

Providing High Availability for SAP Resources

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Providing High Availability for SAP Resources

Providing High Availability is an essential component in the world of business continuity

This paper explains how to use Oracle Clusterware to enable high availability for SAP resources

The term 'service' is used to signify the SAP process that provides either Enqueue or Replication

The nodes that host these services are termed the 'Enqueue Server' and the 'Replication Server'

OVERVIEW OF HIGH AVAILABILITY FOR SAP RESOURCES

Oracle Clusterware can provide high availability for SAP resources just as it does for Oracle resources. Oracle has created an Oracle Clusterware tool, SAP Control (SAPCTL), to enable you to easily manage SAP high availability resources.

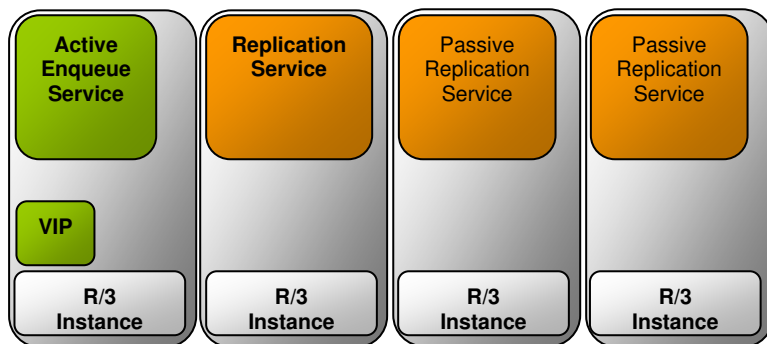
SAPCTL provides an easy-to-use interface to administer the resources, scripts, and dependencies of Oracle Clusterware and SAP high availability components. SAPCTL consolidates the functionality of the Oracle command-line tools by enabling you to easily manage the SAP Enqueue Service, the SAP Replication Service, and the virtual IP address used by the SAP Enqueue Service.

SAP SUPPORT FOR HIGH AVAILABILITY

The SAP Enqueue Service provides distributed lock management for SAP R/3 instances. The SAP Enqueue Service must be available whenever an SAP installation uses more than one SAP R/3 instance.

SAP uses an active/passive approach to enable high availability for the Enqueue Service. There is exactly one Enqueue Service running in the SAP system. The SAP system comprises multiple application instances on different nodes. One or more SAP Replication Services run on the node on which the active Enqueue Service runs in the event of a failure or planned outage.

Each Replication Service maintains a copy of the Enqueue Service's lock table; this copy is kept in a shared memory segment during runtime. The node that supports the Enqueue Service also hosts a virtual IP address (VIP) for communication. Whenever the active node fails or is shut down, the VIP and Enqueue Service fail over to the next node. The available node supports the Replication Service.



SAP Enqueue and Replication Server Nodes

ORACLE CLUSTERWARE

Oracle Clusterware, formerly known as Cluster Ready Services (CRS), is an integrated cluster management solution that enables linking multiple servers so that they function as a single system. While continuing to be required for Oracle RAC databases, Oracle Clusterware can also support non-Oracle applications.

OVERVIEW OF THE SAPCTL IMPLEMENTATION

This solution uses Oracle Clusterware to enable high availability for the SAP Enqueue Service. The implementation uses Oracle Clusterware modeling features so that each managed entity is represented as a resource. This solution uses three resources, one each for the Enqueue Service, Replication Service, and the VIP resource.

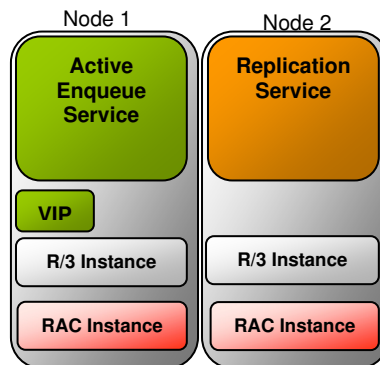
The management policy for the Enqueue Service and VIP are configured so that the two are collocated, while the policy for the Replication Service resource ensures that it is never running on the same node as the Enqueue Service. The failover policy for the Enqueue Service resource guarantees that upon failure, the Enqueue Service is restarted on the node that is currently hosting the Replication Service, if any. The Replication Service will be subsequently relocated to a different node if one is available.

SUPPORTED CONFIGURATIONS

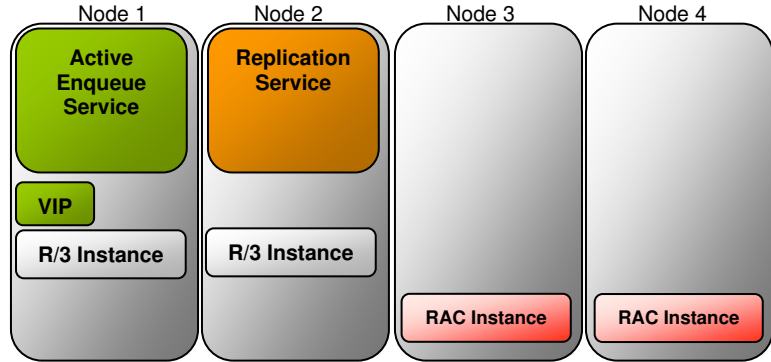
The Enqueue and Replication Services can run on any node that supports SAP R/3 which is limited to the following two configurations:

- All solutions require shared disk for the Oracle Cluster Registry (OCR) and voting disk device.
- All solutions assume that SAP runs in an Oracle RAC environment.

Co-location of Enqueue and Replication Services with the Oracle database. For example, a two-node Linux cluster running Oracle RAC and R/3 in a co-located configuration.



Co-location of Enqueue and Replication Services in the same Oracle RAC environment as the Oracle database. For example, a four-node Linux cluster running Oracle RAC on two nodes and R/3 on two nodes of the same cluster.



