SAP HANA High Availability Cluster Automation Operating on Azure

Getting Started

SUSE Linux Enterprise Server for SAP Applications 15 SP1 and later
Microsoft Azure

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This document explains how to build an automated SAP* HANA System Replication (SR) Performance Optimized High Availability (HA) cluster operating on Microsoft* Azure public cloud. It is based on SUSE® Linux Enterprise Server for SAP Applications 15 SP1. The concept can also be used with newer service packs of SUSE Linux Enterprise Server for SAP Applications.

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Contents

1 About this Guide

1.1 Introduction

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

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

1.2 Additional Documentation and Resources

Chapters in this best practice guide contain links to additional documentation resources that are either available on the system or on the Internet. For the latest documentation updates, check SUSE documentation portal (https://documentation.suse.com) ↗ .

1.3 Feedback

Several feedback channels are available:

Bugs and Enhancement Requests

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

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

Mail

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

2 Document Scope

This guide aims to build an automated SAP HANA System Replication (SR) Performance Optimized High Availability (HA) cluster operating on Microsoft Azure public cloud.

The guide uses the Automated SAP HA Deployments in Public/Private Clouds with Terraform (https://github.com/SUSE/ha-sap-terraform-deployments) ↗ project that offers several functions. One of these functions is to provide an automated way to deploy SAP HANA HA cluster in public clouds.

The Automated SAP HA Deployments in Public/Private Clouds with Terraform project uses *Terraform* for the deployment phase and *Saltstack* for the provisioning phase. The project is organized in directories containing the *terraform* configuration files per public or private cloud providers and *Saltstack* pillars.

For more information about how to create an SAP HANA Database Scale-Up Performance Optimized High Availability cluster on Microsoft Azure public cloud, refer to the guide High Availability of SAP HANA on Azure VMs on SUSE Linux Enterprise Server (https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/sap-hana-high-availability) ↗ .

> ❗ **Important**
>
> SAP HA solutions are highly customized software solutions based on the customer's environments. This guide provides a *testing environment* that enables SUSE customers to understand a basic implementation of an SAP HANA HA solution using the Microsoft Azure public cloud components. **The production environments must be preceded by a proper planning phase prior to the deployment phase.**
>
> Contact SUSE Consulting Services (https://www.suse.com/services/consulting) ↗ for further help.

3 Environment Preparation

3.1 Azure Command-Line Interface Environment Preparation

This guide uses the Azure Command-Line Interface (CLI) which is installed on SUSE Linux Enterprise Server 15 Service Pack 1 (SP1) to interact with the Microsoft Azure public cloud. Follow the Microsoft instructions (https://docs.microsoft.com/en-us/cli/azure/install-azure-cli-zypper?view=azure-cli-latest) ⬈ to install Azure CLI for SUSE distributions.

💡 Tip

Refer to The Azure Command-Line Interface portal (https://docs.microsoft.com/en-us/cli/azure/?view=azure-cli-latest) ⬈ for more information.

After a successful Azure CLI installation, log in to the Azure portal using the `az login` command. Then list the current Azure account information. Find below an example of the Azure account used during the creation date of this guide:

EXAMPLE 1: AZURE ACCOUNT INFORMATION LIST:

```
$ az account list
[
  {
    "cloudName": "AzureCloud",
    "homeTenantId": "<HOME TENANT ID>",
    "id": "<ACCOUNT ID>",
    "isDefault": true,
    "managedByTenants": [],
    "name": "<ACCOUNT NAME>",
    "state": "Enabled",
    "tenantId": "<TENANT ID>",
    "user": {
      "name": "<USER NAME>",
      "type": "<USER TYPE>"
    }
  }
]
```

3.2 Azure Storage Account Preparation

An Azure storage account is needed to host the SAP HANA installation media.

Create a new *file share* inside the Azure storage account, upload the SAP HANA installation media to the newly created file share, and extract it.

> **! Important**
>
> It is a must to extract the SAP HANA installation media inside the Azure storage account file share. Saltstack provisioning will NOT work using the SAP HANA compressed installation media.

> ** Tip**
>
> Refer to Create an Azure Storage account (https://docs.microsoft.com/en-us/azure/storage/common/storage-account-create?tabs=azure-portal) ↗ Microsoft documentation for more information about Azure storage account operations.

3.3 Terraform Installation

Starting with SUSE Linux Enterprise Server 15 SP1, `terraform` has been added to the SUSE Linux Enterprise Public Cloud Module. Activate the Public Cloud Module and install the `terraform` package.

