PRIMECLUSTER™
Reliant Monitor Services (RMS) with Wizard Tools (Solaris®, Linux®)
Configuration and Administration Guide

Edition November 2004
Comments… Suggestions… Corrections…

The User Documentation Department would like to know your opinion of this manual. Your feedback helps us optimize our documentation to suit your individual needs.

Fax forms for sending us your comments are included in the back of the manual.

There you will also find the addresses of the relevant User Documentation Department.

Certified documentation according DIN EN ISO 9001:2000

To ensure a consistently high quality standard and user-friendliness, this documentation was created to meet the regulations of a quality management system which complies with the requirements of the standard DIN EN ISO 9001:2000.

cognitas. Gesellschaft für Technik-Dokumentation mbH
www.cognitas.de

Copyright and Trademarks


All rights reserved.
Delivery subject to availability; right of technical modifications reserved.

Solaris and Java are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and other countries.

Linux is a registered trademark of Linus Torvalds.

All other hardware and software names used are trademarks of their respective companies.

This manual is printed on paper treated with chlorine-free bleach.
<table>
<thead>
<tr>
<th>Preface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>Using the Wizard Tools interface (hvw)</td>
</tr>
<tr>
<td>Configuration example</td>
</tr>
<tr>
<td>Administration</td>
</tr>
<tr>
<td>Advanced RMS concepts</td>
</tr>
<tr>
<td>Appendix—Site preparation</td>
</tr>
<tr>
<td>Appendix—Object types</td>
</tr>
<tr>
<td>Appendix—Attributes</td>
</tr>
<tr>
<td>Appendix—Environment variables</td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix—List of manual pages</td>
<td></td>
</tr>
<tr>
<td>Glossary</td>
<td></td>
</tr>
<tr>
<td>Abbreviations</td>
<td></td>
</tr>
<tr>
<td>Figures</td>
<td></td>
</tr>
<tr>
<td>Tables</td>
<td></td>
</tr>
<tr>
<td>Index</td>
<td></td>
</tr>
</tbody>
</table>
# Contents

1  Preface ................................................................. 1
  1.1 About this manual ................................................ 1
  1.2 PRIMECLUSTER documentation list .............................. 2
  1.3 Conventions ......................................................... 4
    1.3.1 Notation ........................................................ 4
      1.3.1.1 Prompts ................................................... 4
      1.3.1.2 Manual page section numbers ............................ 4
      1.3.1.3 The keyboard ............................................. 4
      1.3.1.4 Typefaces ................................................ 5
      1.3.1.5 Example 1 ................................................ 5
      1.3.1.6 Example 2 ................................................ 5
    1.3.2 Command syntax ............................................... 6
  1.4 Important notes and cautions .................................... 6

2  Introduction .......................................................... 7
  2.1 PRIMECLUSTER overview ......................................... 7
  2.2 How RMS provides high availability ............................ 9
    2.2.1 Applications, resources, and objects ....................... 9
    2.2.2 Relationship of RMS configurations to the real world .... 11
    2.2.3 Node and application failover ............................. 13
    2.2.4 Controlled applications and controller objects .......... 14
      2.2.4.1 Follow controllers ..................................... 15
    2.3 How the Wizard Tools provide easy configuration ............ 16
    2.4 RMS wizard products .......................................... 17
      2.4.1 RMS Wizard Tools ........................................... 19
      2.4.2 RMS Wizard Kit ............................................ 19
    2.5 Cluster Admin administration tool ............................ 20
    2.6 RMS components ............................................... 20
      2.6.1 Base monitor ............................................... 20
      2.6.2 Detectors and states ...................................... 21
      2.6.3 Scripts .................................................... 22
    2.7 RMS CLI ........................................................ 23
    2.8 Object types .................................................. 26
    2.9 Object attributes .............................................. 27
    2.10 Environment variables ........................................ 27
      2.10.1 Script execution environment variables ................ 28
    2.11 RMS Directory structure ..................................... 29

3  Using the Wizard Tools interface (hvw) ............................ 31
  3.1 Overview .......................................................... 31
    3.1.1 RMS Wizard types ........................................... 32
## Contents

3.1.1.1 Turnkey wizards ........................................ 33
3.1.1.2 Resource wizards ....................................... 33
3.2 General configuration procedure .......................... 34
3.3 Creating and editing a configuration ..................... 34
3.3.1 Using the wizard menus .................................. 35
3.3.2 Main configuration menu ................................ 36
3.3.2.1 Main configuration menu when RMS is not active .... 36
3.3.2.2 Main configuration menu when RMS is running ...... 40
3.3.3 Secondary menus ........................................ 41
3.3.4 Basic and non-basic settings ............................ 42
3.4 Activating a configuration .................................. 44
3.5 Configuration elements ..................................... 48
3.5.1 Scripts .................................................. 48
3.5.2 Detectors ............................................... 49
3.5.3 RMS objects ............................................ 49
3.6 Further reading .............................................. 50

4 Configuration example ........................................ 53
4.1 Stopping RMS ................................................. 53
4.2 Creating a configuration ..................................... 54
4.3 Adding hosts to the cluster .................................. 55
4.4 Creating an application ..................................... 56
4.5 Entering Machines+Basics settings ....................... 59
4.6 Entering non-basic settings ................................ 64
4.7 Specifying a display ......................................... 66
4.8 Activating the configuration ............................... 69
4.9 Creating a second application ............................... 71
4.10 Setting up a controlling application ................. 75
4.11 Specifying controlled applications ..................... 76
4.12 Activating the configuration a second time .......... 80
4.13 Starting RMS ............................................... 81

5 Administration .................................................. 83
5.1 Overview .................................................... 83
5.2 Using Cluster Admin ........................................ 84
5.2.1 Starting Cluster Admin ................................ 84
5.2.2 Logging in .............................................. 85
5.2.3 Main Cluster Admin window ........................... 89
5.2.4 Cluster Admin message view ........................... 90
5.3 Viewing RMS status and attributes ..................... 91
5.3.1 RMS tree ............................................... 92
5.3.2 Context-sensitive (pop-up) command menus ....... 94
5.3.3 Confirmation pop-up windows ........................ 96
5.3.4 Displaying environment variables .................... 96
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3.5</td>
<td>Displaying object states</td>
<td>98</td>
</tr>
<tr>
<td>5.3.6</td>
<td>Configuration information or object attributes</td>
<td>100</td>
</tr>
<tr>
<td>5.3.7</td>
<td>Viewing RMS log messages</td>
<td>100</td>
</tr>
<tr>
<td>5.3.8</td>
<td>Using the RMS clusterwide table</td>
<td>109</td>
</tr>
<tr>
<td>5.3.8.1</td>
<td>Using context menus from the clusterwide table</td>
<td>112</td>
</tr>
<tr>
<td>5.3.9</td>
<td>Display during RMS configuration changes</td>
<td>112</td>
</tr>
<tr>
<td>5.4</td>
<td>Controlling RMS operation</td>
<td>114</td>
</tr>
<tr>
<td>5.4.1</td>
<td>Starting RMS</td>
<td>114</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Starting RMS automatically at boot time</td>
<td>116</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Stopping RMS</td>
<td>118</td>
</tr>
<tr>
<td>5.4.4</td>
<td>Overriding automatic application startup</td>
<td>123</td>
</tr>
<tr>
<td>5.4.5</td>
<td>Starting an application</td>
<td>125</td>
</tr>
<tr>
<td>5.4.6</td>
<td>Switching an application</td>
<td>126</td>
</tr>
<tr>
<td>5.4.7</td>
<td>Taking an application offline</td>
<td>127</td>
</tr>
<tr>
<td>5.4.8</td>
<td>Activating an application</td>
<td>128</td>
</tr>
<tr>
<td>5.4.9</td>
<td>Clearing a fault</td>
<td>129</td>
</tr>
<tr>
<td>5.4.10</td>
<td>Clearing a SysNode Wait state</td>
<td>130</td>
</tr>
<tr>
<td>5.4.11</td>
<td>Using maintenance mode</td>
<td>131</td>
</tr>
<tr>
<td>5.5</td>
<td>Related administrative procedures</td>
<td>139</td>
</tr>
<tr>
<td>5.6</td>
<td>Using RMS graphs</td>
<td>139</td>
</tr>
<tr>
<td>5.6.1</td>
<td>RMS full graph</td>
<td>140</td>
</tr>
<tr>
<td>5.6.2</td>
<td>Application graph</td>
<td>143</td>
</tr>
<tr>
<td>5.6.3</td>
<td>Subapplication graph</td>
<td>144</td>
</tr>
<tr>
<td>5.6.4</td>
<td>Composite subapplication graph</td>
<td>146</td>
</tr>
<tr>
<td>5.6.5</td>
<td>Using command pop-up menus from the graph</td>
<td>148</td>
</tr>
<tr>
<td>5.6.6</td>
<td>Changing the displayed detail level</td>
<td>149</td>
</tr>
<tr>
<td>5.6.7</td>
<td>Interpreting the graph after RMS shutdown</td>
<td>152</td>
</tr>
<tr>
<td>6</td>
<td>Advanced RMS concepts</td>
<td>153</td>
</tr>
<tr>
<td>6.1</td>
<td>Internal organization</td>
<td>153</td>
</tr>
<tr>
<td>6.1.1</td>
<td>Application and resource description</td>
<td>153</td>
</tr>
<tr>
<td>6.1.2</td>
<td>Messages</td>
<td>154</td>
</tr>
<tr>
<td>6.2</td>
<td>Initializing</td>
<td>154</td>
</tr>
<tr>
<td>6.3</td>
<td>Online processing</td>
<td>159</td>
</tr>
<tr>
<td>6.3.1</td>
<td>Online request</td>
<td>159</td>
</tr>
<tr>
<td>6.3.1.1</td>
<td>Manual methods</td>
<td>160</td>
</tr>
<tr>
<td>6.3.1.2</td>
<td>Automatic methods</td>
<td>160</td>
</tr>
<tr>
<td>6.3.2</td>
<td>PreCheckScript</td>
<td>161</td>
</tr>
<tr>
<td>6.3.3</td>
<td>Online processing in a logical graph of a userApplication</td>
<td>162</td>
</tr>
<tr>
<td>6.3.4</td>
<td>Unexpected reports during online processing</td>
<td>164</td>
</tr>
<tr>
<td>6.3.5</td>
<td>Fault situations during online processing</td>
<td>165</td>
</tr>
<tr>
<td>6.3.6</td>
<td>Initialization when an application is already online</td>
<td>165</td>
</tr>
<tr>
<td>6.4</td>
<td>Offline processing</td>
<td>166</td>
</tr>
<tr>
<td>6.4.1</td>
<td>Offline request</td>
<td>166</td>
</tr>
</tbody>
</table>

U42117-J-Z100-5-76
Contents

6.4.2 Offline processing in a logical graph of a userApplication .... 167
6.4.3 Unexpected reports during offline processing ............... 169
6.4.4 Fault situations during offline processing ................... 169
6.4.5 Object is already in Offline state .......................... 170
6.4.6 Object cannot be sent to Offline state ....................... 170
6.5 Fault processing .............................................. 170
6.5.1 Faults in the online state or request processing ............ 171
6.5.2 Offline faults ................................................. 173
6.5.3 AutoRecover attribute ..................................... 173
6.5.4 Fault during offline processing ............................. 174
6.5.5 Examples of fault processing ............................... 174
6.5.6 Fault clearing ................................................. 176
6.5.7 SysNode faults ............................................... 178
6.5.7.1 Operator intervention .................................. 179
6.6 Switch processing ................................................ 179
6.6.1 Switch request ............................................... 179
6.7 Special states ..................................................... 181
6.7.1 Restrictions during maintenance mode ....................... 181
6.7.2 The Inconsistent state ..................................... 182

7 Appendix—Site preparation ........................................ 185
7.1 Network database files ......................................... 185
7.2 Configuration resource definitions ............................ 187
7.3 File systems—Linux only ..................................... 190
7.4 File systems—Solaris only ..................................... 192
7.4.1 NFS Lock Failover—Solaris only .......................... 195
7.5 Log files .......................................................... 195
7.6 Other system services and databases ......................... 196

8 Appendix—Object types ........................................... 197

9 Appendix—Attributes ............................................... 199
9.1 Attributes available to the user ............................... 199
9.2 Attributes managed by configuration wizards ................ 206

10 Appendix—Environment variables ............................... 211
10.1 Setting environment variables ................................. 211
10.2 Global environment variables ................................. 212
10.3 Local environment variables ................................. 217
10.4 Script execution environment variables ....................... 221

11 Appendix—List of manual pages ................................. 223
11.1 CCBR ............................................................ 223
11.2 CF .............................................................. 223
## Contents

11.3 CFS ................................................................. 224  
11.4 CIP ................................................................. 224  
11.5 Monitoring Agent ............................................ 225  
11.6 PAS ............................................................... 225  
11.7 RCVM ............................................................. 226  
11.8 Resource Database ........................................... 226  
11.9 RMS ............................................................... 227  
11.10 RMS Wizards ................................................ 229  
11.11 SCON ............................................................ 229  
11.12 SF ................................................................. 229  
11.13 SIS ................................................................. 230  
11.14 Web-Based Admin View ................................. 230  

**Glossary** .......................................................... 233  

**Abbreviations** .................................................. 251  

**Figures** ............................................................ 255  

**Tables** ............................................................. 261  

**Index** .............................................................. 263
1 Preface

PRIMECLUSTER™ 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.

The manual is aimed at system administrators who create and maintain RMS configurations. Familiarity with the following system functions and components is assumed:

- PRIMECLUSTER family of products
- Solaris® or Linux® operating system
- Non-PRIMECLUSTER products such as volume managers and storage area networks.

This document assumes that the PRIMECLUSTER software has been installed as described in the PRIMECLUSTER Installation Guide for your operating system.

1.1 About this manual

This manual is structured as follows:

- The chapter “Introduction” on page 7 provides an introduction to RMS terminology and describes basic principles of operation.
- The chapter “Using the Wizard Tools interface (hvw)” on page 31 describes how to configure RMS using the RMS Wizard Tools.
- The chapter “Configuration example” on page 53 illustrates the Wizard Tools configuration process for two simple applications on a small cluster.
- The chapter “Administration” on page 83 discusses how to administer RMS with the Cluster Admin GUI, including the equivalent CLI procedure for some functions.
- The chapter “Advanced RMS concepts” on page 153 provides details about state detection and transition processing.
- The chapter “Appendix—Site preparation” on page 185 describes network and file settings required for RMS operation.
The chapter “Appendix—Object types” on page 197 lists the object types that are supplied with RMS.

The chapter “Appendix—Attributes” on page 199 lists the attributes that are supported by RMS object types.

The chapter “Appendix—Environment variables” on page 211 describes the RMS environment variables.

The chapter “Appendix—List of manual pages” on page 223 lists the manual pages for PRIMECLUSTER.

1.2 PRIMECLUSTER documentation list

The documents listed below provide details about PRIMECLUSTER products. Please contact your sales representative for ordering information.

- **Concepts Guide (Solaris, Linux)**—Provides conceptual details on the PRIMECLUSTER family of products.

- **Installation Guide (Solaris)**—Provides instructions for installing and upgrading PRIMECLUSTER products.

- **Installation Guide (Linux)**—Provides instructions for installing and upgrading PRIMECLUSTER products.

- **Web-Based Admin View (Solaris) Operation Guide**—Provides information on using the Web-Based Admin View management GUI.

- **Web-Based Admin View (Linux) Operation Guide**—Provides information on using the Web-Based Admin View management GUI.

- **Cluster Foundation (CF) (Solaris) Configuration and Administration Guide**—Provides instructions for configuring and administering the PRIMECLUSTER Cluster Foundation.

- **Cluster Foundation (CF) Configuration and Administration Guide (Linux)**—Provides instructions for configuring and administering the PRIMECLUSTER Cluster Foundation.

PRIMECLUSTER documentation list

- **Reliant Monitor Services (RMS) with PCS (Solaris, Linux) Configuration and Administration Guide**—Provides instructions for configuring and administering PRIMECLUSTER Reliant Monitor Services using the PCS (PRIMECLUSTER Configuration Services) interface.

- **Reliant Monitor Services (RMS) (Solaris, Linux) Troubleshooting Guide**—Describes diagnostic procedures to solve RMS configuration problems, including how to view and interpret RMS log files. Provides a list of all RMS error messages with a probable cause and suggested action for each condition.

- **Scalable Internet Services (SIS) (Solaris, Linux) Configuration and Administration Guide**—Provides information on configuring and administering Scalable Internet Services (SIS).

- **Global Disk Services (Solaris) Configuration and Administration Guide**—Provides information on configuring and administering Global Disk Services (GDS).

- **Global File Services (Solaris) Configuration and Administration Guide**—Provides information on configuring and administering Global File Services (GFS).

- **Global Link Services (Solaris) Configuration and Administration Guide: Redundant Line Control Function**—Provides information on configuring and administering the redundant line control function for Global Link Services (GLS).

- **Global Link Services (Solaris) Configuration and Administration Guide: Multipath Function**—Provides information on configuring and administering the multipath function for Global Link Services (GLS).

- **Data Management Tools (Solaris) Configuration and Administration Guide**—Provides reference information on the Volume Manager (RCVM) and File Share (RCFS) products. (Not available in all markets)


- Release notices for all products—These documentation files are included as HTML files on the PRIMECLUSTER Framework CD. Release notices provide late-breaking information about installation, configuration, and operations for PRIMECLUSTER. Read this information first.

- **RMS Wizards documentation package**—Available on the PRIMECLUSTER CD. These documents deal with Wizard Tools topics such as the configuration of file systems and IP addresses. They also describe the various types of available RMS wizards.
PCS Migration Guide—Available on the PRIMECLUSTER CD. Describes procedures for converting configurations from the Wizard Tools environment to PCS.

1.3 Conventions

To standardize the presentation of material, this manual uses a number of notational, typographical, and syntactical conventions.

1.3.1 Notation

This manual uses the following notational conventions.

1.3.1.1 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 `fuji2#` would mean that the command was run as user `root` on the node named `fuji2`.

1.3.1.2 Manual page section numbers

References to operating system commands are followed by their manual page section numbers in parentheses—for example, `cp(1)`.

1.3.1.3 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.
1.3.1.4 Typefaces

The following typefaces highlight specific elements in this manual.

<table>
<thead>
<tr>
<th>Typeface</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>Computer output and program listings; commands, file names, manual page names and other literal programming elements in the main body of text.</td>
</tr>
<tr>
<td><strong>Italic</strong></td>
<td>Variables in a command line that you must replace with an actual value. May be enclosed in angle brackets to emphasize the difference from adjacent text, e.g., <code>&lt;nodename&gt;</code>RMS; unless directed otherwise, you should not enter the angle brackets. The name of an item in a character-based or graphical user interface. This may refer to a menu item, a radio button, a checkbox, a text input box, a panel, or a window title.</td>
</tr>
<tr>
<td><strong>Bold</strong></td>
<td>Items in a command line that you must type exactly as shown.</td>
</tr>
</tbody>
</table>

Typeface conventions are shown in the following examples.

1.3.1.5 Example 1

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

```
root:x:0:0:0000–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):/
```

1.3.1.6 Example 2

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

```
$ cat file
```
1.3.2 Command syntax

The command syntax observes the following conventions.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[]</td>
<td>Brackets</td>
<td>Enclose an optional item.</td>
</tr>
<tr>
<td>{}</td>
<td>Braces</td>
<td>Enclose two or more items of which only one is used. The items are separated from each other by a vertical bar (</td>
</tr>
<tr>
<td></td>
<td>Vertical bar</td>
<td>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.</td>
</tr>
<tr>
<td>()</td>
<td>Parentheses</td>
<td>Enclose items that must be grouped together when repeated.</td>
</tr>
<tr>
<td>...</td>
<td>Ellipsis</td>
<td>Signifies an item that may be repeated. If a group of items can be repeated, the group is enclosed in parentheses.</td>
</tr>
</tbody>
</table>

1.4 Important notes and cautions

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

Contains important information about the subject at hand.

Indicates a situation that can cause harm to data.
2 Introduction

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

This chapter contains the following sections:

- “PRIMECLUSTER overview” on page 7
- “How RMS provides high availability” on page 9
- “How the Wizard Tools provide easy configuration” on page 16
- “RMS wizard products” on page 17
- “Cluster Admin administration tool” on page 20
- “RMS components” on page 20
- “RMS CLI” on page 23
- “Object types” on page 26
- “Object attributes” on page 27
- “Environment variables” on page 27
- “RMS Directory structure” on page 29

2.1 PRIMECLUSTER overview

The PRIMECLUSTER family 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. Figure 1 illustrates the relationship of PRIMECLUSTER services to each other and to the operating system environment.
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. See your sales representative 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.

Other 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.
Introduction

How RMS provides high availability

2.2 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 storage area networks. RMS also monitors the state of each host in the cluster.

2.2.1 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.

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.

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.
Note that RMS does not use detector processes to monitor the state of machines in the cluster. Instead, each node transmits a **heartbeat** signal at regular intervals, and RMS uses this to determine machine states and connectivity.

**Scripts**

Each object type has an associated set of **scripts**. A script is a command string (possibly including pipes, redirection, command interpolation, and variable substitution) that can be executed by the operating system shell—in other words, a valid shell script. Normally, each script is designed to interact with items in the operating system such as user applications or physical resources. Scripts provide the only means for RMS to directly influence items outside its virtual representation.

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.

Scripts are transient: after performing their programmed tasks, they exit and return a status 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, file 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**.
Introduction

How RMS provides high availability

Machines that are members of a cluster are called nodes. Each node that may run one or more applications in the high availability configuration is represented by an RMS 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.

A complete list of the RMS object types supported by the Wizards Tools is presented in the chapter “Appendix—Object types” on page 197.

Shutdown Facility

While scripts and detectors provide a direct interface between RMS and the operating system, the Shutdown Facility (SF) provides an indirect interface to the machines in the cluster. When it necessary to take a SysNode object offline, RMS works with the SF to guarantee that the corresponding node has been physically shut down, or killed. RMS waits for successful completion of the node kill before switching any userApplication from the offline SysNode 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 the PRIMECLUSTER Cluster Foundation (CF) Configuration and Administration Guide for your operating system.

2.2.2 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. Figure 2 illustrates the relationship between an actual user application in the operating system environment and the corresponding userApplication object in an RMS configuration.
How RMS provides high availability

Introduction

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.

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

How RMS provides high availability

Configuration terminology

This manual discusses configuration procedures within the RMS context (represented by the part of Figure 2 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, it is customary to say, “the xyz file system is offline,” rather than the strictly correct but more verbose, “the gResource object named xyz is in the Offline state.” It is also common to refer to a script by its attribute name, e.g., “the script specified by the PreOnlineScript attribute” becomes simply “the PreOnlineScript.”

2.2.3 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 user application to another cluster node.

### 2.2.4 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 Figure 3.

![Parent application with two dependencies](image)

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. Like resource objects, a controller is configured with detectors and scripts: the detectors monitor the state of the child (controlled) application, and the scripts implement appropriate responses by the parent (controlling) application.
Figure 4 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.

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.

If a child changes to an offline or faulted state, RMS will attempt to switch the parent, the child, and the dependent resources to another node.

2.2.4.1 Follow controllers

RMS controllers operate in follow mode: the child application must always run on the same node as the parent. If the parent is switched to another node, the application 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 must be switched there as well.

Assume the teller application tree is originally online on node1 as shown in Figure 4 above. If either the parent or child application needs to be switched to node2 for any reason, the rest of the tree follows. Figure 5 illustrates the result.
How the Wizard Tools provide easy configuration

Introduction

Figure 5: Result of follow mode switchover

Note the state of the controller in Figure 5. Like the child application, it is brought online only on the same node as the parent. Follow controllers can guarantee that a group of applications and their resources remain closely coupled, so they always run together on the same machine.

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 complete discussion, see the chapter “Advanced RMS concepts” on page 153.

2.3 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
Introduction

RMS wizard products

- 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 wizards 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 wizards 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 or SAP R/3, and they are flexible enough to create custom RMS configurations that can control any other type of application.

2.4 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.

Figure 6 depicts the relationship between RMS, the Wizard Tools, and the RMS Wizard Kit.
RMS wizard products

Introduction

Figure 6: Relationship between RMS and RMS Wizards
2.4.1 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

In addition to the basic resource support, the RMS Wizard Tools package contains the `hvw` command, which is the entry point to the user configuration interface. 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.

2.4.2 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

For information on the availability of the RMS Wizard Kit, contact your local customer support service or refer to the RMS Wizards documentation package.
2.5 Cluster Admin administration tool

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

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

2.6 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

2.6.1 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 depicted by objects, their attributes, and their interdependent relationships
- Receives requests from the RMS command line interface (CLI) to take actions
- Monitors the heartbeat from every node to keep track of each machine’s status and its connectivity to the rest of the cluster
Introduction

RMS components

- Receives input from detectors that report 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 as required by a CLI request or in case of a resource or node failure
- Performs various administrative functions

2.6.2 Detectors and states

Detectors are independent processes that monitor specific sets of resources in order to determine their state. The detector does not determine if the current state of a resource is the correct state or not (for example, if a resource is Offline but is supposed to be Online)—that is the role of the base monitor.

