# SAP S/4HANA and SAP NetWeaver Multi-SID Cluster Guide

SUSE Linux Enterprise Server for SAP Applications 12 and 15

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SUSE® Linux Enterprise Server for SAP Applications is optimized in various ways for SAP* applications. This document explains how to implement multiple SAP NetWeaver and S/4HANA systems in a High Availability Cluster solution. It is based on SUSE Linux Enterprise Server for SAP Applications 12 and 15. The concept can also be used with newer service packs of SUSE Linux Enterprise Server for SAP Applications.

# Contents

# 1 About This Guide

## 1.1 Introduction

SUSE® Linux Enterprise Server for SAP Applications is the optimal platform to run SAP* applications in a high availability environment. Together with a redundant layout of the technical infrastructure, single points of failure can be eliminated.

SAP* Business Suite is a sophisticated application platform for large enterprises and mid-size companies. Many critical business environments require the highest possible SAP* application availability.

The described cluster solution can be used for SAP* SAP S/4HANA ABAP Platform.

SAP S/4HANA ABAP Platform is a common stack of middleware functionality used to support SAP business applications. The SAP Enqueue Replication Server 2 constitutes application level redundancy for one of the most crucial components of the SAP S/4HANA ABAP Platform stack, the enqueue service. An optimal effect of the enqueue replication mechanism can be achieved when combining the application level redundancy with a high availability cluster solution, as provided for example by SUSE Linux Enterprise Server for SAP Applications. During several years of productive operations, these components mentioned above have proven their maturity for customers of different sizes and industries.

## 1.2 Additional Documentation and Resources

Several chapters in this document contain links to additional documentation resources that are either available on the system or on the Internet.

For the latest product documentation updates, see https://documentation.suse.com/.

More guides and best practices documents referring to SUSE Linux Enterprise Server and SAP can be found and downloaded at the SUSE Best Practices Web page:

https://documentation.suse.com/sbp/sap

Here you get access to guides for SAP HANA system replication automation and High Availability (HA) scenarios for SAP NetWeaver and SAP S/4HANA.

Additional resources, such as customer references, brochures or flyer, can be found at the SUSE Linux Enterprise Server for SAP Applications resource library:

https://www.suse.com/products/sles-for-sap/#resources .

## 1.3 Feedback

Several feedback channels are available:

**Bugs and Enhancement Requests**

For services and support options available for your product, refer to http://www.suse.com/support/.

To report bugs for a product component, go to https://scc.suse.com/support/ requests, log in, and select *Submit New SR* (Service Request).

**Mail**

For feedback on the documentation of this product, you can send a mail to doc-team@suse.com (mailto:doc-team@suse.com). Make sure to include the document title, the product version and the publication date of the documentation. To report errors or suggest enhancements, provide a concise description of the problem and refer to the respective section number and page (or URL).

# 2 Scope of This Document

The document at hand explains how to integrate the central services with multi-SID setups in one cluster. Other architectures such as the SAP HANA performance optimized scenario will follow.

## 2.1 Architecture Central Services

### 2.1.1 Integration of SAP S/4HANA and SAP NetWeaver into the Cluster Using the Cluster Connector

The integration of the HA cluster through the SAP control framework using the **sap_suse_cluster_connector** is of special interest. The service **sapstartsrv** controls SAP instances since SAP Kernel versions 6.40. One of the classic problems running SAP instances in a highly available environment is the following: If an SAP administrator changes the status (start/stop) of an SAP instance without using the interfaces provided by the cluster software, the cluster framework will detect that as an error status. In consequence, it will bring the SAP instance into the old status by either starting or stopping the SAP instance. This can result in very dangerous situa-

tions, if the cluster changes the status of an SAP instance during some SAP maintenance tasks. The new updated solution enables the central component **sapstartsrv** to report state changes to the cluster software. This avoids dangerous situations as previously described. More details can be found in the blog article "Using sap_vendor_cluster_connector for interaction between cluster framework and sapstartsrv" at https://blogs.sap.com/2014/05/08/using-sapvendorcluster-connector-for-interaction-between-cluster-framework-and-sapstartsrv/comment-page-1/.

## Note

If you update from an SAP S/4HANA ABAP Platform version less than 1809, read SAP Note 2641019 carefully to adapt your cluster.

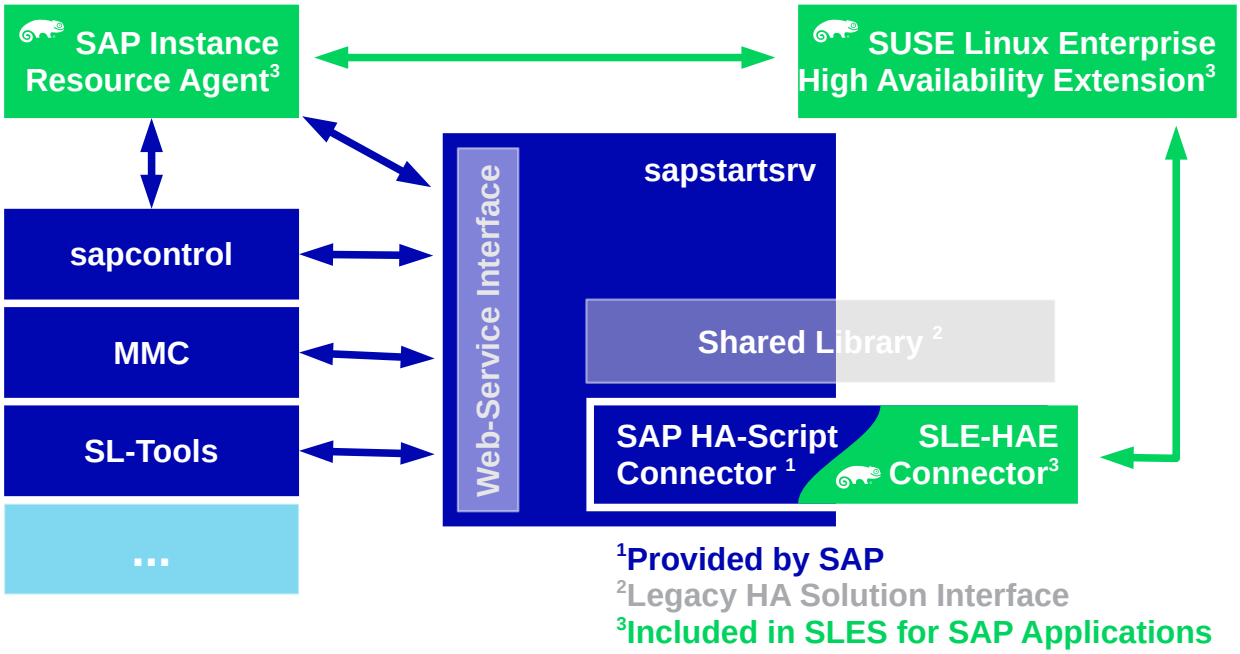


FIGURE 1: CLUSTER CONNECTOR TO INTEGRATE THE CLUSTER WITH THE SAP START FRAMEWORK

## Note

For this scenario, an updated version of the **sap-suse-cluster-connector** is used. It implements the API version 3 for the communication between the cluster framework and the **sapstartsrv** service.

