Oracle® Solaris Cluster Data Service for SAP NetWeaver Guide

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Contents

Preface

Oracle Solaris Cluster Data Service for SAP NetWeaver Guide explains how to install and configure Oracle Solaris Cluster data services.

Note – This Oracle Solaris Cluster release supports systems that use the SPARC and x86 families of processor architectures. In this document, "x86" refers to the larger family of x86 compatible products. Information in this document pertains to all platforms unless otherwise specified.

This document is intended for system administrators with extensive knowledge of Oracle software and hardware. Do not use this document as a planning or presales guide. Before reading this document, you should have already determined your system requirements and purchased the appropriate equipment and software.

The instructions in this book assume knowledge of the Oracle Solaris Operating System and expertise with the volume-manager software that is used with Oracle Solaris Cluster software.

Bash is the default shell for Oracle Solaris 11. Machine names shown with the Bash shell prompt are displayed for clarity.

Using UNIX Commands

This document contains information about commands that are specific to installing and configuring Oracle Solaris Cluster data services. The document does *not* contain comprehensive information about basic UNIX commands and procedures, such as shutting down the system, booting the system, and configuring devices. Information about basic UNIX commands and procedures is available from the following sources:

- Online documentation for the Oracle Solaris Operating System
- Oracle Solaris Operating System man pages
- Other software documentation that you received with your system

Typographic Conventions

The following table describes the typographic conventions that are used in this book.

TABLE P–1 Typographic Conventions

Typeface	Description	Example
`AaBbCc123`	The names of commands, files, and directories, and onscreen computer output	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% you have mail.`
`AaBbCc123`	What you type, contrasted with onscreen computer output	`machine_name%` **`su`** `Password:`
aabbcc123	Placeholder: replace with a real name or value	The command to remove a file is `rm` *filename*.
AaBbCc123	Book titles, new terms, and terms to be emphasized	Read Chapter 6 in the *User's Guide*. A *cache* is a copy that is stored locally. Do *not* save the file. **Note:** Some emphasized items appear bold online.

Shell Prompts in Command Examples

The following table shows UNIX system prompts and superuser prompts for shells that are included in the Oracle Solaris OS. In command examples, the shell prompt indicates whether the command should be executed by a regular user or a user with privileges.

TABLE P–2 Shell Prompts

Shell	Prompt
Bash shell, Korn shell, and Bourne shell	`$`
Bash shell, Korn shell, and Bourne shell for superuser	`#`
C shell	`machine_name%`
C shell for superuser	`machine_name#`

Related Documentation

Information about related Oracle Solaris Cluster topics is available in the documentation that is listed in the following table. All Oracle Solaris Cluster documentation is available at http://www.oracle.com/technetwork/indexes/documentation/index.html.

Topic	Documentation
Hardware installation and administration	*Oracle Solaris Cluster 4.1 Hardware Administration Manual* Individual hardware administration guides
Concepts	*Oracle Solaris Cluster Concepts Guide*
Software installation	*Oracle Solaris Cluster Software Installation Guide*
Data service installation and administration	*Oracle Solaris Cluster Data Services Planning and Administration Guide* and individual data service guides
Data service development	*Oracle Solaris Cluster Data Services Developer's Guide*
System administration	*Oracle Solaris Cluster System Administration Guide* *Oracle Solaris Cluster Quick Reference*
Software upgrade	*Oracle Solaris Cluster Upgrade Guide*
Error messages	*Oracle Solaris Cluster Error Messages Guide*
Command and function references	*Oracle Solaris Cluster Reference Manual* *Oracle Solaris Cluster Data Services Reference Manual* *Oracle Solaris Cluster Geographic Edition Reference Manual* *Oracle Solaris Cluster Quorum Server Reference Manual*
Compatible software	Oracle Solaris Cluster Compatibility Guide available at the Oracle Solaris Cluster Technical Resources page

Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

Getting Help

If you have problems installing or using Oracle Solaris Cluster, contact your service provider and provide the following information.

- Your name and email address (if available)
- Your company name, address, and phone number
- The model number and serial number of your systems
- The release number of the operating environment (for example, Oracle Solaris 11)
- The release number of Oracle Solaris Cluster (for example, Oracle Solaris Cluster 4.1)

Use the following commands to gather information about your system for your service provider.

Command	Function
`prtconf -v`	Displays the size of the system memory and reports information about peripheral devices
`psrinfo -v`	Displays information about processors
`pkg list`	Reports which packages are installed
`prtdiag -v`	Displays system diagnostic information
`/usr/cluster/bin/clnode show-rev -v`	Displays Oracle Solaris Cluster release and package version information for each node

Also have available the contents of the `/var/adm/messages` file.

◆ ◆ ◆ CHAPTER 1

Installing and Configuring HA for SAP NetWeaver

This chapter explains how to install and configure HA for SAP NetWeaver.

This chapter contains the following sections.

HA for SAP NetWeaver Overview

The SAP NetWeaver platform consists of the following components:

- SAP central services, which include these servers:
  - SAP enqueue server
  - SAP message server
  - SAP gateway server
- SAP replicated enqueue server
- SAP primary application instance
- SAP additional dialogue instance

Each component can be treated as a specific instance. Each instance has its own controlling process named `sapstartsrv`.

The SAP NetWeaver platform can be deployed as an ABAP, a JAVA, or a dual stack. In the dual stack, the primary application instance and the dialogue instance combine the ABAP and the JAVA processes in one instance. The central services and the replicated enqueue server implement either the ABAP or the JAVA deployment only.

Caution – For a detailed description of the SAP NetWeaver platform in the High Availability environment, see the SAP documentation at http://service.sap.com/ha. In particular, study the section that provides an overview of the architecture of the SAP NetWeaver to be certain that you understand the basic concepts of your version of the SAP NetWeaver.

To eliminate potential single points of failure in an SAP NetWeaver platform, HA for SAP NetWeaver provides fault monitoring, automatic restart, and automatic failover for the components of the SAP NetWeaver platform.

The primary and additional dialogue instances can be configured as multiple master or failover deployments. All other instances must be failover deployments.

Each component of the SAP NetWeaver platform has a data service that protects the component in an Oracle Solaris Cluster configuration, as described in the following table.

TABLE 1–1 Protection of SAP NetWeaver Components by Oracle Solaris Cluster Data Services

SAP NetWeaver Component	Data Service
SAP `sapstartsrv` process	Resource type for the SAP `sapstartsrv` process.
	The resource type is `ORCL.sapstartsrv`.
SAP central services	Resource type for SAP central services in HA for SAP NetWeaver.
	The resource type is `ORCL.sapcentr`.
SAP replicated enqueue server	Resource type for SAP replicated enqueue server in HA for SAP NetWeaver.
	The resource type is `ORCL.saprepenq`.
SAP primary instance and SAP additional dialogue instance	Resource type for SAP primary instance and SAP additional dialogue instance in HA for SAP NetWeaver.
	The resource type is `ORCL.sapdia`.
SAP replicated enqueue preempter	Resource type for SAP replicated enqueue preempter in HA for SAP NetWeaver.
	The resource type is `ORCL.saprepenq_preempt`.

TABLE 1–1 Protection of SAP NetWeaver Components by Oracle Solaris Cluster Data Services *(Continued)*

SAP NetWeaver Component	Data Service
Database	The data service for the database that you are using.
NFS file system	Oracle Solaris Cluster HA for NFS. For more information about this data service, see *Oracle Solaris Cluster Data Service for Network File System (NFS) Guide*.

Overview of the Installation and Configuration Process for HA for SAP NetWeaver

The following table summarizes the tasks for installing and configuring HA for SAP NetWeaver and provides cross-references to detailed instructions for performing these tasks. Perform the tasks in the order that they are listed in the table.

TABLE 1–2 Tasks for Installing and Configuring HA for SAP NetWeaver

Task	For Instructions, Go To …
Plan the SAP NetWeaver installation	Your SAP documentation *Oracle Solaris Cluster Data Services Planning and Administration Guide* "Planning the HA for SAP NetWeaver Installation and Configuration" on page 12
Install SAP NetWeaver and configure the application to run in a cluster	"Installing and Configuring SAP NetWeaver" on page 17
Verify the SAP NetWeaver installation and configuration	"Verifying the SAP NetWeaver Installation and Configuration" on page 22
Register and configure the HA for SAP NetWeaver data service	"Registering and Configuring HA for SAP NetWeaver" on page 23
(Optional) Use alternate project identifier (ID)	"Using Alternate Project Identification" on page 35
(Optional) Tune the HA for SAP NetWeaver fault monitors	"Tuning the HA for SAP NetWeaver Fault Monitors" on page 35
Verify the HA for SAP NetWeaver installation and configuration	"Verifying the HA for SAP NetWeaver Installation and Configuration" on page 41

Planning the HA for SAP NetWeaver Installation and Configuration

This section contains the information that you need to plan your HA for SAP NetWeaver installation and configuration.

Note – Before you begin, consult your SAP documentation for configuration restrictions and requirements that are not stated in Oracle Solaris Cluster documentation or imposed by Oracle Solaris Cluster software.

Be sure to read all SAP notes that pertain to your release of SAP NetWeaver. For more information, see the SAP documentation at http://service.sap.com/ha.

Note – HA for SAP NetWeaver can be configured to run in a whole root, non-global zone, or zone cluster, if required.

Configuration Restrictions

Caution – Your data service configuration might not be supported if you do not observe these restrictions.

For restrictions that apply to all data services, see the release notes for your release of Oracle Solaris Cluster. The following configuration restriction applies only to HA for SAP NetWeaver.

- The maximum length of the node names depends on the SAP release. Refer to the SAP installation guide for your release of SAP. This limitation is an SAP software restriction.
- Configure the database resource to be in a different resource group from the SAP central services resource, if possible.

  However, if you are using Oracle as the database, and if you must configure Oracle in the same resource group as the SAP central services resource, you must ensure that the value of the `restart_type` extension property for HA for Oracle is set to `RESOURCE_RESTART`. This property setting means that if the response to a fault in the Oracle database is to restart the Oracle resource, only the Oracle database is restarted. If this property is set to `RESOURCE_GROUP_RESTART`, and if the response to a fault in the Oracle database is to restart the Oracle resource, all the resources in the resource group are restarted. However, if the SAP replicated enqueue server is configured and online on another node, the SAP central services must not be restarted locally. Therefore, the `restart_type` property must be set to `RESOURCE_RESTART`.

Configuration Requirements

Caution – Configuration requirements represent actions that you must perform. If your data service configuration does not satisfy these requirements, the data service configuration might not be supported.

For requirements that apply to all data services, see "Configuration Guidelines for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

The following configuration requirements apply only to HA for SAP NetWeaver.