INSTALLATION AND MANAGEMENT

You must install the Oracle Database software that you are using with your SAP installation in the default operating system group, OSDBA (dba). In addition, the users <sid>adm, ora<sid> from SAP as well as the Oracle Clusterware owner (oracle) must belong to the dba group. The dba group is also the primary group for the Oracle Clusterware owner (oracle) and ora<sid>. For more information about groups and users for SAP environments, refer to the SAP documentation.

REQUIREMENTS FOR RUNNING SAPCTL

Before running SAPCTL, your environment must meet the following conditions:

- The ORA_CRS_HOME environment variable must be set to point at the Oracle Clusterware installation.
- You must run 'create', 'remove', and 'update' commands as the 'root' user.
- You may run 'start' and 'stop' commands as 'root', 'sapuser', or any user belonging to the 'sapuser's' primary group.
- You may run 'status' and 'config' commands as any user.

These requirements describe the default Oracle permission scheme. You can, however, modify the permission scheme with the `crs_setperm()` command.

OVERVIEW OF INSTALLATION AND CONFIGURATION

The procedures for installing this solution comprise the following tasks:

- Appropriately configuring the SAP application
- Registering the SAP Enqueue and Replication Services with the Oracle Clusterware.

CONFIGURING SAP

The configuration changes that you need to make to enable SAPCTL are not automated. Instead, you must manually configure the changes. The required changes are, however, minimal and affect only two shell scripts, namely `startsap` and `stopsap`. The changes to these two scripts are documented in Appendix 1 of this paper.

A few other minor modifications to your existing configuration, namely the generation of nearly identical profiles with different file names, are also required. This is because Oracle Clusterware does not change the hostname of the cluster node if the VIP fails over to another node. In addition, the SAP high availability agent configuration must consider that SAP queries the hostname or uses the cluster node's hostname to identify the profile and parameter file sets to run on the node.

Also note that using an Oracle RAC database requires additional profile changes. The configuration steps for this are documented in the white paper 'Configuring SAP R/3 for use with Oracle RAC'.

STARTSAP/STOPSAP SCRIPTS

Use the SAP `'startsap'` and `'stopsap'` scripts to start and stop SAP R/3 application instances. You must adapt these scripts to interact with Oracle Clusterware and to enable the use of the SAP high availability implementation with a standalone Enqueue Service and Enqueue Replication Service.

The modifications required for interaction with Oracle Clusterware are simple: After a successful start or stop of the SAP application instances with instance type ASCS or ENR, run a command with parameters to notify the Oracle Clusterware framework about the change of state. All other modifications in the `startsap` and `stopsap` scripts enable SAPCTL to distinguish the two instance types, ASCS and ENR, from the other application instance types such as dialog (D), batch (B), gateway (GW), spool (S) and update (V).

ASCS is the default name for the standalone Enqueue Service. This ASCS instance contains the Enqueue Service and the message service, with a small number of dialog work processes. ENR is the instance name for the Enqueue Replication service instance, which is actually the replication process.

Appendix 1 shows a small portion of the `'startsap'` and `'stopsap'` scripts with the modifications denoted in boxes to highlight the required changes. This example is from SAP release 620. You can use this example as a template.

USER PROFILE SID<ADM>

The home directory for the SAP user sid<adm> contains profile scripts for the c-shell and the Bourne or bash shell that are commonly used in UNIX environments. There are four sets of scripts and the script sets have the following purposes:

- For the environment of the SAP application.
- To ensure that the Oracle database uses the required environment settings.
- For the SAP Java virtual machine.
- For SAP APO, an SAP tool that requires a specialized environment setup.

The appropriate script set is called during the execution of .login (csh) or .profile (sh). A common attribute of these scripts is the hostname used as the last portion of the script name. Because Oracle Clusterware can start the SAP Enqueue Service and the SAP Enqueue Replication Service on all of the hosts in the cluster with arbitrary hostnames, you must duplicate these scripts with as many different names as there are hosts in the cluster. You must do this on all hosts that are eligible for running the respective programs.

The important assumption is that according to SAP, the Oracle RAC database's home directory also resides on a shared cluster file system. Note that this is not necessarily the case in all SAP Enqueue Replication high availability deployments.

If the home directory is on a cluster file system, then create links with the different hostnames in the cluster to the various profile scripts. In the following example, SAP software has initially been installed on node1 of a four-node cluster. Node2, node3, and node4 are the other cluster members.

```
# su - sid<adm>
# for TYPENAME in "sapenv sapsrc dbenv dbsrc"
do
    for NODENAME in "node2 node3 node4"
    do
        ln .$TYPENAME_node1.sh .$TYPENAME_${NODENAME}.sh
        ln .$TYPENAME_node1.csh .$TYPENAME_${NODENAME}.csh
    done
done
```

In case of a .j2ee or .apo profile script, create the appropriate links in the same manner if these SAP applications are also controlled by Oracle Clusterware. Further discussion of this topic is outside of the scope of this white paper.

Most likely, the SAP Replicated Enqueue implementation is part of an Oracle RAC configuration that enables an SAP system. Delete the environment variable db_s_ora_tnsname from all of the profiles of the user sid<adm>. Refer also to the change in the startsap script explained in Appendix 1. Setting the environment variable db_s_ora_tnsname overrides all of the subsequent settings for the selection of the database connection. Therefore, load balancing and failover to different database instances would not be possible. For details about configuring SAP with Oracle RAC databases, refer to the white paper 'Configuring SAP R/3 for use with Oracle RAC' on the SAP marketplace website at: <http://service.sap.com/dbaora>.

USER PROFILE ORA<SID>

For administrative purposes, a special Oracle database user is created by SAP. This user is known as ora<sid> in SAP installations. The user ora<sid> is the Oracle software owner for the database belonging to the SAP system. For this user account, the same changes to the profiles as for an SAP user account <sid>adm are required. Refer to the previous section, 'USER PROFILE <SID>ADM' for more information about the required changes.

