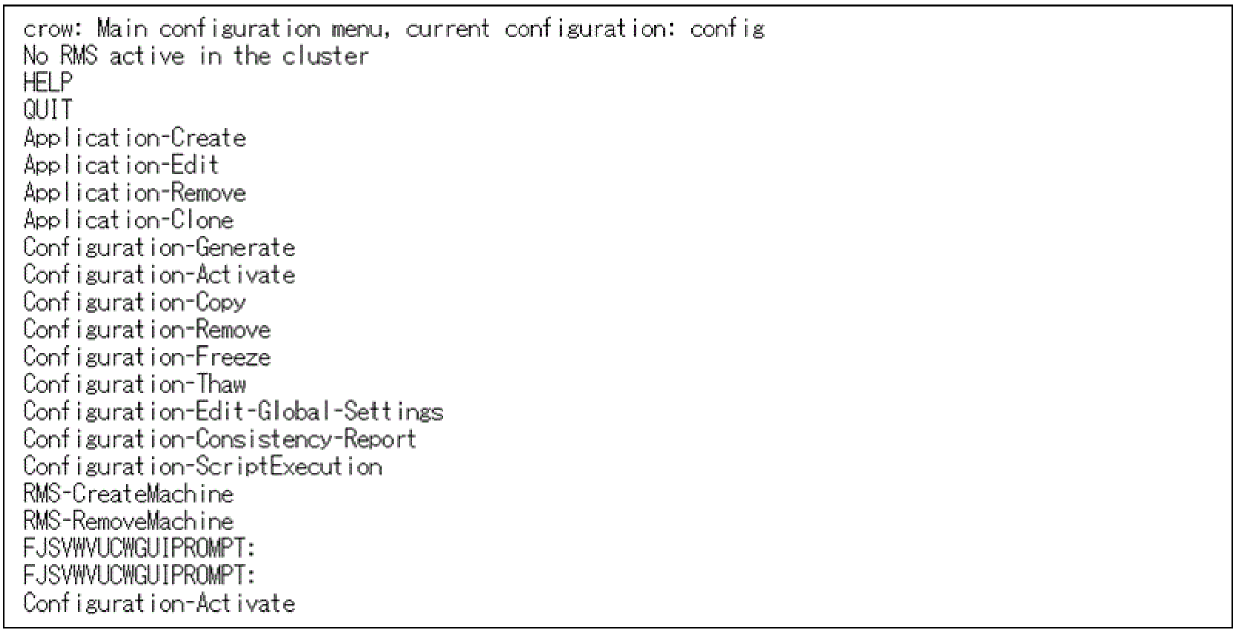
Figure 4.23 [Application selection] menu



```
Edit: Application selection menu:
HELP
QUIT
RETURN
OPTIONS
Cmdline0
ScalableCtrl_0
userApp_0
userApp_1
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
RETURN
```

13. Enter "Configuration-Activate" and then select [Configuration-Activate].

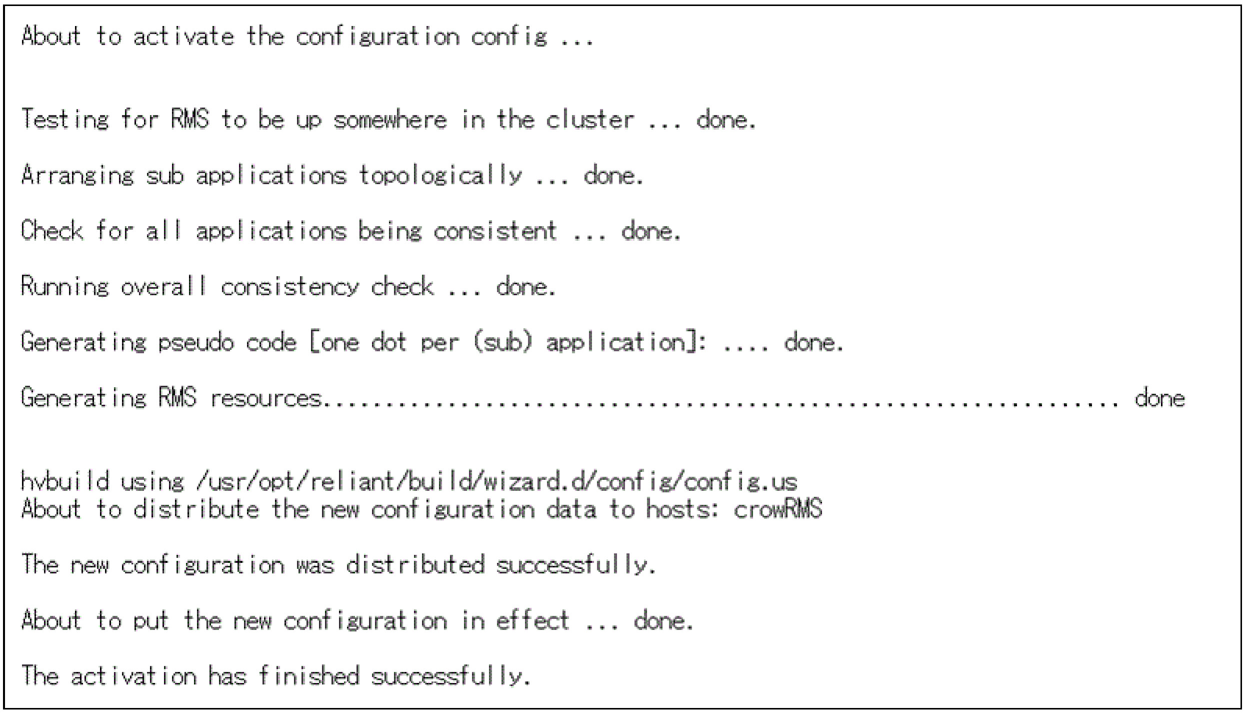
Figure 4.24 Main configuration menu



```
crow: Main configuration menu, current configuration: config
No RMS active in the cluster
HELP
QUIT
Application-Create
Application-Edit
Application-Remove
Application-Clone
Configuration-Generate
Configuration-Activate
Configuration-Copy
Configuration-Remove
Configuration-Freeze
Configuration-Thaw
Configuration-Edit-Global-Settings
Configuration-Consistency-Report
Configuration-ScriptExecution
RMS-CreateMachine
RMS-RemoveMachine
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
Configuration-Activate
```

14. RMS configuration is generated and distributed.

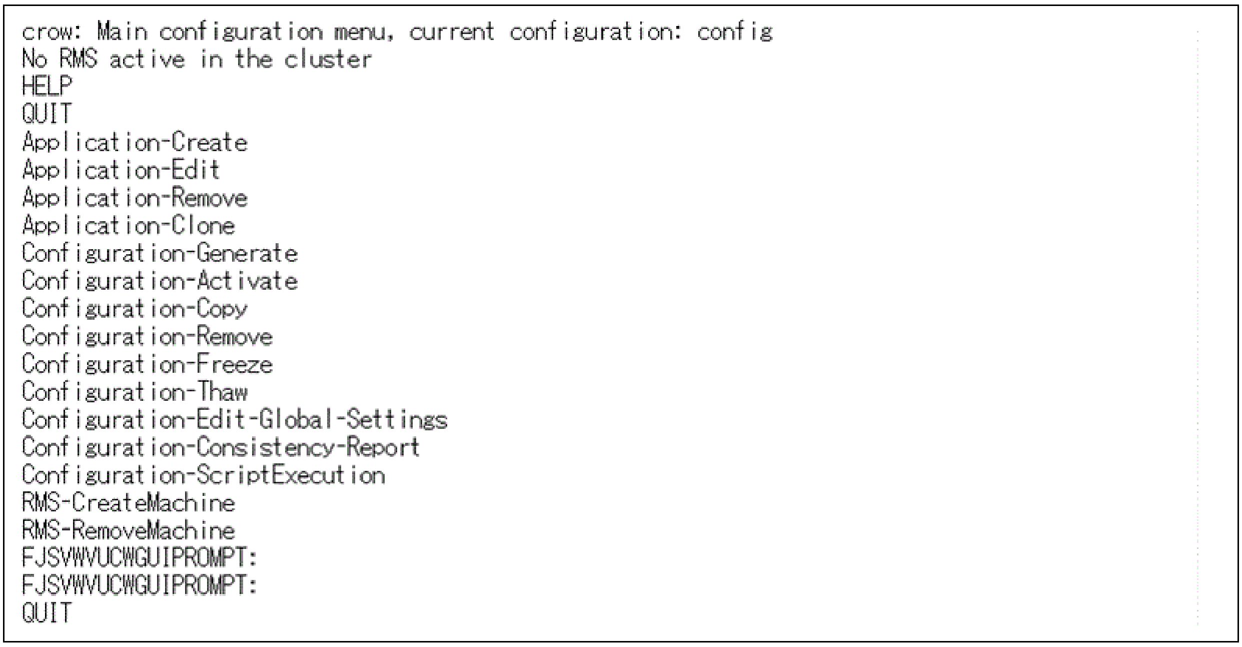
Figure 4.25 Creation and distribution of designated file of RMS configuration



```
About to activate the configuration config ...


Testing for RMS to be up somewhere in the cluster ... done.

Arranging sub applications topologically ... done.

Check for all applications being consistent ... done.

Running overall consistency check ... done.

Generating pseudo code [one dot per (sub) application]: .... done.

Generating RMS resources............................................................ done


hvbuild using /usr/opt/reliant/build/wizard.d/config/config.us
About to distribute the new configuration data to hosts: crowRMS

The new configuration was distributed successfully.

About to put the new configuration in effect ... done.

The activation has finished successfully.
```

15. Enter "QUIT" and then select [QUIT].

Figure 4.26 Quitting main configuration menu



```
crow: Main configuration menu, current configuration: config
No RMS active in the cluster
HELP
QUIT
Application-Create
Application-Edit
Application-Remove
Application-Clone
Configuration-Generate
Configuration-Activate
Configuration-Copy
Configuration-Remove
Configuration-Freeze
Configuration-Thaw
Configuration-Edit-Global-Settings
Configuration-Consistency-Report
Configuration-ScriptExecution
RMS-CreateMachine
RMS-RemoveMachine
FJSVWVUCWGUIPROMPT:
FJSVWVUCWGUIPROMPT:
QUIT
```

Chapter 5 Using the Cluster Admin GUI

This chapter describes PRIMECLUSTER administration using the Cluster Admin graphical user interface (GUI). In addition, some command-line interface (CLI) commands are discussed.

5.1 Overview

RMS administration can be done by means of Cluster Admin GUI or by CLI, but we recommend using Cluster Admin GUI.

For your information, some procedures using CLI are described. However, CLI must be used only by expert system administrators or in those cases where Cluster Admin GUI is not available. If you decide to use a CLI procedure, please note the following:

See

For details on the CLI command, refer to "Appendix G RMS command line interface."

5.2 Starting the Cluster Admin GUI

The following sections discuss how to use the RMS portion of the GUI.

5.2.1 Web-Based Admin View

The login screen is displayed after the Web-Based Admin View is started.

For details, refer to "Chapter 3 Web-Based Admin View screen startup" in "PRIMECLUSTER Web-Based Admin View Operation Guide."

5.2.2 Login

Before logging in, make sure you have a user name and password with the appropriate privilege level. Cluster Admin has the following privilege levels:

- Root privileges

  Can perform all actions including configuration, administration, and viewing tasks.

- Administrative privileges

  Can view and execute commands, but cannot make configuration changes.

- Operator privileges

  Can only perform viewing tasks.

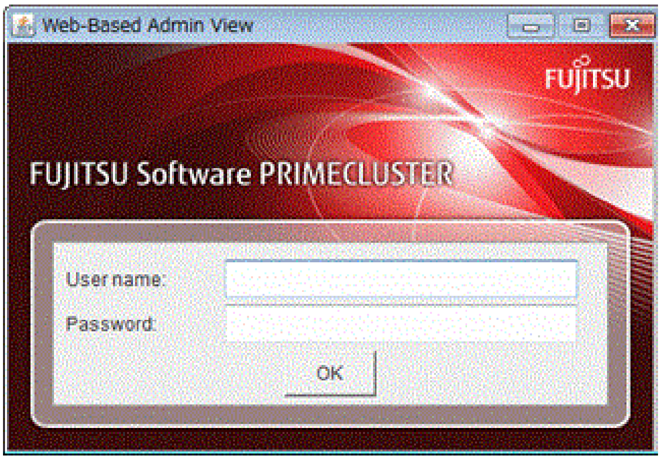
For more details on privilege levels, refer to "4.2.1 Assigning Users to Manage the Cluster" in "PRIMECLUSTER Installation and Administration Guide (Oracle Solaris)" or "4.3.1 Assigning Users to Manage the Cluster" in "PRIMECLUSTER Installation and Administration Guide (Linux)."

After the Web-Based Admin View login window appears, log in as follows:

1. Enter the user name and password for a user with the appropriate privilege level.

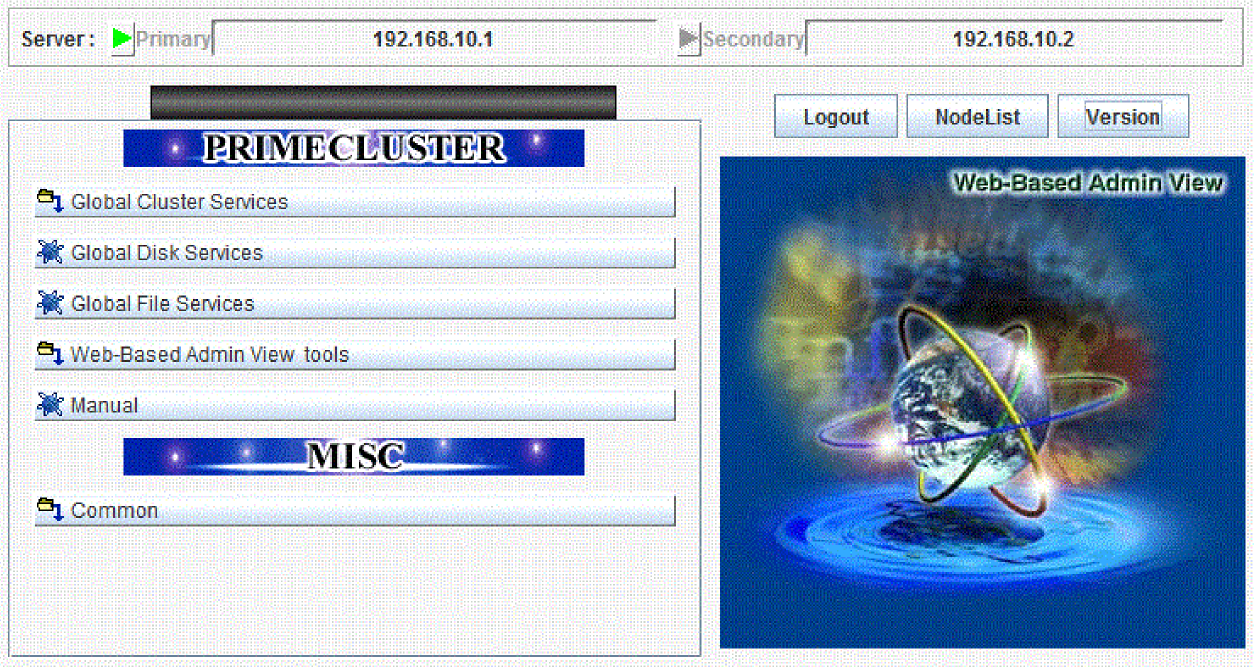
2. Click the OK button.

Figure 5.1 Web-Based Admin View login



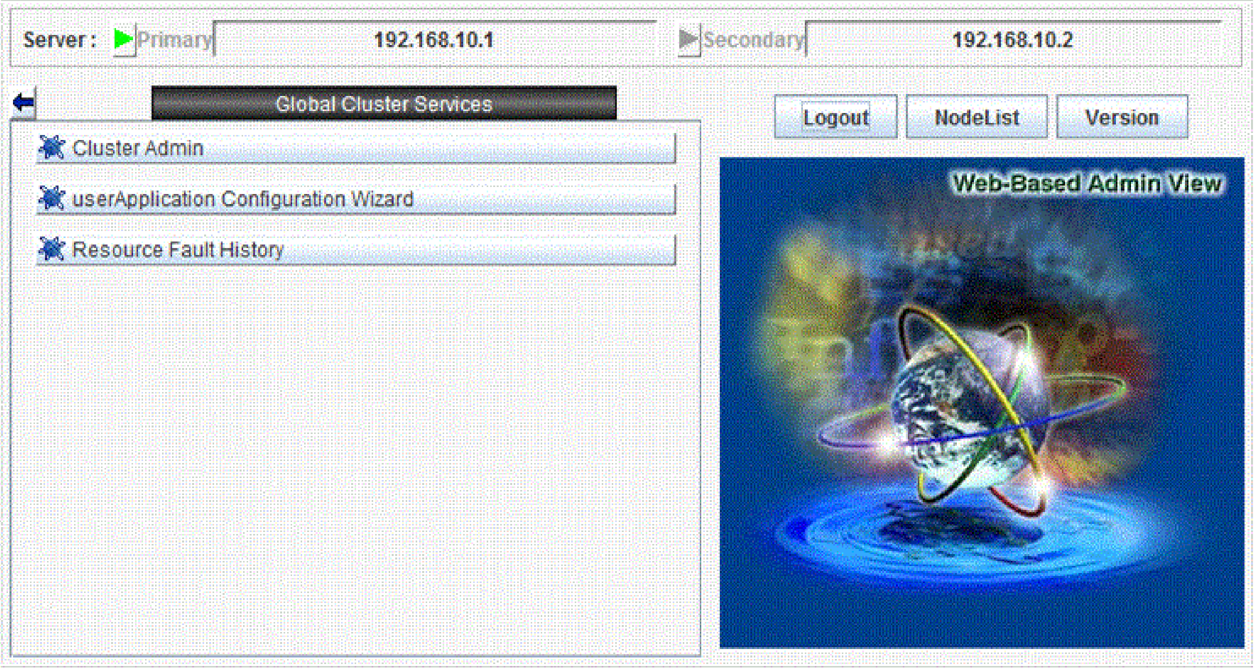
3. After you log in, the Web-Based Admin View window appears.

Figure 5.2 Invoking the Cluster Services GUI



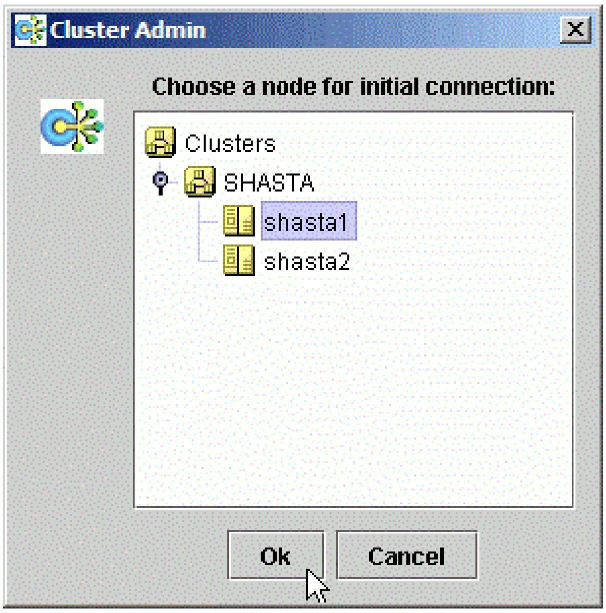
4. Click the Global Cluster Services button to advance to the next view.

Figure 5.3 Invoking Cluster Admin



5. Click the Cluster Admin button. The Choose a node for initial connection window appears.

Figure 5.4 Cluster Admin initial connection menu



The nodes are displayed in alphabetical order, and the first one is selected by default. In most cases, the node you choose is immaterial for administrative tasks.

6. Select the desired node for the connection, and click OK.

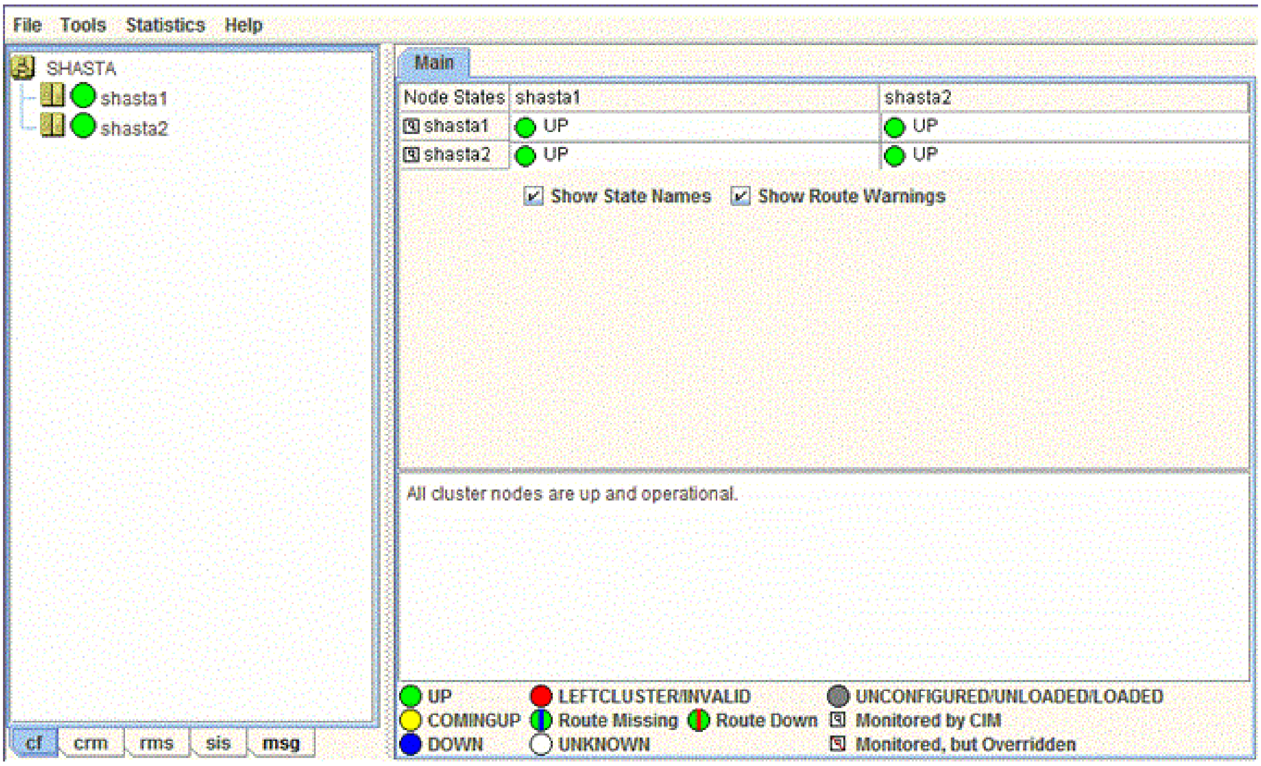
5.2.3 Main Cluster Admin window

The left pane of the Cluster Admin main screen has the following tabs (see the figure below).

- cf
- crm

- rms
- sis
- msg (message window)

Figure 5.5 Main Cluster Admin window - Initial view



Node States	shasta1	shasta2
shasta1	● UP	● UP
shasta2	● UP	● UP

☑ Show State Names ☑ Show Route Warnings

All cluster nodes are up and operational.

Clicking a tab switches the view to the corresponding product. Initially, the cf view is selected.

Cluster Admin GUI has the following standard components common to RMS, CF, SIS, and the message window.

- Pull-down menu

  Select the general functions of Admin GUI and the functions specific to PRIMECLUSTER products.

- Tree panel

  Generally the pane on the left shows the tree panel that displays the configuration information specific to the products. Select the tree component to display additional information in the main panel.

- Main panel

  The large pane on the right is the main work and information area. The content varies according to the product being administered and the functions selected from the menus or tree.

Note

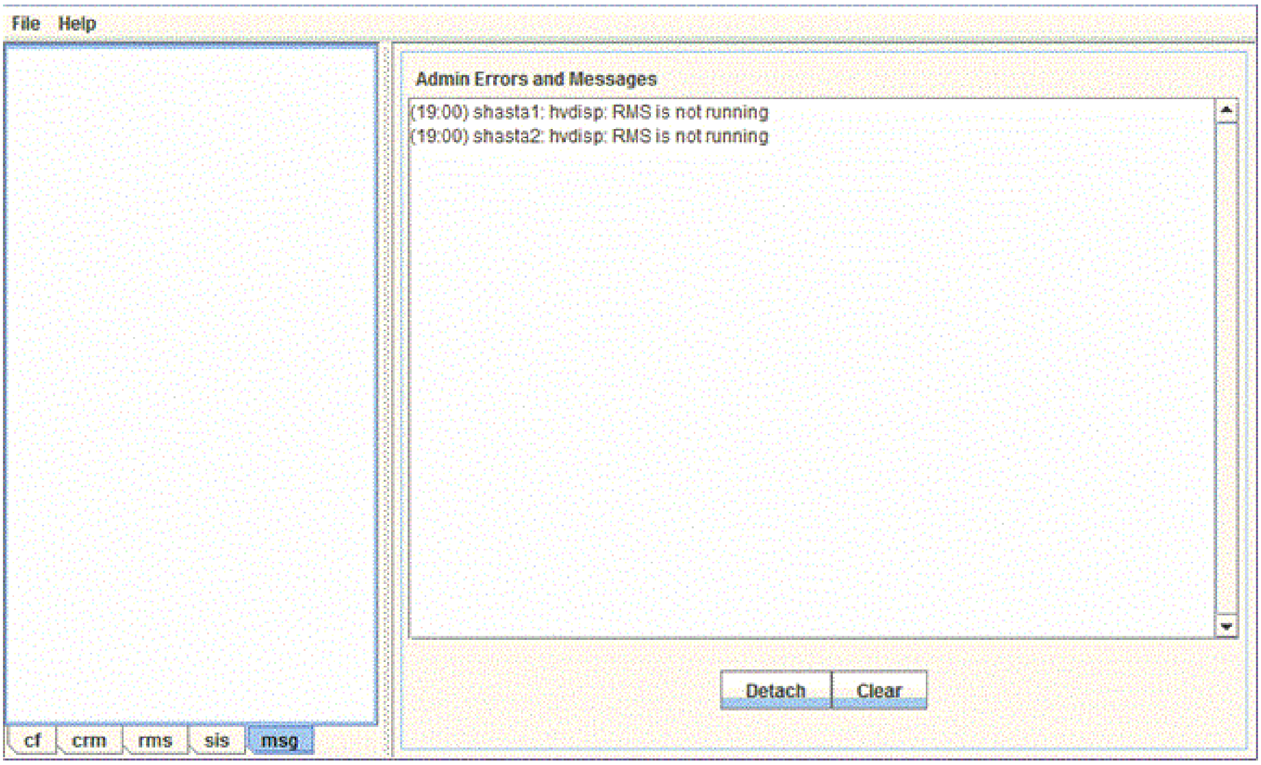
SIS is not available in this version.

5.2.4 Cluster Admin message view

Error and debug messages related to Cluster Admin can be displayed on Cluster Admin.

The tab label is displayed in red if a new message has been added to the text area since it was last viewed.

Figure 5.6 Main Cluster Admin window - message view



(19:00) shasta1: hvdisp: RMS is not running
(19:00) shasta2: hvdisp: RMS is not running

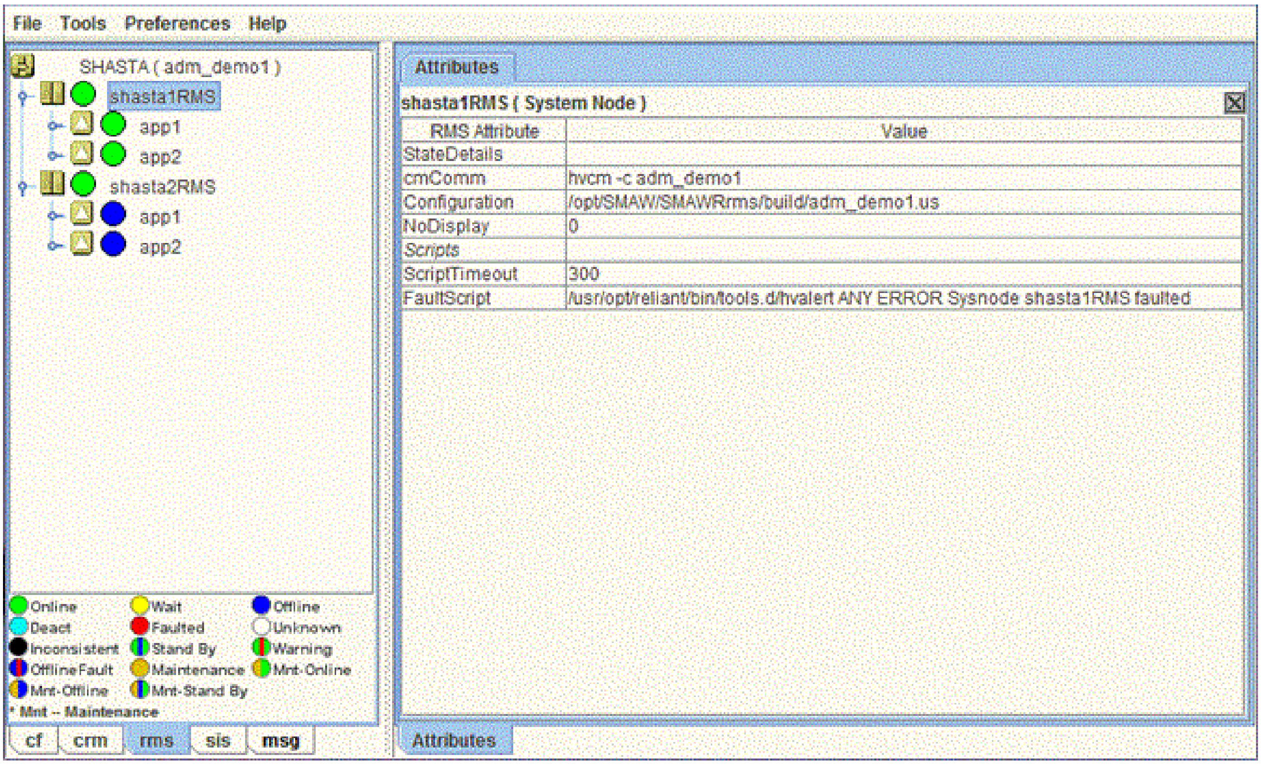
The message pane can be detached or re-attached using the buttons at the bottom of the display. Use the Clear button to delete all messages in the display.

5.3 Monitoring RMS with Cluster Admin

The procedures in this section allow you to view information about the RMS cluster as well as individual nodes, applications, and resources. These procedures are passive: they display data, but they do not change the operation of the configuration.

To enter the RMS portion of the Cluster Admin GUI, click on the rms tab. A typical RMS view is shown in the following figure.

Figure 5.7 Main Cluster Admin window - RMS view



shasta1RMS (System Node)

RMS Attribute	Value
StateDetails	
cmComm	hvcm -c adm_demo1
Configuration	/opt/SMAW/SMAWRrms/build/adm_demo1.us
NoDisplay	0
Scripts	
ScriptTimeout	300
FaultScript	/usr/opt/reliant/bin/tools.d/hvalert ANY ERROR Sysnode shasta1RMS faulted

The main window area is split into two major areas: the left pane contains the RMS tree; the right pane displays configuration information, properties of nodes and objects, RMS logs, or other items. The information displayed depends on what has been selected RMS tree and which operation, if any, has been invoked.

5.3.1 RMS tree

The Cluster Admin RMS tree displays the configuration information for the cluster in a simple hierarchical format. The tree has the following levels:

- Root of the tree

  Represents the cluster. The root is labeled with the cluster name, followed by the RMS configuration name in parentheses. The cluster name is determined by your CF configuration.

- First level

  Represents the system nodes forming the cluster.

- Second level

  Represents the userApplication objects running on each of the system nodes.

- Third level

  Represents subapplications. Also contains groups of non-affiliated objects (andOP, orOP) (see the fourth level description).

- Fourth level

  Represents the resources necessary for each of the subapplications. Also contains non-affiliated objects (andOP, orOP).

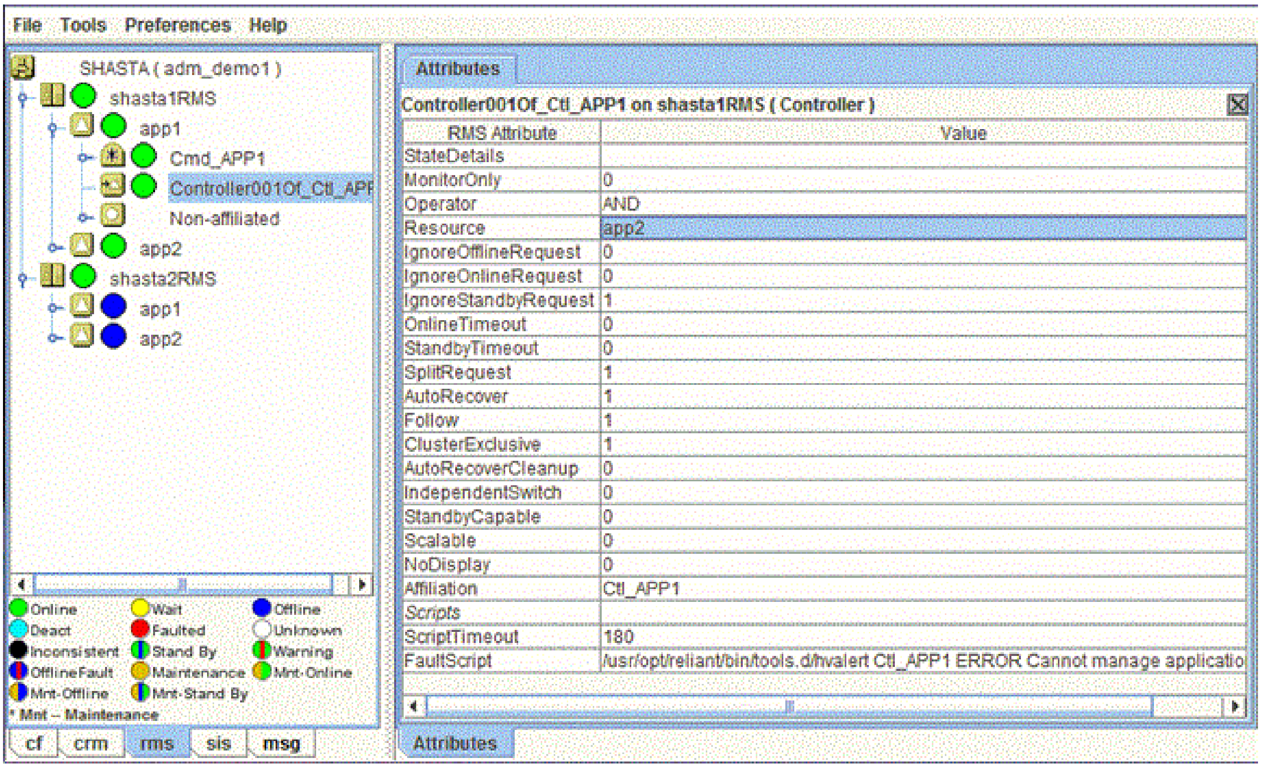
Point

Non-affiliated objects (andOP, orOP) provide logical dependencies and group connectivity between nodes, applications, and subapplications.

If an application has subapplications, the fourth level represents resources used by that subapplication. If an application does not have subapplications, then the third level represents all the resources used by the userApplication.

Dependencies between applications are depicted in the RMS tree by the presence of controller objects. An example of an RMS tree with a controller object is shown in the following figure.

Figure 5.8 RMS tree with a controller object



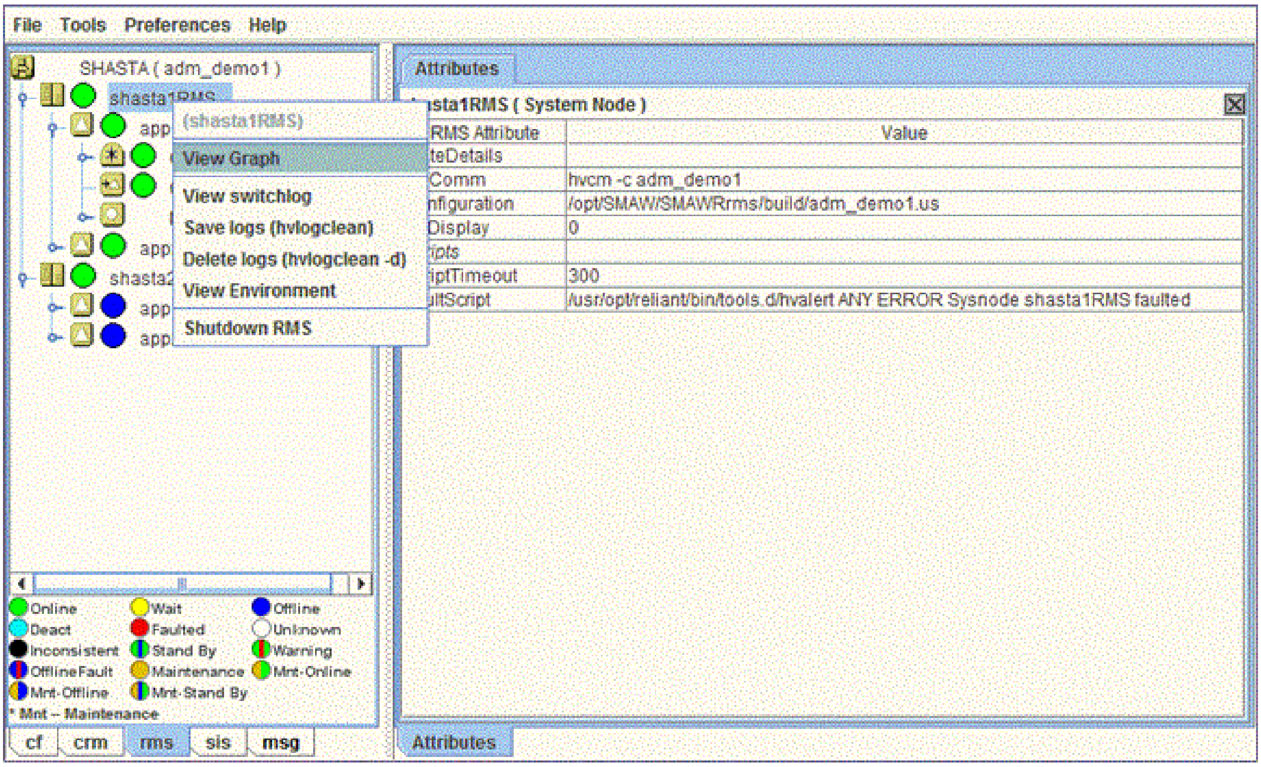
Controller001Of_Ctl_APP1 on shasta1RMS (Controller)

RMS Attribute	Value
StateDetails	
MonitorOnly	0
Operator	AND
Resource	app2
IgnoreOfflineRequest	0
IgnoreOnlineRequest	0
IgnoreStandbyRequest	1
OnlineTimeout	0
StandbyTimeout	0
SplitRequest	1
AutoRecover	1
Follow	1
ClusterExclusive	1
AutoRecoverCleanup	0
IndependentSwitch	0
StandbyCapable	0
Scalable	0
NoDisplay	0
Affiliation	Ctl_APP1
Scripts	
ScriptTimeout	180
FaultScript	/usr/opt/reliant/bin/tools.d/hvalert Ctl_APP1 ERROR Cannot manage applicatio

5.3.2 Pop-up context menus

Each object in the Cluster Admin RMS configuration tree has a pop-up context menu that provides quick access to commonly-used operations. Invoke the context menu by right-clicking on any object. The first item on the menu displays the selected object's name in grayed-out text. The remaining items list the available operations, which vary according to the object's type and current state.

Figure 5.9 Pop-up context menu for a node



sta1RMS (System Node)

RMS Attribute	Value
teDetails	
Comm	hvcm -c adm_demo1
nfiguration	/opt/SMAW/SMAWRrms/build/adm_demo1.us
Display	0
ipts	
iptTimeout	300
ultScript	/usr/opt/reliant/bin/tools.d/hvalert ANY ERROR Sysnode shasta1RMS faulted

Items that affect object states, node states, or the entire RMS configuration appear toward the bottom of the menu. These actions are described in the final sections of this chapter.

Point

To close the context menu without performing an operation, click the grayed-out object name in the menu or press the [Esc] key.

The menu offers different operations for a node object compared to an application object. It also offers different options for an application object in the online state compared to the offline state.

Figure 5.10 Pop-up context menu for an online application

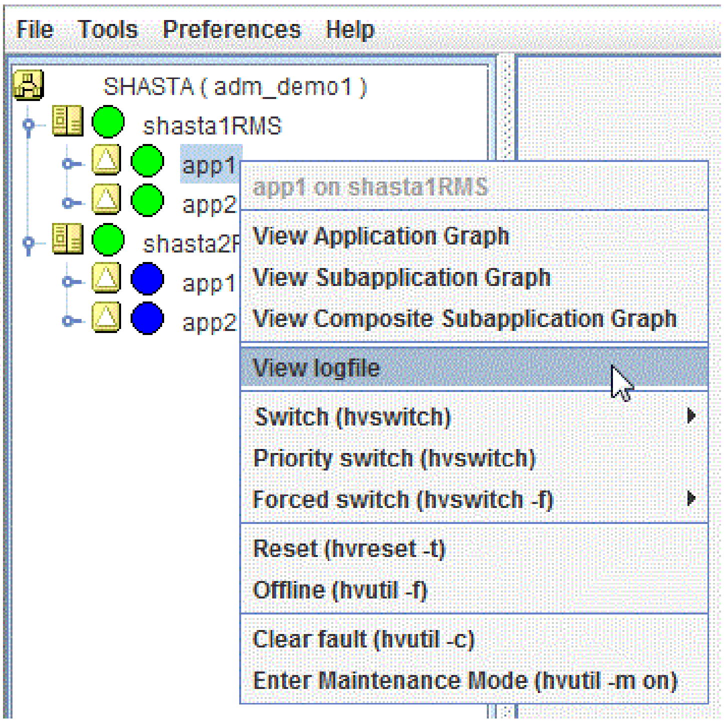
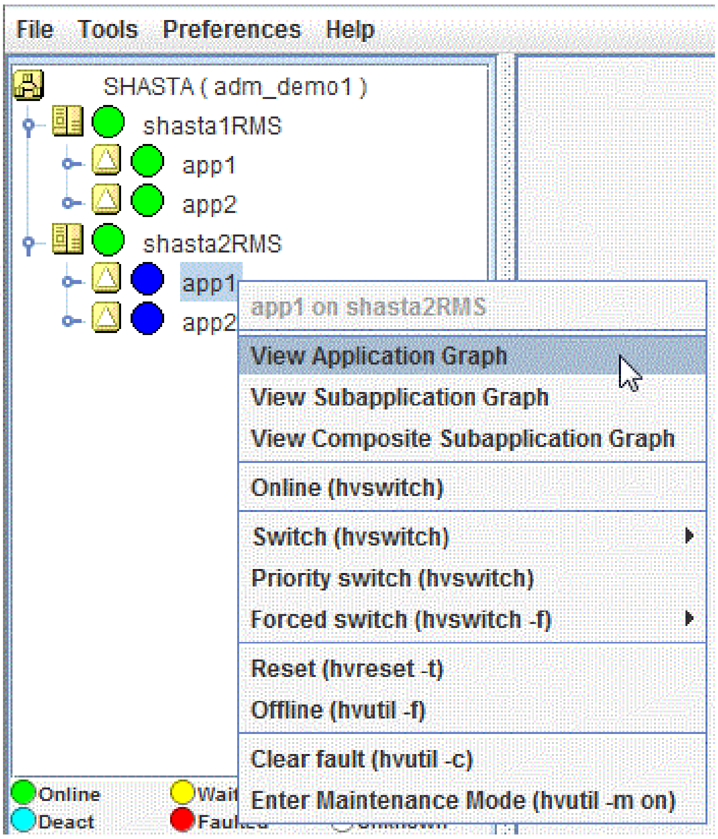


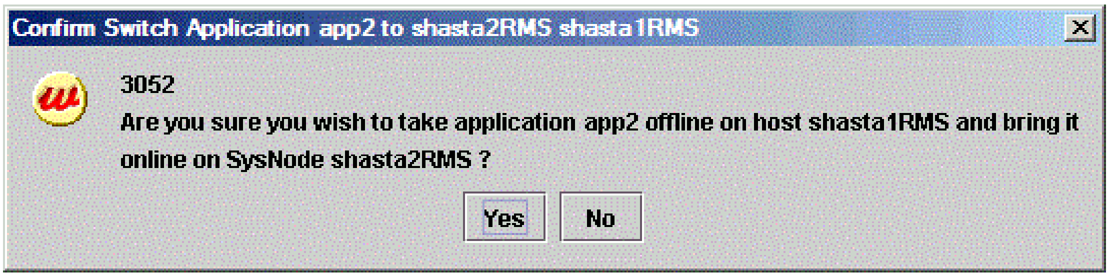
Figure 5.11 Pop-up context menu for an offline application



5.3.3 Pop-up confirmation dialogs

When you select an item in an object's context menu that can cause state changes to that object, a pop-up confirmation dialog appears. To proceed with the action described in the warning message, click Yes; to cancel the action, click No.

Figure 5.12 Pop-up confirmation dialog



Confirm Switch Application app2 to shasta2RMS shasta1RMS

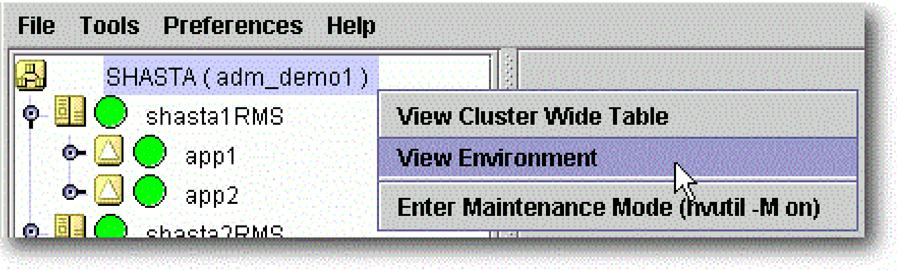
3052
Are you sure you wish to take application app2 offline on host shasta1RMS and bring it online on SysNode shasta2RMS ?

