

A comprehensive guide to setup S/4HANA with High Availability in Azure

USING NFS FOR FILE SHARES

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Overview

Deploying high availability for each production system is a requirement. One way to achieve high availability for S4HANA systems in Azure is using an NFS file share. This document helps you to setup your demo environment so you can learn and understand each step and component of such a complex setup. This is a semi automation approach where all the commands are given to you but you execute them so you understand better what is happening, and then can better assist/setup customer's production landscape.

This document does NOT replace any of the documents published on docs.microsoft.com. The intention here is to provide end to end setup in one single document with screen shots and error resolution, if any.

Terminology

Let's get familiar with the terms and terminologies referred in this document.

- ASCS cluster – SUSE pacemaker cluster for ASCS and ERS instances
- HANA database cluster – SUSE pacemaker cluster for the HANA database in the HSR configuration
- PAS – SAP Primary Application Server
- AAS – SAP Additional Application Server
- HSR – HANA System Replication
- S4H – SAP S4HANA
- Pacemaker – cluster from SUSE
- STONITH – Fencing mechanism (Shoot-The-Other-Node-In-The-Head)
- SBD – iSCSI based STONITH device
- NFS - Network File System
- drbd – Disk replication technology from linux

In this document, we discuss the high availability of the S4HANA with HANA database using an NFS file system in the SUSE pacemaker cluster in Azure. The setup includes the following components:

- SUSE pacemaker cluster for high availability of the application layer (S4HANA)
- SUSE pacemaker cluster for high availability of the NFS file shares
- iSCSI based SBD device for pacemaker to achieve STONITH feature with high availability
- SUSE pacemaker cluster for the high availability of the HANA database (HSR setup)

We will cover the end to end process including the infrastructure deployment, clustering setup, SAP S4H and HANA installation, application instances installation, and failover test.

This is one of the most complex setup, however by following this document **you can complete the end to end deployment in couple days.** This document provides the templates for easy infra installation, and all the required instructions with the screen shots.

Here is the overall flow for deployment go:

1. Create the infrastructure in Azure
2. Create and configure the cluster
 - a. Setup an iSCSI-based SBD device
 - b. Setup the NFS cluster
 - c. Setup the ASCS cluster
 - d. Setup the HANA database cluster
3. Install the SAP S4H and HANA database
 - a. Download the installation bits
 - b. Install the ASCS instance on the cluster
 - c. Install the ERS instance on the cluster
 - d. Install the HANA database and setup HSR
 - e. Install the PAS instance
 - f. Install the AAS instance(s)
4. Perform the tests

Deployment Standards

In this deployment, the following configuration is used. All the diagrams, commands, and screen shots reflect the same. If you intend to change any of the parameters or name, please adjust the execution accordingly. Please be watchful of the **highlighted** statement while you perform the execution.

Infrastructure resources

These resources need to be deployed in the Azure. We chose region **US West 2** for this deployment. All the compute resources (VMs) have SUSE 12 SP3 for SAP operating system with pay-as-you-go option installed.

Resource	Name	IP address	SKU	Notes
Resource group	demo-s4h-ha	NA	NA	
Virtual Network	vnet	NA	NA	
Availability Set	demo-ascsvset	NA	NA	
Availability Set	demo-hana-avset	NA	NA	
Availability Set	demo-nfs-avset	NA	NA	
Availability Set	demo-iscsi-avset	NA	NA	
VM	iscsivm1	10.12.0.9	Standard D2s v3 (2 vcpus, 8 GB memory)	
VM	lscsivm2	10.12.0.7	Standard D2s v3 (2 vcpus, 8 GB memory)	

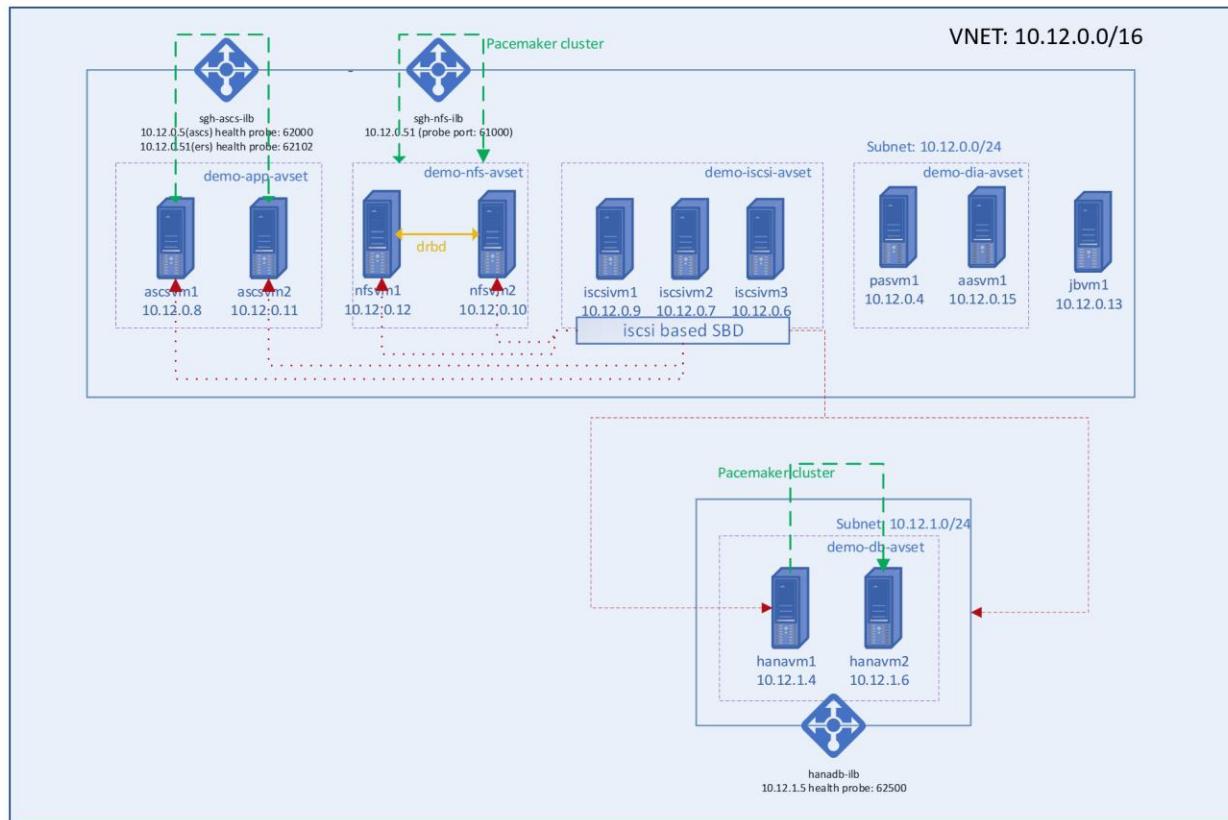
			vcpus, 8 GB memory)	
VM	Iscsivm3	10.12.0.6	Standard D2s v3 (2 vcpus, 8 GB memory)	
VM	nfsvm1	10.12.0.12	Standard DS1 v2 (1 vcpus, 3.5 GB memory)	
VM	nfsvm1	10.12.0.10	Standard DS1 v2 (1 vcpus, 3.5 GB memory)	
VM	ascsvm1	10.12.0.8	Standard DS12 v2 (4 vcpus, 28 GB memory)	
VM	ascsvm2	10.12.0.11	Standard DS12 v2 (4 vcpus, 28 GB memory)	
VM	pasvm1	10.12.0.4	Standard DS15 v2 (20 vcpus, 140 GB memory)	
VM	hanavm1	10.12.1.4	Standard E16s v3 (16 vcpus, 128 GiB memory)	
VM	hanavm2	10.12.1.6	Standard E16s v3 (16 vcpus, 128 GiB memory)	

VM	jbvm1	10.12.0.13	Standard DS1 v2 (1 vcpus, 3.5 GB memory)	
Load Balancer	demo-app-ilb	10.12.0.5 (for ASCS) 10.12.0.50 (for ERS)	Basic	Frontend names: sgh-ascss-ilb and sgh-ers-ilb)
Load Balancer	demo-db-ilb	10.12.1.5	Basic	Frontend name: hanadb-ilb
Load Balancer	demo-nfs-ilb	10.12.0.51	Basic	Frontend name: sgh-nfs-ilb

Software and Instance details

- S4H Version: S4HANA 1809
- ASCS Instance: 00
- ERS Instance: 02
- PAS Instance: 10
- AAS Instance: 11
- S4H SID: SGH
- HANA version: HANA 2 SPS4
- HANA Database Instance: 00
- HANA SID: SGH

Architecture overview



Check list for the deployment

Here is the check list of steps you need to perform. Each item in the list has a link to the detailed steps in this document. **These steps must be performed in the sequence.** Some steps can be done out of sequence or in parallel (like VM creation), but since this is already a very complex step, to avoid any missing action, better you perform them in sequence. You can also print this table and track each step and mark completed when done, this way you know where you are with the deployment.

Step ID	Action	Resource name	Notes	Status
<u>Infrastructure setup</u>				
1	Create a Resource group	Sachin_Demo_S4H	One resource group for all the objects of this setup	
2	Create a VNET and subnets	sachin-demo-vnet		
3	Create Availability set	demo-app-avset demo-hana-avset demo-nfs-avset	Create Four AvSets	

		demo-iscsi-avset		
4. Create VMs				
4.1	Create iSCSC VMs	iscscvm1 iscscvm2 iscscvm3	3 VMs required	
4.2	Create NFS VMs	nfsvm1 nfsvm2	2 VMs required	
4.3	Create ASCS VMs	ascsvm1 ascsvm2	2 VMs required	
4.4	Create HANA DB VMs	hanavm1 hanavm2	2 VMs required	
4.5	Create PAS VM	pasvm1	1 VM required	
4.6	Create a jump box VM	jbvm1	1 VM required	
5. Create Load Balancer				
5.1	Create load balancer for NFS	demo-nfs-ilb		
5.2	Create load balancer for ASCS and ERS	demo-ascsv-ilb	Used for ASCS and ERS both	
5.3	Create load balancer for HANA DB	demo-hana-ilb		
iSCSC and SBD setup				
6	Setup iSCSI			
6.1	Setup iSCSI target	iscscvm1 iscscvm2 iscscvm3	This is to enable iSCSC VMs for targetcli service	
6.2	Create iSCSI device (SBD)	iscscvm1 iscscvm2 iscscvm3		
6.3	Setup(connect) the SBD device(s) to the cluster nodes	nfsvm1 nfsvm2 ascsvm1 ascsvm2 hanavm1 hanavm2	Perform it for NFS, ASCS, and HANADB cluster nodes	
Cluster Setup and Configuration				
7	Configure the pacemaker cluster	nfsvm1 nfsvm2 ascsvm1 ascsvm2 hanavm1 hanavm2	Perform it for NFS, ASCS, and HANADB cluster nodes	
8	Setup NFS server	nfsvm1 nfsvm2		
9	Configure the cluster for DRBD	nfsvm1 nfsvm2		
10	HANA database cluster configuration	hanavm1 hanavm2		

10.1	<u>Hana Installation</u>	hanavm1 hanavm2		
10.2	<u>HSR configuration</u>	hanavm1 hanavm2		
10.3	<u>Add HANA topology and resources to the HANA DB cluster</u>	hanavm1 hanavm2		
11	<u>Prepare ASCS cluster for SAP S4H installation</u>	ascsvm1 ascsvm2		
S4H Installation				
12	<u>ASCS Instance Installation</u>	Run from ascsvm1		
13	<u>ESR Instance Installation</u>	Run from ascsvm2		
14	<u>Post installation activities for ASCS/ERS instances</u>	ascsvm1 ascsvm2		
15	<u>Database Instance Installation</u>	Run from ascsvm1 but it creates the schema, tables etc. on hanavm1		
16	<u>Primary Application Instance Installation</u>	pasvm1		
17	<u>Additional Application Instance Installation</u>	aasvm1		
<u>18 Test cases</u>				
<u>19 Important commands</u>				
<u>20 Appendix</u>				

Infrastructure setup

This section describes the infrastructure required in the Azure for the high availability end to end setup for ASCS, NFS, SBD, and HANA DB.

In this document, we are using the Azure ARM templates. Each infrastructure deployment section (further below in this document), illustrate that what these ARM templates does and what to expect after their execution. Run the respective ARM template “template.json” using the procedure below. You find the folder for each scenario under which the ARM template resides.

Please update the subscription (variable EnterYourSubscription) and resource-group (variable EnterYourResourceGroup) value before executing those templates. Ensure to do it on ARM templates and parameters.json file as well.

- | | |
|---|---|
|  01 Create-DataDisks |  deploy |
|  02 Create-NSGs |  deploy |
|  03 Create-PublicIPs |  deployer.rb |
|  04 Create-LoadBalancers |  DeploymentHelper.cs |
|  05 Create-NWInterfaces |  parameters.json |
|  06 Create-VMs | |
|  Create-AvSet | |
|  Create-VNET |  template.json |

1. Create a Resource group

Click Resource groups from the portal > Select Subscription under which you want to create a resource group > Enter Resource group name “Sachin_Demo_S4H” > Select region > Click Review + Create

2. Create a VNET and subnets

Deploy using the **Create-VNET** ARM templates. This deploys the VNET with the following configuration:

- Location: US West2
- Address space: 10.12.0.0/16
- Subnets: application (10.12.0.0/24); and database (12.12.1.0/24)

Custom deployment
Deploy from a custom template

TEMPLATE

Customized template
3 resources

Edit template Edit param... Learn more

BASICS

* Subscription: SachinGhorpadePEAT

* Resource group: Sachin_Demo_S4H
Create new

* Location: (US) West US 2

SETTINGS

Virtual Networks_sachin_demo_vnet_name: sachin-demo-vnet

3. Create Availability set

Deploy using the **Create-AvSet** ARM templates. This deploys the five availability sets with the following configuration:

- Location: US West2
- Fault domain:2
- Update domain:5
- Availability set names: demo-app-avset; demo-db-avset; demo-dia-avset; demo-iscsi-avset; demo-nfs-avset

4. Create VMs

Ensure that you have quota for the following SKUs in the US West2 region. **Please replace subscription and resource group in these ARM templates with your subscription and resource group before you execute the templates.**

Run the ARM templates **in the following order**:

1. Data Disks – This creates the set of disks for the VMs. **(change subs and RG before executing the ARM)**
2. Network security group – This creates the set of NSGs. **(change subs and RG before executing the ARM)**
3. Public IP – This creates the set of public IPs for the VMs. If you want to change the public IP, please update the ARM template and its parameter file. There is no harm in updating the public IPs as it is not used for any configuration in this document. **(change subs and RG before executing the ARM)**
4. Load Balancer **(change subs and RG before executing the ARM)**

```
"virtualNetworks_sachin_demo_vnet_externalid": {  
    "defaultValue": "/subscriptions/64885497-11-4e0d-a46e-1  
    >edd/resourceGroups/Sachin_Demo_S4H/providers/Micros  
    oft.Network/virtualNetworks/sachin-demo-vnet",  
}
```

5. Network Interface **(change subs and RG before executing the ARM)**. These IPs are referenced in the document for cluster configuration. **Please don't change them.** If you change then please ensure to update the config steps accordingly (steps are mentioned in this document)

```
"virtualNetworks_sachin_demo_vnet_externalid": {  
    "defaultValue": "/subscriptions/64885497-11-4e0d-a46e-1  
    >edd/resourceGroups/Sachin_Demo_S4H/providers/Micros  
    oft.Network/virtualNetworks/sachin-demo-vnet",  
}
```

6. Virtual machine. **(change subs and RG before executing the ARM)**
 - a. Update password (parameter: "adminPassword":)
 - b. Update subs
 - c. Update resource group

Note: If the IPs are not created as defined in the table below, please either

- 1. Update the IP address of the VM thru network card**
- 2. Or, update the IP addresses in all the configuration steps accordingly.**

4.1 Create iSCSI VMs

- We already created the load balancer thru the ARM template before.
- Login to the iSCSI servers thru putty using account you used during VM creation in ARM template.
- Run the command `sudo su -` to change user to root.
- Change the root user password with the command `passwd root`.
- Add the following entries to the host file of each node

```
#iscsi nodes  
10.12.0.9      iscsivm1  
10.12.0.7      iscsivm2  
10.12.0.6      iscsivm3  
  
# nfs nodes  
10.12.0.12     nfsvm1  
10.12.0.10     nfsvm2
```

```

#ascs nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2

# application vm
10.12.0.4      pasvm1
10.12.0.15     aasvm1

#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascs-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1

```

4.2 Create NFS VMs

- We already created the load balancer thru the ARM template before.
- Login to the NFS VMs thru putty using account you used during VM creation in ARM template.
- Run the command `sudo su -` to change user to root.
- Change the root user password with the command `passwd root`.
- Add the following entries to the host file of each node

```

#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3

# nfs nodes
10.12.0.12     nfsvm1
10.12.0.10     nfsvm2

#ascs nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2

# application vm
10.12.0.4      pasvm1
10.12.0.15     aasvm1

```

```
#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascs-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1
```

4.3 Create ASCS VMs

We already created the load balancer thru the ARM template before. Perform the following on both the ascs nodes: ascsvm1 and ascsvm2.

- Login to the ASCS VMs thru putty using account you used during VM creation in ARM template.
- Run the command sudo su - to change user to root.
- Change the root user password with the command passwd root.
- Partition the disk: yast> System>Partitioner>Click Yes on warning (if appear)>Hard Disks>select dev/sdc (256GB)>Click Enter>select primary partition>Next>Next>Next>File System: Ext4> Mount point: /usr/sap>Finish>Next>Finish>Quit. You should see the following mount point now.

```
# df -kh
Filesystem  Size  Used Avail Use% Mounted on
devtmpfs    14G   8.0K  14G  1% /dev
tmpfs       21G   0   21G  0% /dev/shm
tmpfs       14G  42M  14G  1% /run
/dev/sda4   29G  1.7G  26G  7% /
/dev/sda3   976M 77M  849M  9% /boot
tmpfs       14G   0   14G  0% /sys/fs/cgroup
/dev/sda2   200M 664K 200M  1% /boot/efi
/dev/sdb1   55G  52M  53G  1% /mnt/resource
tmpfs       2.8G   0  2.8G  0% /run/user/1000
/dev/sdc1   252G  60M  251G  1% /usr/sap
```

- Add the following entries to the host file of each node

```
#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3
```

```

# nfs nodes
10.12.0.12      nfsvm1
10.12.0.10      nfsvm2

#ascs nodes
10.12.0.8       ascsvm1
10.12.0.11      ascsvm2

# application vm
10.12.0.4       pasvm1
10.12.0.15      aasvm1

#hana DB nodes
10.12.1.4       hanavm1
10.12.1.6       hanavm2

#Load balancers
10.12.0.5       sgh-ascs-ilb
10.12.0.50      sgh-ers-ilb
10.12.0.51      sgh-nfs-ilb
10.12.1.5       hanadb-ilb

#jump box
10.12.0.13      jbvm1

```

4.4 Create HANA DB VMs

- We already created the load balancer thru the ARM template before.
- Login to the HANA DB VMs thru putty using account you used during VM creation in ARM template.
- Run the command sudo su - to change user to root.
- Change the root user password with the command passwd root.
- Partition the disk: yast> System>Partitioner>Click Yes on warning (if appear)>Hard Disks>select disks /dev/sdc1 (1.1T) >Click Enter>select primary partition>Next>Next>Next>File System: Ext4> Mount point: /hana/data >Finish>Next>Finish>Quit.
- Repeat partitioning the disk.
 - /dev/sdd1 541G /hana/log
 - /dev/sde1 1.1T /hana/logbackup
 - /dev/sdf1 541G /hana/shared

You should see the following mount point now.

# df -kh			
Filesystem	Size	Used	Avail
devtmpfs	63G	8.0K	63G
			1% /dev

```

tmpfs      95G 61M 95G 1% /dev/shm
tmpfs      63G 43M 63G 1% /run
/dev/sda4   29G 2.3G 25G 9% /
/dev/sda3   976M 102M 824M 11% /boot
tmpfs      63G 0 63G 0% /sys/fs/cgroup
/dev/sda2   200M 140K 200M 1% /boot/efi
/dev/sdb1   252G 60M 239G 1% /mnt/resource
tmpfs      13G 0 13G 0% /run/user/1000
/dev/sdc1   1007G 72M 1006G 1% /hana/data
/dev/sdd1   504G 70M 503G 1% /hana/log
/dev/sde1   1007G 72M 1006G 1% /hana/logbackup
/dev/sdf1   504G 70M 503G 1% /hana/shared

```

- Add the following entries to the host file of each node

```

#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3

# nfs nodes
10.12.0.12     nfsvm1
10.12.0.10     nfsvm2

#ascs nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2

# application vm
10.12.0.4      pasvm1
10.12.0.15     aasvm1

#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascs-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1

```

4.5 Create PAS VM

- We already created the load balancer thru the ARM template before.
- Login to the PAS VM thru putty using account you used during VM creation in ARM template.
- Run the command sudo su - to change user to root.
- Change the root user password with the command passwd root.
- Partition the disk: yast> System>Partitioner>Click Yes on warning (if appear)>Hard Disks>select dev/sdc (256GB)>Click Enter>select primary partition>Next>Next>Next>File System: Ext4> Mount point: /usr/sap>Finish>Next>Finish>Quit. You should see the following mount point now.

```
pasvm1:~ # df -kh
Filesystem  Size Used Avail Use% Mounted on
devtmpfs    14G  8.0K 14G  1% /dev
tmpfs       21G   0 21G  0% /dev/shm
tmpfs       14G 114M 14G  1% /run
/dev/sda4    29G 1.8G 26G  7% /
/dev/sda3   976M 77M 849M  9% /boot
tmpfs       14G   0 14G  0% /sys/fs/cgroup
/dev/sda2   200M 664K 200M  1% /boot/efi
/dev/sdb1    55G 52M 53G  1% /mnt/resource
tmpfs       2.8G   0 2.8G  0% /run/user/0
/dev/sdc1   252G 60M 251G  1% /usr/sap
```

- Add the following entries to the host file of each node

```
#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3

# nfs nodes
10.12.0.12     nfsvm1
10.12.0.10     nfsvm2

#ascsc nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2

# application vm
10.12.0.4      pasvm1
10.12.0.15     aasvm1

#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2
```

```
#Load balancers
10.12.0.5      sgh-ascs-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1
```

4.6 Create a jump box VM

On the **Jumpbox vm jbvm1**, perform the following:

- Disable IE security from server manager to allow IE to download
IE Enhanced Security Configuration **Off**
- Format the disk of 512B capacity (disk2). Let's call it F: drive.
- Download HANA and S4H bits on the jbvm1. Download to F: drive.
- Download and install putty: <https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>
- Download and install winscp : <https://winscp.net/eng/download.php>
- Download and install SAPGUI.
- Add the following entries to the host file of each node

```
#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3

# nfs nodes
10.12.0.12     nfsvm1
10.12.0.10     nfsvm2

#ascs nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2

# application vm
10.12.0.4      pasvm1
10.12.0.15     aasvm1

#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascs-ilb
10.12.0.50     sgh-ers-ilb
```

10.12.0.51	sgh-nfs-ilb
10.12.1.5	hanadb-ilb
#jump box	
10.12.0.13	jbvm1

5. Create Load Balancer

5.1 Create load balancer for NFS

We already created the load balancer thru the ARM template before. Just validate the settings as following.