The following example shows the terraform version available for SUSE Linux Enterprise Server 15 SP1 at the creation date of this guide:

```
$ sudo zypper in terraform

$ terraform version
Terraform v0.12.19
```

Alternatively, you can also use the `terraform` binary preinstalled in the Azure Cloud Shell (https://azure.microsoft.com/en-us/features/cloud-shell/) ↗. The following example shows the terraform version used in Azure cloud shell at the creation date of this guide:

```
$ terraform version
Terraform v0.12.23
```

> **Tip**
>
> The `terraform` version used to write this guide is `v0.12.19`. The terraform team keeps updating the terraform version over time. A newer version might already have been introduced at the time you are applying this guide.

3.4 GitHub Repository Cloning

This guide assumes that the *project directory path* is `/home/`**`<USERNAME>`**`/ha-sap-terraform-deployments` where **`<USERNAME>`** is the SUSE Linux Enterprise Server 15 SP1 user used to create the project.

Clone the *Automated SAP HA Deployments in Public/Private Clouds with Terraform* GitHub repository:

```
$ cd /home/<USERNAME>

$ git clone https://github.com/SUSE/ha-sap-terraform-deployments.git
```

4 Environment Deployment

4.1 *Saltstack* Pillars Adaptation

SAP HANA and cluster SaltStack Pillars templates are located in the cloned GitHub repository `pillar_example` directory.

Copy the SAP HANA and cluster SaltStack Pillars templates to the proper Salt directory:

```
$ cd /home/<USERNAME>/ha-sap-terraform-deployments

$ cp -av pillar_examples/automatic/hana/*.sls salt/hana_node/files/pillar/
```

Excepting some few parameters' values changes, `/home/`**`<USERNAME>`**`/ha-sap-terraform-deployments/salt/hana_node/files/pillar/hana.sls` SaltStack Pillar contents are suitable for this guide.

The main parameters' values to be updated are:

- SAP users-related passwords

- SAP HANA primary site name

- SPA HANA secondary site name

> ⬢ **Note**
>
> Refer to the section **Appendix → SAP HANA SaltStack Pillar Configuration**, then change the parameters' values highlighted in bold with your appropriate ones.

4.2   Terraform Configuration Adaptation

The `terraform.tfvars.example` file contains the terraform variables template used to create the cluster infrastructure.

In this guide, we kept the default values except for the following changed ones:

- Azure virtual machine (VM) instance type

- SAP HANA VMs and iSCSI operating system (OS) subscription model details

- SSH keys path

- Azure storage account name

- SAP HANA installation media path

- HA/SAP deployment packages software repository

EXAMPLE 2: ADAPT THE TERRAFORM VARIABLES FILE:

1. Change the directory to the terraform azure provider directory path and rename the `terraform.tfvars.example` file to `terraform.tfvars`:

   ```
   $ cd /home/<USERNAME>/ha-sap-terraform-deployments/azure
   ```

```
$ mv -v terraform.tfvars.example terraform.tfvars
```

2. Generate the private and public keys which will be used by the terraform deployment and SaltStack provisioning:

```
$ mkdir -v /home/<USERNAME>/ha-sap-terraform-deployments/salt/hana_node/files/
sshkeys

$ ssh-keygen -t rsa -f /home/<USERNAME>/ha-sap-terraform-deployments/salt/
hana_node/files/sshkeys/cluster.id_rsa
```

3. It is given that this guide uses the following OS-related values:

Parameter	Value
SAP HANA OS version	SUSE Linux Enterprise Server 15 for SAP Applications
iSCSI Target OS version	SUSE Linux Enterprise Server 15 SP1
Subscription Model	Pay as you GO (PAYGO)

Only change the following parameters' values in the `/home/<USERNAME>/ha-sap-terraform-deployments/azure/terraform.tfvars` terraform variables configuration file:

Parameter	Old Value	New Value
instancetype	Standard_M128s	<CHOSEN INSTANCE TYPE>
hana_public_sku	12-sp4	15
admin_user	OUR_USERNAME_HERE	<CHOSEN ADMIN ID>
public_key_location	/path/to/your/public/ssh/key	../salt/hana_node/files/sshkeys/cluster.id_rsa.pub
private_key_location	/path/to/your/private/ssh/key	../salt/hana_node/files/sshkeys/cluster.id_rsa