See Appendix 2 for the changes that are required to these profiles

INSTANCE PROFILE: CENTRAL INSTANCE (ASCS), ENQUEUE AND MESSAGE SERVICE

You must adapt the profiles for use by the standalone enqueue to the actual node in the cluster on which the service runs. The node name is part of the filename. Therefore, you must create a copy of the files with the appropriate name. The directory holding the instance profile and the start commands should reside on a shared cluster file system. The default path is /usr/sap/<SID>/SYS/profile. An example for a standalone Enqueue Service on a two-node cluster is available in Appendix 2.

INSTANCE PROFILE: ENQUEUE REPLICATION INSTANCE (ENR)

See Appendix 3 for the changes that are required to these profiles

The Enqueue Replication instance has an instance and a start profile similar to any other SAP instance. The required modifications to these profiles are the same as those that this paper described for the standalone enqueue instance.

For every node in the cluster, the last part of the file names must match the hostname. In addition, in the instance profile, you must change some of the parameters accordingly as shown in the example in Appendix 3

An example for a standalone Enqueue Replication Instance on a two-node cluster is available in Appendix 3.

INSTANCE PROFILE: APPLICATION SERVER INSTANCES (DV)

The SAP application server instances, either configured as a dialog or dialog and update instances, are also eligible to be under the protection of Oracle Clusterware. The restriction in this case is the fact that these instances must run on the cluster nodes. This is not valid in three-tier configurations. For that, the complete configuration is not covered by this document. In addition, it is currently not part of the SAPCTL implementation because the instance types are not recognized by SAPCTL. Therefore, the remaining application server profiles remain unmodified.

REGISTERING WITH ORACLE CLUSTERWARE

Registration with Oracle Clusterware, as well as the subsequent management of the resources, is done by using SAPCTL. An overview of this utility follows and a 'Worked Example' appears later in this paper.

MANAGEMENT INTERFACE

The management of the Enqueue and Replication Service as well as the VIP resource should be done using SAPCTL. This command line interface can manage any number of the installations on an Oracle Clusterware managed environment.

SAP LEGACY MANAGEMENT INTERFACES

In addition to SAPCTL and the other conventional tools for managing SAP Enqueue and Replication Services, you can also use the startsap and stopsap scripts. However, Oracle recommends that you use only one management interface at the same time. As documented in this paper, these scripts need slight modifications to interact with Oracle Clusterware. Third party software for management of SAP systems will probably require additional configuration changes.

FUNCTIONALITY

A 'worked example' using SAPCTL appears later in this paper

SAPCTL performs the following:

- Updates the Oracle Clusterware configuration of the SAP high availability subsystem.
- Creates and removes the Oracle Clusterware configuration of the SAP high availability subsystem.
- Starts the SAP high availability subsystem that is wrapped with Oracle Clusterware as a whole as well as its individual components.
- Stops the SAP high availability subsystem that is protected by the Oracle Clusterware as a whole as well as its individual components.
- Queries the state (status) of the SAP high availability subsystem as a whole as well as that of the components that comprise it.
- Queries the configuration of the SAP high availability subsystem.

Usage

```
sapctl <command> [<object>] -sapsid <SAP_SID> [options]
    Command: start|stop|status|config|create|remove|update
    Objects: all|enqueue|replication
```

NOTE: Create, remove, and update commands work on all objects only. For detailed help about each command and object and its options, run the following command:

```
sapctl <command> -h
```

<Objects>

all: Includes all of the resources associated with the solution for the specified SAP SID.

enqueue: Refers to the Enqueue Service

replication: Refers to the Replication Service

<Commands>

- start

Starts the resources associated with the object.

- stop

Stops the resources associated with the object.

- status

Displays the current state or status of resources that are associated with the object. This includes the processed output of the resource state as reported by crs_stat

- config

Displays the configuration of the resources associated with the object. This includes the following:

- The location of the Oracle Clusterware Home
- Resource identifier of the SAP Enqueue Service
- Resource identifier of the SAP Replication Service
- The location of the SAP scripts
- The SAP home
- The hosting members
- The public network interface
- Netmask
- The virtual IP address

- create

Creates the Oracle Clusterware resources for the SAP high availability subsystem. This command is only supported for a single object 'all' and must be run as the 'root' user because this operation must create a VIP resource. The following parameter switches are supported:

Parameter	Description
-sapsid	The SID for the SAP instance
-if <adapter name>	The name of the public network adapter
-nm <netmask>	The network mask for the public network interface
-ip <IP Address>	A New IP Address
-u <sapuser>	The SAP User <sid>adm
-n <node1 node2 ... node(n)>	List of nodes in the cluster
-s <path>	The Home directory of the SAP install
-e <EnqInst>	The Enqueue Service identifier
-r <RepInst>	The Replication Service identifier

The VIP resource will be created as being owned by the 'root' user, while other resources are created as being owned by the SAP user. All of the generated Oracle Clusterware action scripts are owned by the SAP user.

- remove

Removes the Oracle Clusterware resources and Oracle Clusterware action scripts for the SAP high availability subsystem. This operand is only supported for a single object 'all' and must be run as the 'root' user because this operation must delete a VIP resource.

- update

Updates the configuration of the SAP high availability subsystem. This operand is only supported for a single object 'all'. The following options are supported:

Parameter	Description
-v <IP Address>	Updates the VIP value for the VIP used by the Enqueue Service.
-a <node1 node2 ... node(n)>	Adds one or more node names as placement candidates for SAPCTL's Oracle Clusterware resources. This option enables you to add nodes to the cluster after the installation.
-d <node1 node2 ... node(n)>	Removes one or more names as placement candidates for SAPCTL's Oracle Clusterware resources. This option enables you to remove nodes from the cluster after installation.