Detectors can report the following states to the base monitor:

- **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 resource states may also be displayed in the GUI status area:

- **Deact**  
  Applies to userApplication objects only. Operator intervention has deactivated the application throughout the cluster (such as for maintenance purposes).
RMS components

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconsistent</td>
<td>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.</td>
</tr>
<tr>
<td>OfflineFault</td>
<td>Fault that occurred in the past has not yet been cleared.</td>
</tr>
<tr>
<td>Unknown</td>
<td>No information is available. Reported before object initialization is completed.</td>
</tr>
<tr>
<td>Wait</td>
<td>Temporarily in transition to a known state. An action has been initiated for the affected resource, and the system is waiting for the action to be completed before allocating one of the above states.</td>
</tr>
<tr>
<td>Warning</td>
<td>Some warning threshold has been exceeded.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>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 state, which is the state that would be attained if the application were immediately taken out of maintenance mode. The maintenance mode intended states are Maintenance-Online, Maintenance-Offline, and Maintenance-Standby.</td>
</tr>
</tbody>
</table>

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.

Detectors for common system functions are provided by the Wizard Tools. Additional application-specific detectors are included with the Wizard Kit.

### 2.6.3 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** — Runs only once when RMS is first started
- **PreCheckScript** — Determines if Online or Standby processing is needed or possible
- **PreOfflineScript** — Prepares a transition to an Offline state
- **OfflineScript** — Transitions a resource to an Offline state
- **PreOnlineScript** — Prepares a transition to an Online state
- **OnlineScript** — Transitions a resource to an Online state

State-triggered scripts react to specific events.

The state-triggered scripts are as follows:
- **PostOnlineScript** — Reaction to the transition to the Online state
- **PostOfflineScript** — Reaction to the transition to the Offline state
- **OfflineDoneScript** — Reaction to a userApplication reaching the Offline state
- **FaultScript** — Reaction to a resource transitioning to the Faulted state
- **WarningScript** — Reaction to a detector reporting the Warning state

Scripts for common system functions are included with the subapplications provided by the Wizard Tools.

### 2.7 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, and, under certain conditions, you may find it useful to invoke the CLI directly.

Table 1 lists the RMS CLI commands available to administrators. Specific procedures using some of these commands are described in the chapter “Administration” on page 83. For a complete description of any command’s usage, see its online man page. For a list of all commands related to RMS, see the chapter “Appendix—List of manual pages” on page 223.
With few exceptions, RMS CLI commands require root privilege. The exceptions are noted in the following table.

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>hvassert</td>
<td>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.</td>
</tr>
<tr>
<td>hvattr</td>
<td>Provides an interface for changing the AutoSwitchOver attribute at runtime. The change can be made from a single node in the cluster and will be applied clusterwide for one or more userApplication objects in the currently running configuration. The values No, HostFailure, Resource-Failure, or ShutDown may be specified. hvattr command arguments are specific to objects and attributes in RMS configurations. The user should be familiar with these attributes, which are described in the chapter “Appendix—Attributes” on page 199.</td>
</tr>
<tr>
<td>hvcm</td>
<td>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.</td>
</tr>
<tr>
<td>hvconfig</td>
<td>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.</td>
</tr>
<tr>
<td>hvdisp</td>
<td>Displays information about the current configuration for RMS resources. Does not require root privilege.</td>
</tr>
</tbody>
</table>
### Introduction

**RMS CLI**

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>hvdist</td>
<td>Distributes the configuration file to all nodes within an RMS configuration.</td>
</tr>
<tr>
<td>hvdump</td>
<td>Gets debugging information about RMS on the local node.</td>
</tr>
<tr>
<td>hvgdmake</td>
<td>Makes (compiles) a custom detector so that it can be used in the RMS configuration. The user first prepares a source file for the detector, which must be a file with a <code>.c</code> extension.</td>
</tr>
<tr>
<td>hvlogclean</td>
<td>Either saves old log files into a subdirectory whose name is the time RMS was last started, or, if invoked with the <code>-d</code> option, deletes old log files. In either case, hvlogclean creates a clean set of log files even while RMS is running.</td>
</tr>
<tr>
<td>hvrclev</td>
<td>Displays or changes the run level used for RMS when it is started automatically at system startup. During installation, pkgadd uses hvrclev to set the RMS run level to the default in <code>/etc/inittab</code>. If the system default run level is changed at a later time, the RMS run level should be adjusted accordingly with hvrclev to ensure that RMS starts in the proper sequence. hvrclev may also be used to display the current system default run level.</td>
</tr>
<tr>
<td>hvreset</td>
<td>Reinitializes the graph of an RMS user application on one or more nodes in the configuration. Running scripts will be terminated, ongoing requests and contracts will be cleaned up, and information about previous failures will be purged. If the process is successful, the entire graph will be brought back into a consistent initial state, but an inconsistent state is also a possible result. Therefore, use this command for test purposes only, and never invoke it on a production cluster. <strong>This command is intended for use by experts only.</strong></td>
</tr>
</tbody>
</table>
| 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—Environment variables” on page 211. |

*Table 1: Available CLI commands*
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
- userApplication
- gResource
- andOp
- orOp
- Controller

Refer to the chapter “Appendix—Object types” on page 197 for the supported types, their required attributes, and a description of each object.

2.8 Object types

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>hvshut</td>
<td>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.</td>
</tr>
<tr>
<td>hvswitch</td>
<td>Manually switches control of a user application resource from one system node to another in the RMS configuration. The resource being switched must be of type userApplication. The system node must be of type SysNode.</td>
</tr>
<tr>
<td>hvthrottle</td>
<td>Prevents multiple scripts within a configuration file from running at the same time by creating queues for sequential processing.</td>
</tr>
<tr>
<td>hvutil</td>
<td>Provides general administration interface to RMS. It performs various resource administration tasks, such as dynamically setting logging levels, sending a resource Offline, clearing faulted resources or hung cluster nodes in the Wait state, setting detector time periods, setting Maintenance Mode, and so forth.</td>
</tr>
</tbody>
</table>

Table 1: Available CLI commands
2.9 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 chapter “Appendix—Attributes” on page 199 for the supported types, their associated values, and a description of each attribute.

2.10 Environment variables

RMS uses global and local environment variables:

- Global variables generally control clusterwide operations and must have the same setting on all nodes in the cluster. At runtime, RMS maintains global environment variables in the ENV object.

  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 variables can differ from node to node. RMS maintains local environment variables in the ENVL object.

  RMS creates the ENV and ENVL objects dynamically when the base monitor starts up:

  1. First, it loads global variables from the <RELIANT_PATH>/bin/hvenv file, which is installed with the package.
Environment variables

Caution

Do not modify the `<RELIANT_PATH>/bin/hvenv` file.

2. Next, it loads both global and local variables from the `<RELIANT_PATH>/bin/hvenv.local` file, which contains configuration-specific variables that are typically set by the Wizard Tools. Experts may change the contents of this file manually with a standard text editor. In any case, changes to the `hvenv.local` file will not take effect until the next RMS startup.

- The `RELIANT_PATH` global variable is defined at installation. By default, it is set to `/opt/SMAW/SMAWRrms`.
- A `/tmp` directory that is nearly full may result in RMS errors, because the base monitor uses the `sort` command to sort RMS environment variables.

While RMS is running, you can display the environment variables with the `hvdisp` command, which does not require root privilege:

- Use `hvdisp ENV` to display the global list.
- Use `hvdisp ENVL` to display the local list.

Refer to the chapter “Appendix—Environment variables” on page 211 for a description of all global and local environment variables. The appendix also describes how to change the value of any environment variable.

2.10.1 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 “Script execution environment variables” on page 221 provides a complete description of each of these variables.
2.11 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. Table 2 illustrates the directory structure of the RMS software after it has been correctly installed.

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELIANT_PATH</td>
<td>Base directory. Default: /opt/SMAW/SMAWRrms</td>
</tr>
<tr>
<td><code>&lt;RELIANT_PATH&gt;/bin</code></td>
<td>Executables, including detectors, commands, and scripts.</td>
</tr>
<tr>
<td><code>&lt;RELIANT_PATH&gt;/build</code></td>
<td>Work and storage area for configuration files.</td>
</tr>
<tr>
<td><code>&lt;RELIANT_PATH&gt;/etc</code></td>
<td>Miscellaneous files used by RMS and the configuration tools.</td>
</tr>
<tr>
<td><code>&lt;RELIANT_PATH&gt;/include</code></td>
<td>RMS include files (header files) used by detectors and configuration files.</td>
</tr>
<tr>
<td><code>&lt;RELIANT_PATH&gt;/lib</code></td>
<td>RMS runtime libraries.</td>
</tr>
<tr>
<td><code>&lt;RELIANT_PATH&gt;/us</code></td>
<td>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.</td>
</tr>
</tbody>
</table>

Table 2: RMS base directory structure

As summarized in Table 3, RMS log files are located in the directory specified in the `RELIANT_LOG_PATH` environment variable.
## RMS Directory structure

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELIANT_LOG_PATH</td>
<td>Contains files that can be used for RMS analyzing and debugging. The base monitor and detectors create log files here. <strong>Default:</strong> <code>/var/opt/SMAWRrms/log</code>&lt;br&gt;The same directory has subdirectories that contain backup copies of the RMS log files. Each backup subdirectory has a name of the form <code>yyyy-mm-dd_HH:MM:SS</code> to indicate the date and time when the backup was created.</td>
</tr>
</tbody>
</table>

Table 3: Log directory structure
3 Using the Wizard Tools interface (hvw)

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

- The section “Overview” on page 31 gives a brief overall description of the configuration process and the RMS Wizards.
- The section “General configuration procedure” on page 34 outlines the four major steps involved in every configuration procedure.
- The section “Creating and editing a configuration” on page 34 describes the wizard interface and how it is used to specify a configuration.
- The section “Activating a configuration” on page 44 describes how to activate a configuration after it has been created or modified.
- The section “Configuration elements” on page 48 provides additional details about basic RMS elements specified in every configuration.
- The section “Further reading” on page 50 contains a list of related documents that provide additional information about the wizards.

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

3.1 Overview

The chapter “Introduction” on page 7 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
Overview

Using the Wizard Tools interface (hwv)

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 hwv menu-based configuration interface
  - The GENERIC application wizard, which allows you to configure a wide range of applications
  - The DEMO wizard, which provides a simple demonstration of the Wizard Tools and RMS
  - 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 GENERIC and DEMO 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 R/3 and ORACLE wizards are components of the Wizard Kit.

For information on the availability of the RMS Wizard Kit, contact your local customer support service or refer to the RMS Wizards documentation package. See the section “Further reading” on page 50 for more information.
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 are designed to configure a specific type of application. The configuration described in the chapter “Configuration example” on page 53 uses the GENERIC and DEMO turnkey wizards. Other examples are the R/3 wizard and the ORACLE wizard. By convention, turnkey wizards have names with all uppercase letters.

3.1.1.2 Resource wizards

Resource wizards (sometimes called sub-application wizards) configure lower-level resources such as file systems or IP addresses. They are invoked by turnkey wizards and are not designed to interact directly with the user. Resource wizards have names that begin with one uppercase letter followed by one or more lowercase letters. 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 send the resource offline) and `CheckScript` (to check the state of a resource).
- **Controller**—Configures applications that control other applications.
- **Fsystem**—Configures local or remote file systems.
- **Gds**—Configures disk classes administrated by Global Disk Services (GDS).
- **Gls**—Configures the IP addresses administrated by Global Link Services (GLS).
- **Ipaddress**—Configures the IP addresses that are needed for communication over a LAN interface.
- **Rcvm**—Configures disk groups administrated by the PRIMECLUSTER Volume Manager (not available in all areas).
- **Vxvm**—Configures disk groups administrated by the Veritas volume manager (not available in all areas).
3.2 General configuration procedure

RMS configuration always involves these four steps:

► Stop RMS.
   Refer to the section “Stopping RMS” on page 118. You can use the Cluster Admin GUI or the command line interface from any node in the cluster.

► Create or edit the configuration.
   The next section provides general information, and the chapter “Configuration example” on page 53 walks through an example.

► Activate the configuration.
   Activation includes generation and distribution. See the section “Activating a configuration” on page 44.

► Start RMS.
   Refer to the section “Starting RMS” on page 114. You can use the Cluster Admin GUI or the command line interface from any node in the cluster.

To avoid network access problems, perform RMS configuration tasks as root, and ensure that CF is installed, properly configured, and running as described in the PRIMECLUSTER Installation Guide for your operating system.

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.
Using the Wizard Tools interface (hwv)  **Creating and editing a configuration**

- `hwv -n configname`

    Edits an existing configuration or creates a new configuration using the specified name. The configuration will be stored in the `RELANT_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 `mydemo` using the DEMO turnkey wizard. This example would be called up as follows:

```
hwv -n mydemo
```

The `hwv` command is documented in the online manual pages. Refer to the chapter “Appendix—List of manual pages” on page 223 for additional information.

### 3.3.1 Using the wizard menus

The `hwv` 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.
Creating and editing a configuration Using the Wizard Tools interface (hwv)

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. Figure 7 shows the Main configuration menu window when RMS is inactive.

```
Fujii2: Main configuration menu, current configuration: mydemo
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:
```

Figure 7: Main configuration menu when RMS is not active
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. This mode is highly recommended because it simplifies complicated tasks like creating linkages between application and sub-applications.

  - Non-turnkey mode (only for expert users)—Non-turnkey mode is meant for advanced/expert users only. If this mode is to be used, some rules must be followed. Otherwise, the resulting configuration may remain in an inconsistent state and RMS will not start. Usage of this mode is not within the scope of this guide.

- **Application-Remove**—Removes an existing application from the high-availability configuration.
Creating and editing a configuration Using the Wizard Tools interface (hwv)

- **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.

- **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).

  **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. If one or more nodes is not available during the distribution phase, you can later use **Configuration-Push** (described in the next section) to update only those nodes.

  **Configuration-Activate** is not available if RMS is already running on one or more nodes.

- **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.
Using the Wizard Tools interface (hvw) 

Creating and editing a configuration

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

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

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

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

- 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. This item is also used to specify the alternate interconnects (AlternateIps) for the cluster.

- 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 Live-Info, 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.

- 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.

- 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.
Creating and editing a configuration Using the Wizard Tools interface (hwv)

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 Figure 8.

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

Figure 8: Main configuration menu when RMS is running

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.

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


Using the Wizard Tools interface (hw) **Creating and editing a configuration**

- **Configuration-Remove**—Removes (deletes) any existing configuration except the one that is currently running.
- **Configuration-Push**—Distributes a complete copy of the currently running configuration to a specific cluster node.

When a configuration is activated, some nodes may not be available. This menu item allows you to update individual cluster nodes that are brought up later, when RMS is already running. For example, if you changed the configuration while a node was down for maintenance, you could use **Configuration-Push** to update the node after it was restarted.

*Configuration-Push* is available only after the configuration has been activated.

- **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** (Figure 9) is an example of a secondary menu. You see this menu after selecting **Application-Create** from the main menu.

```plaintext
Creation: Application type selection menu:
1) HELP
2) QUIT
3) RETURN
4) OPTIONS
5) DEMO
6) GENERIC
7) LIVECACHE
8) R3ANY
9) R3CI
10) RTP
Application Type: 5
```

Figure 9: Application type selection
Creating and editing a configuration Using the Wizard Tools interface (hwv)

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

This option allows you to select an application type to be assigned to the application in question. This is an important step in the configuration procedure since it invokes the specific application-type wizard to provide all the predefined elements (for example, scripts and detectors) that go with that application type.

The chapter “Configuration example” on page 53 shows how to use some of the secondary menus. A more detailed description of these menus is given in the RMS Wizards documentation package.

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 5) DEMO produces the menu in Figure 10.

```
Consistency check ...
Yet to do: process the basic settings using Machines+Basics
Yet to do: choose a proper application name

Settings of turnkey wizard "DEMO"
1) HELP
2) NO-SAVE+EXIT
3) SAVE+EXIT
4) REMOVE+EXIT
5) ApplicationName=APP3
6) BeingControlled=no
7) Machines+Basics(-)
Choose the setting to process: 7
```

Figure 10: Menu leading to basic settings

If you select 7) Machines+Basics, you can configure the basic settings using the menu in Figure 11.
Using the Wizard Tools interface (hwv) **Creating and editing a configuration**

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 (Figure 12). Non-basic settings include specifications for resources such as file systems, IP addresses, disks, and so forth.

---

**Figure 11: Menu to configure basic settings**

Choose the setting to process:

Consistency check ...

Machines+Basics (appl: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]=FujigoRMS 20) (StandbyTransitions=)
8) (PreCheckScript=) 21) (LicenseToKill=no)
9) (PreOnlineScript=) 22) (AutoBreak=yes)
10) (PostOnlineScript=) 23) (HaltFlag=no)
11) (PreOfflineScript=) 24) (PartialCluster=0)
12) (OfflineDoneScript=) 25) (ScriptTimeout=)
13) (FaultScript=)
Consistency check ...
Yet to do: process at least one of the non-basic settings

Settings of turnkey wizard "DEMO"
1) HELP                          11) RemoteFileSystems(-)
2) -                            12) IpAddresses(-)
3) SAVE+EXIT                    13) RawDisks(-)
4) -                            14) RC-VolumeManagement(-)
5) ApplicationName=APP1         15) VERITAS-VolumeManagement(-)
6) Machines+Basics(app1)        16) EMC-RdfManagement(-)
7) CommandLines(-)              17) FibreCat-MirrorView(-)
8) Controllers(-)              18) Gds:Global-Disk-Services(-)
9) DEMO(-)                      19) Gls:Global-Link-Services(-)
10) LocalFileSystems(-)

Choose the setting to process:

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 section “General configuration procedure” on page 34, 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.

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

The starting point for the activation phase is the Main configuration menu (see Figure 13).
Using the Wizard Tools interface (hvw)  

Activating a configuration

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 Figure 14).

---

**Figure 13: Main configuration menu**

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) HELP</td>
<td>Help</td>
</tr>
<tr>
<td>2) QUIT</td>
<td>Quit</td>
</tr>
<tr>
<td>3) Application-Create</td>
<td>Create application</td>
</tr>
<tr>
<td>4) Application-Edit</td>
<td>Edit application</td>
</tr>
<tr>
<td>5) Application-Remove</td>
<td>Remove application</td>
</tr>
<tr>
<td>6) Application-Clone</td>
<td>Clone application</td>
</tr>
<tr>
<td>7) Configuration-Generate</td>
<td>Generate configuration</td>
</tr>
<tr>
<td>8) Configuration-Activate</td>
<td>Activate configuration</td>
</tr>
<tr>
<td>9) Configuration-Copy</td>
<td>Copy configuration</td>
</tr>
<tr>
<td>10) Configuration-Remove</td>
<td>Remove configuration</td>
</tr>
<tr>
<td>11) Configuration-Freeze</td>
<td>Freeze configuration</td>
</tr>
<tr>
<td>12) Configuration-Thaw</td>
<td>Thaw</td>
</tr>
<tr>
<td>13) Configuration-Edit-Global-Settings</td>
<td>Edit-Global-Settings</td>
</tr>
<tr>
<td>14) Configuration-Consistency-Report</td>
<td>Consistency-Report</td>
</tr>
<tr>
<td>15) Configuration-ScriptExecution</td>
<td>ScriptExecution</td>
</tr>
<tr>
<td>16) RMS-CreateMachine</td>
<td>Create machine</td>
</tr>
<tr>
<td>17) RMS-RemoveMachine</td>
<td>Remove machine</td>
</tr>
</tbody>
</table>

Choose an action: 8
Activating a configuration

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 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.

- **i** 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.

---

About to activate the configuration mydemo ...

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/mydemo/mydemo.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

---
Using the Wizard Tools interface (hw)  

Activating a configuration

Press [Enter] to return to the Main configuration menu (see Figure 15).

Figure 15: Quitting the Main configuration menu

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.

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.

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.

The RMS Wizards provide a complete set of scripts for several pre-defined application types such as R/3 or Oracle. If you assign your application to one of these standard types, you automatically take advantage of the built-in scripts.

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, which is described in the section "Further reading" on page 50.
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.

Like the built-in scripts described in the previous section, the RMS Wizards provide built-in detectors for pre-defined application types. If you assign your application to one of these standard types, it automatically uses the built-in detectors.

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**—Provides a dependency linkage so that a 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.
Further reading

Using the Wizard Tools interface (hvw)

3.6 Further reading

The preceding sections were intended to make the reader familiar with some basic concepts and methods of the RMS Wizards. More information may be obtained from a number of documents that provide further reading on these tools and the way they are used.

RMS Wizards documentation package

The RMS Wizards documentation package is available in HTML format on the PRIMECLUSTER CD-ROM. After installation, the documents can also be found in the following locations:

/opt/SMAW/SMAWRrms/htdocs.solaris/wizards.en/ (Solaris)
/usr/doc/packages/SMAWRhv-do/wizards.en/ (Linux)

The information is presented in the following files and subdirectories:

- feature_description.htm
  Describes the features added to recent versions of the RMS Wizard Tools.

- primer.htm
  Provides an introduction to the RMS Wizards, covering many features in more detail than is possible in this chapter.

- wizards/
  Provides information on individual wizards of all three kinds described in this chapter. Covers turnkey wizards, resource wizards, and other wizards, including the generic wizard.

- scripts_and_tools/
  Provides information on some scripts and tools that may be useful in setting up a high-availability configuration by means of the RMS Wizards. Includes gresources.htm, which contains descriptions of a number of detectors.

- manuals/
  Provides current manual pages for commands that are frequently used to configure an application with the RMS Wizards. The hvw and the hvexec commands, which were also described in this chapter, are explained here in more detail.
Using the Wizard Tools interface (hvw)

Further reading

Manual pages

Information on the commands that are used for configuration with the RMS Wizards may also be obtained by calling up the online manual pages with the \texttt{man} command.

Manual pages are available, for instance, for the \texttt{hvw}, \texttt{hvcm}, and \texttt{hvexec} commands, which were used in the procedures described in this chapter.
Further reading

Using the Wizard Tools interface (hvw)
4  Configuration example

This chapter provides an example of the configuration process using the RMS Wizards. Two simple applications are configured for operation on a small cluster. The example includes the following steps:

- “Stopping RMS” on page 53
- “Creating a configuration” on page 54
- “Adding hosts to the cluster” on page 55
- “Creating an application” on page 56
- “Entering Machines+Basics settings” on page 59
- “Entering non-basic settings” on page 64
- “Specifying a display” on page 66
- “Activating the configuration” on page 69
- “Creating a second application” on page 71
- “Setting up a controlling application” on page 75
- “Specifying controlled applications” on page 76
- “Activating the configuration a second time” on page 80
- “Starting RMS” on page 81

An abbreviated version of this example appears in the PRIMECLUSTER Installation Guide for your operating system.

To avoid network access problems, perform RMS configuration tasks as root, and ensure that CF is installed, properly configured, and running as described in the PRIMECLUSTER Installation Guide for your operating system.

4.1  Stopping RMS

Before you create or edit a configuration, ensure that RMS is not active on any machine that would be affected by the changes. You can use the Cluster Admin GUI (see the section “Stopping RMS” on page 118) or you can enter the following command to stop RMS on all nodes from any machine in the cluster:

```bash
# hvshut –a
```
4.2 Creating a configuration

Enter the following command to generate the wizard menu for the configuration example, mydemo:

```
# hvw -n mydemo
```

This will create an RMS configuration file named `mydemo.us` in the `/opt/SMAW/SMAWRms/build/` directory. If you choose a different name and location, the combined length of the file name and path should not exceed 80 characters.

The RMS configuration menu appears, displaying the name of the configuration at the top of the menu (Figure 16).

```
fuji2: Main configuration menu, current configuration: mydemo
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:
```

Figure 16: Main configuration menu
4.3 Adding hosts to the cluster

Before you configure an application, you must define the cluster so that it includes all hosts on which the application may run. The names of all possible RMS hosts should have already been added to the `/etc/hosts` file (see “Appendix—Site preparation” on page 185).

Select the nodes to be included in the configuration. See “Appendix—Cluster planning worksheet” in the PRIMECLUSTER Installation Guide for your operating system.

This example assumes `/etc/hosts` contains the following entries, which follow the RMS naming convention:

```
# host names for RMS
192.168.10.83    fuji2RMS
192.168.10.84    fuji3RMS
```

By default, RMS host names are of the form `<hostname>RMS` to follow the RMS naming convention. To override the default RMS name for a machine, edit that host's `hvenv.local` file and set the `RELIANT_HOSTNAME` variable to the desired name. The contents of that host's `RELIANT_HOSTNAME` variable must match the corresponding `/etc/hosts` entry on every host in the cluster. This must be done before you start the Wizard Tools (`hvw`). If RMS is running, you must also restart RMS.

In this step, you will add the RMS hosts to the cluster.

- At the Main configuration menu, enter the number 16. The Add hosts to a cluster menu appears (Figure 17).

```
Creation: Add hosts to a cluster:
Current set:
  1) HELP
  2) QUIT
  3) RETURN
  4) FREECHOICE
  5) ALL-CF-HOSTS
  6) fuji2RMS
  7) fuji3RMS
Choose the host to add: 7
```

Figure 17: Add hosts to a cluster menu
Creating an application

This menu displays the current set of nodes and lists the machines that can be selected. If you select 5) *ALL-CF-HOSTS*, the RMS Wizards add all nodes in `/etc/cip.cf` to this configuration. Otherwise, you can add hosts individually from the displayed list.

- Select *fuji2RMS* by entering the number 6. Select *fuji3RMS* by entering the number 7 (see Figure 17).

At this screen, you can also choose 4) *FREECHOICE*, which will allow you to enter host names that are not listed in the menu.

- After all host names have been added, use 3) *RETURN* to return to the *Main configuration menu*.