5.3.4 Displaying environment variables

Display the global (clusterwide) environment variables as follows:

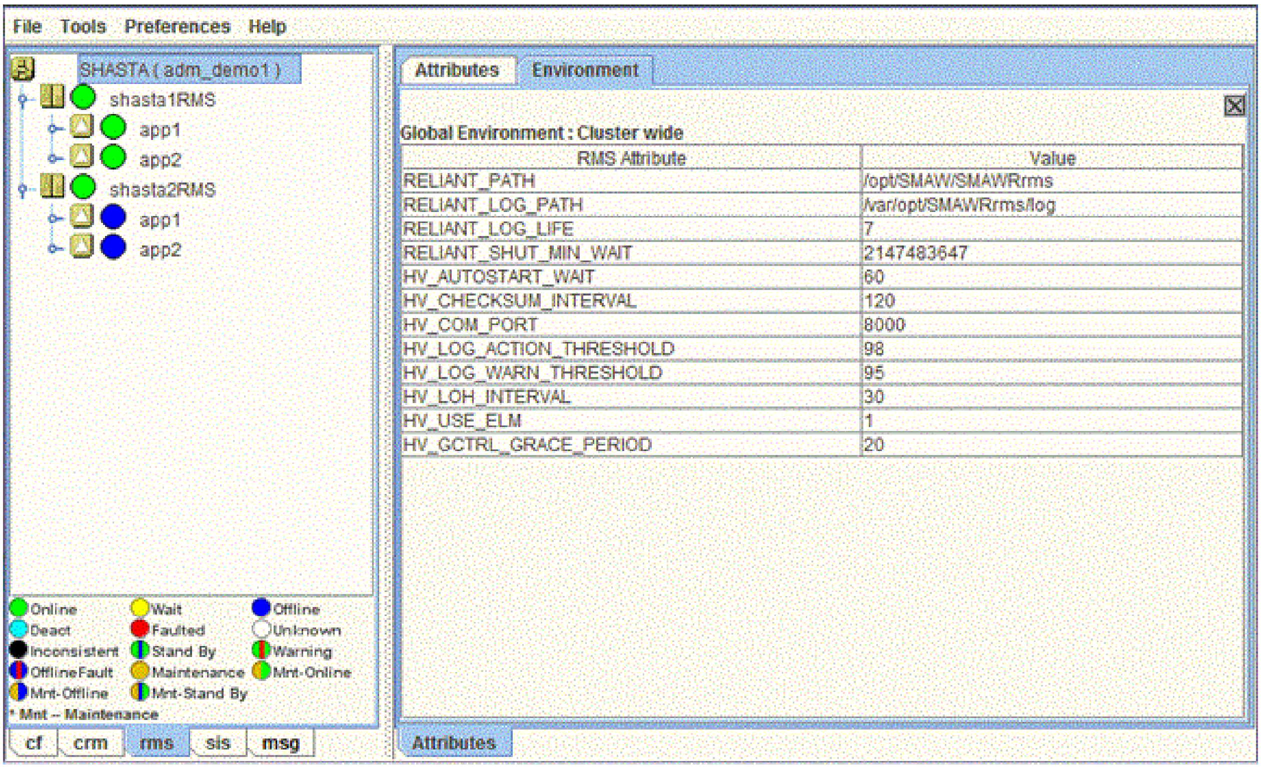
1. Right-click on a cluster in the RMS tree window and select View Environment from the context menu.

Figure 5.13 Displaying global environment variables



2. The global variables will appear under a separate tab in the right pane.

Figure 5.14 Global environment variable view



Global Environment : Cluster wide

RMS Attribute	Value
RELIANT_PATH	/opt/SMAW/SMAWRrms
RELIANT_LOG_PATH	/var/opt/SMAWRrms/log
RELIANT_LOG_LIFE	7
RELIANT_SHUT_MIN_WAIT	2147483647
HV_AUTOSTART_WAIT	60
HV_CHECKSUM_INTERVAL	120
HV_COM_PORT	8000
HV_LOG_ACTION_THRESHOLD	98
HV_LOG_WARN_THRESHOLD	95
HV_LOH_INTERVAL	30
HV_USE_ELM	1
HV_GCTRL_GRACE_PERIOD	20

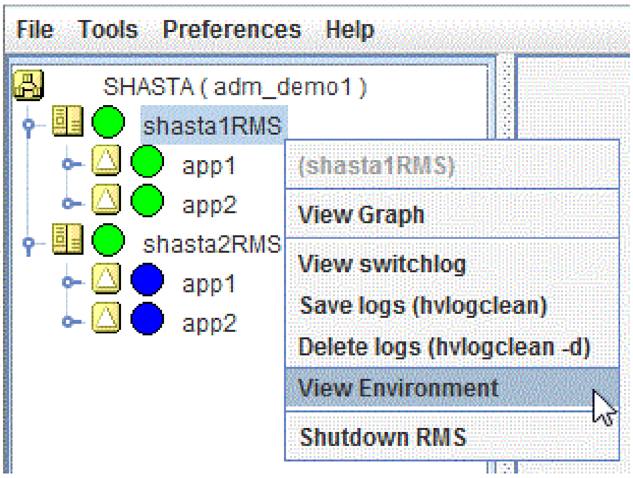
Point

To close a tab view, use the button in the upper-right corner of the view.

Display local environment variables as follows:

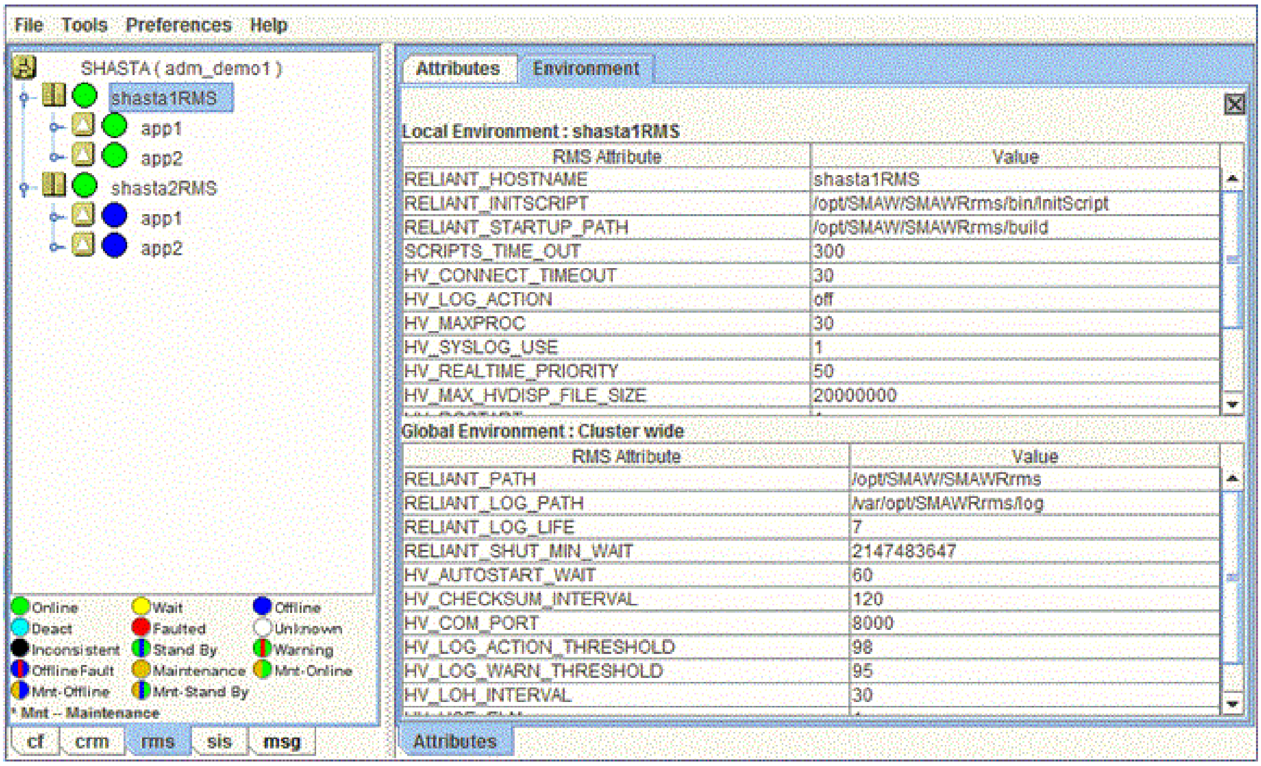
1. Right-click on a node in the RMS tree window and select View Environment from the context menu.

Figure 5.15 Displaying local environment variables



2. Both local and global variables appear on the same tab in the right pane.

Figure 5.16 Local environment variables view



Local Environment : shasta1RMS

RMS Attribute	Value
RELIANT_HOSTNAME	shasta1RMS
RELIANT_INITSCRIPT	/opt/SMAW/SMAWRrms/bin/InitScript
RELIANT_STARTUP_PATH	/opt/SMAW/SMAWRrms/build
SCRIPTS_TIME_OUT	300
HV_CONNECT_TIMEOUT	30
HV_LOG_ACTION	off
HV_MAXPROC	30
HV_SYSLOG_USE	1
HV_REALTIME_PRIORITY	50
HV_MAX_HVDISP_FILE_SIZE	20000000

Global Environment : Cluster wide

RMS Attribute	Value
RELIANT_PATH	/opt/SMAW/SMAWRrms
RELIANT_LOG_PATH	/var/opt/SMAWRrms/log
RELIANT_LOG_LIFE	7
RELIANT_SHUT_MIN_WAIT	2147483647
HV_AUTOSTART_WAIT	60
HV_CHECKSUM_INTERVAL	120
HV_COM_PORT	8000
HV_LOG_ACTION_THRESHOLD	98
HV_LOG_WARN_THRESHOLD	95
HV_LOH_INTERVAL	30

CLI

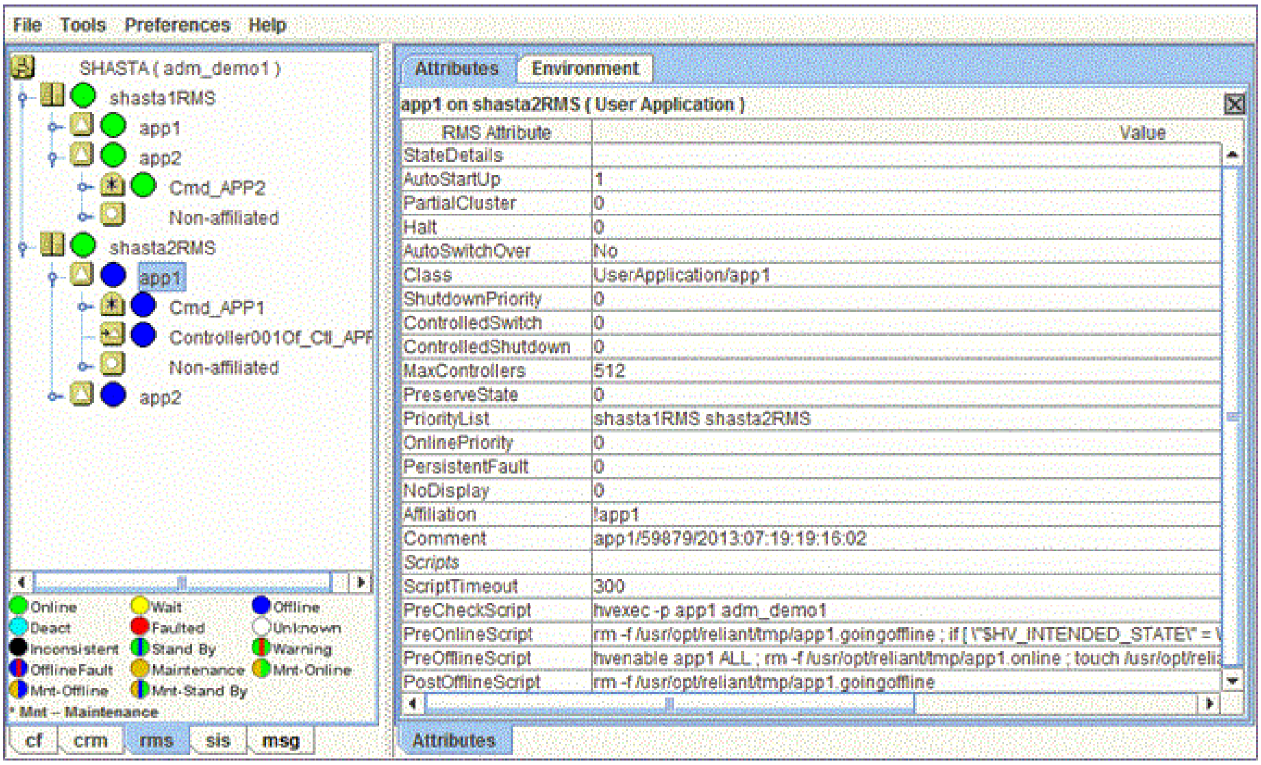
Display the environment variables with the hvdisp command, which does not require root privilege:

```
hvdisp ENV
hvdisp ENVL
```

5.3.5 Displaying object states

The state of each RMS object is indicated by the color of its circular status icon, located immediately to the left of the object's name in the configuration tree. The legend for the object states appears below the RMS tree in the left pane of the RMS view.

Figure 5.17 Displaying application and object states



SHASTA (adm_demo1)
- ● shasta1RMS
  - ● app1
  - ● app2
    - ● Cmd_APP2
    - Non-affiliated
- ● shasta2RMS
  - ● app1
    - ● Cmd_APP1
    - ● Controller001Of_Ctl_APF
    - Non-affiliated
  - ● app2

● Online	● Wait	● Offline
● Deact	● Faulted	○ Unknown
● Inconsistent	● Stand By	● Warning
● OfflineFault	● Maintenance	● Mnt-Online
● Mnt-Offline	● Mnt-Stand By	

* Mnt -- Maintenance

app1 on shasta2RMS (User Application)

RMS Attribute	Value
StateDetails	
AutoStartUp	1
PartialCluster	0
Halt	0
AutoSwitchOver	No
Class	UserApplication/app1
ShutdownPriority	0
ControlledSwitch	0
ControlledShutdown	0
MaxControllers	512
PreserveState	0
PriorityList	shasta1RMS shasta2RMS
OnlinePriority	0
PersistentFault	0
NoDisplay	0
Affiliation	!app1
Comment	app1/59879/2013:07:19:19:16:02
Scripts	
ScriptTimeout	300
PreCheckScript	hvexec -p app1 adm_demo1
PreOnlineScript	rm -f /usr/opt/reliant/tmp/app1.goingoffline ; if [\"$HV_INTENDED_STATE\" = \
PreOfflineScript	hvenable app1 ALL ; rm -f /usr/opt/reliant/tmp/app1.online ; touch /usr/opt/relia
PostOfflineScript	rm -f /usr/opt/reliant/tmp/app1.goingoffline

In the example above, the application app2 is Online (green status icon) on node shasta1RMS, but Offline (blue status icon) on node shasta2RMS.

CLI

The syntax for the CLI is as follows:

```
hvdisp {-a | -c} [-o out_file]
```

Options:

```
-a: Displays the object name, the object type,
     the object's SysNode name, and the object state for each object
     in the configuration
     (automatically generated connectors are not shown)

-c: Displays information in compact format

-o: Sends the output to the designated file
```

The hvdisp command only works when RMS is running, and the root privilege is not required.

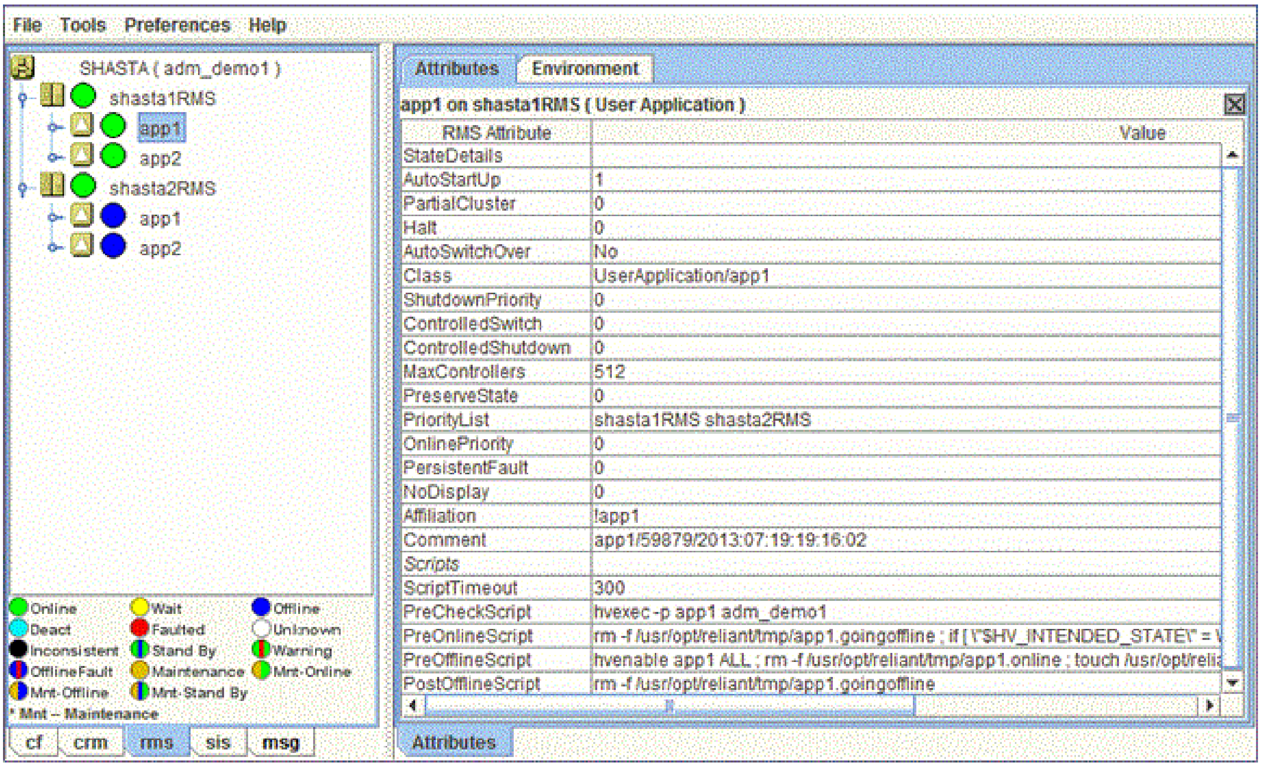
Note

For an object that does not operate on the command execution node, the object name is displayed, but the object state is not displayed.

5.3.6 Configuration information or object attributes

View configuration information for individual objects by left-clicking with the mouse on the object in the tree. The properties are displayed in a tabular format on the right pane of the RMS main window.

Figure 5.18 Configuration information or object attributes



app1 on shasta1RMS (User Application)

RMS Attribute	Value
StateDetails	
AutoStartUp	1
PartialCluster	0
Halt	0
AutoSwitchOver	No
Class	UserApplication/app1
ShutdownPriority	0
ControlledSwitch	0
ControlledShutdown	0
MaxControllers	512
PreserveState	0
PriorityList	shasta1RMS shasta2RMS
OnlinePriority	0
PersistentFault	0
NoDisplay	0
Affiliation	!app1
Comment	app1/59879/2013:07:19:19:16:02
Scripts	
ScriptTimeout	300
PreCheckScript	hvexec -p app1 adm_demo1
PreOnlineScript	rm -f /usr/opt/reliant/tmp/app1.goingoffline ; if [\"$HV_INTENDED_STATE\" = \
PreOfflineScript	hvenable app1 ALL ; rm -f /usr/opt/reliant/tmp/app1.online ; touch /usr/opt/relia
PostOfflineScript	rm -f /usr/opt/reliant/tmp/app1.goingoffline

Chapter 6 Additional administrative tools

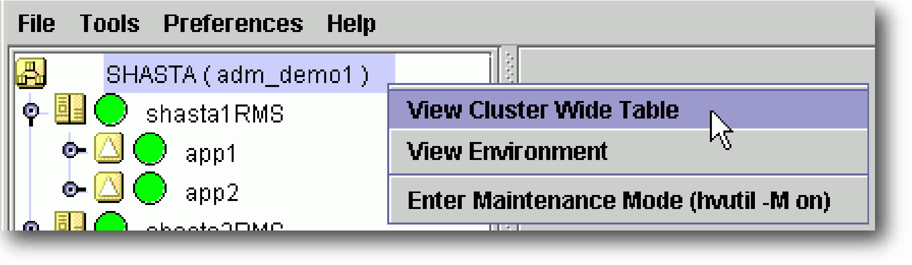
The Cluster Admin GUI provides several additional tools to help you manage RMS operation.

6.1 Using the RMS clusterwide table

The RMS clusterwide table displays the state of each application on each of the system nodes in a concise table.

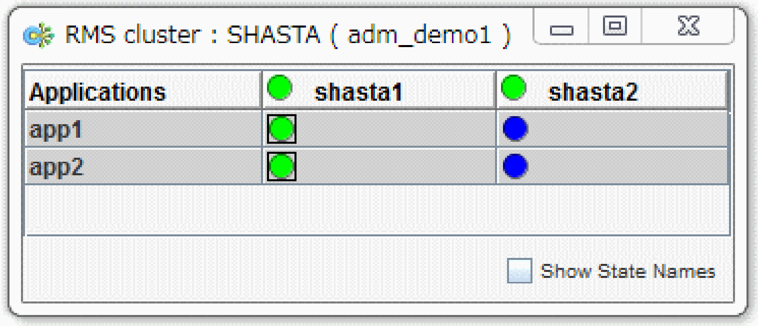
To open the clusterwide table, right-click the cluster name (the root of the RMS tree in the left pane) and then select View Cluster Wide table from the context menu.

Figure 6.1 Opening the clusterwide table



The clusterwide table appears in a separate window.

Figure 6.2 Clusterwide table



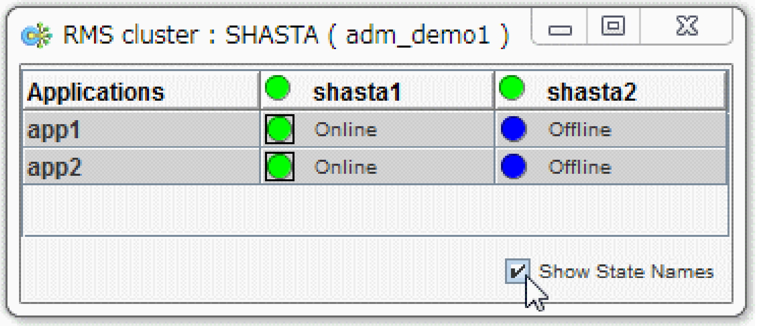
RMS cluster : SHASTA (adm_demo1)

Applications	🟩 shasta1	🟩 shasta2
app1	🟩	🔵
app2	🟩	🔵

□ Show State Names

To display the corresponding state name next to each status icon, click the Show State Names checkbox at the lower-right corner of the window.

Figure 6.3 Clusterwide table with state names



RMS cluster : SHASTA (adm_demo1)

Applications	🟩 shasta1	🟩 shasta2
app1	🟩 Online	🔵 Offline
app2	🟩 Online	🔵 Offline

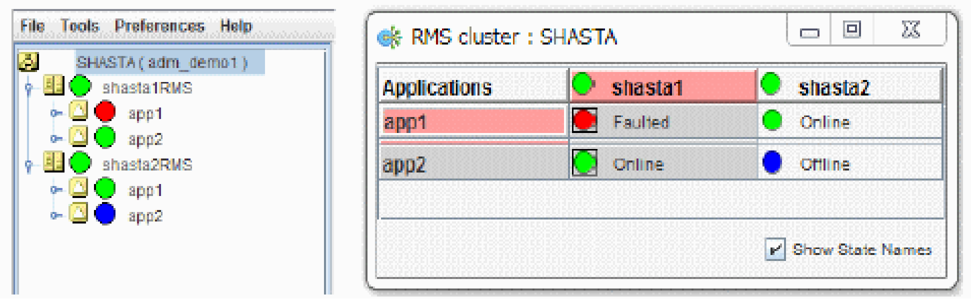
☑ Show State Names

You can increase or decrease the size of the clusterwide table window and the size of the columns by using the mouse. If the window is already large enough to fully display all of the table elements, then you will not be allowed to further increase its size.

A square surrounding the colored state circle indicates the primary node for the application. "Figure 6.3 Clusterwide table with state names" above shows that shasta1 is the primary node for all of the applications.

Normally, the clusterwide table displays applications in alphabetical order from top to bottom. However, Faulted applications are handled specially. If an application is in the Faulted state on any node in the cluster, then it is displayed at the top of the table, and the application's name is highlighted by a pink background. This allows the System Administrator to easily spot any Faulted applications.

Figure 6.4 Faulted applications in the clusterwide table



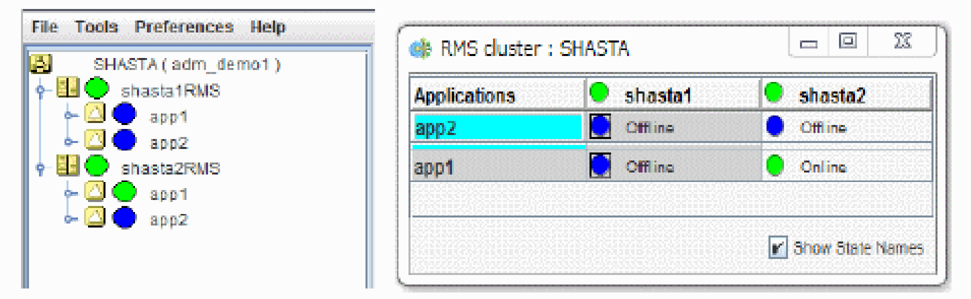
RMS cluster : SHASTA

Applications	shasta1	shasta2
app1	Faulted	Online
app2	Online	Offline

☑ Show State Names

The clusterwide table also makes special provisions for applications that are not online anywhere in the cluster. These applications are also displayed at the top of the table, with the application's name highlighted in light blue. This alerts the system administrator that some applications are not running anywhere and should probably be brought online on some node.

Figure 6.5 Offline applications in the clusterwide table



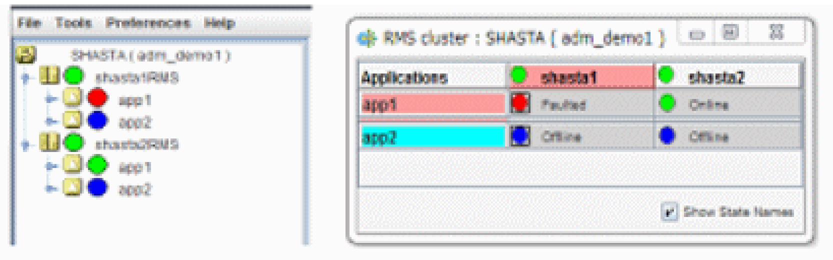
RMS cluster : SHASTA

Applications	shasta1	shasta2
app2	Offline	Offline
app1	Offline	Online

☑ Show State Names

If there are both faulted applications and applications that are not online anywhere, then the faulted applications are listed first.

Figure 6.6 Faulted and offline applications in the clusterwide table



RMS cluster : SHASTA (adm_demo1)

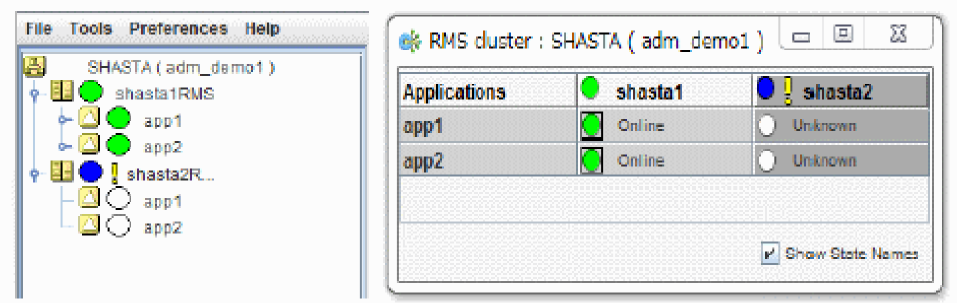
Applications	shasta1	shasta2
app1	Faulted	Online
app2	Offline	Offline

☑ Show State Names

If there is a split-brain condition in the cluster on both the clusterwide table and the RMS tree, then colored exclamation marks will appear after the status icons (colored circles) of the nodes. A colored exclamation mark indicates that the state of that SysNode is different from what another SysNode views it as being. The color of the exclamation mark indicates the state that the other node thinks that the SysNode is in. If there are multiple nodes that see a SysNode in different states, you will see multiple exclamation marks after the colored circle. Exclamation marks are sorted according to the severity of the states.

The following figure shows a clusterwide table with an application of a split-brain condition. Note the yellow exclamation mark before the second node name.

Figure 6.7 Split-brain conditions in the clusterwide table



Applications	● shasta1	● ! shasta2
app1	🟩 Online	○ Unknown
app2	🟩 Online	○ Unknown

Note

Momentary split-brain conditions may be indicated while a node starts up or shuts down.

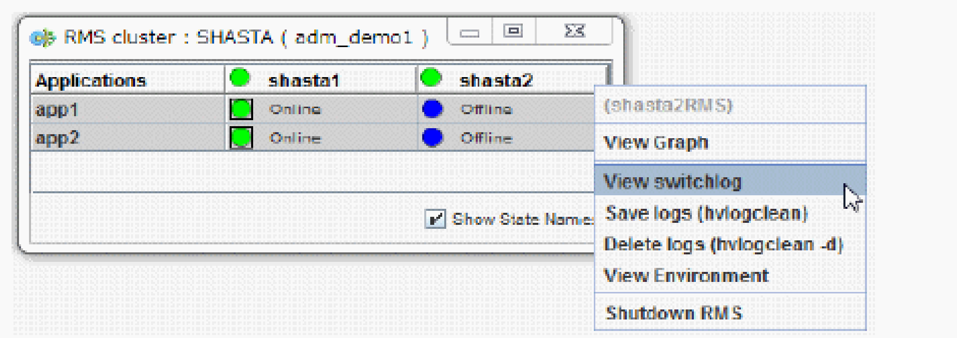
6.1.1 Using context menus from the clusterwide table

Each object in the clusterwide table has a pop-up context menu that provides quick access to commonly-used operations.

To display a context menu, right-click on any object with a status icon, where column headers represent hosts and cells represent applications.

The first item on the menu displays the selected object's name in grayed-out text. The remaining items list the available operations, which vary according to the object's type and current state.

Figure 6.8 Using context menus in the clusterwide table



Applications	● shasta1	● shasta2
app1	🟩 Online	● Offline
app2	🟩 Online	● Offline

Items that affect object states, node states, or the entire RMS configuration appear toward the bottom of the menu. These actions are described in the final sections of this chapter.

To close the context menu without performing an operation, click the grayed-out object name in the menu or press the [Esc] key.

6.2 Using RMS graphs

Cluster Admin provides an alternate way of viewing the RMS configuration hierarchy called graphs. A graph represents the configuration in a true tree structure, where the branches indicate the dependencies that are not generally visible in the RMS configuration tree described earlier. The following types of graphs are available:

- Full graph

  Displays the complete cluster configuration.

- Application graph

  Shows all of the resources used by an application and can be used to look at specific resource properties.

- Subapplication graph

  Lists all of the subapplications used by a given application, and it shows the connections between the subapplications.

- Composite subapplications graph

  Shows all the subapplications that the application depends on directly or indirectly.

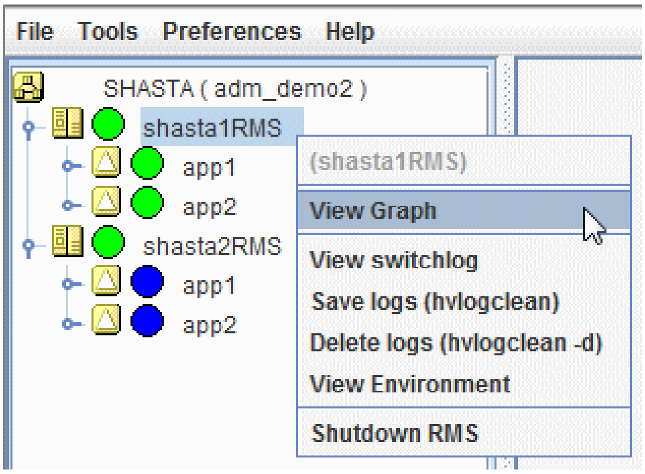
The following sections describe each type in more detail, as well as these graph-related features:

- Obtaining configuration information
- Using command context (pop-up) menus
- Displaying various levels of detail
- Interpreting display changes in the clusterwide table and graphs

6.2.1 RMS full graph

To display the RMS full graph, right-click on any system node and select View Graph from the context menu.

Figure 6.9 Viewing the RMS full graph on a node

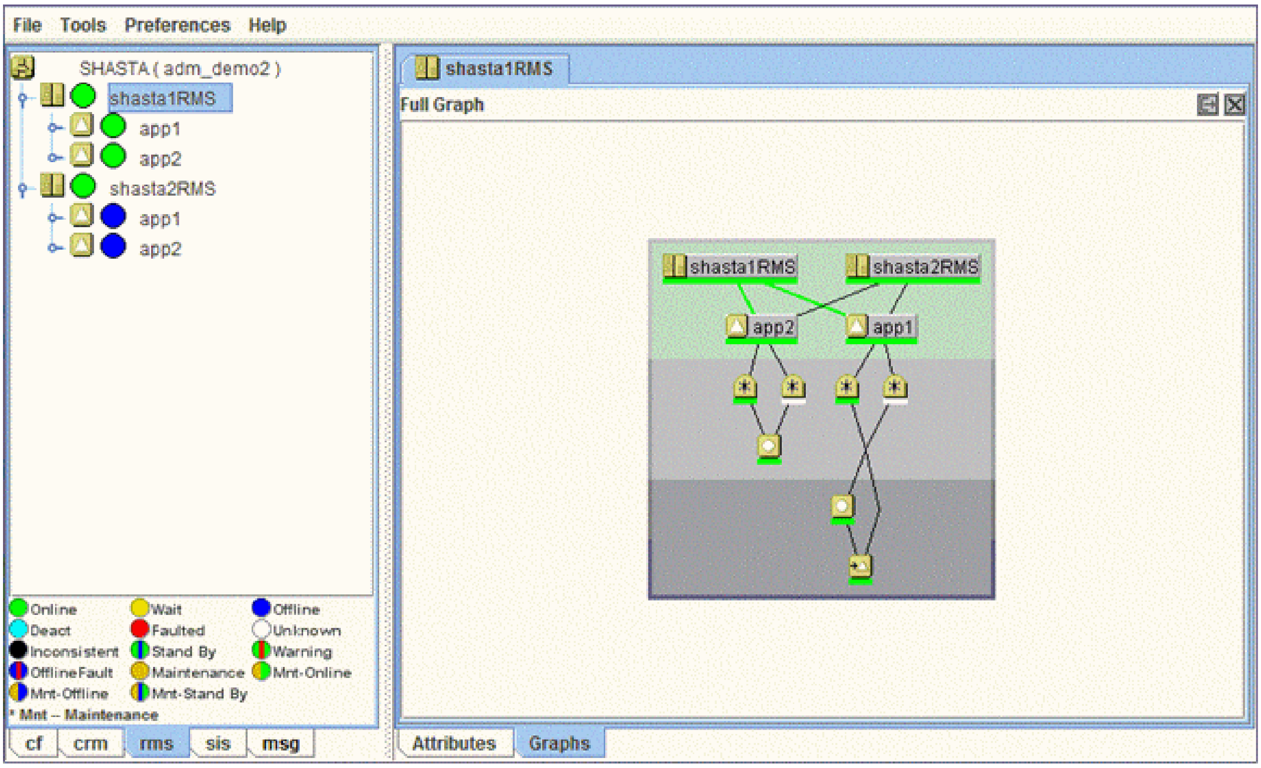


Note

The View Graph menu item is not available if a graph is already open for that node.

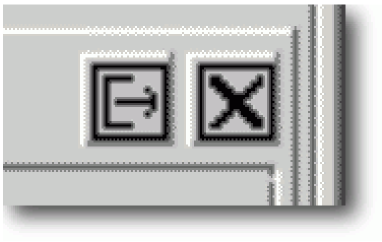
By default, each graph appears as a separate tab in the right pane of the Cluster Admin view.

Figure 6.10 RMS full graph on a node - tab view



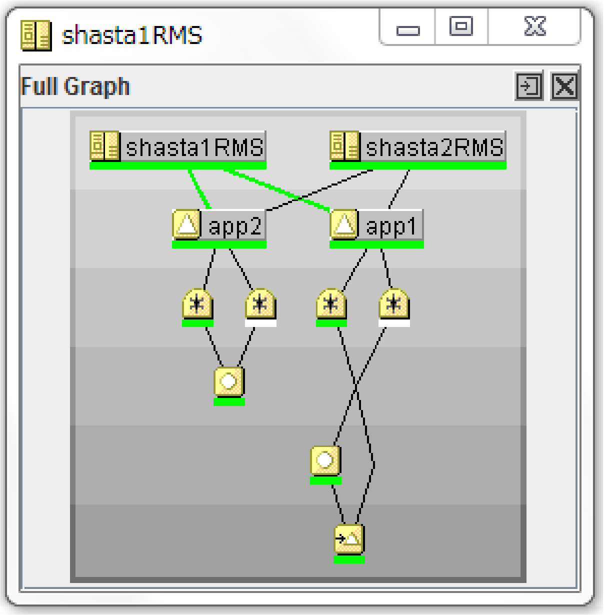
To view any tab in a separate window, click the detach control button. The detach button is located next to the close control button in the upper-right corner of the view.

Figure 6.11 Detail of tab view showing detach button



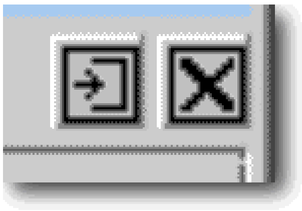
The detached view contains the same information as the tabbed view.

Figure 6.12 RMS full graph on a node - separate window view



To rejoin the detached window to the Cluster Admin view, click the attach control button. The attach button is located next to the view's close control button in the upper-right corner, just below the standard window control buttons.

Figure 6.13 Detail of separate window view showing attach button



The RMS full graph displays the complete RMS configuration of the cluster and represents the following items:

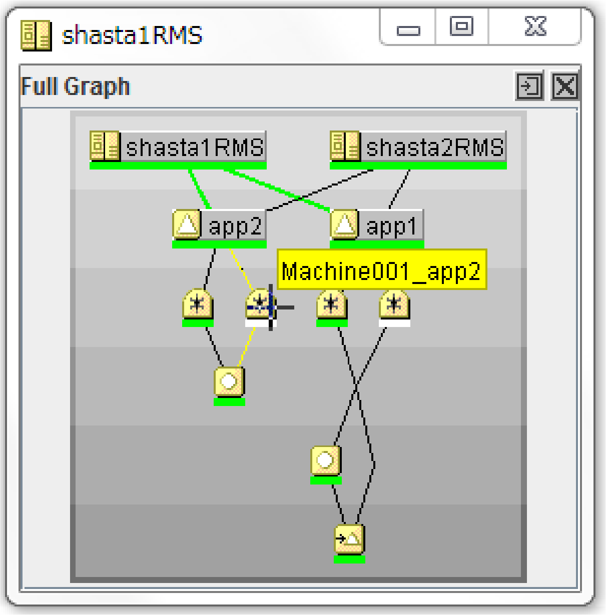
- Node where each application is currently online, indicated by green lines between the node and application objects
- Object types, indicated by the object's icon
- Current object state, indicated by the colored bar beneath each icon
- Relationships between objects
- Dependencies of objects

The RMS graph is drawn from the perspective of the selected node; that is, the state information of all other objects is displayed according to the reports received by that node. The node name in the title bar of the graph identifies the node that is supplying the state information. You can create an RMS graph from the perspective of any node in the cluster.

The background of the graph is shaded from top to bottom with progressively darker gray bands. In large, complicated graphs, this can help to locate objects and identify their dependency level.

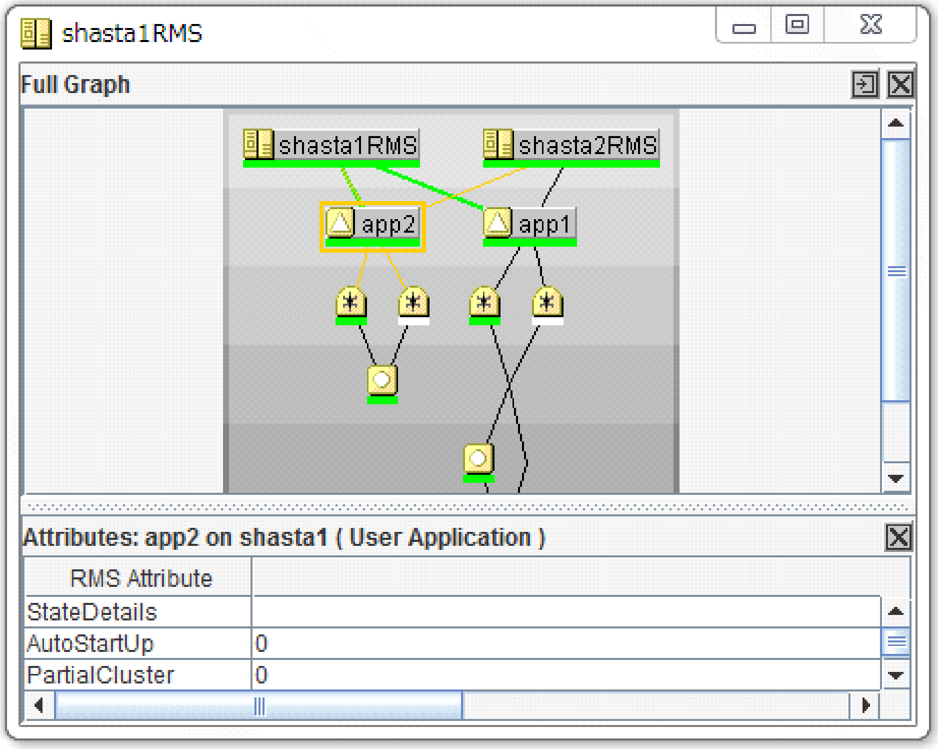
If you position the mouse cursor over an object in the graph, the cursor changes to a crosshair and the object's name appears as a tool tip. Also, the connector lines radiating from the object are highlighted with yellow to indicate its parent and child dependencies.

Figure 6.14 RMS full graph - object tooltip



Clicking on the object brings up a window with further details such as the object's attributes.

Figure 6.15 RMS full graph - object details



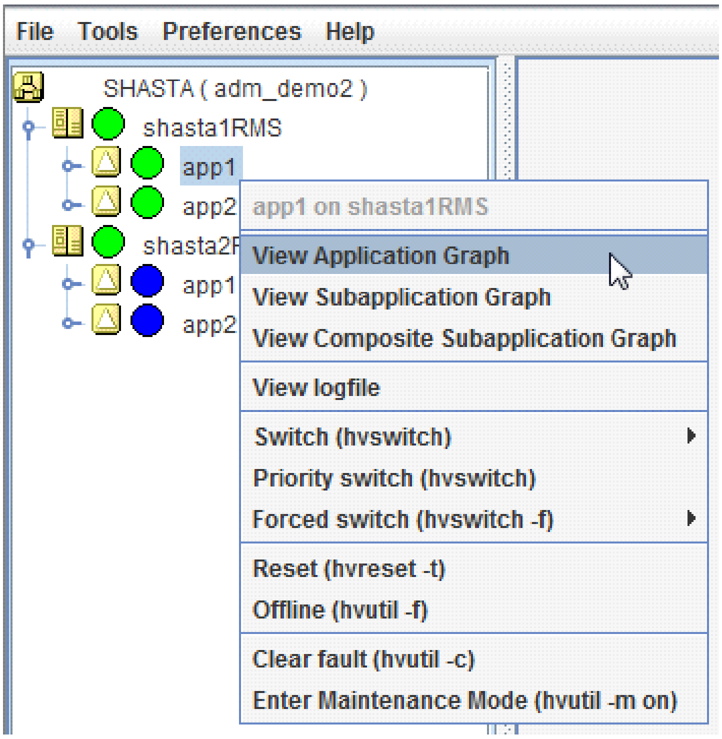
Attributes: app2 on shasta1 (User Application)

RMS Attribute	
StateDetails	
AutoStartUp	0
PartialCluster	0

6.2.2 Application graph

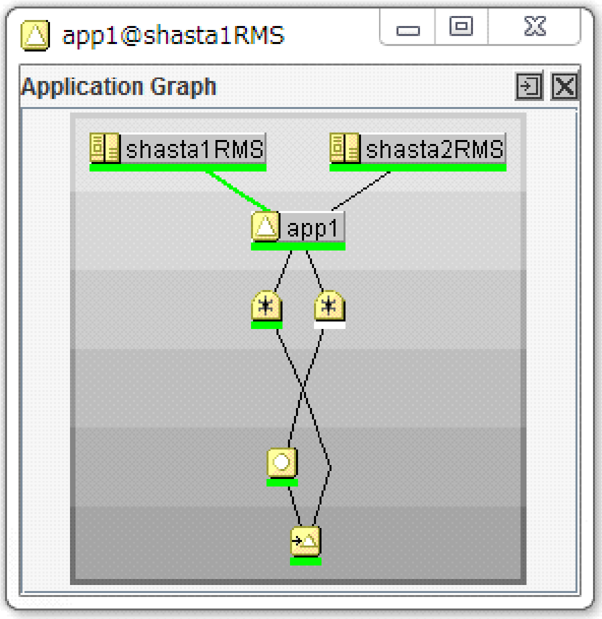
To display the graph for a single application, right-click on the application object and select View Application Graph from the context menu.

Figure 6.16 Viewing an RMS application graph



The application graph shares the same features as the full graph, except that it shows only the selected application and its resources. Like the full graph, the application graph is shown from the perspective of the selected node, and tooltips and details are available for every object.

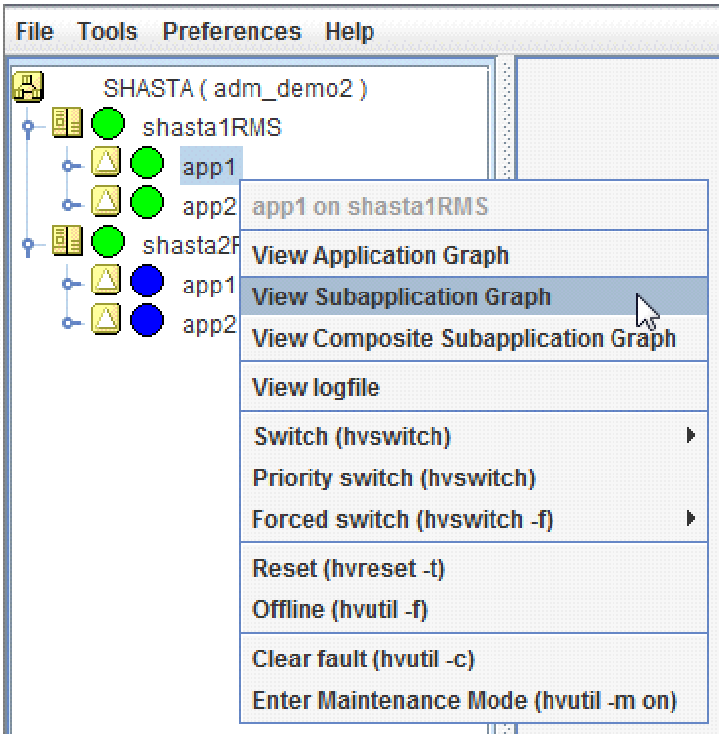
Figure 6.17 Typical RMS application graph



6.2.3 Subapplication graph

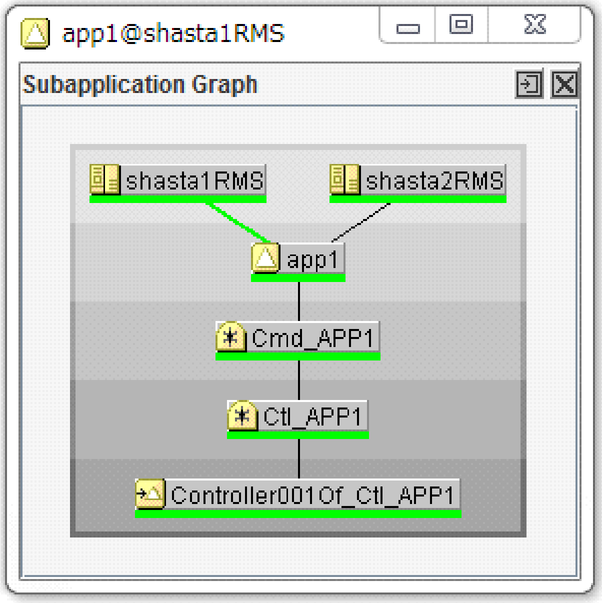
To display a subapplication graph, right-click on the parent application and select View Subapplication Graph from the context menu.