CONCLUSION

This paper has shown how to use Oracle Clusterware to enable protection of both the SAP Enqueue Service and the SAP Replication Service.

Oracle Clusterware provides an easy way to protect SAP Services from failure.

More information about Oracle Clusterware can be found at this link:

<http://www.oracle.com/technology/products/database/clustering> on the Oracle Technology Network.

A paper focusing on SAP on Oracle is available here:

http://www.oracle.com/technology/depoy/performance/pdf/oracle_for_sap_nov1405.pdf

And as a reminder - For details about configuring SAP with Oracle RAC databases, refer to the white paper 'Configuring SAP R/3 for use with Oracle RAC' in folder media library on the SAP marketplace website at: <http://service.sap.com/dbaora> .

WORKED EXAMPLE

This worked example assumes that you have completed the following steps.

- Oracle Clusterware is installed.
- Oracle RAC is installed.
- You have installed SAP and the SAPCTL package
- ORA_CRS_HOME environment variable is set to your Oracle Clusterware home.

You need to know the following information about your SAP installation:

Required Information	Description	Typical Example
SAP_SID	The name of the SAP Instance containing the SAP services that require protection	RAC
interface	The name of the public network interface	eth0
netmask	The IP network Netmask	255.255.240.0
IP address	A new IP address that will be bound to the public network interface	212.16.1.233
user	The SAP user <sid>adm	racadm
hosting_members	The list of nodes that are capable of running the SAP services	“sapnode1 sapnode2”
saphome	The Home directory for the SAP User <sid>adm	/saphome/racadm
enqueue_instance	The name of the SAP enqueue service	ASCS01
replication_instance	The name of the SAP replication service	ENR01

The SAPCTL utility

```
[root@oracx2 bin]# sapctl
Production Copyright 2005, 2006, Oracle. All rights reserved
USAGE:
sapctl <command> [<object>] -sapsid <SAP_SID> [options]
      command : start|stop|status|config|create|remove|update
      objects : all|enqueue|replication
NOTE:
create, remove, and update commands work on all objects only
For detailed help on each command and object and its options use:
sapctl <command> -h
```

Enable Oracle Clusterware Protection for your SAP resources

```
[root@oracx2 bin]# sapctl create -sapsid RAC -if eth0 -nm 255.255.255.0
-ip 140.86.242.63 -u racadm
-n "oracx1 oracx2 oracw1 oracw2" -s /saphome/racadm -e ASCS01 -r ENR01
Production Copyright 2005, 2006, Oracle. All rights reserved
Creating SAP VIP
Creating SAP Enqueue resource
Creating SAP Replication resource
Done
```

In this case, the SAP Central Instance of the SAP system **RAC** owned by the SAP user **racadm** is going to be protected, the SAP enqueue service called **ASCS01** and the Replication service called **ENR01** will be allowed to run on separate nodes from the following node list "**oracx1 oracx2 oracw1 oracw2**". A new virtual IP address **140.86.242.63** with a subnet of **255.255.255.0** will be loaded onto the **eth0** network adapter.

Running this command creates three Oracle Clusterware resources: An application VIP, an Enqueue resource and a Replication resource. The script does not automatically start these resources.

To see which SAP Instances have been protected by Oracle Clusterware

```
[root@oracx2 bin]# sapctl config
Production Copyright 2005, 2006, Oracle. All rights reserved
SAP_SIDs protected by the Oracle Clusterware are :
RAC
```

In this case only one SAP Instance called 'RAC' is being protected by Oracle Clusterware.

Modify the Standard SAP scripts

The sample SAP scripts must be modified according to the details in Appendix 1 of this paper

You must now modify the standard SAP scripts to enable them to work with Oracle Clusterware. See 'Appendix 1— Standard SAP Script Modifications'.

You must ensure that you complete this procedure before attempting to start the SAP resources that the Oracle Clusterware protects.

Check the Configuration

```
[root@oracx2 bin]# sapctl config all -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
CRS_HOME=/oracle/CRS/1020_32
Resource ID of SAP Enqueue service = ASCS01
Resource ID of SAP Replication service = ENR01
Location of CRS SAP scripts = /usr/sap/RAC/SYS/exe/run
SAP Home = /usr/sap/RAC
Hosting Members = oracx1 oracx2 oracw1 oracw2
Interface = eth0
Netmask = 255.255.255.0
IP Address = 140.86.242.63
```

You can check the configuration values for a protected SAP instance using the `config` parameter.

Check the Status of the Oracle Clusterware Protected SAP resources

```
[root@oracx2 bin]# sapctl status all -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
SAP Enqueue service is OFFLINE
SAP VIP is OFFLINE
SAP Replication service is OFFLINE
```

To check the status of the Oracle Clusterware resources that protect the SAP services use the `status` command.

Start the Oracle Clusterware Protected SAP resources

```
[root@oracx2 bin]# sapctl start all -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
Starting SAP Enqueue service
Starting SAP VIP
Starting SAP Replication service
SAP Enqueue service is ONLINE on oracx1
SAP VIP is ONLINE on oracx1
SAP Replication service is ONLINE on oracx2
Done
```

Notice that you can use this command to start either the enqueue or replication services. However you should start the enqueue service first.

Check the Status after the start

```
[root@oracx2 bin]# sapctl status all -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
SAP Enqueue service is ONLINE on oracx1
SAP VIP is ONLINE on oracx1
SAP Replication service is ONLINE on oracx2
```

The resource may take a short while to start. Therefore, some resources may indicate that they are OFFLINE while they are being started.