- The fault monitor probe for the resource type require the `sapcontrol` program. You must download this binary from `http://service.sap.com`. The download is necessary, if your SAP version does not contain the binary at all. Refer to the relevant SAP note for information about obtaining and using the `sapcontrol` program.
- If you configure the SAP NetWeaver ABAP stack and the SAP NetWeaver JAVA stack as two separate stacks in the same cluster, you must not mix the JAVA and the ABAP resources within one resource group.
- If you configure the SAP NetWeaver ABAP stack and the SAP NetWeaver JAVA stack as a dual stack, you must put the central services and the corresponding replicated enqueue servers within the same resource groups.

Application Operation Restrictions

Caution – Your application might experience unplanned downtimes if you do not follow the restrictions noted in this section.

- Once a `sapstartsrv` process is under the control of the cluster, the application operator can only use the `RestartService` function of the `sapcontrol` command to manage the `sapstartsrv` process. Other functions such as `StartService` and `StopService` might lead to unplanned application downtime.
- Unless you enable the Oracle Solaris Cluster and SAP NetWeaver management integration, starting or stopping an instance manually leads to unplanned instance downtime. Once the management integration is enabled, the application administrator can safely stop and start instances with SAP methods as long as the `sapstartsrv` service is under the control of the cluster.

Application Operation Requirement

The following application operation requirement applies only to HA for SAP NetWeaver.

- Once you start the `sapstartsrv` service manually with either the `startsap` or `sapcontrol` command, you **must** stop it before you enable the `sapstartsrv` resource.

Supported Data Service Configurations

HA for SAP NetWeaver supports configurations that conform to the requirements that are specified in the previous section.

All configurations of HA for SAP NetWeaver have the following requirements:

- The SAP central service is configured as a failover resource.
- The SAP replicated enqueue server is configured as a failover resource.
- The SAP dialogue instances which are primary application instances or additional application instances can be configured either as a failover resource or as a multiple master data service resource.
- Each SAP instance resource must be dependent on a SAP `sapstartsrv` resource.
- Do not configure central service resources and replicated enqueue resources in the same resource group.
- The SAP replicated enqueue server resource is configured to depend on the SAP central service resource. This dependency ensures that theSAP replicated enqueue server does not attempt to start until the SAP central service is online.
- The SAP central services resource group is configured to have weak **positive** affinity with the SAP replicated enqueue server resource group. This affinity ensures that, if a hardware or software failure occurs on the node or zone that is mastering the SAP central services resource group, the SAP central services resource group fails over to the node or zone where the SAP replicated enqueue server resource group is currently running.
- If the SAP replicated enqueue server and the SAP central services are running on different instance numbers, you must configure the SAP replicated enqueue preempter resource in the SAP central services resource group. This is to ensure that if the SAP central services resource group fails over to the node running the SAP replicated enqueue server resource group is off-loaded after the central services are online and the enqueue table is copied to the enqueue server process. This off-load happens once a node is available to host the replicated enqueue server resource group.
- If the SAP replicated enqueue server and the SAP central services are configured to have the same instance number, the SAP replicated enqueue server resource group is configured to have strong **negative** affinity with the SAP central services resource group. This affinity ensures that, if the SAP central services resource group fails over, the SAP replica server resource group is off-loaded from the node where it is currently running, before the SAP

central services resource group is brought online on that same node. The SAP replica server resource group is started on another node, if one is available. This is due to the SAP restriction, that every instance running on one node must have a different instance number

The following example shows the following supported configurations of HA for SAP NetWeaver.

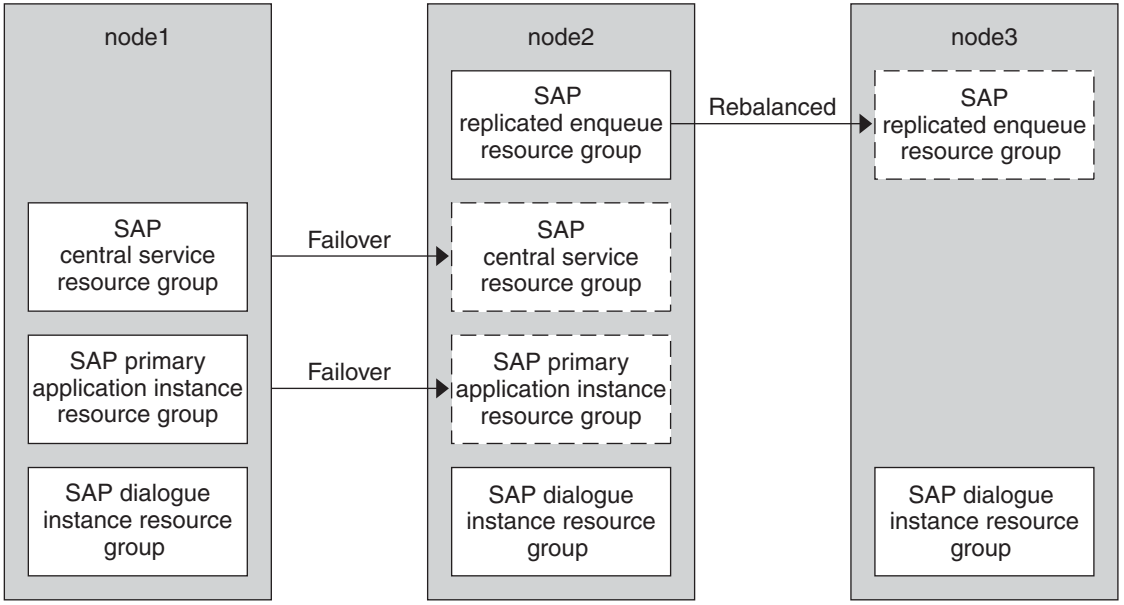
- The SAP NetWeaver component is configured as a failover resource.
- The SAP NetWeaver component is configured as a multiple master resource.

EXAMPLE 1–1 SAP NetWeaver Components Configured as a Failover Resources and Multiple Master Resources

The following example shows a typical SAP NetWeaver HA configuration consisting of central services with enqueue replication in addition a failover primary application instance with multiple master additional dialogue instances.

The boxes that have a solid border represent the location of the resource groups before failover.

The boxes that have a dashed border represent the location of the resource groups after a failover because of a problem on the first node. The SAP central services resource group fails over, and the SAP replicated enqueue server resource group consequently moves to another node. The SAP NetWeaver primary application instance resource group also fails over. Two out of three additional application instances remain available.



Configuration Considerations

The following configuration considerations affect the installation and configuration of HA for SAP NetWeaver.

- The SAP enqueue server and SAP replica server run on different cluster nodes. Therefore, the SAP application files (binary files, configuration files, and parameter files) can be installed either on the global file system or on the local file system. However, the application files for each of these applications must be accessible at all times from the nodes on which these applications are running.

  See "Configuration Guidelines for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*. This section details the advantages and disadvantages of placing the SAP binaries on the local file system or on the cluster file system.
- The resource group for the SAP NetWeaver component can be configured to be a failover resource group or a multiple master resource group. If the SAP NetWeaver component is configured to be a multiple master resource group, the directory `/usr/sap/`*SAPSID*`/`*INSTANCE_NAME* must be local on each node where the SAP NetWeaver component is installed. Note that *SAPSID* represents the SAP system identification and *INSTANCE_NAME* represents the name of the SAP NetWeaver instance. For more information about the supported configurations, see "Supported Data Service Configurations" on page 14.
- During the installation and configuration process, track any system files that you change, because you need to copy those files to all the nodes that are to run the application.

Configuration Planning Questions

Use the questions in this section to plan the installation and configuration of HA for SAP NetWeaver. Write the answers to these questions in the space that is provided on the data service worksheets in Configuration Worksheets in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

- Will you run the SAP dialogue component of the application as a failover resource or as a multiple master resource?
- What is the logical hostname for clients that will access the data service?
- Where will the system configuration files reside?

  See "Configuration Guidelines for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide* for the advantages and disadvantages of placing the SAP binaries on the local file system or on the cluster file system.

Installing and Configuring SAP NetWeaver

To enable HA for SAP NetWeaver to make SAP NetWeaver highly available, additional installation and configuration operations are required. These operations supplement the standard installation and standard configuration of the SAP NetWeaver.

The procedures in this section describe the installation and configuration of the following components of the SAP NetWeaver.

- SAP central services
- SAP replicated enqueue server
- SAP replicated enqueue preempter
- SAP `sapstartsrv` process
- SAP dialogue instance for one of the following engines:
  - ABAP
  - ABAP+J2EE
  - J2EE
  - ABAP single instance

▼ How to Enable the SAP NetWeaver to Run in a Cluster

The following resource groups are created in this procedure.

- SAP central services resource group, to contain the following resources:
  - SAP replicated enqueue preempter
  - SAP central services
  - SAP `sapstartsrv`
  - Logical hostname
- SAP replicated enqueue server resource group, to contain the following resources:
  - SAP replicated enqueue server
  - SAP `sapstartsrv`
  - Logical hostname
- SAP primary application instance resource group, to contain the following resources:
  - SAP dialogue instance component
  - SAP `sapstartsrv`
  - Logical hostname for this resource. In the case of a primary application instance it is configured as a failover resource group. Additional dialogue instances can be configured as multiple master resource groups.

Note – If your deployment is ABAP single instance, you do not need the SAP central services resource group nor the SAP replicated enqueue server resource group.

1 Assume the `root` role on a cluster node.

2 Create the resource group for your storage topology.

The SAP NetWeaver requires shared storage so you must make your storage highly available. For example, you can create a resource group containing the `HAStoragePlus` resource managing the global file systems.

```
# clresourcegroup create -S storage-rg
```

storage-rg
Specifies the name of the resource group to be created. Choose a unique name for each resource group within the cluster.

3 Register the `SUNW.HAStoragePlus` resource type.

```
# clresourcetype register SUNW.HAStoragePlus
```

4 Create your storage resource.

```
# clresource create -g storage-rg \
-t SUNW.HAStoragePlus \
-p filesystemmountpoints=mountpoint-list \
hsp-rs
```

-g *storage-rg*
Specifies that the resource is to be added to the SAP storage resource group.

-t *SUNW.HAStoragePlus*
Specifies that the resource is an instance of the `SUNW.HAStoragePlus` resource type.

-p filesystemmountpoints=*mountpoint-list*
Specifies a list of valid mount points for the file system. For more information, see the SUNW.HAStoragePlus(5) man page.

hsp-rs
Specifies the name of the resource that you are creating.

The resource is created in the enabled state.

```
# clresourcegroup online -M storage-rg
```

5 Create a resource group for the SAP central services.

The SAP central services resource group is a failover resource group to contain the SAP enqueue server resource, the SAP message server resource, and the logical hostname for these resources.

```
# clresourcegroup create central-rg
```

central-rg
Specifies the name of the resource group to be created. Choose a unique name for each resource group within the cluster.