Parameter	Old Value	New Value
storage_account_name	YOUR_STORAGE_AC-COUNT_NAME	<**AZURE STORAGE AC-COUNT ID**>
storage_account_key	YOUR_STORAGE_AC-COUNT_KEY	<**AZURE STORAGE AC-COUNT KEY #1**>
hana_inst_master	//YOUR_STOR-AGE_ACCOUN-T_NAME.file.core.win-dows.net/*path/to/your/hana/installation/master	<**SAP HANA INSTAL-LATION MEDIA PATH**>
ha_sap_deployment_repo	""	"https://download.open-suse.org/repositories/net-work:/ha-clustering:/Fac-tory/SLE_15/"

Note

Refer to the section **Appendix → Terraform Configurations → Pay as you Go Sub-scription Model** to view a complete sample of a `terraform.tfvars` configuration file.

Important

Despite using a specific OS version and subscription model aims to provide a complete test case scenario for this guide, the **Automated SAP HA Deployments in Public/Pri-vate Clouds with Terraform** project gives the opportunity to use different OS version, subscription models and other parameters.

All parameters highlighted in bold in the section **Appendix → Terraform Configura-tions → Pay as you Go Subscription Model** can be adjusted based on the customer's environment and needs.

4.3 Terraform Deployment

1. Initialize the terraform Azure provider:

```
$ cd /home/<USERNAME>/ha-sap-terraform-deployments/azure
$ terraform init
```

2. Create a new terraform workspace. Select it to be used in the terraform plan and apply phases:

```
$ terraform workspace new <TERRAFORM WORKSPACE NAME>
$ terraform workspace select <TERRAFORM WORKSPACE NAME>
```

3. Plan the terraform deployment:

```
$ terraform plan
```

4. Apply the terraform deployment:

```
$ terraform apply
```

> 💡 **Tip**
>
> Terraform deployment and SaltStack provisioning take approximately 40 to 50 minutes.

5 Environment Post-Deployment Validation

5.1 Deployment Validation

The `terraform apply` command output provides information about the created cluster.

EXAMPLE 4: `terraform apply` OUTPUT SAMPLE:

```
$ terraform apply
[OUTPUT TRIMMED]

module.hana_node.null_resource.hana_node_provisioner[1]: Creation complete after 36m4s
 [id=2647934812513863765]
```

```
Apply complete! Resources: 33 added, 0 changed, 0 destroyed.

Outputs:

cluster_nodes_ip = [
  "10.74.1.11",
  "10.74.1.12",
]
cluster_nodes_name = [
  "vmhana01",
  "vmhana02",
]
cluster_nodes_public_ip = [
  "13.81.13.169",
  "13.81.13.149",
]
cluster_nodes_public_name = [
  "",
  "",
]
drbd_ip = []
drbd_name = []
drbd_public_ip = []
drbd_public_name = []
iscsisrv_ip = [
  "10.74.1.14",
]
iscsisrv_name = [
  "vmiscsisrv",
]
iscsisrv_public_ip = [
  "13.81.13.51",
]
iscsisrv_public_name = [
  "",
]
[OUTPUT TRIMMED]
```

5.2   Cluster Status Validation

Connect to any cluster node to check the cluster status:

EXAMPLE 5: **CLUSTER STATUS CHECK:**

1. Copy the created SSH keys to your default SSH directory:

```
$ cp -v /home/<USERNAME>/ha-sap-terraform-deployments/salt/hana_node/files/
sshkeys/cluster.id_rsa*  /home/<USERNAME>/.ssh/
```

2. Change the SSH keys files permissions as follows:

```
$ chmod -v 400 /home/<USERNAME>/.ssh/cluster.id_rsa

$ chmod -v 600 /home/<USERNAME>/.ssh/cluster.id_rsa.pub
```