Figure 6.18 Viewing an RMS subapplication graph



This graph displays all the subapplications used by the selected application, showing the connections between the subapplications.

Figure 6.19 Typical RMS subapplication graph



For clarity, names of the subapplication objects are shown as labels rather than tooltips, and various abstractions such as non-affiliated objects are not included. Like other graphs, clicking on an object brings up a window that displays its attributes.

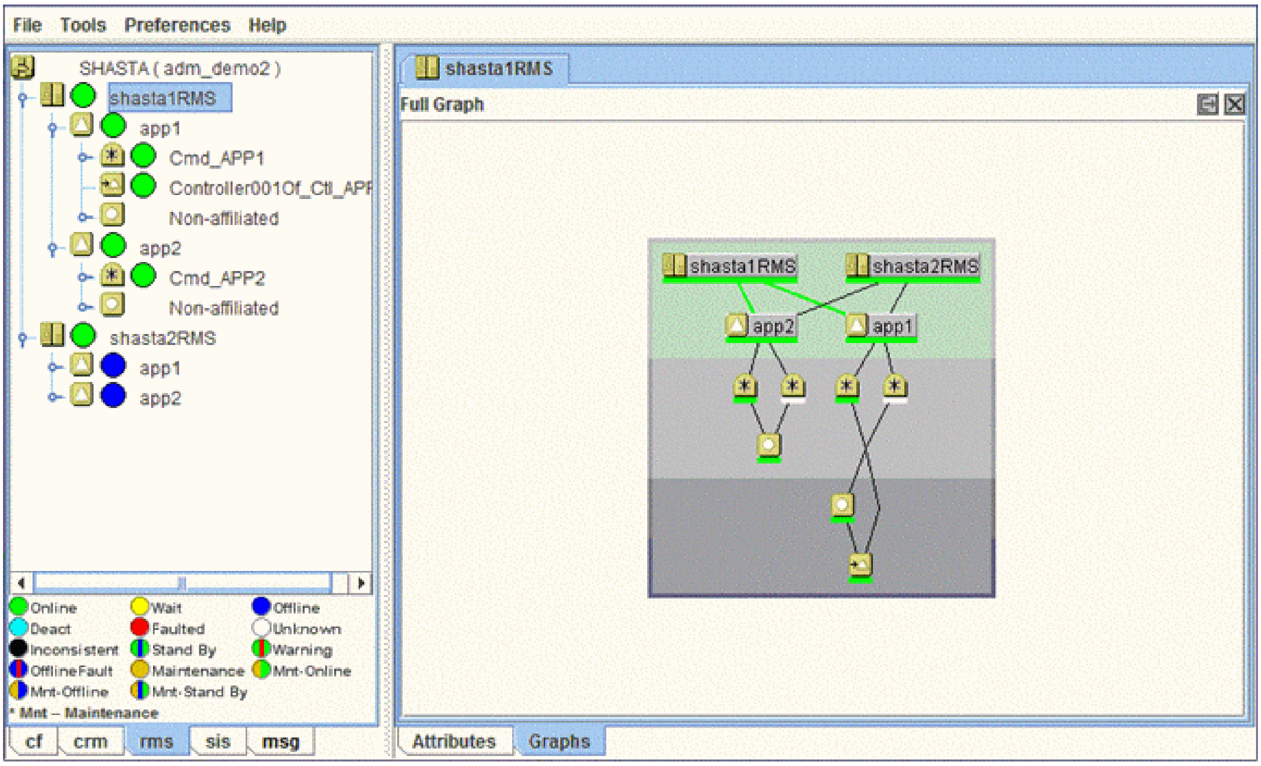
6.2.4 Composite subapplication graph

Note

The composite subapplication graph is available only for applications with controller objects.

When the configuration includes a controller object, the full graph of the node (or of either application) shows the parent and child applications in separate branches.

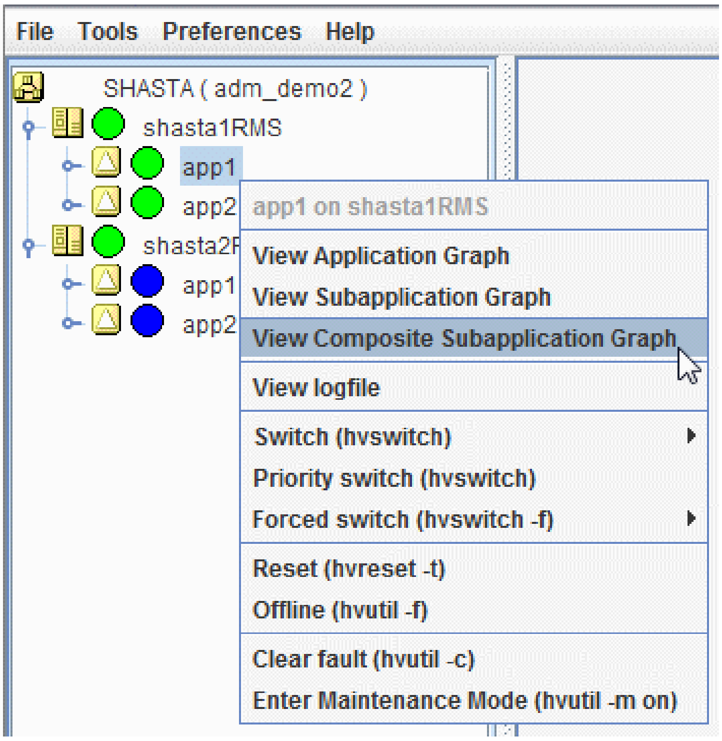
Figure 6.20 Standard view of configuration with controlled application



In some cases, it is convenient to view the child application as a resource of the parent so they both appear in the same branch. This is called a composite subapplication graph.

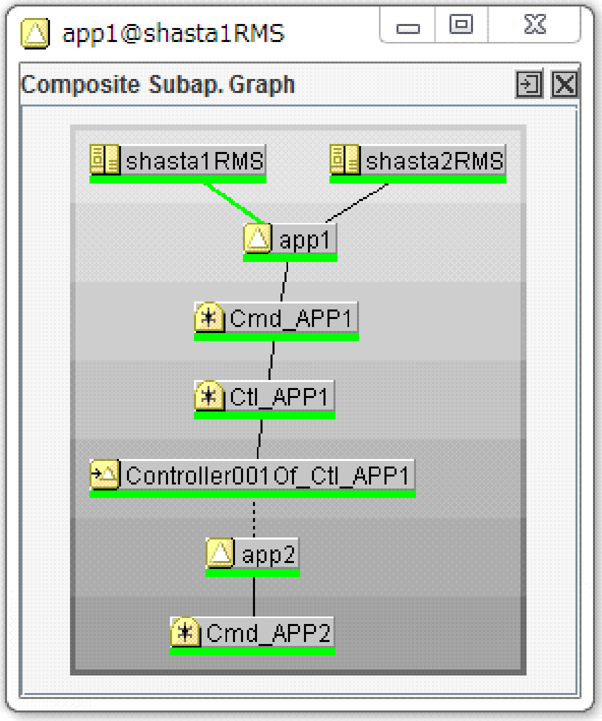
To view a composite subapplication graph, right-click on the parent application and select View Composite Subapplication Graph from the context menu.

Figure 6.21 Viewing an RMS composite subapplication graph



The composite subapplication graph is a type of the subapplication graphs and used when applications to be controlled exist. For every controller object in the subapplication graph, the graph of its controlled application is inserted with a dotted line connection to the parent controller. For example, note where app1 appears in the composite subapplication graph in the figure shown below, and compare this to the standard graph shown earlier in "Figure 6.20 Standard view of configuration with controlled application."

Figure 6.22 Typical composite subapplication graph



If the controlled application has its own controller objects, then the process is recursively repeated. This gives a composite view of all the subapplications that the selected parent application depends on, whether directly or indirectly.

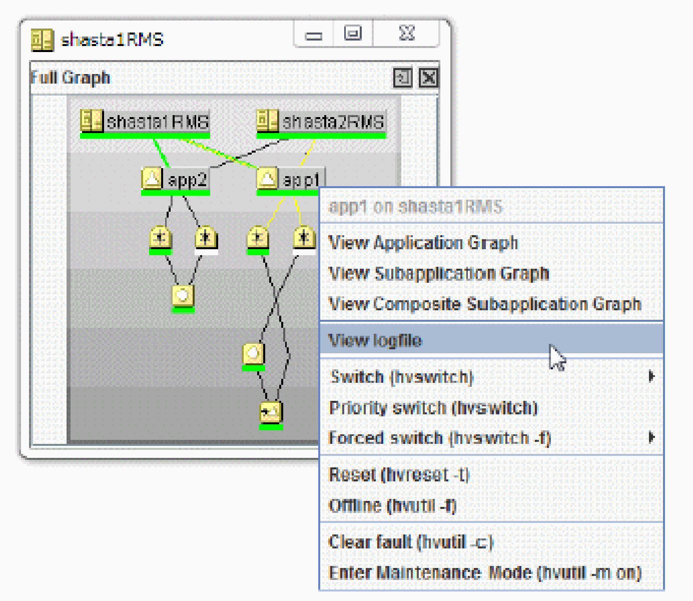
6.2.5 Using pop-up context menus from the graph

Each object in the RMS graph has a pop-up context menu that provides quick access to commonly-used operations.

To display a context menu, right-click on any object in a graph.

The first item on the menu displays the selected object's name in grayed-out text. The remaining items list the available operations, which vary according to the object's type and current state.

Figure 6.23 Using a pop-up context menu from the RMS graph



Items that affect object states, node states, or the entire RMS configuration appear toward the bottom of the menu. These actions are described in the final sections of this chapter.

To close the context menu without performing an operation, click the grayed-out object name in the menu or press the [Esc] key.

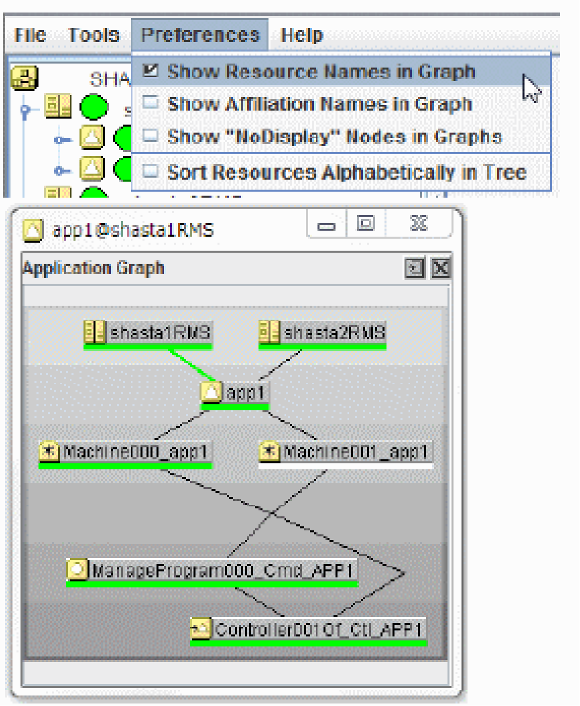
6.2.6 Changing the displayed detail level

By default, the RMS graph does not display the resource (object) names on the graphs. These are available as tool tips and can be seen by placing the mouse over a particular object.

To add any combination of resource names, affiliation names, "NoDisplay" nodes to the graphs, use the checkboxes on the Preferences menu.

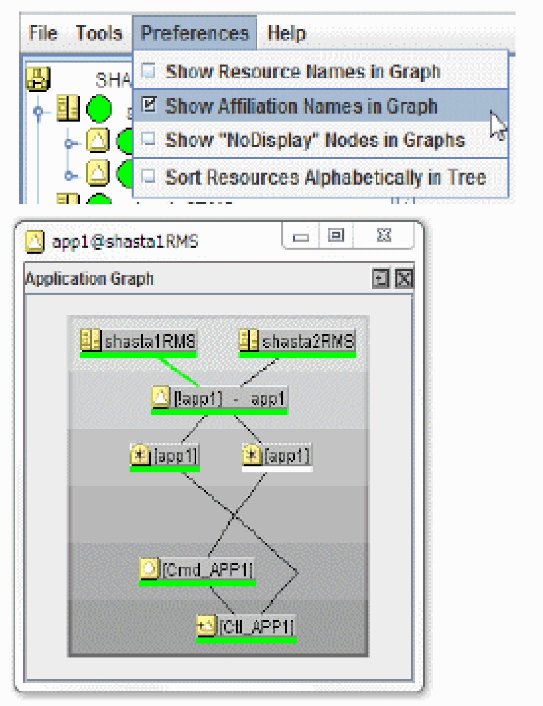
The following figure shows the preference setting and a corresponding graph that displays resource names.

Figure 6.24 Displaying an RMS graph with affiliation names


File
Tools
Preferences
Help
SHA
☑ Show Resource Names in Graph
☐ Show Affiliation Names in Graph
☐ Show "NoDisplay" Nodes in Graphs
☐ Sort Resources Alphabetically in Tree
app1@shasta1RMS
Application Graph
shasta1RMS
shasta2RMS
app1
Machine000_app1
Machine001_app1
ManageProgram000_Cmd_APP1
Controller001Of_Ctl_APP1

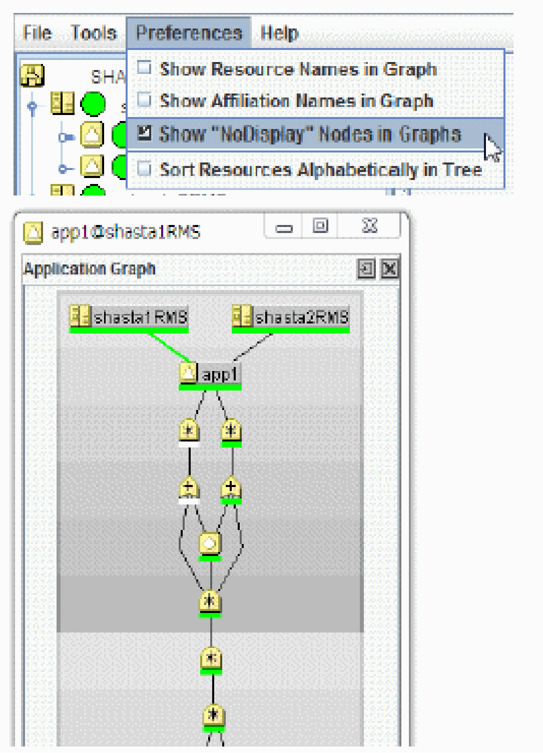
The following figure shows the preference setting and a corresponding graph that displays affiliation names.

Figure 6.25 RMS graph with resource names


☐ Show Resource Names in Graph
☑ Show Affiliation Names in Graph
☐ Show "NoDisplay" Nodes in Graphs
☐ Sort Resources Alphabetically in Tree

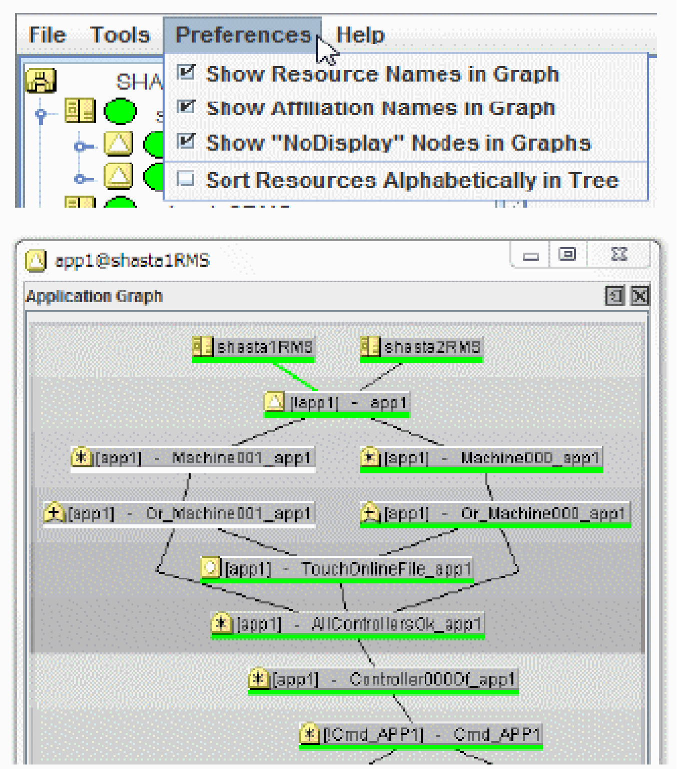
The following figure shows the preference setting and a corresponding graph that displays "NoDisplay" objects. These are typically logical AND/OR objects that are automatically generated by the configuration tool.

Figure 6.26 RMS graph with resource names


☐ Show Resource Names in Graph
☐ Show Affiliation Names in Graph
☑ Show "NoDisplay" Nodes in Graphs
☐ Sort Resources Alphabetically in Tree

If two or more display options are selected, some of the object and resource names will consume more on-screen space as shown in the following figure. Horizontal scrollbars will appear when the graph is larger than the width of the screen, but the graph may still be difficult to read.

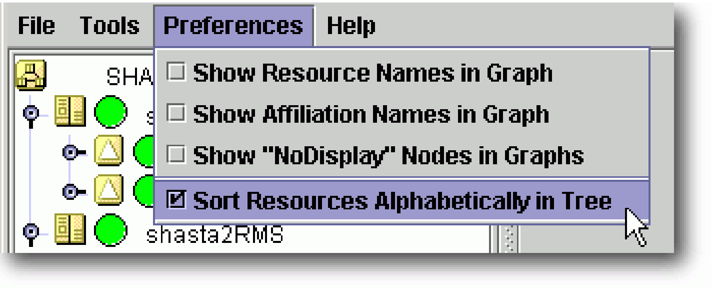
Figure 6.27 RMS graph with resource and affiliation names



☑ Show Resource Names in Graph
☑ Show Affiliation Names in Graph
☑ Show "NoDisplay" Nodes in Graphs
☐ Sort Resources Alphabetically in Tree

In a complicated graph, it may help to sort the resource names alphabetically.

Figure 6.28 Sorting object names in the graph



☐ Show Resource Names in Graph
☐ Show Affiliation Names in Graph
☐ Show "NoDisplay" Nodes in Graphs
☑ Sort Resources Alphabetically in Tree

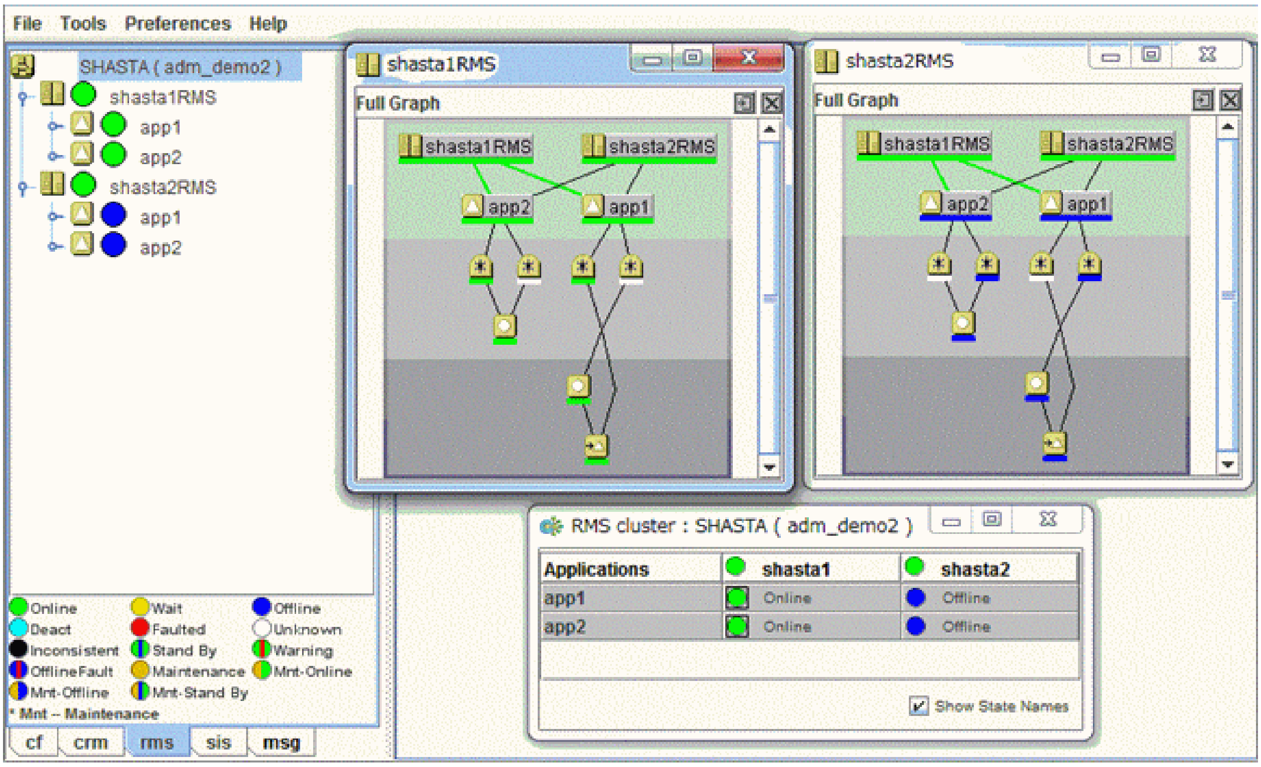
6.3 Interpreting display changes

The Cluster Admin view, the graphs, and the clusterwide table all have methods to denote the state of individual nodes as well as the overall configuration.

6.3.1 Display during RMS configuration changes

When you stop and restart RMS with a different configuration, the RMS tree, the clusterwide table, and the node graphs are redrawn in the same windows. The following figure illustrates a Cluster Admin view overlaid by two individual node graphs and the clusterwide table, all displaying the state of a running configuration that monitors app1 and app2.

Figure 6.29 Cluster state before RMS is shut down

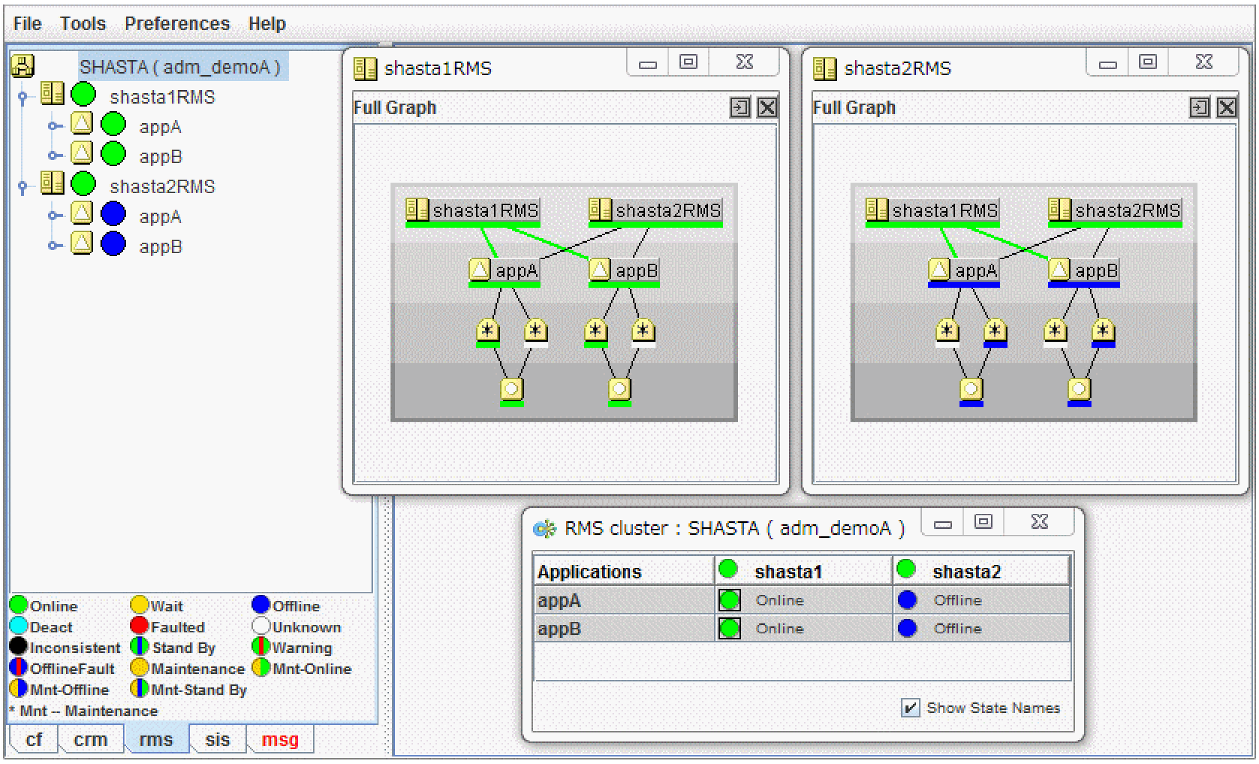


Applications	● shasta1	● shasta2
app1	● Online	● Offline
app2	● Online	● Offline

☑ Show State Names

The following figure shows the same windows after RMS has been restarted, this time with a different configuration that monitors appA and appB.

Figure 6.30 Cluster state after RMS restart with different configuration



Applications	● shasta1	● shasta2
appA	● Online	● Offline
appB	● Online	● Offline

☑ Show State Names

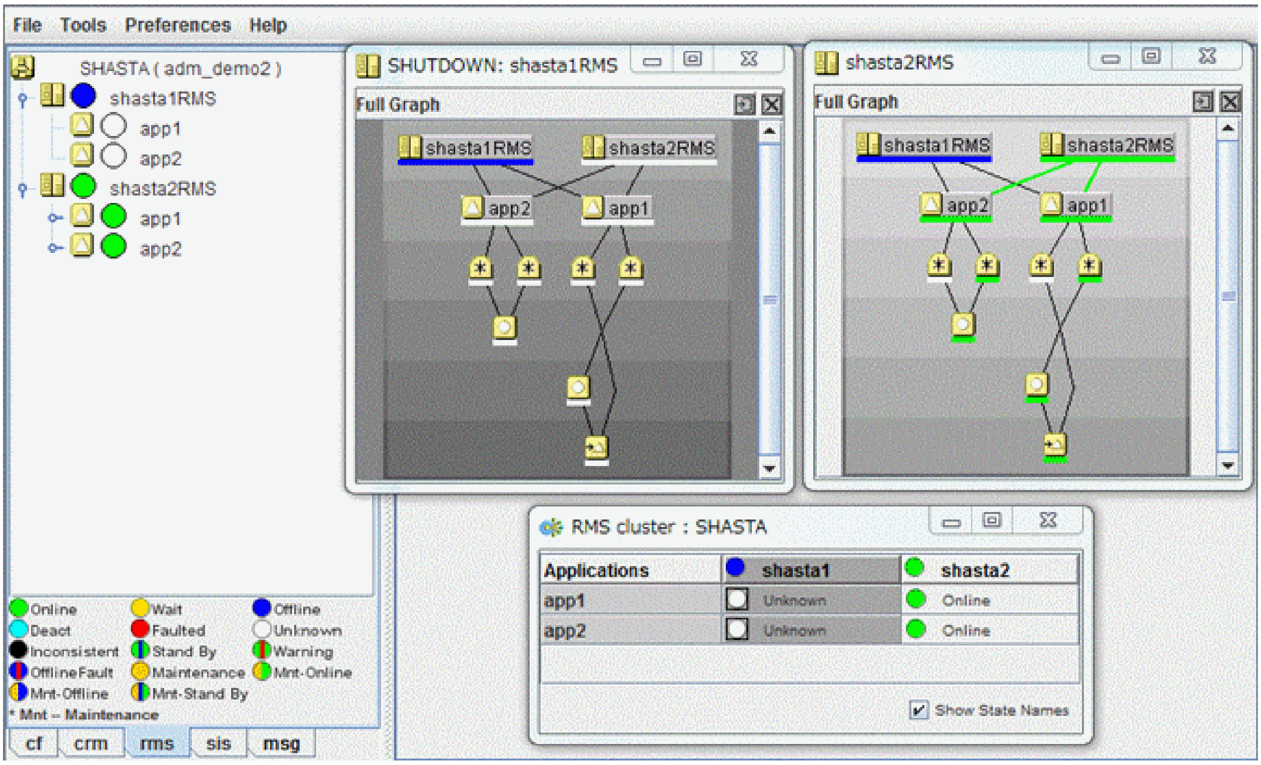
The graphs and clusterwide table display the status of the same SysNode objects (shasta1 and shasta2) before and after the restart, so the windows remain open.

6.3.2 Display after RMS shutdown

After RMS is shut down, the background of RMS graph windows become dark gray on the node from which they are getting their information. In this condition, all the states are white, indicating that the states are unknown. Once the node on which RMS is activated is connected, the GUI starts to display the information again.

For example, suppose RMS is shut down only on one node (shasta1) of our example cluster. The graph on that node and the corresponding column of the clusterwide table will be shared with a dark gray background.

Figure 6.31 RMS main view, graphs, and clusterwide table after shutdown on one node



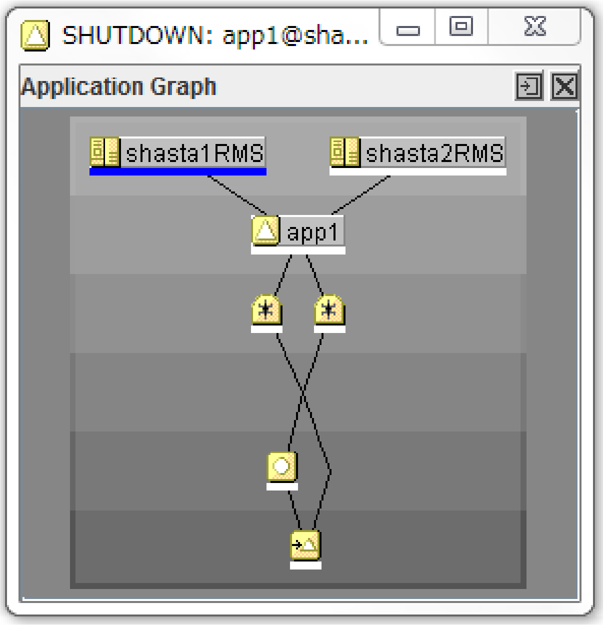
Applications	● shasta1	● shasta2
app1	□ Unknown	● Online
app2	□ Unknown	● Online

However, as long as RMS continues to run on the remaining node, shasta2, the RMS main view, the shasta2RMS graph, and the shasta2 column in the clusterwide table will indicate the online objects.

Application and subapplication graphs

When a node shuts down, any application or subapplication graph on that node would also change to the shutdown state.

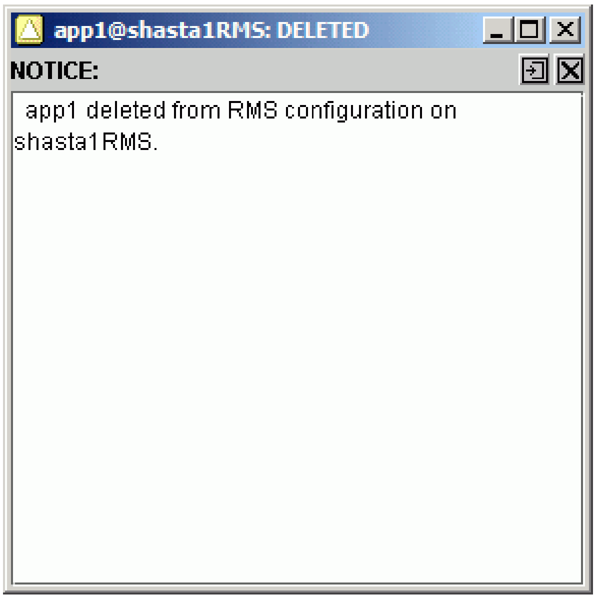
Figure 6.32 Application graph on shutdown node



The graph retains this appearance until the node restarts with the same configuration, at which point it returns to its normal display.

If the node restarts with a different configuration, the graph contents are deleted, because the object(s) no longer exist in the new configuration. However, the empty graph window remains opens until explicitly closed.

Figure 6.33 Graph window for deleted object



app1 deleted from RMS configuration on shasta1RMS.

6.4 Viewing RMS log messages

The Cluster Admin interface provides a log viewer that lets you view and filter entries in the RMS switchlog and individual application logs on any node.

Information

All RMS log files, which normally reside in /var/opt/SMAWRrms/log/, can be viewed directly using a standard UNIX editor like vi.

See

For meanings of error messages and possible corrective actions, refer to "PRIMECLUSTER Messages."

Note

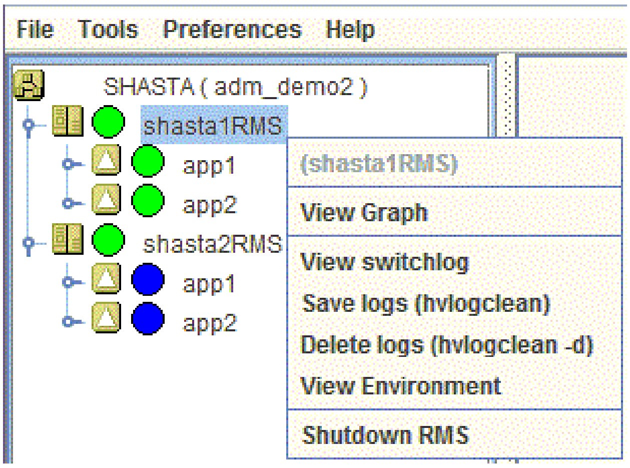
If you have built a cluster system in the following environments, these logs cannot be displayed from the Cluster Admin.

- Cloud environment
- Environment that uses Firewall
- Red Hat OpenStack Platform environment

View the switchlog for a system node as follows:

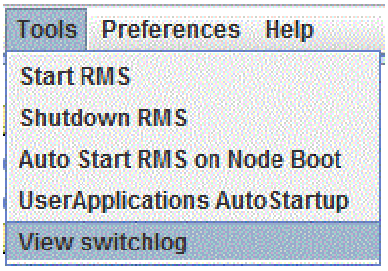
Right-click on the system node and select View Switchlog from the pop-up context menu.

Figure 6.34 Viewing the RMS switchlog file using a context menu



Alternatively, select a node and use Tools -> View switchlog.

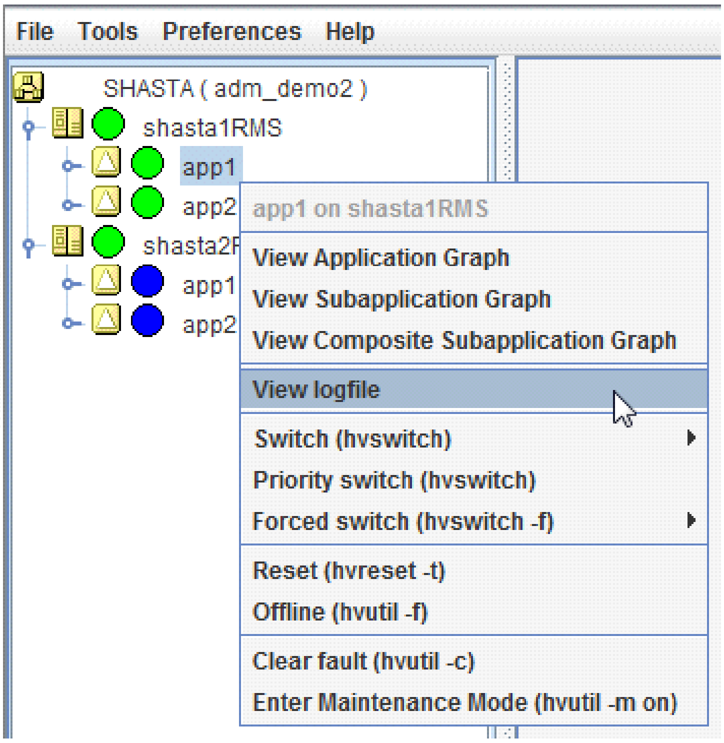
Figure 6.35 Viewing the RMS switchlog file using the Tools menu



View an application log as follows:

Right-click on an application on the RMS tree and choose View logfile from the pop-up context menu.

Figure 6.36 Viewing an application log using a context menu

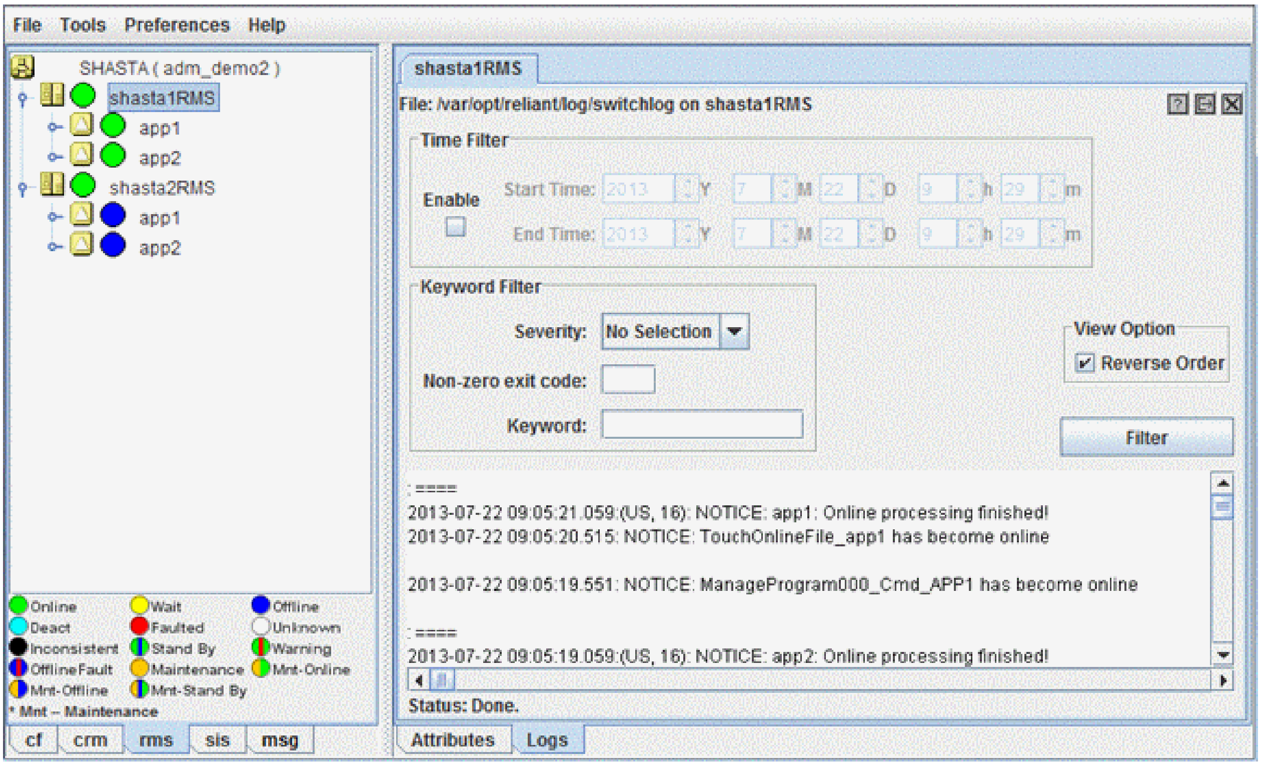


Note

You can invoke equivalent context menus for an object from the Cluster Admin view, from the clusterwide table, or from any RMS graph containing that object.

By default, each log file is displayed in a separate tab in the right pane.

Figure 6.37 RMS switchlog in tab view



File: /var/opt/reliant/log/switchlog on shasta1RMS

Enable □

Start Time: 2013 Y 7 M 22 D 9 h 29 m

End Time: 2013 Y 7 M 22 D 9 h 29 m

Severity: No Selection

Non-zero exit code:

Keyword:

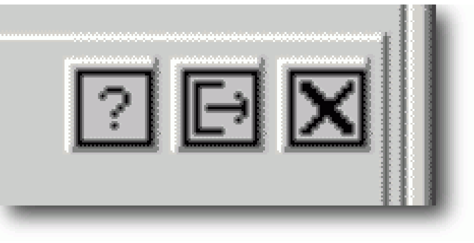
☑ Reverse Order

```
:====
2013-07-22 09:05:21.059:(US, 16): NOTICE: app1: Online processing finished!
2013-07-22 09:05:20.515: NOTICE: TouchOnlineFile_app1 has become online

2013-07-22 09:05:19.551: NOTICE: ManageProgram000_Cmd_APP1 has become online

:====
2013-07-22 09:05:19.059:(US, 16): NOTICE: app2: Online processing finished!
```

Status: Done.

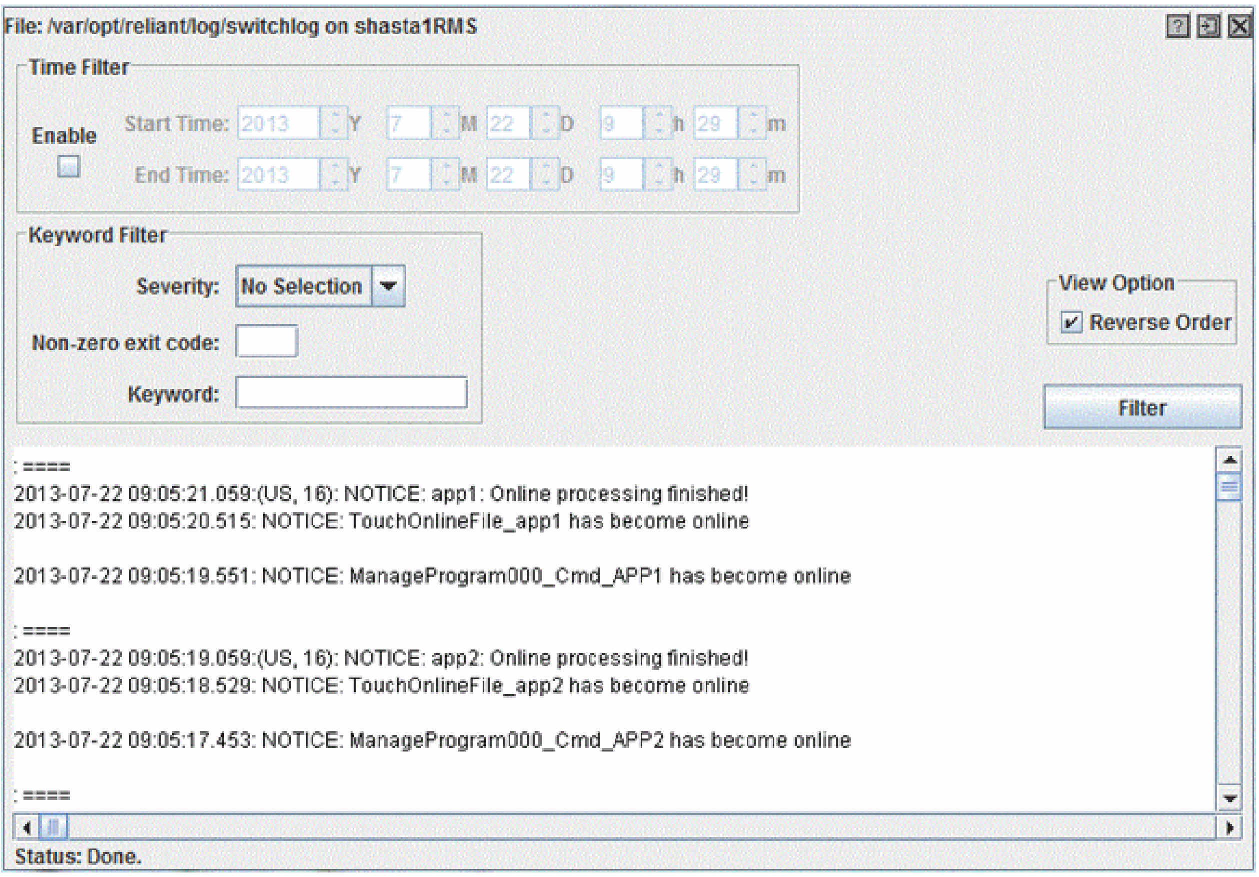
To view any tab in a separate window, click the detach control button. The detach button is located between the help and close control buttons in the upper-right corner of the view.

Figure 6.38 Detail of tab view showing detach button



The detached view contains the same information as the tabbed view.

Figure 6.39 RMS switchlog in detached view



File: /var/opt/reliant/log/switchlog on shasta1RMS

Time Filter

Enable □

Start Time: 2013 Y 7 M 22 D 9 h 29 m

End Time: 2013 Y 7 M 22 D 9 h 29 m

Keyword Filter

Severity: No Selection

Non-zero exit code:

Keyword:

View Option

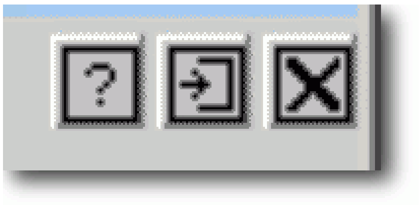
☑ Reverse Order

```
: ====
2013-07-22 09:05:21.059:(US, 16): NOTICE: app1: Online processing finished!
2013-07-22 09:05:20.515: NOTICE: TouchOnlineFile_app1 has become online

2013-07-22 09:05:19.551: NOTICE: ManageProgram000_Cmd_APP1 has become online

: ====
2013-07-22 09:05:19.059:(US, 16): NOTICE: app2: Online processing finished!
2013-07-22 09:05:18.529: NOTICE: TouchOnlineFile_app2 has become online

2013-07-22 09:05:17.453: NOTICE: ManageProgram000_Cmd_APP2 has become online

: ====
```

Status: Done.

To rejoin the detached window to the Cluster Admin view, click the attach control button. The attach button is located between the view's help and close control buttons in the upper-right corner, just below the standard window control buttons.

Figure 6.40 Detail of detached window view showing attach button



Point

While in detached mode, the view's close button and the standard window close button serve the same purpose: they both close the detached window.

In attached mode, the tabbed view's close button closes only the visible tab. All other tabs remain open.