Stop the Enqueue Service (and associated VIP)

```
[root@oracx2 bin]# sapctl stop enqueue -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
Stopping SAP Enqueue service
Stopping SAP VIP
SAP Enqueue service is OFFLINE
SAP VIP is OFFLINE
Done
```

You can use the stop command to stop the Enqueue service. This will also stop the associated VIP.

Start the Enqueue Service (and associated VIP)

```
[root@oracx2 bin]# sapctl start enqueue -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
Starting SAP Enqueue service
Starting SAP VIP
SAP Enqueue service is ONLINE on oracx1
SAP VIP is ONLINE on oracx1
Done
```

You can use the start command to start the Enqueue service. This will also start the associated VIP.

Change the Config

```
[root@oracx2 bin]# sapctl update
Production Copyright 2005, 2006, Oracle. All rights reserved
USAGE:
sapctl update -sapsid <SAP_SID> [-a <add_nodes>] [-d <delete_nodes>] [-ip <IP_Address>]
```

You can use the update command to modify the nodes that the Oracle Clusterware protected SAP services are allowed to run on. You can also use these commands either to add or to delete nodes or to modify the IP address of the Virtual IP resource.

Stop all of the Oracle Clusterware managed SAP resources

```
[root@oracx2 bin]# sapctl stop all -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
Stopping SAP Enqueue service
Stopping SAP VIP
Stopping SAP Replication service
SAP Enqueue service is OFFLINE
SAP VIP is OFFLINE
SAP Replication service is OFFLINE
Done
```

You can choose to not stop all of the Oracle Clusterware resources by replacing all with either 'enqueue' or 'replication' but you should stop the replication service first.

Check the Status after the stop

```
[root@oracx2 bin]# sapctl status all -sapsid RAC
Production Copyright 2005, 2006, Oracle. All rights reserved
SAP Enqueue service is OFFLINE
SAP VIP is OFFLINE
SAP Replication service is OFFLINE
```

After stopping all of the Oracle Clusterware resources, you will see that they are all marked as 'offline'.

Remove Oracle Clusterware protection for SAP resources

```
[root@oracx2 bin]# sapctl remove all -sapsid RAC  
Production Copyright 2005, 2006, Oracle. All rights reserved  
Removing resource SAP Enqueue service  
Removing resource SAP VIP  
Removing resource SAP Replication service  
Done
```

Note you cannot remove clusterware protection for a single resource. You must remove protection for all of the resources within an SAP instance in a single operation. This command must be run as the 'root' user.

APPENDIX 1 – STANDARD SAP SCRIPT MODIFICATIONS

There are two scripts that require changing before the Oracle Clusterware protected resources can start.

Script Name	Location
startsap	/usr/sap/<SID>/SYS/exe/run
stopsap	/usr/sap/<SID>/SYS/exe/run

Copies of the original scripts should be made prior to these changes.

Prior to modifying these scripts copies of original startsap and stopsap scripts should be made. The original scripts should be copied to startsap.orig and stopsap.orig.

Script: startsap

Location: /usr/sap/<SID>/SYS/exe/run directory.

```
#!/bin/sh
#-----
#
# @(#) $Id: //bc/620-1/src/ins/SAPINST/impl/tpls/ind/ind/startsap#22 $
#
# NAME :
#      startsap
#
# ( ----- cut here ---)
#
# .....
set_db_running()
{
    set_sapdbhost;

    if [ "$DB_SID" ]; then

        printf "\nChecking $DB_SID Database\n" | tee -a $LOGFILE
        echo "-----" | tee -a $LOGFILE

        # preserve old values

        # ora
        dbs_ora_tmp=${dbs_ora_tnsname}

```

Remove this :

```
dbs_ora_tnsname=${dbs_ora_tnsname}-${SID} ; export dbs_ora_tnsname
```

Add this :

```
dbs_ora_tnsname=$DB_SID ; export dbs_ora_tnsname
```

```

        # ada
        if test "$DBNAME"; then
            DBNAME_TMP=$DBNAME
        fi

# ( ----- cut here ---)

#-----
#
# FUNCTION: start_instance
#
# PURPOSE: starts the SAP instance
#
start_instance()
{
# ( ----- cut here ---)

# Set START_PROFILE
START_PROFILE=START_${INSTANCE}_${HOSTNAME}

# SET LOGFILE
LOGFILE=$R3S_LOGDIR/`basename ${0}_${INSTANCE}`.log

init_log $0 $*;

printf "\nStarting SAP Instance $INSTANCE\n" | tee -a $LOGFILE
echo "-----" | tee -a $LOGFILE
echo " Startup-Log is written to $LOGFILE"

$$SAPSTART pf=$PROFILE_DIR/$START_PROFILE >> $LOGFILE 2>&1
returncode=$?

```

```

case $returncode in
0) echo " Instance on host $LOCAL_HOST started" | tee -a $LOGFILE
# START IGS
STARTIGS="/usr/sap/$SAPSYSTEMNAME/$INSTANCE/igs/bin/startigs"
STARTIGSCMD="/usr/sap/$SAPSYSTEMNAME/$INSTANCE/igs/bin/startigs -p
/usr/sap/$SAPSYSTEMNAME/$INSTANCE/igs"
if [ -f "$STARTIGS" ]; then
$STARTIGSCMD >> $LOGFILE 2>&1
IGSRETURN=$?
case $IGSRETURN in
0) echo " IGS on host $LOCAL_HOST started" | tee -a $LOGFILE;;
*) echo " Startup of IGS failed" | tee -a $LOGFILE
printf " See $LOGFILE for details\n\n";;
esac
fi

```

Add this :

```

if [ "$SERVICE" = "CS" ]; then
sap2crs start $SAPSYSTEMNAME $SERVICE $INSTANCE
fi
if [ "$SERVICE" = "ER" ]; then
sap2crs start $SAPSYSTEMNAME $SERVICE $INSTANCE
fi;;