3. Connect to any cluster node:

```
$ ssh -i .ssh/cluster.id_rsa <ADMIN USER>@<CLUSTER NODE PUBLIC IP>
```

4. Check the cluster status:

```
$ hostname
vmhana01

$ sudo su -
```

```
vmhana01:~ # crm_mon -rnf1
Stack: corosync
Current DC: vmhana01 (version 1.1.18+20180430.b12c320f5-3.18.1-b12c320f5) -
 partition with quorum
Last updated: Thu Mar  5 16:04:23 2020
Last change: Thu Mar  5 16:04:09 2020 by root via crm_attribute on vmhana01

2 nodes configured
7 resources configured

Node vmhana01: online
        rsc_SAPHana_PRD_HDB00  (ocf::suse:SAPHana):    Master
        rsc_ip_PRD_HDB00       (ocf::heartbeat:IPaddr2):       Started
        stonith-sbd     (stonith:external/sbd): Started
        rsc_SAPHanaTopology_PRD_HDB00  (ocf::suse:SAPHanaTopology):    Started
        rsc_socat_PRD_HDB00    (ocf::heartbeat:anything):      Started
Node vmhana02: online
        rsc_SAPHana_PRD_HDB00  (ocf::suse:SAPHana):    Slave
        rsc_SAPHanaTopology_PRD_HDB00  (ocf::suse:SAPHanaTopology):    Started
```

```
No inactive resources


Migration Summary:
* Node vmhana01:
* Node vmhana02:
```

6 Environment Destroy

Ensure that you are logged in to the Azure account. If you are not logged in, execute the command `az login`.

EXAMPLE 6: DESTROY THE ENVIRONMENT:

1. Change the directory to the terraform azure provider path:

   ```
   $ cd /home/<USERNAME>/ha-sap-terraform-deployments/azure
   ```

2. List the terraform workspaces:

   ```
   $ terraform workspace list
     default
   * <WORKSPACE NAME>
   ```

3. Choose the terraform workspace that has been used to create this project:

   ```
   $ terraform workspace select <WORKSPACE NAME>
   ```

4. Destroy the terraform workspace that has been used to create this project:

   ```
   $ terraform destroy
   ```

7 Appendix

7.1 SAP HANA SaltStack Pillar Configuration

```
$ cat  /home/<USERNAME>/ha-sap-terraform-deployments/salt/hana_node/files/pillar/hana.sls
hana:
  {% if grains.get('qa_mode') %}
  install_packages: false
```

```
{% endif %}
saptune_solution: 'HANA'
nodes:
  - host: {{ grains['name_prefix'] }}01
    sid: prd
    instance: "00"
    password: <PASSWORD>
    install:
      software_path: {{ grains['hana_inst_folder'] }}
      root_user: root
      {% if grains['provider'] == 'libvirt' %}
      root_password: linux
      {% else %}
      root_password: ''
      {% endif %}
      system_user_password: <PASSWORD>
      sapadm_password: <PASSWORD>
    primary:
      name: <PRIMARY SITNE NAME>
      backup:
        key_name: backupkey
        database: SYSTEMDB
        file: backup
      userkey:
        key_name: backupkey
        environment: {{ grains['name_prefix'] }}01:30013
        user_name: SYSTEM
        user_password: <PASSWORD>
        database: SYSTEMDB
    {% if grains.get('monitoring_enabled', False) %}
      exporter:
        exposition_port: 9668
        user: SYSTEM
        password: YourPassword1234
    {% endif %}

  - host: {{ grains['name_prefix'] }}02
    sid: prd
    instance: "00"
    password: <PASSWORD>
    {% if grains['scenario_type'] == 'cost-optimized' %}
    scenario_type: 'cost-optimized'
    cost_optimized_parameters:
      global_allocation_limit: '32100'
      preload_column_tables: False
    {% endif %}
    install:
```

```
        software_path: {{ grains['hana_inst_folder'] }}
        root_user: root
        {% if grains['provider'] == 'libvirt' %}
        root_password: linux
        {% else %}
        root_password: ''
        {% endif %}
        system_user_password: <PASSWORD>
        sapadm_password: <PASSWORD>
    secondary:
      name: <SECONDARY SITE NAME>
      remote_host: {{ grains['name_prefix'] }}01
      remote_instance: "00"
      replication_mode: sync
      operation_mode: logreplay
      primary_timeout: 3000
  {% if grains['scenario_type'] == 'cost-optimized' %}
  - host: {{ grains['name_prefix'] }}02
    sid: qas
    instance: "01"
    password: YourPassword1234
    scenario_type: 'cost-optimized'
    cost_optimized_parameters:
      global_allocation_limit: '28600'
      preload_column_tables: False
    install:
      software_path: {{ grains['hana_inst_folder'] }}
      root_user: root
      {% if grains['provider'] == 'libvirt' %}
      root_password: linux
      {% else %}
      root_password: ''
      {% endif %}
      system_user_password: YourPassword1234
      sapadm_password: YourPassword1234
    {% if grains.get('monitoring_enabled', False) %}
    exporter:
      exposition_port: 9669
      user: SYSTEM
      password: YourPassword1234
    {% endif %}
  {% endif %}
```