The new version of the **sap-suse-cluster-connector** allows starting, stopping and migrating an SAP instance. The integration between the cluster software and the **sapstartsrv** also implements the option to run checks of the HA setup using either the command line tool **sapcontrol** or the SAP management consoles (SAP MMC or SAP MC). Since version 3.1.0 and later the maintenance mode of cluster resources triggered with SAP *sapcontrol* commands is supported.

## 2.2 Architecture DB Services

SUSE has developed multiple cluster architectures for SAP databases running with high availability. Not all of those architectures are planned for multi-SID configurations. The following sections describe common SAP HANA scenarios. You will also find a note if the architecture is available for multi-SID.

### 2.2.1 Scale-Up Scenarios and Resource Agents

SUSE has implemented the scale-up scenario with the `SAPHana` resource agent (RA), which performs the actual check of the SAP HANA database instances. This RA is configured as a master/slave resource. In the scale-up scenario, the master assumes responsibility for the SAP HANA databases running in primary mode. The slave is responsible for instances that are operated in synchronous (secondary) status.

To make configuring the cluster as simple as possible, SUSE developed the `SAPHanaTopology` resource agent. This RA runs on all nodes of a SUSE Linux Enterprise Server for SAP Applications cluster and gathers information about the statuses and configurations of SAP HANA system replications. It is designed as a normal (stateless) clone.

SAP HANA System replication for Scale-Up is supported in the following scenarios or use cases:

- **Performance optimized** ($A \Rightarrow B$). This scenario and setup **will be described in this document in a future update**.

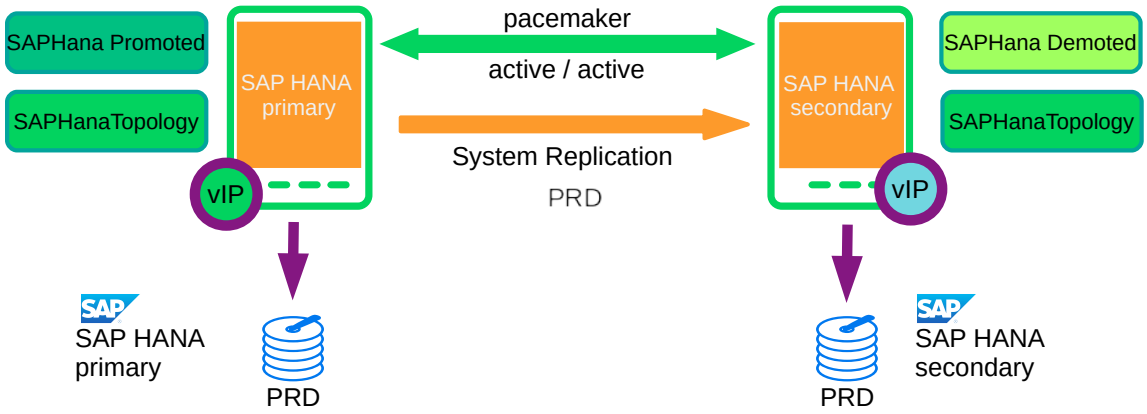


FIGURE 2: SAP HANA SYSTEM REPLICATION SCALE-UP IN THE CLUSTER - PERFORMANCE OPTIMIZED

In the performance optimized scenario an SAP HANA RDBMS site A is synchronizing with an SAP HANA RDBMS site B on a second node. As the HANA RDBMS on the second node is configured to pre-load the tables, the takeover time is typically very short.
One big advantage of the performance optimized scenario of SAP HANA is the possibility to allow read access on the secondary database site. To support this **read enabled** scenario, a second virtual IP address is added to the cluster and bound to the secondary role of the system replication.

### Note

The performance optimized scenario could be implemented also for multi-SID setups, if it is guaranteed that all system replication pairs are handled by the cluster separately. It is not allowed to force an SAP HANA system to process a takeover only because another one is taking over. There is also no load balance for the primary sides.

- **Cost optimized** ($A \Rightarrow B, Q$). This scenario and setup is described in another document available from the documentation Web page (https://documentation.suse.com/sbp/sap/). The document for *cost optimized* is named *"Setting up an SAP HANA SR Cost Optimized Infrastructure"*.

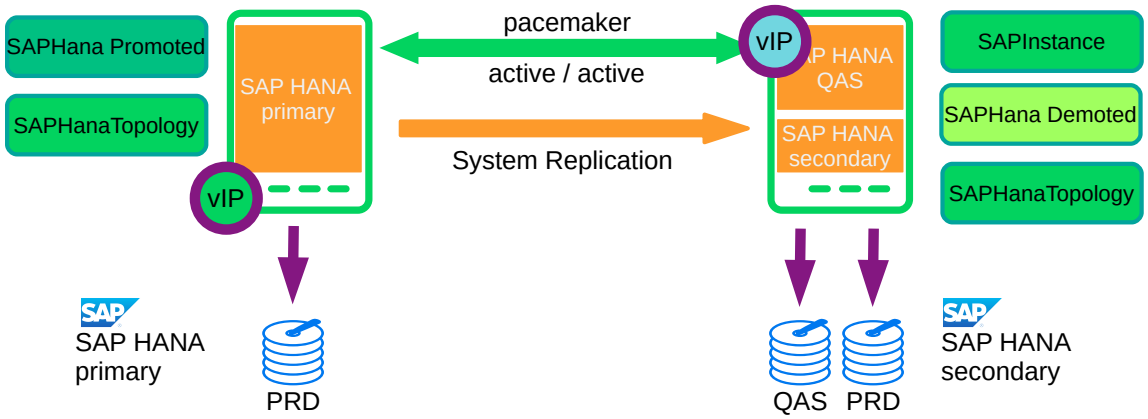


FIGURE 3: SAP HANA SYSTEM REPLICATION SCALE-UP IN THE CLUSTER - COST OPTIMIZED

In the cost optimized scenario the second node is also used for a non-productive SAP HANA RDBMS system (like QAS or TST). Whenever a takeover is needed, the non-productive system must be stopped first. As the productive secondary system on this node must be limited in using system resources, the table preload must be switched off. A possible takeover needs longer than in the performance optimized use case.
In the cost optimized scenario the secondary needs to be running in a reduced memory consumption configuration. This is why *read enabled* must not be used in this scenario.