Name of the load balancer: **demo-nfs-ilb**

Frontend IPs

NAME	IP ADDRESS	RULES COUNT
LoadBalancerFrontEnd	10.12.0.51	2

Backend pool

VIRTUAL MACHINE	VIRTUAL MACHINE STATUS	NETWORK INTERFACE	PRIVATE IP ADDRESS
nfs-backend (2 virtual machines)			
nfsvm1	Stopped (deallocated)	nfsvm1755	10.12.0.7
nfsvm2	Stopped (deallocated)	nfsvm2851	10.12.0.8

Health probe

NAME	PROTOCOL	PORT	USED BY
nfs-asc-healthprobe	TCP	61000	2 rules
nfs-ers-healthprobe	TCP	61001	-

Load balancing rule

NAME	LOAD BALANCING RULE	BACKEND POOL	HEALTH PROBE
fs-lb-2049	fs-lb-2049 (TCP/2049)	nfs-backend	nfs-asc-healthprobe
nfs-lb-udp2049	nfs-lb-udp2049 (UDP/2049)	nfs-backend	nfs-asc-healthprobe

5.2 Create load balancer for ASCS and ERS

We already created the load balancer thru the ARM template before. Just validate the settings as following.

Name of the load balancer: **demo-app-ilb**

Frontend IPs

NAME	IP ADDRESS	RULES COUNT
LoadBalancerFrontEnd	10.12.0.5	8
sgh-ers-ilb	10.12.0.50	4

Backend pool

VIRTUAL MACHINE	VIRTUAL MACHINE STATUS	NETWORK INTERFACE	PRIVATE IP ADDRESS
sgh-ascs-backpool (2 virtual machines)			
ascsvm1	Stopped (deallocated)	ascsvm1882	10.12.0.4
ascsvm2	Stopped (deallocated)	ascsvm2981	10.12.0.6

Health probe

NAME	PROTOCOL	PORT	USED BY
ascscs-62000	TCP	62000	7 rules
ers-62102	TCP	62102	5 rules

Load balancing rule

NAME	LOAD BALANCING RULE	BACKEND POOL	HEALTH PROBE
ers-lb-3202	ers-lb-3202 (TCP/3202)	sgh-ascs-backpool	ers-62102
ers-lb-3302	ers-lb-3302 (TCP/3302)	sgh-ascs-backpool	ers-62102
ers-lb-50213	ers-lb-50213 (TCP/50213)	sgh-ascs-backpool	ers-62102
ers-lb-50214	ers-lb-50214 (TCP/50214)	sgh-ascs-backpool	ers-62102
ers-lb-50216	ers-lb-50216 (TCP/50216)	sgh-ascs-backpool	ers-62102
sgh-lb-3200	sgh-lb-3200 (TCP/3200)	sgh-ascs-backpool	ascscs-62000
sgh-lb-3600	sgh-lb-3600 (TCP/3600)	sgh-ascs-backpool	ascscs-62000
sgh-lb-3900	sgh-lb-3900 (TCP/3900)	sgh-ascs-backpool	ascscs-62000
sgh-lb-50013	sgh-lb-50013 (TCP/50013)	sgh-ascs-backpool	ascscs-62000
sgh-lb-50014	sgh-lb-50014 (TCP/50014)	sgh-ascs-backpool	ascscs-62000
sgh-lb-50016	sgh-lb-50016 (TCP/50016)	sgh-ascs-backpool	ascscs-62000
sgh-lb-8100	sgh-lb-8100 (TCP/8100)	sgh-ascs-backpool	ascscs-62000

5.3 Create load balancer for HANA DB

We already created the load balancer thru the ARM template before. Just validate the settings as following.

Load balancer name: demo-db-ilb

Frontend IP

NAME	IP ADDRESS	RULES COUNT
LoadBalancerFrontEnd	10.12.1.5	5

Backend pools

VIRTUAL MACHINE	VIRTUAL MACHINE STATUS	NETWORK INTERFACE	PRIVATE IP ADDRESS
hana-backpool (2 virtual machines)			
hanavm1	Stopped (deallocated)	hanavm1281	10.12.1.4
hanavm2	Stopped (deallocated)	hanavm2281	10.12.1.6

Health probes

NAME	PROTOCOL	PORT	USED BY
hana-hp	TCP	62500	5 rules

Load balancing rules

NAME	LOAD BALANCING RULE	BACKEND POOL	HEALTH PROBE
hana-lb-30007-tenantdb	hana-lb-30007-tenantdb (TCP/30007)	hana-backpool	hana-hp
hana-lb-30013	hana-lb-30013 (TCP/30013)	hana-backpool	hana-hp
hana-lb-30014	hana-lb-30014 (TCP/30014)	hana-backpool	hana-hp
hana-lb-50013	hana-lb-50013 (TCP/50013)	hana-backpool	hana-hp
hana-lb30003-tenantdb	hana-lb30003-tenantdb (TCP/30003)	hana-backpool	hana-hp

[\[Back to Check list for the deployment\]](#)

6. iSCSI and SBD Setup

We will setup an SBD device which we can use in pacemaker cluster for ASCS, NFS, and HANADB clusters to achieve the STONITH function. We will setup 3 iSCSI servers. These servers will have an iSCSI-based SBD device.

To do this, you need to perform the following steps

1. Setup iSCSI target i.e. enable these VMs for targetcli service
2. Create iSCSI device (SBD) on these iSCSI servers
3. Setup(connect) the SBD device(s) to the cluster nodes (NFS, ASCS, and HANADB clusters)

6.1 Setup iSCSI target

To setup the iSCSI target on the iSCSC VMs, perform the following steps:

1. Connect to all the 3 iSCSI servers using putty. You must have already created 3 iSCSI servers with following config
 - 1.1. OS: SUSE12SP3 for SAP
 - 1.2. Disk: Premium OS disk – this is what we will use as SBD device
 - 1.3. All three iSCSI servers are in the availability set demo-app-avset
 - 1.4. All three iSCSI servers are using application-subnet
2. Pre-requisite
 - 2.1. Do the packages update to get the latest packages installed on the iSCSI VMs. Perform it **on all the three iSCSI servers** iscsivm1, iscsivm2, and iscsivm3.

```
#zypper update
```

- 2.2. Remove the packages `lio-utils` `python-rtslib` `python-configshell` `targetcli` to avoid known errors with SLES12Sp3 and `targetcli`. Perform it **on all the three iSCSI servers** iscsivm1, iscsivm2, and iscsivm3.

```
#zypper remove lio-utils python-rtslib python-configshell targetcli
Loading repository data...
Reading installed packages...
Package 'python-configshell' not found.
Package 'python-rtslib' not found.
'targetcli' not found in package names. Trying capabilities.
No provider of 'targetcli' found.
Resolving package dependencies...

The following 2 packages are going to be REMOVED:
  lio-utils yast2-iscsi-lio-server

2 packages to remove.
After the operation, 471.8 KiB will be freed.
Continue? [y/n/...? shows all options] (y): y
(1/2) Removing yast2-iscsi-lio-server-3.2.1-1.23.noarch
.....[done]
(2/2) Removing lio-utils-4.1-17.3.2.x86_64
.....[done]
```

- 2.3. Ensure that you have packages `targetcli-fb` `dbus-1-python` installed on each iSCSI server. Perform it **on all the three iSCSI servers** iscsivm1, iscsivm2, and iscsivm3.

```
# zypper install targetcli-fb dbus-1-python
Refreshing service 'SMT-http_smt-azure_susecloud_net'.
```

Loading repository data...
 Reading installed packages...
 Resolving package dependencies...

Problem: installed python-dbus-python-1.2.4-2.5.2.x86_64 obsoletes dbus-1-python < 1.2.4 provided by dbus-1-python-1.2.0-4.194.x86_64

Solution 1: Following actions will be done:

deinstallation of python-dbus-python-1.2.4-2.5.2.x86_64

deinstallation of python-SecretStorage-2.3.1-2.5.1.noarch

downgrade of python-keyring-5.7-8.9.1.noarch to python-keyring-5.7-8.2.1.noarch

Solution 2: do not install dbus-1-python-1.2.0-4.194.x86_64

Choose from above solutions by number or cancel [1/2/c] (c): 1

3. Enable iSCSI target. Perform it on all the three iSCSI servers iscsivm1, iscsivm2, and iscsivm3.

This enables and start the targetcli service on iSCSI VMs

```
# systemctl enable targetcli
```

Created symlink from /etc/systemd/system/remote-fs.target.wants/targetcli.service to /usr/lib/systemd/system/targetcli.service.

```
iscsivm1:/etc/systemd/system # systemctl start targetcli
```

4. Verify targetcli service is started on all the three iSCSI servers. Perform it on all the three iSCSI servers iscsivm1, iscsivm2, and iscsivm3.

```
# systemctl status targetcli
```

- targetcli.service - "Generic Target-Mode Service (fb)"
 Loaded: loaded (/usr/lib/systemd/system/targetcli.service; enabled; vendor preset: disabled)
 Active: active (exited) since Thu 2019-04-25 17:43:13 UTC; 9s ago
 Process: 113117 ExecStart=/usr/bin/targetcli restoreconfig \$CONFIG_FILE (code=exited, status=0/SUCCESS)
 Main PID: 113117 (code=exited, status=0/SUCCESS)

Apr 25 17:43:13 iscsivm1 systemd[1]: Starting "Generic Target-Mode Ser....

Apr 25 17:43:13 iscsivm1 targetcli[113117]: Warning: Could not load pre...

Apr 25 17:43:13 iscsivm1 targetcli[113117]: Restore file /etc/target/sa...

Apr 25 17:43:13 iscsivm1 systemd[1]: Started "Generic Target-Mode Serv....

Hint: Some lines were ellipsized, use -l to show in full.

6.2 Create iSCSI device (SBD) on these iSCSI servers

This is to create iSCSI-based SBD device(disk) on all the three iSCSI servers. These SBDs will be used by the clusters (NFS, ASCS, and HANADB clusters) to achieve STONITH capability.

- Run the following commands to create iSCSI device, add ACLs for the SBD (so cluster nodes can access it). Perform it **on all the three iSCSI servers** iscsivm1, iscsivm2, and iscsivm3.
This creates the SBD for NFS, ACSC and HANADB.

```
# Create the root folder for all SBD devices
sudo mkdir /sbd

# Create the SBD device for the NFS server
sudo targetcli backstores/fileio create sbdnfs /sbd/sbdnfs 50M write_back=false
sudo targetcli iscsi/ create iqn.2006-04.nfs.local:nfs
sudo targetcli iscsi/inqn.2006-04.nfs.local:nfs/tpg1/luns/ create /backstores/fileio/sbdnfs
sudo targetcli iscsi/inqn.2006-04.nfs.local:nfs/tpg1/acls/ create iqn.2006-
04.nfsvm1.local:nfsvm1
sudo targetcli iscsi/inqn.2006-04.nfs.local:nfs/tpg1/acls/ create iqn.2006-
04.nfsvm2.local:nfsvm2

# Create the SBD device for the ASCS server of SAP System SGH
sudo targetcli backstores/fileio create sbdascssgh /sbd/sbdascssgh 50M write_back=false
sudo targetcli iscsi/ create iqn.2006-04.ascssgh.local:ascssgh
sudo targetcli iscsi/inqn.2006-04.ascssgh.local:ascssgh/tpg1/luns/ create
/backstores/fileio/sbdascssgh
sudo targetcli iscsi/inqn.2006-04.ascssgh.local:ascssgh/tpg1/acls/ create iqn.2006-
04.ascsvm1.local:ascsvm1
sudo targetcli iscsi/inqn.2006-04.ascssgh.local:ascssgh/tpg1/acls/ create iqn.2006-
04.ascsvm2.local:ascsvm2

# Create the SBD device for the database cluster of SAP System SGH
sudo targetcli backstores/fileio create sbddbsgh /sbd/sbddbsgh 50M write_back=false
sudo targetcli iscsi/ create iqn.2006-04.dbsgh.local:dbsgh
sudo targetcli iscsi/inqn.2006-04.dbsgh.local:dbsgh/tpg1/luns/ create
/backstores/fileio/sbddbsgh
sudo targetcli iscsi/inqn.2006-04.dbsgh.local:dbsgh/tpg1/acls/ create iqn.2006-
04.hanavm1.local:hanavm1
sudo targetcli iscsi/inqn.2006-04.dbsgh.local:dbsgh/tpg1/acls/ create iqn.2006-
04.hanavm2.local:hanavm2

# save the targetcli changes
sudo targetcli saveconfig
```

- Validate the config

```
sudo targetcli ls

# -- Expected output --
o- / ..... [...]
o- backstores ..... [...]
| o- block ..... [Storage Objects: 0]
| o- fileio ..... [Storage Objects: 3]
| | o- sbdascssgh ..... [/sbd/sbdascssgh (50.0MiB) write-thru activated]
```

```

| | | o-alua ..... [ALUA Groups: 1]
| | | o-default_tg_pt_gp ..... [ALUA state: Active/optimized]
| o-sbddsgh ..... [/sbd/sbddsgh (50.0MiB) write-thru activated]
| | o-alua ..... [ALUA Groups: 1]
| | | o-default_tg_pt_gp ..... [ALUA state: Active/optimized]
| o-sbdnfs ..... [/sbd/sbdnfs (50.0MiB) write-thru activated]
| | o-alua ..... [ALUA Groups: 1]
| | | o-default_tg_pt_gp ..... [ALUA state: Active/optimized]
| o-pscsi ..... [Storage Objects: 0]
| o-ramdisk ..... [Storage Objects: 0]
o-iscsi ..... [Targets: 3]
| o-iqn.2006-04.ascssgh.local:ascssgh ..... [TPGs: 1]
| | o-tpg1 ..... [no-gen-acls, no-auth]
| | o-acls ..... [ACLs: 2]
| | | o-iqn.2006-04.ascsvm1.local:ascsvm1 ..... [Mapped LUNs: 1]
| | | | o-mapped_lun0 ..... [lun0 fileio/sbdascssgh (rw)]
| | | | o-iqn.2006-04.ascsvm2.local:ascsvm2 ..... [Mapped LUNs: 1]
| | | | o-mapped_lun0 ..... [lun0 fileio/sbdascssgh (rw)]
| | o-luns ..... [LUNs: 1]
| | | o-lun0 ..... [fileio/sbdascssgh (/sbd/sbdascssgh) (default_tg_pt_gp)]
| | o-portals ..... [Portals: 1]
| | | o-0.0.0:3260 ..... [OK]
| o-iqn.2006-04.dbsgh.local:dbsgh ..... [TPGs: 1]
| | o-tpg1 ..... [no-gen-acls, no-auth]
| | o-acls ..... [ACLs: 2]
| | | o-iqn.2006-04.hanavm1.local:hanavm1 ..... [Mapped LUNs: 1]
| | | | o-mapped_lun0 ..... [lun0 fileio/sbddsgh (rw)]
| | | | o-iqn.2006-04.hanavm2.local:hanavm2 ..... [Mapped LUNs: 1]
| | | | o-mapped_lun0 ..... [lun0 fileio/sbddsgh (rw)]
| | o-luns ..... [LUNs: 1]
| | | o-lun0 ..... [fileio/sbddsgh (/sbd/sbddsgh) (default_tg_pt_gp)]
| | o-portals ..... [Portals: 1]
| | | o-0.0.0:3260 ..... [OK]
| o-iqn.2006-04.nfs.local:nfs ..... [TPGs: 1]
| | o-tpg1 ..... [no-gen-acls, no-auth]
| | o-acls ..... [ACLs: 2]
| | | o-iqn.2006-04.nfsvm1.local:nfsvm1 ..... [Mapped LUNs: 1]
| | | | o-mapped_lun0 ..... [lun0 fileio/sbdnfs (rw)]
| | | | o-iqn.2006-04.nfsvm2.local:nfsvm2 ..... [Mapped LUNs: 1]
| | | | o-mapped_lun0 ..... [lun0 fileio/sbdnfs (rw)]
| | o-luns ..... [LUNs: 1]
| | | o-lun0 ..... [fileio/sbdnfs (/sbd/sbdnfs) (default_tg_pt_gp)]
| | o-portals ..... [Portals: 1]
| | | o-0.0.0:3260 ..... [OK]
o-loopback ..... [Targets: 0]
o-vhost ..... [Targets: 0]
o-xen-pvscsi ..... [Targets: 0]

```

```
# ls /sbd
sbdacssgh sbddbsgh sbdnfs
```

6.3 Setup(connect) the SBD device(s) to the cluster nodes (NFS, ASCS, and HANADB clusters)

Now, you have created the SBD in iSCSI servers, connect these SBDs to the respective cluster servers.

For example: You will connect sbdnfs to nfs cluster, sbdacssgh to ASCS and sbddbsgh to the HANADB cluster.

1. Enable the SBD on the cluster nodes. Run the following on **both** the cluster nodes of NFS (nfsvm1, and nfsvm2), ASCS (ascsvm1, ascsvm2), and HANA (hanavm1, hanavm2).

```
# systemctl enable iscsid
Created symlink from /etc/systemd/system/multi-user.target.wants/iscsid.service to
/usr/lib/systemd/system/iscsid.service.

# systemctl enable iscsi

# systemctl enable sbd
Created symlink from /etc/systemd/system/corosync.service.requires/sbd.service to
/usr/lib/systemd/system/sbd.service.
Created symlink from /etc/systemd/system/pacemaker.service.requires/sbd.service to
/usr/lib/systemd/system/sbd.service.
Created symlink from /etc/systemd/system/dlm.service.requires/sbd.service to
/usr/lib/systemd/system/sbd.service.
```

2. Update the initiator for to update the initiator name we created.

```
# -- FOR NFS NODES - #
#on nfsvm1 node
Update: vi /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.2006-04.nfsvm1.local:nfsvm1

#on nfsvm2 node
Update: vi /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.2006-04.nfsvm2.local:nfsvm2
```

```
# -- FOR ASCS NODES - #
#on ascsvm1 node
Update: vi /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.2006-04.ascsvm1.local:ascsvm1

#on ascsvm2 node
Update: vi /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.2006-04.ascsvm2.local:ascsvm2
```

```
# -- FOR HANADB NODES - #
#on hanavm1 node
Update: vi /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.2006-04.hanavm1.local:hanavm1

#on hanavm2 node
Update: vi /etc/iscsi/initiatorname.iscsi
InitiatorName=iqn.2006-04.hanavm2.local:hanavm2
```

3. Restart the iSCSI service **on each cluster nodes (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2)** so it can read the newly updated initiator name.

```
#systemctl restart iscsid
#systemctl restart iscsi
```

4. Connect to the SBD devices (of iSCSI nodes) **on each cluster nodes (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2)**.

```
# -- FOR NFS NODES – Run on nfsvm1, nfsvm2 #

#To connect first iSCSI SBD device (iscsivm1)
iscsiadm -m discovery --type=st --portal=10.12.0.9:3260
iscsiadm -m node -T iqn.2006-04.nfs.local:nfs --login --portal=10.12.0.9:3260
iscsiadm -m node -p 10.12.0.9:3260 --op=update --name=node.startup --value=automatic

#To connect second iSCSI SBD device (iscsivm2)
iscsiadm -m discovery --type=st --portal=10.12.0.7:3260
iscsiadm -m node -T iqn.2006-04.nfs.local:nfs --login --portal=10.12.0.7:3260
iscsiadm -m node -p 10.12.0.7:3260 --op=update --name=node.startup --value=automatic

#To connect third iSCSI SBD device (iscsivm3)
iscsiadm -m discovery --type=st --portal=10.12.0.6:3260
iscsiadm -m node -T iqn.2006-04.nfs.local:nfs --login --portal=10.12.0.6:3260
iscsiadm -m node -p 10.12.0.6:3260 --op=update --name=node.startup --value=automatic
```

```
# -- FOR ASCS NODES – Run on ascsvm1, ascsvm2#

#To connect first iSCSI SBD device (iscsivm1)
iscsiadm -m discovery --type=st --portal=10.12.0.9:3260
iscsiadm -m node -T iqn.2006-04.ascssgh.local:ascssgh --login --portal=10.12.0.9:3260
iscsiadm -m node -p 10.12.0.9:3260 --op=update --name=node.startup --value=automatic

#To connect second iSCSI SBD device (iscsivm2)
```

```
iscsiadm -m discovery --type=st --portal=10.12.0.7:3260
iscsiadm -m node -T iqn.2006-04.ascssgh.local:ascssgh --login --portal=10.12.0.7:3260
iscsiadm -m node -p 10.12.0.7:3260 --op=update --name=node.startup --value=automatic
```

#To connect third iSCSI SBD device (iscsivm3)

```
iscsiadm -m discovery --type=st --portal=10.12.0.6:3260
iscsiadm -m node -T iqn.2006-04.ascssgh.local:ascssgh --login --portal=10.12.0.6:3260
iscsiadm -m node -p 10.12.0.6:3260 --op=update --name=node.startup --value=automatic
```

-- FOR HANADB NODES -

#To connect first iSCSI SBD device (iscsivm1)

```
iscsiadm -m discovery --type=st --portal=10.12.0.9:3260
iscsiadm -m node -T iqn.2006-04.dbsgh.local:dbsgh --login --portal=10.12.0.9:3260
iscsiadm -m node -p 10.12.0.9:3260 --op=update --name=node.startup --value=automatic
```

#To connect second iSCSI SBD device (iscsivm2)

```
iscsiadm -m discovery --type=st --portal=10.12.0.7:3260
iscsiadm -m node -T iqn.2006-04.dbsgh.local:dbsgh --login --portal=10.12.0.7:3260
iscsiadm -m node -p 10.12.0.7:3260 --op=update --name=node.startup --value=automatic
```

#To connect third iSCSI SBD device (iscsivm3)

```
iscsiadm -m discovery --type=st --portal=10.12.0.6:3260
iscsiadm -m node -T iqn.2006-04.dbsgh.local:dbsgh --login --portal=10.12.0.6:3260
iscsiadm -m node -p 10.12.0.6:3260 --op=update --name=node.startup --value=automatic
```

- Verify that SBD devices are available on each cluster nodes (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

- OUTPUT FOR NFS NODES -

```
# lsscsi
[1:0:0:0] cd/dvd Msft Virtual CD/ROM 1.0 /dev/sr0
[2:0:0:0] disk Msft Virtual Disk 1.0 /dev/sda
[3:0:1:0] disk Msft Virtual Disk 1.0 /dev/sdb
[5:0:0:0] disk Msft Virtual Disk 1.0 /dev/sdc
[6:0:0:0] disk LIO-ORG sbdnfs 4.0 /dev/sdd
[7:0:0:0] disk LIO-ORG sbdnfs 4.0 /dev/sde
[8:0:0:0] disk LIO-ORG sbdnfs 4.0 /dev/sdf
```

- OUTPUT FOR ASCS NODES -

```
# lsscsi
[1:0:0:0] cd/dvd Msft Virtual CD/ROM 1.0 /dev/sr0
[2:0:0:0] disk Msft Virtual Disk 1.0 /dev/sda
[3:0:1:0] disk Msft Virtual Disk 1.0 /dev/sdb
[5:0:0:0] disk Msft Virtual Disk 1.0 /dev/sdc
```

```
[6:0:0:0] disk LIO-ORG sbdascssgh 4.0 /dev/sdd
[7:0:0:0] disk LIO-ORG sbdascssgh 4.0 /dev/sde
[10:0:0:0] disk LIO-ORG sbdascssgh 4.0 /dev/sdf
```

```
# - OUTPUT FOR HANADB NODES -
# lsscsi
[1:0:0:0] cd/dvd Msft Virtual CD/ROM 1.0 /dev/sr0
[2:0:0:0] disk Msft Virtual Disk 1.0 /dev/sda
[3:0:1:0] disk Msft Virtual Disk 1.0 /dev/sdb
[5:0:0:0] disk Msft Virtual Disk 1.0 /dev/sdc
[5:0:0:1] disk Msft Virtual Disk 1.0 /dev/sdf
[5:0:0:2] disk Msft Virtual Disk 1.0 /dev/sdd
[5:0:0:3] disk Msft Virtual Disk 1.0 /dev/sde
[6:0:0:0] disk LIO-ORG sbddbsgh 4.0 /dev/sdh
[7:0:0:0] disk LIO-ORG sbddbsgh 4.0 /dev/sdg
[8:0:0:0] disk LIO-ORG sbddbsgh 4.0 /dev/sdi
```