7.2   Terraform Configurations

7.2.1   Pay-as-you-Go (PAYGO) Subscription Model

```
$ cat /home/<USERNAME>/ha-sap-terraform-deployments/azure/terraform.tfvars
# VM size to use for the cluster nodes
hana_vm_size = "<CHOSEN INSTANCE TYPE>"

# Disk type for HANA
hana_data_disk_type = "StandardSSD_LRS"

# Disk size for HANA
hana_data_disk_size = "60"

# Caching used for HANA disk
hana_data_disk_caching = "ReadWrite"

# Number of nodes in the cluster
hana_count = "2"

# Instance number for the HANA database. 00 by default.
hana_instance_number = "00"

# Region where to deploy the configuration
az_region = "westeurope"

# Variable to control what is deployed in the nodes. Can be all, skip-hana or skip-
cluster
init_type = "all"

# SLES4SAP image information
# If custom uris are enabled public information will be omitted
# Custom sles4sap image
#sles4sap_uri = "/path/to/your/image"

# Custom iscsi server image
#iscsi_srv_uri = "/path/to/your/iscsi/image"

# Custom monitoring server image
#monitoring_uri = "/path/to/your/monitoring/image"

# Custom drbd nodes image
#drbd_image_uri = "/path/to/your/monitoring/image"

# Public sles4sap image
```

```
hana_public_publisher = "SUSE"
hana_public_offer       = "SLES-SAP"
hana_public_sku         = "gen2-15"
hana_public_version   = "latest"

# Public iscsi server image
iscsi_public_publisher = "SUSE"
iscsi_public_offer      = "sles-15-sp1"
iscsi_public_sku        = "gen2"
iscsi_public_version   = "latest"

# Public monitoring server image
#monitoring_public_publisher = "SUSE"
#monitoring_public_offer      = "SLES-SAP-BYOS"
#monitoring_public_sku        = "15"
#monitoring_public_version   = "latest"

# Public drbd nodes image
#drbd_public_publisher = "SUSE"
#drbd_public_offer      = "SLES-SAP-BYOS"
#drbd_public_sku        = "15"
#drbd_public_version   = "latest"

# Admin user
admin_user = "<CHOSEN USER ID>"

# SSH Public key to configure access to the remote instances
public_key_location = "../salt/hana_node/files/sshkeys/cluster.id_rsa.pub"

# Private SSH Key location
private_key_location = "../salt/hana_node/files/sshkeys/cluster.id_rsa"

# Azure storage account name
storage_account_name = "<AZURE STORAGE ACCOUNT NAME>"

# Azure storage account secret key (key1 or key2)
storage_account_key = "<AZURE STORAGE ACCOUNT KEY1>"

# Azure storage account path where HANA installation master is located
hana_inst_master = "//<AZURE STORAGE ACCOUNT NAME>.file.core.windows.net/<SAP HANA
 INSTALLATION MEDIA PATH>"

# Local folder where HANA installation master will be mounted
hana_inst_folder = "/root/hana_inst_media/"

# Device used by node where HANA will be installed
hana_disk_device = "/dev/sdc"
```

```
# Device used by the iSCSI server to provide LUNs
iscsidev = "/dev/sdc"