## Note

**The cost optimized scenario is not intended to be used for multi-SID configuration.** The reason is that, whenever one of the primary systems would be moved to the secondary node, a second memory setup for the primary systems would be needed. Otherwise the removed memory limitation would tell the SAP HANA to consume all available memory. Currently there is no globally defined space where to set such parameters to be used after a takeover.

- **Multi-Tier** ($A \Rightarrow B \rightarrow C$) and **Multi-Target** ($B \Leftarrow A \Rightarrow C$).

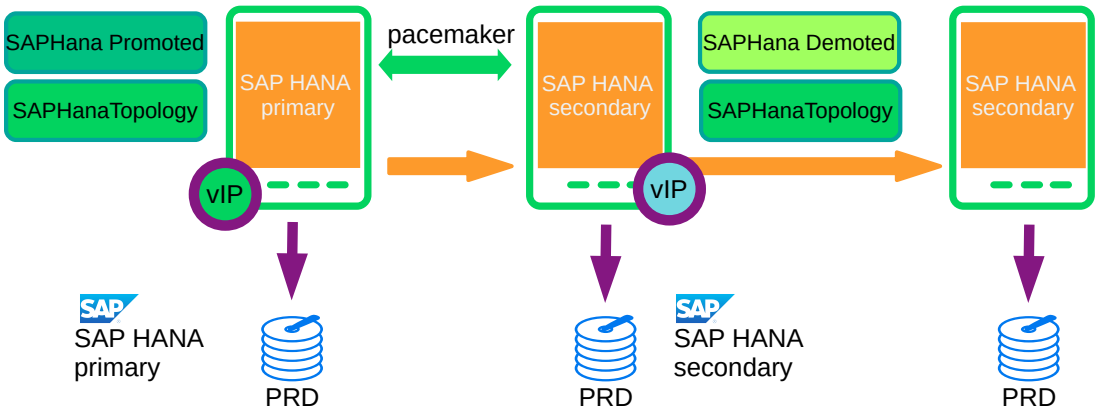


FIGURE 4: SAP HANA SYSTEM REPLICATION SCALE-UP IN THE CLUSTER - PERFORMANCE OPTIMIZED CHAIN

A *Multi-tier* system replication has an additional target. In the past this third side must have been connected to the secondary (chain topology). With current SAP HANA versions also *multiple target topology* is allowed by SAP.

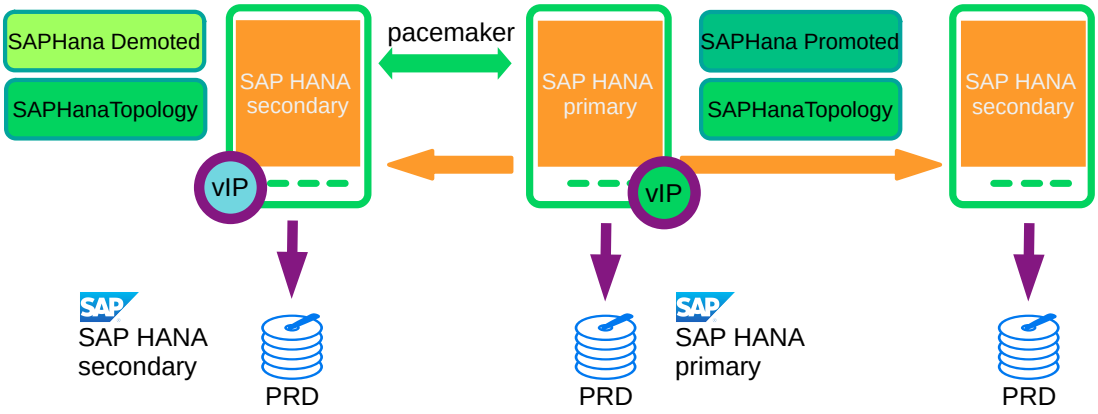


FIGURE 5: SAP HANA SYSTEM REPLICATION SCALE-UP IN THE CLUSTER - PERFORMANCE OPTIMIZED MULTI-TARGET

Multi-tier and multi-target systems are implemented as described in this document. Only the first replication pair (A and B) is handled by the cluster itself. The main difference to the plain performance optimized scenario is that the auto registration must be switched off.

### Note

From a cluster perspective, this type of scenario is very similar to the performance optimized scenario. As long as only A and B are driven by the cluster this scenario is also expected to work with multi-SID setups. However, this has not been tested yet in the labs. Support for this scenario is expected to be added in the future.

- **Multi-tenancy** or MDC.
  Multi-tenancy is supported for all of the above scenarios and use cases. This scenario is supported since SAP HANA SPS09. The setup and configuration from a cluster point of view is the same for multi-tenancy and single container. Thus you can use the above documents for both kinds of scenarios.

### Note

Multi-tenancy has no direct side effect to multi-SID setups. This means that multi-tenancy is supported in combination with multi-SID, if the basic architecture is supported with multi-SID.

# 3 Multi-SID - Central Services

This guide will cover the following scenarios:

- Example ENSA1 in a Two-Node Cluster
- Example ENSA2 in a Two-Node Cluster
- Example ENSA1 in a Multi-Node Cluster
- Example ENSA2 in a Multi-Node Cluster
- Example ENSA1 and ENSA2 in a Two-Node Cluster
- Example ENSA1 and ENSA2 in a Multi-Node Cluster

Configuration examples in this guide are given with cluster-controlled filesystem resources. Nevertheless, also the simple-mount concept based on SAPStartSrv resources (https://documentation.suse.com/sbp/sap/html/SAP-S4HA10-setupguide-simplemount-sle15/) fits well for Multi-SID scenarios.