6. Get the SCSI ID from sdd, sde, and sdf. This SCSI ID is required to create an SBD cluster resource in NFS cluster. Perform it on FIRST node ONLY.

```
# - FOR NFS NODE – On nfsvm1 - #
# ls -l /dev/disk/by-id/scsi-* | grep sdd
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-1LIO-ORG_sbdnfs:42947810-fca0-
483c-812b-2154e84ab438 -> ../../sdd
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-
3600140542947810fca0483c812b2154e -> ../../sdd
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-SLIO-ORG_sbdnfs_42947810-
fca0-483c-812b-2154e84ab438 -> ../../sdd

# ls -l /dev/disk/by-id/scsi-* | grep sde
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-1LIO-ORG_sbdnfs:9ad4d6e0-
bbaa-441c-8d22-5abe083240ea -> ../../sde
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-
360014059ad4d6e0bbaa441c8d225abe0 -> ../../sde
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-SLIO-ORG_sbdnfs_9ad4d6e0-
bbaa-441c-8d22-5abe083240ea -> ../../sde

# ls -l /dev/disk/by-id/scsi-* | grep sdf
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-1LIO-ORG_sbdnfs:b3febbe7-ff6c-
4e4a-aa71-f15a756287b6 -> ../../sdf
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-
36001405b3febbe7ff6c4e4aaa71f15a7 -> ../../sdf
lrwxrwxrwx 1 root root 9 Apr 25 18:46 /dev/disk/by-id/scsi-SLIO-ORG_sbdnfs_b3febbe7-ff6c-
4e4a-aa71-f15a756287b6 -> ../../sdf
```

```
# - FOR ASCS NODE – On ascsvm1 node #

# ls -l /dev/disk/by-id/scsi-* | grep sdd
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-1LIO-ORG_sbda...:2a90d596-f15f-4891-801b-79e29e37fc3b -> ../../sdd
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-360014052a90d596f15f4891801b79e29 -> ../../sdd
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-SLIO-ORG_sbda...:2a90d596-f15f-4891-801b-79e29e37fc3b -> ../../sdd

# ls -l /dev/disk/by-id/scsi-* | grep sde
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-1LIO-ORG_sbda...:fda7b277-c3be-4bf9-8bdf-4cccc867b438 -> ../../sde
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-36001405fda7b277c3be4bf98bdf4cccc -> ../../sde
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-SLIO-ORG_sbda...:fda7b277-c3be-4bf9-8bdf-4cccc867b438 -> ../../sde

# ls -l /dev/disk/by-id/scsi-* | grep sdf
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-1LIO-ORG_sbda...:75a25b08-7836-4603-a020-4328ebf4f8c9 -> ../../sdf
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-3600140575a25b0878364603a0204328e -> ../../sdf
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-SLIO-ORG_sbda...:75a25b08-7836-4603-a020-4328ebf4f8c9 -> ../../sdf
```

For HANA, get the SCSI ID from sdg, sdh, and sdi.

```
# - FOR HANADB NODE – On hanavm1 node#

# ls -l /dev/disk/by-id/scsi-* | grep sdg
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-1LIO-ORG_sbdb...:79340dae-23c6-44f5-bf53-57ce3e1b89e7 -> ../../sdg
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-3600140579340dae23c644f5bf5357ce3 -> ../../sdg
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-SLIO-ORG_sbdb...:79340dae-23c6-44f5-bf53-57ce3e1b89e7 -> ../../sdg

# ls -l /dev/disk/by-id/scsi-* | grep sdh
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-1LIO-ORG_sbdb...:bc9e656f-9fe3-4f17-8cef-ef862e8ff587 -> ../../sdh
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-36001405bc9e656f9fe34f178cefef862 -> ../../sdh
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-SLIO-ORG_sbdb...:bc9e656f-9fe3-4f17-8cef-ef862e8ff587 -> ../../sdh

# ls -l /dev/disk/by-id/scsi-* | grep sdi
```

```
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-1LIO-ORG_sbddbsgh:167bc3b9-f714-4668-a281-288a0b7afbf1 -> ../../sdi
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-36001405167bc3b9f7144668a281288a0 -> ../../sdi
lrwxrwxrwx 1 root root 9 Apr 25 22:52 /dev/disk/by-id/scsi-SLIO-ORG_sbddbsgh_167bc3b9-f714-4668-a281-288a0b7afbf1 -> ../../sdi
```

7. Create an SBD device – Perform it on **FIRST** cluster node ONLY (i.e. nfsvm1, ascsvm1, and hanavm1). Use the SBD ID from the previous steps (bold marked)

```
# - FOR NFS NODE -
sudo sbd -d /dev/disk/by-id/scsi-3600140542947810fca0483c812b2154e -1 60 -4 120 create

# Also create the second and third SBD devices
sudo sbd -d /dev/disk/by-id/scsi-360014059ad4d6e0bbaa441c8d225abe0 -1 60 -4 120
create
sudo sbd -d /dev/disk/by-id/scsi-36001405b3febbe7ff6c4e4aaa71f15a7 -1 60 -4 120 create
```

```
# - FOR ASCS NODE -
sudo sbd -d /dev/disk/by-id/scsi-360014052a90d596f15f4891801b79e29 -1 60 -4 120 create

# Also create the second and third SBD devices
sudo sbd -d /dev/disk/by-id/scsi-36001405fda7b277c3be4bf98bdf4cccc -1 60 -4 120 create
sudo sbd -d /dev/disk/by-id/scsi-3600140575a25b0878364603a0204328e -1 60 -4 120
create
```

```
# - FOR HANADB NODE -
sudo sbd -d /dev/disk/by-id/scsi-3600140579340dae23c644f5bf5357ce3 -1 60 -4 120 create

# Also create the second and third SBD devices
sudo sbd -d /dev/disk/by-id/scsi-36001405bc9e656f9fe34f178cefef862 -1 60 -4 120 create
sudo sbd -d /dev/disk/by-id/scsi-36001405167bc3b9f7144668a281288a0 -1 60 -4 120 create
```

8. Adapt the SBD config. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

```
Change the file vi /etc/sysconfig/sbd with following
[...]
SBD_DEVICE="/dev/disk/by-id/scsi-3600140542947810fca0483c812b2154e;/dev/disk/by-
id/scsi-360014059ad4d6e0bbaa441c8d225abe0;/dev/disk/by-id/scsi-
36001405b3febbe7ff6c4e4aaa71f15a7"
[...]
SBD_PACEMAKER=yes
[...]
SBD_STARTMODE=always
[...]
```

SBD_WATCHDOG=yes

9. Since in the above step, you used the soft-watchdog, we need to create a watch dog. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

`echo softdog | sudo tee /etc/modules-load.d/softdog.conf`

10. Finally, load the softdog module. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

`:/etc/modules-load.d # modprobe -v softdog
insmod /lib/modules/4.4.175-94.79-default/kernel/drivers/watchdog/softdog.ko`

[\[Back to Check list for the deployment\]](#)

Cluster Setup and Configuration

This section describes the pacemaker cluster setup for the NFS, ASCS, and HANA database.

7. Configure the pacemaker cluster

Perform these steps for NFS, ASCS and HANADB cluster nodes.

1. Update SLES. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

```
#zypper update
```

2. Configure the operating system for pacemaker. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

Pacemaker creates many processes, and can exceed the limit of max defined processes. If this happens, cluster nodes may lose heartbeat and cause a failover. To avoid this, we need to perform the following config (increase the max allowed processes).

```
# Edit the configuration file
sudo vi /etc/systemd/system.conf

# Change the DefaultTasksMax
#DefaultTasksMax=512
DefaultTasksMax=4096

#To activate the above setting
sudo systemctl daemon-reload

# test if the change was successful
sudo systemctl --no-pager show | grep DefaultTasksMax
#Output
DefaultTasksMax=4096
```

3. Reduce the dirty cache. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

```
#sudo vi /etc/sysctl.conf

# Change/set the following settings
vm.dirty_bytes = 629145600
vm.dirty_background_bytes = 314572800
```

4. Configure CLOUD_NETCONFIG_MANAGE. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

This is to prevent cloud network plugin removing the vIP.

```
# Edit the configuration file
sudo vi /etc/sysconfig/network/ifcfg-eth0
```

```
# Change CLOUD_NETCONFIG_MANAGE
# CLOUD_NETCONFIG_MANAGE='yes'
CLOUD_NETCONFIG_MANAGE='no'
```

5. Enable SSH access

a. On Node1 nfsvm1

```
#sudo ssh-keygen

# Enter file in which to save the key (/root/.ssh/id_rsa): -> Press ENTER
# Enter passphrase (empty for no passphrase): -> Press ENTER
# Enter same passphrase again: -> Press ENTER

# copy the public key
sudo cat /root/.ssh/id_rsa.pub
```

b. On Node2 nfsvm2

```
# insert the public key you copied in the last step into the authorized keys file on the
second server
#sudo vi /root/.ssh/authorized_keys

#sudo ssh-keygen

# Enter file in which to save the key (/root/.ssh/id_rsa): -> Press ENTER
# Enter passphrase (empty for no passphrase): -> Press ENTER
# Enter same passphrase again: -> Press ENTER

# copy the public key
sudo cat /root/.ssh/id_rsa.pub
```

c. On Node1 nfsvm1

```
# insert the public key you copied in the last step into the authorized keys file on the
first server
#sudo vi /root/.ssh/authorized_keys
```

d. Perform the steps “a” ,“b” and “b” above for nodes pair ascsvm1/ascsvm2 and
hanavm1/hanavm2.

6. Install SUSE fence agent. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

```
#sudo zypper install fence-agents
```

7. Update hosts file for name resolution. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

```
vi /etc/hosts

#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3

# nfs nodes
10.12.0.12    nfsvm1
10.12.0.10    nfsvm2

#ascss nodes
10.12.0.8      ascsvm1
10.12.0.11    ascsvm2

# application vm
10.12.0.4      pasvm1
10.12.0.15    aasvm1

#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascss-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13    jbvm1
```

8. Install cluster. Perform it on FIRST node of the clusters (nfsvm1, ascsvm1, hanavm1).

```
#sudo ha-cluster-init

# ha-cluster-init
! NTP is not configured to start at system boot.
Do you want to continue anyway (y/n)? y
! Could not detect IP address for eth0
/root/.ssh/id_rsa already exists - overwrite (y/n)? n
Configuring csync2
csync2 is already configured - overwrite (y/n)? y
Generating csync2 shared key (this may take a while)...done
csync2 checking files...done
```

```
/etc/corosync/authkey already exists - overwrite (y/n)? y
```

Configure Corosync:

This will configure the cluster messaging layer. You will need to specify a network address over which to communicate (default is eth0's network, but you can use the network address of any active interface).

```
/etc/corosync/corosync.conf already exists - overwrite (y/n)? y
```

Network address to bind to (e.g.: 192.168.1.0) [169.254.169.254] **10.12.0.12 → IP address of node1**

Multicast address (e.g.: 239.x.x.x) [239.115.221.226]

Multicast port [5405]

Configure SBD:

If you have shared storage, for example a SAN or iSCSI target, you can use it avoid split-brain scenarios by configuring SBD. This requires a 1 MB partition, accessible to all nodes in the cluster. The device path must be persistent and consistent across all nodes in the cluster, so /dev/disk/by-id/* devices are a good choice. Note that all data on the partition you specify here will be destroyed.

```
SBD is already configured to use /dev/disk/by-id/scsi-  
3600140542947810fc0483c812b2154e;/dev/disk/by-id/scsi-  
360014059ad4d6e0bbaa441c8d225abe0;/dev/disk/by-id/scsi-  
36001405b3febbe7ff6c4e4aaa71f15a7 - overwrite (y/n)? n
```

Hawk cluster interface is now running. To see cluster status, open:

<https://None:7630/>

Log in with username 'hacluster', password 'linux'

! You should change the hacluster password to something more secure!

Waiting for cluster.....done

Loading initial cluster configuration

Configure Administration IP Address:

Optionally configure an administration virtual IP address. The purpose of this IP address is to provide a single IP that can be used to interact with the cluster, rather than using the IP address of any specific cluster node.

```
Do you wish to configure an administration IP (y/n)? n
```

Done (log saved to /var/log/ha-cluster-bootstrap.log)

8.1 At this time, crm_mon shows below.

Stack: corosync

Current DC: nfsvm1 (version 1.1.16-6.14.1-77ea74d) - partition with quorum
--

```
m
Last updated: Thu May 16 22:20:40 2019
Last change: Thu May 16 22:14:00 2019 by root via crm_attribute on nfsvm1

1 node configured
1 resource configured

Online: [ nfsvm1 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started nfsvm1
```

9. Add node to the cluster. Perform it on SECOND node of the clusters (nfsvm2, ascsvm2, hanavm2).
If you run `crm_mon` on any of the nodes, you don't see two nodes there yet. Don't worry, you still need to perform some more steps (mentioned below).


```
#ha-cluster-join
```
10. Change user hacluster password, if needed. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).


```
passwd hacluster
```

11. Configure corosync. Add the following bold content to the file if the values are not there or different. Make sure to change the token to 30000 to allow Memory preserving maintenance. Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).


```
# -- FOR NFS NODES nfsvm1, nfsvm2 - #
#vi /etc/corosync/corosync.conf

# Please read the corosync.conf.5 manual page
totem {
    version: 2
    secauth: on
    crypto_hash: sha1
    crypto_cipher: aes256
    cluster_name: hacluster
    clear_node_high_bit: yes
    token: 30000
    token_retransmits_before_loss_const: 10
    join: 60
    consensus: 36000
    max_messages: 20
    interface {
```

```
# -- FOR NFS NODES nfsvm1, nfsvm2 - #
#vi /etc/corosync/corosync.conf

# Please read the corosync.conf.5 manual page
totem {
    version: 2
    secauth: on
    crypto_hash: sha1
    crypto_cipher: aes256
    cluster_name: hacluster
    clear_node_high_bit: yes
    token: 30000
    token_retransmits_before_loss_const: 10
    join: 60
    consensus: 36000
    max_messages: 20
    interface {
```

```

        ringnumber: 0
        bindnetaddr: 10.12.0.12
#mcastaddr: 239.249.33.144
        mcastport: 5405
        ttl: 1
    }
transport: udpu
}

nodelist {
node {
    # IP address of prod-cl1-0
    ring0_addr:10.12.0.12
}
node {
    # IP address of prod-cl1-1
    ring0_addr:10.12.0.10
}
}

logging {
    fileline: off
    to_stderr: no
    to_logfile: no
    logfile: /var/log/cluster/corosync.log
    to_syslog: yes
    debug: off
    timestamp: on
    logger_subsys {
        subsys: QUORUM
        debug: off
    }
}

quorum {

    # Enable and configure quorum subsystem (default: off)
    # see also corosync.conf.5 and votequorum.5
    provider: corosync_votequorum
    expected_votes: 2
    two_node: 1
}

```

-- FOR ASCS NODES for ascsvm1, ascsvm2 -

```
#vi /etc/corosync/corosync.conf

[...]
token: 30000
token_retransmits_before_loss_const: 10
join: 60
consensus: 36000
max_messages: 20

interface {
    [...]
}
transport: udpu
# remove parameter mcastaddr
# mcastaddr: IP
}
nodelist {
    node {
        # IP address of node1
        ring0_addr:10.12.0.8
    }
    node {
        # IP address of node2
        ring0_addr:10.12.0.11
    }
}
logging {
    [...]
}
quorum {
    # Enable and configure quorum subsystem (default: off)
    # see also corosync.conf.5 and votequorum.5
    provider: corosync_votequorum
    expected_votes: 2
    two_node: 1
}
```

```
# -- FOR HANA NODES hanavm1, hanavm2 - #
#vi /etc/corosync/corosync.conf

[...]
token: 30000
token_retransmits_before_loss_const: 10
join: 60
consensus: 36000
max_messages: 20
```

```

interface {
    [...]
}
transport:  udpu
# remove parameter mcastaddr
# mcastaddr: IP
}
nodelist {
node {
    # IP address of node1
    ring0_addr:10.12.1.4
}
node {
    # IP address of node2
    ring0_addr:10.12.1.6
}
}
logging {
    [...]
}
quorum {
    # Enable and configure quorum subsystem (default: off)
    # see also corosync.conf.5 and votequorum.5
    provider: corosync_votequorum
    expected_votes: 2
    two_node: 1
}

```

12. Restart the corosync service on both the nodes.

Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

```
#service corosync restart
```

13. Now crm_mon, should show the 2 nodes and 1 resource.

Perform it on all the nodes of clusters NFS, ASCS, and HANA (nfsvm1, nfsvm2, ascsvm1, ascsvm2, hanavm1, hanavm2).

Note: it may take a while (approximately 2-3 minutes) for cluster to initialize.

```

Stack: corosync
Current DC: nfsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Thu Apr 25 21:01:51 2019
Last change: Thu Apr 25 20:47:04 2019 by root via crm_attribute on nfsvm1

2 nodes configured
1 resource configured

Online: [ nfsvm1 nfsvm2 ]

Active resources:

stonith-sbd      (stonith:external/sbd): Started nfsvm1

```

[\[Back to Check list for the deployment\]](#)

8. Setup NFS server

This is to setup the NFS server using the DRBD so this NFS shares can be used in ASCS for sapmnt. This is only required for the NFS cluster (nfsvm1,nfsvm2).

<https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/high-availability-guide-suse-nfs>

1. Prerequisite
 - a. Ensure that Pacemaker cluster is setup for NFS nodes (nfsvm1, nfsvm2)
2. Host name resolution
 - a. Ensure that both the NFS nodes nfsvm1 and nfsvm2 are added in the /etc/hosts file of both the NFS nodes.
 - b. Ensure that load balancer frontend IP address is added to the hosts file of each NFS nodes.

```

Vi /etc/hosts
#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3

# nfs nodes
10.12.0.12     nfsvm1
10.12.0.10     nfsvm2

#ascsv nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2

# application vm
10.12.0.4      pasvm1

```

```

10.12.0.15      aasvm1

#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-asc5-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1

```

3. Enable the NFS server. Perform it on both the NFS nodes nfsvm1 and nfsvm2.

```

:/srv # sh -c 'echo /srv/nfs/ *(rw,no_root_squash,fsid=0\)>/etc/exports'
:/srv # mkdir /srv/nfs/

```

Verify the NFS server is setup.

```

# cat /etc/exports
/srv/nfs/ *(rw,no_root_squash,fsid=0)

# ls /srv
ftp nfs www

```

4. Install the drbd components. This is required to replicate the data from one NFS node to another NFS node. Perform it on both the NFS nodes (nfsvm1, nfsvm2). In our case, these packages were already installed with the OS image.

```
zypper install drbd drbd-kmp-default drbd-utils
```

5. Create a partition for drbd device. Perform it on both the NFS nodes nfsvm1, and nfsvm2.
 - Before you create a partition, check the data disk

```

# ls /dev/disk/azure/scsi1/
total 0
lrwxrwxrwx 1 root root 12 Apr 24 17:34 lun0 -> ../../sdc

```

There is one disk with lun0. This is the disk we had added in the NFS VMs at the time of creation with 256GB size. Azure create the data disks under the directory /dev/disk/azure/scsi1 in the SUSE VMs.

- b. Create a partition.

```
# sh -c 'echo -e "n\nn\nn\nn\nnw\nn" | fdisk /dev/disk/azure/scsi1/lun0'
```

```
Welcome to fdisk (util-linux 2.29.2).
```

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0x5c6bb39e.

Command (m for help): Partition type
p primary (0 primary, 0 extended, 4 free)
e extended (container for logical partitions)

Select (default p):

Using default response p.

Partition number (1-4, default 1): First sector (2048-536870911, default 2048): Last sector, +sectors or +size{K,M,G,T,P} (2048-536870911, default 536870911):
Created a new partition 1 of type 'Linux' and of size 256 GiB.

Command (m for help): The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

6. Create LVM (Logical Volume Manager) configurations. Perform it on both the NFS nodes nfsvm1, and nfsvm2.

- a. List the options

```
# ls /dev/disk/azure/scsi1/lun*-part*
/dev/disk/azure/scsi1/lun0-part1
```

- b. Create LVM volumes for the partition

```
pvcreate /dev/disk/azure/scsi1/lun0-part1
vgcreate vg-SGH-NFS /dev/disk/azure/scsi1/lun0-part1
lvcreate -l 100%FREE -n SGH vg-SGH-NFS
```

7. Configure drbd. Perform it on both the NFS nodes nfsvm1, and nfsvm2.

- a. Update drbd.conf file to include the following two lines. In our case, these entries were already there.

```
# vi /etc/drbd.conf
# include the following two lines
include "drbd.d/global_common.conf";
include "drbd.d/*.*";
```

- b. Change the global drbd configuration. Add the following entries to the handler and net section.

```
#vi /etc/drbd.d/global_common.conf
# add the following entries to the handler and net section
global {
    usage-count no;
}
```

```

common {
    handlers {
        fence-peer "/usr/lib/drbd/crm-fence-peer.sh";
        after-resync-target "/usr/lib/drbd/crm-unfence-peer.sh";
        split-brain "/usr/lib/drbd/notify-split-brain.sh root";
        pri-lost-after-sb "/usr/lib/drbd/notify-pri-lost-after-sb.sh";
        /usr/lib/drbd/notify-emergency-reboot.sh; echo b > /proc/sysrq-trigger ; reboot -f";
    }
    startup {
        wfc-timeout 0;
    }
    options {
    }
    disk {
        md-flushes yes;
        disk-flushes yes;
        c-plan-ahead 1;
        c-min-rate 100M;
        c-fill-target 20M;
        c-max-rate 4G;
    }
    net {
        after-sb-0pri discard-younger-primary;
        after-sb-1pri discard-secondary;
        after-sb-2pri call-pri-lost-after-sb;
        protocol C;
        tcp-cork yes;
        max-buffers 20000;
        max-epoch-size 20000;
        sndbuf-size 0;
        rcvbuf-size 0;
    }
}
}

```

8. Create the NFS drbd devices. **Perform it on both the NFS nodes nfsvm1, and nfsvm2.**
 - a. Create a drbd resource. Create a SGH-nfs.res file and insert the configuration for the new drbd device there.


```
vi /etc/drbd.d/SGH-nfs.res
```
 - b. Add the configuration to SGH-nfs.res file

```

# add the following lines to SGH-nfs.res on both the NFS nodes
resource SGH-nfs {
    protocol C;
    disk {
        on-io-error    detach;
    }
}

```

```

on nfsvm1 {
    address 10.12.0.12:7790;
    device /dev/drbd0;
    disk /dev/vg-SGH-NFS/SGH;
    meta-disk internal;
}
on nfsvm2 {
    address 10.12.0.10:7790;
    device /dev/drbd0;
    disk /dev/vg-SGH-NFS/SGH;
    meta-disk internal;
}

```

- c. Create the drbd device and start it.

```

#drbdadm create-md SGH-nfs
#drbdadm up SGH-nfs

# output of the commands
# drbdadm create-md SGH-nfs
initializing activity log
initializing bitmap (8192 KB) to all zero
Writing meta data...
New drbd meta data block successfully created.

# drbdadm up SGH-nfs

```

9. Skip initial synchronization. **Perform it on FIRST node nfsvm1.**

```
# drbdadm new-current-uuid --clear-bitmap SGH-nfs
```

10. Set the primary node. **Perform it on FIRST node nfsvm1.**

```
#drbdadm primary --force SGH-nfs
```

11. Wait for newly created drbd device to synchronized. **Perform it on FIRST node nfsvm1.**

```
#drbdsetup wait-sync-resource SGH-nfs
```

To check the synchronization status from the second Node nfsvm2:

```

# drbdadm status

SGH-nfs role:Secondary

disk:Inconsistent

```

```
nfsvm1 role:Primary
```

replication:SyncTarget peer-disk:UpToDate done:16.91 <- Percentage is here! Wait for completion.