To remove a node, select 17) *RMS-RemoveMachine* from the *Main configuration menu*. The *Remove hosts from a cluster menu* appears (Figure 18).

```
Removal: Remove hosts from a cluster:
Current set: fuji2RMS fuji3RMS
Choose the host to remove:
1) HELP
2) QUIT
3) RETURN
4) ALL
5) fuji2RMS
6) fuji3RMS
```

Figure 18: Remove hosts from a cluster menu

This menu lists all nodes currently in the cluster. Machines can be removed by selecting them individually or by selecting 4) *ALL* from the menu. In either case, machines being used by one or more applications cannot be removed.

### 4.4 Creating an application

After you have defined the set of hosts that form the cluster, you can configure an application that will run on those hosts. In this step, we will first create the application using the DEMO turnkey wizard. Begin at the *Main configuration menu* (Figure 19).
Configuration example

Creating an application

figure 19: main configuration menu

Select Application-Create by entering the number 3. The Application type selection menu appears (Figure 20).

Figure 20: Application type selection menu

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

This example uses the DEMO application type, which has been designed to familiarize the user with the configuration process and is intended for demonstration purposes only: other than a few user-specified attributes, everything is
Creating an application

preset and ready to run. To configure a real-world application, you would instead select the GENERIC application type, as described in the section “Creating a second application” on page 71.

- Select the DEMO application type by entering the number 5.

You have now assigned the DEMO application type to your application. This means the DEMO turnkey wizard will provide the application with scripts and detectors that were developed for this application type.

There are, however, more parameters to specify before this application can run. One of them might be the application name; you can assign a name of your choice to any application that you configure for RMS. In this case, there is no need to specify an application name, as the DEMO wizard provides APP1 as a default here.

APP1 is a simple application, developed specifically for this example, that generates an animated graphical figure on an X-window display. It will be used to demonstrate how an application can be started, stopped, or switched, and how RMS performs failover when the application process is killed on the initial node.

After performing a consistency check, the wizard informs you what to do next (see Figure 21).

```
Consistency check ...
Yet to do: process the basic settings using Machines+Basics
Yet to do: choose a proper application name

Settings of turnkey wizard "DEMO"
1) HELP
2) NO=SAVE+EXIT
3) SAVE+EXIT
4) REMOVE+EXIT
5) ApplicationName=APP1
6) BeingControlled=no
7) Machines+Basics(-)

Choose the setting to process: 7
```

Figure 21: Prompting for further actions

At each step, the wizard checks the consistency of the application being configured. Only consistent applications are allowed to be part of the high-availability configuration.
If you want to specify a different application name, you could do it here by selecting 5) ApplicationName. However, because we are using the default of APP1, the Yet to do message will disappear after you select 7) Machine+Basics.

4.5 Entering Machines+Basics settings

- Select Machines+Basics by entering the number 7. The Machines+Basics menu appears (Figure 22).

![Figure 22: Consistency check and Machines+Basics menu](image)

At the top of the menu, the wizard shows you the result of the latest consistency check. The application named APP1, which was indicated on the previous screen, has proven to be consistent.

The Machines[0] menu item indicates the node where your application will first attempt to come online. In this case, it is fuji2RMS.

The RMS Wizards retrieve the default settings for Machines[0] from the local node defined in RELIANT_HOSTNAME.
Entering Machines+Basics settings

Configuration example

Subsequent Machines[] items, if any, indicate the list of failover nodes. If the initial node fails, RMS will attempt to switch the application to a failover node, trying each one in the list according to the index order.

At this point, only the initial node appears in the menu, so configure a failover node for your application as follows:

- Select AdditionalMachine by entering the number 5. A menu containing the current list of available nodes appears (Figure 23).

```
1) HELP
2) RETURN
3) fuji2RMS
4) fuji3RMS
Choose a machine for this application: 4
```

Figure 23: List of nodes for failover procedure

The Wizards retrieve the default list of nodes from the CIP configuration file, /etc/cip.cf.

Since our application is presently configured for fuji2RMS, we will select fuji3RMS as the additional node:

- Select fuji3RMS by entering the number 4.

In the menu that follows (Figure 24) you will see your selection confirmed. fuji3RMS now appears under Machines[] as the additional node. If there is a failure on fuji2RMS, your application is configured to switch over to fuji3RMS.
Configuration example  Entering Machines+Basics settings

At this point, the default value of No is specified for 16) AutoSwitchOver. This means that to actually switch your application over, manual action would be required.

To have the switchover procedure carried out automatically, you have to select 16) AutoSwitchOver in this menu, and then specify the desired mode(s) from the menu that follows (Figure 25).

```
Choose the setting to process: 16
```

```
Set flags for AutoSwitchOver:  Currently set: NO (N)
  1) HELP
  2) -
  3) SAVE+RETURN
  4) DEFAULT
  5) NO(N)
  6) HOSTFAILURE(H)
  7) RESOURCEFAILURE(R)
  8) SHUTDOWN(S)

Choose one of the flags: 6
```

Figure 25: AutoSwitchOver mode
Entering Machines+Basics settings

- Set a flag by entering the number 6 for HOSTFAILURE. This means that RMS switches an application to another node automatically in the case of a node failure.

```
Set flags for AutoSwitchOver: Currently set: HOSTFAILURE (H)
1) HELP
2) -
3) SAVE+RETURN
4) DEFAULT
5) NO(N)
6) NOT:HOSTFAILURE(H)
7) RESOURCEFAILURE(R)
8) SHUTDOWN(S)
```

Choose one of the flags: 7

Figure 26: Setting flags for AutoSwitchOver mode

- Enter the number 7 for RESOURCEFAILURE (see Figure 26). This means that RMS switches an application to another node automatically in the case of a resource failure.

- Enter the number 3 for SAVE+RETURN (see Figure 26).

You will be returned to the Machines+Basics menu (Figure 27). Note that item 16 now displays the AutoSwitchOver flags you just set.
Configuration example  Entering Machines+Basics settings

Consistency check ...

Machines+Basics (appl:consistent)
1) HELP
2) –
3) SAVE+EXIT
4) REMOVE+EXIT
5) AdditionalMachine
6) AdditionalConsole
7) Machines[0]=fuji2RMS
8) Machines[1]=fuji3RMS
9) (PreCheckScript=)
10) (PreOnlineScript=)
11) (PostOnlineScript=)
12) (PreOfflineScript=)
13) (OfflineDoneScript=)
14) (FaultScript=)
15) (AutoStartUp=no)
16) (AutoSwitchOver=HostFailure|ResourceFailure)
17) (PreserveState=no)
18) (PersistentFault=0)
19) (ShutdownPriority=)
20) (OnlinePriority=)
21) (StandbyTransitions=)
22) (LicenseToKill=no)
23) (AutoBreak=yes)
24) (HaltFlag=no)
25) (PartialCluster=0)
26) (ScriptTimeout=)

Choose the setting to process: 3

Figure 27: Saving settings

Save your settings now to complete the Application-Create process.

► Select SAVE+EXIT by entering the number 3.
4.6 Entering non-basic settings

The DEMO turnkey wizard performs another consistency check before returning you to the wizard settings menu (Figure 28).

![Consistency check](image)

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.

The menu header indicates there is at least one more setting to specify, but it is not a basic setting.

As described earlier, this application creates an animated graphical picture on an X-window display. Therefore, a display setting for the DEMO wizard must be added to the basic settings you have already entered.

- Select DEMO by entering the number 9. The CommandLines menu appears (Figure 29).
Configuration example

Entering non-basic settings

Consistency check ...
Yet to do: set a display

CommandLines (Dem_APP1: not yet consistent)
1) HELP
2) -
3) SAVE+EXIT
4) REMOVE+EXIT
5) Display=
6) StartCommands[0] = 'hvexec~F~demo~-c'
7) StopCommands[0] = 'hvexec~F~demo~-~-u'
8) CheckCommands[0] = hwdet_demo
9) (Timeout=300)
10) (AutoRecover=no)
11) (MonitorOnly=no)

Choose the setting to process: 5

Figure 29: Prompting for display specification

The menu header indicates that a display still needs to be specified, and the status line tells you that APP1 is not yet consistent; that is, APP1 could not yet run with the present mydemo configuration.

Because the DEMO wizard has been customized for demonstration purposes, some of the items in the menu have been predefined. Items in the menu body indicate the scripts provided by the wizard for starting, stopping, and checking: see the lines beginning with 6) StartCommands[0]=, 7) StopCommands[0]=, and 8) CheckCommands[0]=.

For technical reasons, spaces are displayed as tildes (~) within the wizard menu commands. The actual commands do not have tildes.
Spezifizierung einer Anzeige  

KONFIGURATION BEISPIEL

4.7 Spezifizierung einer Anzeige

Spezifizieren Sie die Anzeige im Menü CommandLines wie folgt:

- Wählen Sie Display, indem Sie die Nummer 5 eingeben. Eine Liste von Anzeigeneinstellungen wird angezeigt (Abbildung 30).

Abb. 30: Liste der Anzeigeeinstellungen

Sie können von der Liste der detektierten Hosts (alle Hosts in /etc/hosts), oder Sie können 3) FREECHOICE wählen, um einen beliebigen Host mit einer geeigneten Anzeige zu spezifizieren.

- Wählen Sie FREECHOICE, indem Sie die Nummer 3 eingeben.

Bei dem >> Befehl geben Sie den Hostnamen oder IP-Adresse für die X-Anzeige ein. In diesem Beispiel verwenden wir den IP-Adresse 172.25.220.27, aber Sie sollten eine Adresse wählen, die in Ihrer LAN ist.

Die Schritt FREECHOICE führt zu einer weiteren Konsistenzprüfung (Abbildung 31).

Abb. 30: Liste der Anzeigeeinstellungen

Sie können von der Liste der detektierten Hosts (alle Hosts in /etc/hosts), oder Sie können 3) FREECHOICE wählen, um einen beliebigen Host mit einer geeigneten Anzeige zu spezifizieren.

- Wählen Sie FREECHOICE, indem Sie die Nummer 3 eingeben.

Bei dem >> Befehl geben Sie den Hostnamen oder IP-Adresse für die X-Anzeige ein. In diesem Beispiel verwenden wir den IP-Adresse 172.25.220.27, aber Sie sollten eine Adresse wählen, die in Ihrer LAN ist.

Die Schritt FREECHOICE führt zu einer weiteren Konsistenzprüfung (Abbildung 31).
Configuration example

Specifying a display

Consistency check ...

CommandLines (Dem_APP1:consistent)

1) HELP
2) -
3) SAVE+EXIT
4) REMOVE+EXIT
5) Display=172.25.220.27
6) StartCommands[0]='hvexec~-F~demo~-c~172.25.220.27'
7) StopCommands[0]='hvexec~-F~demo~-u~172.25.220.27'
8) CheckCommands[0]=hvdet_demo
9) (Timeout=300)
10) (AutoRecover=no)
11) (MonitorOnly=no)

Choose the setting to process: 3

Figure 31: Successful consistency check for APP1

The consistency check is successful: you can now use RMS to run APP1 with the mydemo configuration.

Note that the wizard updated the display information for the scripts in items 6) StartCommands[0] and 7) StopCommands[0].

This completes the specification of the non-basic settings. You can now save the non-basic settings and exit this part of the configuration procedure.

- From the CommandLines menu (Figure 31), select SAVE+EXIT by entering the number 3.

This will take you back to the Settings of turnkey wizard "DEMO" menu (Figure 32).
Specifying a display

Configuring example

Consistency check ...

Settings of turnkey wizard "DEMO"

1) HELP
2) -
3) SAVE+EXIT
4) -
5) ApplicationName=APP1
6) Machines+Basics(app1)
7) CommandLines(-)
8) Controllers(-)
9) DEMO(Dem_APP1)
10) LocalFileSystems(-)

Choose the setting to process: 3

Figure 32: Turnkey wizard DEMO

By specifying the basic and non-basic settings for your application and achieving a consistent result, you have successfully finished the Application-Create part of the configuration procedure.

► Select SAVE+EXIT by entering the number 3. This will take you back to the RMS configuration menu.
4.8 Activating the configuration

As described in the section “General configuration procedure” on page 34, activating a configuration is the third of the four fundamental steps required to set up a high-availability configuration.

You must stop RMS before activating a configuration. In this example, we stopped RMS before creating the configuration.

The starting point for the activation phase is the Main configuration menu (Figure 33).

```
fuji2: Main configuration menu, current configuration: mydemo
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
```

Figure 33: Main configuration menu

► Select Configuration-Activate by entering the number 8.

No further input is required at this stage. As the Wizard completes each task in the activation phase, it displays status information as described in the section “Activating a configuration” on page 44. You will be prompted to continue at the end of the process (see Figure 34).

```
The new configuration was distributed successfully.

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

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

Figure 34: Successful configuration activation
Activating the configuration

Press the [Enter] or [Return] key to return to the Main configuration menu (Figure 35).

Select QUIT by entering the number 2.

This ends the activation phase of the configuration process. At this point, RMS may be started to monitor the newly-configured application.
4.9 Creating a second application

In this section, the mydemo configuration is expanded by adding a second application. This example application differs from the first because duplicate configuration procedures are skipped to simplify the example. However, in other parts of the procedure, new features add to the complexity of the mydemo configuration.

The second application differs from the first as follows:

- The application uses a new application type, GENERIC, instead of DEMO. We will use the name APP2 for the second application.
- APP2 will control the first application (APP1). Therefore, APP2 must be configured with a controller sub-application.

Resume the configuration procedure as follows:

- Stop RMS if it is running.
- Return to the Main configuration menu with the following command:

  ```
  # hwv -n mydemo
  ```

  The Main configuration menu opens (see Figure 36).

  ![Figure 36: Starting again with the Main configuration menu](image)

You can add more machines to the cluster at this point, provided the required site preparation steps have been completed.
Creating a second application

To add machines, select **RMS-CreateMachine** by entering the number 15. Follow the procedure described earlier and then return to the **Main configuration menu** when finished.

From the **Main configuration menu**, select **Application-Create** as follows:

- Select **Application-Create** by entering the number 3.

The **Application type selection** menu opens (see Figure 37).

This time, assign the **GENERIC** application type to the application. This means that the GENERIC turnkey wizard will be in charge of the configuration procedure.

- Select the **GENERIC** application type by entering the number 6.

After the consistency check, you are prompted to configure the basic settings. **APP2** is the default value for the application name.

If you want to change the name, select 5) **ApplicationName** (see Figure 38).
Creating a second application

Consistency check ...
Yet to do: process the basic settings using Machines+Basics
Yet to do: choose a proper application name

Settings of turnkey wizard "GENERIC"
1) HELP
2) NO-SAVE+EXIT
3) SAVE+EXIT
4) REMOVE+EXIT
5) ApplicationName=APP2
6) BeingControlled=no
7) Machines+Basics(-)
Choose the setting to process: 7

Figure 38: Prompting for further specification

Select Machines+Basics by entering the number 7.

The consistency of APP2 is checked, and the result is positive. When the Machines+Basics menu appears, it shows that APP2 is initially configured to run on fuji2RMS (see item 7) Machines[0] in Figure 39.

Consistency check ...

Machines+Basics (app2:consistent)
1) HELP
2) -
3) SAVE+EXIT
4) REMOVE+EXIT
5) AdditionalMachine
6) AdditionalConsole
7) Machines[0]=fuji2RMS
8) (PreCheckScript=)
9) (PreOnlineScript=)
10) (PostOnlineScript=)
11) (PreOfflineScript=)
12) (OfflineDoneScript=)
13) (FaultScript=)
14) (AutoStartUp=no)
15) (AutoSwitchOver=No)
16) (PreserveState=no)
17) (PersistentFault=0)
18) (ShutdownPriority=)
19) (OnlinePriority=)
20) (StandbyTransitions=)
21) (LicenseToKill=no)
22) (AutoBreak=yes)
23) (HaltFlag=no)
24) (PartialCluster=0)
25) (ScriptTimeout=)
Choose the setting to process: 5

Figure 39: Machines+Basics menu
Creating a second application

Configuration example

- Select **AdditionalMachine** by entering the number 5. A menu appears with the list of available machines (Figure 40).

![Figure 40: List of nodes for failover procedure](image)

As with the former application, the additional machine to be specified for the failover procedure is **fuji3RMS**.

- Select **fuji3RMS** by entering the number 4.

In the screen that follows you see your selection confirmed—menu item 8) **Machines[1]** now displays **fuji3RMS** as the additional machine (Figure 41).

![Figure 41: Machines+Basics menu](image)

Note that item 16 indicates **AutoSwitchOver=No**, so **APP2** will not be switched automatically to **fuji3RMS** if **fuji2RMS** fails: it must be switched manually with the GUI or CLI. To enable automatic switchover, select item 16.
Configuration example

Setting up a controlling application

Save your settings and exit this part of the configuration procedure:

- Select SAVE+EXIT by entering the number 3. This takes you to the non-basic settings menu.

4.10 Setting up a controlling application

The basic settings have been specified. However, we still need to set up APP2 to control APP1. This will involve the following two steps, available in the non-basic settings:

- Create a controller object for APP2.
- Specify APP1 as the application to be controlled.

The previous step has taken you to the non-basic settings menu (Figure 42).

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

Settings of turnkey wizard "GENERIC"

1) HELP                              10) RemoteFileSystems(-)
2) -                                 11) IpAddresses(-)
3) SAVE+EXIT                         12) RawDisks(-)
4) -                                 13) RC-VolumeManagement(-)
5) ApplicationName=APP2              14) VERITAS-VolumeManagement(-)
6) Machines+Basics(app2)             15) EMC-RdfManagement(-)
7) CommandLines(-)                   16) FibreCat-MirrorView(-)
8) Controllers(-)                    17) Gds:Global-Disk-Services(-)
9) LocalFileSystems(-)               18) Glsl:Global-Link-Services(-)

Choose the setting to process: 8

Figure 42: Non-basic settings

- Select Controllers by entering the number 8.

This creates a controller object for APP2 and presents a menu that lets you specify the controller settings (Figure 43).
4.11 Specifying controlled applications

Once you specify a controller, the wizard needs to know which application to control.

When an application becomes the child of a controller, the Wizards adjust some of its attributes automatically. In the case of a Follow controller, the child’s Machines entries are overridden by the settings of the parent.

► Select AdditionalAppToControl by entering the number 6.

The menu that appears offers you a list from which to choose an application (Figure 44).

```
Choose an application to control: 4
```

Figure 44: List of applications to be chosen as controlled applications
Configuration example  Specifying controlled applications

The controlled application is APP1, while APP2 is the controlling application. Choose the application to be controlled as follows:

- Select APP1 by entering the number 4. The controller flags menu appears (Figure 45).

```
Set flags for (sub) application: app1
  (Currently set: AUTORECOVER,TIMEOUT (AT180)
1) HELP
2) ~
3) SAVE+RETURN
4) DEFAULT
5) MONITORONLY(M)
6) NOT:AUTORECOVER(A)
7) TIMEOUT(T)
Choose one of the flags:
```

Figure 45: Menu for setting controller flags

There are a number of flags that can be set for a controlled application. In this example, the A (AUTORECOVER) flag has been set. The A flag means If the controlled application becomes offline, the controlling application tries to restart it. The AUTORECOVER menu item is now in the opposite state; that is, ready to be toggled to NOT.

The T (TIMEOUT) flag limits the amount of time tolerated while bringing the controlled application online. In this example, we will reduce the timeout period to 150 seconds.

- Change the timeout period by entering 7.
- In the menu that appears (Figure 46), select FREECHOICE by entering the number 3.

```
1) HELP
2) RETURN
3) FREECHOICE
4) 180
Set an appropriate timeout: 3
  >> 150
```

Figure 46: Changing controller timeout period

- At the >> prompt, enter 150 for the timeout period.
Specifying controlled applications

Configuration example

Press [Enter] or [Return] to return to the menu for controller flags (Figure 47).

Set flags for (sub) application: app1
Currently set: AUTORECOVER, TIMEOUT (AT150)
1) HELP
2) -
3) SAVE+RETURN
4) DEFAULT
5) MONITORONLY(M)
6) NOT:AUTORECOVER(A)
7) TIMEOUT(T)
Choose one of the flags: 3

Figure 47: Saving flags for controller

After completing the settings, save them and return to the Controllers menu as follows:

Select SAVE+RETURN by entering the number 3.

The Controllers menu shows that the controller settings are now consistent (Figure 48).

Consistency check ...

Settings of application type 'Controller' (consistent)
1) HELP
2) -
3) SAVE+EXIT
4) REMOVE+EXIT
5) ControlPolicy=FOLLOW
6) AdditionalAppToControl
7) Controllers[0]=AT150:app1
8) (InParallel=)
9) (FaultScript=)
Choose the setting to process: 3

Figure 48: Indication of flags set for controller

Note that your settings are confirmed on item 7) Controllers[0]: the A and T flags have been set for APP1.
Configuration example

Specifying controlled applications

- Select SAVE+EXIT by entering the number 3.

This takes you back to the GENERIC menu (Figure 49).

![Figure 49: Menu with settings for GENERIC turnkey wizard](image)

In the GENERIC menu, item 8 Controllers now displays a controller assigned to APP2.

- Select SAVE+EXIT by entering the number 3. This takes you back to the Main configuration menu (Figure 50).

![Figure 50: Main configuration menu](image)

This completes the creation of the second application.
4.12 Activating the configuration a second time

After returning to the Main configuration menu, you must activate the mydemo configuration for the second time. This has to be done because you have modified the configuration by adding another application.

RMS cannot be running while you activate a configuration. In this example, we stopped RMS before creating the second application.

To activate the configuration, begin at the Main configuration menu (Figure 51).

Figure 51: Main configuration menu

Select Configuration-Activate by entering the number 8.

No further input is required at this stage. As the Wizard completes each task in the activation phase, it displays status information as described in the section “Activating a configuration” on page 44. You will be prompted to continue at the end of the process (see Figure 44).

The new configuration was distributed successfully.

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

The activation has finished successfully.

Hit CR to continue

Figure 52: Activating the configuration for the second time

Press the [Enter] or [Return] key to return to the Main configuration menu (Figure 53).
Figure 53: Return to Main configuration menu

- Select QUIT by entering the number 2.

This ends the activation phase of the configuration process.

### 4.13 Starting RMS

At this point, you are ready to start RMS on all nodes in the cluster to monitor both applications. You can use the Cluster Admin GUI (see the section “Starting RMS” on page 114) or you can enter the following command from any machine in the cluster:

```
# hvcm -a mydemo
```

Note that you do not have to specify "mydemo" on the hvcm command line if it is the configuration that was most recently activated.

This ends the configuration example.
5 Administration

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

This chapter contains the following major topics:

- “Overview” on page 83
- “Using Cluster Admin” on page 84
- “Viewing RMS status and attributes” on page 91
- “Controlling RMS operation” on page 114
- “Related administrative procedures” on page 139
- “Using RMS graphs” on page 139

5.1 Overview

RMS administration can be done by means of the Cluster Admin GUI or by the CLI. The procedures in this chapter focus on the Cluster Admin GUI.

Most of the GUI examples in this chapter show clusters with typical PRIMECLUSTER product installations. The appearance of some tabs and menus in the GUI display will change according to the products installed for your platform or market.

PRIMECLUSTER Configuration Services (PCS) is not installed when the Wizard Tools are installed.

CLI procedures

Some of the operations described in this chapter describe the equivalent CLI procedure. However, we recommend that the CLI be used only by expert system administrators, or in those cases where a browser is not available. If you decide to use a CLI procedure, please note the following:

- The commands are located in the `<RELIANT_PATH>/bin` directory.
- All the RMS CLI commands accept both CF node names and RMS node names for `SysNode` objects when the RMS naming convention has been followed (that is, when the names are of the form `<CF-name>RMS`).
The CLI procedures presented here are not intended to be a complete description of the commands that are employed. Other options may be available. For more information about any CLI command, see its online manual pages. For the complete list of online documentation related to RMS operation, see “Appendix—List of manual pages” on page 223.

**CLI status codes**

In general, RMS hv* commands send a request to the base monitor and then return immediately without waiting for this request to be processed. They exit with a status code of 0 (success), which indicates a request has been sent to the base monitor successfully. However, this does not guarantee that the request was processed successfully.

Important exceptions include the ‘hvshut’ and ‘hvutil –[mM]’ commands, which remove nodes and applications from RMS control. These commands may return status codes that indicate failure. This type of command also provides an option for “forced” operation, but this should be used with great care and only when absolutely necessary.

### 5.2 Using Cluster Admin

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

**Windows desktop systems** require the Java plug-in as specified in the PRIMECLUSTER Installation Guide for your operating system.

#### 5.2.1 Starting Cluster Admin

Open a Java-enabled browser and enter the following URL in the *Address* location:

```
http://<hostname>:8081/Plugin.cgi
```

The *hostname* should be the name or IP address of the primary or secondary management server. For example, if a cluster named FUJI has fuji2 and fuji3 as its primary and secondary management servers, the URL would be either one of the following:

- http://fuji2:8081/Plugin.cgi
- http://fuji3:8081/Plugin.cgi
The Plugin.cgi URL always attempts to contact the primary management server; after contacting the host, the browser changes the URL suffix from `.cgi` to `.html`. If you instead use the Plugin.html form, Cluster Admin will attempt to make direct contact with the server specified in the URL.

For details on the primary and secondary management servers, refer to the PRIMECLUSTER Installation Guide for your operating system.

### 5.2.2 Logging in

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 the PRIMECLUSTER Installation Guide for your operating system.

After the Web-Based Admin View login window appears (Figure 54), log in as follows:

- Enter the user name and password for a user with the appropriate privilege level.
- Click the OK button.

![Web-Based Admin View login](image)
After you log in, the Web-Based Admin View window appears (Figure 55).

Figure 55: Invoking the Cluster Services GUI

- Click the **Global Cluster Services** button. The window in Figure 56 appears.

Figure 56: Invoking Cluster Admin

- Click the **Cluster Admin** button.
The Choose a node for initial connection window appears (Figure 57).

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.

- Select the desired node for the connection, and click on OK.

The next window that appears depends on how you have set the trust levels for the Cluster Admin Java applets. If you have already chosen to use trusted applets for all sessions, you can skip the following description.

**Trusted applets**

For platform independence and security, the Cluster Admin GUI uses Java applets. When the Java applets run in trusted mode, they are allowed to use some client system resources, such as the clipboard. If you intend to copy and paste text between the Java window and other applications on your workstation, you must run the applets in trusted mode.

PRIMECLUSTER trusted applets are signed by Verisign, Inc.
The first time you start the Cluster Admin applet, a *Java Security Warning* dialog allows you to choose the security level for the current and future sessions (Figure 58).

![Figure 58: Security certificate dialog](image)

- Use one of the buttons at the bottom of the dialog to continue your session:
  - **Yes**—The applet operates in trusted mode for the current session only. You will have to respond to the same dialog the next time the applet is started.
  - **No**—The applet operates in untrusted mode for the current session only, so you cannot use the clipboard or other local system resources from the applet window. You will have to respond to the same dialog the next time the applet is started.
  - **Always**—The applet operates in trusted mode for this and all future sessions. The *Java Security Warning* dialog will not appear again.

We recommend that you click on the **Always** button to proceed.
5.2.3 Main Cluster Admin window

When Cluster Admin opens, the initial view is similar to Figure 59.

![Main Cluster Admin window—Initial view](image.png)

The following tabs appear at the bottom of the left pane:

- **cf**
- **rms & pcs** (or simply **rms** if PCS is not installed)
- **sis**
- **msg** (message window)

Clicking a tab switches the view to the corresponding product. Initially, the CF view is selected. All views have the following common features:

- **Menu bar**—The pull-down menus contain generic administrative functions as well as items specific to the PRIMECLUSTER products. Some entries may be disabled (grayed out) according to the item selected in the current view.
Using Cluster Admin

- **Configuration tree**—The left pane contains product-specific configuration information in a hierarchical display. Clicking on an item in the tree will display the item's properties and, in some views, allow you to change them. Right-clicking on an item generally brings up a context menu specific to that item.

- **Input and message area**—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.

This chapter focuses on RMS administration. For information about operations available on the other tabs, refer to the corresponding product documentation.

### 5.2.4 Cluster Admin message view

Error and debug messages related to Cluster Admin can be displayed at any time:

- Click the *msg* tab on the bottom of the RMS tree pane. (The tab label is red if a new message has been added to the text area since it was last viewed.)
  
The *Admin Errors and Messages* view appears (Figure 60).

![Figure 60: Main Cluster Admin window—message view](image)
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 Viewing RMS status and attributes

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&pcs tab. A typical RMS view is shown in Figure 61.

Figure 61: Main Cluster Admin window—RMS view

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 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, if any. Also contains non-affiliated groups of objects (see fourth level description).

● Fourth level—Represents the resources necessary for each of the subapplications. Also contains non-affiliated objects.

Information about `andOP` and `orOP` objects:

Non-affiliated `andOP` and `orOP` objects are intended for use by RMS experts. These items 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`.

Applications always appear at the second level of the tree, even if some of them are controlled by others. 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 Figure 62.
Application

Viewing RMS status and attributes

Figure 62: RMS tree with a controller object

In the example shown in the figure, the Resource attribute of the highlighted controller object contains the name of the App1 application: this indicates the dependence of App2 on App1.

A complete visual display of object dependence is available from the RMS graph. See the section “Using RMS graphs” on page 139 for a description of the procedure.
5.3.2 Context-sensitive (pop-up) command menus

You can perform many operations on the RMS tree objects by using the context-sensitive, pop-up command menus. Invoke the pop-up menu by right-clicking on the object. The available menu options are based on the type and the current state of the selected object (Figure 63).

For example, the menu offers different options for a node object selection and an application object selection. It also offers different options for an application object in the online state (Figure 64) and in the offline state (Figure 65).
Administration

Viewing RMS status and attributes

Figure 64: Command pop-up menu for an online application

Figure 65: Command pop-up menu for an offline application
5.3.3 Confirmation pop-up windows

When you select an item in an object’s context menu that can cause state changes to that object, a confirmation pop-up window appears (Figure 66). To proceed with the action described in the warning message, click Yes; to cancel the action, click No.

![Figure 66: Confirmation pop-up window](image)

5.3.4 Displaying environment variables

Display the global (clusterwide) environment variables as follows:

- Right-click on a cluster in the RMS tree window and select View Environment from the context menu (Figure 67).

![Figure 67: Displaying global environment variables](image)

The global variables will appear under a separate tab in the right pane (Figure 68).
Display local environment variables as follows:

- Right-click on a node in the RMS tree window and select View Environment from the context menu (Figure 69).

Figure 68: Global environment variable view

Figure 69: Displaying local environment variables
Both local and global variables will appear under a separate tab in the right pane (Figure 70).

**CLI: hvdisp**

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 application states appears below the RMS Tree in the left pane of the RMS view (Figure 71).
In the example above, the application App2 is online (green status icon) on node fuji2RMS, but offline (blue status icon) on node fuji3RMS.

See “Detectors and states” on page 30 for a description of RMS object states.

**CLI: hvdisp**

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 does not require root privilege.
Viewing RMS status and attributes

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 72).

![Figure 72: Configuration information or object attributes](image)

5.3.7 Viewing RMS log messages

Using the Cluster Admin interface, you can view two types of RMS log messages on each node: the RMS switchlog, and individual application logs. For details about the contents of RMS log files, refer to the RMS Troubleshooting Guide.

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 73). Alternatively, select a node and use Tools -> View switchlog (Figure 74).
Viewing RMS status and attributes

Figure 73: Viewing the RMS switchlog file using a context menu

Figure 74: 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 75).
Viewing RMS status and attributes
Administration

Figure 75: Viewing an application log using a context menu

Each log file is displayed in a separate tab in the right pane (Figure 76).

Figure 76: Viewing an RMS log
Viewing RMS status and attributes

The **Detach** button at the bottom of the view will separate the current log display tab and display it in its own window (Figure 77). The detached window can be rejoined to the main window with the **Attach** button.

![Figure 77: Viewing the RMS switchlog file in a detached window](image)

**Figure 77:** Viewing the RMS switchlog file in a detached window

> **All RMS log files, which normally reside in** `/var/opt/SMAWRms/log/`, **can be viewed directly using a standard UNIX editor like** `vi`.

**Common procedures for switchlog and application log viewing**

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:

- **Timestamp:** Click the **Enable** check box and select the period of interest.
- **Resource name** (for an application only), severity of error messages, non-zero exit code, or keyword. Selected and non-blank criteria are combined with a logical **and**.

> Refer to the **RMS Troubleshooting Guide** for a complete description of severity levels and exit codes.

After you enter your filter criteria, click the **Filter** button to display the filtered log entries.
Viewing RMS status and attributes

At any time, you can sort the displayed switchlog entries according to increasing or decreasing time by checking or unchecking the View in Reverse Order checkbox in the log viewer window.

Time filter

Figure 78 shows the view for a search based on the date and time.

Figure 78: Search based on date and time range
Resource name

Figure 79 shows the view for a search based on a resource name. This search is enabled only in an application log.

Figure 79: Search based on resource name
Viewing RMS status and attributes

Severity

Figure 80 shows the view for a search based on the severity level.

Figure 80: Search based on severity level

Table 4 summarizes the RMS severity levels.

<table>
<thead>
<tr>
<th>Severity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>Systems cannot be used</td>
</tr>
<tr>
<td>Alert</td>
<td>Immediate action is necessary</td>
</tr>
<tr>
<td>Critical</td>
<td>Critical condition</td>
</tr>
<tr>
<td>Error</td>
<td>Error condition</td>
</tr>
<tr>
<td>Warning</td>
<td>Warning condition</td>
</tr>
<tr>
<td>Notice</td>
<td>Normal but important condition</td>
</tr>
<tr>
<td>Info</td>
<td>Miscellaneous information</td>
</tr>
<tr>
<td>Debug</td>
<td>Debug messages</td>
</tr>
</tbody>
</table>

Table 4: RMS severity level description
**Exit code**

Enter a numeric exit code in the *Non zero exit code box*.

**Keyword**

Enter a string in the *Keyword* box. Special characters and spaces are valid, but wildcards are not interpreted. The search is case-insensitive. Figure 81 shows the view for a search based on a string.

![Figure 81: Search based on keyword](image)
Viewing RMS status and attributes

You can also search the text in the application log by right-clicking on the displayed text. This brings up a small command pop-up with a Find entry that allows you to perform a case-sensitive search (Figure 82).

![Figure 82: Using the Find pop-up in log viewer](image)

**Removing filters**

To remove all filters, take the following steps:

- Uncheck the time filter Enable box.
- Set drop-down lists to No Selection
- Clear text from input boxes
- Click the Filter button

The unfiltered view will be restored.
5.3.8 Using the RMS clusterwide table

The RMS clusterwide table displays the state information about application objects in a concise, summary table. The user can see the state of each application on each of the system nodes.

Open the clusterwide table by right-clicking the cluster name (the root of the RMS tree in the left pane) and then selecting View Cluster Wide table from the context menu (Figure 83).

![Figure 83: Opening the clusterwide table](image)

The clusterwide table appears in a separate window (Figure 84).

![Figure 84: Clusterwide table](image)

Click the Show State Names checkbox to display the corresponding state name next to each status icon (Figure 85).

![Figure 85: Clusterwide table with state names](image)
Viewing RMS status and attributes

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 84 shows that fuji2 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 (Figure 86). This allows the System Administrator to easily spot any Faulted applications.

![Figure 86: Faulted applications in the clusterwide table](image)

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 (Figure 87). This alerts the system administrator that some applications are not running anywhere and should probably be brought online on some node.

![Figure 87: Offline applications in the clusterwide table](image)
If there are both faulted applications and applications that are not online anywhere, then the faulted applications are listed first (Figure 88).

Figure 88: Faulted and offline applications in the clusterwide table

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.

Figure 89 shows a clusterwide table with an application of a split-brain condition. Note the yellow exclamation mark before the second node name.

Figure 89: Split-brain conditions in the clusterwide table
Viewing RMS status and attributes

5.3.8.1 Using context menus from the clusterwide table

You can use the context-sensitive command pop-up menus to perform some operations on the clusterwide table objects. Invoke the context menu by right-clicking on an object in the table. The menu options are based on the type and the current state of the selected object (Figure 90).

Figure 90: Using command pop-ups in clusterwide table

5.3.9 Display during RMS configuration changes

When you stop and restart RMS with a different configuration, the graphs (described in a later section), the clusterwide table, and the RMS tree are redrawn. In this case, each of the display windows closes and a new display at the same position is displayed.

Figure 91 illustrates the display containing AppA and AppB before RMS is shut down, and Figure 92 shows the RMS GUI after RMS has been restarted with a different configuration that uses app1 and app2.
Administration  

Viewing RMS status and attributes

Figure 91: Cluster state before RMS is shut down

Figure 92: Cluster state after RMS restart with different configuration
5.4  Controlling RMS operation

This section describes basic procedures to control the operation of RMS, including how to start and stop individual nodes and 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 the overview of this chapter, 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.

5.4.1  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 subset of nodes that you select.

1. From the Cluster Admin rms&pcs (or rms) tab, select Tools –> Start RMS (Figure 93).

2. The RMS Start Menu window opens. To start RMS on all nodes, click the all available nodes radio button and then click OK (Figure 94).
3. To start RMS only on selected nodes, click the one node from the list radio button. You can select one or more nodes using the checkboxes in the Selection column. After making your selections, click OK (Figure 95).

Alternatively, you can start RMS on individual nodes directly from the Cluster Admin window:
Controlling RMS operation

1. In the left pane, click the rms&pcs tab to view the cluster tree.

2. Right-click on the node and select Start RMS from the pop-up menu (Figure 96).

![Figure 96: Starting RMS on individual nodes](image)

CLI: hvcm

When you use the CLI, you can start the most recently activated configuration, or you can specify a different configuration. The syntax for the CLI is as follows:

```
hvcm [-c config_file] {-a | -s SysNode}
```

The options are:
- `-c` Use the specified configuration file
- `-a` Start RMS on all nodes in the configuration
- `-s` Start RMS only on the specified node

The `hvcm` command 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 default values are sufficient for most configurations.

If `-c` is not present, RMS uses the default startup file `CONFIG.rms`, which starts the most recently activated configuration. This file is located in `<RELIANT_PATH>/etc/`. If the default for the environment variable `RELIANT_PATH` has not been changed, RMS searches for `CONFIG.rms` in `/opt/SMAW/SMAWRrms/etc/`.

5.4.2 Starting RMS automatically at boot time

You can use the following procedure to activate or deactivate automatic RMS startup when the system boots up.

- From the Cluster Admin `rms&pcs` (or `rms`) tabbed view, select `Tools > Auto Start RMS on Node Boot` (Figure 97).
You can then choose to activate or deactivate the automatic RMS startup (Figure 98).

This setting takes effect at the next system startup.
Controlling RMS operation

Administration

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.

The RMS run level is set to the default system run level in $/etc/inittab$ when RMS is installed. If the default system run level is later changed,
RMS may not start in the correct sequence. You can use the **hvrclev**
command to verify or to change the RMS run level. See the **hvrclev**
online manual for more information.

5.4.3 Stopping RMS

You can stop RMS on all nodes or on a subset that you select.

Use the **Tools** pull-down menu (Figure 99) and select **Shutdown RMS**.

![Figure 99: Using the Tools menu to stop RMS](image)

- To stop RMS on all nodes, click the radio button for **all available nodes** and
  then click **Ok** (Figure 100).
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

**Caution**

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 101).
Controlling RMS operation

Administration

Figure 101: Stopping RMS on one node from the list

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

**Caution**

Leaving the applications running after stopping RMS or using a forced shutdown can cause data inconsistencies or corruption.

- Click the Ok button to initiate the shutdown with your selections.

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 102).
Controlling RMS operation

Figure 102: Using the context menu to stop RMS on one node

Only one node will appear in the confirmation window (Figure 103).

Figure 103: Stopping RMS on one node

Whichever method you use, if you choose to shut down RMS without shutting down the local applications, you will be asked to confirm the operation (Figure 104).
Controlling RMS operation

Administration

Figure 104: Stopping RMS while keeping applications—confirmation

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 nodes

- \( -A \)
  - Shut down RMS on all 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

- \( -s <SysNode> \)
  - Shut down RMS only on the specified node

The `hvshut` command shuts down the RMS software 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 are 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 any `userApplication` objects are online when the `\(-A\)`, `\(-f\)`, or `\(-L\)` options are used, the 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 asked to confirm the operation.

Caution

Use the `hvshut -A`, `\(-f\)`, and `\(-L\)` options carefully as they could result in inconsistencies or data corruption.
### 5.4.4 Overriding automatic application startup

By default, the automatic startup of each application is controlled by its `AutoStartUp` attribute. If `AutoStartUp` is set to 1, the application starts automatically when RMS starts or when the application is switched to another node. If `AutoStartUp` is set to 0, the application must be started manually.

Automatic application startup can cause problems during some maintenance or troubleshooting procedures. If this is the case, you can suppress the `AutoStartUp` attribute for all applications.

The following procedure changes the `HV_AUTOSTARTUP` global environment variable. Changes to `HV_AUTOSTARTUP` do not take effect until the next RMS startup.

From the Cluster Admin `rms&pcs` (or `rms`) tab, select `Tools` → `UserApplications AutoStartup` (Figure 105).

You can then choose to override all `AutoStartUp` settings, or to cancel the override (Figure 106).
Controlling RMS operation

Figure 106: Controlling automatic application startup—step 2

CLI: hvsetenv

The action of each application’s AutoStartUp attribute is controlled by the HV_AUTOSTARTUP environment variable (see the description in “Local environment variables” on page 217). You can set this variable with the hvsetenv command as follows:

```
hvsetenv HV_AUTOSTARTUP [0|1]
```

The allowable values are:

- 0 Prevent automatic application startup at next RMS startup
- 1 Allow automatic application startup at next RMS startup

If no value is specified, the command reports the current value of the HV_AUTOSTARTUP environment variable.
5.4.5 Starting an application

Bring an application online as follows:

Right-click on the application object and select the *Online* option from the pop-up menu (Figure 107).

![Figure 107: Starting an application](image)

**CLI: hvswitch**

The syntax for the CLI is as follows:

```
hvswitch [-f] userApplication [SysNode]
```

The `hvswitch` command manually switches control of a `userApplication` resource from one system node to another in the RMS configuration. The resource being switched must be of type `userApplication`. The system node must be of type `SysNode`. If no `SysNode` is specified, the application is switched to the local node. The `-f` option is a forced-switch option.

**Caution**

Use the `hvswitch -f` option carefully as it could result in inconsistencies or data corruption.
5.4.6 Switching an application

Switch an online application as follows:

- Right-click on the application object and select *Switch* from the context menu. A secondary menu appears, listing the available target nodes for switchover.
- Select the target from the secondary menu to switch the application to that node (Figure 109).

![Figure 108: Switching an application](image)

It is recommended that you use the normal mode of switching applications to ensure that application and data consistencies and integrity are maintained.

**Caution**

Use the forced switch mode only if an application cannot be switched normally. A forced application switch overrides all safety checks and could even result in data corruption or other inconsistencies.

If the application is busy, the command pop-up will not offer the choices to switch the application. Instead, the command pop-up indicates that the application is busy and that you should try later (Figure 110).
5.4.7 Taking an application offline

Shut down an online application as follows:

Right-click on the application object and select the Offline option from the pop-up menu (Figure 111).

CLI: hvswitch

Refer to the section “Starting an application” on page 125 for information on this command.
Controlling RMS operation

Administration

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.

Use the command 'hvutil -s userApplication' to bring an offline userApplication to a Standby state.

5.4.8 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 has nothing to do with activating an RMS configuration—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

You will not need to activate an application unless someone explicitly deactivated it with the command 'hvutil -d userApplication'.
### 5.4.9 Clearing a fault

Clear the fault for an application in the **Faulted** state as follows:

Right-click on the application object and select the **Clear Fault** pop-up menu option (Figure 112).

![Figure 111: Clearing an application fault](image)

You will be informed of the action to be taken and asked to confirm the operation before the command proceeds (Figure 112).

![Figure 112: Clearing an application fault—confirmation dialog](image)

See also “Clearing faults in maintenance mode” on page 136.

**CLI: hvutil -c**

The syntax for the CLI is as follows:

```
hvutil -c userApplication
```

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 asked to confirm the operation before the command proceeds.
5.4.10 Clearing a SysNode Wait state

Clear any node in the Wait state as follows:

- Right-click on the node and select the Online or Offline option from the pop-up menu.

The clearing of the Wait state for a node will be ignored unless the Shutdown Facility (SF) timeout has been exceeded.

CLI: hvutil -o

The syntax for the CLI is as follows:

hvutil -o SysNode

This command clears the Wait state for the specified SysNode on all cluster nodes after the SF failed to kill the cluster node (SysNode) by returning the specified SysNode to the online state. If the SysNode is currently in the Wait state, and if the last detector report for the SysNode is in the online state, the Wait state is cleared and the SysNode goes back to the online state as if no kill request had ever been sent.

Caution

Use care when clearing a SysNode Wait state manually. Clearing a Wait state with ‘hvutil -o SysNode’, ‘cftool -k’, or the GUI causes RMS, CF, and SF to believe that the node in question has been confirmed to be down. Doing so without the node really being down can lead to data corruption.
5.4.11 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.

Entering maintenance mode

You can enter maintenance mode for all applications on all 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 113).

![Figure 113: Starting maintenance mode for all applications](image)

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 114).

![Figure 114: Starting maintenance mode for a single application](image)
In either case, you will be prompted to confirm the operation (Figure 115 and Figure 116).

Figure 115: Maintenance mode confirmation for all applications

Figure 116: Maintenance mode confirmation for one application

Maintenance mode is clusterwide: if an application is in maintenance mode on one node, it is also in maintenance mode on any other node where it can run.

Figure 117 shows the Cluster Admin window after one application is put into maintenance mode.
Controlling RMS operation

Figure 117: Typical cluster in maintenance mode

Note how the application status icons indicate the intended state (the state that would be attained if the application were taken out of maintenance mode).

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 is the parent and which 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 above example, AppA and AppB are independent. While AppA is in MM, AppB continues to operate normally and can be switched from one node to the other. Compare the application states in Figure 117 above to those in Figure 118 below.
Controlling RMS operation

Administration

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 for an application before you can switch that application offline or to another node.
- You must exit MM everywhere in the cluster before you can shut down RMS.

Exiting maintenance mode

To exit maintenance mode, return to the same object you used to enter maintenance mode:

- Right-click on the cluster or the application and select Exit Maintenance Mode from the popup menu (Figure 119 and Figure 120).
In either case, you will be prompted to confirm your action before the operation proceeds.

You can exit maintenance mode for a single application even if you entered maintenance mode for the entire cluster.

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 Figure 121; the prompt for all applications is similar.
Clearing faults in maintenance mode

If a fault occurs in an application while it is in maintenance mode, you must clear the fault before that application can return to normal operation. (It does not prevent other applications from returning to normal mode.)

RMS marks this type of fault condition with a blue exclamation mark next to the Maintenance-Online status icon, and with the state name Online!! in the clusterwide table (Figure 122).

To clear the fault, right-click on the faulted object and choose Clear fault in either the configuration tree (Figure 123) or the clusterwide table (Figure 124).
After the fault is cleared successfully, the application returns to normal maintenance mode (Figure 125). In some cases, it may be necessary to select Force Exit Maintenance Mode from the context menu. If this is successful, the application will return to normal operation mode with the fault cleared.
Controlling RMS operation

CLI: hvutil -m and -M

Control maintenance mode with the hvutil command:

hvutil -M { on | off | forceoff }

hvutil -m { on | off | forceoff } userApplication

Options:

- 
  -M
  Applies the maintenance mode operation to all applications on all nodes

- 
  -m
  Applies the maintenance mode operation to the specified application on all nodes

Operations:

- on
  Starts maintenance mode

- off
  Stops maintenance mode if all resources are in the appropriate state

- forceoff
  Forces maintenance mode 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.
5.5 Related administrative procedures

The Cluster Admin Tools menu provides the following additional entries related to RMS operations:

- **Adaptive Services**
  
  This appears only on Linux platforms. It is disabled (grayed out) if the cluster is not running Adaptive Services.

5.6 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 the graph after RMS is shut down
5.6.1 RMS full graph

You can see the RMS full graph by right-clicking on any system node and selecting View Graph from the context menu (Figure 126).

![Figure 126: Viewing the RMS full graph on a node](image)

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

![Figure 127: Typical RMS full graph](image)
The RMS full graph (Figure 127) displays the complete RMS configuration of the cluster and represents the following items:

- Relationships between objects
- Dependencies of objects
- Object types, indicated by the object's icon
- Current object state, indicated by the colored bar beneath each icon

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.

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 (Figure 128).
Using RMS graphs

Clicking on the object brings up a window with further details such as the object’s attributes (Figure 129).

Figure 129: RMS full graph—object details
5.6.2 Application graph

You can see a graph for a single application by right-clicking on an application and selecting View Application Graph from the context menu (Figure 130).

The application graph is similar to the full graph, except that it shows only the selected application and its resources (Figure 131). 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.
5.6.3 Subapplication graph

You can see a subapplication graph by right-clicking on an application and selecting View Subapplication Graph from the context menu (Figure 132).
This graph displays all the subapplications used by the selected application, showing the connections between the subapplications (Figure 133).

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

You can see a composite subapplication graph by right-clicking on an application and selecting *View Composite Subapplication Graph* from the context menu (Figure 134).

![Composite subapplication graph](image)

Figure 134: Viewing an RMS composite subapplication graph

The composite subapplication graph is a variation of the subapplication graph for controlled application scenarios: 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 how `App1` appears in the composite subapplication graph in Figure 135 below, and compare this to the standard subapplication graph shown in Figure 133 above.
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 application depends on, whether directly or indirectly.

The composite subapplication graph is available only for applications with controller objects.
5.6.5 Using command pop-up menus from the graph

You can use the context sensitive command pop-up menus on the RMS graph nodes to perform the same operations that are available in the Cluster Admin RMS view.Invoke the pop-up menu by right-clicking on an object. The menu options are based on the type and the current state of the selected object (Figure 136).

Figure 136: Using a command pop-up menu from the graph
5.6.6 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 resource names, affiliation names, or both to the graphs, use the checkboxes on the Preferences menu. Figure 137 shows the preference setting and a corresponding graph that displays affiliation names.

Figure 137: Displaying an RMS graph with affiliation names
Figure 138 shows the preference setting and a corresponding graph that displays resource names.

Figure 138: RMS graph with resource names
Using RMS graphs

If both options are selected, graphs will display both the affiliation names and resource names (Figure 139). This combination stretches the graph horizontally, which may make it difficult to read.

Figure 139: RMS graph with resource and affiliation names
5.6.7 Interpreting the graph 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. The main view and the clusterwide table will continue to show the application states until RMS is shut down on all nodes.

For example, suppose RMS is shut down only on one node (fuji2) of our example cluster. Figure 140 shows the full RMS graph obtained from that node.

![Figure 140: RMS graph after shutdown on one node](image)

However, as long as RMS continues to run on the remaining node, fuji3, the RMS main view and the clusterwide table will appear as shown in Figure 141.

![Figure 141: RMS main view and clusterwide table after shutdown on one node](image)
6 Advanced RMS concepts

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. It includes the following sections:

- “Internal organization” on page 153
- “Initializing” on page 154
- “Online processing” on page 159
- “Offline processing” on page 166
- “Fault processing” on page 170
- “Switch processing” on page 179
- “Special states” on page 181

6.1 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 were introduced in the chapter “Introduction” on page 7. The following sections provide more details about RMS internal structure and inter-object communication.

6.1.1 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 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.

6.1.2 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).

6.2 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 since they do not contain 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.

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 a object exits the Unknown state, it does not return to that state. An exception is only that hvreset has been invoked. This command re-initializes the entire tree, the objects are forced back into the Unknown state and repeat the initialization steps.

The following RMS procedure examples 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.
- 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 Figure 142.
Initializing

Figure 142: 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 RMS graph for this configuration as produced by the Wizard Tools is shown in Figure 143. Note the line connecting `fuji2RMS` to `app` is green, indicating where the application is online.
Advanced RMS concepts

Initializing

Figure 143: System graph for initializing examples—Wizard Tools

Figure 144 shows the corresponding output from `hvdisp -a`. 
Figure 144: hvdisp output for initializing examples—Wizard Tools

The graphs contains additional connector objects and dependencies that are automatically inserted to ensure proper operation. Also, the object names automatically generated by the Wizard Tools are more complex than the simplified, generic names shown in the abstract graph of Figure 142. Neither the additional objects nor the complex names are required for a basic understanding of RMS operation. Therefore, to simplify the discussion, the following examples focus on the abstract graph and use the generic names.

Example 1

The following process for the configuration illustrated in Figure 142 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 state 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.

   \textbf{andOp2} is a remote object which is ignored by the base monitor on \textit{fuji2RMS}.

6. \textit{andOp1} is a logical object which has no detector. It uses the message of the child to determine its own state as \texttt{Offline} and notifies this change of state to \textit{app}.

7. \textit{app} is also an object without a detector. When the child \textit{andOp} that corresponds to the local node goes offline, \textit{app} also goes offline.

8. All local child objects of \textit{app} have exited the \texttt{Unknown} state and the initializing procedure is complete.

### 6.3 Online processing

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

The following situations can prevent successful online processing of a \texttt{userApplication}:

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

These situations are discussed in detail in later sections.

#### 6.3.1 Online request

Generating the online request is referred to as \textbf{switching} the \texttt{userApplication}; that is, switching the \texttt{userApplication} online or switching the \texttt{userApplication} to another cluster node (refer also to the section “Switch processing” on page 179).

The following actions can generate an online request:

- Manual request using the GUI or CLI (hvswitch)
Online processing

Advanced RMS concepts

● 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

6.3.1.1 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, left-click on an application (a pop-up menu is displayed).
2. Right-click on the switch or online selections within the pop-up 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.

6.3.1.2 Automatic methods

All automatic methods can only invoke a priority switch.
Advanced RMS concepts

Online processing

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 a 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.

6.3.2 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.
Online processing

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).

6.3.3 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 an 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 configured resources are online (ready to operate). In this case, the term online does not pertain to the state of the actual application. The actual application is started and monitored by the scripts configured for a cmdline child object.

How a cmdline 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 “Relationship of RMS configurations to the real world” on page 11.

Example 2

The scenario for this example is as follows:

- AutoStartUp attribute is set to 1.
- 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 1.

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 and0p1.

9. The and0p1 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.

6.3.4 Unexpected reports during online processing

Unexpected reports are detector reports that arrive out of sequence while a previous request is being processed. This could occur, for example, when RMS receives an Offline report while it is performing online processing. An unexpected report reflects an interim state that may be ignored under certain conditions as described below.

During online processing, unexpected reports are ignored from the point where the pre-online request for an object was received until the object's Online-Script is finished, provided one of the following conditions is true at the end of processing:

- The “expected report,” e.g., DetReportsOnline, was received
- The OnlineScript failed.
- The ScriptTimeout was exceeded without receiving an expected report.
6.3.5 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 section “Fault processing” on page 170). The following can cause faults during online processing:

- Detector reports the Faulted state.
- Detector reports the Offline state for a object that was reported as Online.
- Script fails with an exit status other than 0.
- Script fails with a timeout.
- Detector does not detect the object as online within a specific period after the OnlineScript completes.

6.3.6 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 section “Online processing” on page 159 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 a 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.
Offline processing  Advanced RMS concepts

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.

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.

Caution

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.

6.4 Offline processing

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

6.4.1 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)
Advanced RMS concepts

Offline processing

- 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 (such as if one or more necessary resources fails); this prevents an application that is no longer operating correctly from continuing to operate in an uncontrolled manner (see also the section “Fault processing” on page 170). This offline request is also a primary precondition for any subsequent switchover.

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

6.4.2 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.
Offline processing

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.
Advanced RMS concepts

Offline processing

8. Offline processing completes successfully when app receives the success message.

9. Upon successful completion of offline processing, the OfflineDone-Script is fired. This script is intended for cleanup or for sending information. Its return code has no impact on the state of the userApplication.

6.4.3 Unexpected reports during offline processing

RMS handling of unexpected reports during offline processing is similar to the online processing description earlier in this chapter.

During offline processing, unexpected reports are ignored from the point where the pre-offline request for an object was received until the object's Offline-Script is finished, provided one of the following conditions is true at the end of processing:

- The “expected report,” e.g., DetReportsOffline, was received
- The OfflineScript failed.
- The ScriptTimeout was exceeded without receiving an expected report.

6.4.4 Fault situations during offline processing

The section “Fault processing” on page 170 describes the processing of any faults that occur during offline processing. The following can cause faults during offline processing:

- Detector reports the Faulted state.
- Detector reports the Online state for an object after that object's Offline script completed successfully.
- Script fails with an exit status other than 0.
- Script fails with a timeout.
- Object is not reported by the detector as being Offline within the configured timeout period after the offline script completes.
- Child of a object indicates a fault.
Fault processing

6.4.5 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.

6.4.6 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 Resource 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 pre-offline, offline, and post-offline 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." A 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.

6.5 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.
6.5.1 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 section “Switch processing” on page 179). 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.

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 Halt 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.

A double fault causes the node to be eliminated if the application's Halt attribute is set and the application can be switched to another 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).
Advanced RMS concepts

Fault processing

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.

For more information about the AutoSwitchOver and PreserveState attributes, see the chapter “Appendix—Attributes” on page 199.

6.5.2 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.

6.5.3 AutoRecover attribute

An object of the type gResource that represents a local file system is one example of a 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.
Fault processing

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.

6.5.4 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.

6.5.5 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 Resource-Failure 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:
Advanced RMS concepts

Fault processing

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.

   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 Example 4 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 in **Example 4** above.

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.

### 6.5.6 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. If the graph has an orOp that was also initially online, the online processing will treat that orOp as a leaf object (the end of its branch). Objects below the orOp may continue to be in the faulted state as long as at least one of the children of the orOp is online. To initiate online or offline processing for the entire tree, use `hvswitch -f` or `hvutil -f` as described below.

2. The following command makes a forced online request:

   `hvswitch -f userApplication target_node`

   This starts online processing for the application on the specified node. If the command completes successfully, the application and every object in its graph (including those in orOp subtrees) is switched to the online state, and the fault is cleared.

3. 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 (including those in orOp subtrees) is 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.

   In summary, if the userApplication is in the faulted state, both `hvutil -f` and `hvutil -c` have the same effect: both result in offline processing.
Fault processing

The difference occurs when the userApplication is online and a fault occurs below an orOp: ‘hvutil –f’ would initiate offline processing for the userApplication; but ‘hvutil –c’ would act as if ‘hvswitch –f’ had been invoked, and online processing for the userApplication would begin.

6.5.7 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 the 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 setting 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.
Advanced RMS concepts

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 fuji3RMS starts online processing.

6.5.7.1 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 the 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 chapter “Appendix—Attributes” on page 199.

6.6 Switch processing

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

6.6.1 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.
Switch processing

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.

During switch processing, RMS notifies all 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.
6.7 Special states

6.7.1 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). Figure 145 shows the states of these objects if App1 is put into maintenance mode.

![Diagram showing states of applications and resources in maintenance mode](image)

Figure 145: Example of maintenance mode restrictions

This simple example illustrates the following features:

- Maintenance mode for an application applies everywhere the application could be brought online. Therefore, the Maintenance state of App1 is the same on every node where it could run, no matter what the previous state...
Special states

was on any given node. (For each node, the current intended state—the target state for App1 when it comes out of maintenance mode—is available in the application's StateDetails parameter in the GUI and CLI status 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 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.
- There may be other nodes in the cluster. As long as they are not included in the node list configured for App1, they are not affected by App1's maintenance mode.

This behavior is typical for any application put into maintenance mode with `hvutil -m on`, or if the equivalent GUI operation begins by right-clicking on the individual application. If, however, `hvutil -M on` is employed, or if the GUI operation begins by right-clicking on the cluster name, then maintenance mode is clusterwide and processing is suspended everywhere.

6.7.2 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:
Advanced RMS concepts

Special states

- A userApplication is marked with the Inconsistent state if its actual state is either Offline 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, this is not a true state in the RMS state machine: the true state is either Offline or Faulted. For most operations, the behavior of an Inconsistent userApplication is determined by the underlying true state. For instance, if the true state is Offline, and an Offline request is issued, no Offline script will be fired (see the section “Object is already in Offline state” on page 170).

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'.

Caution

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.
Special states

Advanced RMS concepts
Appendix—Site preparation

The PRIMECLUSTER Installation Guide for your operating system describes how to prepare your cluster to operate RMS. 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.

For convenience, the site preparation descriptions for hosts, file systems, and networks are duplicated here. 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 required for proper operation of your hosts and network are not affected. Resources for market-specific applications may require similar customization.

7.1 Network database files

- /etc/hosts

  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 Table 5.

<table>
<thead>
<tr>
<th>Entry type</th>
<th>RMS naming pattern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS host name</td>
<td>&lt;hostname&gt;RMS</td>
<td>fuji2RMS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fuji3RMS</td>
</tr>
</tbody>
</table>

Table 5: RMS host name conventions in /etc/hosts

The RMS host name for a machine must match the contents of the
RELIANT_HOSTNAME variable in that machine’s hvenv.local config-
uration file, if that file exists.

RMS also supports IPV6 addresses.

Example

The following entries in /etc/hosts are for a cluster with nodes fuji2
and fuji3. The interface names are assigned as follows:

- Standard host names on the public network 172.25.219
- RMS node names on the private network 192.168.10

172.25.219.83    fuji2
172.25.219.84    fuji3
# node names for RMS
192.168.10.83    fuji2RMS
192.168.10.84    fuji3RMS

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.
Appendix—Site preparation

Configuration resource definitions

Example

If the interface fujivip with IP address 172.25.222.10 can be switched between nodes fuji2 and fuji3, then both nodes should contain the following line in /etc/hosts:

```
172.25.222.10    fujivip
```

When you configure the Ip Address subapplication, you specify the interface name as it appears in /etc/hosts, and not the IP address.

- **/.rhosts** (Solaris) and **/root/.rhosts** (Linux)

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 fuji2 and fuji3, then every machine’s /root/.rhosts file should contain the following lines:

```
fuji2 root
fuji3 root
```

The Cluster Foundation (CF) provides the equivalent of .rhosts functionality for all RMS configuration, administration, and operation tasks.

7.2 Configuration resource definitions

- **/opt/SMAW/SMAWRrms/etc/hvipalias**

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.

Each entry must contain the following required fields:

```
<Unname>   <IfName>   <IfDevice>   <Netmask>
```
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.

  If you specify two comma-separated device names, and the first device fails, the logical interface will failover to the second device.

- **Netmask**—The netmask to use with the IP address associated with the interface name, specified in the standard hexadecimal 8-digit format. The netmask is set with an `ifconfig` command after the physical device is brought online.

There must be one line in the file for each combination of interface and host where that interface can be switched.

**Example**

If the interface named `dbhost` can be switched to either `fuji2` or `fuji3`, then `hvipalias` on both nodes should contain the following lines:

```
#Uname  IfName  IfDevice   Netmask
fuji2   dbhost  hme0       0xffffff00
fuji3   dbhost  hme0       0xffffff00
```

**Example**

If you specify the interface as `device1,device2` then the IP address will failover to the second device if the first device fails.

```
#Uname  IfName  IfDevice   Netmask
fuji2   dbhost  hme0,hlme0  0xffffff00
fuji3   dbhost  hme0,hlme0  0xffffff00
```
Optional fields

The following fields are optional. If specified, they must appear after the required fields in the order presented here.

MAC address (Solaris only)

You can specify the MAC address of an interface to ensure that external connections remain valid when the logical name is switched to another controller. Specify this field with the keyword MAC, followed immediately by the MAC address in the standard colon-delimited, 6-byte, hexadecimal format, e.g., MAC00:80:17:28:25:9c.

The leading MAC keyword indicates the address is to be validated before it is used. You may omit the leading MAC keyword to indicate the address does not have to be validated, but this is not recommended.

The MAC Address field must appear after the Netmask field.

The MAC address feature requires the FJSVclmac and FSUNnet packages.

Example

```
#Uname  IfName  IfDevice   Netmask
fuji2   dbhost  hme0,hme1  0xffffff00  MAC00:80:17:28:25:9c
fuji3   dbhost  hme0,hme1  0xffffff00  00:80:17:28:25:9c
```

ifconfig parameters

You can specify a set of arguments to be sent to the ifconfig command. This allows you to specify custom interface settings that may be required for a physical device before the interface is switched there.

The field begins with the IFCONFIG keyword (all uppercase), followed by whitespace, followed by the comma-delimited argument string that will be passed to the ifconfig command. The keyword and arguments must appear after the Netmask field (or the MAC Address field, if present) and before any Route arguments.

For example, if an mtu value of 1200 is required for the local device associated with the dbhost alias, the entry for the local node would be as follows:

```
#Uname  IfName  IfDevice   Netmask
fuji2   dbhost  hme0,hme1  0xffffff00  IFCONFIG mtu,1200
```
After an interface is successfully brought online, the `ifconfig` command with the specified netmask and additional arguments will be invoked for the associated device.

**Route parameters**

Remaining fields at the end of the line are passed to a `route` command for the configured interface. If the string `$INTF` is encountered, it is replaced by the interface name; otherwise, the fields are passed literally.

Do not include the `add` or `delete` subcommands in the argument list. RMS generates these automatically when the interface is brought online or offline.

**Example**

```
fuji2 dbhost hme0,hme1 0xffffff00 default dev $INTF
```

When the interface is brought online, RMS will issue the following command:

```
route add default dev dbhost
```

- `/opt/SMAW/SMAWRms/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.

### 7.3 File systems—Linux only

- `/etc/fstab`

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 need to be mounted locally.
Appendix—Site preparation

File systems—Linux only

For each file system to be managed by RMS, create a line 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.

Do not specify the same file system in both a standard `fstab` entry and a `#RMS#` 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 the remote file system is specified in the form `<server_name>:<server_path>`, then `<server_name>` cannot be an IP address. It must be a host name that appears in the `/etc/hosts` file.

Examples

```
#RMS#/dev/sdb2 /fs2    ext2    defaults 1 2
#RMS#/dev/sda1 /mnt/data1 auto noauto,user 0 0
#RMS#/dev/sda2 /mnt/data2 auto noauto,user 0 0
#RMS#boat:/opt/SUNWspro /opt/SUNWspro  nfs \n  defaults.nfsvers=2.rsize=8192.wsize=8192
```

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.

Examples

```
#RMS:App1#/dev/sdb2  /data3  auto  noauto,user  0 0
#RMS:App2#/dev/sdb6  /data4  auto  noauto,user  0 0
#RMS:App1#boat:/tmp/test0 /tmp/nfs_app1  nfs \n  defaults.nfsvers=2.rsize=8192.wsize=8192
#RMS:App2#boat:/tmp/test1 /tmp/nfs_app2  nfs \n  defaults.nfsvers=2.rsize=8192.wsize=8192
```

● `/etc/exports`

Contains entries for all file systems that are available for mounting on other hosts.

For each file system to be managed by RMS, create a line with the standard `exports` fields, and then insert the string `#RMS#` at the beginning of the line. For more information, see the `exports` manual page.
Example

#RMS#/usr  fuji*(rw)

RMS cannot export a subdirectory of a file system that is mounted
from a remote server. It can only export the root of the remote file
system.

7.4 File systems—Solaris only

- /etc/vfstab

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
tab 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.

Caution

Do not specify the same file system in both a standard vfstab entry
and a #RMS# 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 the 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.

Examples

#RMS#/dev/dsk/c0t0d0s0 /dev/rdsk/c0t0d0s0 /testfs1 \
  ufs 1 yes -
#RMS#/dev/dsk/c0t0d0s7 /dev/dsk/c0t0d0s7 /tmp/foo1 \
  ufs 2 yes -
#RMS#/dev/dsk/c0t0d0s5 /dev/dsk/c0t0d0s5 /tmp/foo2 \
  ufs 2 yes -
Appendix—Site preparation

File systems—Solaris only

If the RMS comment is of the form \texttt{#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.

Examples

\texttt{#RMS:App1#/dev/dsk/c0t0d0s1 /dev/dsk/c0t0d0s1 /tmp/lfs_1 ufs 2 no svr=bart1,p fs=ufs,logging}

\texttt{#RMS:App2#/dev/dsk/c0t0d0s1 /dev/dsk/c0t0d0s1 /tmp/lfs_2 ufs 2 no svr=bart1,p fs=ufs,logging}

\texttt{#RMS#boat:/opt/SUNWspro - /opt/SUNWspro \ nfs - yes ro.bg.soft.intr.timeo=5}

\texttt{#RMS:App1#boat:/tmp/test0 - /tmp/nfs_app1 \ nfs - yes ro.bg.soft.intr.timeo=5}

\texttt{#RMS:App2#boat:/tmp/test1 - /tmp/nfs_app2 \ nfs - yes ro.bg.soft.intr.timeo=5}

Recommended network settings

The inherent delay of an NFS server failover may be interpreted as a permanent service outage by NFS clients, and this can cause application failover on those client nodes. To avoid prolonged service interruptions and unnecessary application switching, we recommend tuning your network with either of the following procedures.

1. On both server and client nodes, adjust TCP delay intervals with the following commands:

\texttt{# ndd -set /dev/tcp tcp_ip_abort_interval 60000}

\texttt{# ndd -set /dev/tcp tcp_rexmit_interval_max 12000}

This will change \texttt{tcp_ip_abort_interval} from the default of 480000 (480 seconds) to 60000 (60 seconds), and \texttt{tcp_rexmit_interval_max} from the default of 60000 (60 seconds) to 12000 (12 seconds).

To execute these commands automatically at RMS startup, add them to the \texttt{/opt/SMAW/SMAWRrms/bin/InitScript} file.

Caution

Carefully consider all other applications that use TCP connections before adjusting these parameters. These changes affect all TCP connections and not just NFS connections.
2. On client nodes, configure the UDP protocol for NFS mounts by specifying the `proto=udp` option for remote volumes in `/etc/vfstab` entries. Example:

```
#RMS#fuji2:/mnt/data - /data nfs - no rw.intr.proto=udp
```

**/etc/dfs/dfstab**

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.

See “Recommended network settings” on page 193 for information about adjusting TCP delay intervals on the server node.

**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
```

**RMS cannot export a subdirectory of a file system that is mounted from a remote server. It can only export the root of the remote file system.**
Appendix—Site preparation

7.4.1  NFS Lock Failover—Solaris only

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.

This feature requires the following site preparation steps:

- You must have a shared disk accessible to all nodes in the cluster.
- You must dedicate a directory to NFS Lock Failover on that shared disk. If
  you specify a directory that already exists, no other applications will be
  allowed to use it after it is configured.
- 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.

Only one file system per userApplication object can be selected for
NFS Lock Failover.

7.5  Log files

- `/var/adm/messages (Solaris) or /var/log/messages (Linux)`

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.
7.6 Other system services and databases

RMS requires the following system services or databases to be configured according to the instructions in the PRIMECLUSTER Installation Guide for your operating system:

- PRIMECLUSTER Cluster Foundation (CF), including CIP
- /etc/nsswitch.conf system service lookup order database
- echo service—Linux only
8 Appendix—Object types

The following alphabetical list describes all object types that are supplied with RMS and configured by PCS or the Wizard Tools.

- **andOp**
  
  **Required attributes:**
  - 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**
  
  **Required attributes:**
  - Resource
  
  Object that allows a userApplication to control one or more userApplication objects.

- **ENV**
  
  **Required attributes:**
  - (none required)
  
  Object containing clusterwide (global) environment variables.

- **ENVL**
  
  **Required attributes:**
  - (none required)
  
  Object containing node-specific (local) environment variables.

- **gResource**
  
  **Required attributes:**
  - rKind
  - rName
  
  Custom (generic) object. Usually represents system resources such as file systems, network interfaces, or system processes.
Appendix—Object types

- **orOp**
  
  *Required attributes:*
  - (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**
  
  *Required attributes:*
  - (none required)

  Represents nodes in the cluster; at least one required. Only userApplication objects are allowed as its children.

- **userApplication**
  
  *Required attributes:*
  - (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—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 list all attributes along with their possible settings and default values.

9.1 Attributes available to the user

Attributes in this section can be changed using the PCS or Wizard Tools user interface.

- **AlternateIp**
  
  **Possible Values:** Any interconnect name  
  **Default:** "" (empty)
  
  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.

- **AutoRecover**
  
  **Possible Values:** 0, 1  
  **Default:** 0
  
  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.

- **AutoStartUp**
  
  **Possible Values:** 0, 1  
  **Default:** 0
  
  Valid for `userApplication` objects. Automatically brings an application `Online` on the `SysNode` with the highest priority when RMS is started. Set to either 0 for no or 1 for yes.
You can override the AutoStartUp attribute for all userApplication objects by setting the HV_AUTOSTARTUP variable. See the description of HV_AUTOSTARTUP in the section “Local environment variables” on page 217.

- **AutoSwitchOver**
  
  **Possible Values:** Valid string containing one or more of the following: No, HostFailure, ResourceFailure, ShutDown
  
  **Default:** No
  
  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 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.

- **ClusterExclusive**
  
  **Possible Values:** 0, 1
  
  **Default:** 0
  
  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.

  The user can modify this attribute for a cmdline subapplication only. The configuration tools control this attribute for all other subapplications.

- **FaultScript**
  
  **Possible Values:** Valid script (character)
  
  **Default:** "" (empty)
  
  Valid for all object types. Specifies a script to be run if the associated resource enters the Faulted state.

- **Halt**
  
  **Possible Values:** 0, 1
  
  **Default:** 0
  
  Valid for userApplication objects. Eliminates a node if a double fault occurs and the userApplication can be switched to another node.
Appendix—Attributes

Attributes available to the user

- **I_List**
  
  *Possible Values:* Space-separated list of `SysNode` names  
  *Default:* "" (empty)

  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.

- **MaxControllers**
  
  *Possible Values:* 0–512  
  *Default:* 512

  Valid for `userApplication` objects. Upper limit of parent `userApplication` objects for the specified child application.

- **MonitorOnly**
  
  *Possible Values:* 0, 1  
  *Default:* 0

  Valid for resource objects. If set to 1, the state of the object is ignored by the parent when calculating the parent's state. Any parent should have at least one child for which `MonitorOnly` is not set.

- **OfflineScript**
  
  *Possible Values:* Valid script (character)  
  *Default:* "" (empty)

  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  
  *Default:* 0

  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
Attributes available to the user

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 may be used to establish consistent time across the nodes in the cluster. Refer to the manual page for xntpd for more information.

The OnlinePriority persistent state information will be cleared if RMS is restarted with the last online node removed from the configuration.

- **OnlineScript**

  **Possible Values:** Valid script (character)
  **Default:** "" (empty)

  Valid for all objects except SysNode objects. Specifies the script to bring the associated resource to the Online state.

- **PartialCluster**

  **Possible Values:** 0, 1
  **Default:** 0

  Valid for userApplication objects. Specifies if an application can negotiate online requests.

  If set to 0, then the application can negotiate its online request only when all 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.
Appendix—Attributes

Attributes available to the user

Note that a local userApplication that has its PartialCluster attribute set will not be affected by startup timeouts from remote nodes: the application can still go online on the local node. See the description of HV_AUTOSTARTUP_WAIT in the section “Global environment variables” on page 212.

- **PersistentFault**
  
  *Possible Values:* 0, 1  
  *Default:* 0

  Valid for userApplication objects. If set to 1, the application maintains a Faulted state across an RMS shutdown and restart. The application returns to the Faulted state if it was Faulted before, unless the fault is explicitly cleared by either `hvutil –c` or `hvswitch –f`, or if RMS is restarted with the Faulted SysNode removed from the configuration.

- **PostOfflineScript**
  
  *Possible Values:* Valid script (character)  
  *Default:* ”” (empty)

  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)  
  *Default:* ”” (empty)

  Valid for all objects except SysNode objects. Specifies the script to be run after the state of the associated resource changes to Online.

- **PreOfflineScript**
  
  *Possible Values:* Valid script (character)  
  *Default:* ”” (empty)

  Valid for all objects except SysNode objects. Specifies the script to run before the object is taken to the Offline state.
Attributes available to the user

Appendix—Attributes

- **PreOnlineScript**
  
  *Possible Values:* Valid script (character)
  
  *Default:* "" (empty)
  
  Valid for all objects except `SysNode` objects. Specifies the script to be run before the associated resource is taken to the *Online* state.