```

```

1) echo " Instance already running" | tee -a $LOGFILE;;
*) echo " Startup of Instance failed" | tee -a $LOGFILE
printf " See $LOGFILE for details\n\n"
exit 5;;
esac
}

```

```

( ----- cut here ---)

#####
#####
#####
##### M A I N Procedure
#####
#####
#####
#####
#####

```

```

( ----- cut here ---)

# Acquire instance name from filesystem
set_instance

TASK="ALL"

elif [ $# -eq 2 ];then

```

Remove this :

```

INSTANCE=`echo $2 | awk '/SCS[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print $1}
/DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print $1}
/J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}`

```

Add this :

```

INSTANCE=`echo $2 | awk '/ENR[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print $1}
/DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print $1}
/J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}`

```

Remove this :

```

if [ -z "$INSTANCE" ]; then
ARGGREPSED="YES"

INSTANCE=`echo $1 | awk '/SCS[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print
$1} /DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print
$1} /J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}`

```

Add this :

```

INSTANCE=`echo $1 | awk '/ENR[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print
$1} /DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print
$1} /J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}`

```

```

fi
if [ ! -f /usr/sap/$SAPSYSTEMNAME/SYS/profile/START_${INSTANCE}_${HOSTNAME}
];then
echo "start profile START_${INSTANCE}_${HOSTNAME} not found"
exit 8
fi

( ----- cut here ---)

elif [ $# -eq 1 ];then

```

Remove this :

```
INSTANCE=`echo $1 | awk '/SCS[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print $1}
DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print $1}
/J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}``
```

Add this :

```
INSTANCE=`echo $1 | awk '/ENR[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print $1}
/DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print $1}
/J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}``
```

```
if [ ! -z "$INSTANCE" ]; then
    TASK="ALL"
else
    # Acquire instance name from filesystem
    set_instance

( ----- cut here ---)

# Set SERVICE

if [ ! -z "`echo $SCS_INSTANCE | awk '/SCS[0-9][0-9]/{print $1}`" ];then
    SERVICE="CS_ONLY"
elif [ ! -z "`echo $ASCS_INSTANCE | awk '/ASCS[0-9][0-9]/{print $1}`" ];then
    SERVICE="CS_ONLY"
fi

if [ ! -z "`echo $INSTANCE | awk '/SCS[0-9][0-9]/{print $1}`" ];then
    SERVICE="CS"
elif [ ! -z "`echo $INSTANCE | awk '/ASCS[0-9][0-9]/{print $1}`" ];then
    SERVICE="CS"
```

Add this :

```
elif [ ! -z "`echo $INSTANCE | awk '/ENR[0-9][0-9]/{print $1}`" ];then
    SERVICE="ER"
elif [ ! -z "`echo $INSTANCE | awk '/DVEBMGS[0-9][0-9]/{print $1}`" ];then
    SERVICE="CI"
elif [ ! -z "`echo $INSTANCE | awk '/JC[0-9][0-9]/{print $1}`" ];then
    SERVICE="JCI"
elif [ ! -z "`echo $INSTANCE | awk '/D[0-9][0-9]/{print $1}`" ];then
    SERVICE="DI"
elif [ ! -z "`echo $INSTANCE | awk '/J[0-9][0-9]/{print $1}`" ];then
    SERVICE="JDI"
elif [ ! -z "`echo $INSTANCE | awk '/G[0-9][0-9]/{print $1}`" ];then
    SERVICE="GW"
fi
if [ "$TRACE" ]; then
    echo "SERVICE=$SERVICE"
fi

if [ -z "$SERVICE" ]; then
    echo "Unknown instance type!"
    exit 8
fi
```



```

echo " Too many arguments..."
echo " Usage: `basename $0` [db|r3|j2ee|all|check] [<instance>]"
echo "       Specify instance if you have installed multiple"
echo "       instances of the same system on one host."
echo "       Example: `basename $0` r3 DVEBMGS00"
exit 2

elif [ $# -eq 1 ];then

    INSTANCE=`echo $1 | awk '/SCS[0-9][0-9]/{print $1} /ASCS[0-9][0-9]/{print $1}
/DVEBMGS[0-9][0-9]/{print $1} /JC[0-9][0-9]/{print $1} /D[0-9][0-9]/{print $1}
/J[0-9][0-9]/{print $1} /G[0-9][0-9]/{print $1}`

    ( ----- cut here ---)

    # Set SERVICE

    if [ ! -z "`echo $SCS_INSTANCE | awk '/SCS[0-9][0-9]/{print $1}`" ];then
        SERVICE="CS_ONLY"
    elif [ ! -z "`echo $ASCS_INSTANCE | awk '/ASCS[0-9][0-9]/{print $1}`" ];then
        SERVICE="CS_ONLY"
    fi

    if [ ! -z "`echo $INSTANCE | awk '/SCS[0-9][0-9]/{print $1}`" ];then
        SERVICE="CS"
    elif [ ! -z "`echo $INSTANCE | awk '/ASCS[0-9][0-9]/{print $1}`" ];then
        SERVICE="CS"
    elif [ ! -z "`echo $INSTANCE | awk '/ENR[0-9][0-9]/{print $1}`" ];then
        SERVICE="ER"
    elif [ ! -z "`echo $INSTANCE | awk '/DVEBMGS[0-9][0-9]/{print $1}`" ];then
        SERVICE="CI"
    elif [ ! -z "`echo $INSTANCE | awk '/JC[0-9][0-9]/{print $1}`" ];then
        SERVICE="JCI"
    elif [ ! -z "`echo $INSTANCE | awk '/D[0-9][0-9]/{print $1}`" ];then
        SERVICE="DI"
    elif [ ! -z "`echo $INSTANCE | awk '/J[0-9][0-9]/{print $1}`" ];then
        SERVICE="JDI"
    elif [ ! -z "`echo $INSTANCE | awk '/G[0-9][0-9]/{print $1}`" ];then
        SERVICE="GW"
    fi
    if [ "$TRACE" ]; then
        echo "SERVICE=$SERVICE"
    fi

    if [ -z $SERVICE ]; then
        echo "Unknown instance type!"
        exit 8
    fi

```

Add this :

APPENDIX 2 – SAMPLE PROFILE SCRIPTS - ENQUEUE SERVICE (ASC)

The following is an example of the profile scripts for a standalone Enqueue Service on a two-node cluster. The hostnames of the cluster nodes are oracx1 and oracx2 in this example.