## 3.1 Two-Node Setup

- The hardware configuration of each node must be able to run all resources in case of a fail over
- Each SAP system (SID) must be independent from each other

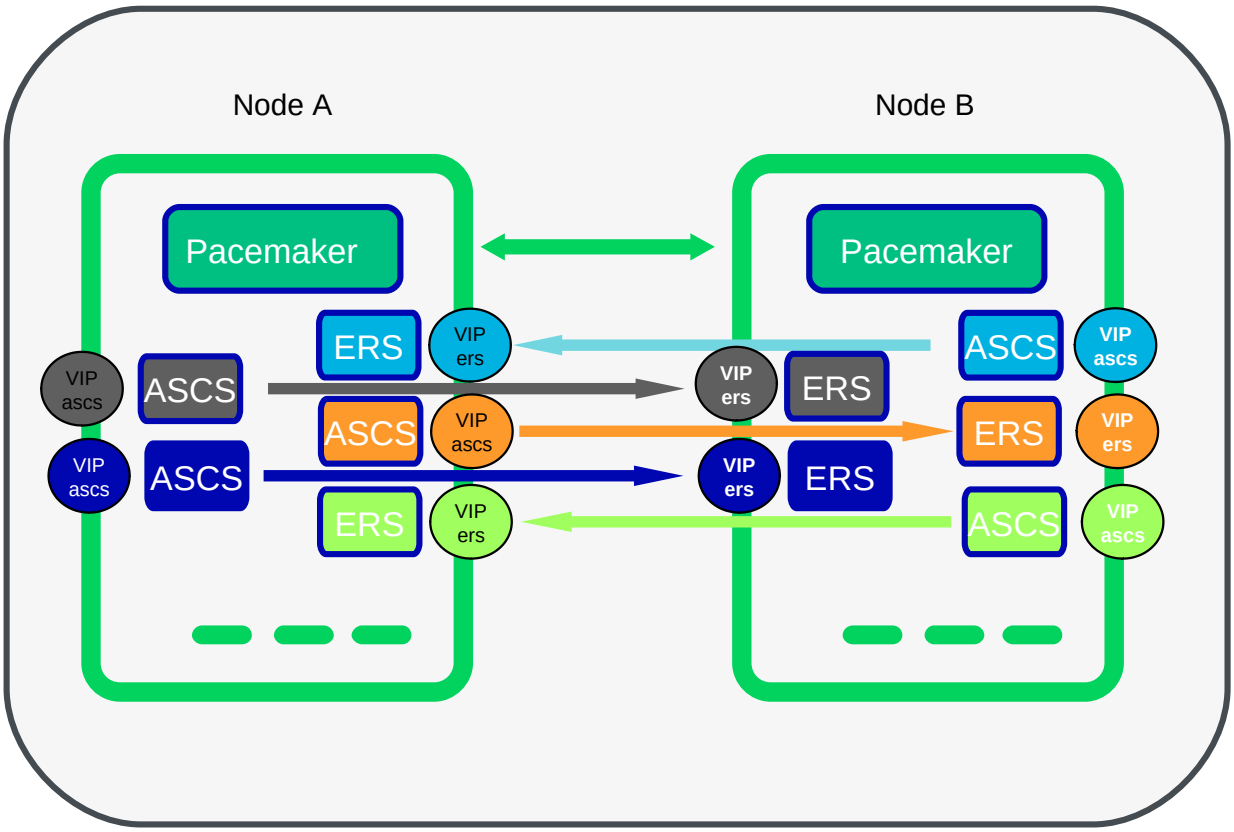


FIGURE 6: MULTIPLE SAP CENTRAL SERVICES INSTANCES RUNNING IN A TWO-NODE CLUSTER

## 3.2 Multi-Node Setup

- The hardware configuration of each node must be able to run additional resources in case of a fail over
- Each SAP system (SID) must be independent from each other
- ENSA2 load balancing (under observation)

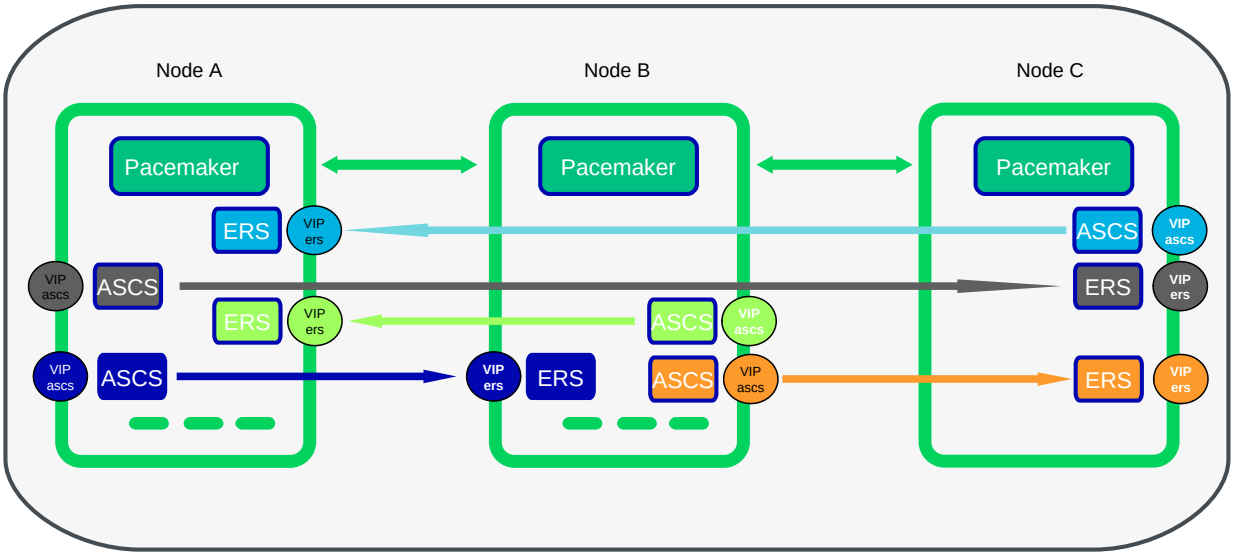


FIGURE 7: MULTIPLE SAP CENTRAL SERVICES INSTANCES RUNNING IN A MULTI-NODE CLUSTER

## 3.3 General Rules and Requirements

### Warning

When adding more resources, be aware of the following risks:

- Higher complexity
- Higher impact if one nodes goes down
- Higher administrative effort in case of maintenance activities, like OS patching

### 3.3.1 Installation

The installation process is described in the **SUSE Best Practices** guides for SAP S/4HANA and SAP NetWeaver. They can be found here: https://documentation.suse.com/sbp/sap

Repeat the steps for preparing the hosts and infrastructure:

- Provide the storage and IP addresses as needed.
- Check the name resolution and time settings on each host.
- Provide the SAP installation sources as you will need.

- Create the directory structure similar to the first SAP instance for all new installations.
- Manually mount the file systems and assign the IP address for the virtual host name.
- Start SAP installation with virtual host name using *swpm*.

The installation process itself is similar to the first setup. The major difference is the ERS installation during the profile selection. At this point you need to choose the right directory to point to the correct ASCS installation.