- **PreserveState**
  
  *Possible Values:* 0, 1
  
  *Default:* 0
  
  Valid for `userApplication` objects. Specifies that resources are not to be taken *Offline* after a fault. Ignored if `AutoSwitchOver` is not set to *No*.

- **PriorityList**
  
  *Possible Values:* Valid list of `SysNode` names (character)
  
  *Default:* "" (empty)
  
  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 a controller, the order of nodes in `PriorityList` is ignored. However, each child application must be able to run on the nodes specified for the controller object.

- **ScriptTimeout**
  
  *Possible Values:* 0–MAXINT (in seconds) or valid string of the form
  "timeout_value[:offline_value][:online_value]"
  
  *Default:* 300
  
  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.
Appendix—Attributes

Attributes available to the user

Use the string format to specify individual timeout values of `offline_value` for `OfflineScript` and `online_value` for `OnlineScript`.

- **ShutdownPriority**
  
  *Possible Values:* 0–MAXINT  
  *Default:* 0  
  
  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  
  *Default:* 0  
  
  Valid for resource objects. If set to 1, the object performs standby processing on all nodes where the parent application is supposed to be `Offline`.
  
  The user can modify this attribute for a `cmdline` subapplication only. The configuration tools control this attribute for all other subapplications.

- **StandbyTransitions**
  
  *Possible Values:* `StartUp`, `SwitchRequest`, `ClearFaultRequest` or any combination joined by vertical bars (|)  
  *Default:* “” (empty)  
  
  Valid for `userApplication` objects. The value specifies when the application will receive a standby request:  
  
  - **StartUp**—at startup, unless the application is already online or unless it is forced to go online due to the `AutoStartUp` attribute.  
  
  - **SwitchRequest**—after application switchover, if the application was online before the switchover.  
  
  - **ClearFaultRequest**—after a faulted state is cleared with `hvutil -c`.
### Attributes managed by configuration wizards

Attributes in this section are managed internally by the configuration wizards or by RMS at runtime.

- **WarningScript**
  
  **Possible Values:** Valid script (character)
  
  **Default:** "" (empty)

  Valid for resource objects with detector. Specifies the script to be run after the posted state of the associated resource changes to **Warning**.

- **Affiliation**
  
  **Possible Values:** Any string
  
  **Default:** "" (empty)

  Valid for resource objects. Used for display purposes in the user interface—no functional meaning within RMS.

- **AutoRecoverCleanup**
  
  **Possible Values:** 0, 1
  
  **Default:** 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
  
  **Default:** Default type defined in the chapter “Appendix—Object types” on page 197.

  Valid for all objects except **SysNode**. Describes the class of the resource object. Used by other programs for various purposes (for example, SNMP agent). This value is supplied by the configuration wizards.
Appendix—Attributes

Attributes managed by configuration wizards

- **Comment**
  
  *Possible Values:* any string  
  *Default:* "" (empty)  
  
  Valid for all objects. Used for documentation in the configuration file—no functional meaning within RMS.

- **ControlledShutdown**
  
  *Possible Values:* 0, 1  
  *Default:* 0  
  
  Valid for controlled **userApplication** objects. If set to 1, RMS does not send an *Offline* request to this application because an explicit request will be generated by a parent application during its offline processing.

- **ControlledSwitch**
  
  *Possible Values:* 0, 1  
  *Default:* 0  
  
  Valid for controlled **userApplication** objects. If set to 1, the application is the child of a controller.

- **DetectorStartScript**
  
  *Possible Values:* Any valid detector start script  
  *Default:* "" (empty)  
  
  Valid for resource object with detector. Specify the detector start command directly in the `<configname>.us` file.

- **HostName**
  
  *Possible Values:* Any *SysNode* name  
  *Default:* "" (empty)  
  
  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.
Attributes managed by configuration wizards

- **IgnoreStandbyRequest**
  
  **Possible Values:** 0, 1
  
  **Default:** 1

  Valid for controller objects. If set to 1, then neither PreOnline nor Online requests during standby processing will be propagated to the child application. If 0, then requests will be propagated. If the controller is not standby capable, then **IgnoreStandbyRequest** must be set to 1.

- **LastDetectorReport**
  
  **Possible Values:** Online, Offline, Faulted, Standby
  
  **Default:** (none)

  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.

- **LieOffline**
  
  **Possible Values:** 0, 1
  
  **Default:** 1

  Valid for all resource objects. If set to 1, allows the resource to remain Online during Offline processing.

- **NoDisplay**
  
  **Possible Values:** 0, 1
  
  **Default:** 0

  Valid for all object types. If set to 1, specifies that the resource should not be displayed when hvdisp is active. Can be overridden by ‘hvdisp -S’.

- **NullDetector**
  
  **Possible Values:** on, off
  
  **Default:** off

  Valid for resource objects with detector. Used to disable a detector at runtime by setting NullDetector to on. This attribute is for the use with dynamic reconfiguration only. NullDetector must never be set hard-coded to on in the RMS configuration file.
Appendix—Attributes

Attributes managed by configuration wizards

- **OfflineDoneScript**
  *Possible Values:* Valid script (character)
  *Default:* “” (empty)
  Valid for userApplication objects. The last script run after the application has completed offline processing.

- **OnlineTimeout**
  *Possible Values:* 0–MAXINT
  *Default:* 0
  Valid for controller objects. Specifies the time (in seconds) allowed for a controller not to react while a child application leaves the Online state.

- **PreCheckScript**
  *Possible Values:* Valid script (character)
  *Default:* “” (empty)
  Valid for userApplication objects. Specifies the script to be forked as the first action during Online or Standby processing. If the script returns with a zero exit code, processing proceeds. If the script returns with an exit code other than zero, processing is not performed and an appropriate warning is logged to the switchlog file.

- **Resource**
  *Possible Values:* Valid name (character)
  *Default:* “” (empty)
  Valid for controller objects. One or more names of child applications, separated by spaces and/or tabs.

- **rKind**
  *Possible Values:* 0–2047
  *Default:* none
  Valid for gResource objects. Specifies the kind of detector for the object.
Attributes managed by configuration wizards

- **rName**
  
  *Possible Values:* Valid string (character)
  
  *Default:* none
  
  Valid for `gResource` objects. Specifies a string to be forwarded to the generic detector.

- **SplitRequest**

  *Possible Values:* 0, 1
  
  *Default:* 0
  
  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.
10 Appendix—Environment variables

This appendix provides a complete list of the environment variables used by RMS, grouped into the following types:

- “Global environment variables” on page 212
- “Local environment variables” on page 217
- “Script execution environment variables” on page 221

The discussion in the section “Environment variables” on page 27 describes how RMS manages environment variables.

10.1 Setting environment variables

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

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
Global environment variables

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

## 10.2 Global environment variables

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.
Appendix—Environment variables

**Global environment variables**

**Caution**

If the `HV_AUTOSTARTUP_IGNORE` environment variable is 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_AUTOSTARTUP_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 that `HV_AUTOSTARTUP_WAIT` timeouts from remote nodes will not affect a local `userApplication` that has its `PartialCluster` attribute set: the application can still go online on the local node. See the description of the `PartialCluster` attribute in the section “Attributes available to the user” on page 199.

  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.
Global environment variables

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_LOG_ACTION_THRESHOLD**
  
  *Possible values:* 0–100  
  *Default:* 98  
  
  Defines the behavior of hvlogcontrol. If the used space on the log disk is larger or equal to this threshold, all subdirectories below log will be removed. Furthermore, if HV_LOG_ACTION is set to on and all subdirectories have already been removed, the actual log files will be removed too. Refer to the section “Local environment variables” on page 217 for more information on HV_LOG_ACTION.

- **HV_LOG_WARN_THRESHOLD**
  
  *Possible values:* 0–100  
  *Default:* 95  
  
  Defines the behavior of hvlogcontrol. If the used space on the file system containing the RMS log disk is larger or equal to this threshold value, the hvlogcontrol script issues a warning to the user regarding the large amount of log files.

- **HV_LOH_INTERVAL**
  
  *Possible values:* 0–MAXINT  
  *Default:* 30  
  
  Minimum difference in seconds when comparing timestamps to determine the last online host for an application. The last online host (LOH) specifies the host where the userApplication was online most recently. It is determined if the OnlinePriority attribute is set.

  If the LOH timestamp entries of the userApplication on two hosts differ by less than this time interval, 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.
Appendix—Environment variables

Global environment variables

- **HV_WAIT_CONFIG**
  
  *Possible values:* 0–MAXINT  
  *Default:* 120 (seconds)  
  
  Interval in seconds during which RMS waits to receive a configuration from an online host if RMS starts up as `hvcm -C`. If the configuration is not received within $HV\_WAIT\_CONFIG$ seconds, the local monitor will attempt to run with the configuration file specified in $RELIANT\_BUILD\_PATH$. If such a file does not exist, the local monitor will continue to run with the minimal configuration; in this case it is possible for it to join an already running RMS cluster via `hvjoin`.

- **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 log files which are 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, PCS, and Wizard Tools log files are stored.

- **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.
Global environment variables

Appendix—Environment variables

- RELIANT_SHUT_MIN_WAIT

  Possible values: 0–MAXINT
  Default: 900 (seconds)

  Defines the period (in seconds) that the command hvshut waits before timing out and generating an error message. This value should be no less than the maximum time required by any application in the configuration to go offline on any node in the cluster.

  If this value is too low, RMS terminates ungracefully: all running scripts are terminated immediately, and some resources under control of RMS will be left in an arbitrary state. These resources must be manually shut down before RMS can be restarted.

  The default value will be adequate for some configurations, but each configuration must be considered individually. Long delays in offline processing may be caused by recurring issues such as large numbers of nodes or resources, or slow network connections or hardware. We recommend that you obtain the advice of an expert who is familiar with the applications and resources in your cluster.

  If expert advice is unavailable, you can still estimate a reasonable value for RELIANT_SHUT_MIN_WAIT. Temporarily set the variable to a large value (e.g., 4000), run a series of tests that simulate production conditions, and then use the worst-case offline processing time plus a safety factor (e.g., 10%).

  Due to the serious effects, you should diagnose the cause of an offline processing timeout before making another attempt to shut down RMS automatically.
10.3 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 section “Attributes available to the user” on page 199). 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:* 0–MAXINT
  
  *Default:* 0 (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.

- **HV_LOG_ACTION**
  
  *Possible values:* on, off
  
  *Default:* off

  Determines if the current log files in the directory RELIANT_LOG_PATH are deleted if the used space on the file system is larger or equal to HV_LOG_ACTION_THRESHOLD.
Local environment variables

- **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–fork limit
  
  Default: 30
  
  Defines the maximum number of scripts RMS can have forked at any time. The default (30) is sufficient in most cases.

- **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.
Appendix—Environment variables

Local environment variables

- **HV_SCRIPTS_DEBUG**

  *Possible values:* 0, 1  
  *Default:* 0

  Controls debugging output from RMS scripts. If this variable is set to 1, each script writes detailed 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 PRIME-CLUSTER products. To disable script debug message logging, delete the `HV_SCRIPTS_DEBUG` entry or set `HV_SCRIPTS_DEBUG=0` in `hvenv.local`.

- **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`.

- **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: `fuji2RMS`), 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 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.
Local environment variables

Appendix—Environment variables

- **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.
10.4 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 values:* 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, Faulted, NoReport
  
  Last detector report for the current object.

- **HV_OFFLINE_REASON**
  
  *Possible values:* one of DEACT, SWITCH, FAULT, STOP
  
  Reason for ongoing offline processing:

  - **DEACT:** deact request ('hvutil -d')
  - **SWITCH:** manual switchover ('hvswitch')
  - **FAULT:** follow-up processing after a previous resource failure
  - **STOP:** userApplication is stopped ('hvutil -f', 'hvutil -c', 'hvshut').
Script execution environment variables  Appendix—Environment variables

- **HV_NODENAME**
  
  *Possible values:* any object name
  
  Name of current object.

- **HV_SCRIPT_TYPE**
  
  *Possible values:* one of PreCheckScript, PreOnlineScript, OnlineScript, PostOnlineScript, PreOfflineScript, OfflineScript, PostOfflineScript, OfflineDoneScript, FaultScript

  Script type.

- **NODE_SCRIPTS_TIME_OUT**
  
  *Possible values:* 0–MAXINT

  Timeout value for the current object and script type.
Appendix—List of manual pages

This appendix lists the online manual pages for CCBR, CF, CFS, CIP, Monitoring Agent, PAS, RCVM, Resource Database, RMS, RMS Wizards, SCON, SF, SIS, and Web-Based Admin View.

To display a manual page, type the following command:

```
$ man man_page_name
```

11.1 CCBR

System administration

```
cfbackup
   save the cluster configuration information for a PRIMECLUSTER node
```

```
cfrestore
   restore saved cluster configuration formation on a PRIMECLUSTER node
```

11.2 CF

System administration

```
cfconfig
   configure or unconfigure a node for a PRIMECLUSTER cluster
```

```
cfset
   apply or modify /etc/default/cluster.config entries into the CF module
```

```
cfrecon
   dynamically reconfigure the cluster interconnects used by a node
```

```
cftool
   print node communications status for a node or the cluster
```

```
rcqconfig
   configures or reports cluster quorum settings
```
CFS

11.3 CFS

fsck_rcfs
   file system consistency check and interactive repair

mount_rcfs
   mount RCFS file systems

rcfs_fumount
   force unmount RCFS mounted file system

rcfs_list
   list status of RCFS mounted file systems

rcfs_switch
   manual switchover or failover of a RCFS file system

ngadmin
   node group administration utility

cfsmntd
   cfs mount daemon for RCFS

11.4 CIP

System administration

cipconfig
   start or stop CIP 2.0

ciptool
   retrieve CIP information about local and remote nodes in the cluster

File format

cip.cf
   CIP configuration file format
11.5 Monitoring Agent

System administration

clrcimonctl  
Start, stop or restart of the RCI monitoring agent daemon, and display of daemon presence

clrcumonctl  
Start, stop or restart of the console monitoring agent daemon, and display of daemon presence

11.6 PAS

System administration

mipcstat  
MIPC statistics

clmstat  
CLM statistics
11.7 RCVM

RCVM is not available in all markets.

System administration

dkconfig
  virtual disk configuration utility
dkmigrate
  virtual disk migration utility
vdisk
  virtual disk driver
dkmirror
  mirror disk administrative utility

File format

dktab
  virtual disk configuration file

11.8 Resource Database

To display a Resource Database manual page, add 
/etc/opt/FJSVcluster/man to the environment variable MANPATH.

System administration

clautoconfig
  execute of the automatic resource registration
clbackuprdb
  save the resource database
clexec
  execute the remote command
cldeldevice
  delete resource registered by automatic resource registration
clinitreset
  reset the resource database
Appendix—List of manual pages

clrestorerdb
  restore the resource database

clsetparam
  display and change the resource database operational environment

clsetup
  set up the resource database

clstartrsc
  resource activation

clstoprsc
  resource deactivation

clsyncfile
  distribute a file between cluster nodes

User command

clgettree
  display the tree information of the resource database

11.9  RMS

System administration

hvassert
  assert (test for) an RMS resource state

hvattr
  make cluster-wide attribute changes at runtime from a single node
  (installed with PCS or the Wizard Tools)

hvcm
  start the RMS configuration monitor

hvconfig
  display or save the RMS configuration file

hvdisp
  display RMS resource information

hvdist
  distribute RMS configuration files
RMS

Appendix—List of manual pages

hvdump
  collect debugging information about RMS

hvgdmake
  compile an RMS custom detector

hvlogclean
  clean RMS log files

hvrclev
  change default RMS start run level

hvreset
  reinitialize the graph of an RMS user application (for use by experts in test conditions only—not for use on production clusters)

hvsetenv
  controls automatic startup of RMS or all user applications on the local host

hvshut
  shut down RMS

hvswitch
  switch control of an RMS user application resource to another node

hvthrottle
  prevent multiple RMS scripts from running simultaneously

hvutil
  manipulate availability of an RMS resource

File formats

hvenv.local
  RMS local environment configuration file
Appendix—List of manual pages

11.10 RMS Wizards

RMS Wizard Tools and RMS Wizard Kit

RMS Wizards are documented as HTML pages in the SMAWRhv-do package on the CD-ROM. After installing this package, the documentation is available in the following directory:

<RELIANT_PATH>/htdocs.solaris/wizards.en (Solaris)
<RELIANT_PATH>/htdocs.linux/wizards.en (Linux)

The default value of <RELIANT_PATH> is /opt/SMAW/SMAWRrms/.

11.11 SCON

scon
    start the cluster console software

11.12 SF

System administration

rcsd
    shutdown daemon for the Shutdown Facility

sdtool
    interface tool for the shutdown daemon

File formats

rcsd.cfg
    configuration file for the Shutdown Daemon

SA_blade.cfg
    configuration file for FSC server blade Shutdown Agent

SA_rccu.cfg
    configuration file for RCCU Shutdown Agent

SA_rps.cfg
    configuration file for Remote Power Switch Shutdown Agent
SA_rsb.cfg
   configuration file for RemoteView Services Board Shutdown Agent

SA_scon.cfg
   configuration file for SCON Shutdown Agent

SA_pprci.cfg
   configuration file for RCI Shutdown Agent (PRIMEPOWER only)

SA_sspint.cfg
   configuration file for Sun E10000 Shutdown Agent

SA_sunF.cfg
   configuration file for sunF system controller Shutdown Agent

SA_wtinps.cfg
   configuration file for WTI NPS Shutdown Agent

11.13 SIS

System administration

dtcpadmin
   start the SIS administration utility

dtcpd
   start the SIS daemon for configuring VIPs

dtcpstat
   status information about SIS

11.14 Web-Based Admin View

System administration

fjsvwwvbs
   stop Web-Based Admin View

fjsvwwvcnf
   start, stop, or restart the web server for Web-Based Admin View

wvCntl
   start, stop, or get debugging information for Web-Based Admin View
Appendix—List of manual pages

**Web-Based Admin View**

- **wvGetparam**
  - display Web-Based Admin View's environment variable
- **wvSetparam**
  - set Web-Based Admin View environment variable
- **wvstat**
  - display the operating status of Web-Based Admin View
Web-Based Admin View

Appendix—List of manual pages
Glossary

Items in this glossary that apply to specific PRIMECLUSTER products are indicated with the following notation:

- (CF)—Cluster Foundation
- (PCS)—PRIMECLUSTER Configuration Services
- (RMS)—Reliant Monitor Services
- (RCVM)—Volume Manager (not available in all markets)
- (SIS)—Scalable Internet Services

Some of these products may not be installed on your cluster. See your PRIMECLUSTER sales representative for more information.

**AC**

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.

**activating a configuration (RMS)**

Preparing an RMS configuration to be run on a cluster. This involves two major actions: first, the configuration is generated on the host where the configuration was created or edited; second, the configuration is distributed to all nodes affected by the configuration. The user can activate a configuration using PCS, the Wizard Tools, or the CLI.

See also generating a configuration (RMS), distributing a configuration (RMS).

**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 Console 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.
Glossary

API
See Application Program Interface.

application (RMS)
A resource categorized as a userApplication used to group resources into a logical collection.

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 PCS, the Wizard Tools, or the PCS Wizard Kit to create object definitions for a specific type of application.

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.

directed switchover (RMS)
The procedure by which RMS automatically switches control of a userApplication over to another node after specified conditions are detected.

symmetrical switchover (RMS)

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 PRIMECLUSTER module resides on top of the basic OS and provides internal interfaces for the CF (Cluster Foundation) functions that the PRIMECLUSTER services use in the layer above.

See also Cluster Foundation (CF).
Glossary

base monitor (RMS)
The RMS module that maintains the availability of resources. The base monitor is supported by daemons and detectors. Each node being monitored has its own copy of the base monitor.

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
See Cluster Configuration Backup and Restore.

CF
See Cluster Foundation (CF).

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).

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, RMS, PCS, and SIS. Cluster Admin is available from the Web-Based Admin View interface.

See also Cluster Foundation (CF), Reliant Monitor Services (RMS), PRIME-CLUSTER Configuration Services (PCS), Scalable Internet Services (SIS), Web-Based Admin View.
Glossary

Cluster Configuration Backup and Restore
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.

concatenated virtual disk (RCVM)
Concatenated virtual disks consist of two or more pieces on one or more disk drives. They correspond to the sum of their parts. Unlike simple virtual disks where the disk is subdivided into small pieces, the individual disks or partitions are combined to form a single large logical disk.
See also mirror virtual disk (RCVM), simple virtual disk (RCVM), striped virtual disk (RCVM), virtual disk.

Configuration Definition Language (PCS)
The syntax for PCS configuration templates.
See also PRIMECLUSTER Configuration Services (PCS).

configuration file (RMS)
The RMS configuration 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.

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 base monitor.

**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).

**distributing a configuration** (RMS)
The process of copying a configuration file and all of its associated scripts and detectors to all nodes affected by the configuration. This is normally done automatically when the configuration is **activated** using PCS, the Wizard Tools, or the CLI.

   See also **activating a configuration** (RMS), **generating a configuration** (RMS).

**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).

**ENS** (CF)
See **Event Notification Services** (CF).

**environment variables**
Variables or parameters that are defined globally.
Glossary

**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), switchover (RMS), symmetrical switchover (RMS)**.

**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)**.

**GDS**
See **Global Disk Services**.

**generating a configuration (RMS)**
The process of creating a single configuration file that can be distributed to all nodes affected by the configuration. This is normally done automatically when the configuration is **activated** using PCS, the RMS Wizards, or the CLI.

See also **activating a configuration (RMS), distributing a configuration (RMS)**.

**GFS**
See **Global File Services**.

**GLS**
See **Global Link Services**.
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 employed to avoid single points of failure.

See also Reliant Monitor Services (RMS).

interconnect (CF)
See cluster interconnect (CF).
Glossary

**Internet Protocol address**
A numeric address that can be assigned to computers or applications.

See also *IP aliasing*.

**Internode Communications 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.

**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*.

**JOIN (CF)**
See *Cluster Join Services (CF)*.

**keyword**
A word that has special meaning in a programming language. For example, in the configuration file, the keyword *object* identifies the kind of definition that follows.

**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 base monitor, wizards, and detectors can have their own log files.

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.

Meta Data Server
GFS daemon that centrally manages the control information of a file
system (meta-data).

mirrored disks (RCVM)
A set of disks that contain the same data. If one disk fails, the remaining
disks of the set are still available, preventing an interruption in data avail-
ability.
See also mirrored pieces (RCVM).

mirrored pieces (RCVM)
Physical pieces that together comprise a mirrored virtual disk. These
pieces include mirrored disks and data disks.
See also mirrored disks (RCVM).
Glossary

mirror virtual disk (RCVM)
Mirror virtual disks consist of two or more physical devices, and all output operations are performed simultaneously on all of the devices.

See also concatenated virtual disk (RCVM), simple virtual disk (RCVM), striped virtual disk (RCVM), virtual disk.

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.

node
A host which is a member of a cluster. A computer node is the same as a computer.

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).

object (RMS)
In the configuration file or a system graph, this is a representation of a physical or virtual resource.

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. The keyword associated with an object definition is `object`.

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 node.

**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), system graph (RMS)`.

**PCS**
See `PRIMECLUSTER Configuration Services (PCS)`.
PCS Wizard Kit (PCS)
RMS configuration products that have been designed for specific applications. Each component of the PCS Wizard Kit includes customized default settings, subapplications, detectors, and scripts. These application wizards also tailor the PCS interface to provide controls for the additional features.

See also PCS, Reliant Monitor Services (RMS).

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 Configuration Services (PCS)
The graphical configuration interface for PRIMECLUSTER products. PCS uses standard templates written in Configuration Definition Language (CDL) to provide a user-friendly configuration environment for products such as RMS. The standard templates can be modified or replaced to provide a customized interface for specific applications or installations.

PRIMECLUSTER services (CF)
Service modules that provide services and internal interfaces for clustered applications.

private network addresses
Private network addresses are a reserved range of IP addresses specified by the Internet Assigned Numbers Authority. They may be used internally by any organization but, because different organizations can use the same addresses, they should never be made visible to the public internet.

private resource (RMS)
A resource accessible only by a single node and not accessible to other RMS nodes.

See also resource (RMS), shared resource.

public LAN
The local area network (LAN) by which normal users access a machine.

See also Administrative LAN.
Glossary

queue
See message queue.

redundancy
This is the capability of one object to assume the resource load of any other object in a cluster, and the capability of RAID hardware and/or RAID software to replicate data stored on secondary storage devices.

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 node.
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.
Glossary

**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)*
RMS configuration products that have been designed for specific applications. Each component of the Wizard Kit includes customized default settings, subapplications, detectors, and scripts. These application wizards also tailor the RMS Wizard Tools interface to provide controls for the additional features.

See also **RMS Wizard Tools** *(RMS)*, **Reliant Monitor Services** *(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)*.

**SAN**
See **Storage Area Network**.

**Scalable Internet Services** *(SIS)*
Scalable Internet Services is a TCP connection load balancer, and dynamically balances network access loads across cluster nodes while maintaining normal client/server sessions for each connection.

**scalability**
The ability of a computing system to dynamically handle any increase in work load. Scalability is especially important for Internet-based applications where growth caused by Internet usage presents a scalable challenge.

**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.
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), 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
The Shutdown Facility provides the interface for managing the shutdown of cluster nodes when error conditions occur. The SF also cares for advising other PRIMECLUSTER products of the successful completion of node shutdown so that recovery operations can begin.

simple virtual disk (RCVM)
Simple virtual disks define either an area within a physical disk partition or an entire partition.

See also concatenated virtual disk (RCVM), mirror virtual disk (RCVM), striped virtual disk (RCVM), virtual disk.

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).