12. Create file system on the drbd device. **Perform it on FIRST node nfsvm1.**

Note: mkfs.xfs takes long. For 256GB SSD disk, it took about 90 minutes.

```
#mkfs.xfs /dev/drbd0
#mkdir /srv/nfs/SGH
#chattr +i /srv/nfs/SGH
#mount -t xfs /dev/drbd0 /srv/nfs/SGH
#mkdir /srv/nfs/SGH/sghsys
#mkdir /srv/nfs/SGH/sapmntsgh
#mkdir /srv/nfs/SGH/trans
#mkdir /srv/nfs/SGH/ASCS
#mkdir /srv/nfs/SGH/ASCSERS
#mkdir /srv/nfs/SGH/SCS
#mkdir /srv/nfs/SGH/SCSERs
#umount /srv/nfs/SGH
```

#output of the mkfs command

```
# mkfs.xfs /dev/drbd0
meta-data=/dev/drbd0 isize=256 agcount=4, agsize=16776446 blks
      = sectsz=4096 attr=2, projid32bit=1
      = crc=0   finobt=0, sparse=0
data  = bsize=4096 blocks=67105783, imaxpct=25
      = sunit=0  swidth=0 blks
naming =version 2 bsize=4096 ascii-ci=0 fttype=1
log   =internal log bsize=4096 blocks=32766, version=2
      = sectsz=4096 sunit=1 blks, lazy-count=1
realtime =none extsz=4096 blocks=0, rtextents=0
```

9 Configure the cluster for DRBD

In this section, you add the drbd device to the NFS cluster as a resource.

You only do these steps on the NFS node1 (nfsvm1).

1. Add the NFS drbd device to SAP system SGH in the cluster configuration.

```
sudo crm configure rsc_defaults resource-stickiness="200"
```

```

# Enable maintenance mode
sudo crm configure property maintenance-mode=true

sudo crm configure primitive drbd_SGH_nfs ocf:linbit:drbd params drbd_resource="SGH-nfs"
op monitor interval="15" role="Master" op monitor interval="30" role="Slave"

sudo crm configure ms ms-drbd_SGH_nfs drbd_SGH_nfs meta master-max="1" master-node-
max="1" clone-max="2" clone-node-max="1" notify="true" interleave="true"

sudo crm configure primitive fs_SGH_sapmnt ocf:heartbeat:Filesystem params
device=/dev/drbd0 directory=/srv/nfs/SGH fstype=xfs op monitor interval="10s"

sudo crm configure primitive nfsserver systemd:nfs-server op monitor interval="30s"

sudo crm configure clone cl-nfsserver nfsserver

sudo crm configure primitive exportfs_SGH ocf:heartbeat:exportfs params
directory="/srv/nfs/SGH" options="rw,no_root_squash,crossmnt" clientspec="*" fsid=1
wait_for_leasetime_on_stop=true op monitor interval="30s"

sudo crm configure primitive vip_SGH_nfs IPAddr2 params ip=10.12.0.51 cidr_netmask=24 op
monitor interval=10 timeout=20

sudo crm configure primitive nc_SGH_nfs anything params binfile="/usr/bin/nc"
cmdline_options="-l -k 61000" op monitor timeout=20s interval=10 depth=0

sudo crm configure group g-SGH_nfs fs_SGH_sapmnt exportfs_SGH nc_SGH_nfs vip_SGH_nfs

sudo crm configure order o-SGH_drbd_before_nfs inf: ms-drbd_SGH_nfs:promote g-
SGH_nfs:start

sudo crm configure colocation col-SGH_nfs_on_drbd inf: g-SGH_nfs ms-drbd_SGH_nfs:Master

```

2. Disable the maintenance mode.

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

3. Cluster resources in crm_mon looks like below.

```

nfsvm1:/dev/disk/azure/scsi1 # crm_mon
Stack: corosync
Current DC: nfsvm1 (version 1.1.16-6.14.1-77ea74d) - partition with quorum
Last updated: Fri May 17 20:36:49 2019
Last change: Fri May 17 20:36:45 2019 by hacluster via crmd on nfsvm2

2 nodes configured

```

```

9 resources configured

Online: [ nfsvm1 nfsvm2 ]

Active resources:

stonith-sbd  (stonith:external/sbd): Started nfsvm1
Master/Slave Set: ms-drbd_SGH_nfs [drbd_SGH_nfs]
    Masters: [ nfsvm1 ]
    Slaves: [ nfsvm2 ]
Clone Set: cl-nfsserver [nfsserver]
    Started: [ nfsvm1 nfsvm2 ]
Resource Group: g-SGH_nfs
    fs_SGH_sapmnt  (ocf::heartbeat:Filesystem): Started nfsvm1
    exportfs_SGH  (ocf::heartbeat:exportfs): Started nfsvm1
    nc_SGH_nfs (ocf::heartbeat:anything): Started nfsvm1
    vip_SGH_nfs  (ocf::heartbeat:IPaddr2): Started nfsvm1

```

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10 HANA Database Cluster Configuration

10.1 Hana Installation

1. Install the HANA database on both nodes hanavm1, and hanavm2.
2. Ensure to update the packages

```
zypper install libgcc_s1 libstdc++6 libatomic1
```

3. Copy the HANA Installation bits to /hana/logbackup/SAP_HANA_DATABASE on both the nodes
4. Change the permission

```
#chmod -R 755 /hana/logbackup/SAP_HANA_DATABASE
```

5. Install the HANA using command line tool hblcm. You can run on both the hana VMs in parallel.

```
hanavm1:/hana/logbackup/SAP_HANA_DATABASE # ./hblcm --ignore=check_signature_file
```

```
SAP HANA Lifecycle Management - SAP HANA Database 2.00.040.00.1553674765
*****
```

Scanning software locations...

Detected components:

SAP HANA Database (2.00.040.00.1553674765) in
 /hana/logbackup/SAP_HANA_DATABASE/server

Choose an action

Index	Action	Description
-------	--------	-------------

1	install	Install new system
2	extract_components	Extract components
3	Exit (do nothing)	

Enter selected action index [3]: 1

Enter Installation Path [/hana/shared]: Press ENTER

Enter Local Host Name [hanavm1]: Press ENTER

Do you want to add hosts to the system? (y/n) [n]: Press ENTER

Enter SAP HANA System ID: SGH

Enter Instance Number [00]: Press ENTER

Enter Local Host Worker Group [default]:

Index	System Usage	Description
-------	--------------	-------------

1	production	System is used in a production environment
2	test	System is used for testing, not production
3	development	System is used for development, not production
4	custom	System usage is neither production, test nor development

Select System Usage / Enter Index [4]: 4

Enter Location of Data Volumes [/hana/data/SGH]: Press ENTER

Enter Location of Log Volumes [/hana/log/SGH]: Press ENTER

Restrict maximum memory allocation? [n]: Press ENTER

Enter Certificate Host Name For Host 'hanavm1' [hanavm1]: Press ENTER

Enter SAP Host Agent User (sapadm) Password:

Confirm SAP Host Agent User (sapadm) Password:

Enter System Administrator (sghadm) Password:

Confirm System Administrator (sghadm) Password:

Enter System Administrator Home Directory [/usr/sap/SGH/home]: Press ENTER

Enter System Administrator Login Shell [/bin/sh]:

Enter System Administrator User ID [1001]:

Enter ID of User Group (sapsys) [79]:

Enter System Database User (SYSTEM) Password:

Confirm System Database User (SYSTEM) Password:

Restart system after machine reboot? [n]:

Summary before execution:

```

SAP HANA Database System Installation
Installation Parameters
  SAP HANA System ID: SGH
  Instance Number: 00
  Local Host Worker Group: default
  System Usage: custom
  Location of Data Volumes: /hana/data/SGH
  Location of Log Volumes: /hana/log/SGH
  Certificate Host Names: hanavm1 -> hanavm1
  System Administrator Home Directory: /usr/sap/SGH/home
  System Administrator Login Shell: /bin/sh
  System Administrator User ID: 1001
  ID of User Group (sapsys): 79
  Remote Execution: ssh
  Database Isolation: low
  Install Execution Mode: standard
  Installation Path: /hana/shared
  Local Host Name: hanavm1
Software Components
  SAP HANA Database
    Install version 2.00.040.00.1553674765
    Location: /hana/logbackup/SAP_HANA_DATABASE/server
Log File Locations
  Log directory: /var/tmp/hdb_SGH_hdblcm_install_2019-04-26_22.07.24
  Trace location: /var/tmp/hdblcm_2019-04-26_22.07.24_101096.trc

```

Do you want to continue? (y/n): y

- HANA installation takes about 10 minutes.

10.2 HSR Configuration

- For HA setup, ensure that package is installed SAPHanaSR **on both the HANA nodes**.

```
#zypper se SAPHanaSR
```

- Take system and tenant database backup

```
sghadm@hanavm1:/usr/sap/SGH/HDB00/exe> hdblcm -d SYSTEM -p "mypassword" -i 00 "BACKUP DATA USING FILE ('initialbackupSYS')"
0 rows affected (overall time 13.020002 sec; server time 13.018478 sec)
```

```
sghadm@hanavm1:/usr/sap/SGH/HDB00/exe> hdblcm -d SGH -u SYSTEM -p "mypassword" -i 00 "BACKUP DATA USING FILE ('initialbackupSGH')"
0 rows affected (overall time 13.289985 sec; server time 13.287974 sec)
```

9. Copy the dat and key files from hanavm1 to hanavm2

```
scp /usr/sap/SGH/SYS/global/security/rsecssfs/data/SSFS_SGH.DAT
hanavm2:/usr/sap/SGH/SYS/global/security/rsecssfs/data/
```

```
scp /usr/sap/SGH/SYS/global/security/rsecssfs/key/SSFS_SGH.KEY
hanavm2:/usr/sap/SGH/SYS/global/security/rsecssfs/key/
```

10. Enable system replication on primary node (hanavm1)

```
sghadm@hanavm1:/usr/sap/SGH/HDB00/exe> hdbnsutil -sr_enable --name=hanavm1
nameserver is active, proceeding ...
successfully enabled system as system replication source site
done.
```

11. Stop the HANA on second system (hanavm2)

```
sghadm@hanavm2:/usr/sap/SGH/HDB00> HDB stop
hdbdaemon will wait maximal 300 seconds for NewDB services finishing.
Stopping instance using: /usr/sap/SGH/SYS/exe/hdb/sapcontrol -prot NI_HTTP -nr 00 -
function Stop 400

17.05.2019 23:33:22
Stop
OK
Waiting for stopped instance using: /usr/sap/SGH/SYS/exe/hdb/sapcontrol -prot NI_HTTP
-nr 00 -function WaitforStopped 600 2

17.05.2019 23:33:56
WaitforStopped
OK
hdbdaemon is stopped.
```

12. Register the second system for replication

```
sghadm@hanavm2:/usr/sap/SGH/HDB00/exe> hdbnsutil -sr_register --
remoteHost=hanavm1 --remoteInstance=00 --replicationMode=sync --name=hanavm2
--operationMode not set; using default from
global.ini/[system_replication]/operation_mode: logreplay
adding site ...
nameserver hanavm2:30001 not responding.
collecting information ...
updating local ini files ...
done.
```

13. Ensure that HSR is in sync

```
sghadm@hanavm1:/usr/sap/SGH/HDB00/exe> ./hdbnsutil -sr_state
```

```

System Replication State
~~~~~
online: true

mode: primary
operation mode: primary
site id: 1
site name: hanavm1

is source system: true
is secondary/consumer system: false
has secondaries/consumers attached: true
is a takeover active: false

Host Mappings:
~~~~~
hanavm1 -> [hanavm2] hanavm2
hanavm1 -> [hanavm1] hanavm1

Site Mappings:
~~~~~
hanavm1 (primary/primary)
|---hanavm2 (syncmem/delta_datashipping)

Tier of hanavm1: 1
Tier of hanavm2: 2

Replication mode of hanavm1: primary
Replication mode of hanavm2: syncmem

Operation mode of hanavm1: primary
Operation mode of hanavm2: delta_datashipping

Mapping: hanavm1 -> hanavm2
done.

```

10.3 Add HANA topology and resources to the HANA DB cluster

This is to create the HANA topology and HANA resources in the HANADB cluster.

1. Create the HANA topology. Perform it on FIRST node hanavm1.

```

# Create the HANA topology

crm configure property maintenance-mode=true

# Replace the bold string with your instance number and HANA system ID

crm configure primitive rsc_SAPHanaTopology_SGH_HDB00 ocf:suse:SAPHanaTopology
operations \$id="rsc_sap_SGH_HDB00-operations" op monitor interval="10" timeout="600"
op start interval="0" timeout="600" op stop interval="0" timeout="300" params SID="SGH"
InstanceNumber="00"

```

```
crm configure clone cln_SAPHanaTopology_SGH_HDB00 rsc_SAPHanaTopology_SGH_HDB00
meta is-managed="true" clone-node-max="1" target-role="Started" interleave="true"
```

2. Create the resources. **Perform it on FIRST node hanavm1.**

```
# Configure the HANA resources

# Replace the bold string with your instance number, HANA system ID, and the front-end IP address of the Azure load balancer.

crm configure primitive rsc_SAPHana_SGH_HDB00 ocf:suse:SAPHana operations \${id=rsc_sap2_SGH_HDB00-operations" op
start interval="0" timeout="3600" op stop interval="0" timeout="3600" op promote interval="0" timeout="3600" op monitor
interval="60" role="Master" timeout="700" op monitor interval="61" role="Slave" timeout="700" params SID="SGH"
InstanceNumber="00" PREFER_SITE_TAKEOVER="true" DUPLICATE_PRIMARY_TIMEOUT="7200" AUTOMATED_REGISTER="false"

crm configure ms msl_SAPHana_SGH_HDB00 rsc_SAPHana_SGH_HDB00 meta is-managed="true" notify="true" clone-max="2"
clone-node-max="1" target-role="Started" interleave="true"

crm configure primitive rsc_ip_SGH_HDB00 ocf:heartbeat:IPaddr2 meta target-role="Started" is-managed="true" operations
\${id=rsc_ip_SGH_HDB00-operations" op monitor interval="10s" timeout="20s" params ip="10.12.1.5"

crm configure primitive rsc_nc_SGH_HDB00 anything params binfile="/usr/bin/nc" cmdline_options="-l -k 62500" op monitor
timeout=20s interval=10 depth=0

crm configure group g_ip_SGH_HDB00 rsc_ip_SGH_HDB00 rsc_nc_SGH_HDB00

crm configure colocation col_saphana_ip_SGH_HDB00 4000: g_ip_SGH_HDB00:Started msl_SAPHana_SGH_HDB00:Master

crm configure order ord_SAPHana_SGH_HDB00 Optional: cln_SAPHanaTopology_SGH_HDB00 msl_SAPHana_SGH_HDB00

# Clean up the HANA resources. The HANA resources might have failed because of a known issue.
crm resource cleanup rsc_SAPHana_SGH_HDB00

crm configure property maintenance-mode=false
crm configure rsc_defaults resource-stickiness=1000
crm configure rsc_defaults migration-threshold=5000
```

3. Verify the cluster status

```
hanavm1:/ # crm_mon -r
Stack: corosync
Current DC: hanavm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Sat Apr 27 18:31:03 2019
Last change: Sat Apr 27 18:30:01 2019 by root via crm_attribute on hanavm1

2 nodes configured
7 resources configured

Online: [ hanavm1 hanavm2 ]

Full list of resources:

stonith-sbd  (stonith:external/sbd): Started hanavm1
Clone Set: cln_SAPHanaTopology_SGH_HDB00 [rsc_SAPHanaTopology_SGH_HDB00]
  Started: [ hanavm1 hanavm2 ]
Master/Slave Set: msl_SAPHana_SGH_HDB00 [rsc_SAPHana_SGH_HDB00]
  Masters: [ hanavm1 ]
  Slaves: [ hanavm2 ]
Resource Group: g_ip_SGH_HDB00
  rsc_ip_SGH_HDB00 (ocf:heartbeat:IPaddr2):   Started hanavm1
  rsc_nc_SGH_HDB00 (ocf::heartbeat:anything):   Started hanavm1
```

How to get ports used by the tenant database – run this on tenant database

```
SELECT SERVICE_NAME, PORT, SQL_PORT, (PORT + 2) HTTP_PORT FROM
SYS.M_SERVICES WHERE ((SERVICE_NAME='indexserver' and
COORDINATOR_TYPE= 'MASTER') or (SERVICE_NAME='xsengine'))
```

Hawlk console dashboard status for HANA cluster

The first screenshot shows the 'Resources' tab of the Hawlk console. It lists several resources with their names, locations, types, and operations. The resources include: cln_SAPHanaTopology_SGH_HDB00 (hanavm1, hanavm2, ocf:suse:SAPHanaTopology (Clone)), rsc_SAPHanaTopology_SGH_HDB00 (hanavm1, hanavm2, ocf:suse:SAPHanaTopology), g_ip_SGH_HDB00 (hanavm1, Group (2)), rsc_ip_SGH_HDB00 (hanavm1, ocf:heartbeat:ipaddr2), rsc_nc_SGH_HDB00 (hanavm1, ocf:heartbeat:anything), msl_SAPHana_SGH_HDB00 (hanavm1, hanavm2, Multi-state), rsc_SAPHana_SGH_HDB00 (hanavm1, hanavm2, ocf:suse:SAPHana), and stonith-sbd (hanavm1, stonith:external/sbd). All resources are in green (healthy).

The second screenshot shows the 'Nodes' tab of the Hawlk console. It lists two nodes: hanavm1 and hanavm2. Both nodes are in green (healthy) and have maintenance and standby status icons.

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11 Prepare ASCS cluster for SAP S4H installation

<https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/high-availability-guide-suse#setting-up-asc>

In this section, Prepare ASCS cluster for SAP S4H installation. You create autoofs file configuration so NFS shares can be attached to the ASCS cluster nodes.

1. Pre-requisite

- NFS cluster – which we already did setup before
- VM and Load Balancer deployed – we did it before already
- Pacemaker cluster – we did setup it before

```
#crm_mon
Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Mon Apr 29 20:40:45 2019
```

```
Last change: Fri Apr 26 02:50:13 2019 by root via crm_attribute on ascsvm1

2 nodes configured
1 resource configured

Online: [ ascsvm1 ascsvm2 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started ascsvm1
```

2. Prepare cluster for SAP

- a. Install SUSE connector. Perform it on both the ASCS nodes.

```
#zypper install sap-suse-cluster-connector
```

- b. Update SAP resource agents. Perform it on both the ASCS nodes.

```
# sudo grep 'parameter name="IS_ERS"' /usr/lib/ocf/resource.d/heartbeat/SAPIstance
# output
<parameter name="IS_ERS" unique="0" required="0">
```

3. Prepare NFS for ASCS.

- a. Create shared directories. Perform it on both the ASCS nodes.

```
mkdir -p /sapmnt/SGH
mkdir -p /usr/sap/trans
mkdir -p /usr/sap/SGH/SYS
mkdir -p /usr/sap/SGH/ASCS00
mkdir -p /usr/sap/SGH/ERS02

chattr +i /sapmnt/SGH
chattr +i /usr/sap/trans
chattr +i /usr/sap/SGH/SYS
chattr +i /usr/sap/SGH/ASCS00
chattr +i /usr/sap/SGH/ERS02
```

- b. Configure autofs. Perform it on **both** the ASCS nodes.

```
sudo vi /etc/auto.master
```

```
# Add the following line to the file, save and exit
+auto.master
/- /etc/auto.direct
```

Create a file /etc/auto.direct. Perform it on both the ASCS nodes.

```
# create a file
```

```
vi /etc/auto.direct
```

```
# Add the following lines to the file, save and exit
/sapmnt/SGH -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/SGH/sapmntsgh
/usr/sap/trans -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/SGH/trans
/usr/sap/SGH/SYS -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/SGH/sghsys
```

- c. Start and enable the autofs service. **Perform it on both the ASCS nodes.**

```
#systemctl enable autofs
#service autofs restart
```

- d. Configure swap file. **Perform it on both the ASCS nodes.**

```
vi /etc/waagent.conf

# Set the property ResourceDisk.EnableSwap to y
# Create and use swapfile on resource disk.
ResourceDisk.EnableSwap=y

# Set the size of the SWAP file with property ResourceDisk.SwapSizeMB
# The free space of resource disk varies by virtual machine size. Make sure that you
do not set a value that is too big. You can check the SWAP space with command
swapon
# Size of the swapfile.
ResourceDisk.SwapSizeMB=2000
```

- e. Restart the agent

```
#service waagent restart
```

4. Create a virtual IP resource and health-probe for the ASCS instance. **Perform it on FIRST node.**

```
sudo crm node standby ascsvm2

sudo crm configure primitive fs_SGH_ASCS Filesystem device='sgh-nfs-ilb:/SGH/ASCS'
directory='/usr/sap/SGH/ASCS00' fstype='nfs4' op start timeout=60s interval=0 op stop timeout=60s
interval=0 op monitor interval=20s timeout=40s

sudo crm configure primitive vip_SGH_ASCS IPAddr2 params ip=10.12.0.5 cidr_netmask=24 op monitor
interval=10 timeout=20

sudo crm configure primitive nc_SGH_ASCS anything params binfile="/usr/bin/nc" cmdline_options="-l
-k 62000" op monitor timeout=20s interval=10 depth=0

sudo crm configure group g-SGH_ASCS fs_SGH_ASCS nc_SGH_ASCS vip_SGH_ASCS meta resource-
stickiness=3000
```

- a. Verify that cluster is running ok.

```
Stack: corosync
Current DC: ascsvm2 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Tue Apr 30 17:14:38 2019
Last change: Tue Apr 30 17:11:53 2019 by root via cibadmin on ascsvm1

2 nodes configured
4 resources configured

Node ascsvm2: standby
Online: [ ascsvm1 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started ascsvm1
Resource Group: g-SGH_ASCS
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm1
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm1
```

Now you see that shares from NFS server is mounted to the ASCS servers.

```
ascsvm1:~ # df -kh
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        14G   0  14G  0% /dev
tmpfs          21G 54M  21G  1% /dev/shm
tmpfs          14G 58M  14G  1% /run
tmpfs          14G   0  14G  0% /sys/fs/cgroup
/dev/sda4       29G 2.3G  25G  9% /
/dev/sda3      976M 102M 824M 11% /boot
/dev/sda2      200M 140K 200M  1% /boot/efi
/dev/sdc1      252G 60M 251G  1% /usr/sap
/dev/sdb1      55G 2.1G  51G  4% /mnt/resource
tmpfs          2.8G   0  2.8G  0% /run/user/0
sgh-nfs-ilb:/SGH/ASCS  256G 32M 256G  1% /usr/sap/SGH/ASCS00
sgh-nfs-ilb:/SGH/sghsys  256G 32M 256G  1% /usr/sap/SGH/SYS
sgh-nfs-ilb:/SGH/sapmntsgh 256G 32M 256G  1% /sapmnt/SGH
sgh-nfs-ilb:/SGH/trans   256G 32M 256G  1% /usr/sap/trans
```

Mount on node2. Note that ASCS is not mounted on the node2.