# IP address of the iSCSI server
iscsi_srv_ip = "10.74.1.14"

# Path to a custom ssh public key to upload to the nodes
# Used for cluster communication for example
cluster_ssh_pub = "salt://hana_node/files/sshkeys/cluster.id_rsa.pub"

# Path to a custom ssh private key to upload to the nodes
# Used for cluster communication for example
cluster_ssh_key = "salt://hana_node/files/sshkeys/cluster.id_rsa"

# Each host IP address (sequential order).
# example : host_ips = ["10.0.1.0", "10.0.1.1"]
host_ips = ["10.74.1.11", "10.74.1.12"]

# Each drbd cluster host IP address (sequential order).
# example : drbd_host_ips = ["10.0.1.10", "10.0.1.11"]
drbd_ips = ["10.74.1.21", "10.74.1.22"]

# Repository url used to install HA/SAP deployment packages"
# The latest RPM packages can be found at:
# https://download.opensuse.org/repositories/network:/ha-clustering:/Factory/{YOUR OS
 VERSION}
# Contains the salt formulas rpm packages.
ha_sap_deployment_repo = "https://download.opensuse.org/repositories/network:/ha-
clustering:/Factory/SLE_15/"

# Optional SUSE Customer Center Registration parameters
#reg_code = "<<REG_CODE>>"
#reg_email = "<<your email>>"

# For any sle12 version the additional module sle-module-adv-systems-management/12/x86_64
 is mandatory if reg_code is provided
#reg_additional_modules = {
#    "sle-module-adv-systems-management/12/x86_64" = ""
#    "sle-module-containers/12/x86_64" = ""
#    "sle-ha-geo/12.4/x86_64" = "<<REG_CODE>>"
#}

# Cost optimized scenario
#scenario_type: "cost-optimized"

# To disable the provisioning process
```

```
#provisioner = ""


# Run provisioner execution in background
#background = true


# Monitoring variables


# Enable the host to be monitored by exporters
#monitoring_enabled = true


# IP address of the machine where Prometheus and Grafana are running
monitoring_srv_ip = "10.74.1.13"


# Enable drbd cluster
#drbd_enabled = true


# Netweaver variables


#netweaver_enabled = true
#netweaver_ips = ["10.74.1.30", "10.74.1.31", "10.74.1.32", "10.74.1.33"]
#netweaver_virtual_ips = ["10.74.1.35", "10.74.1.36", "10.74.1.37", "10.74.1.38"]
#netweaver_storage_account_key = "YOUR_STORAGE_ACCOUNT_KEY"
#netweaver_storage_account_name = "YOUR_STORAGE_ACCOUNT_NAME"
#netweaver_storage_account = "//YOUR_STORAGE_ACCOUNT_NAME.file.core.windows.net/path/to/
your/nw/installation/master"


# QA variables


# Define if the deployment is using for testing purpose
# Disable all extra packages that do not come from the image
# Except salt-minion (for the moment) and salt formulas
# true or false (default)
#qa_mode = false


# Execute HANA Hardware Configuration Check Tool to bench filesystems
# qa_mode must be set to true for executing hwcct
# true or false (default)
#hwcct = false
```