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.
Glossary

**striped virtual disk (RCVM)**
Striped virtual disks consist of two or more pieces. These can be physical partitions or further virtual disks (typically a mirror disk). Sequential I/O operations on the virtual disk can be converted to I/O operations on two or more physical disks. This corresponds to RAID Level 0 (RAID0).

See also **concatenated virtual disk (RCVM)**, **mirror virtual disk (RCVM)**, **simple virtual disk (RCVM)**, **virtual disk**.

**switchover (RMS)**
The process by which RMS switches control of a user application 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 node is able to take on resources from any other RMS node.

See also **automatic switchover (RMS)**, **directed switchover (RMS)**, **failover (RMS, SIS)**, **switchover (RMS)**.

**system graph (RMS)**
A visual representation (a map) of monitored resources used to develop or interpret the 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
With virtual disks, a pseudo device driver is inserted between the highest level of the OS logical Input/Output (I/O) system and the physical device driver. This pseudo device driver then maps all logical I/O requests on physical disks.

See also concatenated virtual disk (RCVM), mirror virtual disk (RCVM), simple virtual disk (RCVM), virtual disk.

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. An enabler is a type of wizard.

Wizard Kit (RMS)
See PCS Wizard Kit (PCS), RMS Wizard Kit (RMS).

Wizard Tools (RMS)
See RMS Wizard Tools (RMS).
Abbreviations

AC
Access Client

API
application program interface

AS
Adaptive Services

bm
base monitor

CCBR
Cluster Configuration Backup/Restore

CDL
Configuration Definition Language

CF
Cluster Foundation or Cluster Framework

CIM
Cluster Integrity Monitor

CIP
Cluster Interconnect Protocol

CLI
command-line interface

CLM
Cluster Manager

CRM
Cluster Resource Management

DLPI
Data Link Provider Interface
Abbreviations

ENS  
Event Notification Services

GDS  
Global Disk Services

GFS  
Global File Services

GLS  
Global Link Services

GUI  
graphical user interface

HA  
high availability

ICF  
Internode Communication Facility

I/O  
input/output

JOIN  
cluster join services module

LAN  
local area network

MDS  
Meta Data Server

MIB  
Management Information Base

MIPC  
Mesh Interprocessor Communication

NIC  
network interface card
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSM</td>
<td>Node State Monitor</td>
</tr>
<tr>
<td>OSD</td>
<td>operating system dependent</td>
</tr>
<tr>
<td>PAS</td>
<td>Parallel Application Services</td>
</tr>
<tr>
<td>PCS</td>
<td>PRIMECLUSTER Configuration Services</td>
</tr>
<tr>
<td>RCCU</td>
<td>Remote Console Control Unit</td>
</tr>
<tr>
<td>RCFS</td>
<td>PRIMECLUSTER File Share</td>
</tr>
<tr>
<td>RCI</td>
<td>Remote Cabinet Interface</td>
</tr>
<tr>
<td>RCVM</td>
<td>PRIMECLUSTER Volume Manager</td>
</tr>
<tr>
<td>RMS</td>
<td>Reliant Monitor Services</td>
</tr>
<tr>
<td>SA</td>
<td>Shutdown Agent</td>
</tr>
<tr>
<td>SAN</td>
<td>Storage Area Network</td>
</tr>
<tr>
<td>SCON</td>
<td>single console software</td>
</tr>
<tr>
<td>SD</td>
<td>Shutdown Daemon</td>
</tr>
<tr>
<td>SF</td>
<td>Shutdown Facility</td>
</tr>
</tbody>
</table>
Abbreviations

SIS
Scalable Internet Services

VIP
Virtual Interface Provider
Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of PRIMECLUSTER products</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Interface between RMS and the operating system</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Parent application with two dependencies</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>RMS representation of controlled application</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Result of follow mode switchover</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>Relationship between RMS and RMS Wizards</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>Main configuration menu when RMS is not active</td>
<td>36</td>
</tr>
<tr>
<td>8</td>
<td>Main configuration menu when RMS is running</td>
<td>40</td>
</tr>
<tr>
<td>9</td>
<td>Application type selection</td>
<td>41</td>
</tr>
<tr>
<td>10</td>
<td>Menu leading to basic settings</td>
<td>42</td>
</tr>
<tr>
<td>11</td>
<td>Menu to configure basic settings</td>
<td>43</td>
</tr>
<tr>
<td>12</td>
<td>Menu to configure non-basic settings</td>
<td>44</td>
</tr>
<tr>
<td>13</td>
<td>Main configuration menu</td>
<td>45</td>
</tr>
<tr>
<td>14</td>
<td>Activating a configuration</td>
<td>46</td>
</tr>
<tr>
<td>15</td>
<td>Quitting the Main configuration menu</td>
<td>47</td>
</tr>
<tr>
<td>16</td>
<td>Main configuration menu</td>
<td>54</td>
</tr>
<tr>
<td>17</td>
<td>Add hosts to a cluster menu</td>
<td>55</td>
</tr>
<tr>
<td>18</td>
<td>Remove hosts from a cluster menu</td>
<td>56</td>
</tr>
<tr>
<td>19</td>
<td>Main configuration menu</td>
<td>57</td>
</tr>
<tr>
<td>20</td>
<td>Application type selection menu</td>
<td>57</td>
</tr>
<tr>
<td>21</td>
<td>Prompting for further actions</td>
<td>58</td>
</tr>
<tr>
<td>22</td>
<td>Consistency check and Machines+Basics menu</td>
<td>59</td>
</tr>
<tr>
<td>23</td>
<td>List of nodes for failover procedure</td>
<td>60</td>
</tr>
<tr>
<td>24</td>
<td>Machines+Basics menu for additional nodes</td>
<td>61</td>
</tr>
</tbody>
</table>
Figures

Figure 25: AutoSwitchOver mode ........................................ 61
Figure 26: Setting flags for AutoSwitchOver mode ................. 62
Figure 27: Saving settings ................................................ 63
Figure 28: Non-basic settings ............................................ 64
Figure 29: Prompting for display specification ....................... 65
Figure 30: List of display options ....................................... 66
Figure 31: Successful consistency check for APP1 ................. 67
Figure 32: Turnkey wizard DEMO ....................................... 68
Figure 33: Main configuration menu .................................... 69
Figure 34: Successful configuration activation ....................... 69
Figure 35: Quitting the Main configuration menu ................... 70
Figure 36: Starting again with the Main configuration menu ...... 71
Figure 37: Application type selection menu ......................... 72
Figure 38: Prompting for further specification ....................... 73
Figure 39: Machines+Basics menu .................................... 73
Figure 40: List of nodes for failover procedure ...................... 74
Figure 41: Machines+Basics menu .................................... 74
Figure 42: Non-basic settings ............................................ 75
Figure 43: Assigning a controller ....................................... 76
Figure 44: List of applications to be chosen as controlled applications 76
Figure 45: Menu for setting controller flags .......................... 77
Figure 46: Changing controller timeout period ...................... 77
Figure 47: Saving flags for controller .................................. 78
Figure 48: Indication of flags set for controller ...................... 78
Figure 49: Menu with settings for GENERIC turnkey wizard ...... 79
Figure 50: Main configuration menu ................................... 79
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>Main configuration menu</td>
<td>80</td>
</tr>
<tr>
<td>52</td>
<td>Activating the configuration for the second time</td>
<td>80</td>
</tr>
<tr>
<td>53</td>
<td>Return to Main configuration menu</td>
<td>81</td>
</tr>
<tr>
<td>54</td>
<td>Web-Based Admin View login</td>
<td>85</td>
</tr>
<tr>
<td>55</td>
<td>Invoking the Cluster Services GUI</td>
<td>86</td>
</tr>
<tr>
<td>56</td>
<td>Invoking Cluster Admin</td>
<td>86</td>
</tr>
<tr>
<td>57</td>
<td>Cluster Admin initial connection menu</td>
<td>87</td>
</tr>
<tr>
<td>58</td>
<td>Security certificate dialog</td>
<td>88</td>
</tr>
<tr>
<td>59</td>
<td>Main Cluster Admin window—Initial view</td>
<td>89</td>
</tr>
<tr>
<td>60</td>
<td>Main Cluster Admin window—message view</td>
<td>90</td>
</tr>
<tr>
<td>61</td>
<td>Main Cluster Admin window—RMS view</td>
<td>91</td>
</tr>
<tr>
<td>62</td>
<td>RMS tree with a controller object</td>
<td>93</td>
</tr>
<tr>
<td>63</td>
<td>Command pop-up menu for a node</td>
<td>94</td>
</tr>
<tr>
<td>64</td>
<td>Command pop-up menu for an online application</td>
<td>95</td>
</tr>
<tr>
<td>65</td>
<td>Command pop-up menu for an offline application</td>
<td>95</td>
</tr>
<tr>
<td>66</td>
<td>Confirmation pop-up window</td>
<td>96</td>
</tr>
<tr>
<td>67</td>
<td>Displaying global environment variables</td>
<td>96</td>
</tr>
<tr>
<td>68</td>
<td>Global environment variable view</td>
<td>97</td>
</tr>
<tr>
<td>69</td>
<td>Displaying local environment variables</td>
<td>97</td>
</tr>
<tr>
<td>70</td>
<td>Local environment variables view</td>
<td>98</td>
</tr>
<tr>
<td>71</td>
<td>Displaying application and object states</td>
<td>99</td>
</tr>
<tr>
<td>72</td>
<td>Configuration information or object attributes</td>
<td>100</td>
</tr>
<tr>
<td>73</td>
<td>Viewing the RMS switchlog file using a context menu</td>
<td>101</td>
</tr>
<tr>
<td>74</td>
<td>Viewing the RMS switchlog file using the Tools menu</td>
<td>101</td>
</tr>
<tr>
<td>75</td>
<td>Viewing an application log using a context menu</td>
<td>102</td>
</tr>
<tr>
<td>76</td>
<td>Viewing an RMS log</td>
<td>102</td>
</tr>
<tr>
<td>Figure 77:</td>
<td>Viewing the RMS switchlog file in a detached window</td>
<td>103</td>
</tr>
<tr>
<td>Figure 78:</td>
<td>Search based on date and time range</td>
<td>104</td>
</tr>
<tr>
<td>Figure 79:</td>
<td>Search based on resource name</td>
<td>105</td>
</tr>
<tr>
<td>Figure 80:</td>
<td>Search based on severity level</td>
<td>106</td>
</tr>
<tr>
<td>Figure 81:</td>
<td>Search based on keyword</td>
<td>107</td>
</tr>
<tr>
<td>Figure 82:</td>
<td>Using the Find pop-up in log viewer</td>
<td>108</td>
</tr>
<tr>
<td>Figure 83:</td>
<td>Opening the clusterwide table</td>
<td>109</td>
</tr>
<tr>
<td>Figure 84:</td>
<td>Clusterwide table</td>
<td>109</td>
</tr>
<tr>
<td>Figure 85:</td>
<td>Clusterwide table with state names</td>
<td>109</td>
</tr>
<tr>
<td>Figure 86:</td>
<td>Faulted applications in the clusterwide table</td>
<td>110</td>
</tr>
<tr>
<td>Figure 87:</td>
<td>Offline applications in the clusterwide table</td>
<td>110</td>
</tr>
<tr>
<td>Figure 88:</td>
<td>Faulted and offline applications in the clusterwide table</td>
<td>111</td>
</tr>
<tr>
<td>Figure 89:</td>
<td>Split-brain conditions in the clusterwide table</td>
<td>111</td>
</tr>
<tr>
<td>Figure 90:</td>
<td>Using command pop-ups in clusterwide table</td>
<td>112</td>
</tr>
<tr>
<td>Figure 91:</td>
<td>Cluster state before RMS is shut down</td>
<td>113</td>
</tr>
<tr>
<td>Figure 92:</td>
<td>Cluster state after RMS restart with different configuration</td>
<td>113</td>
</tr>
<tr>
<td>Figure 93:</td>
<td>Starting RMS from the main menu</td>
<td>114</td>
</tr>
<tr>
<td>Figure 94:</td>
<td>RMS Start Menu for all nodes</td>
<td>115</td>
</tr>
<tr>
<td>Figure 95:</td>
<td>RMS Start Menu for individual nodes</td>
<td>115</td>
</tr>
<tr>
<td>Figure 96:</td>
<td>Starting RMS on individual nodes</td>
<td>116</td>
</tr>
<tr>
<td>Figure 97:</td>
<td>Controlling automatic RMS startup—step 1</td>
<td>117</td>
</tr>
<tr>
<td>Figure 98:</td>
<td>Controlling automatic RMS startup—step 2</td>
<td>117</td>
</tr>
<tr>
<td>Figure 99:</td>
<td>Using the Tools menu to stop RMS</td>
<td>118</td>
</tr>
<tr>
<td>Figure 100:</td>
<td>Stopping RMS on all available nodes</td>
<td>119</td>
</tr>
<tr>
<td>Figure 101:</td>
<td>Stopping RMS on one node from the list</td>
<td>120</td>
</tr>
</tbody>
</table>
Figures

Figure 102: Using the context menu to stop RMS on one node . . . . . 121
Figure 103: Stopping RMS on one node . . . . . . . . . . . . . . . . . . 121
Figure 104: Stopping RMS while keeping applications—confirmation 122
Figure 105: Controlling automatic application startup—step 1 . . . . 123
Figure 106: Controlling automatic application startup—step 2 . . . . 124
Figure 107: Starting an application . . . . . . . . . . . . . . . . . . . . 125
Figure 108: Switching an application . . . . . . . . . . . . . . . . . . . 126
Figure 109: Switching a busy application . . . . . . . . . . . . . . . . . 127
Figure 110: Shutting down an application . . . . . . . . . . . . . . . . 127
Figure 111: Clearing an application fault . . . . . . . . . . . . . . . . 129
Figure 112: Clearing an application fault—confirmation dialog . . . 129
Figure 113: Starting maintenance mode for all applications . . . . . 131
Figure 114: Starting maintenance mode for a single application . . 131
Figure 115: Maintenance mode confirmation for all applications . . 132
Figure 116: Maintenance mode confirmation for one application . . 132
Figure 117: Typical cluster in maintenance mode . . . . . . . . . . . 133
Figure 118: Normal operation of independent application . . . . . . 134
Figure 119: Normal maintenance mode exit for all applications . . . 134
Figure 120: Normal maintenance mode exit for a single application . 135
Figure 121: Forced maintenance mode confirmation for all applications 135
Figure 122: Application with fault condition during maintenance mode 136
Figure 123: Fault clearing from configuration tree . . . . . . . . . . 136
Figure 124: Fault clearing from clusterwide table . . . . . . . . . . . 137
Figure 125: Application returned to normal maintenance mode . . . 137
Figure 126: Viewing the RMS full graph on a node . . . . . . . . . . 140
Figure 127: Typical RMS full graph . . . . . . . . . . . . . . . . . . . . . 140
### Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>RMS full graph—object tooltip</td>
<td>141</td>
</tr>
<tr>
<td>129</td>
<td>RMS full graph—object details</td>
<td>142</td>
</tr>
<tr>
<td>130</td>
<td>Viewing an RMS application graph</td>
<td>143</td>
</tr>
<tr>
<td>131</td>
<td>Typical RMS application graph</td>
<td>144</td>
</tr>
<tr>
<td>132</td>
<td>Viewing an RMS subapplication graph</td>
<td>144</td>
</tr>
<tr>
<td>133</td>
<td>Typical RMS subapplication graph</td>
<td>145</td>
</tr>
<tr>
<td>134</td>
<td>Viewing an RMS composite subapplication graph</td>
<td>146</td>
</tr>
<tr>
<td>135</td>
<td>Typical composite subapplication graph</td>
<td>147</td>
</tr>
<tr>
<td>136</td>
<td>Using a command pop-up menu from the graph</td>
<td>148</td>
</tr>
<tr>
<td>137</td>
<td>Displaying an RMS graph with affiliation names</td>
<td>149</td>
</tr>
<tr>
<td>138</td>
<td>RMS graph with resource names</td>
<td>150</td>
</tr>
<tr>
<td>139</td>
<td>RMS graph with resource and affiliation names</td>
<td>151</td>
</tr>
<tr>
<td>140</td>
<td>RMS graph after shutdown on one node</td>
<td>152</td>
</tr>
<tr>
<td>141</td>
<td>RMS main view and clusterwide table after shutdown on one node</td>
<td>152</td>
</tr>
<tr>
<td>142</td>
<td>Object hierarchy for initializing examples</td>
<td>156</td>
</tr>
<tr>
<td>143</td>
<td>System graph for initializing examples—Wizard Tools</td>
<td>157</td>
</tr>
<tr>
<td>144</td>
<td>hvdisp output for initializing examples—Wizard Tools</td>
<td>158</td>
</tr>
<tr>
<td>145</td>
<td>Example of maintenance mode restrictions</td>
<td>181</td>
</tr>
</tbody>
</table>
Tables

Table 1: Available CLI commands ...................... 24
Table 2: RMS base directory structure ............... 29
Table 3: Log directory structure .................... 30
Table 4: RMS severity level description ............ 106
Table 5: RMS host name conventions in /etc/hosts .. 186
Tables
Index

#RMS# entries
/etc/dfs/dfstab 194
/etc/exports 191
/etc/fstab 191
/etc/vfstab 192
/.rhosts 187
/etc/cip.cf 60
/etc/dfs/dfstab 194
/etc/exports 191
/etc/fstab 190
/etc/hosts 55, 185
   and network interface names 188
/etc/inittab 25, 118
/etc/nsswitch.conf 196
/etc/vfstab 192, 194
/opt/SMAW/SMAWRrms 28, 29
/opt/SMAW/SMAWRrms/bin/InitScript 193
/opt/SMAW/SMAWRrms/build/ 54
/opt/SMAW/SMAWRrms/etc/ 116
   CONFIG.rms 116
/root/.rhosts 187
/var/adm/messages 195
/var/log/messages 195
/var/opt/SMAWRrms/log 30
/var/opt/SMAWRrms/log/ 103
   >> input prompt 35
   ~ as spaces 65

A
activating
   applications 128
   configuration 38, 44, 69
   configuration second time 80
   configurations 114
Adaptive Services
   Tools menu 139
   adding route, in hvipalias file 190
   administrative privileges 85

Affiliation attribute 206
affiliation names, graphs 151
AlternatelP attribute 199
andOp objects 197
applets, Java, trusted 87
application logs
   searching text 108
   viewing 101
applications
   activating 128
   as objects 10
   clearing faults 129
   deactivating 128
   dependencies 92
   displaying states 98
   failover 13
   going offline 166
   maintenance mode, clusterwide 132
   objects 49
   overriding AutoStartUp 217
   starting 125
   startup, overriding 123
   stopping 122, 127
   switching 126, 179
   switching to Standby state 128
   switching to SysNode 26
   taking offline 127
   viewing attributes 100
   viewing graph 143
   viewing log files 100
   viewing logs 101
Attach button 103
attributes 27
   Affiliation 206
   AlternatelP 199
   AutoRecover 199
   AutoRecoverCleanup 206
   AutoStartUp 199
   AutoSwitchOver 200
   Class 206
Index

<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ClusterExclusive</td>
<td>200</td>
</tr>
<tr>
<td>Comment</td>
<td>207</td>
</tr>
<tr>
<td>ControlledShutdown</td>
<td>207</td>
</tr>
<tr>
<td>DetectorStartScript</td>
<td>207</td>
</tr>
<tr>
<td>ENV object</td>
<td>197</td>
</tr>
<tr>
<td>FaultScript</td>
<td>200</td>
</tr>
<tr>
<td>for andOp objects</td>
<td>197</td>
</tr>
<tr>
<td>for Controller objects</td>
<td>197</td>
</tr>
<tr>
<td>for gResource objects</td>
<td>197</td>
</tr>
<tr>
<td>for orOp objects</td>
<td>198</td>
</tr>
<tr>
<td>for SysNode objects</td>
<td>198</td>
</tr>
<tr>
<td>for userApplication objects</td>
<td>198</td>
</tr>
<tr>
<td>Halt</td>
<td>200</td>
</tr>
<tr>
<td>HostName</td>
<td>207</td>
</tr>
<tr>
<td>I_List</td>
<td>201</td>
</tr>
<tr>
<td>IgnoreStandbyRequest</td>
<td>208</td>
</tr>
<tr>
<td>LastDetectorReport</td>
<td>208</td>
</tr>
<tr>
<td>LieOffline</td>
<td>208</td>
</tr>
<tr>
<td>MaxControllers</td>
<td>201</td>
</tr>
<tr>
<td>MonitorOnly</td>
<td>201</td>
</tr>
<tr>
<td>NoDisplay</td>
<td>208</td>
</tr>
<tr>
<td>NullDetector</td>
<td>208</td>
</tr>
<tr>
<td>OfflineDoneScript</td>
<td>209</td>
</tr>
<tr>
<td>OfflineScript</td>
<td>201</td>
</tr>
<tr>
<td>OnlinePriority</td>
<td>201</td>
</tr>
<tr>
<td>OnlineScript</td>
<td>202</td>
</tr>
<tr>
<td>OnlineTimeout</td>
<td>209</td>
</tr>
<tr>
<td>PartialCluster</td>
<td>202</td>
</tr>
<tr>
<td>PersistentFault</td>
<td>203</td>
</tr>
<tr>
<td>PostOfflineScript</td>
<td>203</td>
</tr>
<tr>
<td>PostOnLineScript</td>
<td>203</td>
</tr>
<tr>
<td>PreCheckScript</td>
<td>209</td>
</tr>
<tr>
<td>PreOfflineScript</td>
<td>203</td>
</tr>
<tr>
<td>PreOnLineScript</td>
<td>204</td>
</tr>
<tr>
<td>PreserveState</td>
<td>204</td>
</tr>
<tr>
<td>PriorityList</td>
<td>204</td>
</tr>
<tr>
<td>Resource</td>
<td>209</td>
</tr>
<tr>
<td>rName</td>
<td>210</td>
</tr>
<tr>
<td>ScriptTimeout</td>
<td>204</td>
</tr>
<tr>
<td>ShutdownPriority</td>
<td>205</td>
</tr>
<tr>
<td>SplitRequest</td>
<td>210</td>
</tr>
<tr>
<td>StandbyCapable</td>
<td>205</td>
</tr>
<tr>
<td>viewing, for objects</td>
<td>100</td>
</tr>
<tr>
<td>WarningScript</td>
<td>206</td>
</tr>
<tr>
<td>authentication, trusted</td>
<td>187</td>
</tr>
<tr>
<td>automatic RMS startup</td>
<td>116</td>
</tr>
<tr>
<td>AutoRecover attribute</td>
<td>199</td>
</tr>
<tr>
<td>fault processing</td>
<td>174</td>
</tr>
<tr>
<td>AutoRecoverCleanup attribute</td>
<td>206</td>
</tr>
<tr>
<td>AutoStartUp attribute</td>
<td>199</td>
</tr>
<tr>
<td>overriding</td>
<td>123, 217</td>
</tr>
<tr>
<td>AutoSwitchOver attribute</td>
<td>200</td>
</tr>
<tr>
<td>fault processing</td>
<td>171</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>base monitor</td>
<td>20</td>
</tr>
<tr>
<td>detectors</td>
<td>49</td>
</tr>
<tr>
<td>high availability</td>
<td>9</td>
</tr>
<tr>
<td>basic settings, wizards</td>
<td>42</td>
</tr>
<tr>
<td>bin, RMS directory</td>
<td>29</td>
</tr>
<tr>
<td>browser</td>
<td>84</td>
</tr>
<tr>
<td>build, RMS directory</td>
<td>29</td>
</tr>
<tr>
<td>buttons</td>
<td></td>
</tr>
<tr>
<td>Attach, log viewer</td>
<td>103</td>
</tr>
<tr>
<td>Detach, log viewer</td>
<td>103</td>
</tr>
<tr>
<td>Filter, log viewer</td>
<td>103</td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Caution</td>
<td></td>
</tr>
<tr>
<td>defined</td>
<td>6</td>
</tr>
<tr>
<td>Consider all applications before adjusting TCP delay intervals</td>
<td>193</td>
</tr>
<tr>
<td>Do not explicitly set RMS environment variables in the user environment</td>
<td>211</td>
</tr>
<tr>
<td>Do not modify the /bin/henv file</td>
<td>28</td>
</tr>
<tr>
<td>Do not specify the same file system in both a standard vfstab entry and a #RMS# entry</td>
<td>192</td>
</tr>
<tr>
<td>If the HV_AUTOSTARTUP_IGNORE environment variable is used, ensure that it is correctly</td>
<td></td>
</tr>
</tbody>
</table>
defined on all cluster nodes and that it is always kept up-to-date 213
Leaving applications running after stopping RMS can lead to data corruption 119
Leaving applications running after stopping RMS or using forced shutdown can cause data corruption 120
Use care when clearing a SysNode Wait state manually 130
Use hvshut -A, -f, and -L options carefully as they could result in inconsistencies or data corruption 122
Use the forced switch mode only if an application cannot be switched normally 126
Use the hvswitch -f option carefully as it could result in inconsistencies or data corruption 125

CF
Cluster Admin view 89
configuration 92
LEFTCLUSTER 178
node names 83, 188
tabbed view, Cluster Admin 89
trusted login 187
CF commands
cfconfig 223
cfrecon 223
cftool 223
cqconfig 223
cfset command 223
cfsmntd command 224
cftool command 188
changing configurations, clusterwide table display of 112
detail level in graphs 149
environment variables 211
HV_AUTOSTARTUP 124