```
ascsvm2:~ # df -kh
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        14G   0  14G  0% /dev
tmpfs          21G 61M  21G  1% /dev/shm
tmpfs          14G 26M  14G  1% /run
tmpfs          14G   0  14G  0% /sys/fs/cgroup
/dev/sda4       29G 13G  15G  47%
```

```
/dev/sda3      976M 102M 824M 11% /boot
/dev/sda2      200M 140K 200M 1% /boot/efi
/dev/sdb1      55G 2.1G 51G 4% /mnt/resource
tmpfs         2.8G  0 2.8G 0% /run/user/0
sgh-nfs-ilb:/SGH/sghsys 256G 32M 256G 1% /usr/sap/SGH/SYS
sgh-nfs-ilb:/SGH/sapmntsgh 256G 32M 256G 1% /sapmnt/SGH
sgh-nfs-ilb:/SGH/trans 256G 32M 256G 1% /usr/sap/trans
```

12 ASCS Instance Installation

1. Copy the SWPM and installation bits to ascsvm1
2. Extract the SWPM using `sapcar.exe -xvf SWPMSARFILE`
 - a. Also extract the sapinst file inside the SWPM folder. If you don't use latest sapinst sometimes you get error in SWPM execution "manifest error".
3. Start the S4H Installation for ASCS instance. Start the sapinst using the following command **on ASCS FIRST node**. Ensure that use sapadm is created on the node already.

```
#To create a user
ascsvm1:~ # useradd -m sapadmin
ascsvm1:~ # passwd sapadmin
New password:
Retype new password:
passwd: password updated successfully
```

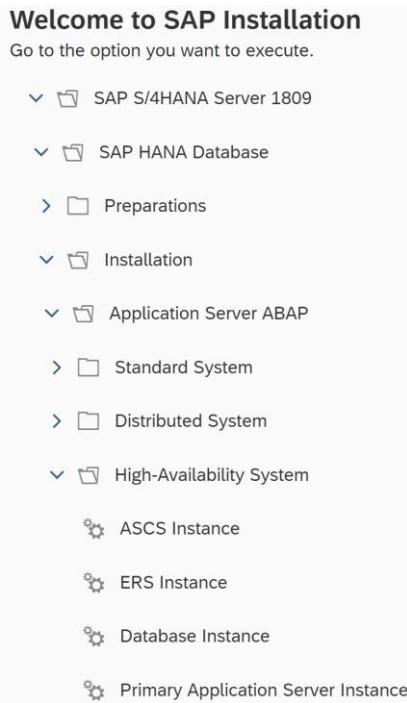
```
ascsvm1:/usr/sap/SWPM # ./sapinst SAPINST_REMOTE_ACCESS_USER=sapadmin
SAPINST_USE_HOSTNAME=sgh-ascs-ilb
[=====] | extracting... done!
INFO 2019-04-30 17:50:07.728 (mainThread) [sixxcreate.cpp:347]
*****
Initial log directory: /root/.sapinst/ascsvm1/20983
*****
****

-----
You are starting SAPinst using SAPINST_REMOTE_ACCESS_USER option.
Using this option within a GUI client requires the GUI user to be a trusted user because the
installation itself is running within privileged level.
Please refer to SAP Note #1745524.

-----
Please confirm (y/n):
```

4. On jbvm1, use the link <https://ascsvm1:4237/sapinst/docs/index.html>, login using the sapadmin user.

5. Select SAP S/4HANA Server 1809 > SAP HANA Database > Installation > High Availability System > ASCS Instance



General SAP System Parameters

Enter the SAP system ID.

SAP System

*SAP System ID (SAPSID)	<input type="text" value="SGH"/>
SAP Mount Directory	<input type="text" value="/sapmnt"/> []

Additional Information

The SAP System ID is an identifier for your SAP system. It must be unique throughout your system landscape. The system is installed under /usr/sap/<SAPSID>/.... Common directories are linked to <SAP Mount Directory>/<SAPSID>/...

It may take a while (approximately 15minutes to seach all the packages in this step).

DNS Domain Name

Enter the DNS domain name for the SAP system to calculate the fully qualified domain name (FQDN).

SAP System Domain Name

[] Set FQDN for SAP system	<input type="text"/>
DNS Domain Name for SAP System	<input type="text"/>

Master Password

Enter the master password for all users.

Master Password

The master password is used for all users that are created. Check the tool help for restrictions and dependencies.

*Password for All Users

.....

*Confirm

.....

SAP System Administrator

Enter the password of the SAP system administrator.

SAP System Administrator

Account: *sghadm*

*Password of SAP System Administrator

.....

*Confirm

.....

Software Package Browser

Specify the path to a download folder containing all software packages, or the paths to media locations or to several individual download locations of software packages.

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path

/usr/sap/S4H1809

**Archive Locations**

You can download the archives from the following locations on SAP Software Download Center:
[SAPEXE.SAR](#) (any version supporting your release)

SAP System Administrator

Enter the password of the SAP system administrator.

SAP System Administrator

Account: *sapadm*

*Password of SAP System Administrator

.....

*Confirm

.....

ASCS Instance

Enter the instance parameters for the ABAP central services (ASCS) instance.

ASCS Instance

The following SAP system instances already exist on this host:

SAP System ID (SAPSID)	Instance Name
*ASCS Instance Number	00
*ASCS Instance Host Name	sgh-asci-ilb

ABAP Message Server Ports

Enter the required message server ports.

ABAP Message Server Ports

*ABAP Message Server Port

3600

*Internal ABAP Message Server Port

3900

Additional Components to be Included in the ASCS Instance

Choose the additional components you want to have installed in the ASCS instance.

Enable Additional Components

- Install an SAP Web Dispatcher integrated in the ASCS instance
- Install a Gateway integrated in the ASCS instance

Cleanup of Operating System Users

Specify whether operating system users are to be removed from group 'sapinst' on UNIX (the group 'SAPINST' is to be removed from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Limit Installation Directory Access

The `sapinst_instdir` directory belongs to a group named `sapinst`. If this group is not available, it is created automatically as a local group. For security reasons, SAP recommends that you remove operating system users from group `sapinst` on UNIX (respectively remove group `SAPINST` from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Yes, clean up operating system users

Operating System Users to be Cleaned Up:

OS User
1 sghadm

Additional Information

Operating system users that are created during the execution of Software Provisioning Manager are added to the group `sapinst` on UNIX (respectively the group `SAPINST` is added to the operating system users on IBM i) as they need access to the `sapinst_instdir` directory. For operating system users that are not local, you either need the required administrator permissions or must adjust the `sapinst` group manually.

Define Parameters » Review Parameters » Execute Service » Service Completed

Parameter Summary
Choose 'Next' to start with the values shown. Otherwise, select the parameters to be changed and choose 'Revise'.

Parameter List

General SAP System Parameters

SAP System ID (SAPSID) SGH

SAP Mount Directory /sapmnt

DNS Domain Name

Set FQDN for SAP system

Master Password

Password for All Users *****

SAP System Administrator

Password of SAP System Administrator *****

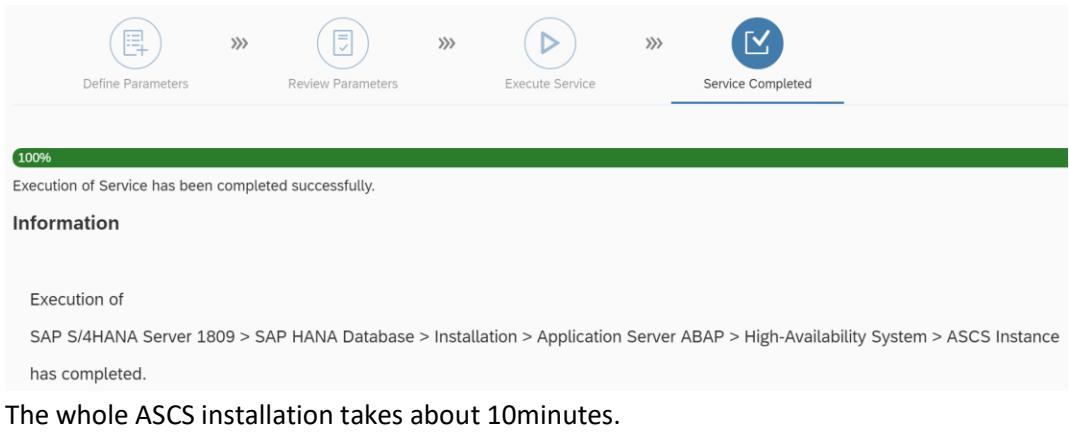
User ID

Group ID of sapsys

Software Package Browser

Define Parameters » Review Parameters » Execute Service » Service Completed

33%



The whole ASCS installation takes about 10minutes.

ERS Preparations

6. Create a virtual IP resource and health-probe for the ERS instance. Perform it on **FIRST node**.

```

sudo crm node online ascsvm2
sudo crm node standby ascsvm1

sudo crm configure primitive fs_SGH_ERS Filesystem device='sgh-nfs-ilb:/SGH/ASCSERS'
directory='/usr/sap/SGH/ERS02' fstype='nfs4' op start timeout=60s interval=0 op stop
timeout=60s interval=0 op monitor interval=20s timeout=40s

sudo crm configure primitive vip_SGH_ERS IPaddr2 params ip=10.12.0.50 cidr_netmask=24
op monitor interval=10 timeout=20

sudo crm configure primitive nc_SGH_ERS anything params binfile="/usr/bin/nc"
cmdline_options="-l -k 62102" op monitor timeout=20s interval=10 depth=0

# WARNING: Resources nc_SGH_ASCS,nc_SGH_ERS violate uniqueness for parameter
"binfile": "/usr/bin/nc"
# Do you still want to commit (y/n)? y

sudo crm configure group g-SGH_ERS fs_SGH_ERS nc_SGH_ERS vip_SGH_ERS

```

Verify the cluster status

```

Ascsvm1:/#crm_mon
Stack: corosync
Current DC: ascsvm2 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 1 21:41:38 2019
Last change: Wed May 1 21:40:44 2019 by root via cibadmin on ascsvm1

```

```
2 nodes configured
7 resources configured
```

```
Node ascsvm1: standby
Online: [ ascsvm2 ]
```

```
Active resources:
```

```
stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm2
fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
```

13 ERS Instance Installation

1. Copy the SWPM and installation bits to ascsvm2
2. Extract the SWPM using sapcar.exe -xvf SWPMSARFILE
 - a. Also extract the sapinst file inside the SWPM folder. If you don't use latest sapinst sometimes you get error in SWPM execution "manifest error".
3. Install the ERS instance. Perform it on **SECOND** node ascsvm2.

Install the Database Instance.

Create a user sapadmin on ascsvm2 node2.

```
Ascsvm2:~ # useradd -m sapadmin
ascsvm2:/usr/sap/HANAClientBits # passwd sapadmin
New password:
Retype new password:
passwd: password updated successfully
```

1. If installation fails, set the permission on /usr/sap folders. Do it on **SECOND** node.

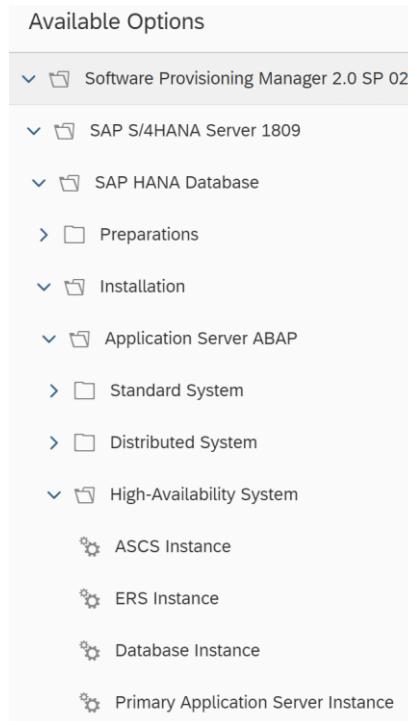
```
chown sghadm /usr/sap/SGH/ASCS00
chgrp sapsys /usr/sap/SGH/ASCS00
chown sghadm /usr/sap/SGH/ERS02
chgrp sapsys /usr/sap/SGH/ERS02

# if the command above gives error like 'chown: changing ownership of
# '/usr/sap/SGH/ERS02/': Operation not permitted', the run the following
# command and then run the chown command again
Ascsvm2:/usr/sap/SGH # sudo chattr -i ERS02
```

Select SAP S/4HANA Server 1809 > SAP HANA Database > Installation > High Availability System > ERS Instance

```
Ascsvm2:/usr/sap/SWPM # ./sapinst SAPINST_REMOTE_ACCESS_USER=sapadmin
```

Use <https://ascsvm2:4237/sapinst/docs/index.html> to access the installer.



General SAP System Parameters

Enter the profile directory of the SAP system.

SAP System Identification

Profile Directory

/usr/sap/SGH/SYS/profile

If you get error “**Cannot determine SAP system ID from profile directory /usr/sap/SGH/SYS/profile: DEFAULT.PFL does not exist.**” Then ensure that the mount points are available.

```
ascsvm2:/sapmnt/SGH # mount sgh-nfs-ilb:/SGH/sghsys /usr/sap/SGH/SYS
ascsvm2:/sapmnt/SGH # df -kh
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        14G   0  14G  0% /dev
tmpfs          21G  47M  21G  1% /dev/shm
tmpfs          14G  26M  14G  1% /run
tmpfs          14G   0  14G  0% /sys/fs/cgroup
/dev/sda4       29G  2.7G  25G 10% /
/dev/sda3     976M 102M 824M 11% /boot
/dev/sda2      200M 140K 200M  1% /boot/efi
/dev/sdc1      252G 2.1G 249G  1% /usr/sap
/dev/sdb1      55G  2.1G 51G  4% /mnt/resource
tmpfs          2.8G   0  2.8G  0% /run/user/0
tmpfs          2.8G   0  2.8G  0% /run/user/1001
sgh-nfs-ilb:/SGH/ASCERS 256G 1.4G 255G  1% /usr/sap/SGH/ERS02
sgh-nfs-ilb:/SGH/sghsys 256G 1.4G 255G  1% /usr/sap/SGH/SYS
```

sgh-nfs-ilb:/SGH/sapmntsgh 256G 1.4G 255G 1% /sapmnt/SGH

DNS Domain Name

Enter the DNS domain name for the SAP system to calculate the fully qualified domain name (FQDN).

SAP System Domain Name

Set FQDN for SAP system

DNS Domain Name for SAP System

Upgrade SAP Host Agent

Decide whether you want to upgrade the existing SAP Host Agent

Detected SAP Host Agent

Upgrade SAP Host Agent to the version of the provided SAPHOSTAGENT.SAR archive

ERS Instance

Enter the parameters for the ERS instance.

ERS Instance

The following instances were detected:

	SAP System ID	Instance Name	Instance Number
1	SGH	ASCS00	00

Name of the ASCS Instance to be Replicated

Number of the ASCS Instance to be Replicated

*Number of the ERS Instance

*ERS Instance Host

Activate Changes

Restart the ASCS instance to activate the applied changes.

Activation of Instance Changes

A restart of the ASCS instance and Windows service is required to activate the applied changes.

ASCS Instance Name

ASCS Instance Host

Automatic Instance and Service Restart

Cleanup of Operating System Users

Specify whether operating system users are to be removed from group sapinst on UNIX (the group 'SAPINST' is to be removed from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Limit Installation Directory Access

The sapinst_instdir directory belongs to a group named sapinst. If this group is not available, it is created automatically as a local group. For security reasons, SAP recommends that you remove operating system users from group sapinst on UNIX (respectively remove group sapinst from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Yes, clean up operating system users

Operating System Users to be Cleaned Up:

OS User
1 sghadmin

Parameter List General SAP System Parameters

Profile Directory

/usr/sap/SGH/SYS/profile

 DNS Domain Name Set FQDN for SAP system Upgrade SAP Host Agent Upgrade SAP Host Agent to the version of the provided SAPHOSTAGENT.SAR archive ERS Instance

Number of the ERS Instance

02

ERS Instance Host

ascsvm1

 Cleanup of Operating System Users Yes, clean up operating system users Media**Media**

	Medium	Package Location	Signature
1	Software Provisioning Manager	/usr/sap/SWPM	signed by SAP



Define Parameters



Review Parameters



Execute Service



Service Completed

44%

Creating system directories for SAP system SGH...



Define Parameters



Review Parameters



Execute Service



Service Completed

100%

Execution of Service has been completed successfully.

Information

Execution of

SAP S/4HANA Server 1809 > SAP HANA Database > Installation > Application Server ABAP > High-Availability System > ERS Instance has completed.

Installation takes about 5minutes.

14 Post installation activities for ASCS/ERS instances

This section describes the activity that needs to be performed after the ASCS and ERS installation is complete. Profiles are updated and the cluster resources for ASCS and ERS are created.

1. Adapt the profiles. Perform it on **FIRST** node.

- a. ASCS profile. DO it on FIRST node.

```
sudo vi /sapmnt/SGH/profile/SGH_ASCS00_sgh-ascss-ilb

# Change the restart command to a start command
#Restart_Program_00 = local ${_EN} pf=${_PF)
Start_Program_00 = local ${_EN} pf=${_PF)

# Add the following lines
service/halib = $(DIR_CT_RUN)/saphascriptco.so
service/halib_cluster_connector = /usr/bin/sap_suse_cluster_connector

# Add the keep alive parameter
enqueue/encni/set_so_keepalive = true
```

- b. ERS profile. Perform it on **FIRST** node.

```
sudo vi /sapmnt/SGH/profile/SGH_ERS02_sgh-ers-ilb

# Change the restart command to a start command
#Restart_Program_00 = local ${_ER} pf=${_PFL) NR=$(SCSID)
Start_Program_00 = local ${_ER} pf=${_PFL) NR=$(SCSID)

# Add the following lines
service/halib = $(DIR_CT_RUN)/saphascriptco.so
service/halib_cluster_connector = /usr/bin/sap_suse_cluster_connector

# remove Autostart from ERS profile
# Autostart = 1
```

2. Configure keep alive. Perform it on **BOTH** the ASCS nodes.

The communication between the SAP NetWeaver application server and the ASCS/SCS is routed through a software load balancer. The load balancer disconnects inactive connections after a configurable timeout. To prevent this you need to set a parameter in the SAP NetWeaver ASCS/SCS profile and change the Linux system settings.

```
# Change the Linux system configuration
sudo sysctl net.ipv4.tcp_keepalive_time=120
```

3. Configure SAP users. **Perform it on both the ASCS nodes.**

```
# Add sidadm to the haclient group
sudo usermod -aG haclient sghadm
```

4. Update sapservice file. **Run it on FIRST node.**

Add the ASCS service entry to the second node and copy the ERS service entry to the first node.

```
cat /usr/sap/sapservices | grep ASCS00 | sudo ssh ascsvm2 "cat >>/usr/sap/sapservices"
sudo ssh ascsvm2 "cat /usr/sap/sapservices" | grep ERS02 | sudo tee -a /usr/sap/sapservices
```

Entry in sapservice file before the above command was executed

```
ascsvm1:/sapmnt/SGH/profile # cat /usr/sap/sapservices
#!/bin/sh
LD_LIBRARY_PATH=/usr/sap/SGH/ASCS00/exe:$LD_LIBRARY_PATH; export
LD_LIBRARY_PATH; /usr/sap/SGH/ASCS00/exe/sapstartsrv
pf=/usr/sap/SGH/SYS/profile/SGH_ASCS00_sgh-ascs-ilb -D -u sghadm
```

Entry in sapservice file after the above command was executed

```
ascsvm1:/sapmnt/SGH/profile # cat /usr/sap/sapservices
#!/bin/sh
LD_LIBRARY_PATH=/usr/sap/SGH/ASCS00/exe:$LD_LIBRARY_PATH; export
LD_LIBRARY_PATH; /usr/sap/SGH/ASCS00/exe/sapstartsrv
pf=/usr/sap/SGH/SYS/profile/SGH_ASCS00_sgh-ascs-ilb -D -u sghadm
LD_LIBRARY_PATH=/usr/sap/SGH/ERS02/exe:$LD_LIBRARY_PATH; export LD_LIBRARY_PATH;
/usr/sap/SGH/ERS02/exe/sapstartsrv pf=/usr/sap/SGH/SYS/profile/SGH_ERS02_sgh-ers-ilb -D
-u sghadm
```

5. Create cluster resource. **Perform it on FIRST node.**

```
sudocrm configure property maintenance-mode="true"

sudocrm configure primitive rsc_sap_SGH_ASCS00 SAPIInstance operations
\$id=rsc_sap_SGH_ASCS00-operations op monitor interval=11 timeout=60 on_fail=restart
params InstanceName=SGH_ASCS00_sgh-ascs-ilb
START_PROFILE="/sapmnt/SGH/profile/SGH_ASCS00_sgh-ascs-ilb"
AUTOMATIC_RECOVER=false meta resource-stickiness=5000

sudocrm configure primitive rsc_sap_SGH_ERS02 SAPIInstance operations
\$id=rsc_sap_SGH_ERS02-operations op monitor interval=11 timeout=60 on_fail=restart
params InstanceName=SGH_ERS02_sgh-ers-ilb
START_PROFILE="/sapmnt/SGH/profile/SGH_ERS02_sgh-ers-ilb" AUTOMATIC_RECOVER=false
IS_ERS=true
```

```

sudocrm configure modgroup g-SGH_ASCS add rsc_sap_SGH_ASCS00
sudocrm configure modgroup g-SGH_ERS add rsc_sap_SGH_ERS02

sudocrm configure colocation col_sap_SGH_no_both -5000: g-SGH_ERS g-SGH_ASCS
sudocrm configure order ord_sap_SGH_first_start_ascs Optional: rsc_sap_SGH_ASCS00:start
rsc_sap_SGH_ERS02:stop symmetrical=false

sudocrm node online ascsvm1
sudocrm configure property maintenance-mode="false"

```

At this time, crm_mon should show like below

```

Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Sun May 5 00:31:46 2019
Last change: Sun May 5 00:31:42 2019 by root via cibadmin on ascsvm1

2 nodes configured
9 resources configured

Online: [ ascsvm1 ascsvm2 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIInstance): Started ascsvm1
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm1
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIInstance): Started ascsvm2

```

Also file system mount looks like below

```

ascsvm1:/sapmnt/SGH/profile # df -kh

```

Filesystem	Size	Used	Avail	Use%	Mounted on
devtmpfs	14G	0	14G	0%	/dev
tmpfs	21G	56M	21G	1%	/dev/shm
tmpfs	14G	122M	14G	1%	/run
tmpfs	14G	0	14G	0%	/sys/fs/cgroup
/dev/sda4	29G	2.6G	25G	10%	/
/dev/sda3	976M	102M	824M	11%	/boot
/dev/sda2	200M	140K	200M	1%	/boot/efi
/dev/sdc1	252G	31G	220G	13%	/usr/sap

```
/dev/sdb1      55G 2.1G 51G 4% /mnt/resource
tmpfs         2.8G 0 2.8G 0% /run/user/0
sgh-nfs-ilb:/SGH/sghsys 256G 1.1G 255G 1% /usr/sap/SGH/SYS
sgh-nfs-ilb:/SGH/sapmntsgh 256G 1.1G 255G 1% /sapmnt/SGH
sgh-nfs-ilb:/SGH/trans   256G 1.1G 255G 1% /usr/sap/trans
sgh-nfs-ilb:/SGH/ASCS    256G 1.1G 255G 1% /usr/sap/SGH/ASCS00
tmpfs         2.8G 0 2.8G 0% /run/user/1003

ascsvm2:/usr/sap/S4H1809 # df -kh
Filesystem      Size Used Avail Use% Mounted on
devtmpfs        14G 4.0K 14G 1% /dev
tmpfs          21G 62M 21G 1% /dev/shm
tmpfs          14G 218M 14G 2% /run
tmpfs          14G 0 14G 0% /sys/fs/cgroup
/dev/sda4       29G 2.5G 25G 10% /
/dev/sda3       976M 102M 824M 11% /boot
/dev/sda2       200M 140K 200M 1% /boot/efi
/dev/sdb1       55G 2.1G 51G 4% /mnt/resource
tmpfs          2.8G 0 2.8G 0% /run/user/0
sgh-nfs-ilb:/SGH/sghsys 256G 1.1G 255G 1% /usr/sap/SGH/SYS
sgh-nfs-ilb:/SGH/trans   256G 1.1G 255G 1% /usr/sap/trans
/dev/sdc1       252G 31G 221G 13% /usr/sap
sgh-nfs-ilb:/SGH/trans   256G 1.1G 255G 1% /usr/sap/trans
sgh-nfs-ilb:/SGH/sapmntsgh 256G 1.1G 255G 1% /sapmnt/SGH
sgh-nfs-ilb:/SGH/ASCERS  256G 1.1G 255G 1% /usr/sap/SGH/ERS02
```

6. Install the hana database client on ASCSVM node 2 (ascsvm2). SAPinst didn't install the client. **– should not be required.**

- Copy the HANA Client installation bits on ASCSVm2
- Install the client. Before installing, create a folder hdbclient under /usr/sap/SGH. And change the ownership from root to sghadm using command

```
ascsvm2:~ # chown sghadm /usr/sap/SGH/hdbclient/
```

```
sghadm@ascsvm2:/usr/sap/HANAClientBits/SAP_HANA_CLIENT> ./hdbinst
SAP HANA Database Client installation kit detected.
```

```
SAP HANA Lifecycle Management - Client Installation 2.4.126.1551801496
*****
```

```
Enter Installation Path [/home/sghadm/sap/hdbclient]: /usr/sap/SGH/hdbclient
```

7. Update the hdbuserstore to update the user store entries

```
# on node1
```

```
ascsvm1:sghadm 66> hdbuserstore List
DATA FILE    : /home/sghadm/.hdb/ascsvm1/SSFS_HDB.DAT
KEY FILE    : /home/sghadm/.hdb/ascsvm1/SSFS_HDB.KEY

KEY DEFAULT
ENV : hanavm1:30013
USER: SAPHANADB
DATABASE: SGH
```

Change it on node1

```
ascsvm1:sghadm 67> hdbuserstoreSET DEFAULT hanadb-ilb30013@SGH SAPHANADB
<Password>
hdbuserstoreSET: Command not found.
ascsvm1:sghadm 68> hdbuserstore SET DEFAULT hanadb-ilb30013@SGH SAPHANADB
<MyPassword>
ascsvm1:sghadm 69> hdbuserstore List
DATA FILE    : /home/sghadm/.hdb/ascsvm1/SSFS_HDB.DAT
KEY FILE    : /home/sghadm/.hdb/ascsvm1/SSFS_HDB.KEY

KEY DEFAULT
ENV : hanadb-ilb30013
USER: SAPHANADB
DATABASE: SGH
```

8. Create userstore entries on asc node2

```
ascsvm2:sghadm 64> hdbuserstore list
DATA FILE    : /home/sghadm/.hdb/ascsvm2/SSFS_HDB.DAT
```

Add an entry

```
ascsvm2:sghadm 65> hdbuserstore SET DEFAULT hanadb-ilb30013@SGH SAPHANADB
<Password>

ascsvm2:sghadm 66> hdbuserstore list
DATA FILE    : /home/sghadm/.hdb/ascsvm2/SSFS_HDB.DAT
KEY FILE    : /home/sghadm/.hdb/ascsvm2/SSFS_HDB.KEY

KEY DEFAULT
ENV : hanadb-ilb30013
USER: SAPHANADB
DATABASE: SGH
```

15 Database Instance Installation

Run it on first asc node.