### 3.3.2 Limitations

We recommend to limit the numbers of SAP systems (SID) running in one cluster. Each new SID will increase the complexity. The tested setup was done with up to **five** SID in one cluster.

## 3.4 Example ENSA1 in a Two-Node Cluster

As known from the setup based on the **SUSE Best Practices** document for SAP NetWeaver (https://documentation.suse.com/sbp/sap → SAP NetWeaver High Availability Cluster 7.40 - Setup Guide), the cluster integration can be done with a configuration file. Create one configuration file for each SID and load them one by one into the cluster. The description below will help to do the steps in the right direction.

The cluster is already up and running and still runs one ASCS / ERS configuration based on the group concept. The following tasks must be executed:

- Stop the new installed SAP system, which will be added to the cluster.
- Unmount the file system with *umount* and remove the IP address from the new SAP system.
- Check and/or modify the ASCS and ERS profile files and add the section for the sap-suse-cluster-connector integration, if not done already.
  - for example for VAS: */sapmnt/VAS/profile/VAS_ASCS20_sapascs2*
  - for example for VAS: */sapmnt/VAS/profile/VAS_ERS30_sapers2*
- Modify the *haclient* group on each cluster node and add the new <sid>adm to it, if not done already.
- Set the cluster into maintenance mode.

- Load the new configuration with *crm configure load update <filename>*.
- Release the cluster from maintenance mode.
- Check the cluster and SAP instances with *crm_mon -1rfn* and *sapcontrol -nr ….*

EXAMPLE 1: CONFIGURATION FILE AND ADAPTING CLUSTER

*As user* **root** prepare a file for the SAP system VAS

```
# cat ensa1-2nd-vas.txt

primitive rsc_fs_VAS_ASCS20 Filesystem \
 params device="172.17.0.1:/srv/install/sapascs2" directory="/usr/sap/VAS/ASCS20"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_fs_VAS_ERS30 Filesystem \
 params device="172.17.0.1:/srv/install/sapers2" directory="/usr/sap/VAS/ERS30"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_ip_VAS_ASCS20 IPaddr2 \
 params ip=172.17.1.17 \
 op monitor interval=10s timeout=20s
primitive rsc_ip_VAS_ERS30 IPaddr2 \
 params ip=172.17.1.18 \
 op monitor interval=10s timeout=20s
primitive rsc_sap_VAS_ASCS20 SAPInstance \
 operations $id=rsc_sap_VAS_ASCS20-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=VAS_ASCS20_sapascs2 START_PROFILE="/sapmnt/VAS/profile/
VAS_ASCS20_sapascs2" AUTOMATIC_RECOVER=false \
 meta resource-stickiness=5000 failure-timeout=60 \
        migration-threshold=1 priority=10
primitive rsc_sap_VAS_ERS30 SAPInstance \
 operations $id=rsc_sap_VAS_ERS30-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=VAS_ERS30_sapers2 START_PROFILE="/sapmnt/VAS/profile/
VAS_ERS30_sapers2" AUTOMATIC_RECOVER=false IS_ERS=true \
 meta priority=1000
group grp_VAS_ASCS20 rsc_ip_VAS_ASCS20 rsc_fs_VAS_ASCS20 rsc_sap_VAS_ASCS20 \
 meta resource-stickiness=3000
group grp_VAS_ERS30 rsc_ip_VAS_ERS30 rsc_fs_VAS_ERS30 rsc_sap_VAS_ERS30
colocation col_sap_VAS_no_both -5000: grp_VAS_ERS30 grp_VAS_ASCS20
location loc_sap_VAS_failover_to_ers rsc_sap_VAS_ASCS20 \
```

```
         rule 2000: runs_ers_VAS eq 1
order ord_sap_VAS_first_start_ascs Optional: rsc_sap_VAS_ASCS20:start
 rsc_sap_VAS_ERS30:stop symmetrical=false
```

EXAMPLE 2: CONFIGURATION EXAMPLE FOR A 3RD SID, FOR EXAMPLE WAS

*As user* **root** prepare a file for the SAP system WAS

```
# cat ensa1-3nd-was.txt

primitive rsc_fs_WAS_ASCS31 Filesystem \
 params device="172.17.0.1:/srv/install/sapascs3" directory="/usr/sap/WAS/ASCS31"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_fs_WAS_ERS41 Filesystem \
 params device="172.17.0.1:/srv/install/sapers3" directory="/usr/sap/WAS/ERS41"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_ip_WAS_ASCS31 IPaddr2 \
 params ip=172.17.1.27 \
 op monitor interval=10s timeout=20s
primitive rsc_ip_WAS_ERS41 IPaddr2 \
 params ip=172.17.1.28 \
 op monitor interval=10s timeout=20s
primitive rsc_sap_WAS_ASCS31 SAPInstance \
 operations $id=rsc_sap_WAS_ASCS31-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=WAS_ASCS31_sapascs3 START_PROFILE="/sapmnt/WAS/profile/
WAS_ASCS31_sapascs3" AUTOMATIC_RECOVER=false \
 meta resource-stickiness=5000 failure-timeout=60 \
        migration-threshold=1 priority=10
primitive rsc_sap_WAS_ERS41 SAPInstance \
 operations $id=rsc_sap_WAS_ERS41-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=WAS_ERS41_sapers3 START_PROFILE="/sapmnt/WAS/profile/
WAS_ERS41_sapers3" AUTOMATIC_RECOVER=false IS_ERS=true \
 meta priority=1000
group grp_WAS_ASCS31 rsc_ip_WAS_ASCS31 rsc_fs_WAS_ASCS31 rsc_sap_WAS_ASCS31 \
 meta resource-stickiness=3000
group grp_WAS_ERS41 rsc_ip_WAS_ERS41 rsc_fs_WAS_ERS41 rsc_sap_WAS_ERS41
colocation col_sap_WAS_no_both -5000: grp_WAS_ERS41 grp_WAS_ASCS31
location loc_sap_WAS_failover_to_ers rsc_sap_WAS_ASCS31 \
         rule 2000: runs_ers_WAS eq 1
```

```
order ord_sap_WAS_first_start_ascs Optional: rsc_sap_WAS_ASCS31:start
 rsc_sap_WAS_ERS41:stop symmetrical=false
```

EXAMPLE 3: CONFIGURATION EXAMPLE FOR A 4TH SID AND FOLLOWING, FOR EXAMPLE XAS

This is similar to the SID examples before. You must adapt the:

- File system sources which will be mounted
- IP address for virtual host name of ASCS and ERS
- Instance number for ASCS and ERS
- Local mount point for ASCS and ERS
- Profile path for ASCS and ERS

After the configuration has been prepared in a file, this can be loaded into the cluster.