6.4.1 Common procedures for switchlog and application log

By default, the entire log is available in the scrolled area at the bottom of the window. You can restrict the entries displayed with the following filters, which are described in subsections below:

- Time Filter

  defines the time period of interest.

- Keyword Filter

  selects a particular resource name (for an application only), error message severity level, non-zero exit code, or keyword.

See

For details on severity levels, see the section "6.4.3.2 Severity", and on exit codes, see "PRIMECLUSTER Messages."

After you enter your filter criteria, click the Filter button to display the filtered log entries.

Note

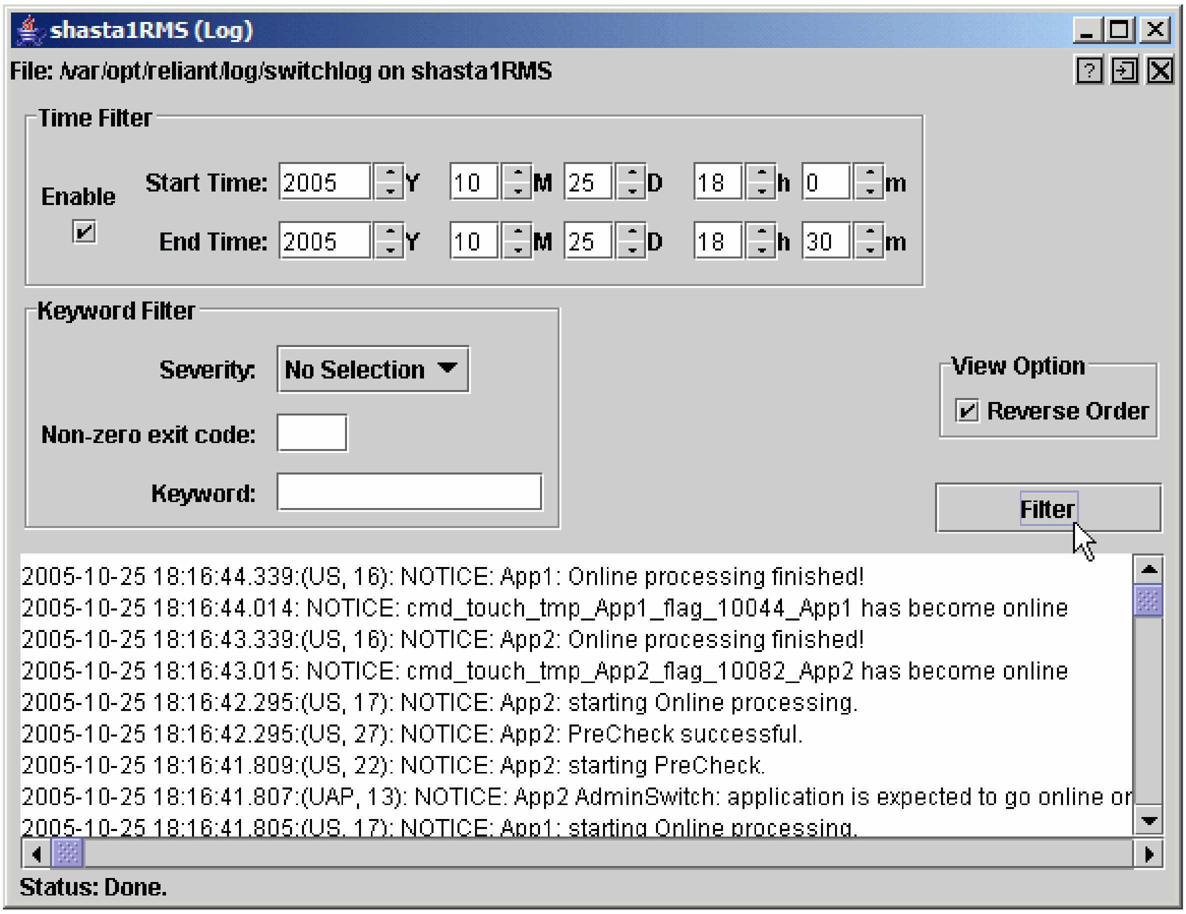
All the selected and non-blank Time Filter and Keyword Filter controls are combined with a logical AND operation.

At any time, you can sort the displayed switchlog entries according to increasing or decreasing time by checking or unchecking the Reverse Order checkbox in the log viewer window.

6.4.2 Time filter

The controls in the Time Filter panel allow you to limit the entries displayed in the log pane according to their date and time.

Figure 6.41 Search based on date and time range



shasta1RMS (Log)

File: /var/opt/reliant/log/switchlog on shasta1RMS

Time Filter

Enable ☑

Start Time: 2005 Y 10 M 25 D 18 h 0 m

End Time: 2005 Y 10 M 25 D 18 h 30 m

Keyword Filter

Severity: No Selection

Non-zero exit code:

Keyword:

View Option

☑ Reverse Order

```
2005-10-25 18:16:44.339:(US, 16): NOTICE: App1: Online processing finished!
2005-10-25 18:16:44.014: NOTICE: cmd_touch_tmp_App1_flag_10044_App1 has become online
2005-10-25 18:16:43.339:(US, 16): NOTICE: App2: Online processing finished!
2005-10-25 18:16:43.015: NOTICE: cmd_touch_tmp_App2_flag_10082_App2 has become online
2005-10-25 18:16:42.295:(US, 17): NOTICE: App2: starting Online processing.
2005-10-25 18:16:42.295:(US, 27): NOTICE: App2: PreCheck successful.
2005-10-25 18:16:41.809:(US, 22): NOTICE: App2: starting PreCheck.
2005-10-25 18:16:41.807:(UAP, 13): NOTICE: App2 AdminSwitch: application is expected to go online or
2005-10-25 18:16:41.805:(US, 17): NOTICE: App1: starting Online processing.
```

Status: Done.

Select the Start Time and End Time using the scrolling input boxes (you can also type in the values directly) and then check the Enable checkbox.

The controls take effect the next time you click the Filter button.

To remove the time filter, uncheck Enable and then click Filter.

6.4.3 Keyword filters

The following items are available in the Keyword Filter panel.

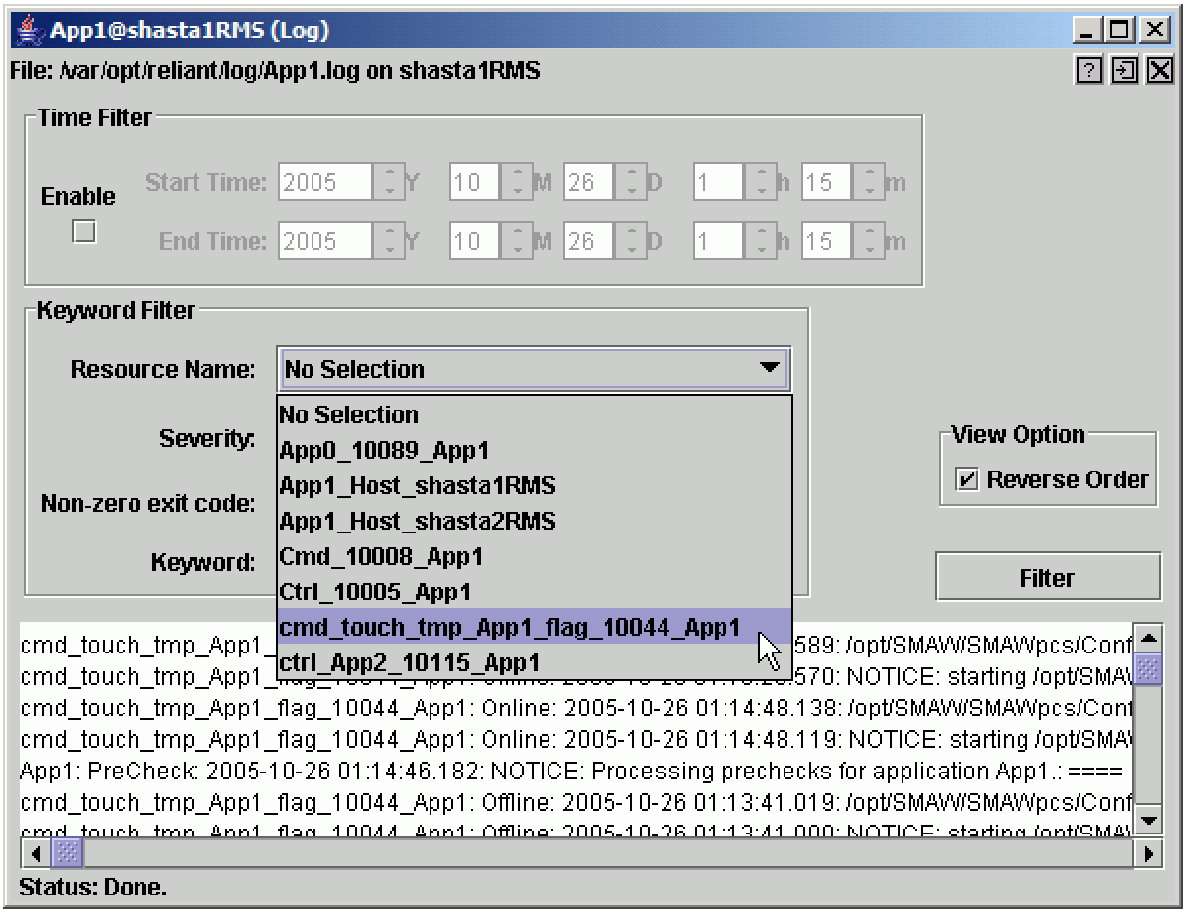
6.4.3.1 Resource Name

Note

The Resource Name control is available only for application logs.

Select a resource name from the dropdown list and then click Filter.

Figure 6.42 Search based on resource name



App1@shasta1RMS (Log)

File: /var/opt/reliant/log/App1.log on shasta1RMS

Time Filter

Enable □

Start Time: 2005 Y 10 M 26 D 1 h 15 m

End Time: 2005 Y 10 M 26 D 1 h 15 m

Keyword Filter

Resource Name: No Selection

- No Selection
- App0_10089_App1
- App1_Host_shasta1RMS
- App1_Host_shasta2RMS
- Cmd_10008_App1
- Ctrl_10005_App1
- cmd_touch_tmp_App1_flag_10044_App1
- ctrl_App2_10115_App1

Severity:

Non-zero exit code:

Keyword:

View Option

☑ Reverse Order

```
cmd_touch_tmp_App1_                                  589: /opt/SMAW/SMAWpcs/Conf
cmd_touch_tmp_App1_                                  570: NOTICE: starting /opt/SMAW
cmd_touch_tmp_App1_flag_10044_App1: Online: 2005-10-26 01:14:48.138: /opt/SMAW/SMAWpcs/Conf
cmd_touch_tmp_App1_flag_10044_App1: Online: 2005-10-26 01:14:48.119: NOTICE: starting /opt/SMAW
App1: PreCheck: 2005-10-26 01:14:46.182: NOTICE: Processing prechecks for application App1.: ====
cmd_touch_tmp_App1_flag_10044_App1: Offline: 2005-10-26 01:13:41.019: /opt/SMAW/SMAWpcs/Conf
cmd_touch_tmp_App1_flag_10044_App1: Offline: 2005-10-26 01:13:41.000: NOTICE: starting /opt/SMAW
```

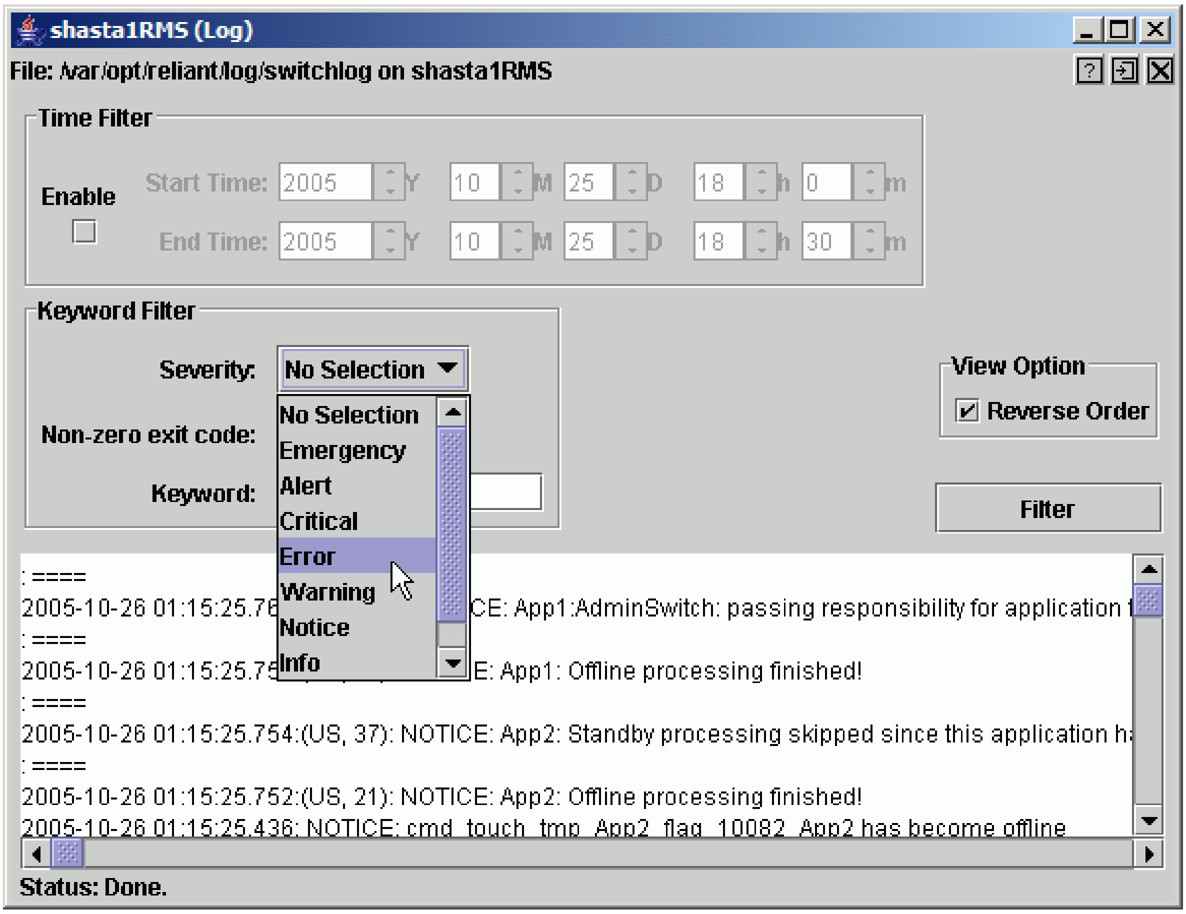
Status: Done.

To remove the resource name filter, select No Selection from the dropdown list and then click Filter.

6.4.3.2 Severity

Select a message severity level from the dropdown list and then click Filter.

Figure 6.43 Search based on severity level



File: /var/opt/reliant/log/switchlog on shasta1RMS

Enable ☐

Start Time: 2005 Y 10 M 25 D 18 h 0 m

End Time: 2005 Y 10 M 25 D 18 h 30 m

Severity: No Selection

Non-zero exit code:

Keyword:

☑ Reverse Order

```
: ====
2005-10-26 01:15:25.76                CE: App1:AdminSwitch: passing responsibility for application t
: ====
2005-10-26 01:15:25.75                E: App1: Offline processing finished!
: ====
2005-10-26 01:15:25.754:(US, 37): NOTICE: App2: Standby processing skipped since this application h
: ====
2005-10-26 01:15:25.752:(US, 21): NOTICE: App2: Offline processing finished!
2005-10-26 01:15:25.436: NOTICE: cmd touch tmp App2 flag 10082 App2 has become offline
```

Status: Done.

The following table summarizes the RMS message log viewer severity levels.

Table 6.1 RMS severity level description

Severity level	Description
Emergency	Systems cannot be used
Alert	Immediate action is necessary
Critical	Critical condition (fatal error)
Error	Error condition (non-fatal error)
Warning	Warning condition
Notice	Normal but important condition
Info	Miscellaneous information
Debug	Debug messages

To remove the severity level filter, select No Selection from the dropdown list and then click Filter.

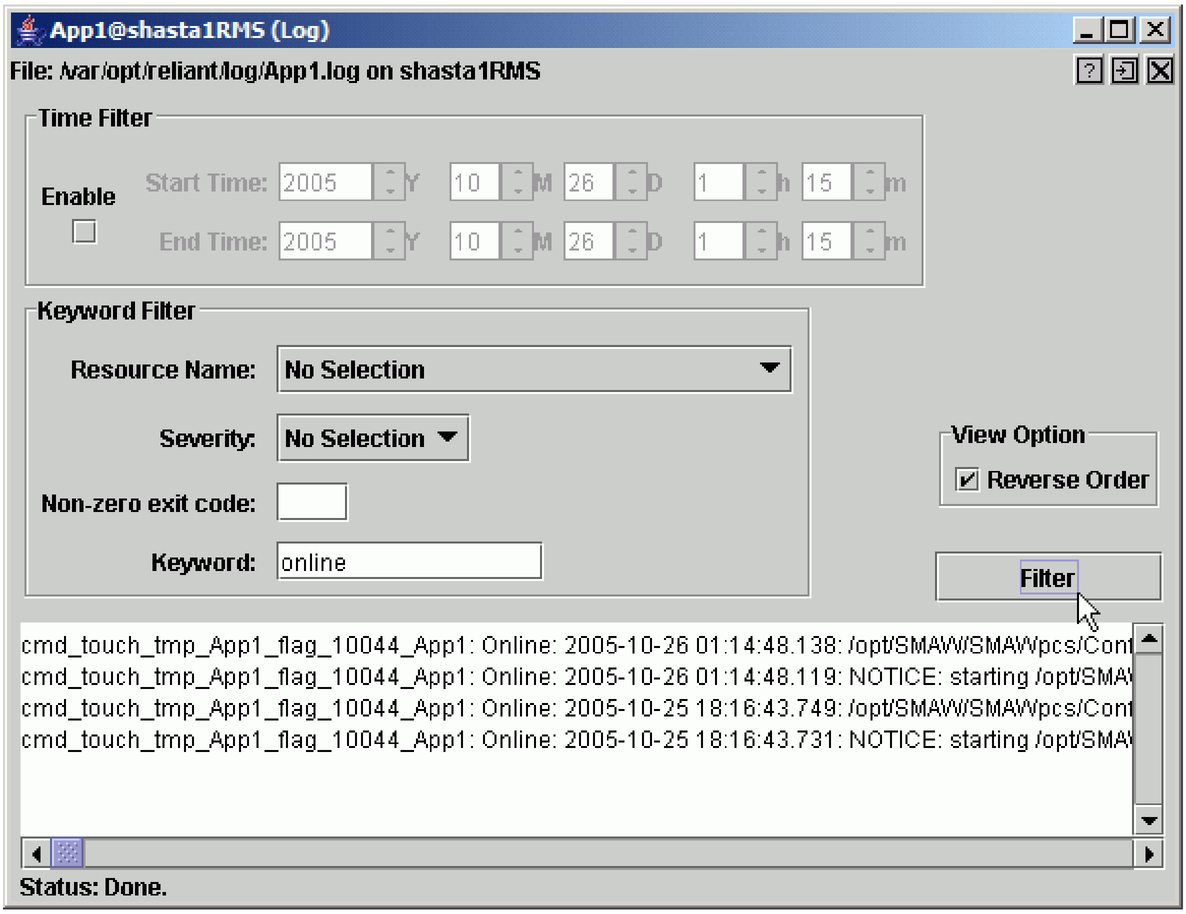
6.4.3.3 Non-zero exit code

Enter a numeric exit code in the Non-zero exit code input box and then click Filter.

6.4.3.4 Keyword

Enter a string in the Keyword box and then click Filter.

Figure 6.44 Search based on keyword


App1@shasta1RMS (Log)
File: /var/opt/reliant/log/App1.log on shasta1RMS
Time Filter
Enable
□
Start Time: 2005 Y 10 M 26 D 1 h 15 m
End Time: 2005 Y 10 M 26 D 1 h 15 m
Keyword Filter
Resource Name: No Selection
Severity: No Selection
Non-zero exit code:
Keyword: online
View Option
☑ Reverse Order
Filter

```
cmd_touch_tmp_App1_flag_10044_App1: Online: 2005-10-26 01:14:48.138: /opt/SMAW/SMAWpcs/Cont
cmd_touch_tmp_App1_flag_10044_App1: Online: 2005-10-26 01:14:48.119: NOTICE: starting /opt/SMAW
cmd_touch_tmp_App1_flag_10044_App1: Online: 2005-10-25 18:16:43.749: /opt/SMAW/SMAWpcs/Cont
cmd_touch_tmp_App1_flag_10044_App1: Online: 2005-10-25 18:16:43.731: NOTICE: starting /opt/SMAW
```

Status: Done.

Note

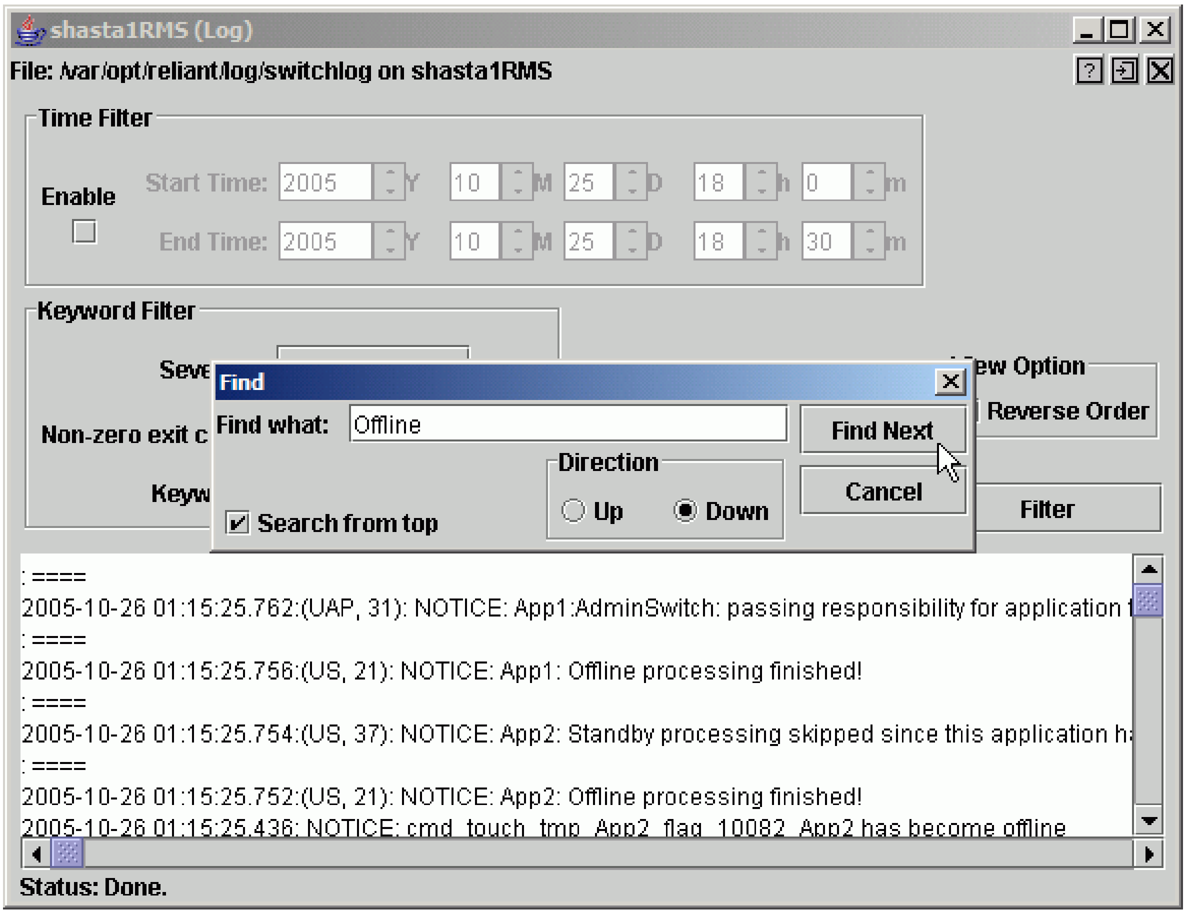
Special characters and spaces are valid, but wildcards are not interpreted. This search is not case-sensitive.

To remove the keyword filter, clear the text in the Keyword box and then click Filter.

6.4.4 Text search

You can search the text in the application log by right-clicking on the displayed text. A pop-up dialog with a Find entry allows you to perform a case-sensitive search in the direction you specify.

Figure 6.45 Using the pop-up Find dialog in log viewer



File: /var/opt/reliant/log/switchlog on shasta1RMS

Enable □

Start Time: 2005 Y 10 M 25 D 18 h 0 m

End Time: 2005 Y 10 M 25 D 18 h 30 m

Find what: Offline

☑ Search from top

Direction: ○ Up ● Down

```
: ====
2005-10-26 01:15:25.762:(UAP, 31): NOTICE: App1:AdminSwitch: passing responsibility for application t
: ====
2005-10-26 01:15:25.756:(US, 21): NOTICE: App1: Offline processing finished!
: ====
2005-10-26 01:15:25.754:(US, 37): NOTICE: App2: Standby processing skipped since this application ha
: ====
2005-10-26 01:15:25.752:(US, 21): NOTICE: App2: Offline processing finished!
2005-10-26 01:15:25.436: NOTICE: cmd_touch_tmp_App2_flag_10082_App2 has become offline
```

Status: Done.

Note

The Find search string is processed literally. You can include spaces and special characters, but wildcards are not interpreted.

6.4.5 Removing filters

To remove all filters, take the following steps:

1. Uncheck the time filter Enable box.
2. Set drop-down lists to No Selection
3. Clear text from input boxes
4. Click the Filter button

The unfiltered view will be restored.

Chapter 7 Controlling RMS operation

This chapter describes operations and management of RMS.

7.1 Managing RMS nodes

This section describes basic procedures to control the operation of RMS, including how to start and stop individual nodes or the entire cluster. Procedures in this section are active: they change the state of the RMS cluster and may have a direct effect on the disposition of data.

As stated in 5.1 Overview, the primary means of administration is through the Cluster Admin GUI. This method should be used whenever possible. However, each procedure in this section includes a CLI alternative.

- The command is stored in <*RELIANT_PATH*>/bin directory.
- If CF code names and RMS node names follow the naming convention (if the structure of the name is <*CFname*>RMS), both are operated as Sysnode object in all of the commands of RMS CLI.
- In the description of commands, only the most frequently used options are stated. Available options may exist other than these. For command details, see the manual pages of each command.

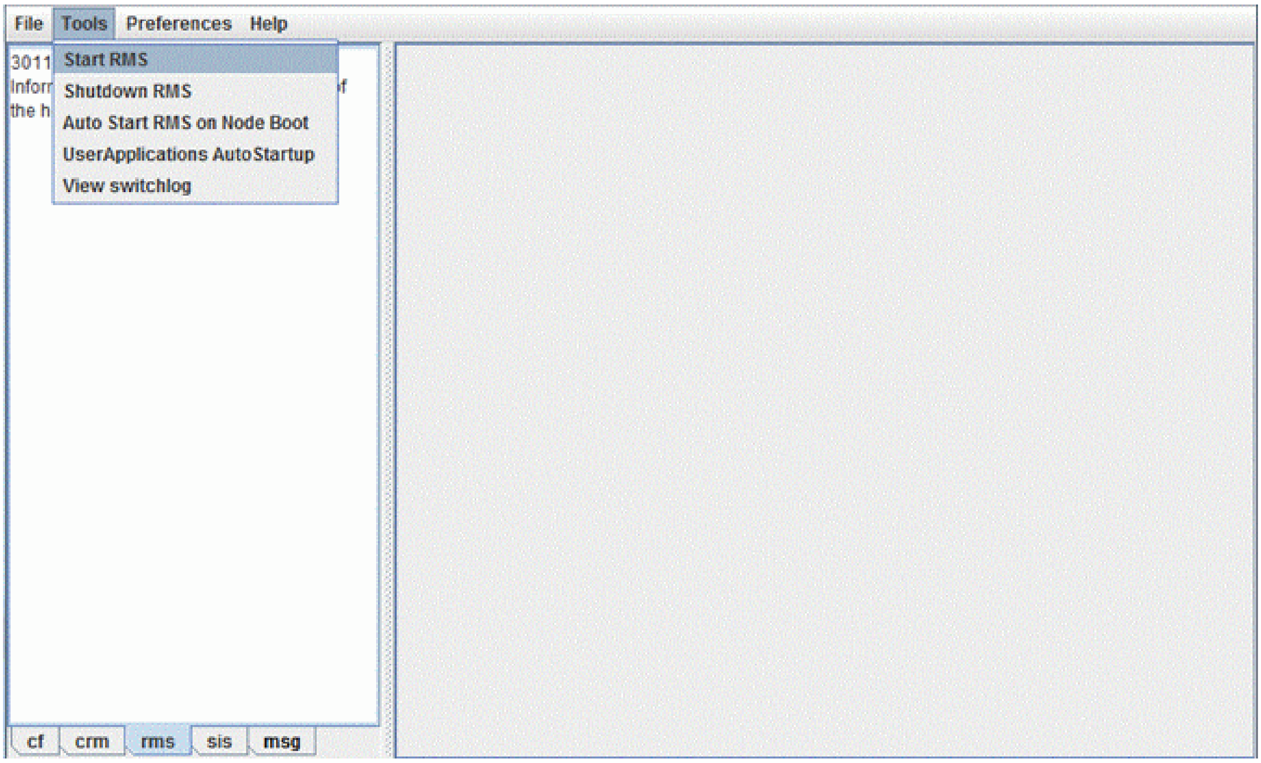
7.1.1 Starting RMS

When you use the GUI, you can only start the most recently activated configuration. To start a different configuration, you must first use the Wizard Tools to activate that configuration.

By default, the GUI will start RMS on all the nodes in the cluster. Alternatively, you can start RMS only on a single node that you select.

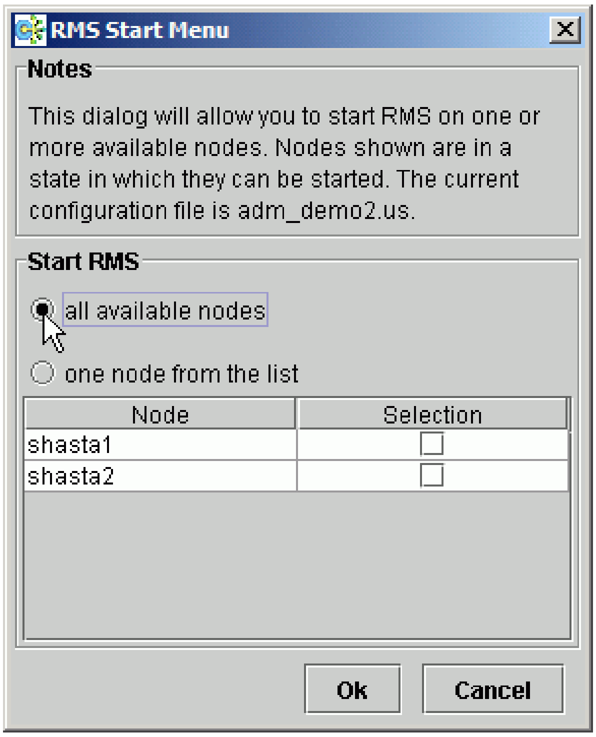
1. From the Cluster Admin rms tab, select Tools -> Start RMS.

Figure 7.1 Starting RMS from the main menu



2. The RMS Start Menu window opens. To start RMS on all the nodes, click the all available nodes radio button and then click OK.

Figure 7.2 RMS Start Menu for all the nodes



RMS Start Menu

Notes

This dialog will allow you to start RMS on one or more available nodes. Nodes shown are in a state in which they can be started. The current configuration file is adm_demo2.us.

Start RMS

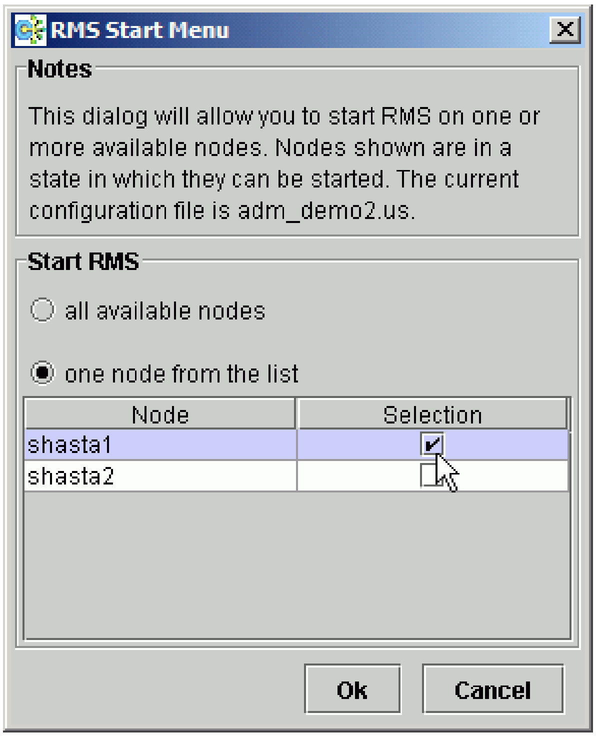
● all available nodes

○ one node from the list

Node	Selection
shasta1	□
shasta2	□

3. To start RMS only on a single node, click the one node from the list radio button, and then choose the node using a checkbox in the Selection column. After making your selections, click OK.

Figure 7.3 RMS Start Menu for individual nodes



RMS Start Menu

Notes

This dialog will allow you to start RMS on one or more available nodes. Nodes shown are in a state in which they can be started. The current configuration file is adm_demo2.us.

Start RMS

○ all available nodes

● one node from the list

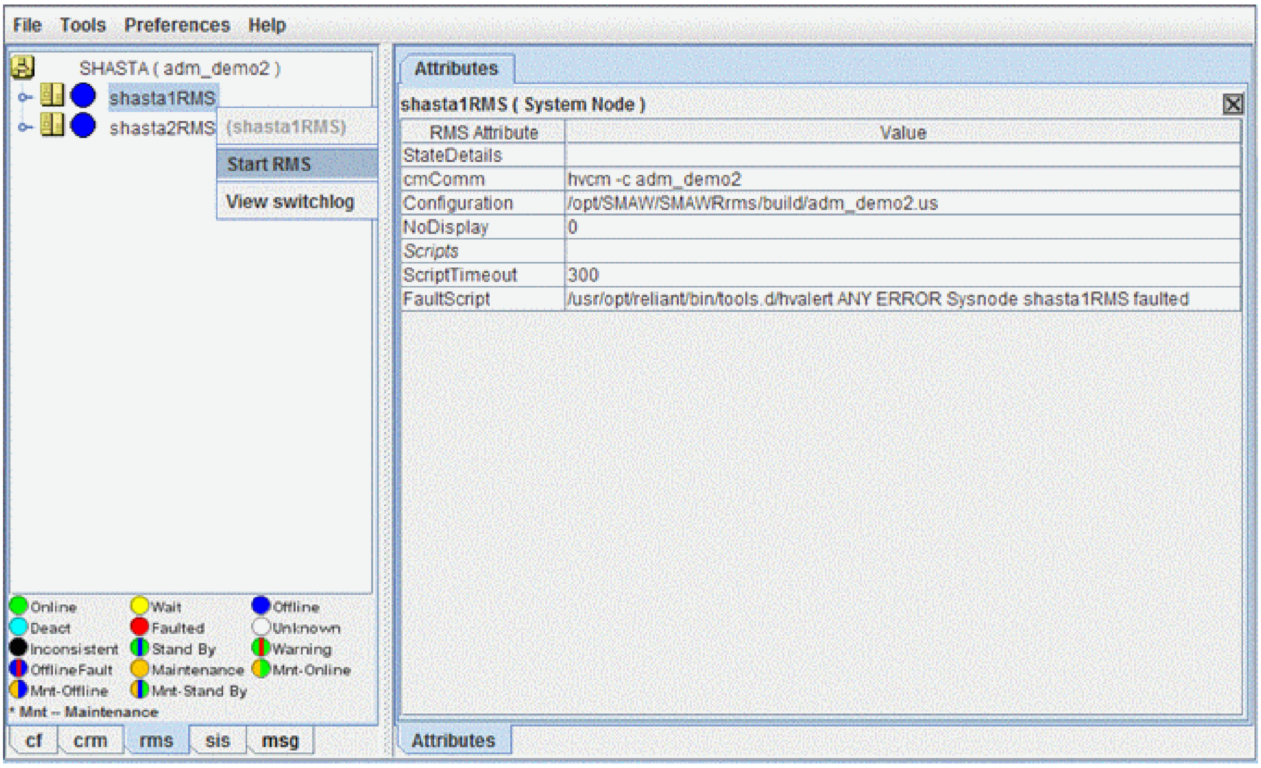
Node	Selection
shasta1	☑
shasta2	□

Alternatively, you can start RMS on individual nodes directly from the Cluster Admin window:

1. In the left pane, click the rms tab to view the cluster tree.

2. Right-click on the node and select Start RMS from the pop-up menu.

Figure 7.4 Starting RMS on individual nodes



shasta1RMS (System Node)

RMS Attribute	Value
StateDetails	
cmComm	hvcm -c adm_demo2
Configuration	/opt/SMAW/SMAWRrms/build/adm_demo2.us
NoDisplay	0
Scripts	
ScriptTimeout	300
FaultScript	/usr/opt/reliant/bin/tools.d/hvalert ANY ERROR Sysnode shasta1RMS faulted

CLI: hvcm

The hvcm command starts the base monitor and the detectors for all monitored resources. The CLI syntax for hvcm has two possible formats:

Format 1

```
hvcm [-a | -s SysNode]
```

Format 2

```
hvcm -c config_name [-a | -s SysNode] [-h timeout] [-l loglevels]
```

The options valid for both formats are:

```
-a:  Start RMS on all the nodes in the configuration

-s:  Start RMS only on the specified node
```

If neither '-a' nor '-s' is specified, hvcm starts RMS only on the local node.

The options valid only for Format 2 are:

```
-c:  Use the specified configuration file

-h:  Use the specified heartbeat recovery timeout

-l:  Activate diagnostic output according to the specified level(s)
```

Note

To start a configuration other than the one most recently activated, change the heartbeat recovery timeout, or set the diagnostic level, you must use the CLI. These parameters cannot be adjusted from the Cluster Admin GUI.

Notes for Format 1

When the 'c' option is not present, hvcm reads the default CONFIG.rms startup file. hvcm looks for the default startup file in <*RELIANT_PATH*>/etc/CONFIG.rms. If the default for the environment variable RELIANT_PATH has not been changed, this resolves to /opt/SMAW/SMAWRrms/etc/CONFIG.rms. Note that the search is always confined to the local node, even if you specify the '-a' or '-s' option to start RMS remotely.

The CONFIG.rms file contains either of the following:

- A simple configuration name, optionally with a '.us' suffix.
- An hvcm command compliant with Format 2 that starts the most recently activated configuration.

You cannot specify the '-h' or '-l' options in Format 1. You can, however, edit the CONFIG.rms file and insert the options to comply with Format 2.

Notes for Format 2

When the '-c' option is present, and the configuration file is not an absolute path, hvcm looks for the first match in <*RELIANT_STARTUP_PATH*>. If the default for the environment variable RELIANT_STARTUP_PATH has not been changed, this resolves to /opt/SMAW/SMAWRrms/build/<*config_name*>.us (hvcm adds the '.us' extension if it is not specified as part of the configuration file name). If an absolute path is specified, hvcm attempts to read only that file. Note that the search is always confined to the local node, even if you specify the '-a' or '-s' option to start RMS remotely.

When hvcm locates the specified configuration file, it checks to see if the default CONFIG.rms file is also present. If it is, hvcm compares the configuration names defined by both files to make sure they agree. If they do not agree, hvcm aborts the startup processing. The default timeout value depends on which method RMS uses to monitor the cluster.

The '-h' option sets the UDP heartbeat recovery timeout value for the cluster. See "Nodes and heartbeats".

- By default, RMS monitors the state of each node with the Enhanced Lock Manager (ELM), which is implemented in the Cluster Foundation. ELM is not a polling method. Instead, it relies on locks that are held by each node and released when the node or its base monitor go down. When ELM is enabled, the UDP heartbeat timeout defaults to 600 seconds.
- ELM can be disabled for rolling upgrade or debugging operations by setting the HV_USE_ELM environment variable to zero (0). See "HV_USE_ELM" in "E.2 Global environment variables." When ELM is disabled, the UDP heartbeat defaults to 45 seconds.

Note

Specifying a heartbeat timeout shorter than the default may cause premature node kills. No data loss will occur, because a node kill begins with a graceful shutdown. However, cluster performance may suffer due to latency as applications are switched to different nodes. Excessively short heartbeat timeouts may also interfere with CF event timeouts.

The '-l' option sets the diagnostic output level at startup time. The *loglevels* specification consists of one or more individual numeric levels or hyphen-delimited ranges, each separated by a comma.

7.1.2 Starting RMS automatically at boot time

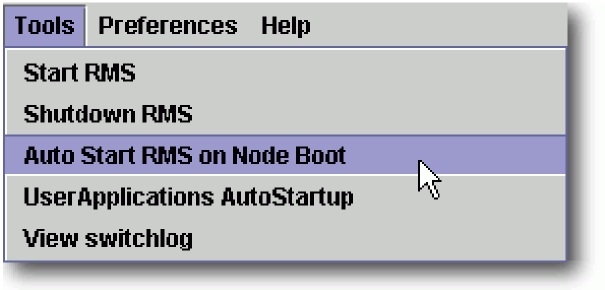
Note

This setting takes effect at the next system startup

You can use the following procedure to activate or deactivate automatic RMS startup when the system boots up.

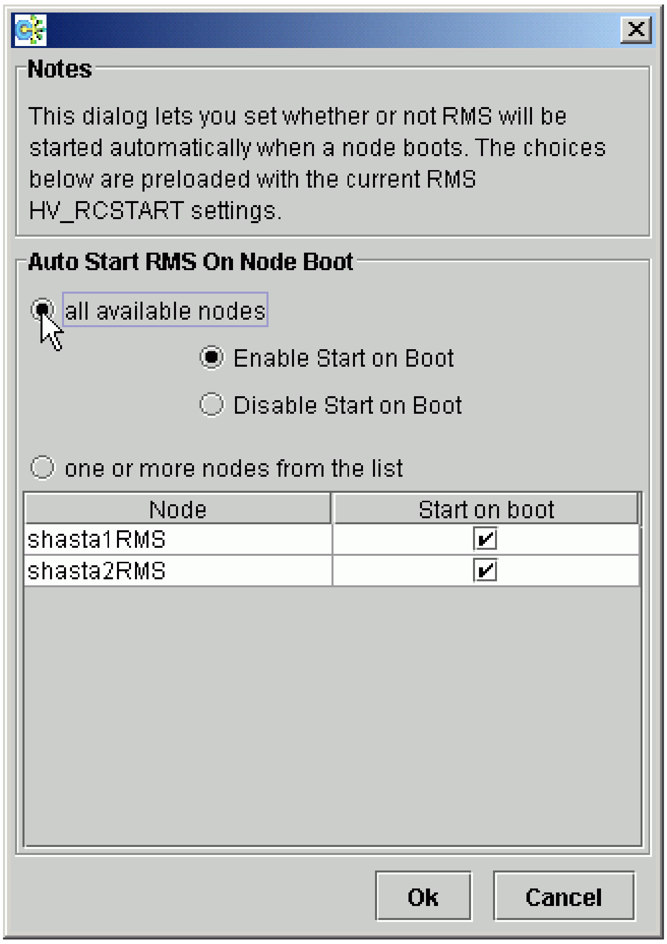
From the Cluster Admin rms tabbed view, select Tools > Auto Start RMS on Node Boot.

Figure 7.5 Controlling automatic RMS startup - step 1



You can then choose to activate (or deactivate) the automatic RMS startup on all the nodes, or on just one node.

Figure 7.6 Controlling automatic RMS startup - step 2



Notes

This dialog lets you set whether or not RMS will be started automatically when a node boots. The choices below are preloaded with the current RMS HV_RCSTART settings.

Auto Start RMS On Node Boot

● all available nodes

● Enable Start on Boot

○ Disable Start on Boot

○ one or more nodes from the list

Node	Start on boot
shasta1RMS	☑
shasta2RMS	☑

Note

To enable this setting, Web-Based Admin View and CF on all the nodes that configure the cluster need to be working.

For how to check the server process status of Web-Based Admin View, and how to start Web-Based Admin View, see "4.3.3 Initial Setup of Web-Based Admin View" in "PRIMECLUSTER Installation and Administration Guide."

For how to check the status of CF and how to start CF, see "4.2 Main CF table" and "4.6 Starting and stopping CF" in "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide."

CLI: hvsetenv

At system startup, the RMS rc script checks the environment variable settings: if the HV_RCSTART environment variable is set to 1, the rc script will attempt to start RMS using the CONFIG.rms file. You can set the HV_RCSTART variable with the hvsetenv command as follows:

```
hvsetenv HV_RCSTART [0|1]
```

The allowable values are:

```
0:  Do not start RMS at boot time
```

```
1:  Start RMS at boot time (default)
```

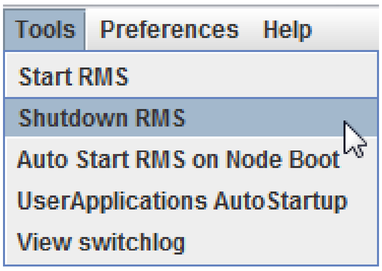
If no value is specified, the command reports the current value of the HV_RCSTART environment variable.

7.1.3 Stopping RMS

You can stop RMS on all the nodes or on a subset that you select.

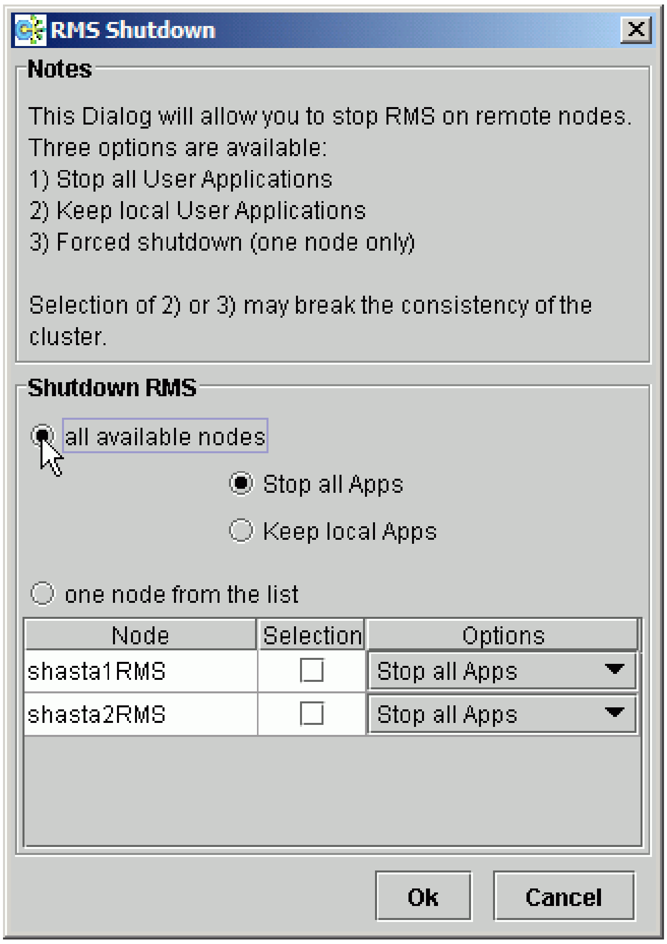
Use the Tools pull-down menu and select Shutdown RMS.