7.2.2   Bring Your Own Subscription (BYOS) Model

```
$ cat /home/<USERNAME>/ha-sap-terraform-deployments/azure/terraform.tfvars
# Instance type to use for the cluster nodes
instancetype = "<CHOSEN INSTANCE TYPE>"
```

```
# Disk type for HANA
hana_data_disk_type = "StandardSSD_LRS"

# Disk size for HANA
hana_data_disk_size = "60"

# Caching used for HANA disk
hana_data_disk_caching = "ReadWrite"

# Number of nodes in the cluster
ninstances = "2"

# Region where to deploy the configuration
az_region = "westeurope"

# Variable to control what is deployed in the nodes. Can be all, skip-hana or skip-
cluster
init_type = "all"

# SLES4SAP image information
# If custom uris are enabled public information will be omitted
# Custom sles4sap image
#sles4sap_uri = "/path/to/your/image"

# Custom iscsi server image
#iscsi_srv_uri = "/path/to/your/iscsi/image"

# Custom monitoring server image
#monitoring_uri = "/path/to/your/monitoring/image"

# Custom drbd nodes image
#drbd_image_uri = "/path/to/your/monitoring/image"

# Public sles4sap image
hana_public_publisher = "SUSE"
hana_public_offer     = "SLES-SAP-BYOS"
hana_public_sku       = "15"
hana_public_version   = "latest"

# Public iscsi server image
iscsi_public_publisher = "SUSE"
iscsi_public_offer     = "SLES-SAP-BYOS"
iscsi_public_sku       = "15"
iscsi_public_version   = "latest"

# Public monitoring server image
#monitoring_public_publisher = "SUSE"
```

```
#monitoring_public_offer     = "SLES-SAP-BYOS"
#monitoring_public_sku       = "15"
#monitoring_public_version   = "latest"


# Public drbd nodes image
#drbd_public_publisher = "SUSE"
#drbd_public_offer     = "SLES-SAP-BYOS"
#drbd_public_sku       = "15"
#drbd_public_version   = "latest"


# Admin user
admin_user = "<CHOSEN USER ID>"


# SSH Public key to configure access to the remote instances
public_key_location = "../salt/hana_node/files/sshkeys/cluster.id_rsa.pub"


# Private SSH Key location
private_key_location = "../salt/hana_node/files/sshkeys/cluster.id_rsa"


# Azure storage account name
storage_account_name = "<AZURE STORAGE ACCOUNT NAME>"


# Azure storage account secret key (key1 or key2)
storage_account_key = "<AZURE STORAGE ACCOUNT KEY1>"


# Azure storage account path where HANA installation master is located
hana_inst_master = "//<AZURE STORAGE ACCOUNT NAME>.file.core.windows.net/<SAP HANA
 INSTALLATION MEDIA PATH>"


# Local folder where HANA installation master will be mounted
hana_inst_folder = "/root/hana_inst_media/"


# Device used by node where HANA will be installed
hana_disk_device = "/dev/sdc"


# Device used by the iSCSI server to provide LUNs
iscsidev = "/dev/sdc"


# Path to a custom ssh public key to upload to the nodes
# Used for cluster communication for example
cluster_ssh_pub = "salt://hana_node/files/sshkeys/cluster.id_rsa.pub"


# Path to a custom ssh private key to upload to the nodes
# Used for cluster communication for example
cluster_ssh_key = "salt://hana_node/files/sshkeys/cluster.id_rsa"


# Each host IP address (sequential order).
```

```
# example : host_ips = ["10.0.1.0", "10.0.1.1"]
host_ips = ["10.74.1.11", "10.74.1.12"]

# Each drbd cluster host IP address (sequential order).
# example : drbd_host_ips = ["10.0.1.10", "10.0.1.11"]
drbd_ips = ["10.74.1.21", "10.74.1.22"]

# Repository url used to install HA/SAP deployment packages"
# The latest RPM packages can be found at:
# https://download.opensuse.org/repositories/network:/ha-clustering:/Factory/{YOUR OS
 VERSION}
# Contains the salt formulas rpm packages.
ha_sap_deployment_repo = "https://download.opensuse.org/repositories/network:/ha-
clustering:/Factory/SLE_15/"

# Optional SUSE Customer Center Registration parameters
reg_code = "<SUSE REGISTRATION CODE>"
reg_email = "<SUSE REGISTRATION EMAIL>"

# For any sle12 version the additional module sle-module-adv-systems-management/12/x86_64
 is mandatory if reg_code is provided
#reg_additional_modules = {
#     "sle-module-adv-systems-management/12/x86_64" = ""
#     "sle-module-containers/12/x86_64" = ""
#     "sle-ha-geo/12.4/x86_64" = "<<REG_CODE>>"
#}

# Cost optimized scenario
#scenario_type: "cost-optimized"

# To disable the provisioning process
#provisioner = ""

# Run provisioner execution in background
#background = true

# Monitoring variables

# Enable the host to be monitored by exporters
#monitoring_enabled = true

# IP address of the machine where Prometheus and Grafana are running
monitoring_srv_ip = "10.74.1.13"

# Enable drbd cluster
#drbd_enabled = true
```