HV_RCSTART 118
CIP 186
CIP commands
cip.cf 224
cipconfig 224
ciptool 224
Class attribute 206
cbackuprdb 226
clearing faulted resources 26
faults 129
faults, in maintenance mode 136
hung nodes 26
SysNode Wait state 130
clgettree 227
CLI see RMS commands
clinitreset 226
close coupled applications 16
clresetrdb command 227
clssetparam command 227
csetup command 227
clstartrsc command 227
clstoprsc command 227
cluster 1
high availability 8
services 7
Cluster Admin 20
administrative privileges 85
application graph 143
clusterwide table 109
command pop-up menus 94
graph 146
GUI 83
initial view 89
logging in 85
object attributes 100
operator privileges 85
overview 8
primary management server 84
RMS graphs 139
RMS tree 92
root privileges 85
searching log text 108
Index

secondary management server 84
starting 84
switchlog 100
switchlog panel 103
SysNode selection 94
userApplication selection 94
using 84
viewing log files 100
cluster file system 7
Cluster Foundation see CF
cluster node
detector timeout for remote 217
ignore at startup 212
wait to report online 213
cluster volume management 7
ClusterExclusive attribute 200
clusterwide
maintenance mode 132
clusterwide table 109
displaying state names 109
special display order 110
Cmdline, resource wizard 33
command pop-up menus
see also context menus
RMS graph 148
RMS tree 94
commands see RMS commands
Comment attribute 207
composite subapplication graph 146
CONFIG.rms default startup file 116, 118, 218
configuration tree
RMS 92
configurations
activating 114
defined 9
displaying 24
displaying information 90, 91
general procedure 34
graph 139
viewing information 100
configuring
applications 31, 33
disk groups 33
file systems 33
IP addresses 33
resources 33
confirming
object actions 96
context menus
clusterwide table 112
environment variables 96
exiting maintenance mode 137
from Cluster Admin 90
from RMS configuration tree 94
from RMS graph 148
RMS configuration tree 94
stopping RMS 120
switching applications 126
viewing application graph 143
viewing clusterwide table 109
viewing RMS graph 140
viewing subapplication graph 144
viewing switchlog 100
controlled applications 14
failover 15
Controller objects 14, 49, 197
dependencies 92
Follow mode 15
graph 146
resource wizard 33
controlling
RMS operation 114
creating
application 54
second application 71
D
daemons
NFS 194
Deact state 21
deactivating
applications 128
debug messages
severity level 106
defining timeout 216
Index

delay intervals, TCP, for NFS failover 193
deleting
   route, in hvialias file 190
DEMO turnkey wizard 33, 35, 56, 58
dependencies
   applications 92
dependent resources 10
Detach button, log viewer 103
detaching
   log view 103
details
   changing level of, in graphs 149
detectors 9, 21
   fault situations 165
   illegal 155
   RMS Wizard Kit 19
   RMS Wizard Tools 19
starting 116
DetectorStartScript attribute 207
dfstab file see /etc/dfs/dfstab
directed switch requests 180
directories
   RMS 29
directory hierarchy
   root directory 215
   specifying root directory 215
disk classes
   as application resources 16
displaying
   see also viewing
   application states 98, 99
   current RMS configuration 24
   environment variables 96, 98
   HV_AUTOSTARTUP 124
   HV_RCSTART 118
   object states 98, 99
   state names, clusterwide table 109
dkconfig command 226
dkmigrate command 226
dkmirror command 226
dktab command 226
DNS
   and /etc/vfstab entries 192
   and cluster host names 186
documentation
   related 2
   wizards 50
double faults 172
   and Halt attribute 172, 200
E
   echo service 196
   ENV object 27, 197
environment variables 27
displaying 96, 98
   HV_APPLICATION 221
   HV_AUTORECOVER 221
   HV_AUTOSTARTUP 217
   HV_AUTOSTARTUP_IGNORE 212
   HV_AUTOSTARTUP_WAIT 213
   HV_CHECKSUM_INTERVAL 213
   HV_CONNECT_TIMEOUT 217
   HV_FORCED_REQUEST 221
   HV_LAST_DET_REPORT 221
   HV_LOG_ACTION 217
   HV_LOG_ACTION_THRESHOLD 214
   HV_LOG_WARN_THRESHOLD 214
   HV_MAXPROC 218
   HV_NODENAME 222
   HV_OFFLINE_REASON 221
   HV_RCSTART 118, 218
   HV_RCSTART, changing 118
   HV_REALTIME_PRIORITY 218
   HV_SCRIPT_TYPE 222
   HV_SCRIPTS_DEBUG 219
   HV_SYSLOG_USE 219
   HV_WAIT_CONFIG 215
   hvenv and hvenvl.local files 27
   NODE_SCRIPTS_TIME_OUT 222
   RELIANT_HOSTNAME 219
   RELIANT_INITSCRIPT 220
## Index

<table>
<thead>
<tr>
<th>Term</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELIANT_LOG_LIFE</td>
<td>215</td>
</tr>
<tr>
<td>RELIANT_LOG_PATH</td>
<td>215</td>
</tr>
<tr>
<td>RELIANT_PATH</td>
<td>215</td>
</tr>
<tr>
<td>RELIANT_SHUT_MIN_WAIT</td>
<td>216</td>
</tr>
<tr>
<td>RELIANT_STARTUP_PATH</td>
<td>220</td>
</tr>
<tr>
<td>SCRIPTS_TIME_OUT</td>
<td>220</td>
</tr>
<tr>
<td>ENVL object</td>
<td>27, 197</td>
</tr>
<tr>
<td>errors</td>
<td></td>
</tr>
<tr>
<td>at initialization</td>
<td>166</td>
</tr>
<tr>
<td>during offline processing</td>
<td>169</td>
</tr>
<tr>
<td>in offline state</td>
<td>173</td>
</tr>
<tr>
<td>reaction to</td>
<td>170</td>
</tr>
<tr>
<td>etc, RMS directory</td>
<td>29</td>
</tr>
<tr>
<td>exports file</td>
<td></td>
</tr>
<tr>
<td>see /etc/exports</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
<tr>
<td>failover</td>
<td></td>
</tr>
<tr>
<td>defined</td>
<td>13</td>
</tr>
<tr>
<td>applications</td>
<td>13</td>
</tr>
<tr>
<td>applications, on NFS clients</td>
<td>193</td>
</tr>
<tr>
<td>controlled applications</td>
<td>15</td>
</tr>
<tr>
<td>interface device, for IP alias</td>
<td>188</td>
</tr>
<tr>
<td>NFS clients</td>
<td>193</td>
</tr>
<tr>
<td>NFS Lock Failover</td>
<td>195</td>
</tr>
<tr>
<td>NFS server</td>
<td>193</td>
</tr>
<tr>
<td>nodes</td>
<td>13</td>
</tr>
<tr>
<td>RCFS file system</td>
<td>224</td>
</tr>
<tr>
<td>fault script</td>
<td>171</td>
</tr>
<tr>
<td>Faulted state</td>
<td>21, 129, 136</td>
</tr>
<tr>
<td>clearing</td>
<td>129, 176</td>
</tr>
<tr>
<td>FaultScript</td>
<td>23</td>
</tr>
<tr>
<td>faults</td>
<td></td>
</tr>
<tr>
<td>clearing</td>
<td>129</td>
</tr>
<tr>
<td>display in clusterwide table</td>
<td>111</td>
</tr>
<tr>
<td>failover</td>
<td>60</td>
</tr>
<tr>
<td>maintenance mode</td>
<td>136</td>
</tr>
<tr>
<td>messages, custom handling</td>
<td>190</td>
</tr>
<tr>
<td>SysNode</td>
<td>178</td>
</tr>
<tr>
<td>FaultScript attribute</td>
<td>23, 200</td>
</tr>
<tr>
<td>features, market-specific</td>
<td>83</td>
</tr>
<tr>
<td>file systems</td>
<td></td>
</tr>
<tr>
<td>as application resources</td>
<td>16, 31</td>
</tr>
<tr>
<td>Fsystem</td>
<td>33</td>
</tr>
<tr>
<td>resource type</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>site preparation</td>
<td>185</td>
</tr>
<tr>
<td>warning threshold</td>
<td>214</td>
</tr>
<tr>
<td>Filter button</td>
<td>103</td>
</tr>
<tr>
<td>fjsvwvbbs</td>
<td>230</td>
</tr>
<tr>
<td>fjsvwvcnf</td>
<td>230</td>
</tr>
<tr>
<td>follow controllers</td>
<td>15, 16</td>
</tr>
<tr>
<td>maintenance mode</td>
<td>133</td>
</tr>
<tr>
<td>forced</td>
<td></td>
</tr>
<tr>
<td>online requests</td>
<td>177</td>
</tr>
<tr>
<td>operations, and status code</td>
<td>84</td>
</tr>
<tr>
<td>shutdown</td>
<td>120</td>
</tr>
<tr>
<td>fsck_rcfs</td>
<td>224</td>
</tr>
<tr>
<td>fstab file</td>
<td></td>
</tr>
<tr>
<td>see /etc/fstab</td>
<td></td>
</tr>
<tr>
<td>Fsystme, resource wizard</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Gds, resource wizard</td>
<td>33</td>
</tr>
<tr>
<td>GENERIC turnkey wizard</td>
<td>33, 58, 72</td>
</tr>
<tr>
<td>Global Disk Services</td>
<td>33</td>
</tr>
<tr>
<td>global environment variables</td>
<td>27</td>
</tr>
<tr>
<td>Global Link Services</td>
<td>33</td>
</tr>
<tr>
<td>Gls, resource wizard</td>
<td>33</td>
</tr>
<tr>
<td>graphs</td>
<td>9, 38, 139</td>
</tr>
<tr>
<td>affiliation names</td>
<td>151</td>
</tr>
<tr>
<td>appearance after shut down</td>
<td>152</td>
</tr>
<tr>
<td>application</td>
<td>143</td>
</tr>
<tr>
<td>changing detail level</td>
<td>149</td>
</tr>
<tr>
<td>composite subapplication</td>
<td>146</td>
</tr>
<tr>
<td>context menus</td>
<td>148</td>
</tr>
<tr>
<td>maintenance mode scope</td>
<td>133</td>
</tr>
<tr>
<td>reinitializing</td>
<td>25</td>
</tr>
<tr>
<td>resource names</td>
<td>151</td>
</tr>
<tr>
<td>subapplications</td>
<td>144</td>
</tr>
<tr>
<td>viewing application</td>
<td>143</td>
</tr>
<tr>
<td>viewing object details</td>
<td>142</td>
</tr>
<tr>
<td>gResource objects</td>
<td>10, 49, 197</td>
</tr>
<tr>
<td>GUI</td>
<td></td>
</tr>
<tr>
<td>configuration objects</td>
<td></td>
</tr>
<tr>
<td>input and message area</td>
<td>90</td>
</tr>
<tr>
<td>menu bar</td>
<td>89</td>
</tr>
<tr>
<td>messages</td>
<td>90</td>
</tr>
<tr>
<td>starting RMS</td>
<td>91</td>
</tr>
</tbody>
</table>
Index

H
Halt attribute 200
    -a option 99
    and double faults 172
    ENV and ENVL 98
    heartbeats 10, 20
        file size 218
        no display 208
        hvdist command 25
    and SysNode faults 178
    high availability 1, 7
        specifying applications 37
    HostName attribute 207
        andOp objects 197
    hosts file  see /etc/hosts
    hosts, site preparation 185
    HTML documentation 229
    HV_APPLICATION 221
    HV_AUTORECOVER 221
    HV_AUTOSTARTUP 200, 217
        changing 123
        -a option 99
    HV_AUTOSTARTUP_IGNORE 212
    HV_AUTOSTARTUP_WAIT 213
        and PartialCluster attribute 203
    HV_CHECKSUM_INTERVAL 213
    HV_CONNECT_TIMEOUT 217
    HV_FORCED_REQUEST 221
    HV_LAST_DET_REPORT 221
    HV_LOG_ACTION 217
    HV_LOG_ACTION_THRESHOLD 214
    HV_LOG_WARN_THRESHOLD 214
    HV_MAX_HVDISP_FILE_SIZE 218
    HV_MAXPROC 218
    HV_NODENAME 222
    HV_OFFLINE_REASON 221
    HV_RCSTART 218
        changing 118
        -a option 99
        activating applications 128
        clear display 128
        -c option 129, 177
        clear faults 129
        clearing Wait state 130
        -d option 128
        deactivate applications 128
        defined 26
        -f option 128
        -f option 128
        -m and -M options 138
        maintenance mode 138
        -o option 130
        -s option 128
        Standby state 128
        stopping applications 128
    hvassert command 24
    hvattr command 24
    hvcm command 24, 116
    hvconfig command 24
    hvconsoles file 190
    hvdisp command 28, 98, 99, 212
    hvexec command 48
    hvgdmake command 25
    hvipalias file 187
    hvlogclean command 25
    hvrclev command 25, 118
    hwreset command 25
    hwssetenv command 25, 118, 124
    HV_AUTOSTARTUP 217
    HV_RCSTART 218
    hvshut command 26, 122
        defining timeout 216
    hvshut command 26, 125, 127
        -f option 177
    hvutil command
        -a option 128
        activating applications 128
        -c option 129, 177
        clear faults 129
        clearing Wait state 130
        -d option 128
        deactivate applications 128
        defined 26
        -f option 128
        -m and -M options 138
        maintenance mode 138
        -o option 130
        -s option 128
        Standby state 128
        stopping applications 128
    hvw command 19
        defined 34
        operation mode 39
        resuming configuration 71
Index

ifconfig command 188, 189
IgnoreStandbyRequest attribute 208
include, RMS directory 29
Inconsistent state 22
initialization 154
   error during 166
   objects 155
   script, specifying 220
   unknown state 155
InitScript 23
initab file see /etc/initab
intended state, maintenance mode 22, 133
Ip Address subapplication
   and /etc/hosts 186
   hvipalias file 188
IP addresses
   defining resources 17
   resource wizard 33
IP alias 187
IPaddress, resource wizard 33
IPV6 addresses 186

J
Java, trusted applets 87

K
killing a node 11, 14

L
LastDetectorReport attribute 208
left pane
   Cluster Admin 89, 90
LEFTCLUSTER 178
lib, RMS directory 29
LieOffline attribute 208
local environment variables 27
log files
   and custom fault messages 190
   specify directory 215
   switchlog 179, 195
   system 195
   time of preservation 215
   viewing 100, 101
log viewer
   tabbed view, Cluster Admin 89
logging in, Cluster Admin 85
logical interface name 187
login, trusted, required by Wizard
   Tools 187

M
MA commands
circumonctl 225
cirimonctl 225
MAC address, in hvipalias file 189
main menu
   wizards 36
maintenance mode 22, 131, 133
   CLI operations 138
   entering 131
   exiting 134
   fault clearing 136
   follow controllers 133
   forced exit 137
   intended state 133
   operating notes 133
   setting 26
   starting 131
   status code when entering 84
   stopping 134
man page, for RMS commands 23
management server 84
manual pages
   display 223
   listing 223
market-specific
   applications 8
   features 83
MaxControllers attribute 201
messages 154
   debug 106
   fault, custom handling 190
MonitorOnly attribute 201
mount_rcfs 224

N
naming conventions, RMS 55, 186
Index

netmask
  in hvipalias file 188

network interfaces
  in /etc/hosts 186
  in hvipalias file 187

networks
  site preparation 185

NFS
  client failover 193
  daemons 194
  failover, TCP delay intervals 193
  failover, UDP protocol 194
  Lock Failover 195
  server failover 193

ngadmin 224

node names
  CF 83
  in configuration files 185
  RMS 186
  NODE_SCRIPTS_TIME_OUT 222

nodes 11
  failover 13
  killing 11, 14
  objects 49
  viewing attributes 100

NoDisplay attribute 208

non-basic settings, wizards 42

NullDetector attribute 208

O

object state timeouts, tracking by base monitor 9

object types
  andOp 197
  Controller 197
  ENV 197
  ENVL 197
  gResource 197
  orOp 198
  SysNode 198
  userApplication 198

objects
  activating applications 128
  attributes 27
  clearing a fault 129
  clusterwide table 109
  command pop-ups 148
  confirming actions 96
  context menus 112
  Controller 14, 49, 92, 146
  dependencies 141
  displaying states 98
  environment variables 27
  graph customization 149
  gResource 10, 49
  maintenance mode 134
  relationships 141
  resource types 26
  RMS full graph 141
  RMS tree 94
  selecting 94
  starting an application 125
  switching applications 126
  SysNode 11, 49, 94
  taking application offline 127
  userApplication 10, 49, 94, 122
  viewing attributes 100
  viewing details in graphs 142

offline processing 10
  definition 166
  fault situations 169
  requests 167
  scripts 19
  Offline state 9, 21
    OfflineDoneScript 23
    OfflineScript 23
    PostOfflineScript 23
    OfflineDoneScript attribute 23, 209
    OfflineFault state 22
    OfflineScript attribute 23, 201
    online processing 10
    online scripts 19
    Online state 9, 21
      OnlineScript 23
      PostOnlineScript 23
      PreCheckScript 23
      PreOnlineScript 23
      OnlinePriority attribute 201
Index

OnlineScript attribute 23, 202
OnlineTimeout attribute 209
operator
  intervention 179
operator privileges 85
overriding
  automatic application startup 123

P
parallel application support 7
PartialCluster attribute 202
  and HV_AUTOSTARTUP_WAIT 213
PAS commands
clmtest 225
mipcstat 225
PCS
tabbed view, Cluster Admin 89
PersistentFault attribute 203
physical disks
  state at initialization 165
physical interfaces
  IP aliases 187
pop-up menu see context menu
PostOfflineScript attribute 23, 203
PostOnlineScript attribute 23, 203
PreCheckScript attribute 23, 209
PreOffline processing 167
PreOfflineScript attribute 203
PreOnlineScript attribute 23, 204
PreserveState attribute 204
  effect on fault processing 171, 172
primary management server 84
PRIMECLUSTER 7
priority switch
  request 179
PriorityList attribute 204
privileges 85
proactive scripts 10
protocol, UDP, for NFS failover 194

R
rcfs_fumount 224
rcfs_list 224
rcfs_switch 224
rcsd 229
rcsd.cfg 229
Rcvm, resource wizard 33
reactive scripts 10
related documentation 2
Reliant Monitor Services
  see also RMS
  components 20
  high availability 9
  overview 8
RELIANT_HOSTNAME 59, 219
RELIANT_INITSCRIPT 220
RELIANT_LOG_LIFE 215
RELIANT_LOG_PATH 30, 215
RELIANT_PATH 28, 29, 215
RELIANT_SHUT_MIN_WAIT 216
RELIANT_STARTUP_PATH 220
requests 154
  offline 167
  offline processing 167
request-triggered scripts
  InitScript 23
  OfflineScript 23
  OnlineScript 23
  PreCheckScript 23
  PreOnlineScript 23
Resource attribute 209
  Controller objects 197
resource wizards
  Cmdline 33
  Controller 33
  Fsystem 33
  Gds 33
  Gls 33
  Ipaddress 33
  Rcvm 33
  Vxvm 33
resources
  clearing faulted 26
  configuring 33
  defining 16
  executing scripts 39
Index

file system entries 190, 192
monitoring 49
names in graphs 151
network interfaces 187
non-basic settings 43
object types 26
objects 49
scripts 21
shared remote entries 194
states 9
right pane
  Cluster Admin 90
  log messages 102
right-click, mouse
  clusterwide table 112
  fault clearing 136
rKind attribute
  gResource objects 197, 209
RMS
  clusterwide table 109
  configuration tree 92
  controlling operation 114
  default directory 29
  directory structure 29
  full graph 140
  graphs 38, 139
  naming conventions 55, 186
  node names 83, 186
  severity levels 106
  shutdown, and graph appearance 152
  starting 114
  startup 193
  startup, and HV_AUTOSTARTUP 123
  stopping 118
  tabbed view, Cluster Admin 89
  tree 92
RMS base monitor 9
RMS CLI
  hvexec 48
RMS commands 23
  see also individual commands
  administration procedures 83
  hvassert 24, 227
  hvattr 24
  hvcm 24, 116, 227
  hvconfig 24, 227
  hvdisp 24, 98, 99, 227
  hvdist 25, 227
  hvdump 25, 228
  hvenv.local 228
  hvgdkmake 25, 228
  hvlogclean 25, 228
  hvrclev 25, 118
  hvreset 25, 228
  hvsetenv 25, 118, 124, 228
  hvshut 26, 122, 228
  hvswitch 26, 125, 127, 177, 228
  hvthrottle 26, 228
  hvutil 26, 128, 129, 130, 138, 177, 228
  options 84
  status codes 84
  RMS Troubleshooting Guide 100, 103
RMS Wizard Kit 8, 17, 19
  detectors 19
  hvw command 19
  scripts 19
RMS Wizard Tools 8, 17
  detectors 19
  hvw command 19
  resource types 19
  scripts 19
RMS wizards
  configuring 17
  rName attribute
    gResource objects 197, 210
root privileges 85
route command 190
running processes 17
S
  SA_blade.cfg 229
  SA_rccu.cfg 229
  SA_rps.cfg 229
  SA_rsb.cfg 230
Index

SA_scon.cfg 230  
SA_sspint.cfg 230  
SA_sunF.cfg 230  
SA_wtinps.cfg 230  
scalability 7  
scon 229  
script top-of-tree 221  
scripts 10, 22  
  Offline 19  
    offline processing 19  
  Online 19  
  proactive 10  
  reactive 10  
  resources 21  
  RMS Wizard Kit 19  
    timeout 220  
  SCRIPTS_TIME_OUT 220  
  ScriptTimeout attribute 204  
sdtool 229  
searching log text 108  
secondary management server 84  
secondary menus, wizards 41  
send clear-fault request 177  
server failover  
  NFS 193  
  severity levels  
    Alert 106  
    Critical 106  
    Debug 106  
    Emergency 106  
    Error 106  
    Info 106  
    Notice 106  
    Warning 106  
  Shut 127  
shutdown  
  RMS 118  
  status code 84  
ShutDown Priority attribute 205  
SIS  
    tabbed view, Cluster Admin 89  
SIS commands  
  dtcpadmin 230  
  dtcpd 230  
  dtcpdbg 230  
  site preparation 185  
  software monitor  
    function 1  
    RMS 8  
  split-brain condition  
    display in clusterwide table 111  
  SplitRequest attribute 210  
  Standby state 21  
  switching to 128  
  StandbyCapable attribute 205  
    starting  
      applications 125  
      applications, automatic 123  
    maintenance mode 131  
    RMS 114, 116  
    RMS, automatically 116  
    starting RMS  
    system run level 118  
    startup file 116  
    state machine 9  
    states 21  
    Deact 21  
  displaying information 109  
  Faulted 21, 129, 136  
  Inconsistent 22  
  Maintenance 22  
  of objects in the graph 9  
  Offline 21  
  OfflineFault 22  
  Online 21  
  Standby 21, 128  
  Unknown 22  
  Wait 22, 130  
  Warning 22  
  state-triggered scripts  
    FaultScript 23  
    OfflineDoneScript 23  
    PostOfflineScript 23  
    PostOnlineScript 23  
    WarningScript 23  
    status codes, RMS CLI 84
Index

status icons
  faults, maintenance mode 136
  maintenance mode 133
stopping
  applications 127
  maintenance mode 134
  RMS 118, 122
subapplications 92
graph 144
sub-menus, wizards 41
summary table 109
switching
  defined 179
  applications 26, 126
switchlog 179, 195
  panel 103
  viewing 100
SysNode 11
  fault 178
  initializing 155
  object selection 94
  object type 49, 198
  switching application to 26
  Wait state, clearing 130
system files, and site preparation 185
  system log 195

T
  tabbed view
    Cluster Admin left pane 89
    Cluster Admin, msg 90
    Cluster Admin, rms&pcs 91
    log viewer 102
tables
  clusterwide 109
  context menus 112
  taking an application offline 127
  TCP delay intervals for NFS failover 193
Tools menu
  Adaptive Services 139
  trusted Java applets 87
  trusted login, required by Wizard Tools 187
  turnkey wizards 33, 37, 50
DEMO 35, 56
GENERIC 72
ORACLE 33
R/3 33
See also wizards 56

U
  UDP protocol for NFS failover 194
uname command 188
Unknown state 22
  exiting 154
  initial state 155
us, RMS directory 29
userApplication objects 10, 49, 155, 198
  activating 128
  clearing faults 129
  hvswitch command 125
  RMS tree 92
  selection 94
  state information 109
  taking Offline 127
  with hvshut 122
variables, environment 27
vdisk 226
Verisign, and trusted Java applets 87
vfstab file see /etc/vfstab
view
  Cluster admin 89
  log viewer 102
  log, attaching and detaching 103
  message 90
viewing
  see also displaying
  application logs 101
  composite subapplication graph 146
  GUI message 90
  object attributes 100
  subapplication graphs 144
  virtual representation 9
Index

volume managers  1, 16
Vxvm, resource wizard  33

W
Wait state  22, 130, 179
  clearing faulted resources  26
  clearing hung nodes  26
  clearing SysNode  130
Warning state  22
  WarningScript  23
WarningScript attribute  23, 206
Web-Based Admin View
  login  85
  primary management server  84
  secondary management server  84
Wizard Kit  17, 19
  configuration  32
Wizard Tools  32
wizards
  basic settings  42
  configuring  32
  DEMO turnkey  35
  frequently used items  35
  general description  32
  GENERIC turnkey  72
  hvexec command  48
  main menu  36
  non-basic settings  42
  ORACLE  33
  R/3  33
  resource wizards  33
  secondary menus  41
  sub-menus  41
  turnkey  33, 37, 50
wizards  see RMS wizards
wvCntl  230
wvGetparam  231
wvSetparam  231
wvstat  231