6 Add a logical hostname resource to the resource group that you created in Step 5.

```
# clreslogicalhostname create -g central-rg central-logical-hostname
```

`-g` *central-rg*
Specifies that the logical hostname resource is to be added to the resource group named *central-rg* that you created in Step 5.

central-logical-hostname
Specifies that the logical hostname of the SAP central services resource is *central-logical-hostname*.

Note – If you require a fully qualified hostname, you must specify the fully qualified name with the `-h` option and you cannot use the fully qualified form in the resource name.

---

7 Bring online the SAP central services resource group.

```
# clresourcegroup online -M central-rg
```

`-M`
Specifies that the resource group is to be brought over into the managed state.

8 Create a resource group for the SAP replicated enqueue server.

Note – If your deployment is ABAP single instance, you do not need the SAP replicated enqueue server resource group.

The SAP replicated enqueue server resource group is a failover resource group to contain the SAP replicated enqueue server, a `sapstartsrv` resource, and the logical hostname for this resource.

```
# clresourcegroup create repl-rg
```

9 Add a logical hostname resource to the resource group that you created in Step 8.

```
# clreslogicalhostname create -g repl-rg saprepl-logical-hostname
```

`-g` *repl-rg*
Specifies the name of the resource group.

saprepl-logical-hostname
Specifies the logical hostname of the SAP replica server resource.

Note – If you require a fully qualified hostname, you must specify the fully qualified name with the `-h` option and you cannot use the fully qualified form in the resource name.

10 Bring online the SAP replica server resource group.

```
# clresourcegroup online -M repl-rg
```

`-M`
Specifies that the resource group is to be brought into the managed state.

11 Set weak positive affinity between the SAP central services resource group and the SAP replicated enqueue server resource group.

The weak positive affinity setting ensures that, in case of failover, the SAP central services resource group fails over to the node where the SAP replicated enqueue server resource group has been running. If you want to configure the central services and the replicated enqueue server on the same instance number you must set the strong negative affinities between replicated enqueue resource group and the central service resource group. Do not do this if you run every instance on its own instance number which is the default SAP installation. .

```
# clresourcegroup set -p RG_affinities=+repl-rg  central-rg
```

central-rg
Specifies the name of the resource group to be modified.

`-p RG_affinities=+`*repl-rg*
Specifies that the *central-rg* resource group has weak positive affinity with the *repl-rg* resource group.

12 Create a resource group for the SAP dialogue instance component.

The SAP dialogue instance resource group can be configured as a failover or multiple master resource group to contain the resource for the SAP dialogue instance component and its `sapstartsrv` resource. If the SAP dialogue instance is configured as a failover resource, the logical hostname for this resource is also contained in the SAP dialogue instance resource group.

- To create a failover resource group, run the following command:

  ```
  # clresourcegroup create diag-rg
  ```

- To create a multiple master resource group, run the following command:

  ```
  # clresourcegroup create \
  -p Maximum_primaries=value \
   -p Desired_primaries=value \
  diag-rg
  ```

`-p Maximum_primaries=`*value*
Specifies the maximum number of primary nodes for this multiple master resource group.

`-p Desired_primaries=`*value*
Specifies the desired number of primary nodes for this multiple master resource group.

diag-rg
Specifies the name of the resource group to be added. This name can be your choice but must be unique for the resource groups within the cluster.

13 If the resource group that you created in Step 12 is configured as a failover resource group, add a logical hostname resource to the resource group.

If the resource group that you created in Step 12 is configured as a multiple master resource group, skip this step.

```
# clreslogicalhostname create -g diag-rg diag-logical-hostname
```

`-g` *diag-rg*
Specifies the name of the resource group.

diag-logical-hostname
Specifies the logical hostname *diag-logical-hostname* of the SAP dialogue instance server resource. By default the name of the logical-host resource is set to the same name as this. If you wish to specify a separate name then place the name of the resource at the end of the command listing.

Note – If you require a fully qualified hostname, you must specify the fully qualified name with the `-h` option and you cannot use the fully qualified form in the resource name.

---

14 Bring online the SAP NetWeaver resource group.

```
# clresourcegroup online -M diag-rg
```

`-M`
Specifies that the resource group is to be brought into the managed state.

diag-rg
Specifies the name of the resource group that needs to be brought online.

15 Install the SAP NetWeaver software.

Follow the instructions in the SAP NetWeaver installation manual to install the SAP NetWeaver software. To understand the SAP NetWeaver high availability concepts, refer to the SAP documentation at http://service.sap.com/ha.

16 Copy all system files that were changed during the SAP NetWeaver installation and configuration process to all the nodes that are to run the SAP NetWeaver resources.

These files might include the following:

- `/etc/user_attr`
- `/etc/hosts`
- `/etc/group`
- `/etc/passwd`
- `/etc/services`

- `/etc/project`

Verifying the SAP NetWeaver Installation and Configuration

Before you install the HA for SAP NetWeaver packages, verify that the SAP NetWeaver software is correctly installed and configured to run in a cluster. These procedures do *not* verify that the SAP NetWeaver application is highly available because you have not yet installed your data service.

Note – For more information, see the SAP documentation at http://service.sap.com/ha.

The procedures in this section verify the installation and configuration of the following SAP NetWeaver components.

- SAP central services
- SAP replicated enqueue server
- SAP primary application instance
- SAP additional dialogue instance

▼ How to Verify the Installation of an SAP NetWeaver

On the node where you installed the SAP NetWeaver instance as the root user, do the following:

1. **Switch to the SAP NetWeaver administrative user.**

   ```
   # su - sidadm
   ```

2. **Stop the SAP NetWeaver instance.**

   ```
   $ stopsap r3 instance name
   ```

3. **Kill all remaining processes.**

   ```
   $ pkill -f instance name
   ```

4. **Start the instance.**

   ```
   $ startsap r3 instance name
   ```

5. **Check if the instance goes online.**

   ```
   $ sapcontrol -nr instance number -function GetProcessList
   ```

   Repeat this step until all the processes show the GREEN status.

6. **Stop the SAP NetWeaver instance.**

   ```
   $ stopsap r3 instance name
   ```

7 **Kill all remaining processes.**

```
$ pkill -f instance name
```

Configuring Your Highly Available Database

SAP supports various databases. You must configure the resource type, the resource group, and the resources for the database that you plan to use so that the database will be highly available. See details in the appropriate Oracle Solaris Cluster Data Services document for the database that you plan to use.

Preparing SAP NetWeaver for High Availability

- If you configure the JAVA stack, you need to know that the JAVA stack does not detect that a database is running on the remote node. You must disable the database start from the start profile of the application instances.

  ```
  # Start_Program_00 = immediate $(_DB)
  ```

- To recover the enqueue replication after network outages, add the following line to the instance profile of the enqueue replication server.

  ```
  enque/enrep/keepalive_count = 1
  ```

- If your SAP version supports an integration between the SAP management console and Oracle Solaris Cluster, issue user administration permission to the SAP administrator. On all nodes, execute the following command:

  ```
  # usermod -A solaris.cluster.admin sidadm
  ```

Note – If you missed this step, you will not be able to start or stop your SAP instance once you enable the `halib` directive in your instance profile.

Registering and Configuring HA for SAP NetWeaver

To enable the HA for SAP NetWeaver data service to make SAP NetWeaver applications highly available, configure the data service as described in the procedures in this section. These procedures perform the following tasks.

- Register and configure the SAP central services resources. The SAP central services consist of the following components:
  - SAP `sapstartsrv`
  - SAP central services
  - SAP replicated enqueue server

  - SAP replicated enqueue preempter
  - SAP dialogue instance
- Register and configure resources for the SAP NetWeaver primary application instance.
- Register and configure the SAP NetWeaver additional dialogue instance.

The resource groups and the storage resource were created in "How to Enable the SAP NetWeaver to Run in a Cluster" on page 17.

Before You Begin

Before performing these procedures, ensure that the HA for SAP NetWeaver data service packages are installed.

The procedures in this section assume that the database resources have been previously created and that these resources are online.

Make your database highly available by following the instructions in the documentation for your database.

Perform these procedures assuming the `root` role on a cluster node.

Setting HA for SAP NetWeaver Extension Properties

The extension properties for HA for SAP NetWeaver are described in Appendix A, "HA for SAP NetWeaver Extension Properties."

You can update some extension properties dynamically. You can update other properties, however, only when you create or disable a resource. The Tunable entry indicates when you can update a property.

The instructions for registering and configuring resources explain how to set *only* extension properties that HA for SAP NetWeaver requires you to set.

To set an extension property of a resource, include the following option in the `clresource` command that creates or modifies the resource:

`-p` *property*=*value*

`-p` *property*
: Identifies the extension property that you are setting.

value
: Specifies the value to which you are setting the extension property.

Registering and Configuring the HA for SAP NetWeaver by using Oracle Solaris Cluster Command Line Interface (CLI)

The procedures in this section describe the registration and configuration of the following components of the SAP NetWeaver by using Oracle Solaris Cluster CLI.

- Register and configure the SAP central services resources. The SAP central services consist of the following components:
  - SAP `sapstartsrv`
  - SAP central services
  - SAP replicated enqueue server
  - SAP replicated enqueue preempter
  - SAP dialogue instance
- Register and configure resources for the SAP NetWeaver primary application instance.
- Register and configure the SAP NetWeaver additional dialogue instance.

How to Register and Configure an SAP NetWeaver sapstartsrv Resource

The SAP NetWeaver `sapstartsrv` resource must be configured in the same resource group with each and every other SAP NetWeaver instance resource. These instance resources must depend on their `sapstartsrv` resource.

The `sapstartsrv` resource is to configured to depend on its storage resource. This dependency ensures that the `sapstartsrv` resource does not attempt to start until its associated storage resource is online.

1 Register the `ORCL.sapstartsrv` resource type.

```
# clresourcetype register ORCL.sapstartsrv
```

`register`
Specifies that a new resource type is to be added.

`ORCL.sapstartsrv`
Specifies the name of the resource type to be added. This name is predefined for SAP `sapstartsrv`.

2 Create a `sapstartsrv` resource.

Note – You can choose to create a failover resource or a multiple master resource as follows.

- **Create a failover `sapstartsrv` resource.**

```
# clresource create -d-g central-rg \
-t ORCL.sapstartsrv \
```

```
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number=instance \
-p instance_name=instance_number \
-p HOST=ip-alias \
-p timeout_return=return_code \
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE} \
sapstartsrv-rs
```

- **Create a multiple master `sapstartsrv` resource.**

```
# clresource create -d-g central-rg \
-t ORCL.sapstartsrv \
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number{node1}=instance 1 \
-p instance_number{node2}=instance 2 \
-p instance_name{node1}=instance_name 1 \
-p instance_name{node2}=instance_name 2 \
-p timeout_return=return_code \
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE} \
sapstartsrv-rs
```

`-g` *central-rg*
: Specifies the resource group to which the resource is to be added. The resource group is confirmed as a failover resource group.