Figure 7.7 Using the Tools menu to stop RMS



To stop RMS on all the nodes, click the radio button for all available nodes and then click Ok.

Figure 7.8 Stopping RMS on all available nodes



This Dialog will allow you to stop RMS on remote nodes.
Three options are available:
1) Stop all User Applications
2) Keep local User Applications
3) Forced shutdown (one node only)

Selection of 2) or 3) may break the consistency of the cluster.

● all available nodes

● Stop all Apps

○ Keep local Apps

○ one node from the list

Node	Selection	Options
shasta1RMS	□	Stop all Apps
shasta2RMS	□	Stop all Apps

When you shut down all available nodes, two radio buttons allow you to choose how you want to handle the applications:

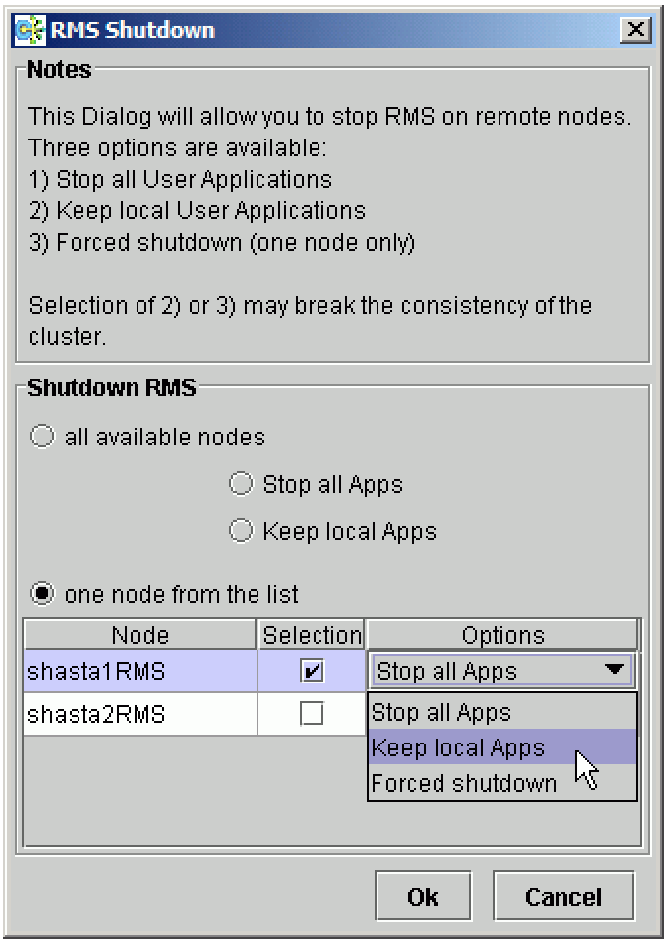
- Stop all Apps: Stops all user applications
- Keep local Apps: Leaves the applications running

Note

Leaving the applications running after stopping RMS can lead to data inconsistencies or corruption.

To stop RMS on one specific node, select the radio button for one node from the list, and then click the checkbox of the node you want to shut down.

Figure 7.9 Stopping RMS on one node from the list



Notes

This Dialog will allow you to stop RMS on remote nodes.
Three options are available:
1) Stop all User Applications
2) Keep local User Applications
3) Forced shutdown (one node only)

Selection of 2) or 3) may break the consistency of the cluster.

Shutdown RMS

○ all available nodes

○ Stop all Apps

○ Keep local Apps

● one node from the list

Node	Selection	Options
shasta1RMS	☑	Stop all Apps
shasta2RMS	☐	

Each node has a dropdown list in the Options column to provide additional control:

- Stop all Apps: Stops all user applications on the selected node
- Keep local Apps: Leaves the applications running on the selected node
- Forced shutdown: Performs a forced shutdown of RMS

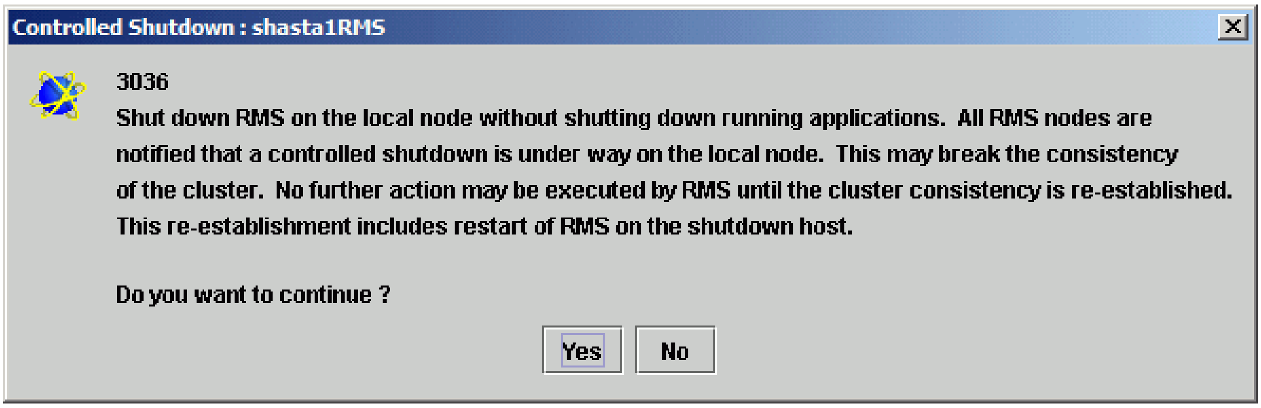
Note

- Keep local Apps or Forced shutdown can cause data inconsistencies or corruption.
- Do not stop RMS while RMS is running. Heartbeats between nodes are interrupted and the node where RMS is stopped may be forcibly shut down.

Click the Ok button to initiate the shutdown with your selections.

Stop all Apps is the default option for shutting down RMS on all the nodes or on one node. If you select an option other than the default, you will be prompted to confirm the operation.

Figure 7.10 Stopping RMS while keeping applications - confirmation

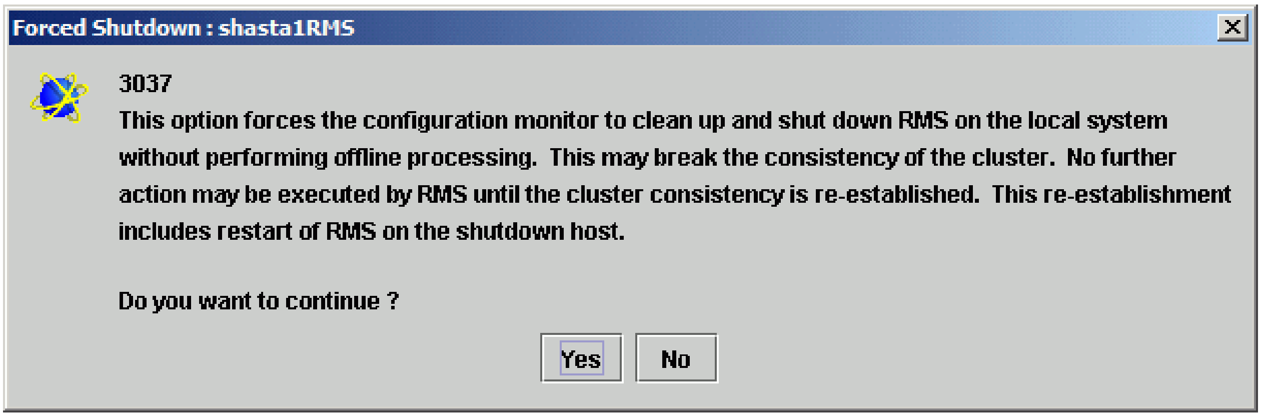


Controlled Shutdown : shasta1RMS

3036
Shut down RMS on the local node without shutting down running applications. All RMS nodes are notified that a controlled shutdown is under way on the local node. This may break the consistency of the cluster. No further action may be executed by RMS until the cluster consistency is re-established. This re-establishment includes restart of RMS on the shutdown host.

Do you want to continue ?

Figure 7.11 Forced shutdown of RMS - confirmation



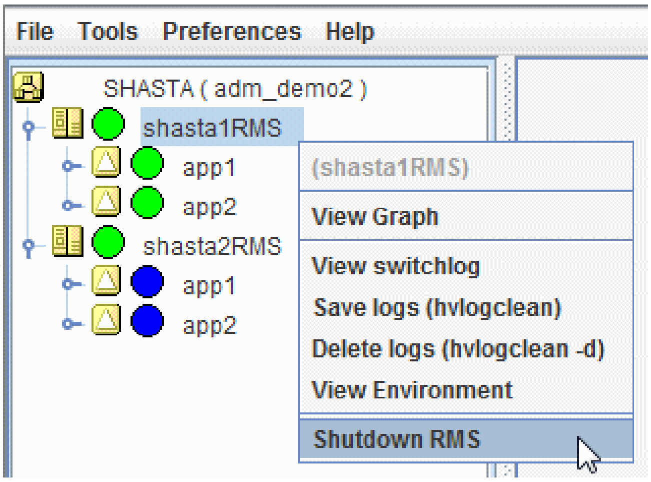
Forced Shutdown : shasta1RMS

3037
This option forces the configuration monitor to clean up and shut down RMS on the local system without performing offline processing. This may break the consistency of the cluster. No further action may be executed by RMS until the cluster consistency is re-established. This re-establishment includes restart of RMS on the shutdown host.

Do you want to continue ?

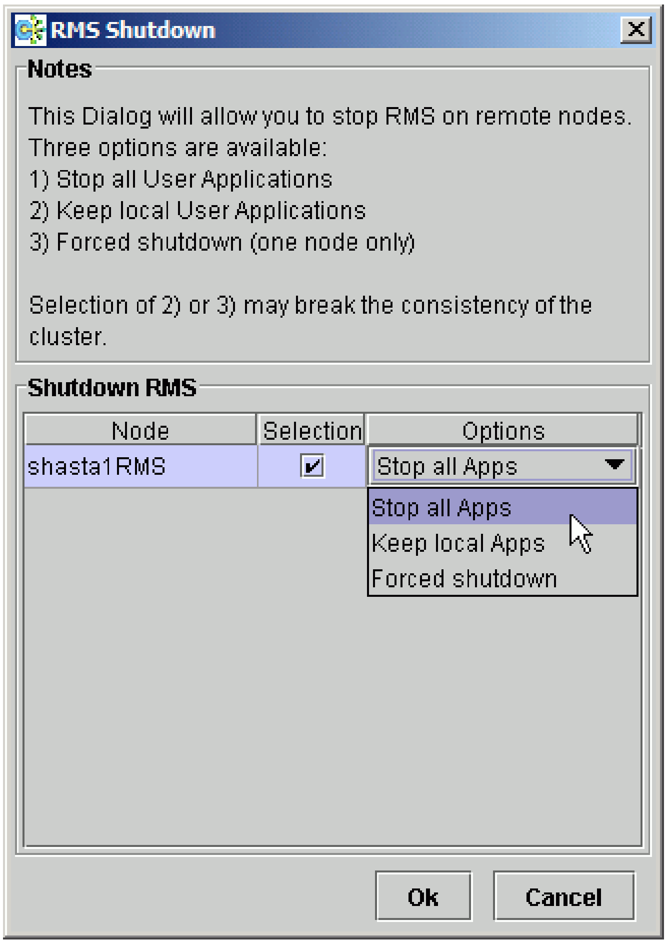
You can also stop RMS on a single node by right-clicking on the node in the RMS tree and then selecting Shutdown RMS from the context menu.

Figure 7.12 Using the context menu to stop RMS on one node



Only one node will appear in the confirmation window.

Figure 7.13 Stopping RMS on one node



This Dialog will allow you to stop RMS on remote nodes.
Three options are available:
1) Stop all User Applications
2) Keep local User Applications
3) Forced shutdown (one node only)

Selection of 2) or 3) may break the consistency of the cluster.

Node	Selection	Options
shasta1RMS	☑	Stop all Apps

Note

When switching online a controlling application with a scalable controller, do not stop RMS during the startup processing. When stopping RMS, the stop processing may timeout.

CLI: hvshut

The syntax for the CLI is as follows:

```
hvshut {-a | -A | -f | -l | -L | -s SysNode}
```

Options:

```
-a:  Shut down RMS and applications on all the nodes

-A:  Shut down RMS on all the nodes without shutting down applications

-f:  Forced (emergency) shutdown of RMS on the local node

-l:  Shut down RMS and applications on the local node

-L:  Shut down RMS on the local node without shutting down applications

-s:  Shut down RMS only on the specified node
```

The hvshut command shuts down RMS on one or more nodes in the configuration. The base monitor on the local node sends a message to other online nodes indicating on which node or nodes RMS is to be shut down. The hvshut command disables all error detection and recovery routines on the nodes being shut down, but does not shut down the operating system.

If the AutoSwitchOver attribute of the userApplication object is set to ShutDown and the -l option is used on the node where the userApplication object is online, the userApplication switchover is also performed.

If any userApplication objects are online when the -A, -f, or -L option is used, the cluster applications remain running but are no longer monitored by RMS. Both The -f and -L options affect only the local node, but the -f option is for emergencies (when other hvshut options do not work).

When you choose to shut down RMS without shutting down the monitored applications, you will be prompted to confirm the operation.

Note

- Use the hvshut -A, -f, and -L options carefully as they could result in inconsistencies or data corruption.
- When you stop RMS in a configuration where the operating userApplication exists on 3 or more nodes, perform one of the following operations.
  - To stop RMS of all nodes

    Perform hvshut -a command with one of the nodes.
  - To stop RMS of 2 or more nodes (not of all nodes)

    Perform hvshut command on each node to stop RMS. After hvshut command returns on a certain node, perform hvshut command on the next node.

7.1.4 Clearing a SysNode Wait state

You can clear a Wait state of SysNode by the following procedure:

1. Manually stop the node in the Wait state. Make sure the node has stopped completely.
2. Check the CF state in the CF main window.
   If the CF state is LEFTCLUSTER, clear LEFTCLUSTER in the CF main window and make sure the node state is changed from LEFTCLUSTER to DOWN.
   For more information on LEFTCLUSTER state, refer to "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide."
3. If the Wait state of SysNode is not cleared after you perform step 2, right-click on the SysNode displayed on the RMS main window and select [Clear Wait & shutdown (hvutil -u)] from the pop-up context menu, and then select the Wait state node from the sub menu.

Note

When you manually clear a Wait state in step 3, RMS and CF consider that the target node has been stopped. Therefore, if you clear the Wait state while the target node is not actually stopped, data corruption may occur.

CLI: hvutil -u

The syntax for performing the operation in step 3 with CLI is as follows:

```
hvutil -u SysNode
```

7.2 Managing RMS applications

This section describes basic procedures related to starting, stopping, and clearing special states of individual applications. Procedures in this section are active: they change the state of the RMS cluster and may have a direct effect on the disposition of data.

As stated in "5.1 Overview", the primary means of administration is through the Cluster Admin GUI. This method should be used whenever possible. However, each procedure in this section includes a CLI alternative.

7.2.1 Overriding automatic application startup

The automatic startup of each application is controlled by its AutoStartUp attribute:

- If AutoStartUp is set to "yes," the application starts automatically when RMS starts.
- If AutoStartUp is set to "no," the application does not start automatically when RMS starts (must be started manually).

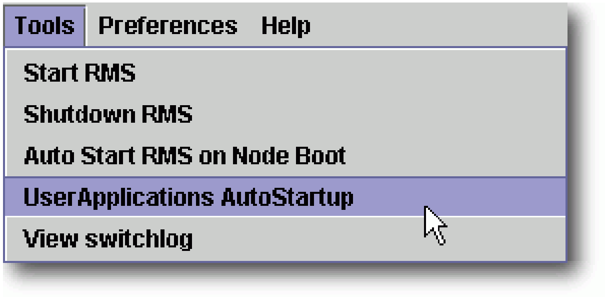
For maintenance or troubleshooting, you may want to suppress the automatic application startup for all applications during RMS startup. In such cases, you can disable the AutoStartUp attribute of all applications at once by changing the value of the RMS environment variable HV_AUTOSTARTUP. The HV_AUTOSTARTUP environment variable can be changed with the following procedure.

Note

Changes to HV_AUTOSTARTUP do not take effect until the next RMS startup.

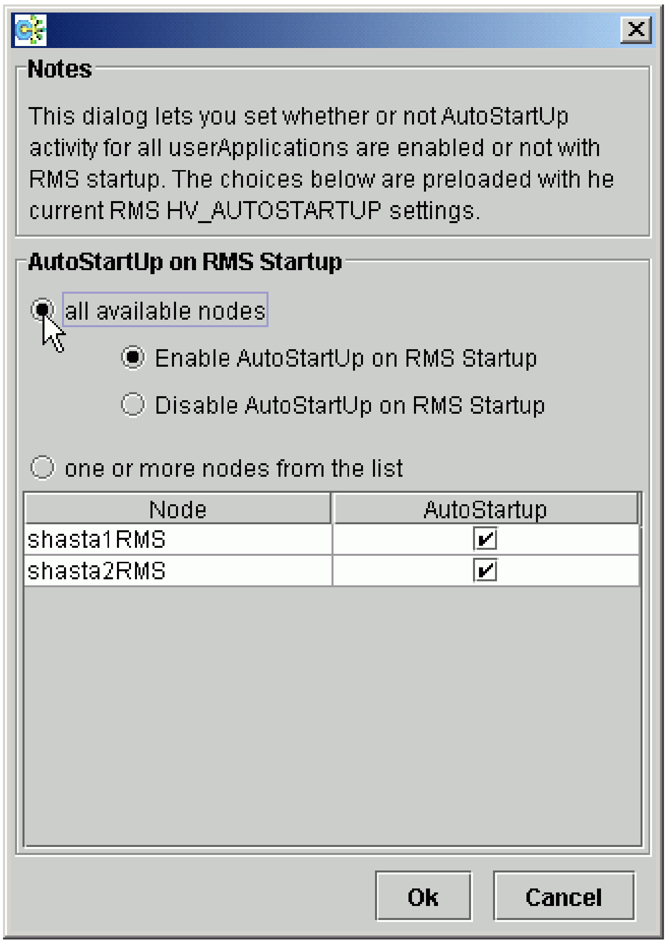
1. From the Cluster Admin rms tab, select Tools -> UserApplications AutoStartup.

Figure 7.14 Controlling automatic application startup - step 1



2. You can then choose to override all AutoStartUp settings, or to cancel the override.

Figure 7.15 Controlling automatic application startup - step 2



Notes

This dialog lets you set whether or not AutoStartUp activity for all userApplications are enabled or not with RMS startup. The choices below are preloaded with he current RMS HV_AUTOSTARTUP settings.

AutoStartUp on RMS Startup

● all available nodes

● Enable AutoStartUp on RMS Startup

○ Disable AutoStartUp on RMS Startup

○ one or more nodes from the list

Node	AutoStartup
shasta1RMS	☑
shasta2RMS	☑

Note

- Even if the userApplication's autostart is enabled, the userApplication where AutoStartUp is set to "no" needs to be started manually.
- The setting for autostart of userApplication is not intended to set the start condition of Standby processing when the RMS starts. For the start condition of Standby processing when RMS starts, follow AutoStartUp and StandbyTransitions attributes. For details, see "How to switch userApplication to Standby automatically when RMS is started, userApplication is switched, or when clearing a fault state of userApplication" in "6.10.1 Setting Contents of a Cluster Application" in "PRIMECLUSTER Installation and Administration Guide."
- To enable this setting, Web-Based Admin View and CF on all the nodes that configure the cluster need to be working.

  For how to check the server process status of Web-Based Admin View, and how to start Web-Based Admin View, see "4.3.3 Initial Setup of Web-Based Admin View" in "PRIMECLUSTER Installation and Administration Guide."

  For how to check the status of CF and how to start CF, see "4.2 Main CF table" and "4.6 Starting and stopping CF" in "PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide."

CLI: hvsetenv

The action of each application's AutoStartUp attribute is controlled by the HV_AUTOSTARTUP environment variable (see the description in "E.3 Local environment variables"). You can set this variable with the hvsetenv command as follows:

```
hvsetenv HV_AUTOSTARTUP [0|1]
```

The allowable values are:

```
0:  Prevents automatic application startup at next RMS startup

1:  Conducts autostart of application in accordance with
     AutoStartUp attribute on the next time RMS starts
```

If no value is specified, the command reports the current value of the HV_AUTOSTARTUP environment variable.

7.2.2 Switching an application

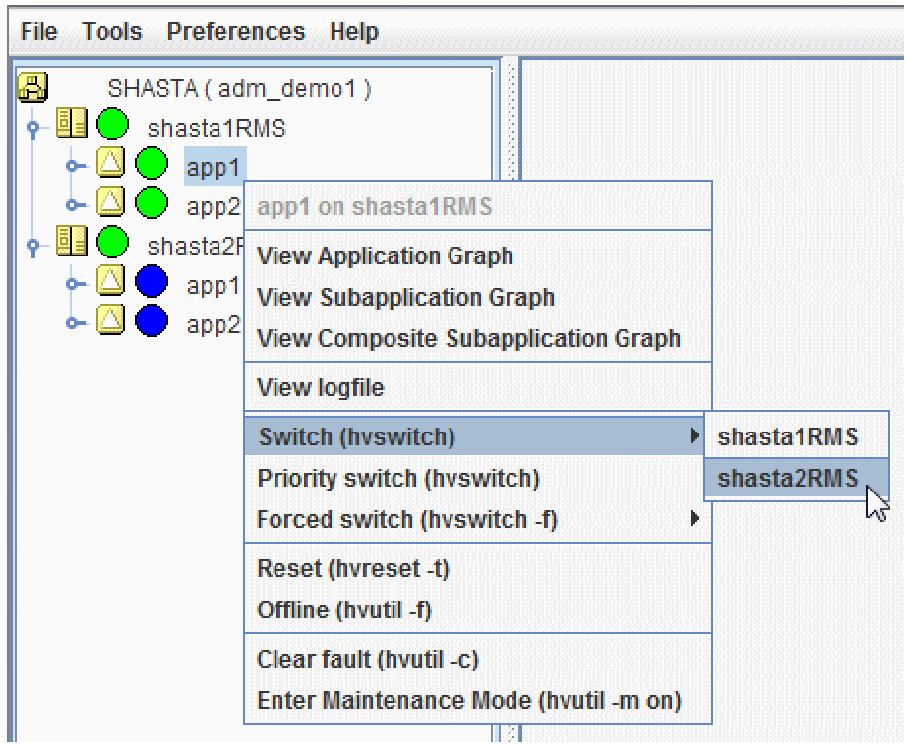
When you switch an application, RMS performs the following tasks:

- If the application is already running in the cluster, RMS shuts it down.
- After the application is completely shut down, RMS starts it on the node you specified.

Switch an application to any node as follows:

1. Right-click on the application object on any node and select Switch from the context menu. A secondary menu appears, listing the available target nodes for switchover.
2. Select the target from the secondary menu to switch the application to that node.

Figure 7.16 Switching an application



You will be prompted to confirm the action before RMS begins the operation.

A Priority switch switches the application to the target node according to the order of nodes in the application's PriorityList attribute.

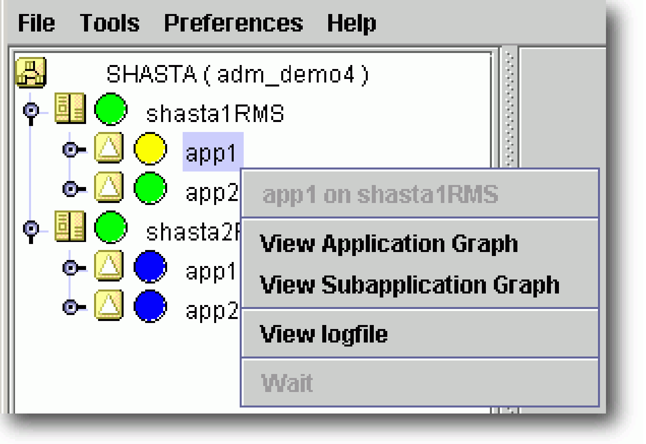
If stopping the application fails, RMS does not start the application. This is because two competing instances of the same application could cause data corruption. In this event, you can start the application by using the Forced switch operation.

Note

Use the Forced switch mode only if an application cannot be switched normally. A forced application switch overrides all safety checks and could therefore result in data corruption or other inconsistencies.
Therefore, RMS may kill the node on which RMS is not running before starting the application to reduce the risk of data corruption when the Forced switch request of an application is issued.

If the application is busy, the pop-up context menu will not offer the choices to switch the application. Instead, the menu will offer view-only operations, and the last menu item will indicate that the application is in a Wait state.

Figure 7.17 Switching a busy application



CLI: hvswitch userApplication

The syntax for the CLI is as follows:

```
hvswitch [-f] userApplication [SysNode]
```

The hvswitch command manually switches control of a userApplication or a gResource between SysNodes in the RMS configuration. When a type of the resource to be switched is userApplication, if no SysNode is specified, the application is switched to the highest priority node. The -f option is a forced-switch option.

Note

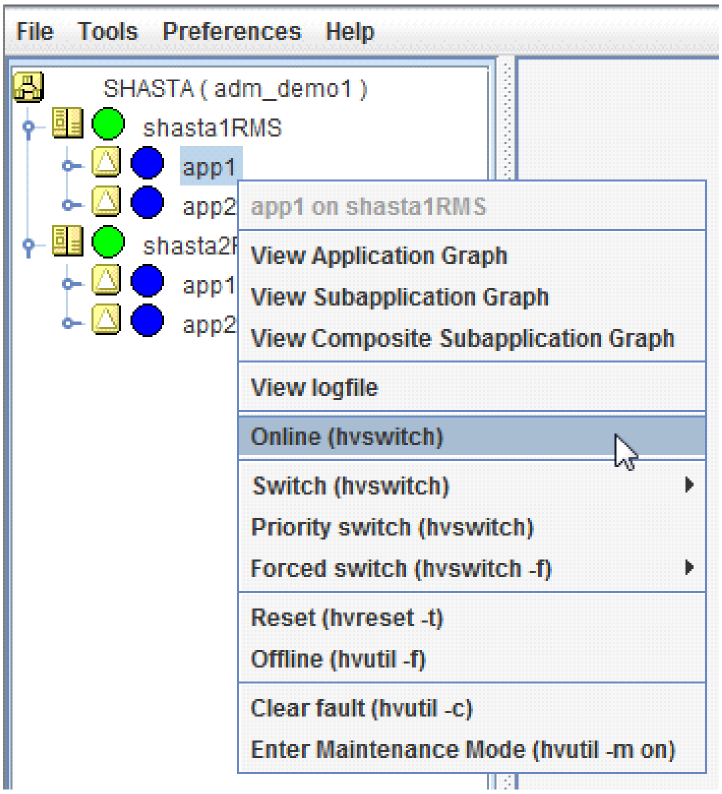
Use the 'hvswitch -f' operation carefully. A forced switch of an application or a resource overrides all safety checks and could therefore result in data corruption or other inconsistencies.
Therefore, RMS may kill the node on which RMS is not running before starting the application to reduce the risk of data corruption when the Forced switch request of an application or a resource is issued.

7.2.3 Starting an application

If the application is already offline everywhere in the cluster, you can start it (bring it online) on a single node as follows:

Right-click on the application object and select Online from the pop-up context menu.

Figure 7.18 Starting an application



You will be prompted to confirm the action before RMS begins the operation.

CLI

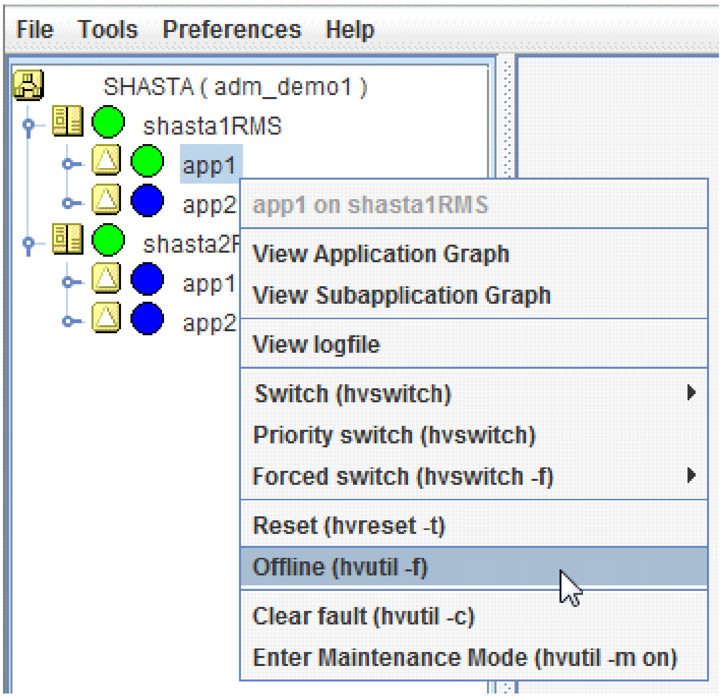
Starting an application on the local node, like switching an application to another node, use the hvswitch command. Refer to "CLI: hvswitch userApplication" for the syntax.

7.2.4 Stopping an application

Stop an online application (take it offline) as follows:

Right-click on the online application object and select Offline from the pop-up context menu.

Figure 7.19 Shutting down an application



You will be prompted to confirm the action before RMS begins the operation.

CLI: hvutil -f

The syntax for the CLI is as follows:

```
hvutil -f userApplication
```

Note that this is a normal offline request. There is no "forced" offline request for a userApplication.

Note

Use the command 'hvutil -s *userApplication*' to bring an offline userApplication to a Standby state.

7.2.5 Resetting an application

This operation completely re-initializes the target application and all objects in its resource tree (i.e., the entire application graph) based on the actual detector reports. It will interrupt any ongoing RMS processing for the application, and any running scripts will be terminated.

Note

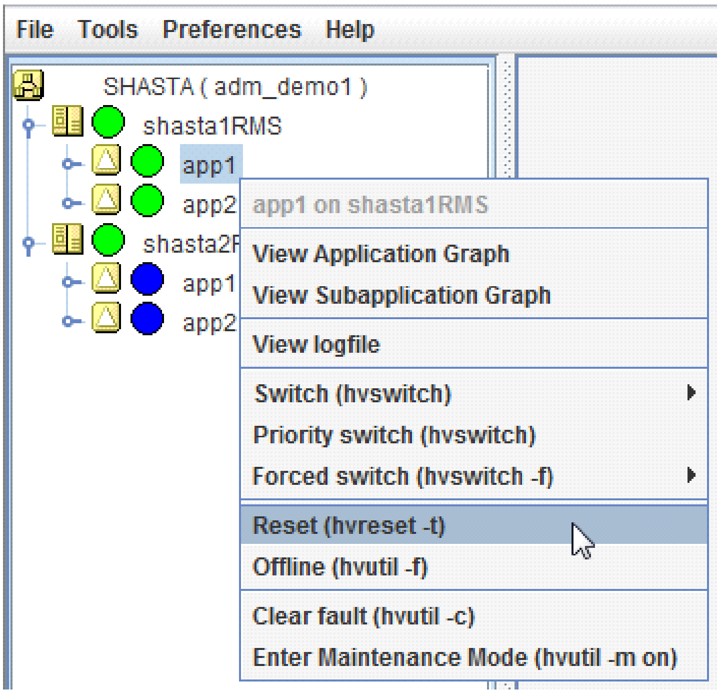
Resetting an application will cause information about previous failures or any other history to be lost. It will most likely result in an Inconsistent state for the application.

This operation is intended for use by an experienced administrator during a test phase. It should never been invoked in a production environment.

Reset (reinitialize) an online application as follows:

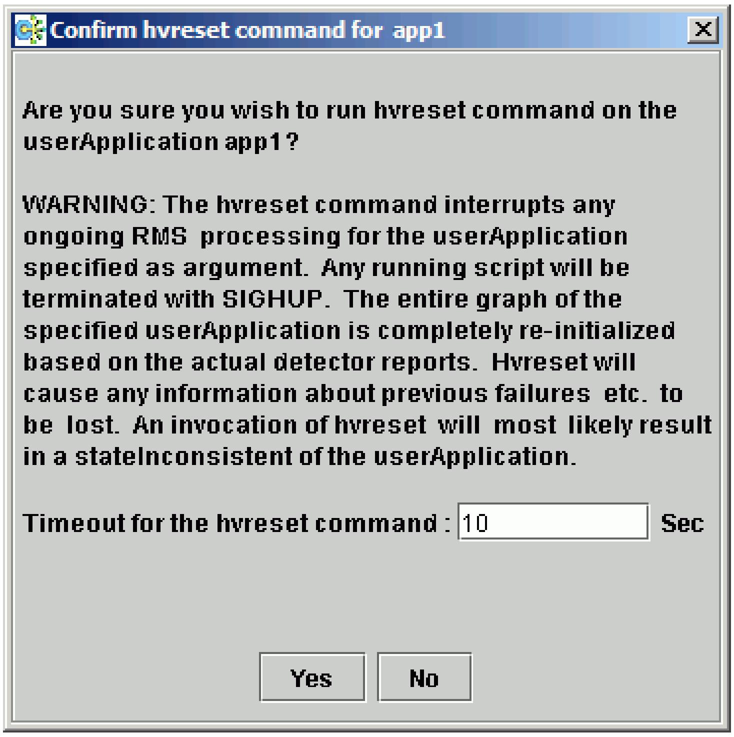
Right-click on the online application object and select Reset from the pop-up context menu.

Figure 7.20 Resetting an application



You will be prompted to enter the reset timeout before RMS begins the operation.

Figure 7.21 Choosing the reset timeout for the application



Confirm hvreset command for app1

Are you sure you wish to run hvreset command on the userApplication app1 ?

WARNING: The hvreset command interrupts any ongoing RMS processing for the userApplication specified as argument. Any running script will be terminated with SIGHUP. The entire graph of the specified userApplication is completely re-initialized based on the actual detector reports. Hvreset will cause any information about previous failures etc. to be lost. An invocation of hvreset will most likely result in a stateInconsistent of the userApplication.

Timeout for the hvreset command : 10 Sec

If RMS fails to re-initialize the entire application graph during this amount of time, it terminates with an error message. Default: 10 seconds

Adjust the timeout value if desired, and then click Yes to reset the application.

CLI: hvreset -t

The syntax for the CLI is as follows:

```
hvreset -t timeout  userApplication
```

hvreset displays a message that warns of the consequences and then prompts you to confirm the action before proceeding.

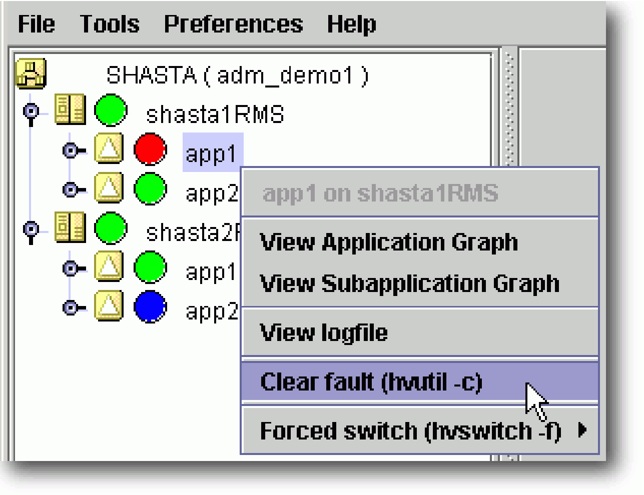
When the userApplication is not performing online, offline, or fault processing, hvreset returns immediately and displays a message stating there is nothing to do. This case is considered to be successful command execution and returns exit code 0.

7.2.6 Clearing a fault

For an application that is in the Faulted state, clear the fault as follows:

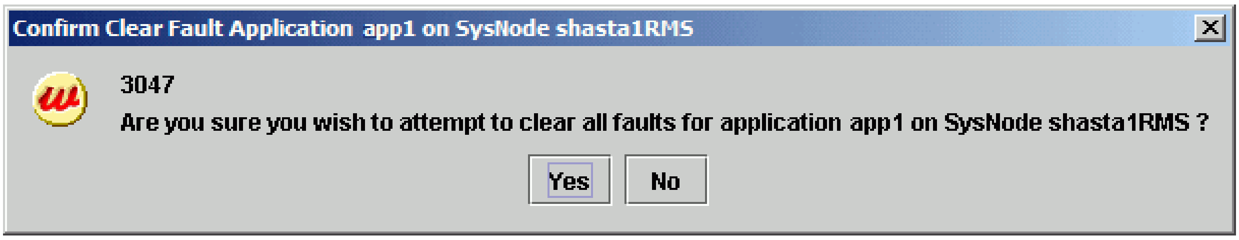
Right-click on the application object and select Clear Fault from the pop-up context menu.

Figure 7.22 Clearing an application fault



Before the command proceeds, you will be informed of the action to be taken and prompted to confirm the operation.

Figure 7.23 Clearing an application fault - confirmation dialog


Confirm Clear Fault Application app1 on SysNode shasta1RMS

3047

Are you sure you wish to attempt to clear all faults for application app1 on SysNode shasta1RMS ?

CLI: hvutil -c

The syntax for the CLI is as follows:

```
hvutil -c userApplication
```

Note

If the userApplication is in the online state, then clearing the fault will cause RMS to attempt to bring the faulted resource to the online state. If the userApplication is in the offline or faulted state, then clearing the fault will attempt to bring the resource to the offline state. You will be informed of the action that is to be taken and prompted to confirm the operation before the command proceeds.

7.2.7 Activating an application

Activating an application takes it from the Deact state to the Offline state. It does not bring it Online. Also, activating a userApplication with the Cluster Admin GUI or the CLI has nothing to do with activating an RMS configuration in the Wizard Tools - the two operations are completely independent. Activate a deactivated application as follows:

Right-click on the application object and select the Activate option from the pop-up menu.

CLI: hvutil -a

The syntax for the CLI is as follows:

```
hvutil -a userApplication
```

Note

You will not need to activate an application unless someone explicitly deactivated it with the command 'hvutil -d *userApplication*'.

7.3 Managing resources

This section describes basic procedures for starting and stopping of each resource.

Procedures in this section are active: they change the state of the RMS cluster and may have a direct effect on the disposition of data.

As stated in "5.1 Overview", the primary means of administration is through the Cluster Admin GUI. This method should be used whenever possible. However, each procedure in this section includes a CLI alternative.

Note

When resources under the userApplication are partially Online, the userApplication becomes the Online state.

7.3.1 Switching a resource

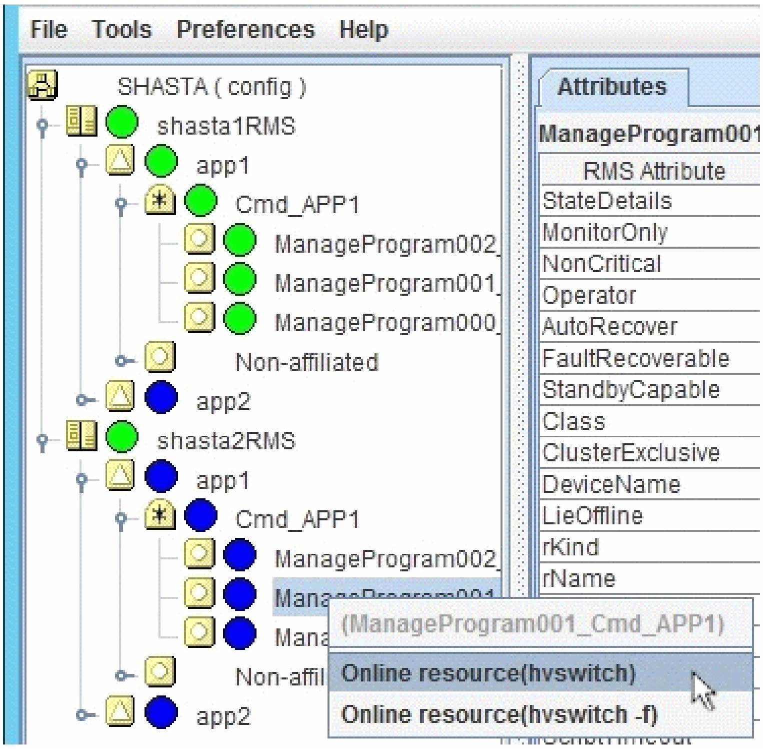
When you switch a resource, RMS performs the following tasks:

- If the userApplication that controls the resource is already started, RMS will stop it.
- After the userApplication is completely stopped, RMS will start the resource on the specified node.

Switch the resource in the Online state according to the following procedure:

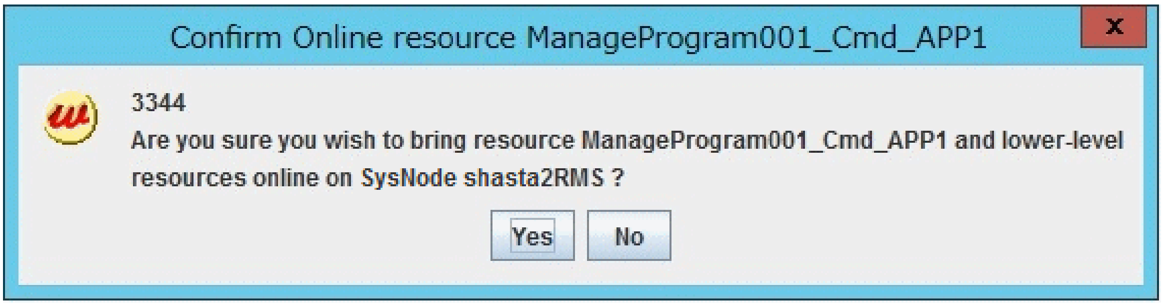
Right-click on the gResource object and select Online resource from the context menu.

Figure 7.24 Switching a resource



You will be prompted to confirm the action before RMS begins the operation. Starts all the resources which the specified resource depends on, and then starts the specified resource.

Figure 7.25 Confirming a resource switchover


Confirm Online resource ManageProgram001_Cmd_APP1

3344
Are you sure you wish to bring resource ManageProgram001_Cmd_APP1 and lower-level resources online on SysNode shasta2RMS ?

If stopping the userApplication fails, RMS does not start the resource. This is because two competing instances of the same application could cause data corruption. In this event, you can start the resource by selecting Forced Resource Online.

Note

Use the Forced switch mode only if a resource cannot be switched normally. A forced resource switch overrides all safety checks and could therefore result in data corruption or other inconsistencies.
Therefore, to reduce the risk of data corruption when the Forced switch request of a resource is issued, the resource may be forcibly started after the node on which RMS is not running is forcibly stopped.

CLI: hvswitch resource

The syntax for the CLI is as follows:

```
hvswitch [-f] resource SysNode
```

The hvswitch command manually switches control of a userApplication or a gResource between SysNodes in the RMS configuration. When a type of the resource to be switched is gResource, the SysNode name of the node on which this command is executed should be specified. The -f option is a forced switch option.

Note

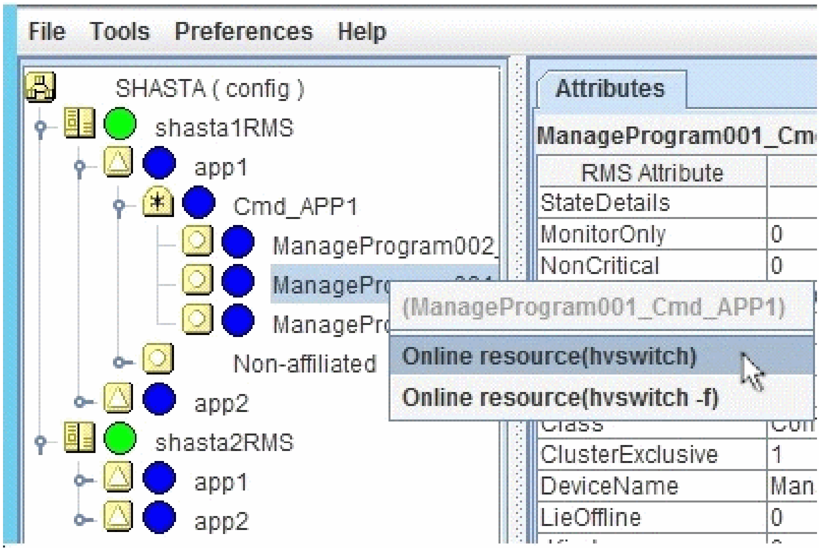
The resource can be switched only when the application to control the resource is Online, Offline, or Standby.

7.3.2 Starting a resource

If a resource is in the Offline state or the Standby state, you can start it (bring it to the Online state) on a single node as follows.

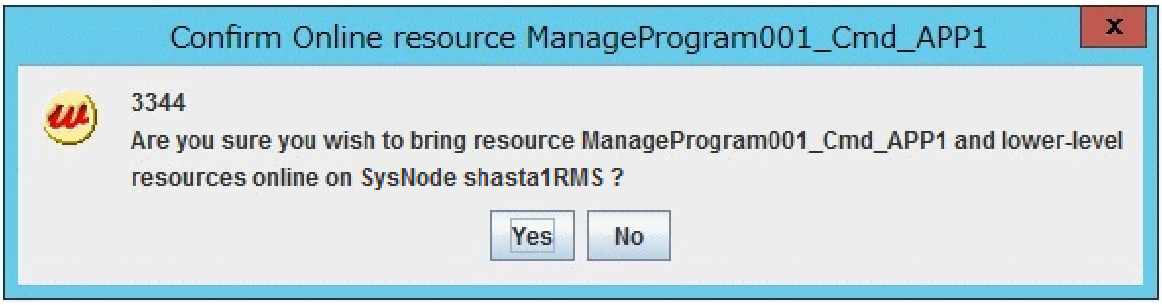
Right-click on the gResource object and select Online resource from the pop-up context menu.

Figure 7.26 Starting a resource



You will be prompted to confirm the action before RMS begins the operation. Starts all the resources which the specified resource depends on, and then starts the specified resource.

Figure 7.27 Confirming a resource start


Confirm Online resource ManageProgram001_Cmd_APP1

3344
Are you sure you wish to bring resource ManageProgram001_Cmd_APP1 and lower-level resources online on SysNode shasta1RMS ?

CLI

You can use the hvswitch command to start a resource on the local node, like switching a resource to another node. See "CLI: hvswitch resource".

Note

- The resource can be started only when the application to control the resource is Online, Offline, or Standby.