```
Ascsvm1:/usr/sap/SWPM # ./sapinst SAPINST_REMOTE_ACCESS_USER=sapadmin
```

Select SAP S/4HANA Server 1809 > SAP HANA Database > Installation > High Availability System > Database Instance

General SAP System Parameters
Enter the profile directory of the SAP system.

SAP System Identification

Profiles Available

Profile Directory

Additional Information

Existing parameters are retrieved from the SAP system profile directory. The location of your SAP system profile directory is as follows:

- Windows: \\<SAPGLOBALHOST>\sapmnt\<SAPSID>\SYS\profile
- UNIX and IBM i: /<SAP Mount Directory>/<SAPSID>/profile **OR** /usr/sap/<SAPSID>/SYS/profile

Master Password
Enter the master password for all users.

Master Password

The master password is used for all users that are created. Check the tool help for restrictions and dependencies.

*Password for All Users

*Confirm

DNS Domain Name
Enter the DNS domain name for the SAP system to calculate the fully qualified domain name (FQDN).

SAP System Domain Name

Set FQDN for SAP system

DNS Domain Name for SAP System

Database for SAP System

Enter the database parameters.

SAP HANA Database Tenant

*Database Host	hanadb-ilb
*Instance Number of the SAP HANA Database	00
*Database ID (DBSID)	SGH
*Password of the Database System Administrator (User: SYSTEM)	*****

SAP HANA Multitenant Database Containers

Enter the database parameters for the system database.

System Database

Database Host	hanadb-ilb
Instance Number of the SAP HANA Database	00
System Database Name	SystemDB
*Password of the System Database Adminstrator (User: SYSTEM)	*****

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path

Archive Locations

This step take 15-20 minutes to scan the directory.

Upgrade SAP Host Agent

Decide whether you want to upgrade the existing SAP Host Agent

Detected SAP Host Agent

Upgrade SAP Host Agent to the version of the provided SAPHOSTAGENT.SAR archive

Detected Packages

	Package Name	Individual Package Location	Status
1	S4HANA1809CORE HANA DB Export 1	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_1.zip	Available
2	S4HANA1809CORE HANA DB Export 10	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_10.zip	Available
3	S4HANA1809CORE HANA DB Export 11	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_11.zip	Available
4	S4HANA1809CORE HANA DB Export 12	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_12.zip	Available
5	S4HANA1809CORE HANA DB Export 13	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_13.zip	Available
6	S4HANA1809CORE HANA DB Export 14	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_14.zip	Available
7	S4HANA1809CORE HANA DB Export 15	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_15.zip	Available
8	S4HANA1809CORE HANA DB Export 16	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_16.zip	Available
9	S4HANA1809CORE HANA DB Export 17	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_17.zip	Available
10	S4HANA1809CORE HANA DB Export 18	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_18.zip	Available
11	S4HANA1809CORE HANA DB Export 19	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_19.zip	Available
12	S4HANA1809CORE HANA DB Export 2	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_2.zip	Available
13	S4HANA1809CORE HANA DB Export 20	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_20.zip	Available
14	S4HANA1809CORE HANA DB Export 3	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_3.zip	Available
15	S4HANA1809CORE HANA DB Export 4	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_4.zip	Available
16	S4HANA1809CORE HANA DB Export 5	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_5.zip	Available
17	S4HANA1809CORE HANA DB Export 6	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_6.zip	Available
18	S4HANA1809CORE HANA DB Export 7	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_7.zip	Available
19	S4HANA1809CORE HANA DB Export 8	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_8.zip	Available
20	S4HANA1809CORE HANA DB Export 9	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_9.zip	Available

Database Schema

Enter the database schema password.

Database Schema

Database ID

SGH

Database Host

hanadb-ilb

Instance Number of the SAP HANA Database

00

Schema

DBACOCKPIT

 Drop Existing Schema***Schema Password**

***Confirm**

Database Schema

Enter the database schema password.

Database Schema

Database ID

SGH

Database Host

hanadb-ilb

Instance Number of the SAP HANA Database

00

Schema

SAPHANADB

Drop Existing Schema

*Schema Password

*Confirm

SAP HANA Import Parameters

Enter the import parameters.

SAP HANA Import

Import Parameters

	*Configuration File	*Section	*Parameter Name	*Parameter Value	Keep after Import
1	indexserver.ini	distribution	client_distribution_mode	statement	<input checked="" type="checkbox"/>
2	global.ini	table_placement	method	2	<input checked="" type="checkbox"/>
3	global.ini	table_placement	prefix	/	<input checked="" type="checkbox"/>
4	indexserver.ini	optimize_compression	min_hours_since_last_merge_of_part	0	<input type="checkbox"/>
5	indexserver.ini	mergedog	num_merge_token	200	<input type="checkbox"/>
6	indexserver.ini	mergedog	token_per_table	2	<input type="checkbox"/>
7	indexserver.ini	mergedog	critical_merge_decision_func	DMS>12000 and (DUC<0.1 or 0.05*DRC>=DUC)	<input type="checkbox"/>
8	indexserver.ini	mergedog	auto_merge_decision_func	DMS>5000 and (DUC<0.1 or 0.05*DRC>=DUC)	<input type="checkbox"/>
9	global.ini	persistence	savepoint_interval_s	300	<input type="checkbox"/>
10	global.ini	persistence	log_mode	overwrite	<input type="checkbox"/>

Ensure you have hanadb-ilb and its IP 10.12.1.5 added to the jump box hosts file. Otherwise web browser for sapinst installation can't resolve the wsdl below.

Installation Export

Specify installation export load options and SAPControl connect data.

Installation Export Load Options

*Number of Parallel Jobs

19

SAP HANA Authentication

*HANA<dbsid>adm

sghadm

*Password of HANA<dbsid>adm

*SAPControl WSDL URL

<http://hanadb-ilb:50013/SAPControl?wsdl>

SAP HANA Client Software Installation Path

Decide on the client path strategy.

Client Path Strategy

Client Software Path

- Local Client Directory
- Central Client Directory

Software Package Browser

Specify the path to a download folder containing all software packages, or the paths to media locations or to several individual download locations of software packages.

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path



Archive Locations

You can download the archives from the following locations on SAP Software Download Center:
[SAP HANA CLIENT](#)

The table below is updated with all packages detected at the specified *Package Path* when you choose *Next*.

While staying on this screen you can add or adjust paths for required packages by searching other locations. When all archives are specified and you do not wish to make any further adjustments, I

Archive Scanning Information

An [information file](#) is written after the archives have been scanned. There you can find detailed information about matching and non matching archive files.
 This information file contains only results of the latest archive scan.

Detected Packages

	Package Name	Individual Package Location	Status
1	SAP HANA CLIENT		Still missing

Cleanup of Operating System Users

Specify whether operating system users are to be removed from group `sapinst` on UNIX (the group `SAPINST` is to be removed from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Limit Installation Directory Access

The `sapinst_instdir` directory belongs to a group named `sapinst`. If this group is not available, it is created automatically as a local group. For security reasons, SAP recommends that you remove operating system users from group `sapinst` on UNIX (respectively remove group `sapinst` from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Yes, clean up operating system users

Operating System Users to be Cleaned Up:

	OS User
1	sghadm

Parameter List General SAP System Parameters Profiles Available

Profile Directory

/usr/sap/SGH/SYS/profile

 Master Password

Password for All Users

 DNS Domain Name Set FQDN for SAP system Database for SAP System

Database Host

hanadb-ilb

Instance Number of the SAP HANA Database

00

Database ID (DBSID)

SGH

Password of the Database System Administrator (User: SYSTEM)

 SAP HANA Multitenant Database Containers

Password of the System Database Administrator (User: SYSTEM)

 Software Package Browser**Detected Packages**

	Package Name	Individual Package Location	Status
1	SAPEXE.SAR (any version supporting your release)	/usr/sap/S4H1809/SAPEXE_28-80003386.SAR	Available
2	SAPEXEDB.SAR (matching SAPEXE Version and Patch)	/usr/sap/S4H1809/SAPEXEDB_28-80003385.SAR	Available

 Upgrade SAP Host Agent Upgrade SAP Host Agent to the version of the provided SAPHOSTAGENT.SAR archive Software Package Browser**Detected Packages**

	Package Name	Individual Package Location	Status
1	S4HANA1809CORE HANA DB Export 1	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_1.zip	Available
2	S4HANA1809CORE HANA DB Export 10	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_10.zip	Available
3	S4HANA1809CORE HANA DB Export 11	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_11.zip	Available
4	S4HANA1809CORE HANA DB Export 12	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_12.zip	Available

4	S4HANA1809CORE HANA DB Export 12	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_12.zip	Available
5	S4HANA1809CORE HANA DB Export 13	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_13.zip	Available
6	S4HANA1809CORE HANA DB Export 14	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_14.zip	Available
7	S4HANA1809CORE HANA DB Export 15	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_15.zip	Available
8	S4HANA1809CORE HANA DB Export 16	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_16.zip	Available
9	S4HANA1809CORE HANA DB Export 17	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_17.zip	Available
10	S4HANA1809CORE HANA DB Export 18	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_18.zip	Available
11	S4HANA1809CORE HANA DB Export 19	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_19.zip	Available
12	S4HANA1809CORE HANA DB Export 2	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_2.zip	Available
13	S4HANA1809CORE HANA DB Export 20	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_20.zip	Available
14	S4HANA1809CORE HANA DB Export 3	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_3.zip	Available
15	S4HANA1809CORE HANA DB Export 4	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_4.zip	Available
16	S4HANA1809CORE HANA DB Export 5	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_5.zip	Available
17	S4HANA1809CORE HANA DB Export 6	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_6.zip	Available
18	S4HANA1809CORE HANA DB Export 7	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_7.zip	Available
19	S4HANA1809CORE HANA DB Export 8	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_8.zip	Available
20	S4HANA1809CORE HANA DB Export 9	/usr/sap/S4H1809/S4CORE103_INST_EXPORT_9.zip	Available

Database Schema

Schema Password

Database Schema

Schema Password

SAP HANA Import Parameters

Import Parameters

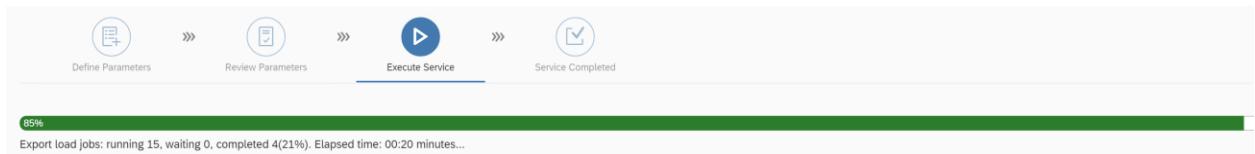
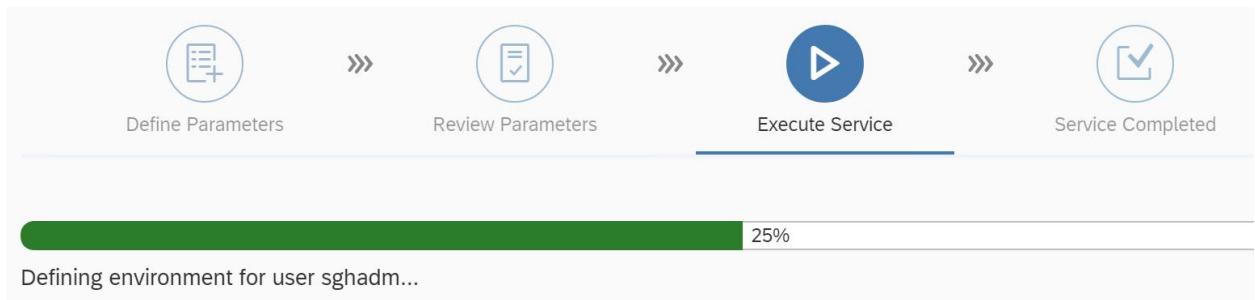
	Configuration File	Section	Parameter Name	Parameter Value	Keep after Import
1	indexserver.ini	distribution	client_distribution_mode	statement	<input checked="" type="checkbox"/>
2	global.ini	table_placement	method	2	<input checked="" type="checkbox"/>
3	global.ini	table_placement	prefix	/	<input checked="" type="checkbox"/>
4	indexserver.ini	optimize_compression	min_hours_since_last_merge_of_part	0	<input type="checkbox"/>
5	Indexserver.ini	mergedog	num_merge_token	200	<input type="checkbox"/>
6	indexserver.ini	mergedog	token_per_table	2	<input type="checkbox"/>
7	indexserver.ini	mergedog	critical_merge_decision_func	DMS>12000 and (DUC<0.1 or 0.05*DRC>=DUC)	<input type="checkbox"/>
8	indexserver.ini	mergedog	auto_merge_decision_func	DMS>5000 and (DUC<0.1 or 0.05*DRC>=DUC)	<input type="checkbox"/>
9	global.ini	persistence	savepoint_interval_s	300	<input type="checkbox"/>
10	global.ini	persistence	log_mode	overwrite	<input type="checkbox"/>

Installation Export

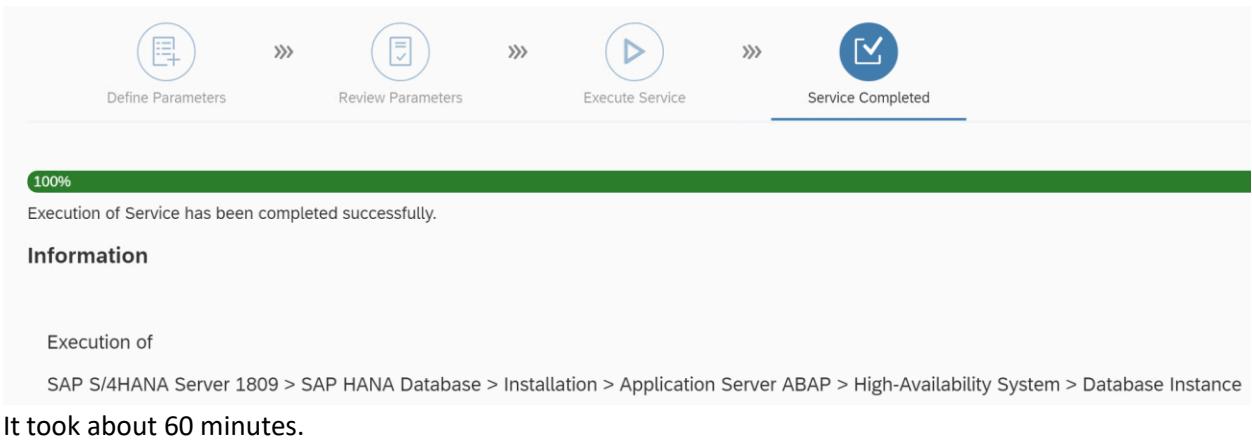
Number of Parallel Jobs

19

<input type="checkbox"/> Installation Export															
Number of Parallel Jobs	19														
HANA<dbsid>adm	sghadm														
Password of HANA<dbsid>adm	*****														
SAPControl WSDL URL	http://hanadb-ilb:50013/SAPControl?wsdl														
<input type="checkbox"/> SAP HANA Client Software Installation Path															
Client Software Path	<input checked="" type="radio"/> Local Client Directory <input type="radio"/> Central Client Directory														
<input type="checkbox"/> Software Package Browser															
Detected Packages <table border="1"> <thead> <tr> <th></th> <th>Package Name</th> <th>Individual Package Location</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>SAP HANA CLIENT</td> <td>/usr/sap/HANAClient/MDB_CLIENT20_004_126-80002082.SAR</td> <td>Available</td> </tr> </tbody> </table>					Package Name	Individual Package Location	Status	1	SAP HANA CLIENT	/usr/sap/HANAClient/MDB_CLIENT20_004_126-80002082.SAR	Available				
	Package Name	Individual Package Location	Status												
1	SAP HANA CLIENT	/usr/sap/HANAClient/MDB_CLIENT20_004_126-80002082.SAR	Available												
<input type="checkbox"/> Cleanup of Operating System Users															
<input type="checkbox"/> Yes, clean up operating system users															
<input type="checkbox"/> Media															
Media <table border="1"> <thead> <tr> <th></th> <th>Medium</th> <th>Package Location</th> <th>Signature</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Software Provisioning Manager</td> <td>/usr/sap/SWPM</td> <td>signed by SAP</td> </tr> </tbody> </table>					Medium	Package Location	Signature	1	Software Provisioning Manager	/usr/sap/SWPM	signed by SAP				
	Medium	Package Location	Signature												
1	Software Provisioning Manager	/usr/sap/SWPM	signed by SAP												
<input type="checkbox"/> Detected Packages Summary															
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	Package Name	Package Location	Signature												
1	SAPEXE.SAR (any version supporting your release)	/usr/sap/S4H1809/SAPEXE_28-80003386.SAR	signed by SAP												
2	SAPEXEDB.SAR (matching SAPEXE Version and Patch)	/usr/sap/S4H1809/SAPEXEDB_28-80003385.SAR	signed by SAP												



Database size in memory originally was about 26GB, after install it is 76GB.



16 Primary Application Server Installation (PAS)

9. Partition the disk (256GB we added to the VM) with mount point name /usr/sap using yast. Use Ext4 file system.
10. Update the OS.

```
#Zypper update
```

11. Copy the SWPM to the PAS application server (pasvm1) from ascsvm1 server

```
scp -r /usr/sap/SWPM pasvm1:/usr/sap/SWPM
```

12. Prepare the PAS server for application server installation

- a. Configure operating system to reduce dirty cache size.

```
sudo vi /etc/sysctl.conf

# Change/set the following settings
vm.dirty_bytes = 629145600
vm.dirty_background_bytes = 314572800
```

- b. Setup hostname resolution

```
#update /etc/hosts
vi /etc/hosts

#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3
# nfs nodes
10.12.0.12      nfsvm1
10.12.0.10      nfsvm2
#ascsv nodes
10.12.0.8      ascsvm1
10.12.0.11      ascsvm2
```

```
#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascs-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1

# pasvm
10.12.0.4      pasvm1
```

c. Create sapmnt directory

```
sudo mkdir -p /sapmnt/SGH
sudo mkdir -p /usr/sap/trans

sudo chattr +i /sapmnt/SGH
sudo chattr +i /usr/sap/trans
```

d. Configure autofs

```
sudo vi /etc/auto.master

# Add the following line to the file, save and exit
+auto.master
/- /etc/auto.direct
```

Create a file auto.direct

```
sudo vi /etc/auto.direct

# Add the following lines to the file, save and exit
/sapmnt/SGH -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/SGH/sapmntsgh
/usr/sap/trans -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/SGH/trans
```

Restart autofs to mount the new shares

```
sudo systemctl enable autofs
sudo service autofs restart
```

e. Configure SWAP file

```
sudo vi /etc/waagent.conf
```

```
# Set the property ResourceDisk.EnableSwap to y  
# Create and use swapfile on resource disk.  
ResourceDisk.EnableSwap=y  
  
# Set the size of the SWAP file with property ResourceDisk.SwapSizeMB  
# The free space of resource disk varies by virtual machine size. Make sure that you  
do not set a value that is too big. You can check the SWAP space with command  
swapon  
# Size of the swapfile.  
ResourceDisk.SwapSizeMB=2000
```

Restart the agent

```
sudo service waagent restart
```

13. Install the SAP PAS Instance

Ensure that user sapadmin is already created on pasvm1 server.