`-t ORCL.sapstartsrv`
: Specifies that the resource is an instance of the `ORCL.sapstartsrv` resource type.

-p sid=*system-id*
: Specifies the SAP system identifier.

-p sap_user=*sidadm*
: Specifies the administrator user for the SAP installation.

-p instance_number=*instance*
: Specifies the SAP instance number of the instance to be controlled.

-p instance_name=*instance_name*
: Specifies the name of the SAP instance to be controlled.

-p HOST=*ip-alias*
: Specifies the IP alias on which the instance is configured.

-p yellow=*return_code*
: Specifies the return code on which the resource probe exits by 80% of the probe timeout.

-p resource_dependencies_offline_restart=*hsp-rs*{LOCAL_NODE}
: Specifies the list of offline restart dependencies.

`sapstartsrv-rs`
: Specifies the resource name of the `sapstartsrv` resource.

3 **Verify that the default values for the SAP `sapstartsrv` extension properties are acceptable.**

Refer to "`ORCL.sapstartsrv` Extension Properties" on page 55.

4 **Enable the SAP `sapstartsrv` resource.**

```
#  clresource enable sapstartsrv-rs
```

`enable`
Specifies that the specified resource is to be enabled.

sapstartsrv-rs
Specifies the name of the resource to be enabled.

How to Register and Configure an SAP Central Service Resource

The SAP NetWeaver central service resource must be configured in the same resource group with its `sapstartsrv` resource. It must depend on this `sapstartsrv` resource.

The central service resource is configured to depend on its storage resource and on the logical host resource. These dependencies ensures that the central service resource does not attempt to start until its associated resources are online.

1 **Register the `ORCL.sapcentr` resource type.**

```
# clresourcetype register ORCL.sapcentr
```

`register`
Specifies that a new resource type is to be added.

`ORCL.sapcentr`
Specifies the name of the resource type to be added. This name is predefined for the SAP central services.

2 **Create a failover `scs-startsrv-rs` for the SAP central servicesresource.**

For information, see "How to Register and Configure an SAP NetWeaver `sapstartsrv` Resource" on page 25.

3 **Create a failover central service resource.**

```
# clresource create -d-g central-rg \
-t ORCL.sapcentr \
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number=instance \
-p instance_name=instance_number \
-p HOST=ip-alias \
-p yellow=return_code \
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE} \
-p resource_dependencies=db-rs,scs-startsrv-rs \
scs-rs
```

`-g` *central-rg*
Specifies the resource group to which the resource is to be added. The resource group is confirmed as a failover resource group.

`-t ORCL.sapcentr`
Specifies that the resource is an instance of the `ORCL.sapcentr` resource type.

-p sid=*system-id*
Specifies the SAP system identifier.

-p sap_user=*sidadm*
Specifies the administrator user for the SAP installation.

-p instance_number=*instance*
Specifies the SAP instance number of the instance to be controlled.

-p instance_name=*instance_name*
Specifies the name of the SAP instance to be controlled.

-p HOST=*ip-alias*
Specifies the IP alias on which the instance is configured.

-p yellow=*return_code*
Specifies the return code on which the resource probe exits if a `sapcontrol` command reports the YELLOW state.

-p resource_dependencies_offline_restart=*hsp-rs*{LOCAL_NODE}
Specifies the list of offline restart dependencies.

-p resource_dependencies=*db-rs,scs-startsrv-rs*
Specifies the list of dependencies.

`scs-rs`
Specifies the resource name of the central service resource.

4 Verify that the default values for the SAP central service resource extension properties are acceptable.

For more information about the SAP central service resource extension properties, see "`ORCL.sapcentr` Extension Properties" on page 47.

5 Enable the `scs-startsrv-rs` resource.

```
# clresource enable scs-startsrv-rs
```

6 Enable the SAP central service resource.

```
# clresource enable scs-rs
```

`enable`
Specifies that the specified resource is to be enabled.

scs-rs
Specifies the name of the resource to be enabled.

How to Register and Configure an SAP Replicated Enqueue Server Resource

The SAP replicated enqueue server resource must be configured in the same resource group with its `sapstartsrv` resource. It must depend on this `sapstartsrv` resource.

The SAP replicated enqueue server resource is to configured to depend on its storage resource and on the logical host resource, as well as on its central service resource. These dependencies ensure that the SAP replicated enqueue server resource does not attempt to start until its associated resources are online.

1 Register `ORCL.saprepenq`, the resource type for the SAP replicated enqueue server.

```
# clresourcetype register ORCL.saprepenq
```

`register`
Specifies that a new resource type is to be added.

`ORCL.saprepenq`
Specifies the name of the resource type to be added. This name is predefined for the SAP replicated enqueue server.

2 Create a failover `rep-startsrv-rs` for the SAP replicated enqueue server resource.

For information, see "How to Register and Configure an SAP NetWeaver `sapstartsrv` Resource" on page 25.

3 Create a failover SAP replicated enqueue server resource.

```
# clresource create -d -g rep-rg \
-t ORCL.saprepenq \
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number=instance \
-p instance_name=instance_name \
-p HOST=ip-alias \
-p yellow=return_code \
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE} \
-p resource_dependencies=scs-rs,rep-startsrv-rs \
rep-rs
```

`-g` *rep-rg*
Specifies the resource group to which the resource is to be added. The resource group is confirmed as a failover resource group.

`-t ORCL.saprepenq`
Specifies that the resource is an instance of the ORCL.saprepenq resource type.

-p sid=*system-id*
Specifies the SAP system identifier.

-p sap_user=*sidadm*
Specifies the administrator user for the SAP installation.

-p instance_number=*instance*
Specifies the SAP instance number of the instance to be controlled.

-p instance_name=*instance_name*
Specifies the name of the SAP instance to be controlled.

-p HOST=*ip-alias*
Specifies the IP alias on which the instance is configured.

-p yellow=*return_code*
Specifies the return code on which the resource probe exits if a `sapcontrol` command reports the YELLOW state.

`-p resource_dependencies_offline_restart=`*hsp-rs*{LOCAL_NODE}
Specifies the list of offline restart dependencies.

`-p resource_dependencies=`*db-rs, rep-startsrv-rs*
Specifies the list of dependencies.

rep-rs
Specifies the resource name of the replicated enqueue server resource.

4 Verify that the default values for the SAP replicated enqueue server extension properties are acceptable.

Refer to "`ORCL.saprepenq` Extension Properties" on page 52.

5 Enable the `rep-startsrv-rs` resource.

```
# clresource enable rep-startsrv-rs
```

6 Enable the SAP replicated enqueue server resource.

```
# clresource enable rep-rs
```

`enable`
Specifies that the specified resource is to be enabled.

rep-rs
Specifies the name of the resource to be enabled.

How to Register and Configure an SAP Replicated Enqueue Preempter Resource

The SAP replicated enqueue preempter resource must be configured in the same resource group with its central service resource. It must depend on this central service resource with an offline restart dependency.

The SAP replicated enqueue preempter resource is to configured to depend on its storage resource and on the logical host resource, as well as on its SAP central services resource. These dependencies ensure that the SAP replicated enqueue preempter resource does not attempt to start until its associated resources are online.

1 Register `ORCL.saprepenq_preempt`, the resource type for the SAP replicated enqueue preempter.

```
# clresourcetype register ORCL.saprepenq_preempt
```

`register`
Specifies that a new resource type is to be registered.

`ORCL.saprepenq_preempt`
Specifies the name of the resource type to be added. This name is predefined for the SAP replicated enqueue preempter.

2 Create a failover SAP replicated enqueue preempter resource.

```
# clresource create -d -g central-rg \
-t ORCL.saprepenq_preempt \
-p sid=system-id \
-p sap_user=sidadm \
-p repenqres=resource_name \
-p enq_instnr=instance_list
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE},scs-rs \
-p resource_dependencies=db-rs \
rep-rs
```

`-g` *rep-rg*
Specifies the resource group to which the resource is to be added. The resource group is confirmed as a failover resource group.

`-t ORCL.saprepenq_preempt`
Specifies that the resource is an instance of the `ORCL.saprepenq_preempt` resource type.

-p sid=*system-id*
Specifies the SAP system identifier.

-p sap_user=*sidadm*
Specifies the administrator user for the SAP installation.

-p enq_instnr=*instance_name*
Specifies the name of the SAP replicated enqueue server server resource.

`-p enq_instnr=`*instance_list*
Specifies the comma separated list of SAP central services instance numbers to be monitored.

`-p resource_dependencies_offline_restart=`*hsp-rs*{LOCAL_NODE},*scs-rs*
Specifies the list of offline restart dependencies, at least one central services resource must be present here.

`-p resource_dependencies=`*db-rs*
Specifies the list of dependencies.

preempt-rs
Specifies the resource name of the SAP replicated enqueue preempter resource.

3 Verify that the default values for the SAP replicated enqueue preempter resource extension properties are acceptable.

Refer to "`ORCL.saprepenq_preempt` Extension Properties" on page 54.

4 Enable the SAP replicated enqueue preempter resource.

`# clresource enable` *preempt-rs*

`enable`
Specifies that the specified resource is to be enabled.

preempt-rs
Specifies the name of the resource to be enabled.

▼ How to Register and Configure an SAP NetWeaver Dialogue Instance Resource

The SAP NetWeaver dialogue instance resource must be configured in the same resource group with its `sapstartsrv` resource. It must depend on this `sapstartsrv` resource.

Us the dialogue instance resource type for the following deployments:

- Primary application instance
- Additional application instance
- Combined instance containing dialogue instance and central services

Configure the dialogue instance resource such that it depends on its storage resource, the logical host resource, the database resource, as well as its central service resource. These dependencies ensure that the dialogue instance resource does not attempt to start until its associated resources are online.

Note – If you configure the dialogue instance resource as a single instance resource it must not depend on a central service resource.

---

1 Register `ORCL.sapdia`, the resource type for the SAP NetWeaver dialogue instance resource.

`# clresourcetype register ORCL.sapdia`

`register`
Specifies that a new resource type is to be added.

`ORCL.sapdia`
Specifies the name of the resource type to be added. This name is predefined for the SAP dialogue instance.

2 Create a `diag-startsrv-rs` for the SAP NetWeaver dialogue instance resource.

For information, see "How to Register and Configure an SAP NetWeaver `sapstartsrv` Resource" on page 25.