EXAMPLE 4: ADD THE 2ND AND FURTHER SID INTO THE CLUSTER

The cluster is already up and running and still runs one ASCS / ERS configuration based on the group concept. The following procedure is recommended:

- Stop the new installed SAP system, which will be added into the cluster.
- Unmount the file system with *umount* and remove the IP address from the new SAP system.
- Check and/or modify the ASCS and ERS profile files and add the section for the sap-suse-cluster-connector integration, if not done already.
  - for example for VAS: */sapmnt/VAS/profile/VAS_ASCS20_sapascs2*
  - for example for VAS: */sapmnt/VAS/profile/VAS_ERS30_sapers2*
- Modify the *haclient* group on each cluster node and add the new <sid>adm to it, if not done already.
- Set the cluster into maintenance mode.
- Load the new configuration with *crm configure load update <filename>*.
- Pre-check the cluster with *crm status*.
- Release the cluster from maintenance mode.
- Check the cluster and SAP instances with *crm_mon* and *sapcontrol -nr ...*.

Log in to one of the cluster nodes and run the commands from there.

*As user* **root**, set the cluster to maintenance and load the configuration into the cluster with *crm configure load update <filename>*.

```
# crm configure property maintenance-mode=true
# crm configure load update ensa1-2nd-vas.txt
# crm configure load update ensa1-3nd-was.txt
# crm configure load update ensa1-4nd-xas.txt
...
# crm status
```

You should get back the prompt only. No further messages should be shown. If a message is displayed, there might be something wrong in the configuration file.

### Note

If a wrong path is used, for example for the profile, this will not be detected during the configuration load. However, it will be shown during the cluster start action.

*As user* **root** verify the new inactive loaded configuration

```
# crm status
freki:~ # crm status
Stack: corosync
Current DC: freki (version 1.1.18+20180430.b12c320f5-3.3.1-b12c320f5) - partition
 with quorum
Last updated: Tue Oct 15 16:57:07 2019
Last change: Tue Oct 15 16:56:56 2019 by hacluster via crmd on freki

2 nodes configured
31 resources configured

*** Resource management is DISABLED ***
The cluster will not attempt to start, stop or recover services

Online: [ freki geri ]

Full list of resources:

Resource Group: grp_YAS_ASCS00
 rsc_ip_YAS_ASCS00 (ocf::heartbeat:IPaddr2): Started freki
 rsc_fs_YAS_ASCS00 (ocf::heartbeat:Filesystem): Started freki
 rsc_sap_YAS_ASCS00 (ocf::heartbeat:SAPInstance): Started freki
Resource Group: grp_YAS_ERS10
 rsc_ip_YAS_ERS10 (ocf::heartbeat:IPaddr2): Started geri
 rsc_fs_YAS_ERS10 (ocf::heartbeat:Filesystem): Started geri
```

```
 rsc_sap_YAS_ERS10 (ocf::heartbeat:SAPInstance): Started geri
 rsc_ip_hawk (ocf::heartbeat:IPaddr2): Started freki
Resource Group: grp_XAS_ASCS42
 rsc_ip_XAS_ASCS42 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_XAS_ASCS42 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_XAS_ASCS42 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_XAS_ERS52
 rsc_ip_XAS_ERS52 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_XAS_ERS52 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_XAS_ERS52 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_WAS_ASCS31
 rsc_ip_WAS_ASCS31 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_WAS_ASCS31 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_WAS_ASCS31 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_WAS_ERS41
 rsc_ip_WAS_ERS41 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_WAS_ERS41 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_WAS_ERS41 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_ZAS_ASCS53
 rsc_ip_ZAS_ASCS53 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_ZAS_ASCS53 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_ZAS_ASCS53 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_ZAS_ERS63
 rsc_ip_ZAS_ERS63 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_ZAS_ERS63 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_ZAS_ERS63 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_VAS_ASCS20
 rsc_ip_VAS_ASCS20 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_VAS_ASCS20 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_VAS_ASCS20 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
Resource Group: grp_VAS_ERS30
 rsc_ip_VAS_ERS30 (ocf::heartbeat:IPaddr2): Stopped (unmanaged)
 rsc_fs_VAS_ERS30 (ocf::heartbeat:Filesystem): Stopped (unmanaged)
 rsc_sap_VAS_ERS30 (ocf::heartbeat:SAPInstance): Stopped (unmanaged)
```

*As user* **root**, release the cluster from maintenance and check that the new cluster resources became active.

```
# crm configure property maintenance-mode=false
# crm_mon -rfn
```

*As user vasadm*, for example on ASCS host, check the SAP system.

```
# su - vasadm
# sapcontrol -nr 20 -function GetSystemInstanceList
# sapcontrol -nr 20 -function GetProcessList -host sapascs2
# sapcontrol -nr 30 -function GetProcessList -host sapers2
```

## Note

Repeat these steps for each SID you have installed.

EXAMPLE 5: EXAMPLE OUTPUT OF FIVE RUNNING SID IN A TWO-NODE CLUSTER

*As user* **root**, use *crm_mon* or *crm status*.

```
# crm_mon -1rfn

Stack: corosync
Current DC: freki (version 1.1.18+20180430.b12c320f5-3.3.1-b12c320f5) - partition
 with quorum
Last updated: Tue Oct 15 16:26:57 2019
Last change: Tue Oct 15 16:25:55 2019 by root via cibadmin on freki

2 nodes configured
31 resources configured

Node freki: online
        rsc_ip_WAS_ASCS31       (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_WAS_ASCS31       (ocf::heartbeat:Filesystem):    Started
        rsc_sap_WAS_ASCS31      (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_VAS_ERS30        (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_VAS_ERS30        (ocf::heartbeat:Filesystem):    Started
        rsc_sap_VAS_ERS30       (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_YAS_ERS10        (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_YAS_ERS10        (ocf::heartbeat:Filesystem):    Started
        rsc_sap_YAS_ERS10       (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_ZAS_ERS63        (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_ZAS_ERS63        (ocf::heartbeat:Filesystem):    Started
        rsc_sap_ZAS_ERS63       (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_XAS_ERS52        (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_XAS_ERS52        (ocf::heartbeat:Filesystem):    Started
        rsc_sap_XAS_ERS52       (ocf::heartbeat:SAPInstance):   Started
Node geri: online
        rsc_ip_WAS_ERS41        (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_WAS_ERS41        (ocf::heartbeat:Filesystem):    Started
        rsc_sap_WAS_ERS41       (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_YAS_ASCS00       (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_YAS_ASCS00       (ocf::heartbeat:Filesystem):    Started
        rsc_sap_YAS_ASCS00      (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_XAS_ASCS42       (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_XAS_ASCS42       (ocf::heartbeat:Filesystem):    Started
        rsc_sap_XAS_ASCS42      (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_VAS_ASCS20       (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_VAS_ASCS20       (ocf::heartbeat:Filesystem):    Started
```

```
        rsc_sap_VAS_ASCS20      (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_ZAS_ASCS53       (ocf::heartbeat:IPaddr2):       Started
        rsc_fs_ZAS_ASCS53       (ocf::heartbeat:Filesystem):    Started
        rsc_sap_ZAS_ASCS53      (ocf::heartbeat:SAPInstance):   Started
        rsc_ip_hawk     (ocf::heartbeat:IPaddr2):       Started

No inactive resources


Migration Summary:
* Node freki:
* Node geri:
```