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```
# Netweaver variables

#netweaver_enabled = true
#netweaver_ips = ["10.74.1.30", "10.74.1.31", "10.74.1.32", "10.74.1.33"]
#netweaver_virtual_ips = ["10.74.1.35", "10.74.1.36", "10.74.1.37", "10.74.1.38"]
#netweaver_storage_account_key = "YOUR_STORAGE_ACCOUNT_KEY"
#netweaver_storage_account_name = "YOUR_STORAGE_ACCOUNT_NAME"
#netweaver_storage_account = "//YOUR_STORAGE_ACCOUNT_NAME.file.core.windows.net/path/to/
your/nw/installation/master"


# QA variables


# Define if the deployment is using for testing purpose
# Disable all extra packages that do not come from the image
# Except salt-minion (for the moment) and salt formulas
# true or false (default)
#qa_mode = false


# Execute HANA Hardware Configuration Check Tool to bench filesystems
# qa_mode must be set to true for executing hwcct
# true or false (default)
#hwcct = false
```

7.3   Cluster Configurations

```
vmhana01:~ # crm configure show
node 1: vmhana01 \
        attributes lpa_prd_lpt=1583424440 hana_prd_vhost=vmhana01 hana_prd_site=NUE
 hana_prd_op_mode=logreplay hana_prd_srmode=sync hana_prd_remoteHost=vmhana02
node 2: vmhana02 \
        attributes lpa_prd_lpt=30 hana_prd_op_mode=logreplay hana_prd_vhost=vmhana02
 hana_prd_remoteHost=vmhana01 hana_prd_site=FRA hana_prd_srmode=sync
# SAP HANA resources
primitive rsc_SAPHanaTopology_PRD_HDB00 ocf:suse:SAPHanaTopology \
        params SID=PRD InstanceNumber=00 \
        op monitor interval=10 timeout=600 \
        op start interval=0 timeout=600 \
        op stop interval=0 timeout=300
primitive rsc_SAPHana_PRD_HDB00 ocf:suse:SAPHana \
        params SID=PRD InstanceNumber=00 PREFER_SITE_TAKEOVER=True
 AUTOMATED_REGISTER=False DUPLICATE_PRIMARY_TIMEOUT=7200 \
        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
# Create virtual ip. gcp must be changed when gcp-vpc-move-route RA is available
primitive rsc_ip_PRD_HDB00 IPaddr2 \
        params ip=10.74.1.200 cidr_netmask=24 nic=eth0 \
        op start timeout=20 interval=0 \
        op stop timeout=20 interval=0 \
        op monitor interval=10 timeout=20
# Platform dependent (stonith, virtual ip address, cib options, etc) resource
primitive rsc_socat_PRD_HDB00 anything \
        params binfile="/usr/bin/socat" cmdline_options="-U TCP-
LISTEN:62500,backlog=10,fork,reuseaddr /dev/null" \
        op monitor timeout=20 interval=10 \
        op_params depth=0
primitive stonith-sbd stonith:external/sbd \
        params pcmk_delay_max=30s
group g_ip_PRD_HDB00 rsc_ip_PRD_HDB00 rsc_socat_PRD_HDB00
ms msl_SAPHana_PRD_HDB00 rsc_SAPHana_PRD_HDB00 \
        meta clone-max=2 clone-node-max=1 interleave=true
clone cln_SAPHanaTopology_PRD_HDB00 rsc_SAPHanaTopology_PRD_HDB00 \
        meta is-managed=true clone-node-max=1 interleave=true
colocation col_saphana_ip_PRD_HDB00 2000: g_ip_PRD_HDB00:Started
 msl_SAPHana_PRD_HDB00:Master
order ord_SAPHana_PRD_HDB00 Optional: cln_SAPHanaTopology_PRD_HDB00 msl_SAPHana_PRD_HDB00
property cib-bootstrap-options: \
        have-watchdog=true \
        dc-version="1.1.18+20180430.b12c320f5-3.18.1-b12c320f5" \
        cluster-infrastructure=corosync \
        cluster-name=hana_cluster \
        stonith-enabled=true
rsc_defaults rsc-options: \
        resource-stickiness=1000 \
        migration-threshold=5000
op_defaults op-options: \
        timeout=600 \
        record-pending=true
```

7.4   SAP System Overview

```
vmhana01:~ # su - prdadm
prdadm@vmhana01:/usr/sap/PRD/HDB00> HDBSettings.sh systemOverview.py
| Section    | Name            | Status  | Value                                      |
| ---------- | --------------- | ------- | ------------------------------------------ |
| System     | Instance ID     |         | PRD                                        |
| System     | Instance Number |         | 00                                         |
| System     | Distributed     |         | No                                         |
```

```
| System     | Version        |         | 2.00.040.00.1553674765 (fa/hana2sp04)        |
| System     | Platform       |         | SUSE Linux Enterprise Server 15              |
| Services   | All Started    | OK      | Yes                                          |
| Services   | Min Start Time |         | 2020-03-05 13:48:38.000                      |
| Services   | Max Start Time |         | 2020-03-05 13:50:51.444                      |
| Memory     | Memory         | OK      | Physical 62.86 GB, Swap 0.00 GB, Used 23.51 |
| CPU        | CPU            | OK      | Available 8, Used 0.32                       |
| Disk       | Data           | OK      | Size 60.0 GB, Used 7.1 GB, Free 88 %         |
| Disk       | Log            | OK      | Size 60.0 GB, Used 3.7 GB, Free 93 %         |
| Disk       | Trace          | OK      | Size 60.0 GB, Used 14.3 GB, Free 76 %        |
| Statistics | Alerts         | WARNING | cannot check statistics w/o SQL connection   |
```

7.5   SAP HANA Database Version

```
vmhana01:~ # su - prdadm
prdadm@vmhana01:/usr/sap/PRD/HDB00> HDB version
HDB version info:
  version:          2.00.040.00.1553674765
  branch:           fa/hana2sp04
  machine config:   linuxx86_64
  git hash:         c8210ee40a82860643f1874a2bf4ffb67a7b2add
  git merge time:   2019-03-27 09:19:25
  weekstone:        0000.00.0
  cloud edition:    0000.00.00
  compile date:     2019-03-27 09:30:26
  compile host:     ld4551
  compile type:     rel
```

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