3 Create a dialogue instance resource.

Note – Depending on the topology that you are using for your dialogue instance resource, you can create the dialogue resource using one of the following options:

- **Create a failover dialogue instance resource.**

```
# clresource create -d -g dia-rg \
-t ORCL.sapdia \
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number=instance \
-p instance_name=instance_number \
-p HOST=ip-alias \
-p yellow=return_code \
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE} \
-p resource_dependencies=db-rs,scs-rs,diag-startsrv-rs \
diag-rs
```

- **Create a multiple master dialogue instance resource.**

```
# clresource create -d -g dia-rg \
-t ORCL.sapdia \
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number{node1}=instance_number \
-p instance_number{node2}=instance_number \
-p instance_name{node1}=instance_name\
-p instance_name{node2}=instance_name \
-p HOST{node 1}=ip-alias \
-p HOST{node 2}=ip-alias \
-p timeout_return=return_code \
-p resource_dependencies=db-rs,scs-rs,diag-startsrv-rs \
diag-rs
```

- **Create a failover combined dialogue instance resource.**

```
# clresource create -d -g dia-rg \
-t ORCL.sapdia \
-p sid=system-id \
-p sap_user=sidadm \
-p instance_number=instance \
-p instance_name=instance_number \
-p Architecture=comb \
-p HOST=ip-alias \
-p yellow=return_code \
```

```
-p resource_dependencies_offline_restart=hsp-rs{LOCAL_NODE} \
-p resource_dependencies=db-rs,diag-startsrv-rs \
diag-rs
```

`-g` *dia-rg*
Specifies the resource group to which the resource is to be added. The resource group is confirmed as a failover or a multiple master resource group.

`-t ORCL.sapdia`
Specifies that the resource is an instance of the `ORCL.sapdia` resource type.

-p sid=*system-id*
Specifies the SAP system identifier.

-p sap_user=*sidadm*
Specifies the administrator user for the SAP installation.

-p instance_number=*instance*
Specifies the SAP instance number of the instance to be controlled.

-p instance_name=*instance_name*
Specifies the name of the SAP instance to be controlled.

-p Architecture=*comb*
Specifies the flag to highlight that a combined instance is configured. In this case this value must be `comb`.

-p HOST=*ip-alias*
Specifies the IP alias on which the instance is configured.

-p yellow=*return_code*
Specifies the return code on which the resource probe exits if a `sapcontrol` command reports the YELLOW state.

-p resource_dependencies_offline_restart=*hsp-rs*{LOCAL_NODE}
Specifies the list of offline restart dependencies.

-p resource_dependencies_offline_restart=*db-rs,logical_host,diag-startsrv-rs*
Specifies the list of dependencies.

diag-rs
Specifies the resource name of the dialogue instance resource.

4 Verify that the default values for the SAP dialogue instance resource extension properties are acceptable.

Refer to "`ORCL.sapdia` Extension Properties" on page 49.

5 Enable the `diag-startsrv-rs` resource.

```
# clresource enable diag-startsrv-rs
```

6 **Enable the SAP dialogue instance resource.**

```
# clresource enable diag-rs
```

`enable`
Specifies that the specified resource is to be enabled.

diag-rs
Specifies the name of the resource to be enabled.

Using Alternate Project Identification

You can create a specific project, that is, an alternate project identification (ID), for the application. Set either `RG_project_name` or `Resource_project_name` or both, for the resource group and/or the resource, so that the application is started up under the specified project. Refer to the RGM doc for how to set these system properties.

See Cluster Administration and Application Development in *Oracle Solaris Cluster Concepts Guide*.

Tuning the HA for SAP NetWeaver Fault Monitors

Fault monitoring for the HA for SAP NetWeaver data service is provided by the following fault monitors:

- The fault monitor for the SAP `sapstartsrv` process
- The fault monitor for the SAP central services
- The fault monitor for the SAP replicated enqueue server
- The fault monitor for the SAP replicated enqueue preempter
- The fault monitor for the SAP dialogue instance

Each fault monitor is contained in a resource whose resource type is shown in the following table.

TABLE 1–3 Resource Types for the Fault Monitors of HA for SAP NetWeaver

Component	Resource Type
SAP `sapstartsrv`	`ORCL.sapstartsrv`
SAP central services	`ORCL.sapcentr`
SAP dialogue instance	`ORCL.sapdia`
SAP replicated enqueue server	`ORCL.saprepenq`
SAP replicated enqueue preempter	`ORCL.saprepenq_preempt`

System properties and extension properties of the resource types control the behavior of the fault monitors. The default values of these properties determine the preset behavior of the fault monitors. The preset behavior should be suitable for most Oracle Solaris Cluster installations. Therefore, you should tune the fault monitors *only* if you need to modify this preset behavior.

Tuning these fault monitors involves the following tasks:

- Setting the interval between fault monitor probes
- Setting the timeout for fault monitor probes
- Defining the criteria for persistent faults
- Specifying the failover behavior of a resource

Perform these tasks when you register and configure HA for SAP NetWeaver, as described in "Registering and Configuring HA for SAP NetWeaver" on page 23.

In addition, perform the following tasks for tuning the SAP NetWeaver profiles and Oracle Solaris Cluster resources:

- Ensure that the SAP enqueue server is not restarted upon process failures, by changing the `Restart_Program_01 = local $(_EN) pf=$(_PF)` line in the SAP central services profile to `Start_Program_01 = local $(_EN) pf=$(_PF)`. For example:

  ```
  #-----------------------------------------------------------------------
  # Start SAP enqueue server
  #-----------------------------------------------------------------------
  _EN = en.sap$(SAPSYSTEMNAME)_$(INSTANCE_NAME)
  Execute_03 = local rm -f $(_EN)
  Execute_04 = local ln -s -f $(DIR_EXECUTABLE)/enserver$(FT_EXE) $(_EN)
  Start_Program_01 = local $(_EN) pf=$(_PF)
  ```

- For every SAP central service resource of the type ORCL.sapcentr, set `retry_count` to 0.

  ```
  # clrs set -p Retry_count=0 resource name
  ```

- (Optional) For every `sapstart` service resource of the type ORCL.sapstartsrv, which includes either the SAP central services resource or the SAP replicated enqueue server resource of the type ORCL.saprepenq, you can set `Child_mon_level` to 5. Follow this for only the `sapstart` service resource which has the same instance name as the SAP central service and the SAP replicated enqueue server resources.

  ```
  # clrs set -p Child_mon_level=5 resource name
  ```

For detailed information about these tasks, see "Tuning Fault Monitors for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

Operation of the Fault Monitor for the SAP sapstartsrv Resource Type

To determine whether the SAP `sapstartsrv` process is operating correctly, the fault monitor for the SAP `sapstartsrv` resource type probes these resources periodically.

The probe uses the `sapcontrol` command to check the health of the `sapstartsrv` process.

```
# su - sidadm -c "sapcontrol -nr instance number -function GetProcessList"
```

sidadm
Specifies the SAP administrative user.

instance number
Specifies the SAP instance number of the `sapstartsrv` process.

The return codes 0, 3, and 4 signal a healthy `sapstartsrv` process. Every other return code indicates a faulty `sapstartsrv` process

If the probe command times out, that is if it reaches 80% of the `probe_timeout` property, the return code of the probe command is determined by the `timeout_return` property.

The number of tolerated consecutive timeouts within `retry_interval` seconds is obtained by dividing 100 over `timeout_return`. If this number is greater than the number you obtain by dividing `retry_interval` by `thorough_probe_interval`, then timeouts will be tolerated forever.

For more information, see "Tuning Fault Monitors for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

Operation of the Fault Monitor for the SAP Central Services Resource Type

To determine whether the SAP central services are operating correctly, the fault monitor for the SAP central services resource type probes these resources periodically.

The probe uses the `sapcontrol` command to check the health of the `sapstartsrv` process.

```
# su - sidadm -c "sapcontrol -nr instance number -function GetProcessList"
```

sidadm
Specifies the SAP administrative user.

instance number
Specifies the SAP instance number of the central service.

The return code indications are as follows:

- 1 signals an internal error.
- 3 signals that everything is running as expected.
- 4 indicates that everything is stopped and a failover is initiated.
- For all other return codes, the output off the `sapcontrol` command is evaluated for the status of the critical processes.

Critical processes are the message server, enqueue server, and the gateway reader, if available. The status of the different processes lead to different actions as shown in the following table.

GREEN	No action
YELLOW	The probe command returns with the number specified in the yellow property
GRAY	The probe indicates a restart
RED	The probe indicates a failover

If the probe command times out, that is if it reaches 80% of the `probe_timeout` property, the return code of the probe command is determined by the YELLOW property.

The number of tolerated consecutive YELLOW states or timeouts within `retry_interval` seconds is obtained by dividing 100 over `timeout_return`. If this number is greater than the number you obtain by dividing `retry_interval` by `thorough_probe_interval`, then timeouts and YELLOW states will be tolerated forever.

For more information, see "Tuning Fault Monitors for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

Operation of the Fault Monitor for the SAP Replicated Enqueue Server Resource Type

To determine whether the SAP central services are operating correctly, the fault monitor for the SAP replicated enqueue server resource type probes these resources periodically.

The probe uses the `sapcontrol` command to check the health of the `sapstartsrv` process.

```
# su - sidadm -c "sapcontrol -nr instance number -function GetProcessList"
```

sidadm
Specifies the SAP administrative user.

instance number
Specifies the SAP instance number of the SAP replicated enqueue server.

The return code indications are as follows:

- 1 signals an internal error.
- 3 signals that everything is running perfectly.
- 4 signals that everything is stopped and a failover is initiated.
- For all other return codes, the output off the `sapcontrol` command is evaluated for the status of the critical processes.

The critical process is SAP replicated enqueue server. The status of the process lead to different actions as shown in the following table.

GREEN	No action
YELLOW	The probe command returns with the number specified in the yellow property
GRAY	The probe indicates a restart
RED	The probe indicates a failover

If the probe command times out, that is if it reaches 80% of the `probe_timeout` property, the return code of the probe command is determined by the YELLOW property.

The number of tolerated consecutive YELLOW states or timeouts within `retry_interval` seconds is obtained by dividing 100 over `timeout_return`. If this number is greater than the number you obtain by dividing `retry_interval` by `thorough_probe_interval`, then timeouts and YELLOW states will be tolerated forever.

For more information, see "Tuning Fault Monitors for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

Operation of the Fault Monitor for the SAP Dialogue Instance Resource Type

To determine whether the SAP dialogue instance is operating correctly, the fault monitor for the SAP dialogue instance resource type probes these resources periodically.

The probe uses the `sapcontrol` command to check the health of the dialogue instance process.

```
# su - sidadm -c "sapcontrol -nr instance number -function GetProcessList"
```

sidadm
Specifies the SAP administrative user.

instance number
Specifies the SAP instance number of the dialogue instance process.

The return code indications are as follows:

- 1 signals an internal error.
- 3 signals that everything is running perfectly.
- 4 signals that everything is stopped and a failover is initiated.
- For all other return codes, the output off the `sapcontrol` command is evaluated for the status of the critical processes.