```
pasvm1:~ # useradd -m sapadmin  
pasvm1:~ # passwd sapadmin  
New password:  
Retype new password:  
passwd: password updated successfully
```

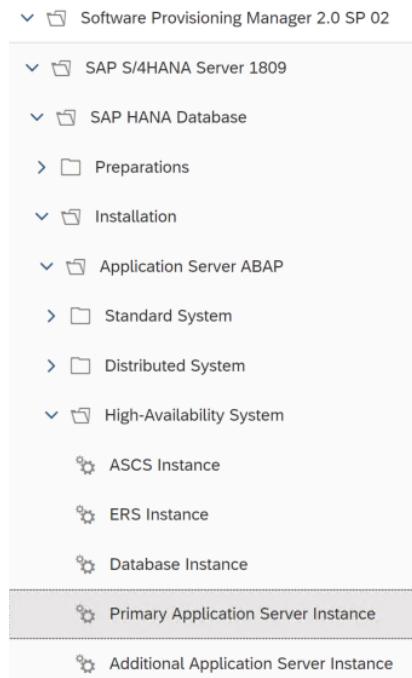
```
#pasvm1:/usr/sap/SWPM # ./sapinst SAPINST_REMOTE_ACCESS_USER=sapadmin
```

Open your browser and paste the following URL address to access the GUI

<https://pasvm1:4237/sapinst/docs/index.html>

Logon users: [sapadmin]

Select SAP S/4HANA Server 1809 > SAP HANA Database > Installation > High Availability >
Primary application server Instance



Parameter Settings

Choose whether you want to run the installation in a typical or a custom mode.

Parameter Settings

Parameter Mode

- Typical
- Custom

General SAP System Parameters

Enter the profile directory of the SAP system.

SAP System Identification

Profile Directory

/sapmnt/SGH/profile

ABAP Message Server

Provide the ABAP message server port

Connection to Message Server

Message Server Port

3600

Master Password

Enter the master password for all users.

Master Password

The master password is used for all users that are created. Check the tool help for restrictions and dependencies.

*Password for All Users

*Confirm

Operating System Users

Enter the account parameters.

SAP System Administrator

Account: *sghadm*

*Password of SAP System Administrator

*Confirm

User ID

1002

Group ID of sapsys

1001

Login Shell

/bin/csh

Home Directory

DNS Domain Name

Enter the DNS domain name for the SAP system to calculate the fully qualified domain name (FQDN).

SAP System Domain Name

Set FQDN for SAP system

DNS Domain Name for SAP System

Software Package Browser

Specify the path to a download folder containing all software packages, or the paths to media locations or to several individual download locations of software packages.

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path

/usr/sap/S4H18094APPInst



Detected Packages

	Package Name	Individual Package Location	Status
1	SAPEXE.SAR (any version supporting your release)	/usr/sap/S4H18094APPInst/SAPEXE_28-80003386.SAR	Available
2	SAPEXEDB.SAR (matching SAPEXE Version and Patch)	/usr/sap/S4H18094APPInst/SAPEXEDB_28-80003385.SAR	Available
3	IGSEXE.SAR	/usr/sap/S4H18094APPInst/igsexe_8-80003187.sar	Available
4	IGSHELPER.SAR	/usr/sap/S4H18094APPInst/igshelper_17-10010245.sar	Available

Software Package Browser

Specify the path to a download folder containing all software packages, or the paths to media locations or to several individual download locations of software packages.

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path

/usr/sap/S4H18094APPInst

**Detected Packages**

	Package Name	Individual Package Location	Status
1	SAPHOSTAGENT.SAR 721 (Latest Patch)		Still missing

Detected Packages

	Package Name	Individual Package Location	Status
1	SAPHOSTAGENT.SAR 721 (Latest Patch)	/usr/sap/S4H18094APPInst/SAPHOSTAGENT41_41-20009394.SAF	Available

SAP System Administrator

Enter the password of the SAP system administrator.

SAP System AdministratorAccount: *sapadm*

*Password of SAP System Administrator

*Confirm

User ID

Group ID of sapsys

1001

SAP HANA Client Software Installation Path

Decide on the client path strategy.

Client Path Strategy

Client Software Path

 Local Client Directory

 Central Client Directory

SAP HANA Database System Administrator

Enter the password of the database system administrator.

SAP HANA Database System Administrator Password

Database ID

SGH

Database Host

hanadb-ilb

*Instance Number of the SAP HANA Database

00

*Password of the Database System Administrator
(User: SYSTEM)

 Initialize Database Tenant**SAP HANA Multitenant Database Containers**

Enter the database parameters for the system database.

System Database

Database ID (DBSID)

SYSTEMDB

*Database Host

hanadb-ilb

*Instance Number of the SAP HANA Database

00

*Password of the SAP HANA Database Superuser

Tenant Database

Tenant ID

SGH

 Recreate Database Tenant

Database Schema

Enter the database schema password.

Database Schema

Database ID

SGH

Database Host

hanadb-ilb

Instance Number of the SAP HANA Database

00

Schema

DBACOCKPIT

Drop Existing Schema

*Schema Password

*Confirm

Database Schema

Enter the database schema password.

Database Schema

Database ID

SGH

Database Host

hanadb-ilb

Instance Number of the SAP HANA Database

00

Schema

SAPHANADB

Drop Existing Schema

*Schema Password

*Confirm

Software Package Browser

Specify the path to a download folder containing all software packages, or the paths to media locations or to several individual download locations of software packages.

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path

/usr/sap/S4H18094APPInst



Archive Locations

Detected Packages			
	Package Name	Individual Package Location	Status
1	SAP HANA CLIENT		Still missing

Detected Packages			
	Package Name	Individual Package Location	Status
1	SAP HANA CLIENT	/usr/sap/S4H18094APPInst/IMDB_CLIENT20_004_126-80002082.	Available

Primary Application Server Instance

Enter the instance parameters for the primary application server (PAS) instance.

Primary Application Server Instance

The following SAP system instances already exist on this host:

	SAP System ID (SAPSID)	Instance Name
*PAS Instance Number	10	
*PAS Instance Host Name		pasvm1

ABAP Message Server Ports

Enter the required message server ports.

ABAP Message Server Ports

*ABAP Message Server Port	3600
*Internal ABAP Message Server Port	3900

ICM User Management for the SAP Web Dispatcher

Enter the password for the web administration user'webadm'used by the SAP Web Dispatcher.

Internet Communication Manager (ICM) User Management

*Password of 'webadm'	*****
*Confirm	*****

SLD Destination for the SAP System OS Level

Enter the destination of the System Landscape Directory (SLD).

Register in System Landscape Directory

SLD Destination

- Use existing SLD for registration
- No SLD destination

Message Server Access Control List

Specify if you want to have a message server Access Control List (ACL) created.

Message Server Access Control List

- Create Message Server Access Control List
- Do not create Message Server Access Control List

SAP System DDIC Users

Enter the password of DDIC user.

DDIC User

- DDIC User Has a Password Different From Default

DDIC Password

Account: *DDIC, client 000*

Password of DDIC in Client 000

Secure Storage Key Generation

Decide whether you want to generate an individual key for the secure storage of the SAP system.

Secure Storage Individual Key Information

- Individual Key (Recommended for Productive Systems)
- Default Key

Cleanup of Operating System Users

Specify whether operating system users are to be removed from group sapinst on UNIX (the group SAPINST is to be removed from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Limit Installation Directory Access

The sapinst_instdir directory belongs to a group named sapinst. If this group is not available, it is created automatically as a local group. For security reasons, SAP recommends that you remove operating system users from group sapinst on UNIX (respectively remove group SAPINST from the operating system users on IBM i) after the execution of Software Provisioning Manager has completed.

Yes, clean up operating system users

Operating System Users to be Cleaned Up:

	OS User
1	sghadm

Parameter Summary

Choose 'Next' to start with the values shown. Otherwise, select the parameters through other screens that have so far been processed.

Parameter List

Parameter Settings

Parameter Mode

Typical

Custom

General SAP System Parameters

Profile Directory

/sapmnt/SGH/profile

ABAP Message Server

Message Server Port

3600

Message Server Port	3600
<input type="checkbox"/> Master Password	*****
Password for All Users	*****
<input type="checkbox"/> Operating System Users	*****
Password of SAP System Administrator	*****
Login Shell	/bin/csh
Home Directory	
<input type="checkbox"/> DNS Domain Name	
<input type="checkbox"/> Set FQDN for SAP system	
<input type="checkbox"/> Software Package Browser	

Detected Packages

	Package Name	Individual Package Location	Status
1	SAPEXE.SAR (any version supporting your release)	/usr/sap/S4H18094APPInst/SAPEXE_28-80003386.SAR	Available
2	SAPEXEDB.SAR (matching SAPEXE Version and Patch)	/usr/sap/S4H18094APPInst/SAPEXEDB_28-80003385.SAR	Available
3	IGSEXE.SAR	/usr/sap/S4H18094APPInst/igsexe_8-80003187.sar	Available
4	IGSHELPER.SAR	/usr/sap/S4H18094APPInst/igshelper_17-10010245.sar	Available

 Software Package Browser**Detected Packages**

	Package Name	Individual Package Location	Status
1	SAPHOSTAGENT.SAR 721 (Latest Patch)	/usr/sap/S4H18094APPInst/SAPHOSTAGENT41_41-20009394.SAF	Available

<input type="checkbox"/> SAP System Administrator	
Password of SAP System Administrator	*****
User ID	
<hr/>	
<input type="checkbox"/> SAP HANA Client Software Installation Path	
Client Software Path	
<input checked="" type="radio"/> Local Client Directory	
<input type="radio"/> Central Client Directory	
<hr/>	
<input type="checkbox"/> SAP HANA Database System Administrator	
Instance Number of the SAP HANA Database	00
Password of the Database System Administrator (User: SYSTEM)	*****
<hr/>	
<input type="checkbox"/> SAP HANA Multitenant Database Containers	
 <hr/>	
<input type="checkbox"/> SAP HANA Multitenant Database Containers	
Database Host	hanadb-ilb
Instance Number of the SAP HANA Database	00
Password of the SAP HANA Database Superuser	*****
<hr/>	
<input type="checkbox"/> Database Schema	
Schema Password	*****
<hr/>	
<input type="checkbox"/> Database Schema	
Schema Password	*****
<hr/>	
<input type="checkbox"/> Software Package Browser	

Detected Packages			
	Package Name	Individual Package Location	Status
1	SAP HANA CLIENT	/usr/sap/S4H18094APPInst/IMDB_CLIENT20_004_126-80002082.	Available

Primary Application Server Instance

PAS Instance Number

PAS Instance Host Name

ABAP Message Server Ports

ABAP Message Server Port

Internal ABAP Message Server Port

Internal ABAP Message Server Port	<input type="text" value="3900"/>
-----------------------------------	-----------------------------------

ICM User Management for the SAP Web Dispatcher

Password of 'webadm'

SLD Destination for the SAP System OS Level

SLD Destination

Use existing SLD for registration

No SLD destination

SLD destinations are required for the SAP System OS level. If no SLD destination is selected, the SAP System OS level will not be available.

Message Server Access Control List

Create Message Server Access Control List

Do not create Message Server Access Control List

Detected Packages

	Package Name	Individual Package Location	Status
1	S4HANA1809CORE HANA DB Export 1	/usr/sap/S4H18094APPInst/S4CORE103_INST_EXPORT_1.zip	Available

SAP System DDIC Users

DDIC User Has a Password Different From Default

Secure Storage Key Generation

Individual Key (Recommended for Productive Systems)

Default Key

Cleanup of Operating System Users

Yes, clean up operating system users

Media

	Medium	Package Location	Signature
1	Software Provisioning Manager	/usr/sap/SWPM	signed by SAP

Detected Packages Summary

Detected Packages

	Package Name	Package Location	Signature
1	SAPEXE.SAR (any version supporting your release)	/usr/sap/S4H18094APPInst/SAPEXE_28-80003386.SAR	signed by SAP
2	SAPEXEDB.SAR (matching SAPEXE Version and Patch)	/usr/sap/S4H18094APPInst/SAPEXEDB_28-80003385.SAR	signed by SAP
3	IGSEXE.SAR	/usr/sap/S4H18094APPInst/igsexe_8-80003187.sar	signed by SAP
4	IGSHELPER.SAR	/usr/sap/S4H18094APPInst/igselper_17-10010245.sar	signed by SAP
5	SAPHOSTAGENT.SAR 721 (Latest Patch)	/usr/sap/S4H18094APPInst/SAPHOSTAGENT41_41-20009394.SAF	signed by SAP



Define Parameters



Review Parameters



Execute Service



Service Completed

23%



Define Parameters



Review Parameters



Execute Service



Service Completed

100%

Execution of Service has been completed successfully.

It takes about 15minutes

14. Create the hdbuser on PAS

```
# current status
pasvm1:sghadm 61> hdbuserstore List
DATA FILE    : /home/sghadm/.hdb/pasvm1/SSFS_HDB.DAT
KEY FILE    : /home/sghadm/.hdb/pasvm1/SSFS_HDB.KEY

KEY DEFAULT
ENV : hanavm1:30013
USER: SAPHANADB
DATABASE: SGH
```

```
# execute the following

pasvm1:sghadm 66> hdbuserstore SET DEFAULT hanadb-ilb:30013@SGH SAPHANADB
<Password>

pasvm1:sghadm 67> hdbuserstore List
DATA FILE    : /home/sghadm/.hdb/pasvm1/SSFS_HDB.DAT
KEY FILE    : /home/sghadm/.hdb/pasvm1/SSFS_HDB.KEY

KEY DEFAULT
ENV : hanadb-ilb:30013
USER: SAPHANADB
DATABASE: SGH
```

17 Additional Application Server Installation (AAS)

1. Partition the disk (256GB we added to the VM) with mount point name /usr/sap using yast. Use Ext4 file system.

2. Update the OS.

```
#Zypper update
```

3. Copy the SWPM to the PAS application server (pasvm1) from ascsvm1 server

```
scp -r /usr/sap/SWPM pasvm1:/usr/sap/SWPM
```

4. Prepare the PAS server for application server installation

- a. Configure operating system to reduce dirty cache size.

```
sudo vi /etc/sysctl.conf

# Change/set the following settings
vm.dirty_bytes = 629145600
vm.dirty_background_bytes = 314572800
```

b. Setup hostname resolution

```
#update /etc/hosts
vi /etc/hosts

#iscsi nodes
10.12.0.9      iscsivm1
10.12.0.7      iscsivm2
10.12.0.6      iscsivm3
# nfs nodes
10.12.0.12     nfsvm1
10.12.0.10     nfsvm2
#ascsv nodes
10.12.0.8      ascsvm1
10.12.0.11     ascsvm2
#hana DB nodes
10.12.1.4      hanavm1
10.12.1.6      hanavm2

#Load balancers
10.12.0.5      sgh-ascsv-ilb
10.12.0.50     sgh-ers-ilb
10.12.0.51     sgh-nfs-ilb
10.12.1.5      hanadb-ilb

#jump box
10.12.0.13     jbvm1

# pasvm
10.12.0.4      pasvm1
```

c. Create sapmnt directory

```
sudo mkdir -p /sapmnt/SGH
sudo mkdir -p /usr/sap/trans

sudo chattr +i /sapmnt/SGH
sudo chattr +i /usr/sap/trans
```

d. Configure autofs

```
sudo vi /etc/auto.master

# Add the following line to the file, save and exit
+auto.master
/- /etc/auto.direct
```

Create a file auto.direct

```
sudo vi /etc/auto.direct

# Add the following lines to the file, save and exit
/sapmnt/SGH -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/sgh/sapmntsgh
/usr/sap/trans -nfsvers=4,nosymlink,sync sgh-nfs-ilb:/SGH/trans
```

Restart autofs to mount the new shares

```
sudo systemctl enable autofs
sudo service autofs restart
```

e. Configure SWAP file

```
sudo vi /etc/waagent.conf

# Set the property ResourceDisk.EnableSwap to y
# Create and use swapfile on resource disk.
ResourceDisk.EnableSwap=y

# Set the size of the SWAP file with property ResourceDisk.SwapSizeMB
# The free space of resource disk varies by virtual machine size. Make sure that you
do not set a value that is too big. You can check the SWAP space with command
swapon
# Size of the swapfile.
ResourceDisk.SwapSizeMB=2000
```

Restart the agent

```
sudo service waagent restart
```

5. Install the SAP PAS Instance

Ensure that user sapadmin is already created on pasvm1 server.

```
pasvm1:~ # useradd -m sapadmin
pasvm1:~ # passwd sapadmin
New password:
Retype new password:
passwd: password updated successfully
```

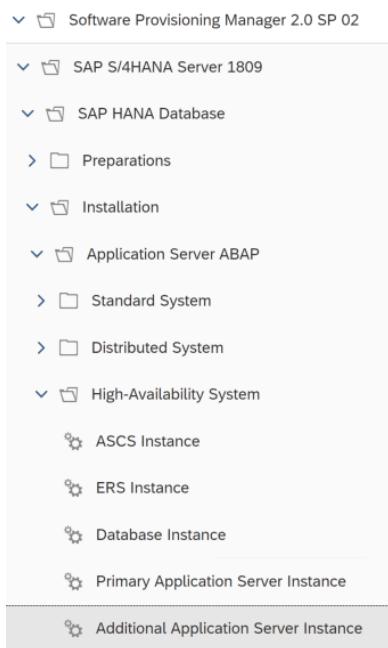
```
#aasvm1:/usr/sap/SWPM # ./sapinst SAPINST_REMOTE_ACCESS_USER=sapadmin
```

Open your browser and paste the following URL address to access the GUI

<https://aasvm1:4237/sapinst/docs/index.html>

Logon users: [sapadmin]

Select SAP S/4HANA Server 1809 > SAP HANA Database > Installation > High Availability > Additional application server Instance



General SAP System Parameters

Enter the profile directory of the SAP system.

SAP System Identification

Profile Directory

/sapmnt/SGH/profile

If you get error that directory does not exist, please ensure that mount from autofs is available on the server. Most common reason is format error when you copy from word to the vi editor. To correct, type manually to the vi editor.

ABAP Message Server

Provide the ABAP message server port

Connection to Message Server

Message Server Port

3600

Master Password

Enter the master password for all users.

Master Password

The master password is used for all users that are created. Check the tool help for restrictions and dependencies.

*Password for All Users

*Confirm

SAP System Administrator

Enter the password of the SAP system administrator.

SAP System Administrator

Account: *sghadm*

*Password of SAP System Administrator

*Confirm

User ID

Group ID of sapsys

Search Location

Specify the path to an archive, a download folder or a media location as *Package Path*.

Package Path

Archive Locations

You can download the archives from the following locations on SAP Software Download Center:

[SAPHOSTAGENT.SAR 721 \(Latest Patch\)](#)

SAP System Administrator

Enter the password of the SAP system administrator.

SAP System Administrator

Account: *sapadm*

*Password of SAP System Administrator

*Confirm

User ID

Group ID of sapsys

SAP HANA Database System Administrator
Enter the password of the database system administrator.

SAP HANA Database System Administrator Password

Database ID	SGH
Database Host	hanadb-ilb
*Instance Number of the SAP HANA Database	00
*Password of the Database System Administrator (User: SYSTEM)	*****

Initialize Database Tenant

SAP HANA Multitenant Database Containers
Enter the database parameters for the system database.

System Database

Database ID (DBSID)	SYSTEMDB
*Database Host	hanadb-ilb
*Instance Number of the SAP HANA Database	00
*Password of the SAP HANA Database Superuser	*****

Tenant Database

Tenant ID	SGH
-----------	-----

Database Schema
Enter the database schema password.

Database Schema

Database ID	SGH
Database Host	hanadb-ilb
Instance Number of the SAP HANA Database	00
Schema	SAPHANADB
<input type="checkbox"/> Drop Existing Schema	
*Schema Password	*****
*Confirm	*****

Detected Packages			
	Package Name	Individual Package Location	Status
1	SAP HANA CLIENT	/usr/sap/HANAClient/IMDB_CLIENT20_004_126-80002082.SAR	Available

Additional Application Server Instance

Enter the required parameters for the additional application server (AAS) instance.

Additional Application Server Instance

The following SAP system instances already exist on this host:

SAP System ID (SAPSID)

*AAS Instance Number	11
----------------------	----

*AAS Instance Host Name	aasvm1
-------------------------	--------

Message Server Access Control List

Specify if you want to have a message server Access Control List (ACL) created.

Message Server Access Control List

- Create Message Server Access Control List
- Do not create Message Server Access Control List

Cleanup of Operating System Users

Specify whether operating system users are to be removed from group 'sapinst' on UNIX (the group 'SAPINST' is to be removed if it exists).

Limit Installation Directory Access

The 'sapinst_instdir' directory belongs to a group named 'sapinst'. If this group is not available, it is created automatically as part of the execution of Software Provisioning Manager has completed.

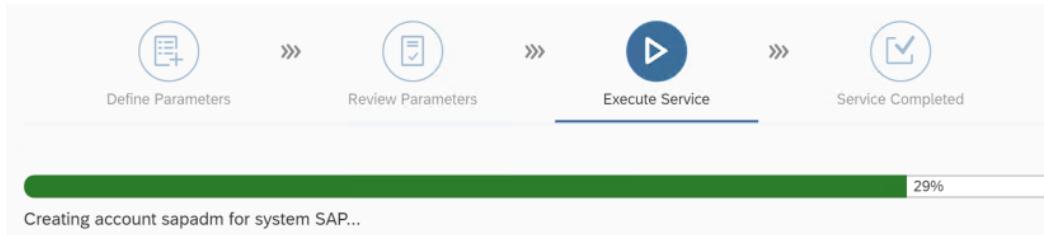
- Yes, clean up operating system users

Operating System Users to be Cleaned Up:

	OS User
1	sghadm

Parameter Summary
Choose 'Next' to start with the values shown. Otherwise, select the parameters to be changed and choose 'Revise'. You are then taken to the screen where you can change

Parameter List	
<input type="checkbox"/> General SAP System Parameters	
Profile Directory	/sapmnt/SGH/profile
<input type="checkbox"/> ABAP Message Server	
Message Server Port	3600
<input type="checkbox"/> Master Password	
Password for All Users	*****
<input type="checkbox"/> SAP System Administrator	
Password of SAP System Administrator	*****
<input type="checkbox"/> Software Package Browser	
Detected Packages	
Package Name	Individual Package Location
1 SAPHOSTAGENT.SAR 721 (Latest Patch)	/usr/sap/S4H1809/SAPHOSTAGENT41_41-20009394.SAR
<input type="checkbox"/> SAP System Administrator	
Password of SAP System Administrator	*****
User ID	
<input type="checkbox"/> SAP HANA Database System Administrator	
Instance Number of the SAP HANA Database	00
Password of the Database System Administrator (User: SYSTEM)	*****
<input type="checkbox"/> SAP HANA Multitenant Database Containers	
Database Host	hanadb-ib



This takes about 5minutes to install.

18 Test cases

Validate the HA config

```
ascsvm1:sghadm 99> sapcontrol -nr 00 -function HAGetFailoverConfig

14.05.2019 20:53:23
HAGetFailoverConfig
OK
HAAactive: TRUE
HAProductVersion: SUSE Linux Enterprise Server for SAP Applications 12 SP3
```

```
HASAPIVersion: SUSE Linux Enterprise Server for SAP Applications 12 SP3
(sap_suse_cluster_connector 3.1.0)
HADocumentation: https://www.suse.com/products/sles-for-sap/resource-library/sap-best-practices/
HAAActiveNode: ascsvm1
HANodes: ascsvm1, ascsvm2
```

Failover test

From HAWK>Migrate to node2.

```
## After failover ASCS instance to node2
Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 15 04:25:42 2019
Last change: Wed May 15 04:24:40 2019 by hacluster via crm_resource on ascsvm1

2 nodes configured
9 resources configured

Online: [ ascsvm1 ascsvm2 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPInstance): Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm1
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPInstance): Started ascsvm1
```

```
## After failback of ASCS instance to node1
```

```
Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 15 04:29:56 2019
Last change: Wed May 15 04:29:43 2019 by hacluster via crmd on ascsvm1

2 nodes configured
9 resources configured
```

Online: [ascsvm1 ascsvm2]

Active resources:

```
stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm1
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm1
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm2
```

Note: You may need to “unmirrate” and/or “cleanup” the resource/resourcegroup if instance does not come up.

Test: ASCS Node crash

Before the crash of node1

```
Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 15 15:40:28 2019
Last change: Wed May 15 04:29:56 2019 by hacluster via crm_resource on ascsvm1
```

2 nodes configured
9 resources configured

Online: [ascsvm1 ascsvm2]

Active resources:

```
stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm1
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm1
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm2
```

Crash the node1 thru crashkernel

```
ascsvm1:/ # echo b > /proc/sysrq-trigger
```

```
#After the node1 crash, crm_mon status
Stack: corosync
Current DC: ascsvm2 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 15 15:45:09 2019
Last change: Wed May 15 04:29:56 2019 by hacluster via crm_resource on ascsvm1
```

2 nodes configured
9 resources configured

Online: [ascsvm2]
OFFLINE: [ascsvm1]

Active resources:

```
stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPInstance): Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPInstance): Started ascsvm2
```

Pacemaker service on node1 is disabled

```
ascsvm1:~ # systemctl status pacemaker
● pacemaker.service - Pacemaker High Availability Cluster Manager
  Loaded: loaded (/usr/lib/systemd/system/pacemaker.service; enabled; vendor preset: disabled)
```

Let's start the pacemaker service on node1 to bring both the nodes to cluster.