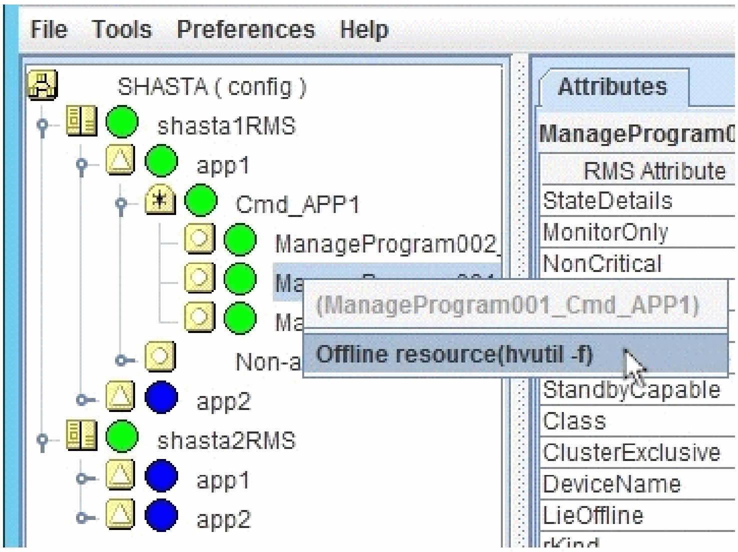
- If some resource becomes Online unexpectedly while the userApplication is partially Online, you cannot specify other inactive resource to start the resource.

7.3.3 Stopping a resource

Stop the online resource (change the resource to offline) as follows:

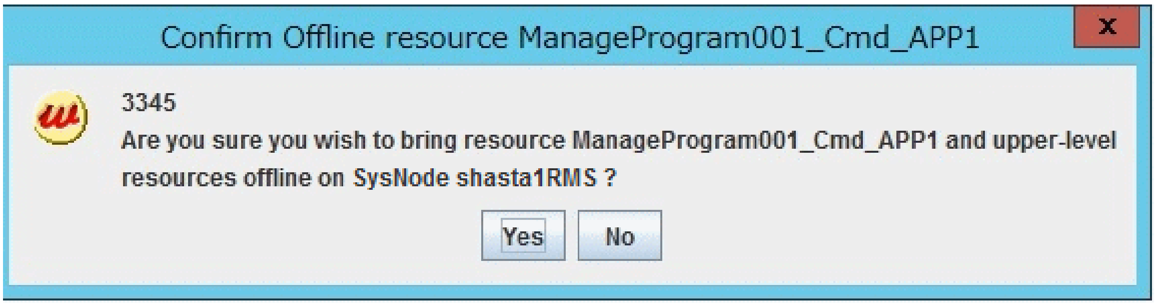
Right-click on the online gResource object and select Offline Resource from the pop-up context menu.

Figure 7.28 Stopping a resource



You will be prompted to confirm the action before RMS begins the operation. Stop all the resources which the specified resource depends on, and then stop the specified resource.

Figure 7.29 Confirming a resource stop


Confirm Offline resource ManageProgram001_Cmd_APP1

3345
Are you sure you wish to bring resource ManageProgram001_Cmd_APP1 and upper-level resources offline on SysNode shasta1RMS ?

CLI: hvutil -f

The syntax for the CLI is as follows:

```
hvutil -f gResource
```

This is a normal offline request. There is no "forced" offline request for gResource.

Note

- Stopping a resource is possible only when the application which controls the resource is Online.
- If some resource becomes Online unexpectedly while the userApplication is partially Online, resource stop request is rejected on the node.

- When a resource fails to be stopped, if the resource, which is not a target resource to be stopped, remains in the Online state, the application becomes the Inconsistent state. To restore this state, remove the cause of the unexpected stop of the resource, and then, use hvutil -f to stop userApplication. After that, start the resource if necessary.

7.3.4 Notes on starting and stopping a resource

Note the following points when starting and stopping each resource:

- The information, on which only some resources under userApplication are being started, is synchronized on all the nodes where this userApplication operates. Therefore, if an application is switched automatically while only some resources are being started, the only resource that was started on the source node can be started on the remote node.

- If some resource becomes Online unexpectedly while the userApplication is partially Online, the userApplication remains in Online state (does not become Inconsistent state). If an application is switched automatically in this state, the unexpected started resource cannot become Online on the remote node.

- To start and stop the resources under a userApplication that is controlled by the scalable controller, the controlled userApplication must be Offline.

Note

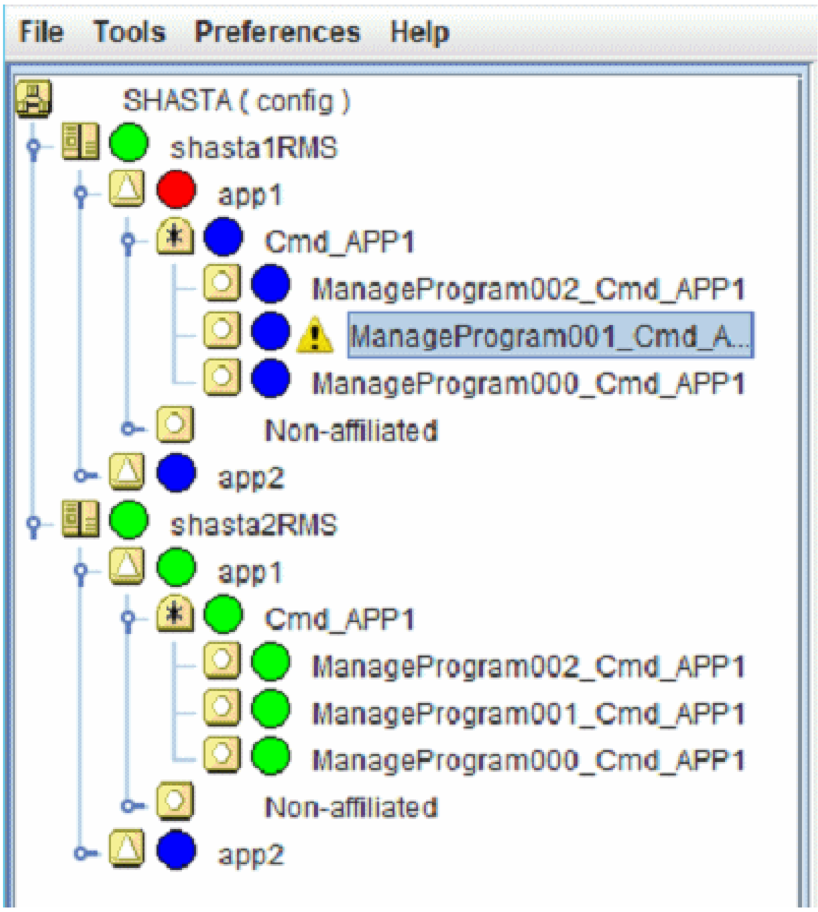
To stop the unexpected started resource, make sure to change the corresponding userApplication to the Maintenance mode, and then stop the target resource manually (if the resource is stopped without changing the mode to Maintenance mode, the resource is considered to be a resource error).

7.3.5 Fault Traces of Resources

When a resource fault occurs, you can check which resource has a fault from the RMS main window of Cluster Admin.

The following fault trace icon (⚠)is displayed in the right side of the state icon of the failed resource in the cluster tree.

Figure 7.30 Checking the failed resource


File
Tools
Preferences
Help
SHASTA (config)
shasta1RMS
app1
Cmd_APP1
ManageProgram002_Cmd_APP1
ManageProgram001_Cmd_A...
ManageProgram000_Cmd_APP1
Non-affiliated
app2
shasta2RMS
app1
Cmd_APP1
ManageProgram002_Cmd_APP1
ManageProgram001_Cmd_APP1
ManageProgram000_Cmd_APP1
Non-affiliated
app2

Note

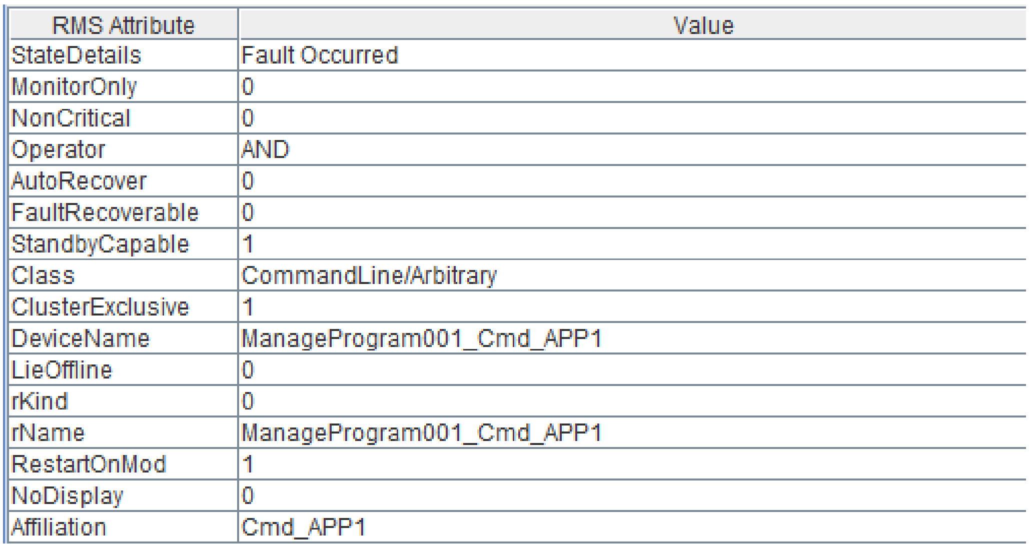
- The fault trace icon shows the resource error has occurred in the past. It does not indicate the current state of the resource. If you want to check the current state of the resource, check the state of the resource object.

- The fault trace icon is displayed in the resource that an error is notified to RMS. Normally, the fault trace icon is displayed on the failed resource. However, the superior resource in the graph tree may detect the failure faster than the actual failed resource depending on the monitoring timing. For example, when the failure occurs in the file system resource, normally the failure is notified to Fsystem resource. Depending on the monitoring timing, however, the superior resource in the graph tree may detect the failure faster than Fsystem resource detects the failure. This can be found when an operation application that accesses the file system is registered as a resource and the operation application first detects the failure. In this case, the fault trace icon may be displayed for only the superior resource.

- If a resource error is notified from another resource during the state transitions, the resource may not be displayed with the fault trace icon.

Fault Occurred is displayed in the StateDetails attribute of the failed resource.

Figure 7.31 Displaying Fault Occurred in the StateDetails attribute



RMS Attribute	Value
StateDetails	Fault Occurred
MonitorOnly	0
NonCritical	0
Operator	AND
AutoRecover	0
FaultRecoverable	0
StandbyCapable	1
Class	CommandLine/Arbitrary
ClusterExclusive	1
DeviceName	ManageProgram001_Cmd_APP1
LieOffline	0
rKind	0
rName	ManageProgram001_Cmd_APP1
RestartOnMod	1
NoDisplay	0
Affiliation	Cmd_APP1

CLI: hvdisp -a

The syntax for the CLI is as follows.

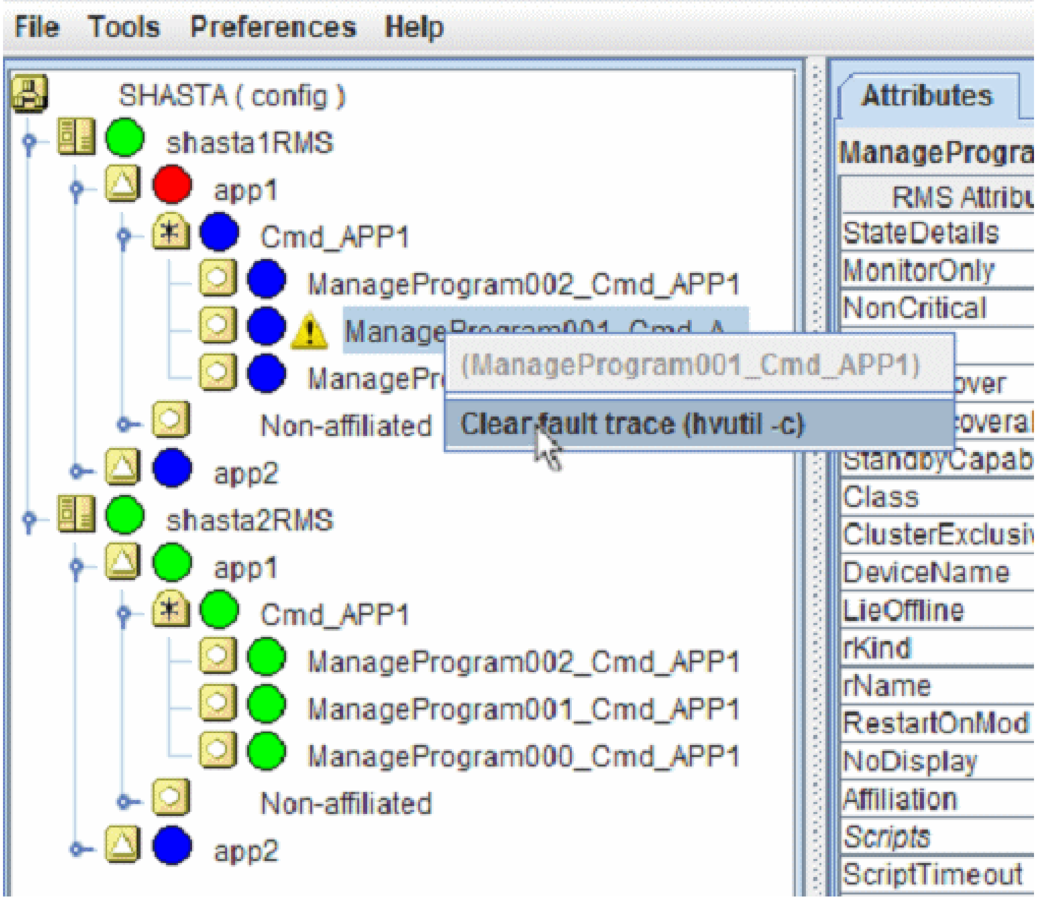
```
hvdisp -a
```

Fault Occurred is displayed in the StateDetails attribute of the failed resource.

Clear the fault trace of the resource with the following procedure.

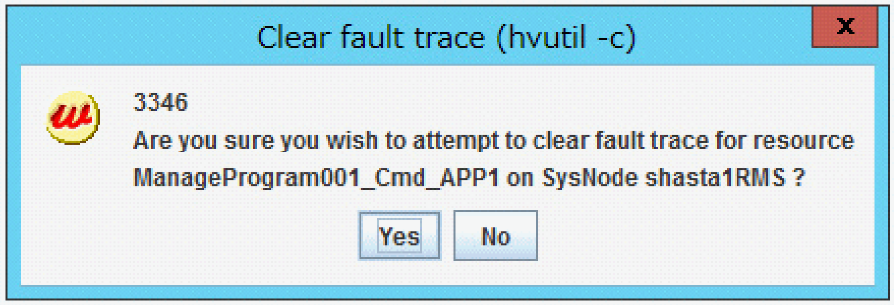
1. Right-click on the failed resource, and then select [Clear fault trace (hvutil -c)] from the pop-up context menu.

Figure 7.32 Clearing the Fault trace



2. Before the command is executed, you are prompted to confirm whether the operation can be performed. Click Yes to start to clear the fault trace.

Figure 7.33 Checking whether the Faulted trace is cleared


Clear fault trace (hvutil -c)

3346
Are you sure you wish to attempt to clear fault trace for resource ManageProgram001_Cmd_APP1 on SysNode shasta1RMS ?

CLI: hvutil -c

The syntax for the CLI is as follows:

```
hvutil -c gResource
```

In addition to the hvutil -c command can clear the fault trace, it can be also cleared automatically when the resource becomes Online next time.
Once the fault trace is cleared, its icon will be disappeared and "Fault Occurred" will not be also displayed in the StateDetails attribute.

7.4 Using maintenance mode

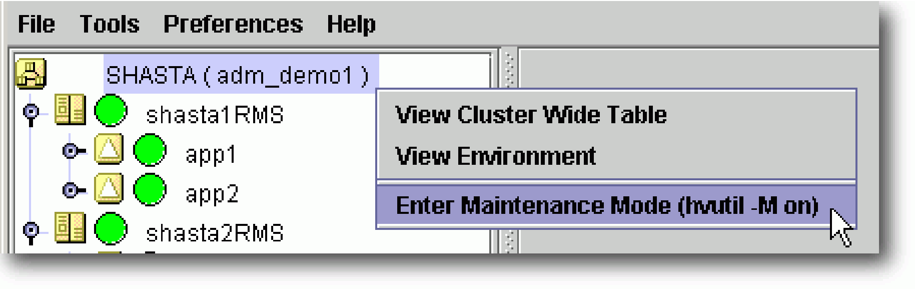
Maintenance mode is a special mode of operation that allows an application to be temporarily decoupled from its dependent resources. This allows, for example, a file system to be taken offline for backup purposes without disrupting the online state of its parent application.

7.4.1 Entering maintenance mode

You can enter maintenance mode for all applications on all the nodes as follows:

Right-click on the cluster at the top of the RMS tree and select Enter Maintenance Mode from the popup menu.

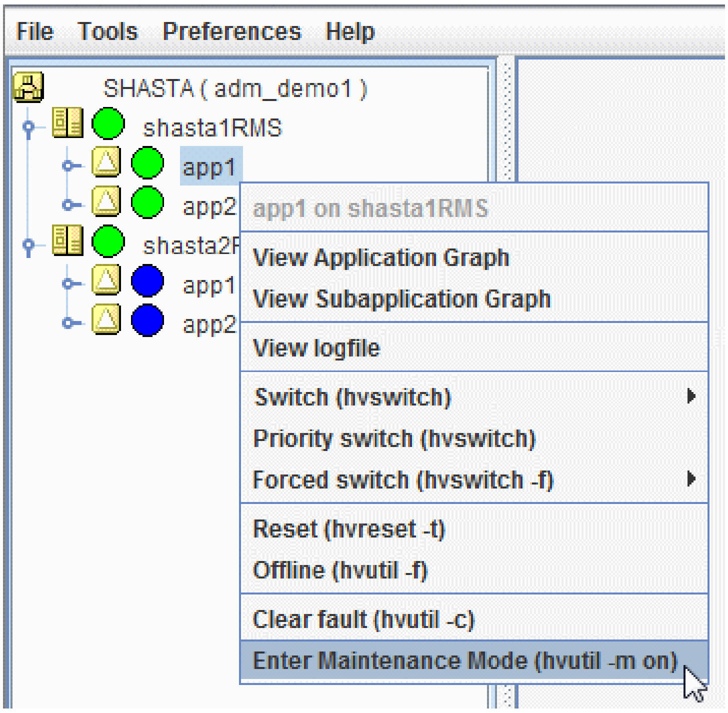
Figure 7.34 Starting maintenance mode for all applications



Enter maintenance mode for only one application as follows:

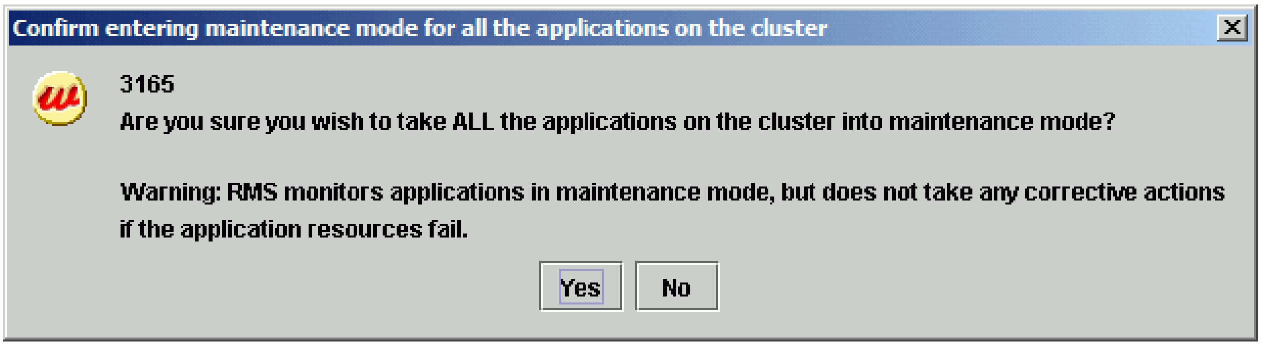
Right-click on an application instance in the RMS tree and select Enter Maintenance Mode from the popup menu.

Figure 7.35 Starting maintenance mode for a single application



In either case, you will be prompted to confirm the operation.

Figure 7.36 Maintenance mode confirmation for all applications



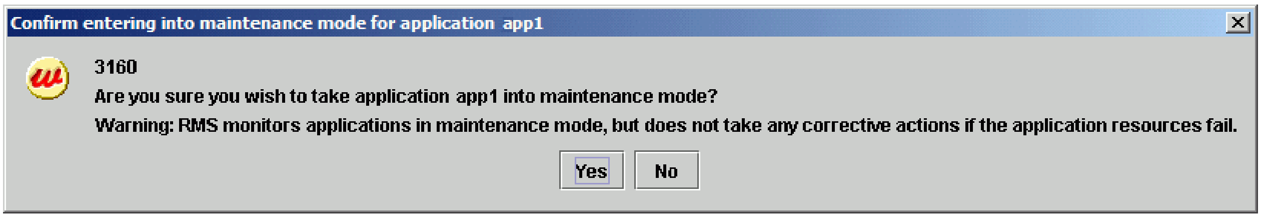
Confirm entering maintenance mode for all the applications on the cluster

3165

Are you sure you wish to take ALL the applications on the cluster into maintenance mode?

Warning: RMS monitors applications in maintenance mode, but does not take any corrective actions if the application resources fail.

Figure 7.37 Maintenance mode confirmation for one application



Confirm entering into maintenance mode for application app1

3160

Are you sure you wish to take application app1 into maintenance mode?

Warning: RMS monitors applications in maintenance mode, but does not take any corrective actions if the application resources fail.

Note

The maintenance mode is applied to the entire cluster. If an application enters the maintenance mode on one node, the maintenance mode is started on all nodes where the application can run.

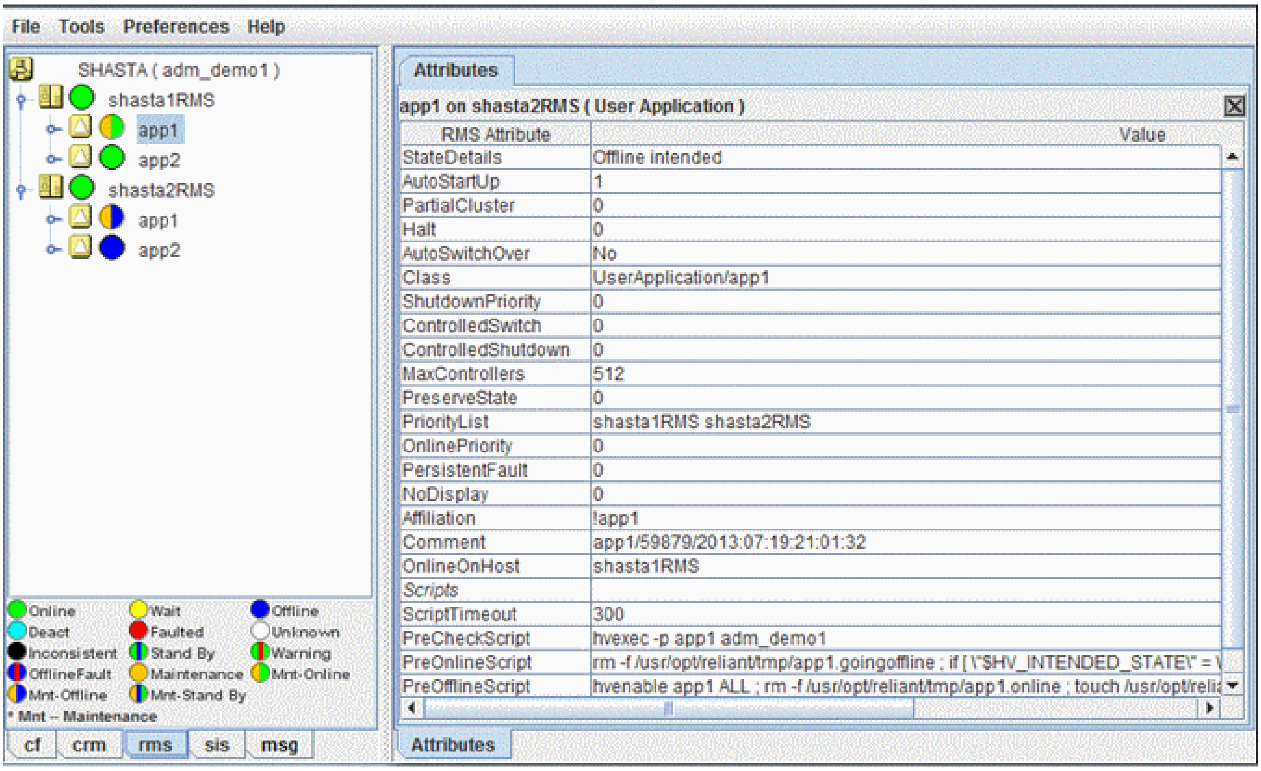
The maintenance mode can be started if the cluster application is in the following states on all nodes.

- Online state
- Standby state
- Offline state
- Warning state
- Inconsistent state (If an application state just before it becomes inconsistent is Faulted state, it is excluded.)

The maintenance mode is rejected if there is any request of dynamic reconfiguration of RMS graph.

The following figure shows the Cluster Admin window after one application is put into maintenance mode.

Figure 7.38 Typical cluster in maintenance mode



app1 on shasta2RMS (User Application)

RMS Attribute	Value
StateDetails	Offline intended
AutoStartUp	1
PartialCluster	0
Halt	0
AutoSwitchOver	No
Class	UserApplication/app1
ShutdownPriority	0
ControlledSwitch	0
ControlledShutdown	0
MaxControllers	512
PreserveState	0
PriorityList	shasta1RMS shasta2RMS
OnlinePriority	0
PersistentFault	0
NoDisplay	0
Affiliation	!app1
Comment	app1/59879/2013:07:19:21:01:32
OnlineOnHost	shasta1RMS
Scripts	
ScriptTimeout	300
PreCheckScript	hvexec -p app1 adm_demo1
PreOnlineScript	rm -f /usr/opt/reliant/tmp/app1.goingoffline ; if [\"$HV_INTENDED_STATE\" = \
PreOfflineScript	hvenable app1 ALL ; rm -f /usr/opt/reliant/tmp/app1.online ; touch /usr/opt/relia

Note how the right half of the application status icons indicate the intended status (the status just before the start of maintenance mode). The intended status is also indicated by the application's StateDetails attribute, which is the first item in the Attributes table in the right pane.

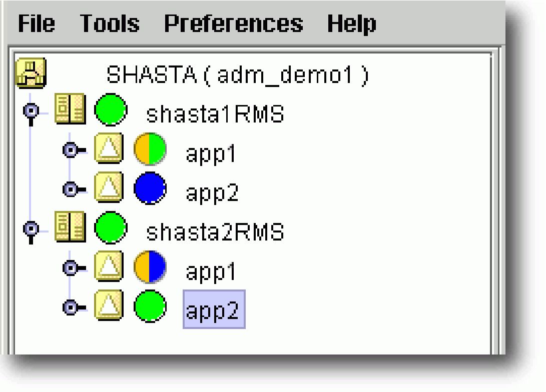
7.4.2 Maintenance mode operating notes

When an application enters maintenance mode (MM), it affects all other applications that share the same graph. For example, if two applications are linked by a controller, then putting one in maintenance mode will cause the other to go into maintenance mode as well; which one is the parent and which one is the child does not matter in this case.

Conversely, if two applications do not share the same graph, i.e., they are not linked by one or more controllers, then one can be put into MM while the other operates under normal RMS control.

For instance, in the example presented earlier, app1 and app2 are independent. While app1 is in MM, app2 continues to operate normally and can be switched from one node to the other, as illustrated in the following figure.

Figure 7.39 Normal operation of independent application



7.4.2.1 Overall cluster restrictions in maintenance mode

Even though some applications may continue to operate under normal RMS control, MM still places restrictions on the overall cluster operation. In particular, note the following:

- You must exit MM before starting or stopping an application or a resource.

- You must exit MM everywhere in the cluster before you can shut down RMS.

7.4.3 Exiting maintenance mode

To exit maintenance mode, use the following procedure:

1. Confirm that there is no ! indicated to the right side of the application icon. If there is, return all the resources under userApplication to the status just before the start of maintenance mode.
   The status just before the start of maintenance mode can be determined with the color of the application's icon. For details on the icon's color, see "7.1.3 RMS Main Window" of "PRIMECLUSTER Installation and Administration Guide."

2. Right-click on the cluster or an application and select Exit Maintenance Mode from the popup menu.

   Figure 7.40 Normal maintenance mode exit for all applications

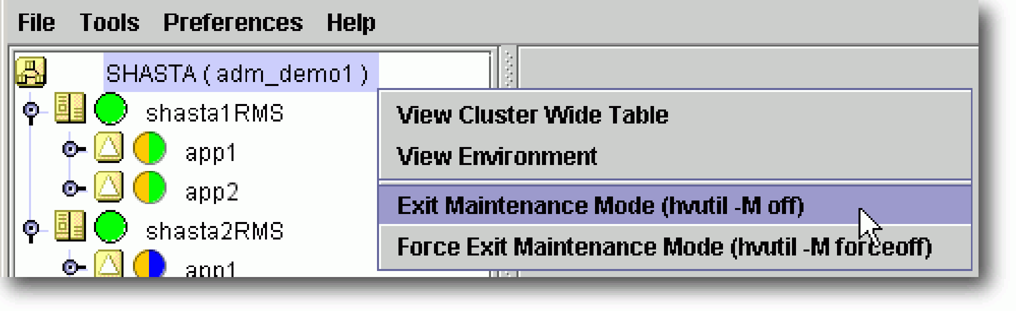
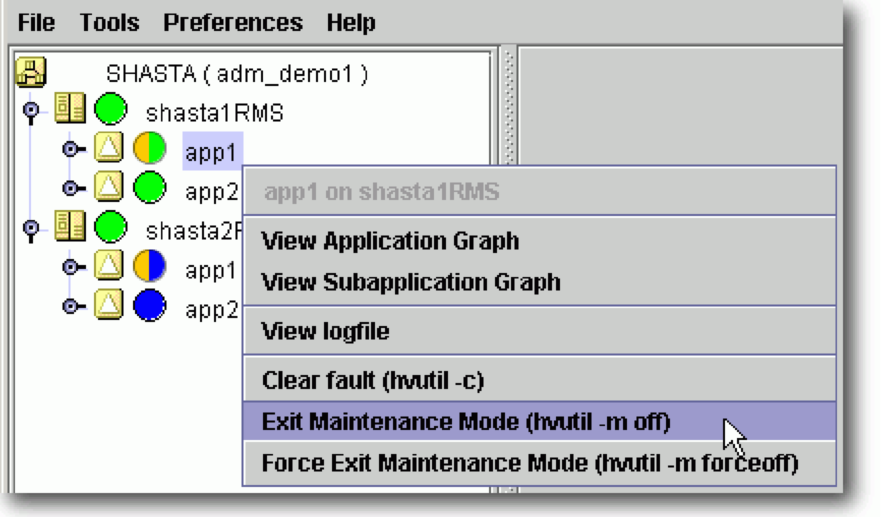


   Figure 7.41 Normal maintenance mode exit for a single application



In either case, you will be prompted to confirm your action before the operation proceeds.

Note

You can exit maintenance mode for a single application even if you entered maintenance mode for the entire cluster.

To exit maintenance mode, the following conditions must be met:

- If you start maintenance mode when the application status is either Online, Offline, Standby, or Warning, statuses of the application and each resource must be the same as those before maintenance mode is started in order to exit maintenance mode. If the status is different, you cannot exit maintenance mode.

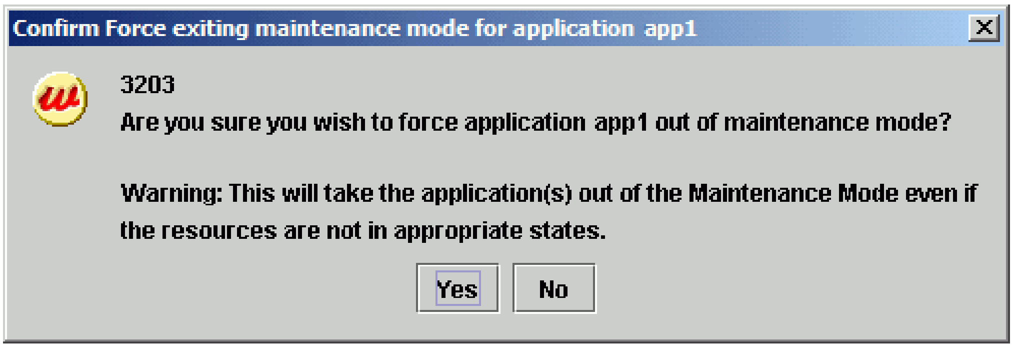
- If you start maintenance mode when the application status is Inconsistent, remove causes which put the application into the Inconsistent state. You cannot exit maintenance mode until causes are removed.

For example, in the above example, there is a file system resource Res1 in the application app1, and Res1 is in the online state on shasta2RMS when starting the maintenance mode in app1. In this case, Res1 must be in the online state on shasta2RMS to exit the maintenance mode of app1.

If you forcibly exit the maintenance mode by using [Force Exit Maintenance Mode] in a different state from when starting the maintenance mode, the application enters the Inconsistent state. Therefore, we do not recommend using [Force Exit Maintenance Mode].

Note that both the cluster and application popup menus shown above contain a Force Exit Maintenance Mode item. If you choose this command, it will force RMS to exit maintenance mode even if some resources are not in the appropriate state. The prompt to confirm the operation for one application is shown in the following figure; the prompt for all applications is similar.

Figure 7.42 Forced maintenance mode confirmation for all applications



Confirm Force exiting maintenance mode for application app1

3203
Are you sure you wish to force application app1 out of maintenance mode?

Warning: This will take the application(s) out of the Maintenance Mode even if the resources are not in appropriate states.

If the status of userApplication before the start of maintenance mode is Online or Standby, Online or Standby processing is executed during the exit of maintenance mode.

In these operations, if resource statuses under userApplication are the same as those before maintenance mode is started, the Online script is not executed and the resource statuses are not changed.

However, if the Online processing is executed for Cmdline resource to which the NULLDETECTOR attribute is set, the Online script is definitely executed despite the actual resource statuses.

7.4.4 Maintenance mode CLI: hvutil -m and -M

Control maintenance mode (MM) with the hvutil command:

```
hvutil -M { on | off | forceoff }
hvutil -m { on | off | forceoff } userApplication
```

Options:

```
-M:  Applies the MM operation to all applications on all the nodes

-m:  Applies the MM operation to the specified application on all the nodes
```

Operations:

```
on:        Starts maintenance mode

off:       Stops MM if all resources are in the appropriate state

forceoff:  Forces MM to stop even if all resources are not in the appropriate state
```

The hvutil maintenance mode commands operate synchronously, so they do not return until the final state has been reached or until an error occurs. In the particular case where '-m off' returns a failure because one or more resources were in an inappropriate state, an error message is displayed that lists the problem resources.

Note

To stop the maintenance mode, confirm that all the resources under userApplication are in the status just before the start of maintenance mode.

If one of the following information is displayed in StateDetails column of the targeted userApplication in the output of hvdisp command, there is a need to return the userApplication status to the status just before start of maintenance mode.

- "Online!!" is being displayed (Online is the status just before starting maintenance mode).
- "Standby!!" is being displayed (Standby is the status just before starting maintenance mode).
- "Offline intended" is being displayed and one or more resources under the userApplication is neither Offline status nor Standby status (Offline is the status before starting maintenance mode).

Appendix A Preparation

Preliminary settings are necessary before installing RMS in the cluster system. Some of the procedures require you to modify system files so that RMS can identify the hosts, file systems, and network interfaces used in a configuration. You should have completed these procedures when RMS was installed.

In some cases, you will be creating or modifying your RMS configuration because changes have been made to your site. Certain site changes may require you to review and update your system files first. These changes include, but are not limited to, the following:

- IP addresses were changed.
- Redundant interconnects were added to the cluster.
- Hosts were added, removed, or renamed.
- Two or more clusters were merged into one.
- File systems or SANs were added or removed.

The following sections describe how to preliminarily set up the configurations related to nodes, file systems, and networks. If any of these specifications have changed since your initial RMS installation, you should review this material and make the necessary adjustments before proceeding with your RMS configuration.

The modifications generally involve adding RMS-specific entries to standard system files; pre-existing entries are not affected. Resources for market-specific applications may require similar customization.

A.1 Network database files

A.1.1 /etc/hosts

The /etc/hosts file must contain the IP addresses and RMS names of all the host systems that are part of the cluster.

RMS uses its own internal set of host names to manage the machines in the cluster. When you configure the cluster, you will use the RMS host names and not the standard host names. These names must be entered in /etc/hosts on each system in the cluster to avoid problems should access to the DNS fail. If you used Cluster Admin to configure CIP for RMS, then /etc/hosts will already contain the correct RMS node names described below.

By default, the names follow the conventions in the following table.

Table A.1 RMS host name conventions in /etc/hosts

Entry type	RMS naming pattern	Examples
RMS host name	<*hostname*>RMS	shasta1RMS shasta2RMS

Note

The RMS host name for a machine must match the contents of the RELIANT_HOSTNAME variable in that machine's hvenv.local configuration file, if that file exists.

Example

The following entries in /etc/hosts are for a cluster with nodes shasta1 and shasta2. The interface names are assigned as follows:

- Standard host names on the public network 172.25.220
- RMS node names on the private network 192.168.10

```
172.25.220.83 shasta1
172.25.220.84 shasta2
# node names for RMS
```

```
192.168.10.83 shasta1RMS
192.168.10.84 shasta2RMS
```

A.1.1.1 Network interface names in /etc/hosts

If you plan to configure one or more network interfaces for switchover with the *Ip Address* subapplication, you must first enter the interface name(s) in the /etc/hosts file on every node where that interface can exist. Each entry consists of the interface IP address and its name in the normal format; no special comments are required.

Example

An example is shown below.

- If you switch the interface shastavip with IPv4 address

```
172.25.222.223 shastavip
```

- If you switch the interface shastavip6 with IPv6 address

```
fd00:1::219:99ff:fe18:1b4e shastavip6
```

Note

- When you configure the Ip Address subapplication, you specify the interface name as it appears in /etc/hosts, and not the IP address.
- IPv6 link local addresses are not available.
- When defining the interface name in the /etc/hosts file, do not assign the same interface name to the IPv4 and IPv6 addresses.

A.1.2 /root/.rhosts (Linux) and /.rhosts (Solaris)

Contains entries to control trusted login from remote hosts.

The Wizard Tools require automatic login or authentication as root on every machine in the cluster. One method is to include the names of trusted hosts in the .rhosts file, which must be modified appropriately on each node. See the rhosts manual page for a complete description of the format.

Example

If the cluster consists of hosts shasta1 and shasta2, then every machine's .rhosts file should contain the following lines:

```
shasta1 root
shasta2 root
```

Note

The Cluster Foundation (CF) provides the equivalent of .rhosts functionality (CF shell, CFCP). Therefore, if cfsh and cfcp of the Cluster Foundation are configured, all RMS configuration, administration, and operation tasks can be performed without .rhosts configuration.

A.2 Configuration resource definitions

A.2.1 /opt/SMAW/SMAWRrms/etc/hvipalias

This file contains entries for all of the network interfaces that are to be used as resources in the configuration. Typically, each entry associates a logical interface name, or IP alias, with a physical interface on a specified node. The IP alias always presents the same IP address, even though it is switched from node to node, and even if the underlying physical interface has different characteristics on each node.

Note

Each IP alias with its IP address must be entered in the /etc/hosts file. The IP address does not appear in the hvipalias file.

Each entry in hvipalias must contain the following fields:

<*Uname*> <*IfName*> <*IfDevice*> <*Netmask/Prefix*>

The fields are defined as follows:

- *Uname* - Name of the machine to host the logical interface. This is usually the value returned by the 'uname -n' command.

  Alternatively, you can use the Cluster Foundation (CF) node name, which is returned by the 'cftool -ql' command. This can be used to differentiate two machines which are configured with the same 'uname -n' setting, provided they were assigned different names when CF was configured.

- *IfName* - Logical interface name, or IP alias. This name must appear with its associated IP address in the node's /etc/hosts file, and the associated IP address must be the same on every node.

- *IfDevice* - Physical device name to be associated with the logical interface when it is switched to the specified machine.

- *Netmask/Prefix* - The netmask (IPv4) or the prefix length (IPv6) to use with the IP address associated with the interface name. The netmask (IPv4) must be set as the 8-digit hexadecimal number string. The prefix length (IPv6) must be set as the decimal number string between 0 and 128.

Note

To avoid network conflicts, a network hostname or address monitored by the *IpAddress* subapplication can be active on only one node in the cluster at any time.

When the configuration is activated, the hvipalias file in the local node is copied in all the nodes. If a file with the same name or path exists in the remote nodes, the file is overwritten with new contents. Therefore, a line in which all interfaces and their switch destination node combinations are described must be included in the file.

For instance, if the interface named dbhost can be switched between two nodes, then hvipalias on each node should contain lines for both the local and remote interfaces:

Example

- Linux

```
#Uname    IfName   IfDevice   Netmask
shasta1   dbhost   eth1       0xffffff00
shasta2   dbhost   eth1       0xffffff00
```

- Solaris

```
#Uname  IfName   IfDevice   Netmask
fuji2   dbhost   hme0       0xffffff00
fuji3   dbhost   hme0       0xffffff00
```

A.2.2 /opt/SMAW/SMAWRrms/etc/hvconsoles

Controls customized handling of fault messages, usually to remote consoles or special devices such as pagers. This does not affect the standard messages written to the RMS or system log files.

Each entry specifies a program to be executed when an RMS resource object encounters a fault. If the file does not exist, you will receive no customized fault information. A complete description of the format is available in the comments in the hvconsoles.template file.

A.3 Linux file systems

To manage Linux file systems with RMS, you must create entries in the /etc/fstab.pcl configuration file as described in the following sections. This configuration file has the following features:

- Leading whitespace and empty lines are ignored.
- A line beginning with the string '#RMS#' or '#RMS:<appname>#' is a file system specification for RMS. The entire specification must be on the same line - continuation to additional lines is not allowed.
- Any other line beginning with a pound sign (#), or any line beginning with an asterisk (*), is treated as a comment.
- All other lines are presently ignored. However, they may be processed by future versions of RMS.

A.3.1 /etc/fstab.pcl

This file contains entries for all of the local and remote file systems that are to be used as resources in the configuration. RMS is responsible for mounting and unmounting each of these file systems in order to bring them online or offline, respectively, according to the requirements of the running configuration.

For each file system to be managed by RMS, create a line in /etc/fstab.pcl with the standard fstab fields, and then insert the string #RMS# at the beginning of the line. For more information, see the fstab manual page.

Note the following restrictions when you create /etc/fstab.pcl:

- Do not specify the same file system in both a standard /etc/fstab entry and an RMS /etc/fstab.pcl entry. The standard entry will mount the file system at system startup, and this will create a conflict when RMS starts up and attempts to mount the same file system.
- If a remote file system is specified in the form <*server_name*>:<*server_path*>, then <*server_name*> must be a host name that appears in the /etc/hosts file. It cannot be an IP address, and you should not rely on DNS to resolve the name.

Example

```
#RMS#/dev/sdb2 /fs2    xfs    defaults 1 2
#RMS#/dev/sda1 /mnt/data1  auto    noauto,user  0 0
#RMS#/dev/sda2 /mnt/data2  auto    noauto,user  0 0
```

A.3.1.1 Configuring file systems for particular applications

If the RMS comment is of the form #RMS:<*appname*>#, the file system entry applies only to the specified application. From an RMS perspective, file systems assigned to a given application are independent of those assigned to other applications. A file system can be assigned to two or more applications, provided only one of the applications is online at any time.

Example

```
#RMS:app1#/dev/sdb2  /data3  auto   noauto,user  0 0
#RMS:app2#/dev/sdb6  /data4  auto   noauto,user  0 0
```

A.3.1.2 Clusterwide configuration issues

In general, if you create an /etc/fstab.pcl control entry for a remote file system or a shared filer on one node, then you should duplicate that entry on every other node in the cluster, even if some nodes will not mount that file system. This helps to ensure that the configuration behaves consistently throughout the cluster.

Use a similar procedure for entries that specify local file systems and mount points. If all the nodes have the same architecture, you may be able to simply copy the entire /etc/fstab.pcl control file. However, if the local physical disk device differs from node to node, you must individually adjust the entries for the same mount point. For example, the respective entries for /mnt1 on node1 and node2 might be as follows:

node1:

```
#RMS#/dev/sda3   /mnt1  ...
```

node2:

```
#RMS#/dev/sdb5   /mnt1  ...
```

In all cases, for each mount point that appears in /etc/fstab.pcl, be sure to create the directory on every node in the cluster.

A.4 Solaris file systems

- /etc/vfstab.pcl

  Contains entries for all of the local file systems that are to be used as resources in the configuration. In other words, this file describes the file systems that should be mounted locally.

  For each file system to be managed by RMS, create a line with the standard vfstab fields, and then insert the string #RMS# at the beginning of the line. RMS entries appear as comments and will be ignored by all processes other than PRIMECLUSTER components. For more information, see the vfstab manual page.

  Example

  ```
  #RMS#/dev/dsk/c0t0d0s0 /dev/rdk/c0t0d0s0 /testfs1 ufs 1 yes -
  ```

- /etc/dfs/dfstab.pcl

  Contains entries for all of the shared remote resources in the high-availability configuration. In other words, this file describes the file systems that can be mounted on a remote node.

  For each file system to be managed by RMS, create a line with the standard dfstab fields, and then insert the string #RMS# at the beginning of the line. RMS entries appear as comments and will be ignored by all processes other than PRIMECLUSTER components. Therefore, to ensure that the NFS daemons start at boot time, there must be at least one non-comment, non-RMS entry in this file.

  The non-RMS entry might be a dummy entry configured for a local file system and shared only to the local node. This would mean that no real sharing to a remote node is done, but it would still cause the NFS daemons to be started. For more information, see the dfstab manual page.

  Example

  The following contains both a non-RMS entry and an RMS entry:

  ```
  share -F nfs -o ro=localhost /var/opt/example
  #RMS# share -F nfs -o rw, root=
  fuji2RMS:fuji2:045nfs045dia1:045msg:fuji2RMS: /sapmnt/045
  ```

A.4.1 NFS Lock Failover

The NFS Lock Failover feature is available for local file systems. If you configure NFS Lock Failover for a file system and the file system subsequently fails, then both the file system and its NFS locks will failover to the same node.

The following preliminary settings are necessary before using this feature:

- You must have a shared disk accessible to all the nodes in the cluster.
- You must prepare a dedicated directory to operate NFS Lock Failover. Do not specify an existing directory. The dedicated directory is used for NFS Lock Failover only. Therefore, if an existing directory is specified, they cannot be used in other applications.
- You must reserve one IP address for each application that uses NFS Lock Failover. You will specify this IP address when you configure the local file system for NFS Lock Failover. You will also configure this address in an Ip Address subapplication so it switches with the application that contains the file system.