The critical processes depend on the deployment variation.

For a pure dialogue instance, the critical processes is as follows:

- disp+work, jstart, or jcontrol

For a combined instance the critical processes are as follows:

- disp+work, jstart, or jcontrol
- Enqueue server
- Message server

The status of a critical process leads to different actions as show in the following table.

GREEN	No action
YELLOW	The probe command returns with the number specified in the yellow property
GRAY	The probe indicates a restart
RED	The probe indicates a failover

If the probe command times out, that is if it reaches 80% of the `probe_timeout` property, the return code of the probe command is determined by the YELLOW property.

The number of tolerated consecutive YELLOW states or timeouts within `retry_interval` seconds is obtained by dividing 100 over `timeout_return`. If this number is greater than the number you obtain by dividing `retry_interval` by `thorough_probe_interval`, then timeouts and YELLOW states will be tolerated forever.

For more information, see "Tuning Fault Monitors for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

Operation of the Fault Monitor for the SAP Replicated Enqueue Preempter Resource Type

To determine whether the SAP replicated enqueue preempter is operating correctly, the fault monitor for the SAP replicated enqueue preempter service resource type probes these resources periodically.

The probe uses the `sapcontrol` command to check the health of the `sapstartsrv` process.

```
# su - sidadm -c "sapcontrol -nr instance number -function GetProcessList"
```

sidadm
Specifies the SAP administrative user.

instance number
Specifies the SAP instance number of the `sapstartsrv` process.

The return code of 0 indicates that everything is running as expected. All other return codes indicate errors.

If the SAP central services and the SAP replicated enqueue server are running on the same node, the probe evaluates if a giveover is possible. If yes, it will initiate the giveover to reinstate the redundancy of the lock table.

If the probe command times out, that is if it reaches 80% of the `probe_timeout` property, the return code of the probe command is determined by the YELLOW property.

The number of tolerated consecutive timeouts within `retry_interval` seconds is obtained by dividing 100 over `timeout_return`. If this number is greater than the number you obtain by dividing `retry_interval` by `thorough_probe_interval`, then timeouts will be tolerated forever.

For more information, see "Tuning Fault Monitors for Oracle Solaris Cluster Data Services" in *Oracle Solaris Cluster Data Services Planning and Administration Guide*.

Verifying the HA for SAP NetWeaver Installation and Configuration

You have installed, registered, and configured the data service for SAP NetWeaver. Now verify that the data service makes the SAP NetWeaver highly available by performing the following tasks.

- Verify the operation of the fault monitor for the SAP `sapstartsrv` process
- Verify the operation of the fault monitor for the SAP central services
- Verify the operation of the fault monitor for the SAP replicated enqueue server
- Verify the operation of the fault monitor for the SAP dialogue instance
- Verify the installation and configuration of the SAP replicated enqueue preempter

See "Tuning the HA for SAP NetWeaver Fault Monitors" on page 35 for a description of the fault monitors.

How to Verify the Operation of the Fault Monitor for the SAP sapstartsrv Process

Perform this procedure on each set of two nodes where the SAP `sapstartsrv` process can run.

1 Assume the `root` role on a cluster node.

2 Ensure that the resource group hosting the SAP `sapstart srv` resource is offline on all nodes.

3 Bring online the resource group to which the SAP `sapstartsrv` belongs.

```
# clresourcegroup online -n node central-rg
```

`-n` *node*
Specifies the name of the node on which the resource group is to be brought online. This node is the node that you have just logged in to.

central-rg
Specifies the name of the resource group to be brought online. This group is the resource group to which the SAP `sapstartsrv` belongs.

4 Terminate the SAP `sapstartsrv` process.

```
# su - sidadm -c "sapcontrol -nr instance number -function StopService"
```

Alternatively, kill the SAP `sapstartsrv` process.

Once you enable the interaction between SAP NetWeaver and Oracle Solaris Cluster, you must kill the instance processes to achieve a restart.

5 Confirm that the SAP `sapstartsrv` process gets restarted.

Run the `clresource status` command to confirm that the SAP `sapstartsrv` resource is online on the first node.

6 Switch over the resource group hosting the SAP `sapstartsrv` to another node if the resource group is configured as a failover resource group. If the resource group is configured as a multiple master resource group, skip this step.

```
# clresourcegroup switch -n node central-rg
```

`-n` *node*
Specifies the name of the node on which the resource group is to be brought online.

central-rg
Specifies the name of the resource group to be brought online. This group is the resource group to which the SAP `sapstartsrv` belongs.

▼ How to Verify the Operation of the Fault Monitor for the SAP Instance Resource Types

This procedure is applicable for the following instance resource types:

- SAP central services
- SAP replicated enqueue server
- SAP dialogue instance

Perform this procedure on each set of two nodes where the SAP instance process can run.

1 Assume the `root` role on a cluster node.

2 Ensure that the resource group hosting the SAP instance resource is offline on all nodes.

3 Bring online the resource group to which the SAP instance belongs.

```
# clresourcegroup online -n node instance-rg
```

`-n` *node*
Specifies the name of the node on which the resource group is to be brought online. This node is the node that you have just logged in to.

instance-rg
Specifies the name of the resource group to be brought online. This group is the resource group to which the SAP instance belongs.

4 Terminate the SAP instance process.

```
# su - sidadm -c "sapcontrol -nr instance number -function Stop"
```

Alternatively, kill the instance processes except the corresponding SAP `sapstartsrv` process.

5 Confirm that the SAP instance resource gets restarted.

Run the `clresource status` command to confirm that the SAP instance resource is online on the first node.

6 Switch over the resource group hosting the SAP `sapstartsrv` to another node if the resource group is configured as a failover resource group. If the resource group is configured as a multiple master resource group, skip this step.

```
# clresourcegroup switch -n node instance-rg
```

`-n` *node*
Specifies the name of the node on which the resource group is to be brought online.

instance-rg
Specifies the name of the resource group to be brought online. This group is the resource group to which the SAP instance belongs.

▼ How to Verify the Operation of the Fault Monitor for the SAP Replicated Enqueue Preempter Resource Type

Perform this procedure on each node where the SAP replicated enqueue preempter can run.

1 Assume the `root` role on a cluster node.

2 Ensure that the resource group hosting the SAP replicated enqueue preempter resource is offline on all nodes.

3 Bring online the resource group to which the SAP replicated enqueue preempter belongs.

```
# clresourcegroup online -n node centr-rg
```

`-n` *node*
Specifies the name of the node on which the resource group is to be brought online. This node is the node that you have just logged in to.

centr-rg
Specifies the name of the resource group to be brought online. This group is the resource group to which the SAP replicated enqueue preempter belongs.

4 Bring online the resource group to which the SAP replicated enqueue server belongs.

```
# clresourcegroup switch -n node2 centr-rg
```

`-n` *node2*
Specifies the name of the node on which the resource group is to be brought online. This node is the node that you have just logged in to.

centr-rg
Specifies the name of the resource group to be brought online. This group is the resource group to which the SAP central services belongs.

5 Switch over the resource group hosting the SAP replicated enqueue preempter to the node hosting the SAP replicated enqueue server.

6 Confirm that the SAP replicated enqueue server resource group gets restarted on a spare node as long as a spare node is available.

Run the `clresource status` command to confirm that the SAP replicated enqueue server resource is online on the first node.

Enabling Interaction Between Oracle Solaris Cluster and SAP NetWeaver

This section shows how to enable interaction between Oracle Solaris Cluster and SAP NetWeaver

▼ How to Enable Interaction Between Oracle Solaris Cluster and SAP NetWeaver

Before You Begin

- You must have downloaded and installed the latest host agent.
- SAP kernel version must be 7.20_EXT or later.
- Perform the steps in this procedure only after you have created the Oracle Solaris Cluster resources.

1 Configure every instance profile with the following lines, assuming that the `saphascriptco.co` script is in the `/usr/sap/hostctrl/exe/saphascriptco` directory.

```
#
# SAP HA Script Connector
#
service/halib = /usr/sap/hostctrl/exe/saphascriptco.so
service/halib_cluster_connector = \
/opt/ORCLscsapnetw/saphacmd/bin/sap_orcl_cluster_connector
service/halib_debug_level = 1
```

2 Create the `/usr/local/bin` directory on every node.

3 Create the following symbolic links in the `/usr/local/bin` directory on every node

```
# ls -la /usr/local/bin
total 8
drwxr-xr-x   2 root     root           4 May 29 02:22 .
drwxr-xr-x   3 root     root           3 May 29 02:13 ..
lrwxrwxrwx   1 root     root          48 May 29 02:22 \
functions_sap_ha -> /opt/ORCLscsapnetw/saphacmd/bin/functions_sap_ha
lrwxrwxrwx   1 root     root          58 May 29 02:14 \
sap_cluster_connector -> /opt/ORCLscsapnetw/saphacmd/bin/sap_orcl_cluster_connector

# cd /usr/local/bin
# ln -s  /opt/ORCLscsapnetw/saphacmd/bin/functions_sap_ha \
./functions_sap_ha
# ln -s /opt/ORCLscsapnetw/saphacmd/bin/sap_orcl_cluster_connector \
sap_orcl_cluster_connector
```

4 Restart the instances and the corresponding `sapstartsrv` process.

Once you completed this step, the `startsap` and `stopsap` commands will always use the Oracle Solaris Cluster methods.

◆ ◆ ◆ APPENDIX A

HA for SAP NetWeaver Extension Properties

Extension properties for HA for SAP NetWeaver resource types are described in the following sections:

For details about system-defined properties, see the r_properties(5) man page and the rg_properties(5) man page.

ORCL.sapcentr Extension Properties

The extension properties of the ORCL.sapcentr resource type are as follows:

Debug_level
: This property indicates the level to which debug messages for the SAP NetWeaver resources are logged. When the debug level is increased, more debug messages are written to the system log /var/adm/messages as follows:

0	No debug messages
1	Function Begin and End messages
2	All debug messages and function Begin and End messages

  You can specify a different value of the debug_level extension property for each node that can master the resource.

  Data type Integer

  Default 0

Range `0–2`

Tunable Any time

`Sap_user`
This property indicates the administrative user for an SAP NetWeaver installation.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Sid`
This property indicates the SAP NetWeaver System Identifier (SID). This is `SAPSYSTEMNAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_name`
This property indicates the name of the SAP central service component instance. This is `INSTANCE_NAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_number`
This property indicates the two-digit SAP system number for the SAP central service component instance. This is `SAPSYSTEM` in the SAP profile.

Data type Number

Default None defined

Range Not applicable

Tunable When disabled

`Host`
This property indicates the host alias on which the central services are configured.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Start_script`
This property indicates the full path to the start script for the instance.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Stop_script`
This property indicates the full path to the stop script for the instance.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Yellow`
This property indicates the SAP NetWeaver probe return value for the central services `YELLOW` status.