Each group consists of three resources, *rsc_ip*, *rsc_fs* and *rsc_sap*. The resource *rsc_ip_hawk* is the optional virtual IP for the HAWK Web interface.

## 3.5 Example ENSA2 in a Two-Node Cluster

As known from the setup based on the **SUSE Best Practice** document for SAP S/4HANA (https://documentation.suse.com/sbp/sap → SAP S/4HANA - Enqueue Replication 2 High Availability Cluster - Setup Guide), the cluster integration can be done with a configuration file. Create one configuration file for each SID and load them one by one into the cluster. The following description will help to do the steps in the right direction.

The cluster is already up and running and still runs one ASCS / ERS configuration based on the group concept. The following tasks must be executed:

- Stop the new installed SAP system, which will be added to the cluster.
- Unmount the file system with *umount* and remove the IP address from the new SAP system.
- Check and/or modify the ASCS and ERS profile files and add the section for the sap-suse-cluster-connector integration, if not done already.
  - for example for VAS: */sapmnt/VAS/profile/VAS_ASCS20_sapascs2*
  - for example for VAS: */sapmnt/VAS/profile/VAS_ERS30_sapers2*
- Modify the *haclient* group on each cluster node and add the new <sid>adm to it, if not done already.
- Set the cluster into maintenance mode.
- Load the new configuration with *crm configure load update <filename>*.

- Pre-check the cluster with *crm status*.
- Release the cluster from maintenance mode.
- Check the cluster and SAP instances with *crm_mon* and *sapcontrol -nr …*.

EXAMPLE 6: PREPARE A CONFIGURATION FILE AND EXTEND THE CLUSTER

*As user* **root** prepare a file for the SAP system VAS

```
#  cat ensa2-2nd-vas.txt

primitive rsc_fs_VAS_ASCS20 Filesystem \
 params device="172.17.0.1:/srv/install/sapascs2" directory="/usr/sap/VAS/ASCS20"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_fs_VAS_ERS30 Filesystem \
 params device="172.17.0.1:/srv/install/sapers2" directory="/usr/sap/VAS/ERS30"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_ip_VAS_ASCS20 IPaddr2 \
 params ip=172.17.1.17 \
 op monitor interval=10s timeout=20s
primitive rsc_ip_VAS_ERS30 IPaddr2 \
 params ip=172.17.1.18 \
 op monitor interval=10s timeout=20s
primitive rsc_sap_VAS_ASCS20 SAPInstance \
 operations $id=rsc_sap_VAS_ASCS20-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=VAS_ASCS20_sapascs2 START_PROFILE="/sapmnt/VAS/profile/
VAS_ASCS20_sapascs2" AUTOMATIC_RECOVER=false \
 meta resource-stickiness=5000
primitive rsc_sap_VAS_ERS30 SAPInstance \
 operations $id=rsc_sap_VAS_ERS30-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=VAS_ERS30_sapers2 START_PROFILE="/sapmnt/VAS/profile/
VAS_ERS30_sapers2" AUTOMATIC_RECOVER=false IS_ERS=true
group grp_VAS_ASCS20 rsc_ip_VAS_ASCS20 rsc_fs_VAS_ASCS20 rsc_sap_VAS_ASCS20 \
 meta resource-stickiness=3000
group grp_VAS_ERS30 rsc_ip_VAS_ERS30 rsc_fs_VAS_ERS30 rsc_sap_VAS_ERS30
colocation col_sap_VAS_no_both -5000: grp_VAS_ERS30 grp_VAS_ASCS20
order ord_sap_VAS_first_start_ascs Optional: rsc_sap_VAS_ASCS20:start
 rsc_sap_VAS_ERS30:stop symmetrical=false
```

*As user* **root** prepare a file for the SAP system WAS

```
#  cat ensa2-3nd-was.txt

primitive rsc_fs_WAS_ASCS31 Filesystem \
 params device="172.17.0.1:/srv/install/sapascs3" directory="/usr/sap/WAS/ASCS31"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_fs_WAS_ERS41 Filesystem \
 params device="172.17.0.1:/srv/install/sapers3" directory="/usr/sap/WAS/ERS41"
 fstype=nfs options="vers=3" \
 op start timeout=60s interval=0 \
 op stop timeout=60s interval=0 \
 op monitor interval=20s timeout=300s
primitive rsc_ip_WAS_ASCS31 IPaddr2 \
 params ip=172.17.1.27 \
 op monitor interval=10s timeout=20s
primitive rsc_ip_WAS_ERS41 IPaddr2 \
 params ip=172.17.1.28 \
 op monitor interval=10s timeout=20s
primitive rsc_sap_WAS_ASCS31 SAPInstance \
 operations $id=rsc_sap_WAS_ASCS31-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=WAS_ASCS31_sapascs3 START_PROFILE="/sapmnt/WAS/profile/
WAS_ASCS31_sapascs3" AUTOMATIC_RECOVER=false \
 meta resource-stickiness=5000
primitive rsc_sap_WAS_ERS41 SAPInstance \
 operations $id=rsc_sap_WAS_ERS41-operations \
 op monitor interval=11 timeout=60 on-fail=restart \
 params InstanceName=WAS_ERS41_sapers3 START_PROFILE="/sapmnt/WAS/profile/
WAS_ERS41_sapers3" AUTOMATIC_RECOVER=false IS_ERS=true
group grp_WAS_ASCS31 rsc_ip_WAS_ASCS31 rsc_fs_WAS_ASCS31 rsc_sap_WAS_ASCS31 \
 meta resource-stickiness=3000
group grp_WAS_ERS41 rsc_ip_WAS_ERS41 rsc_fs_WAS_ERS41 rsc_sap_WAS_ERS41
colocation col_sap_WAS_no_both -5000: grp_WAS_ERS41 grp_WAS_ASCS31
order ord_sap_WAS_first_start_ascs Optional: rsc_sap_WAS_ASCS31:start
 rsc_sap_WAS_ERS41:stop symmetrical=false
```