Note

Only one file system per userApplication object can be selected for NFS Lock Failover.

A.5 NFS servers

In a high availability environment such as RMS, an exported file system must be able to failover transparently when its server node is taken out of service: clients that mounted the file system before the failover should experience no access problems after the failover. NFS file systems require special preparation to achieve this result.

When a client mounts a remote NFS file system, it creates an internal file handle that it uses for future operations with the file system. To comply with NFS architecture, the client file handle includes the server's major and minor device numbers for the file system. This design can create access problems in the RMS environment. If the file system goes offline on the original server, and then comes back online on a second server that assigns different major and minor device numbers, the file handle will no longer be valid. This condition is called a stale file handle. The solution is to assign the same major and minor device numbers to the file system on every NFS server that may advertise that file system.

The above discussion refers to file systems in general, but in a high availability environment, the file system will actually be a shared disk volume that is accessible from any node that will export it. Preparing a shared disk volume with the same major and minor device number may require changes in the hardware or software configuration. If the shared disk volume is built on top of volume management software, additional steps may be necessary when the volume manager is installed.

This section provides some tips for preparing volume managers for use as NFS servers in the RMS environment.

A.6 Log files

A.6.1 /var/log/messages (Linux) or /var/adm/messages (Solaris)

By default, all RMS messages go to both the system log, messages, and the RMS switchlog file (located by default in /var/opt/SMAWRrms/log). If you do not want to send messages to the system log, then set HV_SYSLOG_USE=0 in the hvenv.local file. By default, HV_SYSLOG_USE=1.

A.7 Other system services and databases

To configure RMS, the following system service or database must be configured. For details, contact field engineers.

- PRIMECLUSTER Cluster Foundation (CF), including CIP
- /etc/nsswitch.conf system service lookup order database

Appendix B States

B.1 Basic states

The following table lists the states that detectors may report to the base monitor:

Table B.1 States reported by detectors for RMS objects

State	Description
Faulted	Error condition encountered. The error may have occurred in the resource, in one of its children, or during script processing.
Offline	Disabled, not ready for use. The scripts have successfully disabled the resource.
Online	Enabled, ready for use. All required children are online, and no errors were encountered while scripts were processed.
Standby	Ready to be quickly brought Online when needed.

The following table lists additional resource states that may be displayed in the Cluster Admin GUI or by hvdisp:

Table B.2 Additional states that may be displayed for RMS objects

State	Description
Deact	Disabled for the purpose of maintenance.
Inconsistent	Applies to userApplication objects only. The object is Offline or Faulted, but one or more resource objects in its graph have their ClusterExclusive attribute set to 1 and are Online or Faulted.
OfflineFault	Fault that occurred in the past has not yet been cleared.
Unknown	No information is available. Reported before object initialization is completed.
Wait	Under state transition.
Warning	Some warning threshold has been exceeded. Note that this state is reported only for selected resources.
Maintenance	Manual, temporary mode of operation in which the state of an application is decoupled from the states of its dependent resources. This allows, for example, a file system to be taken offline for backup without disturbing the state of its parent application. An application in maintenance mode is usually marked with its intended status. The intended status is the status just before the start of maintenance mode.The maintenance mode intended statuses are Maintenance- Online,Maintenance-Offline, and Maintenance- Standby.

The interpretation of Offline and Faulted may depend on the resource type. For instance, a mount point resource can be either Online (mounted) or Offline (not mounted); in this case, the detector would never report the Faulted state. On the other hand, a detector for a physical disk can report either Online (normal operation) or Faulted (input or output error); it would never report Offline.

B.2 State details

Besides the basic states listed above, RMS may report additional state details in the following locations:

- In the Cluster Admin GUI, the properties view of an object includes the State Details item at the top of the list. Unlike most other attributes, which are determined at configuration time by the Wizard Tools, this information-only field is dynamically set by RMS at runtime.
- In the output of the hvdisp utility, the StateDetails column appears at the end of each line.

In most cases, the StateDetails field is empty. RMS typically provides this extra information when an application is in maintenance mode, or when an object is in a transitional, inconsistent, or standby state. The following table lists all possible StateDetails values for RMS objects.

Table B.3 StateDetails values for RMS objects

Value	Description
Failed Over	Failed Over Offline processing successful and failover initiated
Faulted	Received Faulted report
Fault Occurred	The resource error has occurred in the past. This value is displayed until the Fault trace is cleared.
Inconsistent on remote	userApplication is Online on multiple hosts, but is not Online on the local host
Initial Fault	userApplication already faulted when RMS started
Joined	SysNode is in Offline state because it has joined the cluster
Killed	SysNode is in Faulted state because of a successful kill
Not Joined	SysNode is in Offline state because it has not yet joined the cluster
Offline	Received Offline report
Offline Failed	Offline processing failed
Offline Success	Offline processing successful
Offline intended	Intended state is Offline
Online	Received Online report userApplication is Online on multiple hosts
Online !!	Intended state is Online, but some resources under userApplication are not Online
Online intended	Intended state is Online
Partial	Resources under the userApplication are partially started
PreCheckScriptFailed	PreCheckScript failed
Preserved	PreserveState set, no Offline processing initiated
Shutdown	SysNode is in Faulted state because it has been shutdown
Standby	Received Standby report
Standby !!	Intended state is Standby, but some resources under userApplication are not Standby
Standby intended	Intended state is Standby
Remote Faulted	Control application is Faulted in at least one node.
Remote Offline	Control application is not Standby in any node.

For example, if an application was online on a particular node before it was put into maintenance mode, it will generally return to the online state on the same node when it leaves maintenance mode. RMS indicates this by reporting Online intended in the state details field on that node. On other nodes where the application was previously offline, RMS will report Offline intended in the state details field.

Appendix C Object types

The following alphabetical list describes all object types that are supplied with RMS and configured by the Wizard Tools.

Table C.1 Object types

Type	Required attributes	Description
andOp	HostName (for direct children of a userApplication object)	Object associated with its children by a logical *AND* operator. This object type is online if all children are online, and offline if all children are offline.
controller	Resource	Object that controls one or more userApplication objects.
ENV	(none required)	Object containing clusterwide (global) environment variables.
ENVL	(none required)	Object containing node-specific (local) environment variables.
gResource	- rKind - rName	Custom (generic) object. Usually represents system resources such as file systems, network interfaces, or system processes.
orOp	(none required)	Object associated with its children by a logical *OR* operator. This object type is online if at least one child is online.
SysNode	(none required)	Represents nodes in the cluster; at least one required. Only userApplication objects are allowed as its children.
userApplication	(none required)	Represents an application to be monitored; at least one required. Must have one or more SysNode objects as its parents. For each SysNode parent, it must have one child andOp with its HostName attribute set to the name of the corresponding SysNode.

Appendix D Attributes

Some object types require specific attributes for RMS to monitor that object type. Some attributes can be modified through the user interface, while others are managed internally by the Wizard Tools. The following sections describe the possible values of all attributes. The default value varies depending on each resource.

D.1 Attributes available to the user

Attributes in this section can be changed by users who use the Wizard GUI or hvw command.

- AutoRecover

  Possible Values: 0, 1

  Valid for resource objects. If set to 1, executes the online script for an object if the object becomes faulted while in an Online state. If the object is able to return to the Online state, the fault is recovered.

  This attribute must be 0 for Controller and controller objects: RMS handles switchover of child applications automatically.

- AutoStartUp

  Possible Values: yes, no

  Valid for userApplication objects. If set to "yes," automatically brings the application Online when RMS is started.

  You can override the AutoStartUp attribute for all userApplication objects by setting the HV_AUTOSTARTUP variable. See the description of HV_AUTOSTARTUP in the "E.3 Local environment variables".

- AutoSwitchOver

  Possible Values: Valid string containing one or more of the following: No, HostFailure, ResourceFailure, ShutDown

  Valid for userApplication objects. Configures an application for automatic switchover if it becomes faulted. The values can be combined using the vertical bar ("|") character. The No value inhibits automatic switchover and cannot be combined with any other value.

  For backward compatibility, the numeric values 0 and 1 are accepted: 0 is equivalent to No, and 1 is equivalent to HostFailure | ResourceFailure | ShutDown.

- ClusterExclusive

  Possible Values: 0, 1

  Valid for resource objects. If set to 1, guarantees that the resource is online on only one node in the cluster at any time. If set to 0, allows a resource to be online on more than one node at a time. Note that "online" in this context refers to any phase of online processing. For instance, if a resource is in the Online state on one node while its PreOnlineScript is executing on another node, then both resource objects would be considered as online for the purposes of this test.

  The user can modify this attribute for Cmdline subapplications only. The configuration tools control this attribute for all other subapplications.

- FaultScript

  Possible Values: Valid script (character)

  Valid for all object types. Specifies a script to be run if the associated object enters the Faulted state.

  - The argument specified during registration of script will be specified as it is during execution of script.

  - Wait until this script finishes in the Fault processing.

  - If the script returns with an exit code value other than zero, the message indicating script failure will be recorded in switchlog file but the Fault processing continues.

  For details about Fault processing, refer to "2.1.5 Fault processing".

- HaltFlag (Halt)

  Possible Values: no(0), yes(1)

Valid for userApplication objects. Controls local node elimination in the event of a double fault. A double fault occurs when a second fault is generated during the initial fault processing of an application.

If HaltFlag is set to yes, and another node is available to run the application, a double fault will trigger the following sequence of events:

1. First, RMS on the local node will exit immediately.

2. Next, RMS on another node will invoke the Shutdown Facility to eliminate the local node.

3. Finally, all applications that were online on the local node, and that have their AutoSwitchOver parameter set to include HostFailure, will be switched over to the available node.

Note

Even if all the conditions for the HaltFlag attribute are met for an application (AutoSwitchOver setting, additional hosts available), other applications running on the same host may block the HaltFlag operation. For instance, another application may have no other available hosts, or it may not have the appropriate AutoSwitchOver setting. In either case, RMS will continue to run on the local node. To prevent this, allocate additional hosts for the other applications and adjust their priority lists to minimize node conflicts with the application that has its HaltFlag attribute set.

- LieOffline

  Possible Values: 0, 1

  Valid for all resource objects. If set to 1, allows the resource to remain Online during Offline processing.

- MonitorOnly

  Possible Values: 0, 1

  Valid for resource objects. If set to 1, the userApplication does not become Faulted and a switchover does not occur even if the resource becomes Faulted.

  However, if the resource becomes Faulted during the Offline processing due to a switchover, the userApplication becomes Faulted even when this attribute is set to 1. Thus, when HaltFlag is set to yes for the userApplication, the Faulted node will be forcibly stopped and remain switched.

  When moving from the previous version, setting the MonitorOnly attribute to 0 is recommended. When the value is set to 0, the cluster can be switched even if the Offline processing of the Fsystem resource fails during the Offline processing due to a resource failure or manual switchover.

- OfflineDoneScript

  Possible Values: Valid script (character)

  Valid for userApplication objects. Specifies the script to be run after the Offline processing of userApplication has completed.

  - The argument specified during registration of script will be specified as it is during execution of script.

  - Do not wait for this script to finish in the Offline processing.

  - If the script returns with an exit code value other than zero, the message indicating script failure will be recorded in switchlog file but the Offline processing continues.

  For details about Offline processing, refer to "2.1.4 Offline processing".

- OfflineScript

  Possible Values: Valid script (character)

  Valid for all object types except SysNode objects. Specifies the script to be run to bring the associated resource to the Offline state.

- OnlinePriority

  Possible Values: 0, 1

  Valid for userApplication objects. Allows RMS to start the application on the node where it was last online when the entire cluster was brought down and then restarted. If set to 0 or not set (the default), the application comes online on the node with the highest priority in the attribute PriorityList. If set to 1, the application comes online on the node where it was last online. In case of AutoStartUp or a priority switch, this last-online node has the highest priority, regardless of its position in the priority list.

RMS keeps track of where the application was last online by means of timestamps. The node which has the latest timestamp for an application is the node on which the application will go online. Different cluster nodes should be in time-synchronization with each other, but this is not always the case.
Since RMS does not provide a mechanism for ensuring time-synchronization between the nodes in the cluster, this responsibility is left to the system administrator.
If RMS detects a severe time-discrepancy between the nodes in the cluster, an ERROR message is printed to the switchlog. NTPD or CHRONY can be used to establish consistent time across the nodes in the cluster.
Refer to the manual page for xntpd or chronyd for more information.
When executing [Configuration-Activate] with the hvw command, the information indicating the node where the cluster application was last online will be cleared.

- OnlineScript

  Possible Values: Valid script (character)

  Valid for all objects except SysNode objects. Specifies the script to bring the associated resource to the Online or Standby state.

- PartialCluster

  Possible Values: 0, 1

  Valid for userApplication objects. Specifies whether or not processes to check that userApplication to be started is already working for all nodes in which userApplication can work are performed at userApplication startup.

  If set to 0, then the application can negotiate its online request only when all the nodes where it can possibly run are online.

  If set to 1, then the application can negotiate its online request within the current set of online nodes, even if some other nodes (including the application's primary node) are offline or faulted.

- PersistentFault

  Possible Values: 0, 1

  Valid for userApplication objects. If set to 1, when RMS is starting, the state of userApplication that stopped last time will be checked. Under any one of the following conditions, the userApplication becomes the Faulted state (InitialFault) right after RMS is started.

  - The shutdown processing of RMS is not performed.

  - userApplication is in the Faulted state when RMS is stopped.

  If userApplication becomes the Faulted state, remove the cause of this error first, and then, use hvutil -c to clear the Faulted state.

  Note

  - If the PersistentFault attribute is set to 0, the cluster application does not become the Faulted state at RMS startup after a panic reboot of the operating system, such as when an error occurs on the node. In this case, as it is not the Faulted state, this node is accepted as it can be switched or failed back. If the error definitely occurs on all the nodes that constitute the cluster during the Online processing and also a panic reboot of the operating system occurs, the failover may repeat infinitely.

  - If the PersistentFault attribute is set to 1, the cluster application becomes the Faulted state at RMS startup after a panic reboot of the operating system, such as when an error occurs on the node. Therefore, clear the fault manually. If the application is stopped, start the userApplication.

- PostOfflineScript

  Possible Values: Valid script (character)

  Valid for all objects except SysNode objects. Specifies the script to be run after the state of the associated resource changes to Offline.

- PostOnlineScript

  Possible Values: Valid script (character)

  Valid for all objects except SysNode objects. Specifies the script to be run after the state of the associated object changes to Online or Standby.

  - The argument specified during registration of script will be specified as it is during execution of script.

  - Wait until this script finishes in the Online processing.

    - If the script returns with an exit code value other than zero, the message indicating script failure will be recorded in switchlog file and the Fault processing will start.

  For details about Online processing, refer to "2.1.3 Online processing".

- PreCheckScript

  Possible Values: Valid script (character)

  Valid for userApplication objects. Specifies the script to be run before the start of Online or Standby processing.

    - The argument specified during registration of script will be specified as it is during execution of script.

    - If the script returns with an exit code zero, the Online or Standby processing will be started. If the script returns with an exit code value other than zero, the message indicating script failure will be recorded in switchlog file and the Online or Standby processing will not be started.

  For details, refer to "2.1.3.2 PreCheckScript".

- PreOfflineScript

  Possible Values: Valid script (character)

  Valid for all objects except SysNode objects. Specifies the script to run before the object is taken to the Offline state.

    - The argument specified during registration of script will be specified as it is during execution of script.

    - Wait until this script finishes in the Offline processing.

    - If the script returns with an exit code value other than zero, the message indicating script failure will be recorded in switchlog file but the Offline processing continues. Fault processing will start after the Offline processing is completed.

  For details about Offline processing, refer to "2.1.4 Offline processing".

- PreOnlineScript

  Possible Values: Valid script (character)

  Valid for all objects except SysNode objects. Specifies the script to be run before the associated object is taken to the Online or Standby state.

    - The argument specified during registration of script will be specified as it is during execution of script.

    - Wait until this script finishes in the Online processing.

    - If the script returns with an exit code value other than zero, the message indicating script failure will be recorded in switchlog file and the Fault processing will start.

  For details about Online processing, refer to "2.1.3 Online processing".

- PreserveState

  Possible Values: 0, 1

  Valid for userApplication objects. If set to 1, the resources are not to be taken Offline after a fault. Ignored if ResourceFailure is set to AutoSwitchOver.

- ScriptTimeout

  Possible Values: 0-*MAXINT* (in seconds) or valid string of the form "*timeout_value*[:[*offline_value*][:*online_value*]]"

  Valid for all object types. Specifies the timeout value for all scripts associated with that object in the configuration file. RMS sends a kill signal to the script if the timeout expires.

  Specify the *offline_value* timeout value and the *online_value* timeout value respectively in this string format.

- ShutdownPriority

  Possible Values: 0-20

  Valid for userApplication objects. ShutdownPriority assigns a weight factor to the application for use by the Shutdown Facility.

When interconnect failures and the resulting concurrent node elimination requests occur, SF calculates the shutdown priority of each subcluster as the sum of the subcluster's SF node weights plus the RMS ShutdownPriority of all online application objects in the subcluster. The optimal subcluster is defined as the fully connected subcluster with the highest weight.

- StandbyCapable

  Possible Values: 0, 1

  Valid for resource objects. If set to 1, the object performs standby processing on all the nodes where the parent application is supposed to be Offline.

  The user can modify this attribute for Cmdline subapplications only. The configuration tools control this attribute for all other subapplications.

- StandbyTransitions

  Possible Values: StartUp, SwitchRequest, ClearFaultRequest or any combination joined by vertical bars (|)

  Valid for userApplication objects. The value specifies when standby processing is initiated for the application object:

  - StartUp - at startup. This setting is ignored if the real-world application is already online, or if the application object is forced to go online because the AutoStartUp attribute is set.

  - SwitchRequest - after application switchover, if the application was online before the switchover.

  - ClearFaultRequest - after a faulted state is cleared with 'hvutil -c'.

- WarningScript

  Possible Values: Valid script (character)

  Valid for resource objects with detector. Specifies the script to be run after the posted state of the associated resource changes to Warning.

D.2 Attributes managed by configuration wizards

Attributes in this section are managed internally by the configuration wizards or by RMS at runtime.

- AlternateIp

  Possible Values: Any interconnect name

  Valid for SysNode objects. Space-separated list that RMS uses as additional cluster interconnects if the interconnect assigned to the SysNode name becomes unavailable. All these interconnects must be found in the /etc/hosts database. By default, the configuration wizards assume the alternate interconnects to node <*nodename*> have names of the form <*nodename*>rmsAI<*nn*>, where <*nn*> is a two-digit, zero-filled number. This setting is restricted to very specific configurations and must never be used in a cluster with CF as interconnect.

- Affiliation

  Possible Values: Any string

  Valid for resource objects. Used for display purposes in the user interface - no functional meaning within RMS.

- AutoRecoverCleanup

  Possible Values: 0, 1

  Valid for controller objects. If set to 1, and AutoRecover is 1, then a faulted child application is requested to go Offline before recovering. If set to 0 and AutoRecover is 1, then a faulted child application recovers without going Offline.

- Class

  Possible Values: any string

  Valid for all objects except SysNode. Describes the class of the resource object. Used by other programs for various purposes (for example, SNMP agents). This value is supplied by the configuration wizards.

- Comment

  Possible Values: any string

Valid for all objects. Used for documentation in the configuration file - no functional meaning within RMS.

- ControlledSwitch

  Possible Values: 0, 1

  Valid for controlled userApplication objects. If set to 0, RMS allows a manual switch request from the CLI or the GUI. If set to 1, only the parent controller can issue switch requests to this userApplication.

- DetectorStartScript

  Possible Values: Any valid detector start script

  Valid for resource objects with detector. Specify the detector start command directly in the <*configname*>.us file.

  Note that a controller object has no detector because RMS determines its state internally.

- HostName

  Possible Values: Any SysNode name

  Must be set only in the first-level andOp children of a userApplication object. Each of these andOp objects associates its parent application with the SysNode specified in its HostName attribute; the child andOp objects also determine the priority of the application's nodes.

- I_List

  Possible Values: Space-separated list of SysNode

  Valid for all SysNode objects. List of additional cluster interconnects that should be monitored by RMS. These interconnects are used only by customer applications and not by any PRIMECLUSTER products. All monitored interconnects must be found in the /etc/hosts database. In addition, all SysNode objects must have the same number of additional interconnects.

- LastDetectorReport

  Possible Values: Online, Offline, Faulted, Standby

  Valid for resource objects with detector. This attribute contains the most recent detector report for the object. The value may be displayed in the Cluster Admin GUI; the possible values depend on the type of resource the object represents.

- MaxControllers

  Possible Values: 0-512

  Valid for userApplication objects. Upper limit of parent userApplication objects for the specified child application.

- NoDisplay

  Possible Values: 0, 1

  Valid for all object types. The resource object set to 1 is displayed only when specifying it with the -i option of the hvdisp command.

- NullDetector

  Possible Values: on, off

  Valid for resource objects with detector. Used to disable a detector at runtime by setting NullDetector to on. This attribute is for use with dynamic reconfiguration only. NullDetector must never be set hard-coded to on in the RMS configuration file.

- PriorityList

  Possible Values: Valid list of SysNode names (character)

  Valid for userApplication objects. Contains a list of SysNode objects where the application can come Online. The order in the list determines the next node to which the application is switched during a priority switchover, ordering a switchover after a Fault. The list is processed circularly. The user specifies this attribute indirectly when selecting the nodes for an application. RMS uses the order in which the nodes were selected and creates PriorityList automatically. The user can change the PriorityList by adding individual nodes from the list in the desired order, rather than automatically selecting the entire list.
  For applications controlled by local gController or controller objects, the order of nodes in PriorityList is ignored. However, each controlled application must be able to run on the nodes specified by the controller objects.

- Resource

  Possible Values: Valid name (character)

Valid for gController and controller objects. Contains the name of the child (controlled) userApplication.

- rKind

  Possible Values: 0-2047

  Valid for gResource objects. Specifies the kind of detector for the object.

- rName

  Possible Values: Valid string (character)

  Valid for gResource objects. Specifies a string to be forwarded to the generic detector.

- SplitRequest

  Possible Values: 0, 1

  Valid for controller objects. If set to 1, then PreOffline and PreOnline requests will be propagated to child applications separately from the Offline and Online requests. If 0, then separate PreOffline or PreOnline requests will not be issued for the child applications.

- StateDetails

  Possible Values: Any string

  Valid for all objects. Displays additional state details in the Cluster Admin GUI or the hvdisp CLI user interface. In most cases, the state details field is empty. RMS typically provides this extra information when an application is in maintenance mode, or when an object is in a transitional, inconsistent, or standby state.

Appendix E Environment variables

This appendix provides a complete list of the environment variables used by RMS, grouped into the following types:

- "E.2 Global environment variables"
- "E.3 Local environment variables"
- "E.4 Script execution environment variables"

E.1 Setting environment variables

Note

- Do not change the hvenv configuration file. Changes to your configuration's environment variables should be confined to the hvenv.local file.

The values of environment variables are specified as export directives in the hvenv.local file. To adjust a variable's setting, you would open hvenv.local with a text editor of your choice and modify (or add) the appropriate line.

A typical export directive would appear as follows:

```
export SCRIPTS_TIME_OUT=200
```

When RMS starts, it reads the values of environment variables from hvenv and hvenv.local and initializes the ENV and ENVL objects respectively. No further reference is made to these two configuration files while RMS is running. Therefore, any changes you make to hvenv.local will not take effect until the next time RMS starts up.

Values in the ENVL (local) object override values in the ENV (global) object. If a global variable setting appears in the hvenv.local file, it will override the corresponding setting in the hvenv file. However, if you adjust a global variable in the hvenv.local file on one node, you must make the same adjustment to hvenv.local on every other node in the cluster. Global variable settings must agree clusterwide.

While RMS is running, you can display the environment variables with the hvdisp command, which does not require root privilege:

```
hvdisp ENV
hvdisp ENVL
```

E.2 Global environment variables

Note

- Global variable settings (ENV) are included in the configurations checksum that is common to the cluster. The checksum is verified on each node during startup of the base monitor. RMS will fail to start if it detects a checksum difference between the values on any two nodes.
- The default values of the environment variables are found in <*RELIANT_PATH*>/bin/hvenv. They can be redefined in the hvenv.local configuration file.

The following list describes the global environment variables for RMS:

HV_AUTOSTARTUP_IGNORE

Possible values*:* List of RMS cluster nodes. The list of RMS cluster nodes must be the names of the SysNodes as found in the RMS configuration file. The list of nodes cannot include the CF name.
Default: "" (empty)

List of cluster nodes that RMS ignores when it starts. This environment variable is not set by default. A user application will begin its automatic startup processing if the AutoStartUp attribute is set and when all cluster nodes defined in the user application have reported Online. If a cluster node appears in this list, automatic startup processing will begin even if this node has not yet reported the Online state.

Use this environment variable if one or more cluster nodes need to be taken out of the cluster for an extended period and RMS will continue to use the configuration file that specifies the removed cluster nodes. In this case, specifying the unavailable cluster nodes in this environment variable ensures that all user applications are automatically brought online even if the unavailable cluster nodes do not report Online.

Note

If the environment variables are used, ensure that it is correctly defined on all cluster nodes and that it is always kept up-to-date. When a node is brought back into the cluster, remove it from this environment variable. If this does not occur, data loss could occur because RMS will ignore this node during the startup procedure and will not check whether the application is already running on the nodes specified in this list. It is the system administrator's responsibility to keep this list up-to-date if it is used.

HV_AUTOSTART_WAIT

Possible values: 0 - *MAXINT*
Default: 60 (seconds)

Defines the period (in seconds) that RMS waits for cluster nodes to report Online when RMS is started. If this period expires and not all cluster nodes are online, a switchlog message indicates the cluster nodes that have not reported Online and why the user application(s) cannot be started automatically.

Note

This attribute generates a warning message only. AutoStartUp will proceed even if the specified period has expired.

HV_CHECKSUM_INTERVAL

Possible values: 0 - *MAXINT*
Default: 120 (seconds)

Interval in seconds for which the RMS base monitor waits for each Online node to verify that its checksum is the same as the local checksum.

If checksums are confirmed within this interval, then RMS on the local node continues its operations as usual. However, if a checksum from a remote node is not confirmed, or if it is confirmed to be different, then the local monitor shuts down if it has been started less than HV_CHECKSUM_INTERVAL seconds before.

Also, if a checksum from a remote node is not confirmed, or if the checksum is confirmed to be different, then the local monitor considers the remote node as Offline if that local monitor has been started more than HV_CHECKSUM_INTERVAL seconds before.

HV_COM_PORT

Possible values: 0 - 65535
Default: 8000

The communication port used by the RMS base monitor on all the nodes in the cluster.

HV_LOG_ACTION_THRESHOLD

Possible values: 0 - 100
Default: 98

Determines conditions under which hvlogcontrol cleans up RMS log files. If the percentage of used space on the file system containing *RELIANT_LOG_PATH* is greater than or equal to this threshold, all subdirectories below *RELIANT_LOG_PATH* will be removed. Furthermore, if HV_LOG_ACTION is set to on and all subdirectories have already been removed, the current log files will be removed too. See HV_LOG_ACTION for more information.

HV_LOG_WARN_THRESHOLD

Possible values: 0 - 100
Default : 95

Defines when hvlogcontrol warns the user about the volume of RMS log files. If the percentage of used space on the file system containing *RELIANT_LOG_PATH* is greater than or equal to this threshold value, hvlogcontrol issues a warning to the user. See also HV_LOG_ACTION_THRESHOLD above.

HV_LOH_INTERVAL

Possible values: 0 - *MAXINT*
Default: 30

Specifies the minimum difference in seconds when comparing timestamps to determine the last online host (LOH) for userApplication. It is determined if the OnlinePriority attribute is set to 1.

If the difference between the LOH timestamp entries logged in the userApplication on two cluster nodes is less than the time specified by this attribute, RMS does not perform AutoStartUp and does not allow priority switches. Instead, it sends a message to the console and waits for operator intervention.

When adjusting this variable, the quality of the time synchronization in the cluster must be taken into account. The value must be larger than any possible random time difference between the cluster hosts.

HV_USE_ELM

Possible values: 0, 1
Default: 1

Specifies the heartbeat monitoring mode used by the RMS base monitor:

0 - remote node and base monitor states are detected by periodically sending UDP heartbeat packets across the network. If no heartbeats are received from a remote node during an interval defined by HV_CONNECT_TIMEOUT, RMS marks the node as down and waits for a recovery period before taking further action.

1 - combines the Enhanced Lock Manager (ELM) method and the UDP heartbeat method. This setting is valid only when CF is installed and configured. The ELM lock is taken and held by the local node until ELM reports a remote node down or remote base monitor down. In either of these cases, the remote node is immediately killed. Until ELM reports a change in a remote node's state, RMS also monitors the UDP heartbeat of each remote node as described above, but with a much longer recovery timeout.

Whether or not ELM is enabled, a remote node is killed if its UDP heartbeat is not received before its heartbeat recovery timeout expires. When CF is not present, ELM is disabled automatically, and the heartbeat recovery timeout defaults to 45 seconds. When CF is present, ELM is enabled by default, and the heartbeat recovery timeout defaults to 600 seconds; this avoids premature node kills when the remote node is slow to respond.

Only experts should disable ELM manually. When CF is present but ELM is disabled, the default 600 second heartbeat recovery timeout is too long for efficient detection of remote RMS or node outages. In this case, the recovery timeout on the local node must also be adjusted manually by starting RMS with the 'hvcm -h <*timeout*> -c <*config_file*>' command. Note that the recovery timeout should be set to the same value on every node in the cluster. When ELM is disabled, the recommended global value is 45 seconds.

RELIANT_LOG_LIFE

Possible values: Any number of days
Default: 7 (days)

Specifies the number of days that RMS logging information is retained. Every time RMS starts, the system creates a directory that is named on the basis of when RMS was last started, and which contains all constituent log files. All RMS log files are preserved in this manner. All sub directories under RELIANT_LOG_PATH whose update time (ctime) is older than the number of days specified in this variable are deleted by a cron job.

RELIANT_LOG_PATH

Possible values: Any valid path
Default: /var/opt/SMAWRrms/log

Specifies the directory where all RMS and Wizard Tools log files are stored. The location to store the internal log will not be changed even if the value of this variable is changed.

RELIANT_PATH

Possible values: Any valid path
Default: /opt/SMAW/SMAWRrms

Specifies the root directory of the RMS directory hierarchy. Users do not normally need to change the default setting.

RELIANT_SHUT_MIN_WAIT

Possible values: 0 - *MAXINT*
Default: *MAXINT* (seconds)

Defines the period (in seconds) until the hvshut command times out.

If the hvshut command is executed with any of the -l, -s, and -a options, RMS performs shutdown processing after it performs offline processing of the active applications.

Set the total time of the following items for RELIANT_SHUT_MIN_WAIT:

1. Maximum time required to complete offline processing of applications

2. Maximum time required to shut down base monitor (30 seconds)

Use the total value of the script timeout of all resources included in an application for the value of 1.

To check the script timeout value of each resource, execute the hvdisp command by using the resource name as the argument and see the setting value (in seconds) of the ScriptTimeout attribute of the resource with which the OfflineScript attribute is not blank.

When the ScriptTimeout attribute is in "*timeout_value*[:[*offline_value*][:*online_value*]]" format, use the *offline_value* timeout value if *offline_value* exists. If *offline_value* does not exist, use the *timeout_value* timeout value.

If there are two or more applications, use the largest value of the total values of the script timeout for each application.

Note

By increasing the value of RELIANT_SHUT_MIN_WAIT, the following effects occur if delay or hang-up in offline processing of applications occurs.

- It may take longer time than the setting value of RELIANT_SHUT_MIN_WAIT to shut down RMS or the operating system.

- It may take longer time than the setting value of RELIANT_SHUT_MIN_WAIT to automatically switch applications by shutting down RMS or the operating system.

If the value of RELIANT_SHUT_MIN_WAIT is too large, use the processing time in the case that it is expected to take the longest time until timeout of the assumed cases where offline processing of an application times out for the value of the item 1 above.

Note that if the value of RELIANT_SHUT_MIN_WAIT is too small, timeout of the hvshut command may frequently occur before offline processing of applications completes. Tune RELIANT_SHUT_MIN_WAIT carefully.

Note

Resources may remain active without stopping because RMS terminates abnormally when the hvshut command times out. Under this situation, if you start RMS on a different node and forcibly activate the application, the resources may become active on several nodes at the same time, and data may be corrupted when a shared disk is controlled by the resources. For this reason, if the hvshut command times out, shut down the operating system of the node where RMS has terminated abnormally, or forcibly shut down the node to ensure that resources stop. Then, start RMS and applications.

E.3 Local environment variables

Local environment variable settings can vary from node to node. The following list describes the local environment variables for RMS:

HV_AUTOSTARTUP

Possible values: 0, 1
Default: 1 (normal processing of AutoStartUp attribute)

Controls the action of the AutoStartUp attribute for all userApplication objects on the local node. If set to 1 (the default value) the automatic startup of each userApplication is determined by its AutoStartUp attribute (see the "D.1 Attributes available to the user"). If set to 0, the AutoStartUp attribute is ignored and no automatic startup occurs. HV_AUTOSTARTUP can be set in the Cluster Admin Tools menu or by using the hvsetenv command; in either case, the change does not take effect until the next RMS startup.

HV_CONNECT_TIMEOUT

Possible values: 5 - *MAXINT*
Default: 30 (seconds). Users do not normally need to change the default setting.

The maximum time (in seconds) that the heartbeat from a node is not received before the base monitor assumes the connection to that node has been lost and starts the UDP heartbeat recovery timer.

Input values less than 5 are converted internally to 5.

HV_LOG_ACTION

Possible values: on, off
Default: off

Determines whether the current log files in the RELIANT_LOG_PATH directory will be deleted when the percentage of used space on the file system containing RELIANT_LOG_PATH is greater than or equal to HV_LOG_ACTION_THRESHOLD. See HV_LOG_ACTION_THRESHOLD for more information.

HV_MAX_HVDISP_FILE_SIZE

Possible values: 0 - *MAXINT*
Default: 20,000,000 (bytes)

Prevents the unlimited growth of the temporary file that RMS uses to supply hvdisp with configuration data and subsequent configuration and state changes. The value of this variable is the maximum size in bytes of the temporary file <*RELIANT_PATH*>/locks/.rms.<*process id of the hvdisp process*>.

HV_MAXPROC

Possible values: 0 - 99
Default: 30

Defines the maximum number of scripts that RMS can execute at one time. The default (30) is sufficient in most cases.

HV_MLOCKALL

Possible values: 0, 1
Default: 0

If set to 1, the base monitor process and any memory it allocates will be locked in memory. If set to 0 (the default), the base monitor may be swapped out.

HV_RCSTART

Possible values: 0, 1
Default: 1 (start RMS in the rc script)

Determines if RMS is started in the rc script. If set to 1 (the default value), RMS is started automatically at system boot time. If set to 0, RMS must be started manually. HV_RCSTART can be set in the Cluster Admin Tools menu or by using the hvsetenv command. (Prerequisite for rc start: CONFIG.rms exists and contains a valid entry.)

HV_REALTIME_PRIORITY

Possible values: 0 - 99
Default: 50

Defines the real time priority for the RMS base monitor and its detectors. Caution should be used when adjusting this variable. High settings can prevent other OS real-time processes from getting their processor time slice. Low settings can prevent the RMS base monitor from reacting to detector reports and from performing requests from command line utilities.

This variable is processed only on Solaris platforms. It has no effect on Linux platforms.

HV_SCRIPTS_DEBUG

Possible values: 0, 1
Default: 0

Controls debugging output from RMS scripts. If this variable is set to 1, it overrides the setting for scripts that are generated and managed by the Wizard Tools, causing them to write detailed runtime information about the commands that are executed to the RMS switchlog file. The type of information logged may vary according to the script. This setting applies only to those scripts provided with

PRIMECLUSTER products. To disable script debug message logging, delete the HV_SCRIPTS_DEBUG entry or set HV_SCRIPTS_DEBUG=0 in hvenv.local.

Note

When this variable appears in hvenv.local, RMS adds it to the script environment but otherwise makes no attempt to process it. Therefore, it is not reported in the Cluster Admin GUI or in 'hvdisp ENVL' output.

HV_SYSLOG_USE

Possible values: 0, 1
Default: 1 (in hvenv)

Controls output to the system log from the RMS base monitor. RMS always records RMS ERROR, FATAL ERROR, WARNING, and NOTICE messages in the RMS switchlog file. By default, these messages are duplicated in the system log file /var/adm/messages (Solaris) or /var/log/messages (Linux). To disable RMS messages in the system log, set HV_SYSLOG_USE=0 in hvenv.local.

Note

It is recommended for Linux to change this variable to 0. If this variable is set to 1 on Linux, under a high load on the system, the system log output will hang due to the performance limit of the system log processing by OS. In this case, RMS may not respond to any heartbeat from other node.

HV_VM_ENABLE_IP_ADVERTISE

Possible values: 0, 1
Default: 0

Specifies enabling or disabling of function which transmits the ARP packets of takeover IP address from the switching destination node periodically (advertises the communication routes of communication devices) if a node is switched by the I/O fencing in the VMware environment using the I/O fencing function.

If setting to 1, the function is enabled. After this setting is performed, the switching destination node transmits the ARP packets in 60-second cycle. If any of the following conditions are met, the ARP packet transmission ends.

- The ARP packets are transmitted in the times specified by the RMS environment variable HV_VM_IP_ADVERTISE_COUNT (for about four hours by default).
- The panic switching source node is restarted by the I/O fencing function and CF is started.
- The userApplication Offline process is performed in the switching destination node.

If setting to 0, the function is disabled.

Note

- When switching userApplication, the communication route to the takeover IP address is updated to the switching destination node in the course of Gls resource or takeover network resource Online process. However, if the panic process on the switching source node is delayed due to OS hang, etc., the communication route may return to the switching source node. This function is enabled when the communication route of takeover IP address returns to the switching source node, the communication route can be re-updated to the switching destination node in a short time.
- In any one of the following cases, the function is not enabled even it is set:
  - Using IPv6 address as the takeover IP address
  - Not registering Gls resource or the takeover network resource to userApplication

HV_VM_IP_ADVERTISE_COUNT

Possible values: valid times
Default: 240 (times)

In the VMware environment using the I/O fencing function, when using the function which transmits the ARP packets of takeover IP address from the switching destination node, the ARP packet transmission times in a 60-second cycle can be specified by this environment variable.

If setting to 0, the restriction of transmission times is eliminated and the ARP packets continue being sent.

RELIANT_HOSTNAME

Possible values: valid name
Default: <*nodename*>RMS

The name of the local node in the RMS cluster. The default value of this variable is the node name with an RMS suffix (for example: shasta1RMS), as generated by the following command:

```
export RELIANT_HOSTNAME=`cftool -l 2>/dev/null | \
tail -1 | cut -f1 -d" "`RMS
```

If this preset value is not suitable, it must be modified accordingly on all the nodes in the cluster.

The specified cluster node name must correspond to the SysNode name in the <*configname*>.us configuration file. The node name determines the IP address that RMS uses for establishing contact with this node.

RELIANT_INITSCRIPT

Possible values: any executable
Default: <*RELIANT_PATH*>/bin/InitScript

Specifies an initialization script to be run by RMS when the system is started. This script is run before any other processes are activated. It is a global script that is run once on every cluster node on which it is defined.

RELIANT_STARTUP_PATH

Possible values: any valid path
Default : <*RELIANT_PATH*>/build

Defines where RMS searches at start time for the configuration files.

SCRIPTS_TIME_OUT

Possible values: 0 - *MAXINT*
Default: 300 (seconds)

Specifies the global period (in seconds) within which all RMS scripts must be terminated. If a specific script cannot be terminated within the defined period, it is assumed to have failed and RMS begins appropriate processing for a script failure.

If this value is too low, error conditions will be produced unnecessarily, and it may not be possible for the applications to go online or offline. An excessively high value is unsuitable because RMS will wait for this period to expire before assuming that the script has failed.

In case the global setting is not appropriate for all objects monitored by RMS, this global value can be overridden by an object-specific setting of the ScriptTimeout attribute.

E.4 Script execution environment variables

The variables in this section are set by the RMS base monitor when it executes an object's script. These exist only in the script's environment and only for the duration of the script execution. Since these variables are explicitly set, they have no default values.

HV_APPLICATION

Possible values: any userApplication name

Name of the userApplication object at the top of the sub-tree that contains the current object.

HV_AUTORECOVER

Possible value : 0, 1

If set to 1, the script was initiated due to an AutoRecover attempt.

HV_FORCED_REQUEST

Possible values: 0, 1

If set to 1, the script is currently processing a forced request.

HV_LAST_DET_REPORT

Possible values: one of Online, Offline, Standby, Faulted

Last detector report for the current object.

HV_OFFLINE_REASON

Possible values: one of DEACT, SWITCH, FAULT, STOP, SHUT

Reason for a resource to become Offline is set:
SWITCH: switch request from userApplication ('hvswitch').
STOP: stop request from userApplication ('hvutil -f', 'hvutil -c').
FAULT: resource failure
DEACT: deact request from userApplication ('hvutil -d')
SHUT: stop request from RMS ('hvshut').

HV_NODENAME

Possible values: any object name

Name of current object.

HV_REQUESTING_CONTROLLER

Possible values: controller name and node name

If non-empty, contains the name of the controller and node that initiated the request for the current script execution.

HV_SCALABLE_CONTROLLER

Possible values: scalable controller name

The name of the scalable controller that controls this application.

HV_SCALABLE_INFO

Possible values: scalable applications list

Contains the list of all scalable applications everywhere in the cluster.

HV_SCRIPT_TYPE

Possible values: any of the following script types: PreCheck, PreOnline, Online, PostOnline, PreOffline, Offline, PostOffline, OfflineDone, Fault

NODE_SCRIPTS_TIME_OUT

Possible value : 0 - *MAXINT*

Timeout value for the current object and script type.

Note

HV_REQUESTING_CONTROLLER ,HV_SCALABLE_CONTROLLER and HV_SCALABLE_INFO can be used only by the Online/Offline processing of the application controlled with the controller object.

Appendix F Troubleshooting

This chapter discusses some PRIMECLUSTER facilities for debugging RMS configurations from both the command line interface (CLI) and from the Cluster Admin graphical user interface (GUI). This chapter provides details on log files, their location, how to turn on logging levels, how to view logs from the GUI, and how to view log files from CLI.

F.1 Overview

The RMS troubleshooting process usually begins after you observe an error condition or unexpected state change in Cluster Admin in one of the following areas:

- Clusterwide table
- RMS tree
- Graph

The clusterwide table contains summary information and is a good place to start looking for error conditions. For additional details, you can look at the RMS tree or the graph. Depending on whether you need to look at the switchlogs or application logs, you can then use the log viewer facility to view the log files.

The log viewer has search facilities based on the following:

- Keywords
- Severity
- Non-zero exit codes

Search for causes of errors using the keywords and the date range fields. For emergency, alert, and critical conditions, you can do a search based on severity. For proactive troubleshooting, you can perform a search based on severity for the error, warning, notice, and info severity codes.

Note

- It is recommended that you periodically use the log viewer and check the log files based on the severity levels to avoid serious problems. If you cannot diagnose the cause of a problem, look at the log viewer from two or more nodes in the cluster.
- Refer to the "F.9 RMS troubleshooting" for an explanation on corrective action.

Resolve error conditions as follows:

1. Use the Cluster Admin GUI.
2. View the log files if needed.
3. Change log levels to get more details.
4. If you cannot resolve an error condition with the GUI, you can use the command line interface. Use standard UNIX commands.
5. If a problem persists, check if it is a non-RMS issue and refer to the appropriate manual.
6. Check for system-related issues like operating system, hardware, or network errors.
7. Contact field engineers if you cannot resolve the issue.

F.2 Debug and error messages

RMS writes debug and error messages to log files when its components (such as the base monitor or detectors) operate. The default setting is for RMS to store these files in the /var/opt/SMAWRrms/log directory. Users can change the directory with the RELIANT_LOG_PATH environment variable, which is set in the hvenv.local file.

When RMS starts, logging begins. The default setting is for the base monitor to write all error messages to its log file or to stderr. Normally, you do not need to change the default setting because the default options allow for very detailed control of debug output.

If required, you can use the base monitor to record every state and message of any node. However, in most cases, the information requires a detailed knowledge of internal RMS operation to interpret the debug output, which can only be evaluated by field engineers.

For the administrator of an RMS cluster, evaluating the switchlog file is normally sufficient. This file records all important RMS actions; for example, incoming switch requests or faults that occur in nodes or resources.

Note

There are also configuration-specific log files in the log directory. It is recommended that administrators evaluate these if necessary. The name of each log file (normally <*userApplication*>.log) depends on the configuration that was set up using the RMS Wizard Tools. Refer to the chapter "F.5 Managing application log output" for further information.

The bmlog log file can also be useful for problem solving.

F.3 Log file categories

Table 10 identifies and explains the RMS log files contained in /var/opt/SMAWRrms/log.

Table F.1 Log files

Module	File Name	Contents
base monitor	tracelog	Records all messages between objects and all modification instructions. By default, RMS places no messages in tracelog.
base monitor	abortstartlog	When the following message is displayed while starting, this file is created. FATAL ERROR: RMS has failed to start! Further details about the problem may appear in the switchlog. This file is created for field engineers to identify the cause of RMS startup failure.
base monitor	bmlog	General RMS error and message logging information ranges from simple message reporting to more complete information. The error log level determines the contents of this file, which is specified when the base monitor is started. See "F.4 Managing base monitor log output" for more information. This file includes all messages received by the base monitor at runtime. It also contains information generated by hvdump (see "F.10.1 Using the hvdump command (RMS)"). Should be used by experts only, since turning on log level flags consumes a great deal of disk space. By default, RMS places no messages in bmlog.
Object's detector and script related to applications	<*application_name*>.log	All messages related to applications are recorded. The output of all the scripts which are executed by the application is also written to the log file.

Module	File Name	Contents
Everything (base monitor, generic detector)	switchlog	Operational events, such as resource switches or bugs. Normally, switchlog is the only log file users need to examine.
generic detector	<*program*>log	All messages and job assignments received by the detector. Also contains resource state change information and all error messages. program is the name of the detector under RELIANT_PATH.

F.4 Managing base monitor log output

At runtime, the RMS base monitor can generate log messages in the RELIANT_LOG_PATH/switchlog file and in the system log file. This section describes how you can control the log level (the amount of detail) in the log files. Each log level reports an internal function that is intended for expert use.

Note

Executing RMS with several active log levels will affect system performance. This feature should be enabled for testing or debugging purposes only.

F.4.1 Managing base monitor log levels

By default, base monitor logging is not running when RMS starts up. You can set the initial log level by specifying hvcm with the -l option:

```
hvcm -l <level> -c <configuration_file> ...
```

Is RMS is already running, you can use the following commands to manage the base monitor log level:

```
hvutil -l display
hvutil -l off
hvutil -l <level>
```

The first hvutil command displays the current base monitor log level setting, and the second hvutil command turns off base monitor logging.