Data type Number

Default `10`

Range `1–50`

Tunable Any time

ORCL.sapdia Extension Properties

The extension properties of the `ORCL.sapdia` resource type are as follows:

`Debug_level`
This property indicates the level to which debug messages for the SAP NetWeaver resources are logged. When the debug level is increased, more debug messages are written to the system log `/var/adm/messages` as follows:

`0` No debug messages

`1` Function Begin and End messages

`2` All debug messages and function Begin and End messages

Data type Integer

Default 0

Range `0`–`2`

Tunable Any time

`Sap_user`
This property indicates the administrative user for an SAP NetWeaver installation.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Sid`
This property indicates the SAP NetWeaver System Identifier (SID). This is `SAPSYSTEMNAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_name`
This property indicates the name of the SAP central service component instance. This is `INSTANCE_NAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_number`
This property indicates the two-digit SAP system number for the SAP central service component instance. This is `SAPSYSTEM` in the SAP profile.

Data type Number

Default None defined

Range Not applicable

Tunable When disabled

`Host`
This property indicates the host alias on which the central services are configured.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Start_script`
This property indicates the full path to the start script for the instance.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Stop_script`
This property indicates the full path to the stop script for the instance.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Yellow`
This property indicates the SAP NetWeaver probe return value for the dialog instance `YELLOW` status.

Data type Integer

Default `10`

Range `1–50`

Tunable Any time

`Architecture`
A flag to indicate if a dialogue instance is a combined instance or a normal dialogue instance. The valid values are `space` or `comb`.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

ORCL.saprepenq Extension Properties

The extension properties of this resource type are as follows:

`Debug_level`
This property indicates the level to which debug messages for the SAP NetWeaver resources are logged. When the debug level is increased, more debug messages are written to the system log `/var/adm/messages` as follows:

`0` No debug messages

`1` Function Begin and End messages

`2` All debug messages and function Begin and End messages

Data type Number

Default 0

Range `0`–`2`

Tunable Any time

`Sap_user`
This property indicates the administrative user for an SAP NetWeaver installation.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Sid`
This property indicates the SAP NetWeaver System Identifier (SID). This is `SAPSYSTEMNAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_name`
This property indicates the name of the SAP central service component instance. This is `INSTANCE_NAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_number`
This property indicates the two-digit SAP system number for the SAP central service component instance. This is `SAPSYSTEM` in the SAP profile.

Data type Number

Default None defined

Range Not applicable

Tunable When disabled

`Host`
This property indicates the host alias on which the central services are configured.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Start_script`
This property indicates the full path to the start script for the instance.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Stop_script`
This property indicates the full path to the stop script for the instance.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Yellow`
This property indicates the SAP NetWeaver probe return value for the replicated enqueue services `YELLOW` status.

Data type Number

Default `10`

Range `1–50`

Tunable Any time

ORCL.saprepenq_preempt Extension Properties

The extension properties of this resource type are as follows:

`Debug_level`
This property indicates the level to which debug messages for the SAP NetWeaver resources are logged. When the debug level is increased, more debug messages are written to the system log `/var/adm/messages` as follows:

`0` No debug messages

`1` Function Begin and End messages

`2` All debug messages and function Begin and End messages

Data type Number

Default `0`

Range `0`–`2`

Tunable Any time

`Sap_user`
This property indicates the administrative user for an SAP NetWeaver installation.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Sid`
This property indicates the SAP NetWeaver System Identifier (SID). This is `SAPSYSTEMNAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Repenqres`
This property indicates the name of the SAP replicated enqueue server resource name.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Enq_instnr`
This property indicates a list of two-digit SAP system numbers for the SAP central service components in this resource group. This instance number is `SAPSYSTEM` in the SAP profile.

Data type String array

Default None defined

Range Not applicable

Tunable When disabled

`Timeout_return`
This property indicated the return code when the probe method reaches 80 percent of the probe timeout.

Data type Number

Default 10

Range Not applicable

Tunable Anytime

ORCL.sapstartsrv Extension Properties

The extension properties of this resource type are as follows:

`Debug_level`
This property indicates the level to which debug messages for the SAP NetWeaver resources are logged. When the debug level is increased, more debug messages are written to the system log `/var/adm/messages` as follows:

`0` No debug messages

`1` Function Begin and End messages

`2` All debug messages and function Begin and End messages

Data type Number

Default 0

Range `0`–`2`

Tunable Any time

`Sap_user`
This property indicates the administrative user for an SAP NetWeaver installation.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Sid`
This property indicates the SAP NetWeaver System Identifier (SID). This is `SAPSYSTEMNAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_name`
This property indicates the name of the SAP central service component instance. This is `INSTANCE_NAME` in the SAP profile.

Data type String

Default None defined

Range Not applicable

Tunable When disabled

`Instance_number`
This property indicates the two-digit SAP system number for the SAP central service component instance. This is `SAPSYSTEM` in the SAP profile.

Data type Number

Default None defined

Range Not applicable

Tunable When disabled

`Timeout_return`
This property indicates the return code when the probe method of the `sapstartsrv` process reaches 80 percent of the probe timeout.

Data type Number

Default 10

Range Not applicable

Tunable Anytime

`Host`

This property indicates the host alias on which the central services are configured.

Data type String

Default None

Range `1–50`

Tunable When disabled

◆ ◆ ◆ APPENDIX B

Deployment Example: How to Configure the Oracle Solaris Cluster HA for SAP NetWeaver Agent

This example shows how to install a dual stack with enqueue replication on a two-node cluster consisting of the nodes `pbono1` and `pbono2`. The chosen enqueue replication model requires different instance numbers between central services and the replicated enqueue server.

In this example, the primary application instance is installed in a failover resource group. Two additional dialog instances are deployed on the physical hosts, `pbono1` and `pbono2`, in a multiple-master resource group.

Pick a database that can be made highly available. Depending on your choice, you might need a different resource group layout for the database.

The logical host are as follows:

- `bono1` — Central services
- `bono2` — Database
- `bono3` — Replicated enqueue server
- `bono4` — Primary application instance

The following instance numbers will be installed.

- 00 — Central services for ABAP
- 01 — Central services for Java
- 10 — Replicated enqueue server ABAP
- 11 — Replicated enqueue server Java
- 02 — Primary application instance
- 03 — Additional dialogue instance on `pbono1`
- 04 — Additional dialogue instance on `pbono2`

You need the following resource groups:

- Database — `db-rg` (failover)
- Central services — `scs-rg` (failover/positive affinity for `rep-rg`)
- Replicated enqueue services — `rep-rg` (failover)
- Primary application instance — `pas-rg` (failover)

- Additional application instance — `dia-rg` (multiple masters)

How to Prepare the Hosts

1. On all Oracle Solaris 11 hosts, add the following packages to install SAP:

```
# pkg set-publisher -O your repository solaris
# pkg install solaris-large-server
# pkg install solaris-desktop
# pkg install motif
# pkg install unrar
# pkg install xclock
# pkg install expect
# pkg install library/medialib
# pkg install pkg:/developer/library/lint
# svcadm enable svc:/application/graphical-login/gdm:default
# pkg install pkg:/compatibility/ucb
# svcadm enable svc:/network/login:rlogin
# svcadm enable telnet
For additional locales, do the following:
# pkg change-facet facet.locale.*=True
# pkg install system/input-method/iiim
# pkg install pkg:/system/locale/extra
# pkg install pkg:/library/motif/libdpstkxm
```

2. On all hosts, add modifications for SAP to the `/etc/system` directory and reboot.

```
# set rlim_fd_cur=8192
```

3. For 7.3, add 40 GBytes swap space per node.
4. Add a fully qualified domain name to all hostnames and logical hosts in the `/etc/hosts` directory.
5. Add the following groups.

```
# groupadd -g 700 sapinst
# groupadd -g 701 sapsys
# groupadd -g 702 sdba
```

6. Add the users as follows:

```
# useradd -o -u 0 -g 1 -d / -c "validation" -s /bin/tcsh emroot

On Oracle Solaris 11:
# useradd -o -u 699 -g 1 -d / -c "validation" -s /bin/tcsh emroot
# useradd -u 700 -g 701 -m -d /export/qe3adm  \
-c "SAP system administrator" -s /bin/tcsh qe3adm
# useradd -u 701 -g 702 -m -d /export/sdb  \
-c "SAPDB software owner" -s /bin/tcsh sdb
# useradd -u 702 -g 701 -m -d /export/sqdqe3  \
-c "Owner of the database instance QE3" -s /bin/tcsh sqdqe3
# useradd -u 703 -g 701 -m -d /export/sapadm  \
-c "SAP system administrator" -s /bin/tcsh sapadm
# useradd -u 704 -g 701 -m -d /export/daaadm  \
-c "owner of the instance DAA" -s /bin/tcsh daaadm
```

   Depending on the database of your choice, you might need different users other than `sdb` and `sqdqe1`.

7. Place all the users except `sdb` and `emroot` in the `sapinst` group.

You must place `sqdqe3` in the `sdba` group. Whether you need the `sdb` user or others will depend on the database that you choose.

8. Give `daaadm` a password that is the same as the master password you will choose later on.

Note – On all nodes, `QE3` is the SAP system name in this example.

Do not give a password to the `sdb` user.

9. Add the users, `qe3adm` and `sapadm`, to the `sapinst` group in the `/etc/group` directory.
10. Add the user, `sqdqe3`, to the `sdba` group in the `/etc/group` directory.
11. Define the project for `QE3` on all the nodes.

```
QE3:223:SAP System QE3:daaadm,emroot,qe3adm,sapadm,\
sdb,sqdqe3::process.max-file-descriptor=(basic,65536,deny) \
;process.max-sem-nsems=(priv,2048,deny) \
;project.max-sem-ids=(priv,9216,deny) \
;project.max-shm-ids=(priv,256,deny) \
;project.max-shm-memory=(priv,18446744073709551615,deny)
```

12. Define the project in the `/etc/user_attr` directory on all the nodes.

```
qe3adm::::project=QE3
sqdqe3::::project=QE3
sdb::::project=QE3
emroot::::project=QE3
sapadm::::project=QE3
```

13. Give the `sidadm` user cluster administration rights on all the nodes.

```
# usermod -A solaris.cluster.admin qe3adm # for 7.30 (kernel 7.20_EXT)
```

Note – If you want to do the installation as `root`, `root` must have project limits of `QE3`. On Oracle Solaris 11 systems, the alternative to the `root` user is `sudo su` as `UID 0` will not work for `emroot`. The alternate user requires a modification in the `/etc/sudoers` directory.