```
ascsvm1:~ # systemctl start pacemaker
```

Now, both the nodes are online; and ASCS and ERS resources are already split between them.

```
ascsvm1:~ # crm_mon
Stack: corosync
```

Current DC: ascsvm2 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
 Last updated: Wed May 15 15:51:10 2019
 Last change: Wed May 15 04:29:56 2019 by hacluster via crm_resource on ascsvm1

2 nodes configured
 9 resources configured

Online: [ascsvm1 ascsvm2]

Active resources:

stonith-sbd (stonith:external/sbd): Started ascsvm2
 Resource Group: g-SGH_ASCS
 fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm2
 nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm2
 vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm2
 rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm2
 Resource Group: g-SGH_ERS
 fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm1
 nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm1
 vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm1
 rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm1

Test: HANA stopped on node1

Status before
 Stack: corosync
 Current DC: hanavm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
 Last updated: Wed May 15 16:09:27 2019
 Last change: Wed May 15 16:09:17 2019 by root via crm_attribute on hanavm1

2 nodes configured
 7 resources configured

Online: [hanavm1 hanavm2]

Active resources:

stonith-sbd (stonith:external/sbd): Started hanavm1
 Clone Set: cln_SAPHanaTopology_SGH_HDB00 [rsc_SAPHanaTopology_SGH_HDB00]
 Started: [hanavm1 hanavm2]
 Master/Slave Set: msl_SAPHana_SGH_HDB00 [rsc_SAPHana_SGH_HDB00]
 Masters: [hanavm1]
 Slaves: [hanavm2]
 Resource Group: g_ip_SGH_HDB00
 rsc_ip_SGH_HDB00 (ocf::heartbeat:IPaddr2): Started hanavm1

```
rsc_nc_SGH_HDB00 (ocf::heartbeat:anything): Started hanavm1
```

Stopped the HANA instance on node1

```
hanavm1:~ # su - sghadm
sghadm@hanavm1:/usr/sap/SGH/HDB00> HDB stop
hdbdaemon will wait maximal 300 seconds for NewDB services finishing.
Stopping instance using: /usr/sap/SGH/SYS/exe/hdb/sapcontrol -prot NI_HTTP -nr 00 -function Stop
400

15.05.2019 17:42:46
Stop
OK
Waiting for stopped instance using: /usr/sap/SGH/SYS/exe/hdb/sapcontrol -prot NI_HTTP -nr 00 -
function WaitforStopped 600 2

15.05.2019 17:44:10
WaitforStopped
OK
hdbdaemon is stopped.

sghadm@hanavm1:/usr/sap/SGH/HDB00> /usr/sap/hostctrl/exe/sapcontrol -nr 00 -function
GetProcessList

15.05.2019 17:44:28
GetProcessList
OK
name, description, dispstatus, textstatus, starttime, elapsedtime, pid
hdbdaemon, HDB Daemon, GRAY, Stopped, , , 118269
sghadm@hanavm1:/usr/sap/SGH/HDB00>
```

At this time, HANA is stopped on node1. Cluster status shows below on node2.

```
Stack: corosync
Current DC: hanavm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 15 17:53:52 2019
Last change: Wed May 15 17:52:48 2019 by root via crm_attribute on hanavm2

2 nodes configured
7 resources configured

Online: [ hanavm1 hanavm2 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started hanavm1
```

```

Clone Set: cln_SAPHanaTopology_SGH_HDB00 [rsc_SAPHanaTopology_SGH_HDB00]
  Started: [ hanavm1 hanavm2 ]
Master/Slave Set: msl_SAPHana_SGH_HDB00 [rsc_SAPHana_SGH_HDB00]
  Masters: [ hanavm2 ]
Resource Group: g_ip_SGH_HDB00
  rsc_ip_SGH_HDB00 (ocf::heartbeat:IPaddr2): Started hanavm2
  rsc_nc_SGH_HDB00 (ocf::heartbeat:anything): Started hanavm2

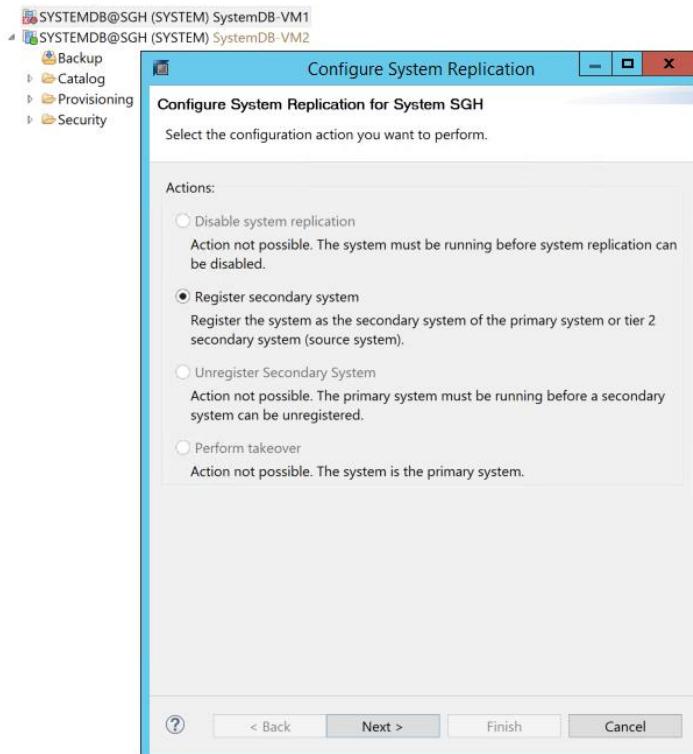
Failed Actions:
* rsc_SAPHana_SGH_HDB00_start_0 on hanavm1 'not running' (7): call=91, status=co
mplete, exitreason="",
  last-rc-change='Wed May 15 17:44:51 2019', queued=0ms, exec=2394ms

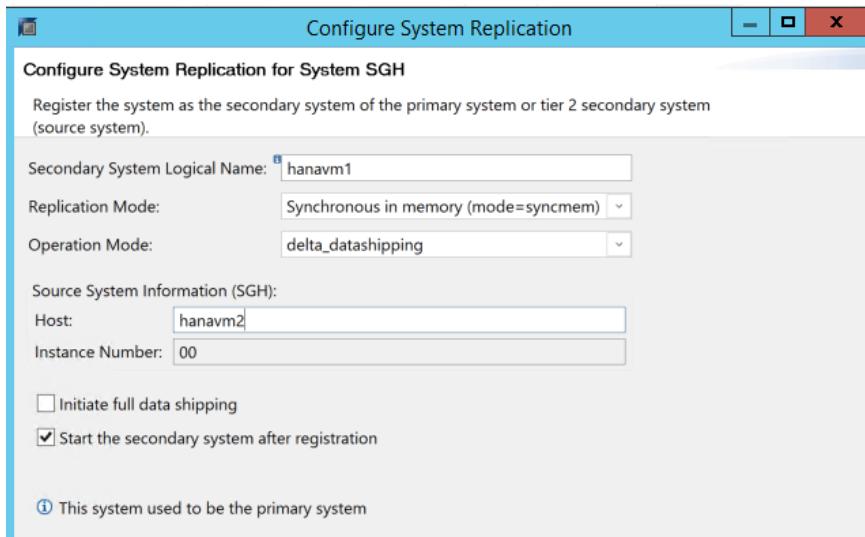
```

HANA Instance is up on the node2.

Register the previous primary (hanavm1) to the new primary (hanavm2).

In studio, select hanavm1 instance, right click, Configuration and Monitoring, and configure system replication.





Now, HSR is in sync from node 2 to node1

SYSTEMDB@SGH (SYSTEM) SystemDB-VM2 hanavm2 00

Overview Landscape Alerts Performance Volumes Configuration System Information Diagnosis Files Trace Configuration

Services Hosts Redistribution System Replication

Enter your filter Visible rows: 5/5

HOST	SECONDARY_HOST	REPLICATION_MODE	REPLICATION_STATUS	REPLICATION_STATUS_DETAILS	PORT
hanavm2	hanavm1	SYNCMEM	ACTIVE		30,007
hanavm2	hanavm1	SYNCMEM	ACTIVE		30,040
hanavm2	hanavm1	SYNCMEM	ACTIVE		30,003
hanavm2	hanavm1	SYNCMEM	ACTIVE		30,011
hanavm2	hanavm1	SYNCMEM	ACTIVE		30,001

Cluster status shows below.

```
Stack: corosync
Current DC: hanavm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Wed May 15 18:00:22 2019
Last change: Wed May 15 18:00:17 2019 by root via crm_attribute on hanavm1

2 nodes configured
7 resources configured

Online: [ hanavm1 hanavm2 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started hanavm1
Clone Set: cln_SAPHanaTopology_SGH_HDB00 [rsc_SAPHanaTopology_SGH_HDB00]
  Started: [ hanavm1 hanavm2 ]
Master/Slave Set: msl_SAPHana_SGH_HDB00 [rsc_SAPHana_SGH_HDB00]
```

```
Masters: [ hanavm2 ]
Slaves: [ hanavm1 ]
Resource Group: g_ip_SGH_HDB00
rsc_ip_SGH_HDB00 (ocf::heartbeat:IPaddr2): Started hanavm2
rsc_nc_SGH_HDB00 (ocf::heartbeat:anything): Started hanavm2
```

Ensure you are able to connect from SAP application (use SAPGUI).

Test: Reboot Primary Node

Before reboot

```
Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.14.1-77ea74d) - partition with quorum
Last updated: Thu May 23 21:14:00 2019
Last change: Thu May 23 21:13:07 2019 by hacluster via crmd on ascsvm1

2 nodes configured
9 resources configured

Online: [ ascsvm1 ascsvm2 ]

Active resources:

stonith-sbd (stonith:external/sbd): Started ascsvm1
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm1
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm1

Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm2
```

Shutdown primary node (csvfilem1)

```
ascsvm1:/sapmnt/SGH/profile # shutdown -r
Shutdown scheduled for Thu 2019-05-23 21:00:44 UTC, use 'shutdown -c' to cancel.
```

After reboot of previous primary (csvfilem1)

ASCS Instance failed over to node2 and as soon as node1 came online, ERS instance was migrated to node1 automatically.

```

Stack: corosync
Current DC: ascsvm2 (version 1.1.16-6.14.1-77ea74d) - partition with quorum
Last updated: Thu May 23 21:17:09 2019
Last change: Thu May 23 21:13:07 2019 by hacluster via crmd on ascsvm1

2 nodes configured
9 resources configured

Online: [ ascsvm1 ascsvm2 ]

Active resources:

stonith-sbd  (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS    (ocf::heartbeat:Filesystem):  Started ascsvm2
  nc_SGH_ASCS    (ocf::heartbeat:anything):  Started ascsvm2
  vip_SGH_ASCS   (ocf::heartbeat:IPaddr2):  Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance):  Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS    (ocf::heartbeat:Filesystem):  Started ascsvm1
  nc_SGH_ERS    (ocf::heartbeat:anything):  Started ascsvm1
  vip_SGH_ERS   (ocf::heartbeat:IPaddr2):  Started ascsvm1
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance):  Started ascsvm1

```

Test: reboot secondary (where ERS is running)

Before state

```

Stack: corosync
Current DC: ascsvm2 (version 1.1.16-6.14.1-77ea74d) - partition with quorum
Last updated: Thu May 23 21:17:09 2019
Last change: Thu May 23 21:13:07 2019 by hacluster via crmd on ascsvm1

2 nodes configured
9 resources configured

Online: [ ascsvm1 ascsvm2 ]

Active resources:

stonith-sbd  (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS    (ocf::heartbeat:Filesystem):  Started ascsvm2
  nc_SGH_ASCS    (ocf::heartbeat:anything):  Started ascsvm2
  vip_SGH_ASCS   (ocf::heartbeat:IPaddr2):  Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance):  Started ascsvm2
Resource Group: g-SGH_ERS

```

```
fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm1
nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm1
vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm1
rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm1
```

Reboot secondary (ascsvm1)

```
# when node1 (ascsvm1) was down
```

Stack: corosync

Current DC: ascsvm2 (version 1.1.16-6.14.1-77ea74d) - partition with quorum

Last updated: Thu May 23 21:19:26 2019

Last change: Thu May 23 21:13:07 2019 by hacluster via crmd on ascsvm1

2 nodes configured

9 resources configured

Node ascsvm1: UNCLEAN (online)

Online: [ascsvm2]

Full list of resources:

```
stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): FAILED ascsvm1
  nc_SGH_ERS (ocf::heartbeat:anything): FAILED ascsvm1
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): FAILED ascsvm1
```

After node1 came online; pacemaker service was disabled and hence ERS service started on ascsvm2 (where ASCS was already active).

Stack: corosync

Current DC: ascsvm2 (version 1.1.16-6.14.1-77ea74d) - partition with quorum

Last updated: Thu May 23 21:21:58 2019

Last change: Thu May 23 21:13:07 2019 by hacluster via crmd on ascsvm1

2 nodes configured

9 resources configured

Online: [ascsvm2]

OFFLINE: [ascsvm1]

Full list of resources:

```
stonith-sbd (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ASCS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ASCS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ERS (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm2
```

pacemaker status on ascsvm1

```
ascsvm1:~ # systemctl status pacemaker
● pacemaker.service - Pacemaker High Availability Cluster Manager
  Loaded: loaded (/usr/lib/systemd/system/pacemaker.service; enabled; vendor preset: disabled)
  Active: inactive (dead) since Thu 2019-05-23 21:21:29 UTC; 1min 12s ago
    Docs: man:pacemakerd
          https://clusterlabs.org/pacemaker/doc/en-US/Pacemaker/1.1/html-
single/Pacemaker_Explained/index.html
   Process: 2395 ExecStart=/usr/sbin/pacemakerd -f (code=exited, status=100)
 Main PID: 2395 (code=exited, status=100)

May 23 21:21:29 ascsvm1 pacemakerd[2395]: notice: Stopping cib
May 23 21:21:29 ascsvm1 cib[2424]: warning: new_event_notification (2424-2...2)
May 23 21:21:29 ascsvm1 cib[2424]: warning: Notification of client crmd/50...ed
May 23 21:21:29 ascsvm1 cib[2424]: warning: new_event_notification (2424-2...2)
May 23 21:21:29 ascsvm1 cib[2424]: warning: Notification of client stonith...ed
May 23 21:21:29 ascsvm1 cib[2424]: notice: Caught 'Terminated' signal
May 23 21:21:29 ascsvm1 cib[2424]: notice: Disconnected from Corosync
May 23 21:21:29 ascsvm1 cib[2424]: notice: Disconnected from Corosync
May 23 21:21:29 ascsvm1 pacemakerd[2395]: notice: Shutdown complete
May 23 21:21:29 ascsvm1 pacemakerd[2395]: notice: Attempting to inhibit re...
Hint: Some lines were ellipsized, use -l to show in full.
```

Started the pacemaker on ascsvm1; ERS instance automatically moved to ascsvm1 node

```
Stack: corosync
Current DC: ascsvm2 (version 1.1.16-6.14.1-77ea74d) - partition with quorum
Last updated: Thu May 23 21:25:12 2019
Last change: Thu May 23 21:13:07 2019 by hacluster via crmd on ascsvm1
```

2 nodes configured

9 resources configured

```
Online: [ ascsvm1 ascsvm2 ]
```

Full list of resources:

```
stonith-sbd  (stonith:external/sbd): Started ascsvm2
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS  (ocf::heartbeat:Filesystem): Started ascsvm2
  nc_SGH_ASCS  (ocf::heartbeat:anything): Started ascsvm2
  vip_SGH_ASCS  (ocf::heartbeat:IPaddr2): Started ascsvm2
  rsc_sap_SGH_ASCS00 (ocf::heartbeat:SAPIstance): Started ascsvm2
Resource Group: g-SGH_ERS
  fs_SGH_ERS (ocf::heartbeat:Filesystem): Started ascsvm1
  nc_SGH_ERS (ocf::heartbeat:anything): Started ascsvm1
  vip_SGH_ERS  (ocf::heartbeat:IPaddr2): Started ascsvm1
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance): Started ascsvm1
```

19 Important commands

```
# To put cluster into the maintenance mode
crm configure property maintenance-mode=true
crm configure property maintenance-mode=false
```

```
# To delete a resource from the cluster
```

```
crm configure delete fs_SGH_ASCS
```

```
# To start a resource in the cluster
```

```
crm resource start vip_SGH_ERS
```

```
# To view resource list in the cluster
```

```
crm resource list
```

```
# To remove a node from the cluster
```

```
ha-cluster-remove ascsvm2 –force
```

```
# To copy whole directory with its contents
```

```
scp -r /usr/sap/SWPM pasvm1:/usr/sap/SWPM
```

Error: File or folder does not exist, even though it is there
 solution: check if mountpoints are available.

Error: Cluster resource for ASCS fails with the following error:

Failed Actions:

* rsc_sap_SGH_ASCS00_start_0 on ascsvm1 'not configured' (6): call=42, status=complete, exitreason='',
 last-rc-change='Mon May 6 19:47:59 2019', queued=0ms, exec=72ms

Possible causes: File server resource fs_SGH_ASCS is not started

To start/stop/status of SAP instance

```
./sapcontrol -nr 02 -function Stop
./sapcontrol -nr 02 -function GetProcessList
./sapcontrol -nr 02 -function Start
```

HAWLK status good status

The screenshot shows the HAWLK Status interface with two tabs: 'Resources' (9) and 'Nodes' (2). The 'Resources' tab displays a table with columns: Status, Name, Location, Type, and Operations. The 'Nodes' tab shows two nodes: ascsvm1 and ascsvm2, each with its own set of resources. All resources listed are in a healthy state (green).

	Status	Name	Location	Type	Operations
-	●%	g-SGH_ASCS	ascsvm1	Group (4)	[] [] []
→	●	fs_SGH_ASCS	ascsvm1	ocf:heartbeat:Filesystem	[] [] []
→	●	nc_SGH_ASCS	ascsvm1	ocf:heartbeat:anything	[] [] []
→	●	rsc_sap_SGH_ASCS00	ascsvm1	ocf:heartbeat:SAPIstance	[] [] []
→	●	vip_SGH_ASCS	ascsvm1	ocf:heartbeat:IPaddr2	[] [] []
-	●%	g-SGH_ERS	ascsvm2	Group (4)	[] [] []
→	●	fs_SGH_ERS	ascsvm2	ocf:heartbeat:Filesystem	[] [] []
→	●	nc_SGH_ERS	ascsvm2	ocf:heartbeat:anything	[] [] []
→	●	rsc_sap_SGH_ERS02	ascsvm2	ocf:heartbeat:SAPIstance	[] [] []
→	●	vip_SGH_ERS	ascsvm2	ocf:heartbeat:IPaddr2	[] [] []
+	●	stonith-sbd	ascsvm1	stonith:external/sbd	[] [] []

Cluster resource status – good

```

Stack: corosync
Current DC: ascsvm1 (version 1.1.16-6.11.1-77ea74d) - partition with quorum
Last updated: Tue May 14 20:45:12 2019
Last change: Tue May 14 20:27:00 2019 by hacluster via crmd on ascsvm2

2 nodes configured
9 resources configured

Online: [ ascsvm1 ascsvm2 ]

Full list of resources:

stonith-sbd      (stonith:external/sbd): Started ascsvm1
Resource Group: g-SGH_ASCS
  fs_SGH_ASCS      (ocf::heartbeat:Filesystem):     Started ascsvm1
  nc_SGH_ASCS      (ocf::heartbeat:anything):       Started ascsvm1
  vip_SGH_ASCS     (ocf::heartbeat:IPAddr2):        Started ascsvm1
  rsc_sap_SGH_ASCS0 (ocf::heartbeat:SAPIstance):   Started ascsvm1
Resource Group: g-SGH_ERS
  fs_SGH_ERS      (ocf::heartbeat:Filesystem):     Started ascsvm2
  nc_SGH_ERS      (ocf::heartbeat:anything):       Started ascsvm2
  vip_SGH_ERS     (ocf::heartbeat:IPAddr2):        Started ascsvm2
  rsc_sap_SGH_ERS02 (ocf::heartbeat:SAPIstance):  Started ascsvm2

```

Final mounting on nodes

```

ascsvm1:/usr/sap/SGH/SYS/profile # df -kh
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        14G   0  14G  0% /dev
tmpfs          21G  63M  21G  1% /dev/shm
tmpfs          14G  1.5G  13G 11% /run
tmpfs          14G   0  14G  0% /sys/fs/cgroup
/dev/sda4        29G  2.9G  24G 11% /
/dev/sda3      976M 102M 824M 11% /boot
/dev/sda2      200M 140K 200M  1% /boot/efi
/dev/sdc1      252G  33G 219G 13% /usr/sap
/dev/sdb1      55G  2.1G  51G  4% /mnt/resource
tmpfs          2.8G   0  2.8G  0% /run/user/1003
tmpfs          2.8G   0  2.8G  0% /run/user/0
sgh-nfs-ilb:/SGH/ASCS  256G 1.7G 255G  1% /usr/sap/SGH/ASCS00
tmpfs          2.8G   0  2.8G  0% /run/user/1002
sgh-nfs-ilb:/SGH/sapmntsgh 256G 1.7G 255G  1% /sapmnt/SGH
sgh-nfs-ilb:/SGH/sghsys  256G 1.7G 255G  1% /usr/sap/SGH/SYS
sgh-nfs-ilb:/SGH/ASCSERS 256G 1.7G 255G  1% /usr/sap/SGH/ERS02

```

```
ascsvm2:/usr/sap/SGH/SYS/profile # df -kh
Filesystem      Size  Used Avail Use% Mounted on
devtmpfs        14G   0  14G  0% /dev
tmpfs          21G  46M  21G  1% /dev/shm
tmpfs          14G  18M  14G  1% /run
tmpfs          14G   0  14G  0% /sys/fs/cgroup
/dev/sda4       29G  3.0G  24G  12% /
/dev/sda3     976M 102M 824M 11% /boot
/dev/sda2     200M 140K 200M 1% /boot/efi
/dev/sdc1      252G 2.4G 249G 1% /usr/sap
/dev/sdb1      55G 2.1G 51G  4% /mnt/resource
tmpfs          2.8G   0  2.8G  0% /run/user/1003
tmpfs          2.8G   0  2.8G  0% /run/user/0
sgh-nfs-ilb:/SGH/sapmntsgh 256G 1.7G 255G  1% /sapmnt/SGH
sgh-nfs-ilb:/SGH/sghsys  256G 1.7G 255G  1% /usr/sap/SGH/SYS
sgh-nfs-ilb:/SGH/ASCSERS 256G 1.7G 255G  1% /usr/sap/SGH/ERS02
tmpfs          2.8G   0  2.8G  0% /run/user/1002
sgh-nfs-ilb:/SGH/ASCS  256G 1.7G 255G  1% /usr/sap/SGH/ASCS00
```

20 Appendix

<https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/high-availability-guide-suse>

<https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/high-availability-guide-suse-nfs>