Script Name	Location
RAC_ASCS01_oracx1	/usr/sap/RAC/SYS/profile
RAC_ASCS01_oracx2	/usr/sap/RAC/SYS/profile
START_ASCS01_oracx1	/usr/sap/RAC/SYS/profile
START_ASCS01_oracx2	/usr/sap/RAC/SYS/profile

Script: RAC_ASCS01_oracx1

Location: /usr/sap/RAC/SYS/profile directory.

```
SAPLOCALHOST=oracx1
SAPLOCALHOSTFULL=oracx1.de.oracle.com
INSTANCE_NAME=ASCS01
SAPSYSTEM=02
SAPSYSTEMNAME=RAC
rdisp/myname=oracx1_RAC_01
rdisp/mshost=ora_sap_vip
enque/table_size=4096
enque/process_location=LOCAL
enque/server/internal_replication=true
enque/server/replication=true
enque/enrep/keepalive_count=0
#for performance tuning
enque/server/threadcount=1
# these are needed to prevent the pools from being created
ipc/shm_psize_16=0
ipc/shm_psize_24=0
ipc/shm_psize_34=0
ipc/shm_psize_66=0
```

Script: RAC_ASCS01_oracx2

Location: /usr/sap/RAC/SYS/profile directory.

```
SAPLOCALHOST=oracx2
SAPLOCALHOSTFULL=oracx2.de.oracle.com
INSTANCE_NAME=ASCS01
SAPSYSTEM=02
SAPSYSTEMNAME=RAC
rdisp/myname=oracx2_RAC_01
rdisp/mshost=ora_sap_vip
enque/table_size=4096
enque/process_location=LOCAL
enque/server/internal_replication=true
enque/server/replication=true
enque/enrep/keepalive_count=0
#for performance tuning
enque/server/threadcount=1
# these are needed to prevent the pools from being created
ipc/shm_psize_16=0
ipc/shm_psize_24=0
ipc/shm_psize_34=0
ipc/shm_psize_66=0
```

Script: START_ASCS01_oracx1

Location: /usr/sap/RAC/SYS/profile directory.

```
# *****
# *
#.*          Start profile START_ASCS01_oracx1
#.*
# *****
#-----
SAPSYSTEM          =00
SAPSYSTEMNAME      =RAC
INSTANCE_NAME      =ASCS01

#-----
# start SCSA administration
#-----

Execute_00 =local $(DIR_EXECUTABLE)/sapmscsa -n
pf=$(DIR_PROFILE)/RAC_ASCS01_oracx1
```

```

#-----
# start syslog send daemon
#-----
_SE                =se.sapRAC_ASCS01_oracx1
Execute_01         =local ln -s -f $(DIR_EXECUTABLE)/rslgsend $_SE
Start_Program_01  =local $_SE -F pf=$(DIR_PROFILE)/RAC_ASCS01_oracx1

#-----
# start syslog collector daemon
#-----
_CO                =co.sapRAC_ASCS01_oracx1
Execute_02         =local ln -s -f $(DIR_EXECUTABLE)/rslgcoll $_CO
Start_Program_02  =local $_CO -F pf=$(DIR_PROFILE)/RAC_ASCS01_oracx1

#-----
# start message server
#-----
_MS                =ms.sapRAC_ASCS01_oracx1
Execute_03         =local ln -s -f $(DIR_EXECUTABLE)/msg_server $_MS
Start_Program_03  =local $_MS pf=$(DIR_PROFILE)/RAC_ASCS01_oracx1

#-----
# start enqueue server
#-----
_EN                =en.sapRAC_ASCS01_oracx1
Execute_04         =local ln -s -f $(DIR_EXECUTABLE)/enserver $_EN
Start_Program_04  =local $_EN pf=$(DIR_PROFILE)/RAC_ASCS01_oracx1

#-----

```

Script: START_ASCS01_oracx2

Location: /usr/sap/RAC/SYS/profile directory.

```

# .*****
# .*
# .*          Start profile START_ASCS01_oracx2
# .*
# .*****
#-----
SAPSYSTEM          =00
SAPSYSTEMNAME      =RAC
INSTANCE_NAME      =ASC01

#-----
# start SCSA administration
#-----
Execute_00 =local $(DIR_EXECUTABLE)/sapmscsa -n
pf=$(DIR_PROFILE)/RAC_ASCS01_oracx2

#-----
# start syslog send daemon
#-----
_SE                =se.sapRAC_ASCS01_oracx2
Execute_01         =local ln -s -f $(DIR_EXECUTABLE)/rslgsend $_SE
Start_Program_01  =local $_SE -F pf=$(DIR_PROFILE)/RAC_ASCS01_oracx2

#-----
# start syslog collector daemon
#-----
_CO                =co.sapRAC_ASCS01_oracx2
Execute_02         =local ln -s -f $(DIR_EXECUTABLE)/rslgcoll $_CO
Start_Program_02  =local $_CO -F pf=$(DIR_PROFILE)/RAC_ASCS01_oracx2

#-----
# start message server
#-----
_MS                =ms.sapRAC_ASCS01_oracx2
Execute_03         =local ln -s -f $(DIR_EXECUTABLE)/msg_server $_MS
Start_Program_03  =local $_MS pf=$(DIR_PROFILE)/RAC_ASCS01_oracx2

#-----
# start enqueue server
#-----
_EN                =en.sapRAC_ASCS01_oracx2
Execute_04         =local ln -s -f $(DIR_EXECUTABLE)/enserver $_EN
Start_Program_04  =local $_EN pf=$(DIR_PROFILE)/RAC_ASCS01_oracx2

#-----

```

APPENDIX 3 – SAMPLE PROFILE SCRIPTS - REPLICATION SERVICE (ENR)

The following is an example of the profile scripts for a standalone Replication Service on a two-node cluster. The hostnames of the cluster nodes are oracx1 and oracx2 in this example.