The following links are assumed on the global mount at `/sapstore`.

```
# mkdir /sapstore/sap
# mkdir /sapstore/sapmnt
# mkdir /sapstore/sapdb
# ln -s /sapstore/sapdb /sapdb
# ln -s /sapstore/sap /usr/sap
# ln -s /sapstore/sapmnt /sapmnt
```

This example is based on a lab storage layout. On production systems, the process will be different. In this example, you need only one `HAStoragePlus` resource. On production systems, you will need a different layout.

How to Create Resource Groups

1. Create a resource group `scs-rg` containing the `HAStoragePlus` resource, and a logical host to contain the central services like the message server, the enqueue server, and a logical host.
2. Ensure that the resource group containing the `HAStoragePlus` resource is online on the node where you want to install SAP.
3. Set the `AffinityOn` property to `TRUE`, if it is not done already.

```
# clrt register HAStoragePlus
# clrg create scs-rg
# clrslh create -g scs-rg bono-1
Note: Create the HAStoragePlus resource here, if appropriate.
# clrg online -eM +
```

4. Create a resource group with a logical host `db-rg`, to contain the database.

```
# clrg create db-rg
# clrslh create -g db-rg bono-2
Note: Create the HAStoragePlus resource here, if appropriate.
# clrg online -eM db-rg
```

5. Create a resource group with a logical host `rep-rg`, to contain the replicated enqueue server.

```
# clrg create rep-rg
# clrslh create -g rep-rg bono-3
Note: Create the HAStoragePlus resource here, if appropriate.
# clrg online -eM rep-rg
```

6. Set the affinity from `scs-rg` to `rep-rg`.

```
# clrg set -p rg_affinities=+rep-rg scs-rg
```

7. Create a resource group with a logical host `pas-rg`, to contain the primary application instance `DVBEMGS02`.

```
# clrg create pas-rg
# clrslh create -g pas-rg bono-4
Note: Create the HAStoragePlus resource here, if appropriate.
# clrg online -eM pas-rg
```

8. Create a multiple-master resource group `dia-rg`, for the additional application instances.

```
# clrg create -p maximum_primaries=2 -p desired_primaries=2 dia-rg
```

9. Ensure that no logical host is deprecated.

   For all deprecated interfaces of the logical hosts, do the following:

   `ifconfig` *`if`* `-deprecated up`

Notes about SAP installation

- Install SAP in the layout of your choice.
- Install everything on one node of the cluster and redistribute it when you create the resources. If you run the installation in a VNC session, log in as `emroot` to get the right project
- Configure all logical hosts as not deprecated.
- All DVDs must be on a local drive. Before you install additional dialog instances, bring the previous instances and the database under cluster control. However, do not test the failover.

- After the installation, copy the `/etc/services` directory on all nodes.
- Copy all the user home directories to all the nodes, including `daadm`.
- Set the interfaces of the logical host to deprecated. For example:

```
ifconfig nge0:1 deprecated up
```

Configure SAP for the Java stack

As long as the JAVA stack does not detect that the database is online on a remote node, unset the database start from the application instance's start profile.

```
# Start_Program_00 = immediate $(_DB)
```

Configure SAP for the enqueue server

To recover the enqueue replication after network outages, add the following to the instance profile of the enqueue replication server.

```
# enque/enrep/keepalive_count = 1
```

Register the resource types

```
# clrt register sapstartsrv
# clrt register sapcentr
# clrt register saprepenq
# clrt register sapdia
# clrt register saprepenq_preempt
```

Make the database highly available

Follow the instructions in the appropriate Oracle Solaris Cluster documentation. Name the database as `db-rs`.

Register the SAP resources with the appropriate commands

Follow the instructions in the appropriate Oracle Solaris Cluster documentation. Name the database as `db-rs`.

Create the sapstartsrv resource for the ABAP central services resource

As `qe3adm`:

- call `stopsap r3 ASCS00 bono-1`
- kill the `sapstartsrv` process for the instance `ASCS00`

```
# clrs create -d -g scs-rg -t sapstartsrv \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=00 \
-p instance_name=ASCS00 \
-p HOST=bono-1 \
```

```
-p timeout_return=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
abapscs-strt-rs
```

Create the ABAP central services resource

```
# clrs create -d -g scs-rg -t sapcentr \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=00 \
-p instance_name=ASCS00 \
-p HOST=bono-1 \
-p yellow=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
-p resource_dependencies=db-rs,abapscs-strt-rs \
abapscs-rs
# clrg online -eM +
```

Create the sapstartsrv resource for the JAVA Central Services Resource

As `qe3adm`:

- `call stopsap r3 SCS00 bono-1`
- kill the `sapstartsrv` process for the instance `SCS01`

```
# clrs create -d -g scs-rg -t sapstartsrv \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=01 \
-p instance_name=SCS01 \
-p HOST=bono-1 \
-p timeout_return=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
javascs-strt-rs
```

Create the JAVA central services resource

```
# clrs create -d -g scs-rg -t sapcentr \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=01 \
-p instance_name=SCS01 \
-p HOST=bono-1 \
-p yellow=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
-p resource_dependencies=db-rs,javascs-strt-rs \
javascs-rs
# clrg online -eM +
```

Create the sapstartsrv resource for the ABAP replicated enqueue service

As `qe3adm`:

- call `stopsap r3 ERS10 bono-3`
- kill the `sapstartsrv` process for the instance `ERS10`

```
# clrs create -d -g rep-rg -t sapstartsrv \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=10 \
-p instance_name=ERS10 \
-p HOST=bono-3 \
-p timeout_return=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
abaprep-strt-rs
```

Create the ABAP replicated enqueue service resource

```
# /usr/cluster/bin/clrs create -d -g rep-rg -t saprepenq \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=10 \
-p instance_name=ERS10 \
-p HOST=bono-3 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
-p resource_dependencies=abapscs-rs,abaprep-strt-rs \
abaprep-rs
# clrg online -eM +
```

Create the sapstartsrv resource for the JAVA replicated enqueue service

As `qe3adm`:

- call `stopsap r3 ERS11 bono-3`
- kill the `sapstartsrv` process for the instance `ERS11`

```
# clrs create -d -g rep-rg -t sapstartsrv \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=11 \
-p instance_name=ERS11 \
-p HOST=bono-3 \
-p timeout_return=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
javarep-strt-rs
```

Create the JAVA replicated enqueue resource

```
# /usr/cluster/bin/clrs create -d -g rep-rg -t saprepenq \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=11 \
-p instance_name=ERS11 \
-p HOST=bono-3 \
-p debug_level=0 \
```

```
-p resource_dependencies_offline_restart=hsp-rs \
-p resource_dependencies=javascs-rs,javarep-strt-rs \
javarep-rs
# clrg online -eM +
```

Create the replicated pre-empter

```
# /usr/cluster/bin/clrs create -d -g scs-rg -t saprepenq_preempt \
-p sid=QE3 \
-p sap_user=qe3adm \
-p repenqres=abaprep-rs \
-p enq_instnr=00,01 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs,abapscs-rs,javascs-rs \
-p resource_dependencies=db-rs \
preempt-rs
```

Create the sapstartsrv resource for the primary application server resource

As `qe3adm`:

- call `stopsap r3 DVEBMGS02 bono-4`
- kill the `sapstartsrv` process for the instance `DVEBMGS02`

```
# /usr/cluster/bin/clrs create -d -g pas-rg -t sapstartsrv \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=02 \
-p instance_name=DVEBMGS02 \
-p HOST=bono-4 \
-p timeout_return=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
pas-strt-rs
```

Create the primary application server resource

```
# /usr/cluster/bin/clrs create -d -g pas-rg -t sapdia \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number=02 \
-p instance_name=DVEBMGS02 \
-p HOST=bono-4 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
-p resource_dependencies=db-rs,abapscs-rs,javascs-rs,pas-strt-rs \
pas-rs
# clrg online -eM +
```

Create the sapstartsrv resource for the additional application server

On the first node, as `qe3adm`:

- call `stopsap r3 D03`
- kill the `sapstartsrv` process for the instance `D03`

On the second node, as `qe3adm`:

- call `stopsap r3 D04`
- kill the `sapstartsrv` process for the instance `D04`

```
# /usr/cluster/bin/clrs create -d -g dia-rg -t sapstartsrv \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number{pbono1}=03 \
-p instance_number{pbono2}=04 \
-p instance_name{pbono1}=D03 \
-p instance_name{pbono2}=D04 \
-p timeout_return=20 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
dia-strt-rs
```

Create the additional application server resource

```
# /usr/cluster/bin/clrs create -d -g dia-rg -t sapdia \
-p sid=QE3 \
-p sap_user=qe3adm \
-p instance_number{pbono1}=03 \
-p instance_number{pbono2}=04 \
-p instance_name{pbono1}=D03 \
-p instance_name{pbono2}=D04 \
-p HOST{pbono1}=pbono1 \
-p HOST{pbono2}=pbono2 \
-p debug_level=0 \
-p resource_dependencies_offline_restart=hsp-rs \
-p resource_dependencies=db-rs,abapscs-rs,javascs-rs,dia-strt-rs \
dia-rs
# clrg online -eM +
```

How to Integrate Oracle Solaris Cluster Management and SAP Instance Management

Download and install the latest hostagent.

1. Configure every instance profile with the following lines, assuming that `saphascriptco.co` is in the `/usr/sap/hostctrl/exe/saphascriptco` directory.

   ```
   #
   # SAP HA Script Connector
   #
   service/halib = /usr/sap/hostctrl/exe/saphascriptco.so
   service/halib_cluster_connector = /
   /opt/ORCLscsapnetw/saphacmd/bin/sap_orcl_cluster_connector
   service/halib_debug_level = 1
   ```

2. Create the `/usr/local/bin` directory on every node.
3. Create the following symbolic links under the `/usr/local/bin` directory on every node.

   ```
   # ls -la /usr/local/bin
   total 8
   drwxr-xr-x   2 root     root           4 May 29 02:22 .
   drwxr-xr-x   3 root     root           3 May 29 02:13 ..
   ```

```
lrwxrwxrwx   1 root     root          48 May 29 02:22 /
functions_sap_ha -> /opt/ORCLscsapnetw/saphacmd/bin/functions_sap_ha
lrwxrwxrwx   1 root     root          58 May 29 02:14 /
sap_cluster_connector -> /opt/ORCLscsapnetw/saphacmd/bin/sap_orcl_cluster_connector

# cd /usr/local/bin
# ln -s  /opt/ORCLscsapnetw/saphacmd/bin/functions_sap_ha /
./functions_sap_ha
# ln -s /opt/ORCLscsapnetw/saphacmd/bin/sap_orcl_cluster_connector /
sap_orcl_cluster_connector
```

4. Restart the instances and the corresponding `sapstartsrv` process.

Generic test case

For all `sapstartsrv` resources, kill the `sapstartsrv` process. The underlying instance will be restarted as well.

For all instance resources, kill the instance processes. The underlying instance will be restarted or failed over in case of a central service.

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