Specifying '-l <*level*>' with hvcm or hvutil activates base monitor logging, where <*level*> is one or more numbers in one of the following formats:

- A single number.
- A comma-delimited or space-delimited list. If the list is space-delimited, enclose the list in quotes.
  Examples: 2,4,5,7 "2 4 5 7"
- A single hyphen-separated range in the form *n1*-*n2*. This includes all log levels from *n*1 up to and including *n*2. Specifying -*n2* is the same as 1-*n2*, and specifying *n1*- includes all log levels above *n1*. The *n1* value must be greater than or equal to 1.
  Examples: 2-7 -7 2-

Note

- Specifying a log level of 0 (zero) activates all log levels. You must specify the special level off to deactivate logging.
- If RMS is being operated continuously for one day or more days when the base monitor logging is activated, to avoid the RMS logs taking up the disk space, configure the cron job setting to execute the hvlogclean command once a day. According to the setting, the log files are saved for each day. The older log files beyond the days specified by RELIANT_LOG_LIFE are deleted automatically. For details on the hvlogclean command, see the section "F.8.1 hvlogclean".

The current log level remains in effect until another 'hvutil -l <*level*>' is issued, a 'hvutil -l off' is issued, or until RMS is shut down.

Table 11 lists the valid base monitor log levels.

Table F.2 Base monitor log levels

Log Level	Meaning
0	Turn on all log levels
1	Unused
2	Turn on detector tracing
3	hvdisp level
4	Turn on mskx tracing (stack tracing of the base monitor)
5	Error or warning message
6	Heartbeats and communication
7	Base monitor level
8	Generic controller message
9	Administrative command message
10	Basic-type level
11	Dynamic reconfiguration contracting level
12	Shutdown debug level
13	Token level
14	Detector message
15	Local queue level
16	Local queue level
17	Script level
18	userApplication contract level
19	Temporary debug traces
20	SysNode traces
21	Message level
22	bm tracelog
23	Unused

F.4.2 Controlling base monitor output to the system log

By default, the RMS base monitor writes the same messages to both the switchlog file and the system log file. This behavior is controlled by the HV_SYSLOG_USE environment variable.

The default setting in hvenv is HV_SYSLOG_USE=1. This sends all RMS NOTICE, WARNING, ERROR, and FATAL ERROR messages to the system log and switchlog.

To suppress RMS messages in the system log, edit the hvenv.local file and set HV_SYSLOG_USE=0. You will have to restart RMS for the change to take effect.

Note

For Log3 RMS messages, the component number is 1080023.

F.5 Managing application log output

Runtime components provided by the RMS Wizard Tools write log messages to files in the same log directory as the RMS base monitor, which is defined in the RELIANT_LOG_PATH environment variable. Messages from these components can be broken down into two categories:

- Messages from resource detectors
- All other messages

Detector logging is described in "F.6 Managing detector log output". The following discussion applies to all other log messages.

The runtime components provided by the configuration tools log everything at an application level. In addition to the normal user-oriented messages, they can also generate debug messages with various levels of detail. The user and debug messages may be written to the following files in RELIANT_LOG_PATH:

- Switchlog - The standard subapplications supplied by the RMS Wizard Tools record detector reports related to fault and offline transitions into the switchlog file.
- <*application_name*>.log - The application-specific log file records all messages associated with that application. The output from any scripts run by the application also go into its log file. The file is created when either offline or online processing for the application begins.
- hvdet_<*xxx*>.g<*n*>log - These are detector log files which record all relevant information regarding the resources they are monitoring, such as all state transitions.

When debugging application problems, the switchlog file, the application-specific log file, and any appropriate detector log files may all need to be viewed and interpreted.

F.5.1 Controlling debug messages from standard scripts

You can control debug output from the standard RMS Wizard Tools scripts by setting the environment variable HV_SCRIPTS_DEBUG in the hvenv.local file:

- To turn on debug output, create the following entry:

```
export HV_SCRIPTS_DEBUG=1
```

- To turn off debug output, either remove the HV_SCRIPTS_DEBUG entry, comment it out, or set the value to 0.

F.6 Managing detector log output

Each instance of an RMS detector writes information to both the switchlog file and to its own dedicated log file, which has a name of the form

```
RELIANT_LOG_PATH/<detector_name>.g<n>log
```

where <*detector_name*> is the name of the detector and <*n*> is the instance number of the detector. There is one such file for every running instance of a detector. Note that the RMS Wizard Tools detectors are named hvdet_<*xxx*>, where <*xxx*> denotes the resource type.

For instance, the log file for the first (and only) *hvdet_system* detector is <*RELIANT_LOG_PATH*>/hvdet_system.g1log.

Resource state changes are recorded in both the switchlog file and the detector's dedicated log file. All other detector messages are recorded only in the dedicated log file.

F.6.1 Debug messages and log levels

Each detector instance maintains an internal 10 KB memory buffer that it uses to maintain debug messages. These are written to the dedicated log file when a debug event (an unexpected resource status report) occurs. The buffer is circular, so when a new message would cause the buffer to overflow, it will instead overwrite one or more of the oldest stored messages. This continues until a debug event causes the entire buffer to be written to the log file, at which time the buffer is reset. Therefore, only the latest messages will be logged. Some older data may be lost, depending on when a debug event occurs.

When the buffer contents are flushed to the log file, the messages are written in chronological order. It is important to note that the latest message in the buffer was generated by the debug event, but earlier messages in the buffer may or may not be related. Therefore, when you examine the detector log, you may find a series of benign messages, followed by a debug event message, followed by more benign messages, followed by another debug event message, etc. This means you must check the timestamp and text of every detector debug message to see if it pertains to the problem you're trying to resolve.

Every message that the detector can generate has an assigned detail level, where higher detail levels produce more debugging information. At runtime, only those messages with a detail level less than or equal to the detector's current log level will be added to the internal buffer. The default value of each detector log level is set to 1.

Note

The amount of information produced by a specific log level depends on the detector resource type. A high log level for one detector may produce less output than a low log level for another detector.

F.6.2 Setting the detector log level

You can set individual log levels for each resource detector from the command line and the RMS Wizard Tools.

Note

To enable detector logging, the RMS base monitor log level must include level 2 (detector tracing), regardless of the individual detector log level settings. By default, the base monitor log level is off, so detector logging is suppressed. See "F.4 Managing base monitor log output".

F.6.2.1 Setting the detector log level with hvutil -L

If RMS is already running, you can use the following commands to manage the detector log level:

```
hvutil -L display <resource>
hvutil -L <level> <resource>
```

The first hvutil command displays the current detector log level for the indicated resource, and the second form of the command sets the log level:

- <*level*> can be either 0 (zero) to turn off logging for the resource, or a positive number to turn on logging at that level.
- <*resource*> is the name of the resource monitored by the detector. This must be a generic resource, *i.e.*, it must be an object of type gResource. You can find these in the 'hvdisp -a' output.

The current log level remains in effect until another 'hvutil -L' command changes the log level, 'hvutil -l off' is issued, or until RMS is shut down.

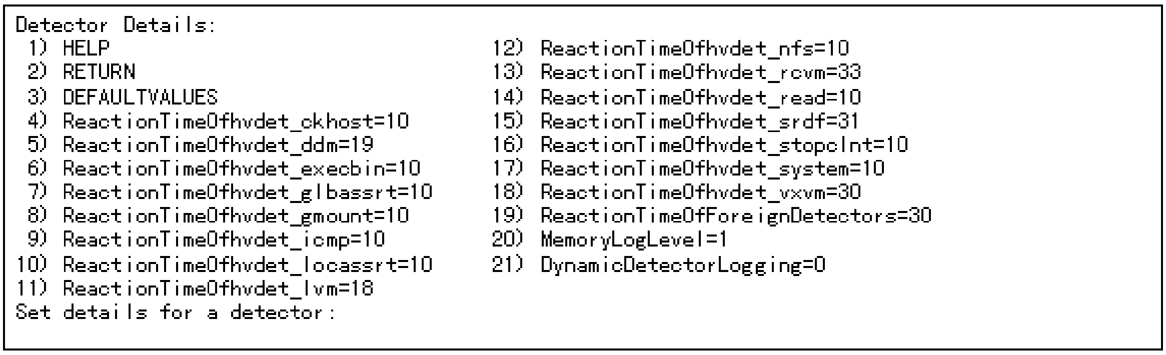
F.6.2.2 Setting the log level in the Wizard Tools

The valid range of log levels is 1 to 9, and the default value is 1. The log level can be modified from the hvw command as follows:

1. Select the Configuration-Edit-Global-Settings menu.

2. Choose the DetectorDetails sub-menu. The following screen is displayed.

Figure F.1 Wizard Tools Detector Details menu



```
Detector Details:
 1) HELP                              12) ReactionTimeOfhvdet_nfs=10
 2) RETURN                            13) ReactionTimeOfhvdet_rcvm=33
 3) DEFAULTVALUES                     14) ReactionTimeOfhvdet_read=10
 4) ReactionTimeOfhvdet_ckhost=10     15) ReactionTimeOfhvdet_srdf=31
 5) ReactionTimeOfhvdet_ddm=19        16) ReactionTimeOfhvdet_stopclnt=10
 6) ReactionTimeOfhvdet_execbin=10    17) ReactionTimeOfhvdet_system=10
 7) ReactionTimeOfhvdet_glbassrt=10   18) ReactionTimeOfhvdet_vxvm=30
 8) ReactionTimeOfhvdet_gmount=10     19) ReactionTimeOfForeignDetectors=30
 9) ReactionTimeOfhvdet_icmp=10       20) MemoryLogLevel=1
10) ReactionTimeOfhvdet_locassrt=10   21) DynamicDetectorLogging=0
11) ReactionTimeOfhvdet_lvm=18
Set details for a detector:
```

3. Select MemoryLogLevel and change the value to the desired level. The log level applies to all detectors.

Changing the log level while running RMS

It is possible to turn debug reporting on or off dynamically from the RMS Wizard detectors by using the hvw command as follows:

1. Select Configuration-Edit-Global-Settings.

2. Choose the DetectorDetails sub-menu.

3. Select the DynamicDetectorLogging menu item.

The default value is 0, which turns off debugging. Values in the range 1 to 9 turn on debugging, and higher numbers produce more information. The volume of generated log messages varies according to the detector, so a high value for one detector may produce fewer messages than a low value for another. Changes to this value do not take effect until the next time the configuration is activated.

Using hvw to turn on dynamic logging actually creates the file <*RELIANT_PATH*>/etc/wizardloglevel, which simply contains the desired debug level as a single-digit ASCII number. You can bypass the hvw command and create (or delete) the wizardloglevel file manually, as long as you observe the following rules:

- If the file does not exist, or If the file contains the number 0 (zero), then debugging is turned off.

- If the file exists but is empty, a value of 3 is assumed.

- If the file contains a value in the range 1 to 9, debugging is turned on.

Note

Turning on debugging should only be done when problems occur. Once the problems are resolved, debugging should be turned off to avoid filling the file system with extraneous information.

F.7 Interpreting RMS log messages

This section describes the format of messages from various RMS components.

F.7.1 switchlog message format

The RELIANT_LOG_PATH/switchlog file records RMS events relevant to the user, such as switch requests and fault indications. It contains the following five message types:

1. Informational messages (notices)

2. Warning messages

3. Error messages

4. Fatal error messages

5. Output from scripts run by RMS

Notices, warnings, errors, and fatal errors

The first four categories of messages all appear in this format:

```
timestamp: (err_code, err_number): msg_type: msg_text: msg_end
```

There is a colon followed by a space (:) between each field of the message. The fields are as follows:

1. *timestamp* has the format

   ```
   yyyy-mm-dd hh:mm:ss.xxx
   ```

2. (*err_code, err_number*) is a two or three letter code denoting the internal component that generated the message, followed by the unique number of the message for that component.

3. *msg_type* is one of the following:

   - NOTICE
   - WARNING
   - ERROR
   - FATAL ERROR

4. *msg_text* is any text generated by the RMS product. This consists of one or more lines of text, each followed by a newline character.

5. *msg_end* is a series four equal signs (====) followed by a newline character. With the terminal newline of the preceding *msg_text* field and the intervening colon-space field delimiter, this appears as a colon, a space, and four equal signs on a separate line in the log file. This uniquely identifies the end of each message, regardless of the number of lines.

For listings of all RMS ERROR and FATAL ERROR messages (without the leading *timestamp* and trailing *msg_end* fields), see "PRIMECLUSTER Messages."

Script output

The fifth category of messages, script output, follows no specific format. These messages are simply the redirected standard output and standard error streams generated by scripts defined in the RMS configuration. They generally have neither a leading *timestamp* field nor a trailing *msg_end* field.

Here is an example of a short sequence of script messages:

```
Starting Reliant Monitor Services now
loadcount: 0
loadcount lt 3
```

F.7.2 Application log message format

Applications and resources configured by the RMS Wizard Tools produce log messages in the following format:

```
resource_name: state: timestamp: msg_type: msg_text: msg_end
```

There is a colon followed by a space (:) between each field of the message. The fields are as follows:

1. *resource_name* is the name of the particular resource node in the RMS graph whose script is running. This field may be empty if no resource is associated with the message.

2. *state* is an indication of the type of action that is being performed, and is the value as set by RMS in the environment variable HV_SCRIPT_TYPE. The field typically contains the values online or offline. The RMS configuration tools also set the field with the value PreCheck, when a PreCheck script is being run. This field will be empty for messages of type DEBUG being printed.

3. *timestamp* contains the date and time when the message was generated. It appears in the format *yyyy-mm-dd hh:mm:ss.xxx*.

4. *msg_type* is one of the following:
    - DEBUG
    - NOTICE
    - WARNING
    - ERROR
    - FATAL ERROR
5. *msg_text* contains the text generated by the RMS Wizard product. This text may consist of more than one line, *i.e.*, it may have embedded newline characters. In general, it is not terminated with a newline character.
6. *msg_end* is a series of four equal signs (====). Since *msg_text* is not usually terminated with a newline, *msg_end* appears on the same line.

F.7.3 Program log message format

RMS consists of a number of individual programs that contribute to the overall high availability management. Each of these programs can generate its own trace and error messages in a dedicated log file, which can be found at

```
RELIANT_LOG_PATH/<program_name>log
```

For example, the RMS base monitor program is named bm, and its dedicated log file is *RELIANT_LOG_PATH*/bmlog.

Program trace and error messages are intended for internal troubleshooting purposes only. The format is described here in case you are asked to provide the information to a PRIMECLUSTER consultant.

Trace messages have the following prefix:

```
timestamp: file: line:
```

Error messages have the following prefix:

```
timestamp: file: line: ERROR
```

Here is an example of a short sequence of trace messages:

```
2005-12-17 14:42:46.256: det_generic.C: 756: Return from GdCheck
2005-12-17 14:42:46.256: det_generic.C: 773: Call to GdGetAttribute
2005-12-17 14:42:46.257: det_generic.C: 775: Return from GdGetAttribute
2005-12-17 14:42:46.257: det_generic.C: 790: reporting state to bm
```

F.8 RMS log file cleanup

RMS provides two methods for housekeeping of its log files:

1. hvlogclean deletes or backs up log files based on elapsed time
2. hvlogcontrol issues warnings or deletes files based on the available space in the file system

Both of these are automatically installed and configured with default settings as part of the RMS installation. This section outlines their functions and lists their control settings.

F.8.1 hvlogclean

The hvlogclean utility saves the current log files into a backup subdirectory of RELIANT_LOG_PATH whose name is the time RMS was last started. If invoked with the -d option, it will delete the current log files rather than copy them. In either case, hvlogclean creates a clean set of log files even while RMS is running.

hvlogclean also purges old files in the backup subdirectory. It determines whether or not a backup file is "old" by checking the value of the RELIANT_LOG_LIFE environment variable. If the backup file is older (in days) than the number in the variable, the file will be deleted. See RELIANT_LOG_LIFE for more information.

F.8.2 hvlogcontrol

The hvlogcontrol utility prevents log files from consuming all the free space on the file system containing *RELIANT_LOG_PATH*. According to the limits set in the configuration, hvlogcontrol can warn the user, delete only the subdirectories in *RELIANT_LOG_PATH*, or delete all RMS log files. See the descriptions of the following RMS environment variables for more information:

- HV_LOG_ACTION_THRESHOLD (global)
- HV_LOG_WARN_THRESHOLD (global)
- HV_LOG_ACTION (local)

Changing these controls requires editing the hvenv.local file and then restarting RMS. See "E.1 Setting environment variables".

Note

hvlogcontrol is invoked periodically from the crontab file. It has no manual page.

F.8.3 Logging of background scripts

A Command Line subapplication can invoke a script that executes another command or script in the background. If the background process writes to stdout or stderr, that output will be directed to a log file that remains open until the process ends normally or is terminated. This will cause the log file to be handled differently when RMS log files are cleaned via the cron job or hvlogclean.

When hvlogclean cleans up old log files, it moves them into a backup directory named according to the time RMS was last started. The open log file of the background process will be moved there, too. Because the background process continues to write into the open file, future output for the process will therefore be found in the backup directory, and not in /var/opt/reliant/log along with the rest of the RMS processes.

If the log file of the background process is removed while the process is still running (for example, either manually or by the 'hvlogclean -d' command), the log file will no longer be visible. However, the file will still exist, and the background process will continue to write into the now-invisible file until the process ends or is stopped.

F.9 RMS troubleshooting

When problems occur, RMS prints out meaningful error messages that will assist you in troubleshooting the cause. If no message is available, the following information may help you diagnose and correct some unusual problems:

- RMS dies immediately after being started.
- At startup, the RMS base monitor exchanges its configuration checksum with the other base monitors on remote nodes. If the checksum of the starting base monitor matches the checksums from the remote nodes, the startup process continues. If the checksums do not match, then the RMS base monitor shuts down if all of the following conditions are true:

  1. The base monitor has encountered a different checksum from a remote monitor within the initial startup period (see "HV_CHECKSUM_INTERVAL").
  2. There are no applications on this node that are online, waiting, busy, or locked.
  3. There are no online remote base monitors encountered by this base monitor.

     Otherwise, the base monitor keeps running, but all remote monitors whose checksums do not match the local configuration checksum are considered to be offline. Therefore, no message exchange is possible with these monitors, and no automatic or manual switchover will be possible between the local monitor and these remote monitors.

  When different checksums are encountered, certain messages are placed in the switchlog explaining the situation.

  Note

  Configuration checksum differences often result when global environment variables are changed manually but inconsistently on different nodes.

Action:

To verify that a configuration checksum difference is not the cause of the problem, ensure that all the nodes have been updated with the proper configuration by using the following procedure:

1. Stop all RMS in the cluster.
2. Determine which configuration to run. Use 'hvdisp -a' or 'hvdisp -T SysNode' on each node to verify the name of the configuration file. (The hvdisp command does not require root privilege.)
   A configuration may have the same name but different contents on two or more nodes if one of the following has occurred:
   - When a previous RMS configuration distribution fails
   - When RMS Wizard Tools are used on multiple nodes in the cluster
3. Activate the correct configuration with the same tool (Wizard Tools) that was used to create it. For the correct procedure, see the section "3.4 Activating a configuration".
   Alternatively, redistribute the existing <*configname*>.us file with one of the following methods:
   - In the RMS Wizard Tools, use Configuration Push.

   Make sure the activation is successful so that all the nodes are updated.
4. Start RMS on all of the nodes in the cluster.

- RMS hangs after startup (processes are running, but hvdisp hangs)
  This problem might occur if the local node is in the CF state LEFTCLUSTER from the point of view of one or more of the other nodes in the cluster.

  Action:

  Verify the problem by using 'cftool -n' on all cluster nodes to check for a possible LEFTCLUSTER state.

  Use 'cftool -k' to clear the LEFTCLUSTER state. RMS will continue to run as soon as the node has joined the cluster. No restart should be necessary.

- RMS loops (or even dies) shortly after being started.

  This problem could occur if the CIP configuration file /etc/cip.cf contains entries for the netmask. These entries are useless (not evaluated by CIP). From the RMS point of view these entries cannot be distinguished from IP addresses, which have the same format, so RMS will invoke a gethostbyaddr(). This normally does no harm, but in some unusual cases the OS may become confused.

  Action:

  Verify the problem by checking if netmask entries are present in /etc/cip.cf.

  Remove the netmask entries, and restart RMS.

- RMS detects a failure of another node, but the node is not killed.

  This problem could occur if SysNode is in the Wait state.

  Action:

  Check the CF state by using cftool -n.

  If the CF state is LEFTCLUSTER, manually stop the LEFTCLUSTER node, and then clear the LEFTCLUSTER state by using cftool -k.

  Once CF state changes from LEFTCLUSTER to DOWN, execute "hvdisp -T SysNode" to see the state of all SysNode objects.

  If there is any SysNode in Wait state, execute "hvutil -u SysNode" to clear the Wait state.

Note

When using the cftool -k command and the hvutil -u command, you must manually stop the node in the Wait state before executing the commands. The execution of these commands may invoke the failover of the applications. Therefore, if you execute these commands without stopping the node in the Wait state, this may cause data corruption.

- The RMS base monitor detects a loss of detector heartbeat, but there is no indication as to the reason for the loss.

  In this case, system administrators collect the information as follows.

  1. Invokes truss(1) or strace(1) to trace the detector process

  2. Turns on full RMS and detector logging with the -l0 (lowercase "L", zero) option

  3. Gathers system and users times for the process

  The truss(1)/strace(1) invocation and logging levels will be terminated after the number of seconds specified in the ScriptTimeout attribute. All information is stored in the switchlog file.

  Note that user-specified operations such as detector tracing will continue on each node, even if it appears to have left the cluster. In extreme cases, turning on high detail trace levels may affect the performance of a node and contribute to delays in its base monitor heartbeat.

  Action:

  See the switchlog for the diagnostic information.

F.10 Collecting information for advanced troubleshooting

The procedures in this section provide advanced debugging information and are intended for use by consultants and developers.

F.10.1 Using the hvdump command (RMS)

The hvdump command collects RMS debugging information on the local node. A normal RMS installation creates the file

```
RELIANT_PATH/bin/hvdump
```

By default, *RELIANT_PATH* is /opt/SMAW/SMAWRrms/. Symbolic links to the same file are also created in /usr/bin/hvdump (which is usually in the default search path) and /opt/SMAW/bin/hvdump.

Invoking hvdump gathers log files and configuration data and places them in the RELIANT_PATH directory in the following archive:

```
<nodename>RMS.<timestamp>.debug_information.tar.<suf>
```

where the suffix <*suf*> is 'gz' on Linux platforms, and 'Z' on Solaris platforms.

The archive file is intended for use by RMS support specialists. The hvdump(1M) manual page presents a detailed list of the files and information included in the archive.

F.11 SNMP Notification of Resource Failure

If an error was detected, SNMP Trap can be sent to the server on which the SNMP manager is running.

By using this function, the SNMP manager can monitor the cluster system.

For details on how to set this function, see "6.10.1 Setting Contents of a Cluster Application" in "PRIMECLUSTER Installation and Administration Guide (Linux)."

For SNMP Trap, the version 2c is used and the following pieces of information are contained in SNMP Trap to be sent.

- OIDs corresponding to the resource types

- Message indicating the resource failure

To send SNMP Trap, the snmptrap command is used and the following operation is performed.

```
snmptrap -v 2c -c <Community name> <Destination host> .1.3.6.1.4.1.211.4.68.257 <OID> s <Message>
```

The following table shows OIDs set for SNMP Trap.

Table F.3 OID set in SNMP Trap

No	OID	Description
1	.1.3.6.1.4.1.211.4.68.257.1	This OID is set when a resource failure occurs in an application or middleware. It is set when a failure is detected in the Cmdline resource, procedure resource, or in middleware resource.
2	.1.3.6.1.4.1.211.4.68.257.2	This OID is set when a network failure occurs. It is set when a failure is detected in the Gls resource, or in the takeover network resource.
3	1.3.6.1.4.1.211.4.68.257.3	This OID is set when a file system failure is detected. It is set when a failure is detected in the Fsystem resource.
4	.1.3.6.1.4.1.211.4.68.257.4	This OID is set when a disk failure is detected. It is set when a failure is detected in the Gds resource.

The message which RMS outputs to switchlog when the resource failure occurs is contained in "Message indicating a resource failure." The message indicates what failure is detected in which resource.

Example of a message:

```
2014-07-28 17:07:09.254:(DET, 7): ERROR: FAULT REASON: Resource <ManageProgram000_Cmd_APP1>
transitioned to a Faulted state due to the resource unexpectedly becoming Offline.
```

You can also confirm the cause and action of the resource failure by searching the message in "PRIMECLUSTER Messages."

Note

- If an error occurs in the communication path between the cluster node and the host on which the SNMP manager is running, the notification of resource failure by SNMP Trap does not work.

- If the userApplication is switched over when the multiple resource failures are detected in one userApplication at the same time, only one of the resource failures will be notified. Check if other resource failures occur in the switchlog file after the cause of the notified resource failure has been removed on the cluster node.

Appendix G RMS command line interface

The primary interface for configuring RMS is the RMS Wizard Tools, and the primary interface for administering RMS is the Cluster Admin GUI. These user interfaces call the RMS command line interface (CLI), and, under certain conditions, you may find it useful to invoke the CLI directly.

The following section lists the RMS CLI commands available to administrators. Specific procedures using some of these commands are described in the "Chapter 7 Controlling RMS operation". For all PRIMECLUSTER commands related to RMS, see the manual pages of each command.

Note

With few exceptions, RMS CLI commands require root privilege. The exceptions are noted in the following list.

G.1 Available RMS CLI commands

hvassert

Tests an RMS resource for a specified resource state. It can be used in scripts when a resource must achieve a specified state before the script can issue the next command. Does not require root privilege.

hvcm

Starts the base monitor and the detectors for all monitored resources. In most cases, it is not necessary to specify options to the hvcm command.The base monitor is the decision-making module of RMS. It controls the configuration and access to all RMS resources. If a resource fails, the base monitor analyzes the failure and initiates the appropriate action according to the specifications for the resource in the configuration file.

hvconfig

Either displays the current RMS configuration or sends the current configuration to an output file. The output of the hvconfig command is equivalent to the running RMS configuration file, but does not include any comments that are in the original file. Also, the order in which the resources are listed in the output might vary from the actual configuration file.

hvdisp

Displays information about the current configuration for RMS resources. Does not require root privilege.

hvdispall

Display the resource information of all the nodes in RMS.

hvdump

Gets debugging information about RMS on the local node.

hvlogclean

Either saves old log files into a subdirectory whose name is the time RMS was last started, or, if invoked with the -d option, deletes old log files. In either case, hvlogclean creates a clean set of log files even while RMS is running.

hvreset

Reinitializes the graph of an RMS user application on one or more nodes in the RMS configuration. Running scripts will be terminated, ongoing requests will be cleaned up, and information about previous failures will be purged.

Note

The entire graph is returned to its initial consistent state by this command, but it may also become an inconsistent state. Therefore, use this command for test purposes only, and never execute it on a production cluster system.

hvsetenv

Provides an interface for changing the following RMS environment variables on the local node:

- HV_RCSTART controls the automatic startup of RMS.
- HV_AUTOSTARTUP controls the automatic startup of all applications.

For more information about these environment variables, see "Appendix E Environment variables".

hvshut

Shuts down RMS on one or more nodes in the configuration. The base monitor on the local node sends a message to other online nodes indicating which node or nodes will be shut down.

hvswitch

Manually switches control of a userApplication or a gResource between SysNodes in the RMS configuration.

hvutil

Provides general administration interface to RMS and performs the following administration tasks.

- Dynamically setting logging levels
- userApplication Offline
- Clearing faulted resources
- Stopping cluster nodes in the Wait state
- Setting detector monitoring time periods
- Setting maintenance mode, and so forth

Note

Setting high logging levels in hvutil can cause disk overflow if enabled for too long. See the section "F.4.1 Managing base monitor log levels" for more information.

Appendix H Release information

This appendix lists information about the changed sections in this manual.

No	Edition	Location	Description
1	Second edition	7.2.1 Overriding automatic application startup	Changed the note in step 2.

Glossary

Items in this glossary that apply to specific PRIMECLUSTER components are indicated with the following notation:

(CF) - Cluster Foundation

(RMS) - Reliant Monitor Services

(SIS) - Scalable Internet Services

Some of these products may not be installed on your cluster. See your PRIMECLUSTER sales representative for more information.

AC (Access Client)

See Access Client.

Access Client

GFS kernel module on each node that communicates with the Meta Data Server and provides simultaneous access to a shared file system.

administrative LAN

In PRIMECLUSTER configurations, an administrative LAN is a private local area network (LAN) on which machines such as the System Console and Cluster operation management PC reside. Because normal users do not have access to the administrative LAN, it provides an extra level of security. The use of an administrative LAN is optional.

See also public LAN.

API

See Application Program Interface.

application (RMS)

In the RMS context, an application object is a special resource used to group other resources into a logical collection. Typically, it is used to represent a real-world application or application suite in a high-availability configuration.

Application Program Interface

A shared boundary between a service provider and the application that uses that service.

application template (RMS)

A predefined group of object definition value choices used by RMS Wizard kit to create object definitions for a specific type of application.

AS

Adaptive Services.

attribute (RMS)

The part of an object definition that specifies how the base monitor acts and reacts for a particular object type during normal operations.

automatic power control

This function is provided by the Enhanced Support Facility (ESF), and it automatically switches the server power on and off.

automatic switchover (RMS)

The procedure by which RMS automatically switches control of a userApplication over to another node after specified conditions are detected.

See also directed switchover (RMS), failover (RMS, SIS), switchover (RMS), symmetrical switchover (RMS).

availability

Availability describes the need of most enterprises to operate applications via the Internet 24 hours a day, 7 days a week. The relationship of the actual to the planned usage time determines the availability of a system.

base cluster foundation (CF)

This RIMECLUSTER module resides on top of the basic OS and provides internal interfaces for the CF (Cluster Foundation) functions that the RIMECLUSTER services use in the layer above.

See also Cluster Foundation (CF).

base monitor (RMS)

The RMS module that maintains the availability of resources. The base monitor is supported by daemons and detectors. Each host being monitored has its own copy of the base monitor.

bm

base monitor.

BMC (Baseboard Management Controller)

A dedicated processor for monitoring and diagnosis of environmental factors (e.g. temperature, voltage) and parts and units.

Cache Fusion

The improved interprocess communication interface in Oracle 9i that allows logical disk blocks (buffers) to be cached in the local memory of each node. Thus, instead of having to flush a block to disk when an update is required, the block can be copied to another node by passing a message on the interconnect, thereby removing the physical I/O overhead.

CCBR (Solaris)

See Cluster Configuration Backup and Restore (Solaris).

CDL

Configuration Definition Language

CF

See Cluster Foundation (CF). Cluster Foundation or Cluster Framework

CF node name (CF)

The CF cluster node name, which is configured when a CF cluster is created.

child (RMS)

A resource defined in the configuration file that has at least one parent. A child can have multiple parents, and can either have children itself (making it also a parent) or no children (making it a leaf object).

See also resource (RMS), object (RMS), parent (RMS).

CIM

Cluster Integrity Monitor

CIP

Cluster Interconnect Protocol

CLI

command line interface

CLM

Cluster Manager

cluster

A set of computers that work together as a single computing source. Specifically, a cluster performs a distributed form of parallel computing.

See also RMS configuration (RMS).

Cluster Admin

A Java-based, OS-independent management tool for PRIMECLUSTER products such as CF, SIS, and RMS. Cluster Admin is available from the Web-Based Admin View interface.

See also Cluster Foundation (CF), Scalable Internet Services (SIS), Reliant Monitor Services (RMS), Web-Based Admin View.

Cluster Configuration Backup and Restore (Solaris)

CCBR provides a simple method to save the current PRIMECLUSTER configuration information of a cluster node. It also provides a method to restore the configuration information.

Cluster Foundation (CF)

The set of PRIMECLUSTER modules that provides basic clustering communication services.

See also base cluster foundation (CF).

cluster interconnect (CF)

The set of private network connections used exclusively for PRIMECLUSTER communications.

Cluster Join Services (CF)

This PRIMECLUSTER module handles the forming of a new cluster and the addition of nodes.

configuration file (RMS)

In the RMS context, the single file that defines the monitored resources and establishes the interdependencies between them. The default name of this file is config.us.

console

See single console.

CRM

Cluster Resource Management

custom detector (RMS)

See detector (RMS).

custom type (RMS)

See generic type (RMS).

daemon

A continuous process that performs a specific function repeatedly.

database node (SIS)

Nodes that maintain the configuration, dynamic data, and statistics in a SIS configuration.

See also gateway node (SIS), service node (SIS), Scalable Internet Services (SIS).

detector (RMS)

A process that monitors the state of a specific object type and reports a change in the resource state to the RMS base monitor.

DHCP

Dynamic Host Control Protocol. A standard method of delivering information to a host at boot time. This is most often used to dynamically assign the host's IP address and netmask, but many other parameters are possible, including domain names, DNS servers, and time servers.

directed switchover (RMS)

The RMS procedure by which an administrator switches control of a userApplication over to another node.

See also automatic switchover (RMS), failover (RMS, SIS), switchover (RMS), symmetrical switchover (RMS).

DLPI

Data Link Provider Interface

DOWN (CF)

A node state that indicates that the node is unavailable (marked as down). A LEFTCLUSTER node must be marked as DOWN before it can rejoin a cluster.

See also UP (CF), LEFTCLUSTER (CF), node state (CF).

Enhanced Lock Manager (ELM) (CF)

A light weight, high performance, highly responsive lock manger, specifically designed for providing a high reliability heartbeat messaging mechanism for PRIMECLUSTER modules.

ENS (CF)

See Event Notification Services (CF).

environment variables

Variables or parameters that are defined globally.

error detection (RMS)

The process of detecting an error. For RMS, this includes initiating a log entry, sending a message to a log file, or making an appropriate recovery response.

Event Notification Services (CF)

This PRIMECLUSTER module provides an atomic-broadcast facility for events.

failover (RMS, SIS)

With SIS, this process switches a failed node to a backup node. With RMS, this process is known as switchover.

See also automatic switchover (RMS), directed switchover (RMS), symmetrical switchover (RMS), switchover (RMS).

Fast switching mode

One of the LAN duplexing modes presented by GLS. This mode uses a multiplexed LAN simultaneously to provide enhanced communication scalability between servers, and highspeed switchover if a LAN failure occurs.

gateway node (SIS)

Gateway nodes have an external network interface. All incoming packets are received by this node and forwarded to the selected service node, depending on the scheduling algorithm for the service.

See also service node (SIS), database node (SIS), Scalable Internet Services (SIS).

generic type (RMS)

An object type which has generic properties. A generic type is used to customize RMS for monitoring resources that cannot be assigned to one of the supplied object types.

See also object type (RMS).

Global Disk Services

This optional product provides volume management that improves the availability and manageability of information stored on the disk unit of the Storage Area Network (SAN).

Global File Services

This optional product provides direct, simultaneous accessing of the file system on the shared storage unit from two or more nodes within a cluster.

Global Link Services

This PRIMECLUSTER optional module provides network high availability solutions by multiplying a network route.

generic type (RMS)

An object type which has generic properties. A generic type is used to customize RMS for monitoring resources that cannot be assigned to one of the supplied object types.

See also object type (RMS).

graph (RMS)

See system graph (RMS).

graphical user interface

A computer interface with windows, icons, toolbars, and pull-down menus that is designed to be simpler to use than the command-line interface.

GUI

See graphical user interface.

high availability

A system design philosophy in which redundant resources are used to avoid single points of failure.

See also Reliant Monitor Services (RMS).

Intelligent Platform Management Interface

A firmware and hardware specification that provides common interfaces for monitoring and managing computers. IPMI operates through an onboard Baseboard Management Controller (BMC) on the target machine to provide OS-independent remote management functions, whether or not the target machine is powered on.

interconnect (CF)

See cluster interconnect (CF).

Internet Protocol address

A numeric address that can be assigned to computers or applications.

See also IP aliasing.

Internode communication facility

This module is the network transport layer for all PRIMECLUSTER internode communications. It interfaces by means of OS-dependent code to the network I/O subsystem and guarantees delivery of messages queued for transmission to the destination node in the same sequential order unless the destination node fails.

I/O

input/output

IP address

See Internet Protocol address.

IP aliasing

This enables several IP addresses (aliases) to be allocated to one physical network interface. With IP aliasing, the user can continue communicating with the same IP address, even though the application is now running on another node.

See also Internet Protocol address.

IPMI

See Intelligent Platform Management Interface.

JOIN (CF)

See Cluster Join Services (CF) .

keyword

A word that has special meaning in a programming language. For example, in an RMS configuration file, the keyword object identifies the kind of definition that follows.

LAN

Local area network.

leaf object (RMS)

A bottom object in a system graph. In the configuration file, this object definition is at the beginning of the file. A leaf object does not have children.

LEFTCLUSTER (CF)

A node state that indicates that the node cannot communicate with other nodes in the cluster. That is, the node has left the cluster. The reason for the intermediate LEFTCLUSTER state is to avoid the network partition problem.

See also UP (CF), DOWN (CF), network partition (CF), node state (CF).

link (RMS)

Designates a child or parent relationship between specific resources.

local area network

See public LAN.

local node

The node from which a command or process is initiated.

See also remote node, node.

log file

The file that contains a record of significant system events or messages. The Wizard Tools, the RMS base monitor, and RMS detectors each maintain their own log files as well.

Management Information Base

A hierarchical database of information about the local network device. The database is maintained by network management software such as an SNMP agent.

See also Simple Network Management Protocol.

MDS

See Meta Data Server.

message

A set of data transmitted from one software process to another process, device, or file.

message queue

A designated memory area which acts as a holding place for messages so they can be processed in the same order they were received.

Meta Data Server

GFS daemon that centrally manages the control information, or meta-data, of a file system.

MIB

See Management Information Base.

MIPC

Mesh Interprocessor Communication.

MMB

Abbreviation for Management Board, which is one of the hardware units installed in PRIMEQUEST.

mount point

The point in the directory tree where a file system is attached.

multihosting

Multiple controllers simultaneously accessing a set of disk drives.

native operating system

The part of an operating system that is always active and translates system calls into activities.

network partition (CF)

This condition exists when two or more nodes in a cluster cannot communicate over the interconnect; however, with applications still running, the nodes can continue to read and write to a shared device, compromising data integrity.

NIC

network interface card

NIC switching mode

One of the LAN duplexing modes presented by GLS. The duplexed NIC is used exclusively, and LAN monitoring between the server and the switching HUB, and switchover if an error is detected are implemented.

node

A host which is a member of a cluster.

node state (CF)

Every node in a cluster maintains a local state for every other node in that cluster. The node state of every node in the cluster must be either UP, DOWN, or LEFTCLUSTER.

See also UP (CF), DOWN (CF), LEFTCLUSTER (CF).

NSM

Node State Monitor

object (RMS)

A representation of a physical or virtual resource in the RMS configuration file or in a system graph.

See also leaf object (RMS), object definition (RMS), object type (RMS).

object definition (RMS)

An entry in the configuration file that identifies a resource to be monitored by RMS. Attributes included in the definition specify properties of the corresponding resource.

See also attribute (RMS), object type (RMS).

object type (RMS)

A category of similar resources monitored as a group, such as disk drives. Each object type has specific properties, or attributes, which limit or define what monitoring or action can occur. When a resource is associated with a particular object type, attributes associated with that object type are applied to the resource.

See also generic type (RMS).

online maintenance

The capability of adding, removing, replacing, or recovering devices without shutting or powering off the host.

operating system dependent (CF)

This module provides an interface between the native operating system and the abstract, OS-independent interface that all PRIMECLUSTER modules depend upon.

Oracle Real Application Clusters (RAC)

Oracle RAC allows access to all data in a database to users and applications in a clustered or MPP (massively parallel processing) platform. Formerly known as Oracle Parallel Server (OPS).

OSD (CF)

See operating system dependent (CF).

parent (RMS)

An object in the configuration file or system graph that has at least one child.

See also child (RMS), configuration file (RMS), and system graph (RMS).

PAS

Parallel Application Services

physical IP address

IP address that is directly assigned to the interface of a network interface card (for example, hme0).

primary node (RMS)

The default node on which a user application comes online when RMS is started. This is always the node name of the first child listed in the userApplication object definition.

PRIMECLUSTER services (CF)

Service modules that provide services and internal interfaces for clustered applications.

private network address

Private network addresses are a reserved range of IP addresses specified by the Internet Corporation for Assigned Names and Numbers (ICANN). Modern switches and routers prevent these addresses from being routed to the Internet, allowing two or more organizations to assign the same private addresses for internal use without causing conflicts or security risks.

private resource (RMS)

A resource accessible only by a single host and not accessible to other RMS hosts.

See also resource (RMS), shared resource.

public LAN

The local area network (LAN) by which normal users access a machine.

See also administrative LAN.

queue

See message queue.

RCCU

Remote Console Control Unit

RCI

Remote Cabinet Interface

redundancy

The capability of one component to assume the resource load of another physically similar component in case the original component fails or is shut down. Common examples include RAID hardware and/or RAID software to replicate data stored on secondary storage devices, multiple network connections to provide alternate data paths, and multiple nodes that can be dynamically reprovisioned to maintain critical services in a cluster.

Reliant Monitor Services (RMS)

The package that maintains high availability of user-specified resources by providing monitoring and switchover capabilities.

remote node

A node that is accessed through a LAN or telecommunications line.

See also local node, node.

reporting message (RMS)

A message that a detector uses to report the state of a particular resource to the base monitor.

resource (RMS)

A hardware or software element (private or shared) that provides a function, such as a mirrored disk, mirrored disk pieces, or a database server. A local resource is monitored only by the local host.

See also private resource (RMS), shared resource.

resource definition (RMS)

See object definition (RMS).

resource label (RMS)

The name of the resource as displayed in a system graph.

resource state (RMS)

Current state of a resource.

RMS

See Reliant Monitor Services (RMS).

RMS commands (RMS)

Commands that enable RMS resources to be administered from the command line.

RMS configuration (RMS)

A configuration made up of two or more nodes connected to shared resources. Each node has its own copy of operating system and RMS software, as well as its own applications.

RMS Wizard kit (RMS)

Each component of RMS Wizard Kit adds new menu items to the RMS Wizard Tools of the specific applications (Oracle and Networker).

See also RMS Wizard Tools (RMS), Reliant Monitor Services (RMS), and wizard (RMS).

RMS Wizard Tools (RMS)

A software package composed of various configuration and administration tools used to create and manage applications in an RMS configuration.

See also RMS Wizard kit (RMS), Reliant Monitor Services (RMS).

route

In the PRIMECLUSTER Concepts Guide, this term refers to the individual network paths of the redundant cluster interfaces that connect the nodes to each other.

SA

Shutdown Agent. SA forcibly stops the target node by receiving instructions from the Shutdown Facility.

SAN (Storage Area Network)

See Storage Area Network.

SC

Scalability Cluster

scalability

The ability of a computing system to efficiently handle any dynamic change in work load. Scalability is especially important for Internet-based applications where growth caused by Internet usage presents a scalable challenge.

Scalable Internet Services (SIS)

The package that dynamically balances network traffic loads across cluster nodes while maintaining normal client/server sessions for each connection.

SCON

See single console.

script (RMS)

A shell program executed by the base monitor in response to a state transition in a resource. The script may cause the state of a resource to change.

SD

Shutdown Daemon

service node (SIS)

Service nodes provide one or more TCP services (such as FTP, Telnet, and HTTP) and receive client requests forwarded by the gateway nodes.

See also database node (SIS), gateway node (SIS), and Scalable Internet Services (SIS).

SF

See Shutdown Facility

shared resource

A resource, such as a disk drive, that is accessible to more than one node.

See also private resource (RMS), resource (RMS).

Shutdown Facility

A facility that forcibly stops a node in which a failure has occurred. When PRIMECLUSTER decides that system has reached a state in which the quorum is not maintained, it uses the Shutdown Facility (SF) to return the cluster system to the quorum state.

Simple Network Management Protocol

A set of protocols that facilitates the exchange of information between managed network devices. The protocols are implemented by software agents residing in the devices. Each agent can read and write data in the local Management Information Base (MIB) in response to SNMP requests from other devices on the network.

See also Management Information Base.

single console

The workstation that acts as the single point of administration for nodes being monitored by RMS. The single console software, SCON, is run from the single console.

SIS

See Scalable Internet Services (SIS).

SNMP

See Simple Network Management Protocol.

state

See resource state (RMS).

Storage Area Network

The high-speed network that connects multiple, external storage units and storage units with multiple computers. The connections are generally fiber channels.

subapplication (RMS)

A part of the configuration template that is designed to configure one resource type for high availability. The RMS configuration may include multiple instances of each resource type. The Generic template contains subapplications for commands, application controllers, IP addresses, virtual network interfaces, local and remote file systems, volume managers, and storage managers.

switching mode

LAN duplexing mode presented by GLS. There are switching mode types: fast switching mode, NIC switching mode, GS/SURE linkage mode (Solaris), GS linkage mode (Linux), virtual NIC mode, and multipath mode (Solaris).

switchover (RMS)

The process by which RMS switches control of a userApplication over from one monitored node to another.

See also automatic switchover (RMS), directed switchover (RMS), failover (RMS, SIS), symmetrical switchover (RMS).

symmetrical switchover (RMS)

This means that every RMS host is able to take on resources from any other RMS host.

See also automatic switchover (RMS), directed switchover (RMS), failover (RMS, SIS), switchover (RMS).

synchronized power control

When the power of one node is turned in the cluster system configured with PRIMEPOWER, this function turns on all other powered-off nodes and disk array unit that are connected to nodes through RCI cables.

system disk (GDS)

Disk on which the active operating system is installed. System disk refers to the entire disk that contains the slices that are currently operating as one of the following file systems (or the swap area):

For Solaris: /, /usr, /var, or swap area

For Linux: /, /usr, /var, /boot, /boot/efi, or swap area

system graph (RMS)

A visual representation (a map) of monitored resources used to develop or interpret the RMS configuration file.

See also configuration file (RMS).

template

See application template (RMS).

type

See object type (RMS).

UP (CF)

A node state that indicates that the node can communicate with other nodes in the cluster.

See also DOWN (CF), LEFTCLUSTER (CF), node state (CF).

virtual disk

A pseudo-device that allows a portion or a combination of physical disks to be treated as a single logical disk. The virtual disk driver is inserted between the highest level of the OS logical input/output (I/O) system and the physical device driver(s), allowing all logical I/O requests to be mapped to the appropriate area on the physical disk(s).

See also subapplication (RMS).

VIP

Virtual Interface Provider

Web-Based Admin View

A Java-based, OS-independent interface to PRIMECLUSTER management components.

See also Cluster Admin.

wizard (RMS)

An interactive software tool that creates a specific type of application using pretested object definitions.

Wizard Kit (RMS)

See RMS Wizard kit (RMS)

Wizard Tools (RMS)

See RMS Wizard Tools (RMS)

XSCF

eXtended System Control Facility

Index