Script Name	Location
RAC_ENR01_oracx1	/usr/sap/RAC/SYS/profile
RAC_ENR01_oracx2	/usr/sap/RAC/SYS/profile
START_ENR01_oracx1	/usr/sap/RAC/SYS/profile
START_ENR01_oracx2	/usr/sap/RAC/SYS/profile

Script: RAC_ENR01_oracx1

Location: /usr/sap/RAC/SYS/profile directory.

```
SAPLOCALHOST=oracx1
SAPLOCALHOSTFULL=oracx1.de.oracle.com
INSTANCE_NAME=ENR01
SAPSYSTEM=02
SAPSYSTEMNAME=RAC
rdisp/myname=oracx1_ENR_01
rdisp/mshost=ora_sap_vip
enque/table_size=4096
enque/process_location=LOCAL
enque/server/internal_replication=true
enque/server/replication=true
enque/enrep/keepalive_count=0
#for performance tuning
enque/server/threadcount=1
# these are needed to prevent the pools from being created
ipc/shm_psize_16=0
ipc/shm_psize_24=0
ipc/shm_psize_34=0
ipc/shm_psize_66=0
```

Script: RAC_ENR01_oracx2

Location: /usr/sap/RAC/SYS/profile directory.

```
SAPLOCALHOST=oracx2
SAPLOCALHOSTFULL=oracx2.de.oracle.com
INSTANCE_NAME=ENR01
SAPSYSTEM=02
SAPSYSTEMNAME=RAC
rdisp/myname=oracx2_ENR_01
rdisp/mshost=ora_sap_vip
enque/table_size=4096
enque/process_location=LOCAL
enque/server/internal_replication=true
enque/server/replication=true
enque/enrep/keepalive_count=0
#for performance tuning
enque/server/threadcount=1
# these are needed to prevent the pools from being created
ipc/shm_psize_16=0
ipc/shm_psize_24=0
ipc/shm_psize_34=0
ipc/shm_psize_66=0
```

Script: START_ENR01_oracx1

Location: /usr/sap/RAC/SYS/profile directory.

```
#####
#.*
#.*          Startprofil START_ENR01_oracx1
#.*
#.*          #####
#-----
SAPSYSTEMNAME      =RAC
INSTANCE_NAME      =ENR01

#-----
# start enqueue replication server
#-----

_ENR                =enr.sapRAC_ENR01_oracx1
Execute_01          =local ln -s -f $(DIR_EXECUTABLE)/enrepsvrer $_ENR
Start_Program_01    =local $_ENR pf=$(DIR_PROFILE)/RAC_ENR01_oracx1

#-----
```

Script: START_ENR01_oracx2

Location: /usr/sap/RAC/SYS/profile directory.

```
#####
#.*
#.*          Startprofil START_ENR01_oracx2
#.*
#.*          #####
#-----
SAPSYSTEMNAME      =RAC
INSTANCE_NAME      =ENR01

#-----
# start enqueue replication server
#-----

_ENR                =enr.sapRAC_ENR01_oracx2
Execute_01          =local ln -s -f $(DIR_EXECUTABLE)/enrepsvrer $_ENR
Start_Program_01    =local $_ENR pf=$(DIR_PROFILE)/RAC_ENR01_oracx2

#-----
```

APPENDIX 4 – TROUBLESHOOTING AND LOG FILES

The troubleshooting content in this section assumes that you are familiar with the Oracle Clusterware and SAP R/3 commands. You can troubleshoot SAPCTL by examining the log files as described in this section.

The following is the log of the actions that SAPCTL performs. You should also check to see which commands were executed:

```
/usr/sap/${SAP_SID}/sapctl.log
```

If you cannot resolve your problem, then examine the following log file to determine why resource actions do not perform as expected:

```
/usr/sap/${SAP_SID}/crs.log
```

You can also examine the following file to troubleshoot issues with VIP resources:

```
${ORA_CRS_HOME}/log/<hostname>/racg/sap.${SAP_SID}.vip.log
```

In addition to the vip.log file, you can also examine the content of the CRSD log file:

```
${ORA_CRS_HOME}/log/<hostname>/crsd/crsd.log
```

APPENDIX 5 - SAPCTL BILL OF MATERIALS

This section describes the SAPCTL bill of materials (BOM). The un-compressed tar file contains the following items:

- `./bin/sapctl` – This is a shell script that runs `bin/sapctl.pl`; it is included for convenience.
- `./bin/sapctl.pl` – This is a Perl-based SAPCTL management utility implementation.
- `./doc/sapctl.doc` – This is a copy of this document.
- `./templates/crssapactions.pl.sbs` – This is a template for the action perl script used internally by SAPCTL.
- `./templates/sap2crs.sbs` – This is a template for the 'SAP to crs' proxy script used internally by SAPCTL.
- `./templates/sapwrap.sbs` – This is a template for the action script wrapper used internally by SAPCTL.



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Authors: David Austin, Mark Bauer, Andrey Gusev, Kurt Broeg, and Rajiv Jayaraman

Contributing Authors: Philip Newlan

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:

Phone: +1.650.506.7000

Fax: +1.650.506.7200

oracle.com

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