EXAMPLE 7: CONFIGURATION EXAMPLE FOR SID XAS AND FOLLOWING

This is similar to the SID examples before. You must adapt the:

- File system sources which will be mounted
- IP address for virtual host name of ASCS and ERS
- Instance number for ASCS and ERS

- Local mount point for ASCS and ERS
- Profile path for ASCS and ERS

EXAMPLE 8: ADD THE 2ND AND FURTHER SID INTO THE CLUSTER

The cluster is already up and running and still run one ASCS / ERS configuration based on the group concept. The following tasks must be executed:

- Stop the new installed SAP system, which will be added to the cluster.
- Unmount the file system with *umount* and remove the IP address from the new SAP system.
- Check and/or modify the ASCS and ERS profile files and add the section for the sap-suse-cluster-connector integration, if not done already.
  - for example for VAS: */sapmnt/VAS/profile/VAS_ASCS20_sapascs2*
  - for example for VAS: */sapmnt/VAS/profile/VAS_ERS30_sapers2*
- Modify the *haclient* group on each cluster node and add the new <sid>adm to it, if not done already.
- Set the cluster into maintenance mode.
- Load the new configuration with *crm configure load update <filename>*.
- Pre-check the cluster with *crm status*.
- Release the cluster from maintenance mode.
- Check the cluster and SAP instances with *crm_mon -1rnf* and *sapcontrol -nr ...*.

Login to one of the cluster nodes and run the commands from there.

*As user* **root** set cluster from maintenance and load the configuration into the cluster

```
# crm configure property maintenance-mode=true
# crm configure load update ensa2-2nd-vas.txt
# crm configure load update ensa2-3nd-was.txt
# crm configure load update ensa2-4nd-xas.txt
...
# crm status
```

You should get back the prompt only. No further messages should be shown. If a message is displayed, there might be something wrong in the configuration file.

### Note

If a wrong path is used, for example for the profile, this will not be detected during the configuration load. However, it will be shown during the cluster start action.

*As user* **root** release cluster from maintenance and check the new cluster resources

```
# crm configure property maintenance-mode=false
# crm_mon -rfn
```

*As user vasadm*, for example on ASCS host, check the SAP system

```
# su - vasadm
# sapcontrol -nr 20 -function GetSystemInstanceList
# sapcontrol -nr 20 -function GetProcessList -host sapascs2
# sapcontrol -nr 30 -function GetProcessList -host sapers2
```

### Note

Repeat the steps for each SID you have installed.

## 3.6 Example ENSA1 in a Multi-Node Cluster

This base setup is already documented in the **SUSE Best Practices** document for SAP NetWeaver (https://documentation.suse.com/sbp/sap → SAP S/4HANA - SAP NetWeaver High Availability Cluster 7.40 - Setup Guide - Best Practice Guide). The OS and node preparation must be done for each future cluster member:

- patch level
- settings for date and time, DNS
- access to the same fencing device (method)

The major difference compared to the two-node setup is: run the ha-cluster-join command multiple time until all nodes are member of the cluster.

The cluster integration can be done with a configuration file. Create one configuration file for each SID and load them one by one into the cluster. The steps are equal to the steps described in *Section 3.4, "Example ENSA1 in a Two-Node Cluster"*.

## 3.7 Example ENSA2 in a Multi-Node Cluster

This base setup is already documented in the **SUSE Best Practices** document for SAP S/4HANA (https://documentation.suse.com/sbp/sap → SAP S/4HANA - Enqueue Replication 2 High Availability Cluster - Best Practice Guide). The OS and node preparation must be done for each future cluster member:

- patch level
- settings for date and time, DNS
- access to the same fencing device (method)

The major difference compared to the two-node setup is: run the *ha-cluster-join* command multiple times until all nodes are member of the cluster.

The cluster integration can be done with a configuration file. Create one configuration file for each SID and load them one by one into the cluster. The steps are equal to the steps described in *Section 3.5, “Example ENSA2 in a Two-Node Cluster”*.

## 3.8 Example ENSA1 and ENSA2 in a Two-Node Cluster

As known from the setup based on the **SUSE Best Practices** document for SAP NetWeaver and SAP S/4HANA (https://documentation.suse.com/sbp/sap → SAP NetWeaver High Availability Cluster 7.40 - Setup Guide) (https://documentation.suse.com/sbp/sap → SAP S/4HANA - Enqueue Replication 2 High Availability Cluster - Setup Guide), the cluster integration can be done with a configuration file. Create one configuration file for each SID and load them one by one into the cluster.

We expect the cluster is already up and running and still runs one ASCS / ERS configuration based on the group concept.

### Note

Follow and combine the chapters "Example ENSA1 in a Two-Node Cluster" and "Example ENSA2 in a Two-Node Cluster". Be careful and keep in mind each SAP system must be independent from each other.

*Section 3.4, “Example ENSA1 in a Two-Node Cluster”*

*Section 3.5, “Example ENSA2 in a Two-Node Cluster”*

## 3.9 Example ENSA1 and ENSA2 in a Multi-Node Cluster

The setup here is similar to the one described in the chapter *Section 3.8, "Example ENSA1 and ENSA2 in a Two-Node Cluster"* but only with more nodes in the cluster.

After the basic cluster part is done, the procedure is the same as for a two-node cluster setup. Check the following chapter for further instructions: *Section 3.8, "Example ENSA1 and ENSA2 in a Two-Node Cluster"*.

## 3.10 Workload Balancing of Central Services

### Note

Under evaluation.

### 3.10.1 Automatic Load Balancing by Pacemaker

There is no additional task necessary.

### 3.10.2 Manual Load Balancing by Pacemaker

### Note

Under evaluation.

## 3.11 Testing the New Configuration of Multiple SID in One Cluster

### Important

A well-defined and overall test of the new configuration is extremely recommended. Read the requirements for each setup carefully. The test procedure will demonstrate if the cluster works as expected. We already have described multiple test scenarios in our base Best Practices documentation for SAP NetWeaver and SAP S/4HANA.

# 4 Multi-SID - Database Services

## Note

This is currently under evaluation. Send an e-mail to saphana@suse.com (mailto:s-aphana@suse.com) if this might be from interest for you.

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